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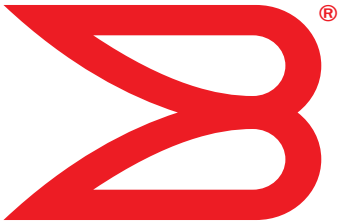

Network OS

NETCONF Operations Guide

Supporting Network OS v4.1.1

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How this document is organized

This document is organized to help you find the information that you want as quickly and easily as possible.

Section 1, Network OS Administration contains the following components:

- Chapter 1, "NETCONF Overview" provides an overview of the basic features of NETCONF.
- Chapter 2, "Basic NETCONF Operations" provides instructions for performing basic NETCONF operations such as establishing a session, editing the configuration, and retrieving operational data.
- Chapter 3, "Basic Switch Management" provides procedures for connecting to a switch, setting switch attributes, enabling or disabling a chassis, rebooting, managing slots, modules and ports, configuring the switch banner, uploading SupportSave data, and managing system logs.
- Chapter 4, "Network Time Protocol" provides instructions and examples for using NETCONF operations to configure NTP servers, and to set the date, time, and time zone on a switch.
- Chapter 5, "Installing and Maintaining Firmware" provides preparations and procedures for performing firmware downloads.
- Chapter 6, "Administering Licenses" provides procedures for verifying and activating Brocade licenses.
- Chapter 7, "SNMP" provides procedures for setting community strings and other SNMP configurations.
- Chapter 8, "Fabric" provides procedures for configuring fabric parameters.
- Chapter 9, "Metro VCS" provides procedures for configuring Metro VCS.
- Chapter 10, "Administering Zones" provides procedures for administering fabric-based zoning.
- Chapter 11, "Configuring Fibre Channel Ports" provides procedures for configuring Fibre Channel ports.

- Chapter 12, “System Monitor Configuration” provides procedures monitoring the health of each fan, power supply, temperature sensor, chassis identification (CID) card, small form-factor pluggable (SFP) device, management module (MM), line card, or switch fabric module (SFM), or compact flash of the switch.
- Chapter 13, “VMware vCenter” provides procedures for configuring VMware vCenter.
- Chapter 14, “Configuring Remote Monitoring” provides procedures for configuring Remote Monitoring.

Section 2, Network OS Security Configuration, contains the following components:

- Chapter 15, “Managing User Accounts” provides procedures for creating, modifying, and unlocking user accounts, creating and managing user-defined roles, defining role-based command access rules, and managing passwords.
- Chapter 16, “External Server Authentication” provides procedures for configuring an external RADIUS, TACACS+, or LDAP server for remote user authentication.
- Chapter 17, “Fabric Authentication” provides procedures to configure fabric authentication and Switch Connection Control (SCC) policies.

Section 3, Network OS Layer 2 Switch Features, contains the following components:

- Chapter 18, “Administering Edge-Loop Detection” provides procedures for administering edge-loop detection.
- Chapter 19, “Configuring AMPP” provides procedures for configuring the Auto Migrating Port Profile (AMPP) profiles.
- Chapter 20, “Configuring FCoE Interfaces” provides procedures for configuring Fibre Channel over Ethernet (FCoE) interfaces.
- Chapter 21, “Configuring VLANs” provides procedures for configuring Virtual LANs.
- Chapter 23, “Configuring Virtual Fabrics” provides procedures for configuring Virtual Fabrics.
- Chapter 24, “Configuring Spanning Tree Protocols” provides procedures for configuring the Spanning Tree Protocol (STP), Rapid STP (RSTP), Multiple STP (MSTP), and Per-VLAN Spanning Tree (PVST).
- Chapter 25, “Configuring UDLD” provides procedures for configuring UDLD.
- Chapter 26, “Configuring Link Aggregation” provides procedures for configuring Link Aggregation and the Link Aggregation Control Protocol (LACP).
- Chapter 27, “Configuring LLDP” provides procedures for configuring the Link Layer Discovery Protocol (LLDP) and the DCB Capability Exchange Protocol (DCBX).
- Chapter 28, “Configuring ACLs” provides procedures for configuring Access Control Lists (ACLs).
- Chapter 29, “Configuring QoS” provides procedures for configuring Quality of Service (QoS), including the Policer feature.
- Chapter 30, “Configuring 802.1x Port Authentication” provides procedures for configuring the 802.1x Port Authentication protocol.
- Chapter 31, “Configuring sFlow” provides procedures for configuring sFlow.
- Chapter 32, “Configuring Switched Port Analyzer” provides procedures for configuring Switched Port Analyzer (SPAN).

Section 4, Network OS Layer 3 Routing Features, contains the following components:

- Chapter 32, “IP Route Policy” provides procedures for configuring IP prefix lists and route maps that are used for controlling IP subnet transportation between subsystems.

- Chapter 33, “IP Route Management” provides procedures for configuring the route manager to optimize forwarding of IP packets.
- Chapter 34, “Configuring OSPF” provides procedures for configuring Open Shortest Path First (OSPF).
- Chapter 35, “Configuring VRRP” provides procedures for configuring the Virtual Router Redundancy Protocol (VRRP).
- Chapter 36, “Configuring VRF” provides procedures for configuring remote monitoring (RMON).
- Chapter 37, “Configuring BGP” provides procedures for configuring BGP.
- Chapter 38, “Configuring IGMP” provides procedures for configuring IGMP snooping.
- Chapter 39, “Configuring DHCP Relay” provides procedures for configuring DHCP Relay.

Section 5, Appendixes, contains the following component:

- Appendix A, “Managing NETCONF” provides procedures for viewing NETCONF client capabilities and for monitoring NETCONF statistics and session information.

Supported hardware and software

In those instances in which procedures or parts of procedures documented here apply to some switches but not to others, this guide identifies exactly which switches are supported and which are not.

Although many different software and hardware configurations are tested and supported by Brocade Communications Systems, Inc. for Network OS v4.1.1, documenting all possible configurations and scenarios is beyond the scope of this document.

The following hardware platforms are supported by this release of Network OS:

- Brocade VDX 6710
- Brocade VDX 6720
- Brocade VDX 6730
- Brocade VDX 6740
- Brocade VDX 6740T
- Brocade VDX 8770-4
- Brocade VDX 8770-8

Document conventions

This section describes text formatting conventions and important notice formats used in this document.

Text formatting

The narrative-text formatting conventions that are used are as follows:

bold text	Identifies command names Identifies the names of user-manipulated GUI elements Identifies keywords and operands Identifies text to enter at the GUI or CLI
italic text	Provides emphasis Identifies variables Identifies paths and Internet addresses Identifies document titles
`code` text	Identifies CLI output Identifies command syntax examples

Notes, cautions, and warnings

The following notices and statements are used in this manual. They are listed below in order of increasing severity of potential hazards.

NOTE
A note provides a tip, guidance, or advice, emphasizes important information, or provides a reference to related information.

ATTENTION
An Attention statement indicates potential damage to hardware or data.

CAUTION

A Caution statement alerts you to situations that can be potentially hazardous to you or cause damage to hardware, firmware, software, or data.

DANGER

A Danger statement indicates conditions or situations that can be potentially lethal or extremely hazardous to you. Safety labels are also attached directly to products to warn of these conditions or situations.

Key terms

For definitions specific to Brocade and Fibre Channel, refer to the technical glossaries on MyBrocade. See "Brocade resources" on page xxxi for instructions on accessing MyBrocade.

For definitions of SAN-specific terms, visit the Storage Networking Industry Association online dictionary at:

http://www.snia.org/education/dictionary

Notice to the reader

This document may contain references to the trademarks of the following corporations. These trademarks are the properties of their respective companies and corporations.

These references are made for informational purposes only.

TABLE 1 Trademark references

Corporation	Referenced Trademarks and Products
Microsoft Corporation	Windows, Windows NT, Internet Explorer
Red Hat, Inc.	Red Hat, Red Hat Network, Maximum RPM, Linux Undercover
Tail-f Systems	confD

Additional information

This section lists additional Brocade and industry-specific documentation that you might find helpful.

Brocade resources

To get up-to-the-minute information, go to *http://my.brocade.com* to register at no cost for a user ID and password.

White papers, online demonstrations, and data sheets are available through the Brocade website at:

http://www.brocade.com/products-solutions/products/index.page

For additional Brocade documentation, visit the Brocade website:

http://www.brocade.com

Release notes are available on the MyBrocade website.

Other industry resources

For additional resource information, visit the Technical Committee T11 website. This website provides interface standards for high-performance and mass storage applications for Fibre Channel, storage management, and other applications:

http://www.t11.org

For information about the Fibre Channel industry, visit the Fibre Channel Industry Association website:

http://www.fibrechannel.org

Getting technical help

Contact your switch support supplier for hardware, firmware, and software support, including product repairs and part ordering. To expedite your call, have the following information available:

1. General Information
    - Switch model
    - Switch operating system version
    - Software name and software version, if applicable
    - Error numbers and messages received
    - **supportSave** command output
    - Detailed description of the problem, including the switch or fabric behavior immediately following the problem, and specific questions
    - Description of any troubleshooting steps already performed and the results
    - Serial console and Telnet session logs
    - syslog message logs
2. Switch Serial Number

    The switch serial number and corresponding bar code are provided on the serial number label, as illustrated below:

    The serial number label is located on the switch ID pull-out tab located on the bottom of the port side of the switch.

Document feedback

Quality is our first concern at Brocade and we have made every effort to ensure the accuracy and completeness of this document. However, if you find an error or an omission, or you think that a topic needs further development, we want to hear from you. Forward your feedback to:

documentation@brocade.com

Provide the title and version number of the document and as much detail as possible about your comment, including the topic heading and page number and your suggestions for improvement.

Section

I

Network OS Administration

This section describes basic Network OS administration features, and includes the following chapters:

- NETCONF Overview 3
- Basic NETCONF Operations 9
- Basic Switch Management 23
- Network Time Protocol 47
- Installing and Maintaining Firmware 53
- Administering Licenses 65
- SNMP 73
- Fabric 85
- Metro VCS. 97
- Administering Zones 101
- Configuring Fibre Channel Ports. 133
- System Monitor Configuration 143
- VMware vCenter. 163
- Configuring Remote Monitoring 167

Chapter

1

NETCONF Overview

In this chapter

- NETCONF and YANG 3
- NETCONF in client/server architecture 4
- NETCONF support in Network OS 7

NETCONF and YANG

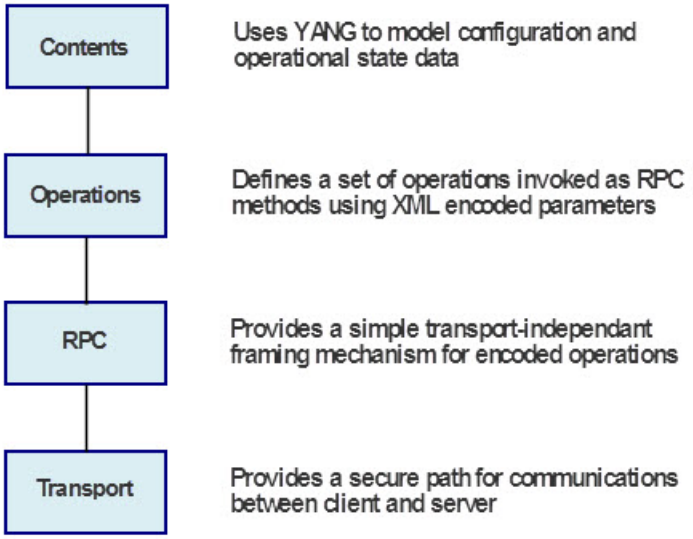
Brocade Network OS provides support for the Network Configuration Protocol (NETCONF) and the YANG data modeling language. Using Extensible Markup Language (XML) constructs, the NETCONF protocol provides the ability to manipulate configuration data and view state data modeled in YANG. NETCONF uses a client/server architecture in which remote procedure calls (RPCs) manipulate the modeled data across a secure transport, such as Secure Shell version 2 (SSHv2).

NETCONF provides mechanisms through which you can perform the following operations:

- Manage network devices
- Retrieve configuration data and operational state data
- Upload and manipulate configurations

NETCONF is partitioned conceptually into four layers, as shown in Figure 1.

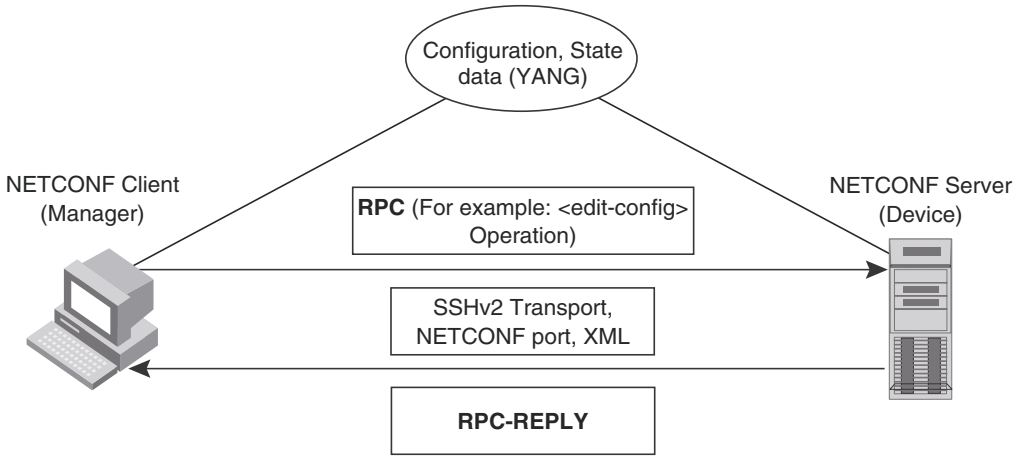
FIGURE 1 Four layers of NETCONF



NETCONF in client/server architecture

The NETCONF protocol uses RPCs to facilitate communication between the client (NETCONF Manager or application) and the server (NETCONF Agent or managed device). A client encodes an RPC in XML and sends it to a server using a secure, connection-oriented session. The server responds with a reply encoded in XML, as shown in Figure 2.

FIGURE 2 NETCONF communication



The communication between the client and server consists of a series of alternating request and reply messages. The NETCONF peers use <rpc> and <rpc-reply> elements to provide transport protocol-independent framing of NETCONF requests and responses. The NETCONF server processes the RPC requests sequentially in the order in which they are received.

RPC request

The <rpc> element is used for enclosing a NETCONF request sent from the client to the server. Every <rpc> element contains a mandatory attribute, the message-id. This attribute has a unique value for every RPC request, and is used to associate every RPC request with the corresponding response. The message-id value is a monotonically increasing integer string. The maximum length of the string is 4095 characters. If the message-id is not present in the RPC request, the server rejects the request by returning an <rpc-error> with an <error-tag> element set to “missing-attribute”.

If there are any additional attributes present in the RPC request, the NETCONF server returns them unmodified in the corresponding RPC reply.

RPC reply

An <rpc-reply> element is sent in response to every RPC request. The <rpc-reply> element contains the mandatory attribute message-id copied from the corresponding RPC request, along with any additional attributes that are present in the RPC request.

For successfully processed <get> or <get-config> requests, the response data is encoded as the content of the <rpc-reply> element.

For successfully processed <edit-config> or <close-session> requests, the <ok> element is encoded as the content of the <rpc-reply> element.

For unsuccessful RPC requests, one or more <rpc-error> elements are encoded inside the <rpc-reply> element.

RPC and error handling

If the RPC request fails, an <rpc-error> element is encoded inside the <rpc-reply> element and sent to the client. The <rpc-error> element indicates the first detected error. The server is not required to detect or report multiple errors. If the server detects multiple errors then the order of the error detection and reporting is at the discretion of the server.

Partial success behavior in logical chassis

NETCONF clients should explicitly handle an <rpc-error> in logical chassis mode as shown in the following example. NETCONF clients consider it as a warning, but do not stop operation. The database is committed with the new configuration. The following example is a sample of an <rpc-reply> that is partially successful.

```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2">
    <rpc-error>
        <error-type>application</error-type>
            <error-tag>operation-failed</error-tag>
                <error-severity>error</error-severity>
                    <error-message
unknown:lang="en">FRAMEWORK_CLUSTER_PARTIAL_SUCCESS | Warning: Operation context
"/qos:nas/server-ip[server-ip="10.0.0.0/24"]/vrf[vrf-name="Testing_Vrf"]".
Cluster wide operation failed on Rbridge-id(s): 6. Succeeded on Rbridge-id(s): 1.
Rbridge-id(s): 6 Reason: %Error: Command is not supported on this
platform.</error-message>
    </rpc-error>
</rpc-reply>
```

SSH subsystem

The NETCONF client must use Secure Shell Version 2 (SSHv2) as the network transport to connect to the NETCONF server. Only the SSHv2 protocol is supported as the NETCONF transport protocol.

To run NETCONF over SSHv2, the client establishes an SSH transport connection using the SSH transport protocol to the NETCONF port. The default NETCONF port is 830. The underlying SSH client and server exchange keys for message integrity and encryption.

The SSHv2 client invokes the ssh-userauth service to authenticate the user. All currently supported SSH user authentication methods such as the public-key, password, and keyboard-interactive authentications are supported for a NETCONF session also. If the SSH user authentication is disabled, the user is allowed full access.

On successful user authentication, the client invokes the ssh-connection service, also known as the SSH connection protocol. After the SSH session is established, the NETCONF client invokes NETCONF as an SSH subsystem called *netconf*.

RFC references

For details about NETCONF and YANG as defined by the Internet Engineering Task Force (IETF), refer to the following documents:

- RFC 6241, "*NETCONF Configuration Protocol*."
- RFC 4742 "*Using the NETCONF Configuration Protocol over Secure SHell (SSH)*."

- RFC 6020, "*YANG - A Data Modeling Language for the Network Configuration Protocol (NETCONF)*"
- RFC 6021, "*Common YANG Data Types*"

NETCONF support in Network OS

This section describes the support in Network OS for NETCONF features.

Table 2 describes the degree of support in Network OS for each NETCONF RPC. For details of the RPCs listed in Table 2, refer to RFC 4741.

TABLE 2 NETCONF RPCs supported in Network OS

RPC	Function	Support in Network OS
<copy-config>	Copies the startup configuration to the running configuration, copies the running configuration to the startup configuration, copies the startup or running configuration to a remote file, or copies the remote file to the startup or running configuration.	Use <bna-config-cmd> custom RPC instead.
<close-session>	Terminates the current NETCONF session gracefully.	Supported
<delete-config>	Deletes a configuration datastore.	Supported
<edit-config>	Makes changes to a configuration datastore.	The merge and delete operations are supported. The replace and create operations are not supported. The <running> target is supported. The <candidate> target is not supported. The <error-option> element supports only the *stop-on-error* value. It does not support the *continue-on-error* or *rollback-on-error* values.
<get>	Retrieves the entire or partial configuration data and operational state data.	Retrieval of configuration data is supported. Retrieval of operational state data is not supported through the <get> RPC. Operational state data is retrieved using the Brocade custom RPCs and the custom action mechanism. Configuration state data is not modeled in the data models.
<get-config>	Retrieves the entire or partial configuration data.	Supported
<kill-session>	Forces the termination of a NETCONF session.	Supported
<lock>	Locks a configuration datastore.	Not supported
<unlock>	Unlocks a configuration datastore.	Not supported

To retrieve operational state data, Network OS supports two mechanisms: the Brocade custom RPCs and the custom action mechanism. Refer to Chapter 2, "Basic NETCONF Operations," for details about Brocade customized RPCs and the custom action mechanism.

1 NETCONF support in Network OS

Chapter

Basic NETCONF Operations

2

In this chapter

- Establishing a NETCONF session 9
- Retrieving configuration data 11
- Retrieving operational data 15
- Editing the configuration 18
- Managing the configuration 19
- Disconnecting from a NETCONF session 21

Establishing a NETCONF session

Up to 16 concurrent sessions can be established with a NETCONF server. A session times out if it is idle for 30 minutes.

Each NETCONF session begins with a handshake in which the NETCONF server and the client specify the NETCONF capabilities they support. The following sections describe the message exchange on starting a NETCONF session.

Hello messages exchange

After establishing a secure transport connection, both the NETCONF server and client send a <hello> element simultaneously to announce their capabilities and session identifier.

The NETCONF server must include the <session-id> element in the <hello> element. The <session-id> element contains the unique session value for the NETCONF session. If the client receives the <hello> element without the <session-id>, the client aborts the NETCONF session by closing the underlying SSH session.

The NETCONF client must not include the <session-id> element in the <hello> element. If the server receives the <hello> element with the <session-id>, the server aborts the NETCONF session by closing the underlying SSH session.

The NETCONF client must include a valid xmlns attribute in the <hello> element. If the server receives the <hello> element without a valid xmlns attribute, the server aborts the NETCONF session by closing the underlying SSH session.

The NETCONF client must include a base capability. The server receiving the <hello> element without a NETCONF base capability aborts the NETCONF session by closing the underlying SSH session.

The server receiving an <rpc> element without first receiving a <hello> element aborts the NETCONF session by closing the underlying SSH session.

The following example shows a <hello> element from the NETCONF server.

```
<hello xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <capabilities>
        <capability>urn:ietf:params:netconf:base:1.0</capability>
        <capability>urn:ietf:params:netconf:capability:writable-running:1.0
         </capability>
        <capability>urn:ietf:params:netconf:capability:startup:1.0</capability>
        <capability>urn:ietf:params:netconf:capability:xpath:1.0</capability>
        <capability>urn:ietf:params:netconf:capability:validate:1.0</capability>
        <capability>http://tail-f.com/ns/netconf/actions/1.0</capability>
        <capability>http://tail-f.com/ns/aaa/1.1?revision=2010-06-17&module=tailf-
aaa</capability>
        <capability>urn:brocade.com:mgmt:brocade-aaa?revision=2010-10-21&module=br
ocade-aaa</capability>
        <capability>urn:brocade.com:mgmt:brocade-aaa-ext?revision=2010-09-21&modul
e=brocade-aaa-ext</capability>
        <capability>urn:brocade.com:mgmt:brocade-cdp?revision=2010-08-17&module=br
ocade-cdp</capability>
        <capability>urn:brocade.com:mgmt:brocade-cee-map?revision=2011-04-18&modul
e=brocade-cee-map</capability>
        <capability>
urn:brocade.com:mgmt:brocade-chassis?revision=2011-04-11&module=brocade-chassis
         </capability>
  </capabilities>
(output truncated)
  <session-id>4</session-id>
</hello>
```

Server capabilities

A NETCONF capability is a set of protocol extensions that supplements the base NETCONF specification. A NETCONF capability is identified with a Uniform Resource Identifier (URI). Capabilities augment the base operations of the NETCONF server, describing both the additional operations and the contents allowed inside the operations. To support a capability, the NETCONF server must support all the dependent capabilities.

The following capabilities are supported on Network OS switches:

- Base capability—The set of operations and contents that any NETCONF implementation must support. The URI for the base capability is urn:ietf:param:xml:ns:netconf:base:1.0. Both the NETCONF client and server must support the base capability.
- Writable-running capability—Indicates that the device supports <edit-config> and <copy-config> operations where the <running> configuration is the target. The URI is urn:ietf:params:netconf:capability:writable-running:1.0.
- Startup capability—Supports separate datastores for the running and startup configuration. Operations performed on the *running-config* datastore do not affect the startup configuration until a <copy-config> operation is performed to explicitly copy the running configuration to the startup configuration. The URI for the startup capability is urn:ietf:params:netconf:capability:startup:1.0.
- Xpath capability—Supports XPath expressions in <filter> elements. <filter> elements are used in <get> and <get-config> operations to limit the scope of the retrieved data. The URI for the xpath capability is urn:ietf:params:netconf:capability:xpath:1.0.
- Validate capability—Allows validation to be performed on a configuration. The URI for the validate capability is urn:ietf:params:netconf:capability:validate:1.0.

- Actions capability—Allows operations to be performed on the datastore using the custom action mechanism for features that are supported by this mechanism in the YANG code. Refer to "Using the custom action mechanism" on page 17 for details. The URI for the actions capability is http://tail-f.com/ns/netconf/actions/1.0.
- tailf-aaa capability—Supports proprietary authentication, authorization, and accounting (AAA). The URI for the tailf-aaa capability is http://tail-f.com/ns/aaa/1.1?revision=2010-06-17&module=tailf-aaa.
- Brocade proprietary capabilities—A set of capabilities that support Brocade Network OS features. Each capability references a namespace containing instance data. Each namespace corresponds to a file containing the YANG module that models the data. For example the brocade-cee-map capability at URI urn:brocade.com:mgmt:brocade-cee-map?revision=2011-04-18&module=brocade-cee-map provides support for the features modeled in the brocade-cee-map module.

  For an overview of each YANG module and structural details, refer to the *Network OS YANG Reference Manual*. For element definitions, refer to the YANG file itself.

NOTE
The Candidate Configuration capability and Confirmed Commit capability are not supported.

Client capabilities

The client must support the base capability. In addition, Brocade recommends that the client specify the identification capability with URI http://tail-f.com/ns/netconf/identification/1.0 while establishing a session with the server. This capability provides client information to the server, including the vendor, product name, and version of the client application in addition to user information. Server administrators can subsequently gather information about who is accessing the server using the **show netconf client-capabilities** command or the <get-netconf-client-capabilities> custom RPC. Refer to Appendix A, "Managing NETCONF," for details.

The following example shows a <hello> element from the NETCONF client.

```
<hello xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <capabilities>
        <capability>urn:ietf:params:netconf:base:1.0</capability>
        <capability>http://tail-f.com/ns/netconf/identification/1.0?
         vendor=brocade&amp;product=bna&amp;version=3.0&amp;
         client-identity=adminUser</capability>
    </capabilities>
</hello>
```

Retrieving configuration data

You can retrieve configuration data using either the <get-config> or <get> RPC. RFC 4741, *NETCONF Configuration Protocol* specifies that the <get-config> RPC returns only configuration data while the <get> RPC returns configuration data and operational state data. In the Brocade implementation, the <get> RPC does not return operational state data; Brocade instead provides a set of custom RPCs and actions for returning operational state data. In the Brocade implementation, the <get-config> and <get> operations are essentially the same. This document will typically refer to the <get-config> operation, though <get> can be used equally.

The following example shows a client message that issues the <get-config> operation in its most basic form. It retrieves the entire running configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="200" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
    </get-config>
</rpc>
```

Such a request, however, typically results in an unwanted or unmanageable amount of output. To restrict the output to the portion of the configuration you want, Brocade supports two types of filtering: subtree filtering and xpath filtering.

For complete details about subtree filtering and xpath filtering, refer to the RFC 4741, *The NETCONF Protocol*. The following sections provide some examples.

Subtree filtering

Subtree filtering defines a point in the configuration hierarchy that limits the returned configuration data. Only data at this point and the subtrees below it are returned. For example, to retrieve the Fibre Channel configuration for all Fibre Channel interfaces configured on the switch, use the following filter. This operation returns all configuration data for all Fibre Channel ports on the managed device.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="201" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port/>
            </interface>
        </filter>
    </get-config>
</rpc>
```

The purpose of each filter element is as follows:

- The <filter> element tag contains a type statement that identifies the filter type as a subtree filter.
- The <interface> element constrains the output to the interface configuration in the urn:brocade.com:mgmt:brocade-interface namespace.
- The <fc-port> element further constrains the output to the information under the <fc-port> node. Used in this way, <fc-port> is termed a *containment node*.

To further restrict the output and retrieve Fibre Channel configuration data for only one specific Fibre Channel interface, use the following filter. In this example, the <name> element is termed a *content match* node; the filter returns the values of all Fibre Channel attributes for the specified port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
```

```
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                </fc-port>
            </interface>
        </filter>
    </get-config>
</rpc>
```

If all you want to know is the setting of one specific Fibre Channel port attribute, such as the configured speed, use a filter such as the following. In this case, <fc-speed-cfg> suppresses the inclusion of all its sibling nodes. It is termed a *selection node*.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="203" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                    <fc-speed-cfg/>
                </fc-port>
            </interface>
        </filter>
    </get-config>
</rpc>
```

The following example retrieves the configuration for the Fibre Channel port 1 on routing bridge 8.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="204" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                </fc-port>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="204" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <fc-port>
            <name>8/0/1</name>
            <ifindex>1</ifindex>
            <fc-speed-cfg>8gbps</fc-speed-cfg>
            <long-distance>ld</long-distance>
            <vc-link-init>arb</vc-link-init>
            <desire-distance>0</desire-distance>
```

```
            <trunk-enable></trunk-enable>
        </fc-port>
    </interface>
</rpc-reply>
```

xpath filtering

Sometimes the data element that qualifies the information you want is at a lower level in the data hierarchy than the information you need. For example, if you want to return a list of interfaces that are bound to a CoS-to-CoS mutation QoS map, the element to be used for the selection criteria (<cos-mutation>*name*</cos-mutation>) resides at a lower level in the hierarchy than the information to be retrieved (the interface name), as shown in the following representation of the QoS map structure. In such cases, you must use an xpath filter and not a subtree filter.

```
|  +--rw tengigabitethernet [name]
          +--rw name                          interface-type
             .
             .
             .
          +--rw qos:qos
             +--rw qos:default-cos?           int32
             +--rw qos:trust
                +--rw qos:trust-cos?     empty
                +--rw qos:trust-dscp?    empty
             +--rw qos:cos-mutation?          map-name-type
             +--rw qos:cos-traffic-class?     map-name-type
             +--rw qos:dscp-mutation?         map-name-type
```

The following example returns the interface names to which the CoS-to-CoS mutation QoS map named “test” is bound. In this case, the map named “test” is bound to interfaces 0/59 and 0/60. The <filter> element tag specifies that the filter type is xpath and also specifies the data path and selection criteria.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="205">
    <get-config>
        <source>
            <running></running>
        </source>
        <filter type="xpath"
            select="/interface/tengigabitethernet/qos[cos-mutation='test']">
        </filter>
    </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="205">
    <data>
        <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
            <tengigabitethernet>
                <name>0/59</name>
                <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                    <default-cos>0</default-cos>
                    <cos-mutation>test</cos-mutation>
                </qos>
            </tengigabitethernet>
            <tengigabitethernet>
                <name>0/60</name>
                <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
```

```
                <default-cos>0</default-cos>
                <cos-mutation>test</cos-mutation>
              </qos>
            </tengigabitethernet>
        </interface>
    </data>
</rpc-reply>
```

Retrieving operational data

In the Brocade Network OS implementation of NETCONF, two mechanisms are used for retrieving operational data: Brocade custom RPCs and custom actions. Custom RPC and action support is added to some of the YANG modules to support the return of specific operational data.

For a complete list of the Brocade custom RPCs and actions, and their locations, refer to the *Network OS YANG Reference Manual*.

Brocade Network OS does not support retrieving operational data using the standard <get> RPC.

Using custom RPCs

If an RPC is defined in a YANG module, you can use that RPC to return the associated namespace information defined in its output elements. For example, to return information about port-profiles to which interfaces are applied, you can use the <get-port-profile-for-intf> RPC defined in the brocade-port-profile-ext.yang file.

The brocade-port-profile-ext.yang file defines the structure of the <get-port-profile-for-intf> RPC as follows:

```
+---x get-port-profile-for-intf
      +--ro input
         +--ro interface-type?   enumeration
         +--ro interface-name?   union
      +--ro output
         +--ro interface
            +--ro interface-type?   enumeration
            +--ro interface-name?   union
            +--ro port-profile
               +--ro name?   common-def:name-string64
```

The following example shows the <rpc> message and reply. The <get-port-profile-for-intf> element contains an xmlns attribute that identifies the corresponding namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="206">
    <get-port-profile-for-intf
        xmlns="urn:brocade.com:mgmt:brocade-interface-ext"/>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="206">
    <interface xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
        <interface-type>tengigabitethernet</interface-type>
        <interface-name>9/0/53</interface-name>
        <port-profile>
            <name>auto-VM_Network</name>
        </port-profile>
    </interface>
    <interface xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
```

```
        <interface-type>tengigabitethernet</interface-type>
        <interface-name>9/0/54</interface-name>
        <port-profile>
            <name>auto-for_iscsi</name>
        </port-profile>
    </interface>
</rpc-reply>
```

Refer to the *Network OS YANG Reference Manual* for a list of custom RPCs, a brief description of their function, and their location.

Retrieving operational data with pagination

Some RPCs return operational data that consists of lists of entities. For example, an RPC might return detailed information about every interface. For these kinds of applications, to make the output manageable, pagination is supported by providing a <has-more> element in the output of the RPC.

The following example shows how the <has-more> element works to provide pagination for the <get-vlan-brief> RPC. In the input, you can request information about a specific VLAN, or about all VLANs by not providing an input parameter. If you request input about all VLANs, you will first receive information about the VLAN with the lowest VLAN ID. You can then check the <has-more> element in the output to determine whether information is available for additional VLANs. If <has-more> is true, use the value returned in <last-vlan-id> as the <last-rcvd–vlan-id> input parameter to the next call to <get-vlan-brief>. The <get-vlan-brief> RPC then returns the next available VLAN. Continue until <has-more> returns false.

```
+---x get-vlan-brief
      +--ro input
      |  +--ro (request-type)?
      |     +--:(get-request)
      |     |  +--ro vlan-id?             interface:vlan-type
      |     +--:(get-next-request)
      |        +--ro last-rcvd-vlan-id?   interface:vlan-type
      +--ro output
         +--ro vlan [vlan-id]
         |  +--ro vlan-id       interface:vlan-type
         |  +--ro vlan-type?    enumeration
         |  +--ro vlan-name?    string
         |  +--ro vlan-state?   enumeration
         |  +--ro interface [interface-type interface-name]
         |     +--ro interface-type    enumeration
         |     +--ro interface-name    union
         |     +--ro tag?              enumeration
         +--ro last-vlan-id?   interface:vlan-type
         +--ro has-more?       boolean
```

The following example uses the <get-interface-brief> RPC to return information about the first VLAN. In this case, the first VLAN is VLAN 20.

```
<rpc message-id="207" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-vlan-brief xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
    </get-vlan-brief>
</rpc>

rpc-reply message-id="207" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <vlan xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <vlanid>20</vlanid>
        <vlan-type>static</vlan-type>
```

```
        <vlan-name>vlan-20</vlan-name>
        <vlan-state>active</valan-state>
        <interface>
            <interface-type>tengigabitethernet</interface-type>
            <interfce-name>66/0/10</interface-name>
            <tag>tagged</tag>
        </interface>
    </vlan>
    <last-vlan-id>20</last-vlan-id>
    <has-more>true</has-more>
</rpc-reply>
```

The <has-more> field is true, so use the value returned in <last-vlan-id> as the <last-rcvd-vlan-id> in the next call to <get-vlan-brief> to return information about the next VLAN.

```
<rpc message-id="208" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-vlan-brief xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <last-rcvd-vlan-id>20</last-rcvd-vlan-id>
    </get-vlan-brief>
</rpc>

<rpc-reply message-id="208" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <vlan xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <vlanid>30</vlanid>
        <vlan-type>static</vlan-type>
        <vlan-name>vlan-30</vlan-name>
        <vlan-state>active</valan-state>
        <interface>
            <interface-type>tengigabitethernet</interface-type>
            <interfce-name>66/0/12</interface-name>
            <tag>tagged</tag>
        </interface>
    </vlan>
    <last-vlan-id>30</last-vlan-id>
    <has-more>false</has-more>
</rpc-reply>
```

If the <has-more> field returns false, no more VLAN data can be retrieved.

Using the custom action mechanism

An *action* is a proprietary mechanism used for implementing operations that do not affect the configuration datastore. Several implementations of actions exist in the Network OS implementation for retrieving operational information. The following structure is defined in the brocade-zone.yang module for displaying operational data related to zoning.

```
+--rw common-def:show
   +--rw brocade-zone:zoning
         +--action brocade-zone:operation-info
            +--input
            +--output
               +--ro brocade-zone:db-max
               +--ro brocade-zone:db-avail
               +--ro brocade-zone:db-committed
               +--ro brocade-zone:db-transaction
               +--ro brocade-zone:transaction-token
               +--ro brocade-zone:last-zone-changed-timestamp
               +--ro brocade-zone:last-zone-committed-timestamp
```

The following example shows use of the <zoning>/<operation-info> action.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="209">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <zoning xmlns="urn:brocade.com:mgmt:brocade-zone"/>
            </show>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="209">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <db-max>1045274</db-max>
        <db-avail>1043895</db-avail>
        <db-committed>367</db-committed>
        <db-transaction>373</db-transaction>
        <transaction-token>1</transaction-token>
        <last-zone-changed-timestamp>2011-11-16 16:54:31 GMT-7:00
        </last-zone-changed-timestamp>
        <last-zone-committed-timestamp>2011-11-16 16:23:44 GMT-7:0
        </last-zone-committed-timestamp>
    </zoning>
</rpc-reply>
```

For a list of available actions and their locations, refer to the *Network OS YANG Reference Manual*.

Editing the configuration

All configuration editing is done using the merge or delete operations of the <edit-config> RPC. The create and replace operations are not supported. Refer to RFC 4741, *The NETCONF Protocol*, for details about these operations.

NOTE
Every NETCONF <edit-config> request should have a one-to-one mapping with a Brocade command. You cannot combine two CLI operations into one NETCONF request.

The following example of the default merge operation adds a static address to the MAC address table. The operation is performed on the running configuration and configures the <mac-address-table> node in the urn:brocade.com:mgmt:brocade-mac-address-table namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="210" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac-address-table
            xmlns="urn:brocade.com:mgmt:brocade-mac-address-table">
                <static>
                    <mac-address>0011.2222.3333</mac-address>
                    <forward>forward</forward>
                    <interface-type>tengigabitethernet</interface-type>
                    <interface-name>66/0/1</interface-name>
                    <vlan>vlan</vlan>
                    <vlanid>100</vlanid>
```

```
            </static>
          </mac-address-table>
       </config>
    </edit-config>
</rpc>

<rpc-reply message-id="210" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The delete operation is used to remove or disable part of the configuration. The following example disables MSTP on the managed device.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="211" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="211" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Managing the configuration

Network OS provides the custom <bna-config-cmd> PRC for performing any of the following operations:

- Copy the *running-config* file to the *startup-config* file.
- Copy the *running-config* file to a remote file.
- Copy the *startup-config* file to a remote file.
- Copy a remote file to the *running-config* file.
- Copy a remote file to the *startup-config* file.

Some simple examples are provided here. Refer to the *Network OS Administrator's Guide* for the following related information:

- General configuration management concepts
- Details and recommendations about how to apply these operations in a modular chassis or a Brocade VCS Fabric
- How to perform management configuration using the Brocade Network OS command line interface (CLI)

The most common configuration management operation is to copy the *running-config* file to the *startup-config* file. You must perform this operation to save configuration changes across reboots. To copy the running-config file to the startup-config file, issue the following RPC.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="212">
   <bna-config-cmd xmlns="urn:brocade.com:mgmt:brocade-ras">
      <src>running-config</src>
      <dest>startup-config</dest>
   </bna-config-cmd>
</rpc>

<rpc-reply message-id="212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <session-id xmlns="urn:brocade.com:mgmt:brocade-ras">5</session-id>
    <status xmlns="urn:brocade.com:mgmt:brocade-ras">in-progress</status>
</rpc-reply>
```

To monitor the progress of the copy operation, issue the <bna-config-cmd-status> custom RPC. Provide the session-ID returned by the corresponding <bna-config-cmd> as the input parameter.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="212">
   <bna-config-cmd-status xmlns="urn:brocade.com:mgmt:brocade-ras">
      <session-id>5</session-id>
    </bna-config-cmd-status>
</rpc>

<rpc-reply message-id="212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <status xmlns="urn:brocade.com:mgmt:brocade-ras">completed</status>
</rpc-reply>
```

To archive or back up the *running-config* or *startup-config* file, specify <running/> or <startup/> as the <src> parameter, and the URL of the archive as the <dest> parameter. The following example archives the *running-config* file.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="212">
   <bna-config-cmd xmlns="urn:brocade.com:mgmt:brocade-ras">
      <src>running-config</src>
      <dest>https://user@brocade.com:passphrase/cfg/archiveMay7.txt</dest>
   </bna-config-cmd>
</rpc>

<rpc-reply message-id="212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <session-id xmlns="urn:brocade.com:mgmt:brocade-ras">6</session-id>
    <status xmlns="urn:brocade.com:mgmt:brocade-ras">in-progress</status>
</rpc-reply>
```

To restore an archived configuration, specify the archive URL as the <source> parameter and <running/> or <startup/> as the <target>.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="212">
   <bna-config-cmd xmlns="urn:brocade.com:mgmt:brocade-ras">
      <src>https://user@brocade.com:passphrase/cfg/archiveMay7.txt</src>
      <dest>running-config</dest>
   </bna-config-cmd>
</rpc>

<rpc-reply message-id="212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <session-id xmlns="urn:brocade.com:mgmt:brocade-ras">6</session-id>
    <status xmlns="urn:brocade.com:mgmt:brocade-ras">in-progress</status>
</rpc-reply>
```

Disconnecting from a NETCONF session

To disconnect from a NETCONF session, issue the standard <close-session> RPC. This operation causes the server to release any resources associated with the session and gracefully close any associated connections.

```
<rpc message-id="215" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <close-session/>
</rpc>

<rpc-reply message-id="215" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The <kill-session> RPC is also supported. Issuing <kill-session> aborts all operations and closes the session.

Chapter

Basic Switch Management 3

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Basic switch management with NETCONF overview

This chapter provides procedures for performing some basic switch operations using the NETCONF interface.

Refer to the *Network OS Administrator's Guide* for the following related information:

- Conceptual and overview information
- Using DHCP Automatic Deployment (DAD)
- Procedures for configuring the Ethernet management interface
- Basic switch configuration using the Network OS command line interface (CLI)

Using the NETCONF interface, you can perform the following basic switch configuration operations described in this chapter:

- Use the <edit-config> RPC to set host attributes, configure a line card type on a chassis slot, configure a switch banner, enable or disable first failure data capture (FFDC), and configure logging.
- Use custom actions to enable or disable a chassis, reboot a switch, power on/off a line card, obtain slot and module status, and upload supportSave data.
- Use the <show-raslog> custom RPC to return RASlog messages.

Switch management parameters described in this chapter are defined mostly in the brocade-ras, brocade-linecard-management, and brocade-chassis YANG modules. For structural maps of these YANG modules, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of parameters, refer to the corresponding .yang file.

Connecting to the switch

For NETCONF operations, you must connect to the switch through a Secure Shell (SSH) connection to the management port. You can use any account login present in the local switch database or on a configured authentication, authorization, and accounting (AAA) server for authentication. For initial setup procedures, use the preconfigured administrative account that is part of the default switch configuration.

The switch must be physically connected to the network. If the switch network interface is not configured or the switch has been disconnected from the network, use a console session on the serial port.

- Refer to the Brocade VDX Hardware Reference Manuals for information on connecting through the serial port.
- Refer to the *Network OS Administrator's Guide* for configuring the management interface.

Connecting through an SSH session

For NETCONF operations, you musty connect to the switch using SSH.

1. Connect through a serial port to the switch.
2. Verify that the switch's network interface is configured and that it is connected to the IP network through the RJ-45 Ethernet port.
3. Log off the switch's serial port.
4. From a management station, open an SSH connection using the management IP address of the switch to which you want to connect.
5. Enter the account user name at the login prompt.
6. Enter the password.

   Brocade recommends that you change the default account password when you log in for the first time. For more information on changing the default password, refer to the Brocade VDX Hardware Reference Manuals.
7. Verify that the login was successful.

   The prompt displays the host name followed by a pound sign (#).

```
login as: admin
admin@10.20.49.112's password:******

--------------------------------------------------
WARNING: The default password of 'admin' and 'user' accounts have not been
changed.
Welcome to the Brocade Network Operating System Software
admin connected from 10.110.100.92 using ssh on VDX6720-24
```

Switch attributes

A switch can be identified by its IP address, World Wide Name (WWN), switch ID or RBridge ID, or by its host name and chassis name. You can customize the host name and chassis name with the NETCONF interface.

- A host name can be from 1 through 30 characters long. It must begin with a letter, and can contain letters, numbers, and underscore characters. The default host name is “sw0.” The host name is displayed at the system prompt.
- Brocade recommends that you customize the chassis name for each platform. Some system logs identify the switch by its chassis name; if you assign a meaningful chassis name, logs are more useful. A chassis name can be from 1 through 30 characters long, must begin with a letter, and can contain letters, numbers, and underscore characters. The default chassis names are:
  - VDX8770-4
  - VDX8770-8
  - VDX6710
  - VDX6720-24
  - VDX6720-60
  - VDX6730-32
  - VDX6730-76
  - VDX6740-48
  - VDX6740-64
  - VDX6740T-48
  - VDX6740T-64
  - VDX6740T-1G

Setting host attributes

To set the host attributes, perform the following steps.

1. Issue the <edit-config> RPC to configure the <system> node in the urn:brocade.com:mgmt:brocade-ras namespace.
2. Under the <system> node, include the <switch-attributes> node.
3. Under the <switch-attributes> node, include the following leaf elements.
   a. In the <rbridge-id> element, identify the switch for which you want to set attributes.
   b. In the <host-name> element, specify a name for the host.
   c. In the <chassis-name> element, specify a name of the chassis.
4. Issue the <bna-config-cmd> custom RPC in the urn:brocade.com:mgmt:brocade-ras namespace to save the configuration changes made in the *running-config* file to the *startup-config* file.

The following example names the host and the chassis for routing bridge 27.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="300" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system xmlns="urn:brocade.com:mgmt:brocade-ras">
```

```
                <switch-attributes>
                    <rbridge-id>27</rbridge-id>
                    <host-name>lab1_vdx0023</host-name>
                    <chassis-name>lab1_vdx0023</chassis-name>
                </switch-attributes>
            </system>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="300" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Obtaining host attribute information

To return the configured host attribute information, issue the <get-config> RPC with a subtree filter to return only the information under the <system>/<switch-attributes> node in the urn:brocade.com:mgmt:brocade-ras namespace, as shown in the following example. Include the <rbridge-id> leaf element under the <switch-attributes> node to restrict output to a specific switch.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <system xmlns="urn:brocade.com:mgmt:brocade-ras">
                <switch-attributes>
                    <rbridge-id>27</rbridge-id>
                </switch-attributes>
            </system>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <system xmlns="urn:brocade.com:mgmt:brocade-ras">
        <switch-attributes>
            <rbridge-id>27</rbridge-id>
            <host-name>lab1_vdx0023</host-name>
            <chassis-name>lab1_vdx0023</chassis-name>
        </switch-attributes>
    </system>
</rpc-reply>
```

Disabling or enabling a chassis

By default, the chassis is enabled after power is turned on and diagnostics and switch initialization routines have finished. All interfaces are online. You can disable and re-enable the chassis as necessary.

- Disable the chassis if you want to take all interfaces offline. If the switch was part of an Ethernet fabric, the fabric reconfigures.

- Enable the chassis to bring the interfaces back online. All interfaces that passed POST are enabled and come back online. If the switch was part of an Ethernet fabric, it rejoins the fabric.

NOTE
Disabling the chassis is a disruptive operation. Alternatively, you can shut down and re-enable individual interfaces.

To enable a chassis, issue the <chassis>/<enable> custom action located in the urn:brocade.com:mgmt:brocade-chassis namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="302">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <chassis xmlns="urn:brocade.com:mgmt:brocade-chassis">
                <enable/>
            </chassis>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="302">
    <ok/>
</rpc-reply>
```

To re-enable a disabled chassis, issue the <chassis>/<disable> custom action also located in the urn:brocade.com:mgmt:brocade-chassis namespace.

```
rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="303">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <chassis xmlns="urn:brocade.com:mgmt:brocade-chassis">
                <disable/>
            </chassis>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="303">
    <ok/>
</rpc-reply>
```

Rebooting a Brocade switch

Network OS NETCONF interface provides the following methods to reboot your system: fastboot, and ha chassisreboot.

- Use the fastboot operation to reboot a compact chassis or just the management module of a modular chassis. Power-on self-test (POST) is bypassed.
- The ha chassisreboot operation performs a “cold reboot” (power off and restart) of the entire modular chassis. If POST is enabled, POST is executed when the system comes back up.

CAUTION
Do not perform a reload operation between a disable operation and an enable operation on a chassis. Your ports will be closed.

To perform a reboot of the entire modular chassis, issue the <ha>/<chassisreboot> custom action located in the urn:brocade.com:mgmt:brocade-ha namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="304">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <ha xmlns="urn:brocade.com:mgmt:brocade-ha">
                <chassisreboot/>
            </ha>
        </nca:data>
    </nca:action>
</rpc>
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="304">
    <ok/>
</rpc-reply>
```

To perform a fastboot operation, issue the <reboot>/<fastboot> custom action located in the urn:brocade.com:mgmt:brocade-firmware namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="305">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <reboot xmlns="urn:brocade.com:mgmt:brocade-firmware">
                <fastboot/>
            </reboot>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="305">
    <ok/>
</rpc-reply>
```

NOTE
Both reboot operations are disruptive, and you are prompted for confirmation before executing. When you reboot a switch connected to a fabric, all traffic to and from that switch stops. All ports on that switch remain inactive until the switch comes back online.

Interfaces, slots, and modules

This section describes a few frequently used or important operations performed on slots, modules, or interfaces. Refer to the *Network OS Administrator's Guide* for an extensive overview of modular platform basics.

Obtaining interface configuration information

To obtain interface information, issue the <get-config> RPC with a subtree filter to return only information under the <interface> node located in the urn:brocade.com:mgmt:brocade-interface namespace.

The following example further restricts the output to 10 Gigabit Ethernet interfaces by specifying the <tengigabitethernet> node in the subtree filter.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="306" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet/>
            </interface>
        </filter>
    </get-config>
</rpc>
```

Obtaining slot and module status information

To show information about all slots in the chassis, issue the <slotsinfor>/<slots> custom action located in the urn:brocade.com:mgmt:brocade-linecard-management namespace. The <slotsinfor> node is included in the <show> node of the urn:brocade.com:mgmt:brocade-common-def namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="307">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <slotsinfor
                 xmlns="urn:brocade.com:mgmt:brocade-linecard-management">
                    <slots/>
                </slotsinfor>
            </show>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="307">
    <ok/>
</rpc-reply>
```

Similarly, you can show information about specific module types by issuing the following custom actions:

- Issue the <mminfor>/<mm> custom action to display information for the management modules.
- Issue the <sfminfo>/<sfm> custom action to display information for the switch fabric modules.
- Issue the <linecardinfo>/<linecard> custom action to display information for the interface modules.

Replacing an interface module

You can remove an interface module without powering it off. However, doing so will not remove the configuration. When you replace a module with a different type, you must first remove the configuration and then reconfigure the slot for the new interface module type.

Removing the configuration requires the interface module to be powered off.

The example RPCs shown in the following procedure replace the card in slot 1 with a LC48x10G module. These examples assume VCS Fabric mode. For standalone mode, replace the <rbridgeid>/<global-lc-holder> node elements with the <standalone-lc-holder> node element.

1. Power off the interface module by issuing the <linecardservice>/<power-off> custom action located in the urn:brocade.com:mgmt:brocade-linecard-management namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="308">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <linecardservice
             xmlns="urn:brocade.com:mgmt:brocade-linecard-management">
               <power-off>
                   <linecard>1</linecard>
               </power-off>
            </linecardservice>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply message-id="308" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Clear the slot configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="309" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>5</rbridge-id>
                <global-lc-holder
                 xmlns="urn:brocade.com:mgmt:brocade-linecard-management">
                   <linecard>
                       <linecards
                        xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                        operation="delete">
                          <linecardName>1</linecardName>
                       </linecards>
                   </linecard>
                </global-lc-holder>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="309" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Remove the interface module.

4. Specify the new line card type.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="310" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
            <rbridge-id>5</rbridge-id>
                <global-lc-holder
                 xmlns="urn:brocade.com:mgmt:brocade-linecard-management">
                   <linecard>
                       <linecards>
                           <linecardName>1</linecardName>
                           <linecardType>LC48x10G</linecardType>
                       </linecards>
                   </linecard>
                </global-lc-holder>
            </rbridgeid>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="310" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. Insert the new interface module into the configured slot.
6. To power on the new line card, reissue the <linecardservice>/<power-off> custom action located in the urn:brocade.com:mgmt:brocade-linecard-management namespace.
7. Issue the <bna-config-cmd> custom RPC in the urn:brocade.com:mgmt:brocade-ras namespace to copy the *running-config* file to the *startup-config* file and save your configuration changes.
8. To verify the configuration change, issue the <get-config> RPC with a subtree filter to return only the contents of the <linecard>/<linecards> node in the urn:brocade.com:mgmt:brocade-linecard-management namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="311" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <rbridgeid xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>5</rbridge-id>
                <global-lc-holder
                 xmlns="urn:brocade.com:mgmt:brocade-linecard-management">
                   <linecard>
                       <linecards>
                           <linecardName>1</linecardName>
                       </linecards>
                   </linecard>
                </global-lc-holder>
            </rbridgeid>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="311" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <rbridgeid xmlns="urn:brocade.com:mgmt:brocade-rbridge">
        <rbridge-id>5</rbridge-id>
```

```
        <global-lc-holder
         xmlns="urn:brocade.com:mgmt:brocade-linecard-management">
            <linecard>
                <linecards>
                    <linecardName>1</linecardName>
                    <linecardType>LC48x10G</linecardType>
                </linecards>
            </linecard>
        </global-lc-holder>
    </rbridgeid>
</rpc-reply>
```

Configuring a switch banner

A banner is a text message that displays on the console of the CLI. It can contain information about the switch that an administrator may want users to know when accessing the switch.

The following procedure sets and verifies a switch banner.

1. Issue the <edit-config> RPC to configure the <banner> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <banner> node, include the <login> leaf element and specify the banner that is to be displayed when a user logs in.

   Optionally, add the <motd> node to configure the Message of the Day.

   The banner is a string up to 2048 characters long.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="312" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <banner xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <login>Please do not disturb the setup on this switch</login>
                <motd>TPS reports are due every Thursday.</motd>
            </banner>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="312" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. To verify the banner, issue the <get-config> RPC with a subtree filter to return the contents of the <banner> node in the urn:brocade.com:mgmt:brocade-aaa namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="313" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <banner xmlns="urn:brocade.com:mgmt:brocade-aaa">
```

```
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="313" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <banner xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <login>Please do not disturb the setup on this switch</login>
    </banner>
</rpc-reply>
```

supportSave data

If you are troubleshooting a production system, you will have to capture data for further analysis or send the data to your switch service provider. The <copy>/<support> custom action located in the urn:brocade.com:mgmt:brocade-ras namespace provides a mechanism for capturing critical system data and uploading the data to an external host or saving the data to an attached USB device.

Uploading supportSave data to an external host interactively

To upload supportSave data interactively, issue the <copy>/<support-interactive> action located in the urn:brocade.com:mgmt:brocade-ras namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="314">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <copy xmlns="urn:brocade.com:mgmt:brocade-ras">
                <support-interactive/>
            </copy>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="314">
    <ok/>
</rpc-reply>
```

The switch responds with a dialog for accessing and uploading to the external host.

Uploading supportSave to an external host using FTP

To upload supportSave data to an external host using FTP, issue the <copy>/<support>/<ftp> custom action located in the urn:brocade.com:mgmt:brocade-ras namespace. Under the <ftp> node, include the following leaf elements:

- In the <user> and <password> elements, provide valid login credentials for an account on the FTP server.
- In the <host> field, specify the IP address of the FTP server.

  IPv6 addresses are valid only on Network OS 3.0.0 platforms.
- In the <directory> field, specify the path to the directory on the FTP server where you want to store the supportSave data.

- (VCS Fabric mode only) In the <rbridge-id> field, specify the RBridge ID of the switch whose supportSave data you want to save.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="315">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <copy xmlns="urn:brocade.com:mgmt:brocade-ras">
                <support>
                    <ftp>
                        <user>admin</user>
                        <host>10.38.33.131</host>
                        <directory>/home/admin/support</directory>
                        <password>h8F!@m</password>
                        <rbridge-id>5</rbridgeid>
                    </ftp>
                </support>
            </copy>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="315">
    <copy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
        <support>
            <ftp>
                <supportSaveResult>
                    <rbridge-id>5</rbridge-id>
                    <status-code>success</status-code>
                </supportSaveResult>
            </ftp>
        </support>
    </copy>
</rpc-reply>
```

Uploading supportSave to an external host using SCP

To upload supportSave data to an external host using SCP, issue the <copy>/<support>/<scp> custom action located in the urn:brocade.com:mgmt:brocade-ras namespace. Under the <scp> node, include the following leaf elements:

- In the <user> and <password> elements, provide valid login credentials for an account on the SCP server.
- In the <host> field, specify the IP address of the SCP server.

  IPv6 addresses are valid only on Network OS 3.0.0 platforms.
- In the <directory> field, specify the path to the directory on the SCP server where you want to store the supportSave data.
- (VCS Fabric mode only) In the <rbridge-id> field, specify the RBridge ID of the switch whose supportSave data you want to save.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="316">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <copy xmlns="urn:brocade.com:mgmt:brocade-ras">
                <support>
                    <scp>
                        <user>admin</user>
```

```
                    <host>10.38.33.131</host>
                    <directory>/home/admin/support</directory>
                    <password>h8F!@m</password>
                    <rbridge-id>5</rbridgeid>
                </scp>
            </support>
        </copy>
    </nca:data>
</nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="316">
    <copy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
        <support>
            <scp>
                <supportSaveResult>
                    <rbridge-id>5</rbridge-id>
                    <status-code>success</status-code>
                </supportSaveResult>
            </scp>
        </support>
    </copy>
</rpc-reply>
```

Saving supportSave data to an attached USB device

You can use a Brocade-branded USB device to save the support data. The Brocade-branded USB device comes with factory-configured default directories and interacts with the Network OS CLI.

1. To enable the USB device, issue the <system>/<usb>/<on> custom action located in the urn:brocade.com:mgmt:brocade-ras namespace.

   In the VCS Fabric mode only, include the <rbridge-id> leaf element under the <on> node and specify the routing bridge on which you want to enable the USB device.

   ```
   <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="317">
       <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
           <nca:data>
               <system xmlns="urn:brocade.com:mgmt:brocade-ras">
                   <usb>
                       <on>
                           <rbridge-id>27</rbridge-id>
                       </on>
                   </usb>
               </system>
           </nca:data>
       </nca:action>
   </rpc>

   <rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="317">
       <ok/>
   </rpc-reply>
   ```

2. To display the default directories, issue the <system>/<usb>/<dir> custom action located in the urn:brocade.com:mgmt:brocade-ras namespace.

   In the VCS Fabric mode only, include the <rbridge-id> leaf element under the <dir> node and specify the routing bridge for which you want to display the default directories.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="318">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <system xmlns="urn:brocade.com:mgmt:brocade-ras">
                <usb>
                    <dir>
                        <rbridge-id>27</rbridge-id>
                    </dir>
                </usb>
            </system>
        </nca:data>
    </nca:action>
</rpc>


<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="318">
    <ok/>
</rpc-reply>
```

3. Issue the <copy>/<support>/<usb> custom action located in the urn:brocade.com:mgmt:brocade-ras namespace to copy the supportSave information to the USB device. Under the <usb> node, include the following leaf elements:

   - In the <directory> element, specify the directory where the supportSave data will be copied.
   - (VCS Fabric mode only) In the <rbridge-id> element, specify the RBridge ID of the switch whose data you want copied. Specify “all” to copy supportSave data for all switches in the Fabric cluster.
   - (Optional) In the <timeout> element, provide a supportSave timeout multiplier. This value increases timeout values associated with supportSave operations. For example, a value of 2 doubles timeouts.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="319">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <copy xmlns="urn:brocade.com:mgmt:brocade-ras">
                <support>
                    <usb>
                        <directory>support</directory>
                        <rbridge-id>5</rbridgeid>
                        <timeout>2</timeout>
                    </usb>
                </support>
            </copy>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="319">
    <copy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
        <support>
            <usb>
                <supportSaveResult>
                    <rbridge-id>5</rbridge-id>
                    <status-code>success</status-code>
                </supportSaveResult>
            </usb>
        </support>
```

```
    </copy>
</rpc-reply>
```

Enabling or disabling FFDC

First failure data capture (FFDC) is enabled by default.

To re-enable FFDC in the VCS Fabric mode, perform the following steps.

1. Issue the <edit-config> RPC to configure the <support> node in the urn:brocade.com:mgmt:brocade-ras namespace.
2. Under the <support> node, include the <rbridge-id> node element.
3. Under the <rbridge-id> node, include the following leaf elements.
    a. In the <rbridge-id> element, specify the switch on which you want to enable FFDC.
    b. Include the empty <ffdc> element to enable FFDC on the routing bridge.

The following example enables FFDC on routing bridge 56.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="320" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <support xmlns="urn:brocade.com:mgmt:brocade-ras">
                <rbridge-id>
                    <rbridge-id>56</rbridge-id>
                    <ffdc/>
                </rbridge-id>
            </support>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="320" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To enable FFDC in standalone mode, include the empty <ffdc> leaf element directly under the <support> node.

To disable FFDC, use the same RPC, but include the delete operation in the leading tag of the <rbridge-id> node element.

Syslog server setup

The system logging daemon (syslogd) is an IP-based service for logging system messages. The syslog daemon is part of the UNIX and Linux operating systems. It is available as a third-party application for Windows operating systems.

You can configure your switch to forward system events and error messages securely or non-securely to log files on a remote server. The server can be running UNIX, Linux, or any other operating system that supports the standard syslogd functionality.

Secure syslog sends log messages securely over the network using the Transport Layer Security (TLS) protocol. TLS is an encryption protocol over the TCP/IP network protocol, so it can be used only with TCP-based destinations.

You can configure up to four secure or non-secure syslog servers. When you add a syslog server, you must specify the IPv4 or IPv6 address of the server. You can also specify the security mode (secure or non-secure), and the port number on which the syslog server is listening. By default, the security mode is non-secure, and the port number is UDP 514.

Brocade recommends configuring a different port number for secure TLS connections. You must also set the same TLS port number on the secure syslog server to receive the log messages from the switch. For secure syslog to function correctly, you must also import a syslog CA certificate.

Syslog configuration applies fabric-wide.

Adding syslog servers

To add a syslog server, perform the following steps.

1. Issue the <edit-config> RPC to configure the <logging> node in the urn:brocade.com:mgmt:brocade-ras namespace.
2. Under the <logging> node, for each syslog server you want to add, include a <syslog-server> node element.
3. Under each <syslog-server> node, include the following elements:
   a. In the <syslogip> element, specify the IPv4 or IPv6 address of the syslog server you want to add.
   b. Include the empty <secure> element, to set the secure mode. Include the delete operation in the element tag to set the non-secure mode.

      The default value is non-secure mode.
   c. Optionally, if secure mode is set, in the <port> element, specify an IP port number.

   The following example adds four syslog servers. It sets the secure mode on servers 192.168.163.233 and fec0:60:69bc:92:218:8bff:fe40:15c4 and specifies a port number for each server. It also adds 192.168.163.235 and 192.168.162.326 in non-secure mode with the default port value of 514.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="321" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <logging xmlns="urn:brocade.com:mgmt:brocade-ras">
                <syslog-server>
                    <syslogip>192.168.163.233</syslogip>
                    <secure/>
                    <port>2000</port>
                </syslog-server>
                <syslog-server>
                    <syslogip>fec0:60:69bc:92:218:8bff:fe40:15c4</syslogip>
                    <secure/>
                    <port>1999</port>
                </syslog-server>
                <syslog-server>
                    <syslogip>192.168.163.235</syslogip>
                </syslog-server>
                <syslog-server>
```

```
                    <syslogip>192.168.163.236</syslogip>
                </syslog-server>
            </logging>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="321" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. To verify the syslog server configuration, issue the <edit-config> RPC with a subtree filter to return only information under the <logging> node in the urn:brocade.com:mgmt:brocade-ras namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="322" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <logging xmlns="urn:brocade.com:mgmt:brocade-ras">
                <syslog-server/>
            </logging>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="322" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <logging xmlns="urn:brocade.com:mgmt:brocade-ras">
        <syslog-server>
            <syslogip>192.168.163.233</syslogip>
            <secure/>
            <port>2000</port>
        </syslog-server>
        <syslog-server>
            <syslogip>fec0:60:69bc:92:218:8bff:fe40:15c4</syslogip>
            <secure/>
            <port>1999</port>
        </syslog-server>
        <syslog-server>
            <syslogip>192.168.163.235</syslogip>
        </syslog-server>
        <syslog-server>
            <syslogip>192.168.163.236</syslogip>
        </syslog-server>
    </logging>
</rpc-reply>
```

Modifying the syslog server configuration

You can change the secure mode and the port number of a configured syslog server. The following example disables secure mode for the syslog server 192.168.163.233, enables secure mode for the syslog server 192.168.163.236. It also sets the port number for the newly secured server to 2001.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="323" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <logging xmlns="urn:brocade.com:mgmt:brocade-ras">
                <syslog-server>
                    <syslogip>192.168.163.233</syslogip>
                    <secure xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </syslog-server>
                <syslog-server>
                    <syslogip>192.168.163.236</syslogip>
                    <secure/>
                    <port>2001</port>
                </syslog-server>
            </logging>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="323" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Importing a syslog CA certificate

You must install a syslog CA certificate for secure syslog to function correctly. You do not need to import a syslog CA certificate to log messages in non-secure mode.

You can install only one syslog CA certificate. This procedure returns an error if a syslog CA certificate is already installed.

1. Issue the <syslogca> action located in the <certutil>/<import> node in the urn:brocade.com:mgmt:brocade-certutil namespace.
2. Under the <syslogca> node, include the following leaf elements to specify the input parameters.
    a. In the <protocol> element, specify either SCP or FTP to identify the protocol to be used for importing the certificate.
    b. In the <user> element, enter the login user name for the remote server where the certificate resides.
    c. In the <password> element, enter the password for the user account.
    d. In the <host> element, enter the IPv4 address of the remote host.
    e. In the <directory> element, specify the path to the directory that contains the certificate file on the remote host.
    f. In the <file> element, specify the certificate filename.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="324">
   <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <certutil xmlns="urn:brocade.com:mgmt:brocade-certutil">
                <import>
                    <syslogca>
                        <protocol>SCP</protocol>
```

```
                    <user>testuser</user>
                    <password>password</password>
                    <host>10.70.4.101</host>
                    <directory>/users/home40/testuser</directory>
                    <file>ca.cert</file>
                </syslogca>
            </import>
        </certutil>
    </data>
</action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="324">
    <ok/>
</rpc-reply>
```

Removing a syslog CA certificate

To delete the CA certificate, issue the <syslogca> action located in the <no>/<certutil> node, where the <no> element resides in the urn:brocade.com:mgmt:brocade-common-def namespace and the <certutil> node resides in the urn:brocade.com:mgmt:brocade-certutil namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="325">
   <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
       <data>
           <no xmlns="urn:brocade.com:mgmt:brocade-common-def">
               <certutil xmlns="urn:brocade.com:mgmt:brocade-certutil">
                   <syslogca/>
               </certutil>
           </no>
       </data>
   </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="325">
    <ok/>
</rpc-reply>
```

Removing a syslog server

To remove a syslog server, perform the following steps.

1. Issue the <edit-config> RPC to configure the <logging> node in the urn:brocade.com:mgmt:brocade-ras namespace.
2. Under the <logging> node, for the syslog server you want to remove, include a <syslog-server> node element and include the delete operation in the element tag.
3. Under the <syslog-server> node, include a <syslogip> node and specify the IPv4 or IPv6 address of the syslog server you want to delete.
4. To verify the syslog server configuration, issue the <edit-config> RPC with a subtree filter to return only information under the <logging> node in the urn:brocade.com:mgmt:brocade-ras namespace.

The following example removes a syslog server.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="326" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <logging xmlns="urn:brocade.com:mgmt:brocade-ras">
                <syslog-server xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete">
                   <syslogip>192.168.163.236</syslogip>
                </syslog-server>
            </logging>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="326" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

RASlog configuration

RASlog messages record system events filtered by configured severity levels. Each message includes a timestamp, a message ID, an external sequence number, a severity level, the chassis name, and the message body. Using NETCONF interfaces, you can configure RASlog to filter messages by severity level.

To clear RASlog messages requires the Network OS command line interface (CLI). For more information on RASlog messages, refer to the *Network OS Message Reference*.

Brocade VCS Fabric RASlog

Brocade VCS Fabric RASlog messages are supported in the fabric cluster. A Brocade VCS Fabric RASlog message can be generated from any node and is distributed to all nodes in the cluster. Its primary use is to broadcast Fabric-wide events.

A Brocade VCS Fabric RASlog message has the same format as a normal RASlog message, with additional attributes: Brocade VCS Fabric and RBridge ID.

Displaying the RASlog messages

To display the RASlog messages, issue the <show-raslog> custom RPC located in the urn:brocade.com:mgmt:brocade-ras-ext namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="327">
    <show-raslog xmlns="urn:brocade.com:mgmt:brocade-ras-ext"/>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="327">
    <show-all-raslog xmlns="urn:brocade.com:mgmt:brocade-ras-ext">
        <rbridge-id>tengigabitethernet</interface-type>
        <number-of-entries>237</number-of-entries>
        <raslog-entries>
            <index>13187</index>
            <message-id>NSM-2006</message-id>
            <date-and-time-info>2000-03-11/20:12:03.1234</date-and-time-info>
```

```
            <severity>informational</severity>
            <message>Port-profile aa1 removed successfully on TenGigabitEthernet/
             2/0/17</message>
            <message-flag>other</message-flag>
            <switch-or-chassis-name>switchA</switch-or-chassis-name>
        </raslog-entries>
        <raslog-entries>
(output truncated)
```

Setting the RASlog severity filter

You can choose one of the following severity levels to filter RASlog messages: INFO (default), ERROR, WARNING, or CRITICAL. Input values are case-sensitive. The configured severity level marks the reporting threshold. All messages with the configured severity or higher are displayed.

To set the RASlog severity filter in the VCS Fabric mode, perform the following steps.

1. Issue the <edit-config> RPC to configure the <logging> node in the urn:brocade.com:mgmt:brocade-ras namespace.
2. Under the <logging> node, include the <rbridge-id> node element.
3. Under the <rbridge-id> node, include the <rbridge-id> leaf element.
4. Under the <rbridge-id> node, include the <raslog> node element.
5. Under the <raslog> node, include the <console> leaf element and specify INFO, ERROR, WARNING, or CRITICAL.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="328" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <logging xmlns="urn:brocade.com:mgmt:brocade-ras">
                <rbridge-id>
                    <rbridge-id>23</rbridge-id>
                    <raslog>
                        <console>WARNING</console>
                    </raslog>
                </rbridge-id>
            </logging>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="328" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To set the RASlog filter in standalone mode, include the <raslog>/<console> elements directly under the <logging> node.

Audit log configuration

Audit log messages contain user information such as login name and login IP address. The audit log's purpose is to enable tracking of important user-originated events in the cluster; this is in contrast to RASlog messages, which are primarily used for abnormal or error-related events.

When an audit log message is generated on a switch, it is forwarded to the syslog server. To limit the audit log messages to the syslog server and facilitate monitoring of the audit log messages, three audit log classes are defined: FIRMWARE, SECURITY, and CONFIGURATION.

You must enable the audit log class to generate the audit log messages for that class. The classes are enabled by default. To enable or disable the auditing of these classes, perform the following steps.

1. Issue the <edit-config> RPC to configure the <logging> node in the urn:brocade.com:mgmt:brocade-ras namespace.
2. Under the <logging> node, include the <auditlog> node element.
3. Under the <auditlog> node, include a <class> node element for each class you want to enable or disable.
4. Under each <class> node, include a <class> leaf element and specify the class of message you want to enable or disable.
5. To disable a class, include the delete operation in the <class> node element tag.

The following example enables SECURITY and WARNING messages, but disables CONFIGURATION messages.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="329" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <logging xmlns="urn:brocade.com:mgmt:brocade-ras">
                <auditlog>
                    <class xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete">
                       <class>CONFIGURATION</class>
                    </class>
                    <class>
                        <class>WARNING</class>
                    </class>
                    <class>
                        <class>SECURITY</class>
                    </class>
                </auditlog>
            </logging>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="325" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

4

Network Time Protocol

In this chapter

- Time management with NETCONF overview 47
- Date and time settings 47
- Time zone settings. 48
- Network Time Protocol 50

Time management with NETCONF overview

Through the NETCONF interface, you can perform the following operations for managing time:

- Use the <clock-set-datetime> action to set the local clock date and time.
- Use the <clock-set-timezone> action to set the time zone.
- Use the <no>/<clock>/<timezone> action to clear the time zone data.
- Use the <show-clock> RPC to return the local time, date, and time zone.
- Use the <edit-config> RPC to configure an NTP server.
- Use the <show-ntp> custom RPC to obtain the NTP server address.
- Use the <get-config> RPC to validate configuration settings.

NTP parameters are defined in the brocade-ntp YANG module. Date and time parameters are defined in the brocade-clock YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Date and time settings

Brocade switches maintain the current date and time inside a battery-backed real-time clock (RTC) circuit. Date and time are used for logging events. Switch operation does not depend on the date and time; a switch with incorrect date and time settings can function correctly. However, because the date and time are used for logging, error detection, and troubleshooting, you should set them correctly.

Setting the date and time

The <clock-set-datetime> action sets the local clock date and time. This action is defined in the urn:brocade.com:mgmt:brocade-clock namespace. An active NTP server, if configured, automatically updates and overrides the local clock time. Time values are limited to between January 1, 1970 and January 19, 2038.

To set the date and time, perform the following steps.

1. Issue the <clock-set-datetime> action located in the urn:brocade.com:mgmt:brocade-clock namespace.
2. Under the <clock-set-datetime> node, specify the < clock> node element.
3. Under the <clock> node element, specify the <set> element and provide a value for the desired date and time in the format CCYY-MM-DDTHH:MM:SS.

The following example sets the local time to 2:15 in the afternoon of May 17, 2012.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="304">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <clock-set-datetime xmlns="urn:brocade.com:mgmt:brocade-clock">
                <clock>
                    <set>2012-05-17T14:15:00</set>
                </clock>
            </clock-set-datetime>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
    message-id="304">
    <ok/>
</rpc-reply>
```

Time zone settings

You can set the time zone by specifying one of the following regions with a city from that region: Africa, America, Pacific, Europe, Antarctica, Arctic, Asia, Australia, Atlantic, and Indian. Refer to the *Network OS Administrator's Guide* for a list of accepted time zones for each region.

Setting the time zone

Use the <clock-set-timezone> action to set the time zone for a switch. This action is defied in the urn:brocade.com:mgmt:brocade-clock namespace. You must use this operation for all switches for which a time zone must be set. However, you must set the time zone only once on each switch because the value is written to nonvolatile memory.

NOTE
After upgrading your switch firmware, you may need to reconfigure the time zone information.

To set the time zone, in the <clock-set-timezone>/<clock-zone> node, set the <timezone> element to the desired time zone.

The following example sets the time zone for Los Angeles, California.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="305">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <clock-set-timezone xmlns="urn:brocade.com:mgmt:brocade-clock">
                <clock>
                        <timezone>America/Los_Angeles</timezone>
                </clock>
            </clock-set-timezone>
```

```
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
     message-id="305">
    <ok/>
</rpc-reply>
```

Retrieving the current local clock and time zone

The <show-clock> RPC in the urn:brocade.com:mgmt:brocade-clock namespace returns the local time, date, and time zone. The local clock is used unless a switch ID is specified. Specify “all” as the <rbridge-id> to request local clocks from all switches in the cluster.

The following example returns the clock and time zone information for the switch with routing bridge ID 66.

```
<rpc message-id="307" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-clock xmlns="urn:brocade.com:mgmt:brocade-clock">
        <rbridge-id>66</rbridge-id>
    </show-clock>
</rpc>

rpc-reply message-id="307" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <clock-time xmlns="urn:brocade.com:mgmt:brocade-clock">
        <rbridge-id-out>66</rbridge-id-out>
        <current-time>2012-05-17T12:15:00</current-time>
        <timezone>America/Los_Angeles</<timezone>
    </clock-time>
</rpc-reply>
```

Removing the time zone setting

To clear the time zone data, issue the <no>/<clock>/<timezone> action. The <no> node is located in the urn:brocade.com:mgmt:brocade-common-def namespace. The <clock> node element and <timezone> leaf element are located in the urn:brocade.com:mgmt:brocade-clock node and added to the common-def:no node by augmentation.

The following example removes the time zone setting.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="306">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <no xmlns:"urn:brocade.com:mgmt:brocade-common-def">
                <clock xmlns="urn:brocade.com:mgmt:brocade-clock">
                    <timezone/>
                </clock>
            </show>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
    message-id="306">
    <ok/>
</rpc-reply>
```

Network Time Protocol

Network Time Protocol (NTP) maintains uniform time across all switches in a network. Network OS supports the configuration of an external time server to maintain synchronization between all local clocks in a network.

To keep the time in your network current, it is recommended that each switch have its time synchronized with at least one external NTP server. External NTP servers should be synchronized among themselves in order to maintain fabric-wide time synchronization.

All switches in the fabric maintain the current clock server value in nonvolatile memory. By default, this value is the local clock server of the switch.

NOTE
Network Time Protocol (NTP) must be configured on each individual switch. Network time synchronization is guaranteed only when a common external time server is used by all switches.

You can provide up to five NTP server addresses in IPv4 or IPv6 format in one NETCONF operation. When multiple NTP server addresses are passed, the first obtainable address is set as the active NTP server. If no reachable time server exists, then the local switch time is the default time.

Synchronizing the local time with an external source

Use this operation to add an NTP server IP address to a list of server IP addresses. At least one IP address in the list must be a reachable, configured NTP server or the request will fail.

To add an NTP server IP address to the list of server IP addresses, issue the <edit-config> RPC to configure the <ntp>/<server> node in the urn:brocade.com:mgmt:brocade-ntp namespace. Under the <server> node, set the value of the <ip> element to the IPv4 or IPv6 address, as shown in the following example.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ntp xmlns="urn:brocade.com:mgmt:brocade-ntp" >
                <server>
                    <ip>192.168.10.1</ip>
                </server>
            </ntp>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Retrieving an NTP server IP address

Use the <show-ntp> custom RPC located in the urn:brocade.com:mgmt:brocade-ntp namespace to return the IP address of the currently active NTP server. If no server is configured or no server can be reached, “LOCL” is returned instead (for local switch time). The request is for the local switch unless a switch ID is specified in the <rbridge-id> element.

NOTE
Specifying “all” in the <rbridge-id> element returns only local information.

The response includes either an <ip> element containing the IPv4 or IPv6 address, or a Boolean <LOCL> element, with its value set to “true”.

```
<rpc message-id="303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-ntp xmlns="urn:brocade.com:mgmt:brocade-ntp">
        <rbridge-id>66</rbridge-id>
    </show-ntp>
</rpc>

rpc-reply message-id="303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <node-active-server xmlns="urn:brocade.com:mgmt:brocade-ntp">
        <rbridge-id-out>66</rbridge-id-out>
        <LOCL>true</LOCL>
    </node-active-server>
</rpc-reply>
```

Removing an NTP server IP address

Use this operation to remove an NTP server IP address from a list of server IP addresses. At least one IP address in the remaining list must be a reachable, configured NTP server or the remove request fails.

To remove an NTP server IP address from the list of server IP addresses, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ntp>/<server> node in the urn:brocade.com:mgmt:brocade-ntp namespace.
2. In the <server> tag, include the delete operation.
3. Under the <server> node element, specify an <ip> element and include the IPv4 or IPv6 address of the server you want to remove.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ntp xmlns="urn:brocade.com:mgmt:brocade-ntp" >
                <server xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete">
                    <ip>192.168.10.1</ip>
                </server>
            </ntp>
        </config>
    </edit-config>
```

```
</rpc>

<rpc-reply message-id="302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

Installing and Maintaining Firmware 5

In this chapter

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- Preparing for a firmware download 54
- Downloading the firmware from a remote server 56
- Downloading firmware from a USB device 58
- Evaluating a firmware upgrade 59
- Firmware upgrade in Brocade VCS Fabric mode 64

Firmware upgrade with NETCONF overview

Brocade firmware upgrades consist of multiple firmware packages listed in a .plist file. The .plist file contains specific firmware information (time stamp, platform code, version, and so forth) and the names of the firmware packages to be downloaded. These packages are made available periodically to add features or to remedy defects in the firmware.

Firmware upgrades are performed incrementally. The firmware download operation compares the new firmware packages against the current installation and only downloads the packages that contain new features or have been modified.

You can download the firmware from a remote server using the File Transfer Protocol (FTP), Secure Copy Protocol (SCP), Secure File Transfer Protocol (SFTP), or you can download the firmware from an attached Brocade-branded USB device.

This chapter describes procedures for installing and maintaining firmware using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following information:

- Firmware download concepts
- Overview information about how Network OS performs firmware upgrade on compact switches and on modular switches
- Upgrade and downgrade considerations
- Error handling

Through the NETCONF interface, you can perform the following operations on firmware:

- Use the <show-firmware-version> custom RPC to obtain firmware version information.
- Use the <download>/<ftp> action to download firmware from an FTP server.
- Use the <download>/<scp> action to download firmware from a Secure Copy Protocol.
- Use the <download>/<sftp> action to download firmware from a Secure FTP server.
- Use the <download>/<usb> action to load firmware from a USB device.
- Use the <usb>/<on> device to gain access to a USB device.

- Use the <fwdl-status> custom RPC to query the status of a download operation.
- Use the <firmware-commit> action to commit a firmware upgrade.
- Use the <firmware-restore> action to restore a previous firmware version.

Firmware download parameters, custom RPCs, and actions are defined in the brocade-firmware YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Preparing for a firmware download

To prepare for a firmware upgrade, perform the tasks listed in this section. In the unlikely event of a failure or timeout, you will be able to provide your switch support provider the information required to troubleshoot the firmware download.

1. Verify the current firmware version. Refer to "Obtaining the switch firmware version" on page 54 for details.
2. Decide on a migration path. Check the connected devices to ensure firmware compatibility and that any older versions are supported. Refer to the Network OS Compatibility section of the *Brocade Network OS Release Notes* for the recommended firmware version.
3. Back up your switch configuration prior to the firmware download. Refer to "Managing the configuration" on page 19 for details.
4. *Optional:* For additional support, connect the switch to a computer with a serial console cable. Ensure that all serial consoles and any open network connection sessions, such as Telnet, are logged and included with any trouble reports.
5. Perform the copy support operation to collect all current core files before executing the firmware download. This information helps to troubleshoot the firmware download process in the event of a problem.
6. *Optional:* Clear RASlog messages to erase all existing messages in addition to internal messages.

Obtaining the switch firmware version

Use the <show-firmware-version> custom RPC to obtain the following information:

- Network Operating System version—The firmware version number
- Build time—The build date and time of the firmware
- Firmware name—The label of the firmware image
- Control Processor—CP model and memory

To retrieve switch firmware information, issue the <show-firmware-version> custom RPC from the urn:brocade.com:mgmt:brocade-firmware-ext namespace, and specify the routing bridge ID of the switch you want to query in the <switchid> input parameter.

```
<rpc message-id="401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
           <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
       </show-firmware-version>
</rpc>

<rpc-reply message-id="401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
        <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
            <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
            <os-name>Network Operating system Software</os-name>
            <os-version>4.0.0</os-version>
            <copy-right-info>1995-2010 Brocade Communications Systems, Inc.
             </copy-right-info>
            <build-time>19:18:58 Jun 23, 2012</build-time>
            <firmware-full-version>v4.0.0_bldg56</firmware-full-version>
            <control-processor-vendor>Freescale Semiconductor
             </control-processor-vendor>
            <control-processor-chipset>8548E</control-processor-chipset>
            <control-processor-memory>2000 MB</control-processor-memory>
            <node-info>
                <slot-no>1</slot-no>
                <node-instance-no>1</node-instance-no>
                <node-type>type-mm</node-type>
                <is-active-cp>ytue</is-active-cp>
                <firmware-version-info>
                    <primary-version>v4.0.0_bldg56</primary-version>
                    <secondary-version>v4.0.0_bldg56</secondary-version>
                </firmware-version-info>
            </node-info>
        </show-firmware-version>
</rpc>
```

Obtaining and decompressing firmware

Firmware upgrades are available for customers with support service contracts and for partners on the Brocade website at *http://www.mybrocade.com*.

You must download the firmware package either to an FTP server or to a USB device and decompress the package before you can use the download operations described in this chapter to update the firmware on your equipment. Use the UNIX **tar** command for .tar files, the **gunzip** command for all .gz files, or a Windows unzip program for all .zip files.

When you unpack the downloaded firmware, it expands into a directory that is named according to the firmware version. The firmware download operations, when issued with the path to the directory where the firmware is stored, perform an automatic search for the correct package file type associated with the device.

Connecting to the switch

When you upgrade firmware in default mode, you connect to the switch through the management IP address. Modular switches have one management IP address for the chassis and separate IP addresses for each management module. To upgrade both management modules, you can either connect to the chassis management IP address or to the IP address of the active management module. If you want to upgrade a single management module only, you must connect to the IP address of that management module and perform the firmware download operation in manual mode. In manual mode, only the local management module is upgraded.

Downloading the firmware from a remote server

Under normal circumstances, it is recommended to perform firmware download in the default mode. Do not disable autocommit mode unless you want to evaluate a firmware upgrade before committing to it. Refer to "Evaluating a firmware upgrade" on page 59 for details about overriding the autocommit mode.

When upgrading multiple switches, complete the following steps on each switch before you upgrade the next one.

1. Verify that the FTP or SSH server is running on the remote server and that you have a valid user ID and password on that server.
2. Download the firmware package from the Brocade website and store the file on the FTP or SSH server.

   To download the firmware from an attached USB device, refer to "Downloading firmware from a USB device" on page 58.
3. Decompress the firmware archive.
4. Connect to the switch or management module you are upgrading.
5. Obtain the switch firmware version information. Refer to "Obtaining the switch firmware version" on page 54 for details.
6. Issue the <download>/<ftp> action in the urn:brocade.com:mgmt:brocade-firmware namespace to perform the firmware download operation. Provide the following input elements:
   - <user>—The user ID on the remote server
   - <password>—The user password
   - <host>—The IPv4 or IPv6 IP address
   - <directory>—The directory on the remote server where the firmware file is located
   - <file>—The firmware filename

   The reply message contains a session ID in the <fwdl-tid> element.

NOTE
To be able to mention the FTP server by name, a Domain Name System (DNS) entry must exist for the server.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="402">
<action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
    <data>
        <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
            <download>
                <ftp>
                    <user>fvt</user>
                    <password>party4green</password>
                    <host>10.1.2.30</host>
                    <directory>/</directory>
                    <file>release.plist</file>
                </ftp>
            </download>
        </firmware>
    </data>
</action>
</rpc>
```

```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
message-id="402">
    <data>
        <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
            <download>
                <ftp>
                    <fwdl-tid>34</fwdl-tid>
                    <fwdl-status>0</fwdl-status>
                </ftp>
            </download>
        </firmware>
    </data>
</rpc-reply>
```

CAUTION

Do not interrupt the firmware download process. If you encounter a problem, wait for the timeout (30 minutes for network problems) before attempting the firmware download operation again. Disrupting the process (for example, by disconnecting the switch from the power source) can render the switch inoperable and may require you to seek help from your switch service provider.

7. While the upgrade is proceeding, you can use the <fwdl-status> custom RPC with the value returned in the <fwdl-tid> element in step 6 to query the status of the download, as shown in the following example.

```
<rpc message-id="403" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <fwdl-status xmlns="urn:brocade.com:mgmt:brocade-firmware">
        <fwdl-tid>34</fwdl-tid>
    </fwdl-status>
</rpc>

<rpc-reply message-id="403" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <data>
        <number-of-entries>1</number-of-entries>
        <fwdl-state>complete</fwdl-state>
        <fwdl-entries>
            <index>54</index>
            <message-id>1</message-id>
            <date-and-time-info>2012-07-23/14:32:24:1234</date-and-time-info>
            <message>Firmware has been downloaded successfully</message>
            <blade-slot>1</blade-slot>
            <blade-swbd>v4.0.0_bldg56</blade-swdb>
            <blade-name>A1</blade-name>
            <blade-state>active</blade-state>
            <blade-app>BFOS</blade-app>
        </fwdl-entries>
        <fwdl-entries>
            <index>55</index>
            <message-id>2</message-id>
            <date-and-time-info>2012-07-23/14:32:24:1234</date-and-time-info>
            <message>The commit operation has completed successfully</message>
        </fwdl-entries>
    </data>
</rpc>
```

8. After the switch reboots, issue the <show-firmware-version> custom RPC located in the urn:brocade.com:mgmt:brocade-firmware-ext namespace to verify the firmware upgrade.

```
<rpc message-id="404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
    </show-firmware-version>
</rpc>

<rpc-reply message-id="404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
        <os-name>Network Operating system Software</os-name>
        <os-version>4.0.0</os-version>
        <copy-right-info>1995-2010 Brocade Communications Systems, Inc.
         </copy-right-info>
        <build-time>19:18:58 Jun 23, 2012</build-time>
        <firmware-full-version>v4.0.0_bldg56</firmware-full-version>
        <control-processor-vendor>Freescale Semiconductor
         </control-processor-vendor>
        <control-processor-chipset>8548E</control-processor-chipset>
        <control-processor-memory>2000 MB</control-processor-memory>
        <node-info>
            <firmware-version-info>
                <primary-version>v4.0.0_bldg56</primary-version>
            </firmware-version-info>
        </node-info>
    </show-firmware-version>
</rpc>
```

CAUTION

Do not interrupt the firmware download process. If you encounter a problem, wait for the timeout (30 minutes for network problems) before attempting the download operation again. Disrupting the process (for example, by disconnecting the switch from the power source) can render the switch inoperable and may require you to seek help from your switch service provider.

Downloading firmware from a USB device

The Brocade VDX 6710, 6720, 6730, 6740, and 8770 switches support firmware download from a Brocade-branded USB device. Third-party USB devices are not supported. Before you can access the USB device, you must enable the device and mount it as a file system. The firmware images to be downloaded must be stored in the factory-configured firmware directory. Multiple images can be stored under this directory.

1. Ensure that the USB device is connected to the switch.
2. Issue the <usb>/<on> action located in the brocade.com:mgmt:brocade-ras namespace and specify the routing bridge ID in the <switchid> input element, as shown in the following example.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="405">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <usb xmlns="urn:brocade.com:mgmt:brocade-ras">
                <on>
                    <switchid>23</switchid>
                </on>
            </usb>
```

```
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="405">
    <ok/>
</rpc-reply>
```

3. Issue the <download>/<usb> action located in the urn:brocade.com:mgmt:brocade-firmware namespace to perform the firmware download operation. In the <directory> element, provide the directory on the remote server where the firmware file is located.

   The reply message contains a session ID in the <fwdl-tid> element.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="406">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
                <download>
                    <usb>
                        <directory>NOS_v4.0.0</directory>
                    </usb>
                </download>
            </firmware>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
 message-id="406">
    <data>
        <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
            <download>
                <ftp>
                    <fwdl-tid>34</fwdl-tid>
                    <fwdl-status>0</fwdl-status>
                </ftp>
            </download>
        </firmware>
    </data>
</rpc-reply>
```

Evaluating a firmware upgrade

CAUTION

Because of potential compatibility issues, Brocade does not recommend restoring Network OS v2.1.x after you upgraded to Network OS v3.0.0.

You can restore a previous firmware version after downloading and evaluating a newer (or older) version by downloading the firmware to a single partition only. The previous version is preserved on the secondary partition and you can restore it if necessary.

- To enable firmware restoration on a compact switch, you perform the firmware download operation with the <nocommit> option. This option prevents the firmware download from copying the firmware to both partitions and committing the upgrade.

- To enable firmware restoration on a modular switch with two management modules, you update the firmware on each management module separately by performing the firmware download operation with both the <manual> and <nocommit> options. This sequence or operations preserves the previous firmware on the secondary partitions of all system components and ensures that you will be able to restore the previous firmware version.

ATTENTION
When you evaluate a firmware upgrade, make sure you disable all features that are supported only by the upgraded firmware before restoring the original version.

Downloading firmware to a single partition

1. Verify that the SFTP, FTP, or SSH server is running on the host server and that you have a user ID on that server.
2. Obtain the firmware file from the Brocade website at *http://www.mybrocade.com* or from your switch support provider and store the file on the FTP or SSH server.
3. Unpack the compressed firmware archive.
4. Issue the <show-firmware-version> custom RPC located in the urn:brocade.com:mgmt:brocade-firmware-ext namespace to view the current firmware version.

```
<rpc message-id="407" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
    </show-firmware-version>
</rpc>

<rpc-reply message-id="407" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
        <os-name>Network Operating system Software</os-name>
        <os-version>4.0.0</os-version>
        <copy-right-info>1995-2010 Brocade Communications Systems, Inc.
         </copy-right-info>
        <build-time>19:18:58 Jun 23, 2012</build-time>
        <firmware-full-version>v4.0.0_bldg56</firmware-full-version>
        <control-processor-vendor>Freescale Semiconductor
         </control-processor-vendor>
        <control-processor-chipset>8548E</control-processor-chipset>
        <control-processor-memory>2000 MB</control-processor-memory>
        <node-info>
            <firmware-version-info>
                <primary-version>v4.0.0_bldg56</primary-version>
                <secondary-version>v4.0.0_bldg56</primary-version>
            </firmware-version-info>
        </node-info>
    </show-firmware-version>
</rpc>
```

5. Issue the <download>/<ftp> action located in the urn:brocade.com:mgmt:brocade-firmware namespace to perform the firmware download operation. Provide the following input elements:
   - <user>—The user ID on the remote server.
   - <password>—The user password.
   - <host>—The IPv4 or IPv6 IP address.

- <directory>—The directory on the remote server where the firmware file is located.
- <file>—The firmware filename.
- <nocomit>—Ensures the firmware image is downloaded only to the primary partition.

The reply message contains a session ID in the <fwdl-tid> element.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="408">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
                <download>
                    <ftp>
                        <user>fvt</user>
                        <password>pary4green</password>
                        <host>10.1.2.30</host>
                        <directory>/</directory>
                        <file>release.plist</file>
                        <nocommit>
                    </ftp>
                </download>
            </firmware>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
message-id="408">
    <data>
        <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
            <download>
                <ftp>
                    <fwdl-tid>34</fwdl-tid>
                    <fwdl-status>0</fwdl-status>
                </ftp>
            </download>
        </firmware>
    </data>
</rpc-reply>
```

The switch will perform a reboot and come up with the new firmware. Your current switch session will automatically disconnect.

6. Issue the <show-firmware-version> custom RPC to confirm that the primary partition of the switch contains the new firmware, and the secondary does not.

```
<rpc message-id="409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
    </show-firmware-version>
</rpc>

<rpc-reply message-id="409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
        <os-name>Network Operating system Software</os-name>
        <os-version>4.0.0</os-version>
        <copy-right-info>1995-2010 Brocade Communications Systems, Inc.
         </copy-right-info>
        <build-time>19:18:58 Jun 23, 2012</build-time>
        <firmware-full-version>v4.0.0_bldg56</firmware-full-version>
```

```
        <control-processor-vendor>Freescale Semiconductor
         </control-processor-vendor>
        <control-processor-chipset>8548E</control-processor-chipset>
        <control-processor-memory>2000 MB</control-processor-memory>
        <node-info>
            <firmware-version-info>
                <primary-version>v3.0.1_bldg57</primary-version>
                <secondary-version>v4.0.0_bldg56</primary-version>
            </firmware-version-info>
        </node-info>
    </show-firmware-version>
</rpc>
```

ATTENTION

If you want to *restore* the firmware, stop here and skip ahead to "Restoring the previous firmware version" on page 63; otherwise, continue to "Commiting the firmware upgrade" on page 62 to complete the firmware download process.

You are now ready to evaluate the new version of firmware.

Commiting the firmware upgrade

If you decide to keep the firmware upgrade, use the firmware commit operation to update the secondary partition with new firmware. On modular switches you must perform this operation on both management modules. It may take several minutes to complete the commit operation.

1. Issue the <firmware> action and specify the <commit> element.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="410">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
                <commit/>
            </firmware>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
message-id="410">
    <data>
        <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
            <commit>
                <result></result>
            </commit>
        </firmware>
    </data>
</rpc-reply>
```

2. Issue the <show-firmware-version> custom RPC to confirm that both the primary partition and the secondary partition of the switch contain the new firmware.

```
<rpc message-id="411" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
    </show-firmware-version>
</rpc>
```

```
<rpc-reply message-id="411" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
        <os-name>Network Operating system Software</os-name>
        <os-version>4.0.0</os-version>
        <copy-right-info>1995-2010 Brocade Communications Systems, Inc.
         </copy-right-info>
        <build-time>19:18:58 Jun 23, 2012</build-time>
        <firmware-full-version>v4.0.0_bldg56</firmware-full-version>
        <control-processor-vendor>Freescale Semiconductor
         </control-processor-vendor>
        <control-processor-chipset>8548E</control-processor-chipset>
        <control-processor-memory>2000 MB</control-processor-memory>
        <node-info>
            <firmware-version-info>
                <primary-version>v4.0.1_bldg67</primary-version>
                <secondary-version>v4.0.1_bldg67</primary-version>
            </firmware-version-info>
        </node-info>
    </show-firmware-version>
</rpc>
```

Restoring the previous firmware version

Use the firmware restore operation to back out of a firmware upgrade. This option works only if autocommit mode was disabled during the firmware download. On modular switches you must perform this operation on both management modules.

1. Issue the <firmware> action and specify the <restore> element.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="412">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
                <restore/>
            </firmware>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="412">
    <data>
        <firmware xmlns="urn:brocade.com:mgmt:brocade-firmware">
            <commit>
                <result></result>
            </commit>
        </firmware>
    </data>
</rpc-reply>
```

   The switch will reboot and come up with the original firmware.

   The firmware commit operation will begin to copy the original firmware from the secondary partition to the primary partition. When this process completes, both partitions will have the original firmware. It may take several minutes to complete the operation.

2. Wait until all processes have completed and the switch is fully up and operational.

3. Issue the <show-firmware-version> custom RPC and verify that both partitions on the switch have the original firmware.

```
<rpc message-id="413" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
    </show-firmware-version>
</rpc>

<rpc-reply message-id="413" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-firmware-version xmlns="urn:brocade.com:mgmt:brocade-firmware-ext">
        <switchid xmlns="urn:brocade.com:mgmt:brocade-ras-ext">24</switchid>
        <os-name>Network Operating system Software</os-name>
        <os-version>4.0.0</os-version>
        <copy-right-info>1995-2010 Brocade Communications Systems, Inc.
         </copy-right-info>
        <build-time>19:18:58 Jun 23, 2012</build-time>
        <firmware-full-version>v4.0.0_bldg56</firmware-full-version>
        <control-processor-vendor>Freescale Semiconductor
         </control-processor-vendor>
        <control-processor-chipset>8548E</control-processor-chipset>
        <control-processor-memory>2000 MB</control-processor-memory>
        <node-info>
            <firmware-version-info>
                <primary-version>v4.0.0_bldg56</primary-version>
                <secondary-version>v4.0.0_bldg56</secondary-version>
            </firmware-version-info>
        </node-info>
    </show-firmware-version>
</rpc>
```

Firmware upgrade in Brocade VCS Fabric mode

In the Network OS v4.1.1 release, the firmware download operation supports local switch upgrades only. To upgrade the entire cluster, you must issue the firmware download operation on each switch separately. For each switch in the fabric, complete the firmware download on the current switch before initiating a firmware download on the next switch. This process minimizes traffic disruption between switches.

Issue the <fwdl-status> custom RPC to verify that the download process is complete, and then move on to the next switch.

Chapter

6

Administering Licenses

In this chapter

- Licensing with NETCONF overview 65
- Retrieving the switch license ID 65
- Obtaining a license key 66
- Installing or removing a license 67
- Activating the Dynamic POD feature 67
- Obtaining the Dynamic POD assignments 68
- Overriding Dynamic POD assignments. 68

Licensing with NETCONF overview

The Brocade Network Operating System (Network OS) includes platform support in standalone and Brocade VCS Fabric modes as well as optional features that are enabled by license keys.

The following licenses are available in Network OS v4.1.1:

- Ports On Demand (POD)1 license—Provisions additional Ethernet ports on the Brocade VDX 6720 and VDX 6730 platforms.
- POD2 license—Provisions yet more Ethernet ports on the Brocade VDX 6720 and VDX 6730 platforms.
- Brocade FCoE license—Enables Fibre Channel over Ethernet functionality.
- Brocade Layer 3 license—Enables licensed Layer 3 features and is only required on VDX chassis switches.

This chapter describes NETCONF operations that install, activate, remove, and verify licences. Refer to the *Network OS Administrator's Guide* for the following information:

- Instructions for adding and removing licenses. You cannot add or remove licenses using the NETCONF interface.
- Platform variations for each license, including the effect of POD1 and POD2 licenses
- The specific features enabled by each license
- Temporary and permanent licenses
- Firmware upgrade and downgrade considerations

Retrieving the switch license ID

The switch license ID identifies the switch for which the license is valid. You will need the switch license ID when you activate a license key.

To retrieve the switch license ID, issue the <show>/<license>/<id> action that resides in the urn:brocade.com:mgmt:brocade-license namespace. The license ID is in the <license-id> field in the reply message.

The following example returns the license ID for all switches in the fabric. To return the licence ID of a specific switch, replace the <all/> element with an <rbridge-id> element containing the routing bridge ID.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="701">
   <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
       <data>
           <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
               <license xmlns="urn:brocade.com:mgmt:brocade-license">
                   <id>
                       <all/>
                   </id>
               </license>
           </show>
       </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="701">
   <data>
        <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
           <license xmlns="urn:brocade.com:mgmt:brocade-license">
               <id>
                   <licenseid-list>
                       <licenseid-rbridge-id>2</licenseid-rbridge-id>
                       <license-id>10:00:00:05:33:54:C6:3E</license-id>
                   </licenseid-list>
               </id>
           </license>
       </show>
    </data>
</rpc-reply>
```

Obtaining a license key

License upgrade orders are fulfilled either through a license activation paperpack, or by an e-mail message containing a transaction key and a link to the Brocade software portal. A device-specific license file is generated in the software portal when you enter the transaction key along with the switch license ID. Use the <show>/<license>/<id> action to obtain the switch license ID.

Follow the instructions in the paperpack or the e-mail message as described for your platform and license type. The transaction key is case-sensitive; you must enter the key exactly as it appears in the paperpack. To lessen the chance of an error, copy and paste the transaction key when you install the license on your switch.

You will receive an e-mail message with the software license keys embedded in an XML file along with installation instructions.

NOTE
Store the license key in a safe place for future reference. You cannot retrieve the license key from the configuration datastore.

Installing or removing a license

Refer to the *Network OS Administrator's Guide* for procedures for installing and removing licenses. You cannot install or remove licenses using the NETCONF interface.

Activating the Dynamic POD feature

To activate the Dynamic POD feature, complete the following steps.

1. Verify the current states of the ports with the <get-interface-detail> custom RPC located in the urn:brocade.com:mgmt:brocade-interface-ext namespace.

   The <line-protocol-state> and <line-protocol-state-info> fields shown in bold typeface in the following example indicate whether a port is licensed.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="714">
    <get-interface-detail xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            TenGigabitEthernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">
            22/0/1</interface-name>
    </get-interface-detail>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="714">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            TenGigabitEthernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">1/0/1
            </interface-name>
        <ifindex>27</ifindex>
        <mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</mtu>
        <ip-mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</ip-mtu>
        <if-name>1/0/1</if-name>
        <if-state
xmlns="urn:brocade.com:mgmt:brocade-interface">down</if-state>
        <line-protocol-state
xmlns="urn:brocade.com:mgmt:brocade-interface">down
            </line-protocol-state>
        <line-protocol-state-info>No DPOD License</line-protocol-state-info>
(output truncated)
```

2. Install the Brocade Dynamic POD license.

   For instructions on how to install a license, refer to "Installing or removing a license" on page 67.

3. Disable and re-enable the ports.

   Alternatively, you can disable and re-enable the chassis to activate ports.

4. Issue the <get-interface-detail> custom RPC again to verify the newly activated ports and port details.

Obtaining the Dynamic POD assignments

To display the Dynamic POD assignments, issue the <show>/<dpod> action located in the urn:brocade.com:mgmt:brocade-license namespace. The reply provides a summary of the POD license status.

In the following example, all 24 ports are licensed and potentially available. Currently, the three unassigned ports are disabled persistently, and therefore are not assigned to any Dynamic POD license port set.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="715">
   <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
       <data>
           <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
               <dpod xmlns="urn:brocade.com:mgmt:brocade-license">
                   <rbridge-id>2</rbridge-id>>
               </dpod>
           </show>
       </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="715">
   <data>
        <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
           <dpod xmlns="urn:brocade.com:mgmt:brocade-license">
               <show-dpod-list>
                   <showdpod-rbridge-id>2</showdpod-rbridge-id>
                   <dpod-details>
                       <dpod-ports>24</dpod-ports>
                       <dpod-licenses-installed>1</dpod-licenses-installed>
                       <num-ports-provisioned>24</num-ports-provisioned>
                       <num-ports-reserved></num-ports-reserved>
                       <num-ports-license-available>3</num-ports-license-available>
                   </dpod-details>
               </show-dpod-list>
           </dpod>
       </show>
    </data>
</rpc>
```

Overriding Dynamic POD assignments

You can override the automatic port license assignments by releasing Dynamic POD assignments from a port and by reserving an assignment for a specific port.

Reserving a port assignment

Reserving an assignment for a port assigns that port to a POD license regardless of whether the port is online or offline. Reserving assignments allocates the POD license to specified ports. This operation overrides automatic port assignments. The reserved assignment will not be available to other ports that come online. To reserve an assignment for a port, a free assignment must be available.

If all ports are assigned, select a port to release its POD assignment. Follow the instructions in "Releasing a port from a POD set" on page 70 to release a port from its POD assignment. Once the port is released, you can reuse the assignment for another port.

1. Select the port for which you want to reserve an assignment and issue the <edit-config> RPC to configure the <dpod> node to reserve the desired ports. Set the <port-id>/<operation> element for each port to "reserve".

   The following example reserves ports 5/0/10 and 5/0/11.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="716">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <dpod xmlns="urn:brocade.com:mgmt:brocade-license">
                <port-id>
                    <port-id>5/0/10</port-id>
                    <operation>reserve</operation>
                </port-id>
                <port-id>
                    <port-id>5/0/11</port-id>
                    <operation>reserve</operation>
                </port-id>
            </dpod>
        </config>
    </edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="716">
    <ok/>
</rpc-reply>
```

NOTE
License reservations or removals do not persist across switch reboots and power cycles. To make them persistent, save the configuration changes by copying the running configuration to the startup configuration before you reboot the switch.

2. Issue the <bna-config-cmd> RPC to save the configuration changes to the startup configuration.

3. Issue the <reboot>/<fastboot> custom action located in the urn:brocade.com:mgmt:brocade-firmware namespace to reboot the switch.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="718">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <reboot xmlns="urn:brocade.com:mgmt:brocade-firmware">
                <fastboot/>
            </reboot>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="718">
    <ok/>
</rpc-reply>
```

4. Issue the <get-config> RPC to retrieve the DPOD configuration for the ports you reserved in step 1 to verify that the ports are reserved.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="719">
    <get-config>
        <target>
            <running/>
        </target>
        <filter type="subtree">
            <dpod xmlns="urn:brocade.com:mgmt:brocade-license>
                <port-id>
                    <port-id>5/0/10</port-id>
                    <port-id>5/0/11</port-id>
                </port-id>
            </dpod>
        </filter>
    </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="719">
    <dpod xmlns="urn:brocade.com:mgmt:brocade-logical-switch">
        <port-id>
            <port-id>5/0/10</port-id>
            <operation>reserve</operation>
        </port-id>
        <port-id>
            <port-id>5/0/11</port-id>
            <operation>reserve</operation>
        </port-id>
    </dpod>
</rpc-reply>
```

Releasing a port from a POD set

Once a port has been assigned to a Dynamic POD license port set, it remains licensed (or “reserved”) until you remove the port from the port set. You remove a port from the port set by editing the DPOD configuration with the <edit-config> RPC. Releasing a port removes it from the Dynamic POD license port set; the port appears as unassigned until it comes back online.

To prevent a port from coming back online and taking a POD assignment, disable the port and save the running configuration. This action will disable the port persistently.

A port POD assignment can only be released if the port is currently offline. Shut the port down to disable the port or disable the switch if you plan to release multiple ports.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace to shut down the interface.

   The following example shuts down interface 1/0/10.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="720">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
```

```
            <tengigabitethernet>
                <name>1/0/10</name>
                <shutdown/>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="720">
    <ok/>
</rpc-reply>
```

2. Issue the <edit-config> RPC to configure the <dpod> node located in the urn:brocade.com:mgmt:brocade-license namespace and set the <operation> element to “release”.

   The following example releases ports 5/0/10 and 5/0/11.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="721">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <dpod xmlns="urn:brocade.com:mgmt:brocade-license">
                <port-id>
                    <port-id>5/0/10</port-id>
                    <operation>release</operation>
                </port-id>
                <port-id>
                    <port-id>1/0/10</port-id>
                    <operation>release</operation>
                </port-id>
            </dpod>
        </config>
    </edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="721">
    <ok/>
</rpc-reply>
```

3. Issue the <edit-config> RPC to configure the <interface>/<tengigabitethernet> node in the urn:brocade.com:mgmt:brocade-interface namespace and include the following elements to re-enable the port:

   a. In the <name> element, specify the port name in [*rbridge-id/*]*slot/port* format.

   b. In the <shutdown> element, include the delete operation in the element tag to enable the port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="722">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
```

```
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/10</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="722">
    <ok/>
</rpc-reply>
```

4. Issue the <bna-config-cmd> RPC to save the configuration changes by copying the running configuration to the startup configuration.

NOTE

Do not release a port unless you plan to disconnect the optical link or disable the port persistently. If you leave the link in a state where the port could be brought online, the POD mechanism will detect this unassigned port and attempt to reassign it to a port set.

Chapter

7

SNMP

In this chapter

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- Obtaining SNMP user names 76
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- Support for multiple SNMP server contexts 82
- Support for password encryption for SNMPv3 users 83

SNMP management with NETCONF overview

This chapter provides procedures and examples for Brocade SNMP management using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of concepts related to SNMP
- Guidelines and restrictions regarding SNMP
- How to perform SNMP management using the Network OS command line interface

Using the NETCONF interface, you can perform the following fabric configuration operations:

- Use the <edit-config> remote procedure call (RPC) to perform the following operations:
  - Enable and disable SNMP community strings
  - Configure SNMP server hosts
  - Enable and disable fabric trunking
  - Configure multiple SNMP server contexts
  - Configure the VCS Fabric virtual IP address
  - Configure password encryption for SNMPv3 users
- Use the <get-config> RPC to verify all or part of the SNMP configuration.
- Use the <show-vcs> custom RPC to return configuration state information about SNMP.

Brocade SNMP parameters are defined in the brocade-snmp YANG module. For structural maps of this YANG module, refer to the *Network OS YANG Reference Manual*.

SNMP community strings

SNMP versions 1 and 2c use community strings to restrict access to the switch. There are six default community strings: three read-write strings and three read-only strings. There is support for a total of 256 SNMP communities, all user-configurable.

The following default community strings are read-write:

- Secret C0de
- OrigEquipMfr
- private

The following default community strings are read-only:

- public
- common
- ConvergedNetwork

Adding an SNMP community string

To add an SNMP community string, perform the following steps.

1. Issue the <edit-config> RPC to configure the <snmp-server> node in the urn:brocade.com:mgmt:brocade-snmp namespace.
2. Under the <snmp-server> node, specify the <community> node element.
3. Under the <community> node element, specify the <community> leaf element, and set its value to the community string to be added.
4. Optionally, under the <community> node element, include the <access> leaf element and set its value to “rw” for read-write access, or to “ro” for read-only access.

   The default value is “ro”.

The following example adds a community string named “private” to the SNMP configuration and sets its access permission to read-write.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp" >
                <community>
                    <community>private</community>
                    <access>rw</access>
                </community>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Changing the access of a read-only community string

To change the access permission for an SNMP community string to read-write, perform the following steps.

1. Issue the <edit-config> RPC to configure the <snmp-server> node in the urn:brocade.com:mgmt:brocade-snmp namespace.
2. Under the <snmp-server> node, specify the <community> node element.
3. Under the <community> node element, specify the <community> leaf element, and set its value to the name of the community string for which you want to change the access permission.
4. Under the <community> node element, include the <access> leaf element and set its value to “rw”.

The following example changes the access permission of an existing community string named “user123” to read-write.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1002" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp" >
                <community>
                    <community>user123</community>
                    <access>rw</access>
                </community>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1002" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Removing an SNMP community string

To remove an SNMP community string, perform the following steps.

1. Issue the <edit-config> RPC to configure the <snmp-server> node in the urn:brocade.com:mgmt:brocade-snmp namespace.
2. Under the <snmp-server> node, specify the <community> node element, and include the delete operation in the opening element tag.
3. Under the <community> node element, set the <community> leaf element value to the name of the community string you want to remove.

The following example removes the community string named “private” from the SNMP configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id=”1003" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
```

```
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp">
                <community xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete">
                    <community>private</community>
                </community>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1003" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Obtaining SNMP user names

To obtain the configured user names, issue the <get-config> RPC and provide a subtree filter to return only the <snmp-server>/<user> node information from the urn:brocade.com:mgmt:brocade-snmp namespace in the running configuration. For each configured SNMPv3 user name, the reply message contains a <user> node containing the user name and any assigned group, authentication protocol, or privacy protocol. If an authentication password or privacy password has been assigned, the encrypted password is returned in the corresponding leaf element with the encrypted flag.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1006" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp">
                <user/>
            </snmp-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1006" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp">
        <user>
            <username>snmp</username>
        </user>
        <user>
            <username>snmpadmin2</username>
            <groupname>snmpadmin</groupname>
        </user>
        <user>
            <username>snmpadmin3</username>
            <groupname>snmpadmin</groupname>
        </user>
        <user>
            <username>snmpuser2</username>
```

```
        </user>
        <user>
            <username>snmpuser3</username>
            <auth>md5</md5>
            <priv>DES</priv>
        </user>
    </snmp-server>
</rpc-reply>
```

SNMP server hosts

Operations described in this section set the trap destination IP address, and optionally the destination port and severity level for the SNMP server host. For SNMP versions 1 and 2c, the SNMP version and community string are also set. For SNMP version 3, the user name is also set.

To configure SNMP trap hosts associated with community strings, you must first create the community string before configuring the host. Refer to "Adding an SNMP community string" on page 74.

To configure SNMPv3 hosts associated with user names, the user name must first be added to the SNMP configuration. Refer to "Obtaining SNMP user names" on page 76.

Setting the SNMP version 1 or 2c server host

Setting the SNMP version 1 or 2c server host sets the trap destination IP addresses, version, community string, and destination port for the SNMP server host. To set the SNMP server host, perform the following steps.

1. Issue the <edit-config> RPC to configure the <snmp-server>/<host> node in the urn:brocade.com:mgmt:brocade-snmp namespace.
2. Under the <host> node element, specify the following elements.
    a. In the <ip> element, specify the IPv4, IPv6, or DNS address of the SNMP host.
    b. In the <community> element, specify the existing community string to be associated with the trap destination.
    c. Optionally, in the <version> element, specify 1 or 2c depending on the community string version to be sent to the trap host.

        The default value is 1.
    d. Optionally, in the <udp-port> element, specify the UDP port where SNMP traps will be received.

        The default value is 162.
    e. Optionally, in the <severity-level> field, specify the severity level to be associated with SNMP traps.

The following example sets up "commaccess" as a read-only user and specifies the SNMP version 2c host using an IPv6 address. The host will receive SNMP traps on target port 162.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1007" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp" >
                <host>
                    <ip>1050:0:0:0:5:600:300c:326b</ip>
                    <community>commaccess</community>
                    <udp-port>162</udp-port>
                </host>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1007" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Setting the SNMP version 3 host

Setting the SNMP version 3 server host sets the trap destination IP addresses, user name, notification type, destination port, and engine ID for the SNMP server host.

1. Issue the <edit-config> RPC to configure the <snmp-server> node in the urn:brocade.com:mgmt:brocade-snmp namespace.
2. Under the <snmp-server> node, include the <v3host> node element.
3. Under the <v3host> node, include the following leaf element.
    a. In the <hostip> element, specify the IPv4, IPv6, or DNS address of the SNMP host.
    b. In the <username> element, specify the name of the user to be associated with the SNMP server host.

       This user name must already be defined in the <snmp-server>/<user> node.
    c. Optionally, in the <udp-port> element, specify the UDP port where SNMP traps will be received.

       The default value is 162.
    d. Optionally, in the <notifytype> element, specify “informs” or “traps” depending on whether informs or traps are to be sent to the host.

       The default value is “traps”.
    e. Optionally, in the <engineid> element, specify the remote engine ID to receive informs on the host.

       The default value is 00:00:00:00:00:00:00:00:00:00.
    f. Optionally, in the <severity-level> field, specify the level of trap to be associated with SNMP traps.

The following example configures dns1.mycorp.com as an SNMPv3 host and associates the snmpuser3 version 3 user with it. In this case, a DNS address is used to identify the server.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1008" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp">
                <v3host>
                    <hostip>dns1.mycorp.com</hostip>
                    <username>snmpuser3</username>
                </host>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1008" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Removing the SNMP server host

To remove version 2c from the host and replace it with version 1, perform the following steps.

1. Issue the <edit-config> RPC to configure the <snmp-server>/<host> node in the urn:brocade:com:mgmt:brocade-snmp workspace and specify the following leaf elements.
2. Under the <snmp-server> node, include the <host> node element.
3. Under the <host> node, include the following leaf elements.
    a. In the <ip> leaf element, specify the IPv4, IPv6, or DNS address of the SNMP host.
    b. In the <community> leaf element, specify the community string associated with the host.
    c. In the <version> element, include the delete operation in the opening tag.

Deleting the version restores the default value of version 1.

```
<rpc message-id="1009" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp">
                <host>
                    <ip>10.32.147.6</ip>
                    <community>public</community>
                    <version xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete">2c</version>
                </host>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1009" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To remove the SNMP host from the switch configuration altogether, place the delete operation in the opening tag of the <host> element.

Setting the SNMP server contact

To set the SNMP server contact string, issue the <edit-config> RPC to configure the <snmp-server>/<agtconfig> node in the urn:brocade:com:mgmt:brocade-snmp workspace and specify the contact string in the <contact> leaf element.

The default contact string is *Field Support*.

The following example changes the default contact string to “Operator 12345.”

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1010" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp" >
                <agtconfig>
                    <contact>Operator 12345</contact>
                </agtconfig>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1010" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Setting the SNMP server location

To set the SNMP server location string, issue the <edit-config> RPC to configure the <snmp-server>/<agtconfig> node in the urn:brocade:com:mgmt:brocade-snmp workspace and specify the server location string in the <location> leaf element.

The default server location string is *End User Premise*.

The following example changes the server location string to “Building 3 Room 214”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1012" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp" >
                <agtconfig>
                    <location>Building 3 Room 214</location>
                </agtconfig>
            </snmp server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1012" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Returning the SNMP configuration

To display the current SNMP configuration for the SNMP host, community strings, user names, contact, and location, issue the <get-config> RPC and provide a subtree filter to return the <snmp-server> node from the urn:brocade.com:mgmt:brocade-snmp workspace in the running configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="117" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="117" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp">
        <community>
            <community>ConvergedNetwork</community>
            <access>ro</access>
        </community>
        <community>
            <community>OrigEquipMfg</community>
            <access>rw</access>
        </community>
        <community>
            <community>Secret COde</community>
            <access>rw</access>
        </community>
        <community>
            <community>common</community>
            <access>ro</access>
        </community>
        <community>
            <community>private</community>
            <access>rw</access>
        </community>
        <community>
            <community>public</community>
            <access>ro</access>
        </community>
        <user>
            <username>snmp</username>
        </user>
        <user>
            <username>snmpadmin2</username>
            <groupname>snmpadmin</groupname>
        </user>
        <user>
            <username>snmpadmin3</username>
            <groupname>snmpadmin</groupname>
        </user>
        <user>
            <username>snmpuser2</username>
        </user>
```

```
        <user>
            <username>snmpuser3</username>
            <auth>md5</md5>
            <priv>DES</priv>
        </user>
        <host>
            <ip>10.17.37.107</ip>
            <community>public</community>
        </host>
        <agtconfig>
            <contact>Field Support</contact>
            <location>End User Premise</location>
        </agtconfig>
    </snmp-server>
</rpc-reply>
```

Support for multiple SNMP server contexts

A single SNMP agent can be supported by the multiple instances of the same MIB module by mapping the context name with the VRF. The context can be mapped to a VRF as described in "Setting the SNMP server context". The SNMP agent supports 256 contexts to support context to VRF mapping.

Setting the SNMP server context

To map a context to the name of a Virtual Routing and Forwarding (VRF) instance.

1. Issue the <edit-config> RPC to configure the <snmp-server> node in the urn:brocade.com:mgmt:brocade-snmp namespace.
2. Under the <snmp-server> node, specify the <context> node element.
3. Under the <context> node element, specify the <context> leaf element, and set its value to the context string to be added.
4. Under the <context> node element, include the <vrf-name> leaf element and set its value to the name string.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp" >
                <context>
                    <context>mycontext</context>
                    <vrf-name>myvrf</vrf-name>
                </context>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
```

```
</rpc-reply>
```

Support for password encryption for SNMPv3 users

For SNMPv3 user, the passwords for <auth-password> and <priv-password> are encrypted. You can configure either with plain text password or encrypted password. In both the cases, the passwords are shown as encrypted.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <snmp-server xmlns="urn:brocade.com:mgmt:brocade-snmp" >
                <user>snmpadmin2<user/>
                <groupname>snmpadmin</groupname>
                <auth>md5</auth>
                <auth-password>MVb+360X3kcfBzug5Vo6dQ==\n</auth-password>
                <priv>DES</priv>
                <priv-password>ckJFoHbzVvhR0xFRPjsMTA==\n
                </priv-password>
                    </encrypted>
            </snmp-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

NOTE

This process may not be successful where encrypted passwords are generated by third-party or open-source tools.

7 Support for password encryption for SNMPv3 users

Chapter

Fabric 8

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- Brocade VCS Fabric configuration management 86
- Fabric interface configuration management 87

Fabric management with NETCONF overview

This chapter provides procedures and examples for Brocade VCS Fabric management using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of concepts related to Brocade VCS Fabric technology, such as the Transparent Interconnection of Lots of Links (TRILL) protocol, routing bridges, neighbor discovery, trunks, and fabric formation
- How to perform fabric management using the Network OS command line interface

Using the NETCONF interface, you can perform the following fabric configuration operations:

- Use the <edit-config> remote procedure call (RPC) to perform the following operations:
  - Enable and disable VCS Fabric mode
  - Enable and disable fabric ISL and configure long distance ISL ports
  - Enable and disable fabric trunking
  - Configure the routing bridge priority for broadcast, unknown unicast, and multicast forwarding
  - Configure the VCS Fabric virtual IP address
  - Perform ECMP load balancing
- Use the <get-config> RPC to verify all or part of the VCS Fabric management configuration.
- Use the <show-vcs> custom RPC to return configuration state information about the VCS Fabric.

Brocade VCS Fabric parameters are defined in the brocade-vcs YANG module. Fabric interface management parameters are defined in the brocade-fabric-service and brocade-fcoe YANG modules. For structural maps of these YANG modules, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all VCS Fabric management parameters, refer to the brocade-fabric-service.yang, and brocade-fcoe.yang files.

Brocade VCS Fabric configuration management

To add a new switch into a VCS Fabric, you must complete the following configuration steps.

1. Enable VCS Fabric mode.
2. Assign a routing bridge ID.
3. Reboot the switch.

You can enable VCS Fabric mode using the NETCONF interface. You cannot assign a routing bridge ID using the NETCONF interface. To assign a routing bridge ID or other VCS Fabric parameters such as the VCS Fabric ID, you must use the **vcs** command at the Network OS command line interface. Refer to the *Network OS Administrator's Guide* for details.

Enabling VCS Fabric mode

To enable VCS Fabric mode, perform the following steps.

1. Issue the <edit-config> RPC to configure the <vcsmode> node in the urn:brocade.com:mgmt:brocade-vcs namespace.
2. Under the <vcsmode> node, include the empty <vcs-node> leaf element to enable VCS Fabric mode.

The following example RPC enables VCS Fabric mode.

```
<rpc message-id="1200" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vcsmode xmlns="urn:brocade.com:mgmt:brocade-vcs">
                <vcs-mode/>
            </vcsmode>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1200" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling VCS Fabric mode

To disable VCS Fabric mode, include the delete operation in the <vcs-mode> leaf element tag.

```
rpc message-id="1201" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vcsmode xmlns="urn:brocade.com:mgmt:brocade-vcs">
                <vcs-mode xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
            </vcsmode>
```

```
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1201" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Fabric interface configuration management

A physical interface in a virtual switch cluster can either be an edge port or a fabric port, but not both. Similar to a switch-port configuration on a physical interface, you can also use the NETCONF interface to change a fabric-port configuration on its physical interface to be a fabric ISL port or a fabric trunk port as described in the following sections.

NOTE
Fabric ISLs apply only to 10-Gigabit Ethernet interfaces and 40-Gigabit Ethernet interfaces.

Enabling a fabric ISL

Configuring the port for fabric ISL controls whether an ISL should be formed between two cluster members. With the default setting of ISL discovery to **auto** and the ISL formation mode enabled, an ISL automatically forms between two cluster switches.

Enabling fabric ISL on an operational ISL has no effect. However, disabling fabric ISL disables ISL formation and triggers the switch to inform its neighbor that the local interface is ISL disabled. Upon receiving such information, a neighbor switch stops its ISL formation activity regardless of its current interface state.

To enable fabric ISL, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element, include the <name> leaf element and specify the name of the interface on which you want to enable fabric ISL. Specify the name in [*rbridge-id/*]*slot/port* format.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element, include the <fabric> node element in the urn:brocade.com:mgmt:brocade-fcoe namespace.
5. Under the <fabric> node, include the <fabric-isl> node element.
6. Under the <fabric-isl> node element, include the empty <fabric-isl-enable> element to enable fabric ISL on the interface.

The following example enables fabric ISL on 10-Gigabit Ethernet port 1/0/2.

```
<rpc message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/2</name>
                    <fabric xmlns="urn:brocade.com:mgmt:brocade-fcoe">
                        <fabric-isl>
                            <fabric-isl-enable/>
                        </fabric-isl>
                    </fabric>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

NOTE
After you repair any segmented or disabled ISL ports, toggle the fabric ISL in order to propagate the changes.

NOTE
A <shutdown> node on an operating ISL interface not only brings down the physical link but also its FSPF adjacency. The main difference between a <shutdown> node and disabling fabric ISL is that the link stays up after disabling fabric ISL, while the link stays down after a shutdown.

NOTE
Upon fabric reconvergence due to topology change involving the ECMP fabric-ISL path, there may be sub-second flooding of known unicast traffic.

NOTE
Using an XGIG analyzer between switches in a Brocade VCS Fabric may cause a signal detection timeout, causing the fabric ISL link to fail.

Enabling a fabric trunk

Fabric trunking is enabled on fabric ISLs by default. If trunking has been disabled, you can re-enable it with the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element, include the <name> leaf element and specify the name of the interface on which you want to enable fabric trunking. Specify the name in [*rbridge-id/*]s*lot/port* format.

4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element, include the <fabric> node element in the urn:brocade.com:mgmt:brocade-fcoe namespace.
5. Under the <fabric> node, include the <fabric-trunk> node element.
6. Under the <fabric-trunk> node element, include the empty <fabric-trunk-enable> element to enable trunking on the ISL.

The following example enables trunking on 10-Gigabit Ethernet port 1/0/4.

```
<rpc message-id="1205" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/4</name>
                    <fabric xmlns=”urn:brocade.com:mgmt:brocade-fcoe”>
                        <fabric-trunk>
                            <fabric-trunk-enable/>
                        </fabric-trunk>
                    </fabric>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1205" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling a fabric trunk

Fabric trunking is enabled by default. Disable fabric trunking to revert the ISL back to a standalone adjacency between two Brocade VCS Fabric switches.

The following example disables fabric trunking on port 1/0/4.

```
<rpc message-id="1206" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/4</name>
                    <fabric xmlns=”urn:brocade.com:mgmt:brocade-fcoe”>
                        <fabric-trunk>
                            <fabric-trunk-enable
                             xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                             operation="delete"/>
                        </fabric-trunk>
                    </fabric>
                </tengigabitethernet>
            </interface>
```

```
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1206" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Broadcast, unknown unicast, and multicast forwarding

All switches in a Brocade VCS Fabric share a single multicast tree rooted at the routing bridge with the lowest RBridge ID (domain ID). All broadcast, unknown unicast, and multicast traffic between two edge routing bridges is forwarded on this multicast tree inside the Brocade VCS Fabric. The multicast tree includes all routing bridges in the Brocade VCS Fabric.

Multicast distribution tree-root selection

Network OS software supports the following distribution tree behaviors.

- The root of the distribution tree is the switch with the lowest RBridge ID. The automated selection process does not require any user intervention.
- Each switch in the cluster optionally carries a multicast root priority. This priority setting overrides the automatically-selected multicast root. In deployments where a multicast root is required to be a specific switch that does not have the lowest RBridge ID, then the priority setting on that switch can override the root selection. If there are two switches with the same priority, then the switch with the lower RBridge ID prevails.
- A backup multicast root is pre-selected, which is the switch with the next lowest RBridge ID. The backup multicast root is automatically selected by all switches should the current multicast root fail.

Priorities

As stated previously, the root of the tree is auto-selected as the switch with the lowest RBridge ID. For example, if you had a cluster with RBridge IDs 5, 6, 7, and 8, then 5 would be the root. If you then added RBridge ID 1 to this fabric, the tree would be re-calculated with 1 as the root.

In order to avoid this behavior, you can set a priority (default is 1). The highest priority overrides the lowest RBridge ID and becomes the root.

For example, to build a fabric with RBridge ID 7 or 8 as the root, set their priority to something higher than 1 (priority values are 1 through 255). If there is a tie in priority, the lower RBridge ID is still chosen. If RBridge ID 7 and 8 are both set to priority 1, 7 becomes the root.

Changing the priority

To change the priority of a routing bridge, perform the following steps.

1. Issue the <edit-config> RPC to configure the <fabric> node in the urn:brocade.com:mgmt:brocade-fabric-service namespace.
2. Under the <fabric> node, include the <route>/<mcast>/<rbridge-id> hierarchy of node elements.
3. Under the <rbridge-id> node element, include the following leaf elements.

a. In the <rbridge-id> leaf element, specify the RBridge ID of the switch for which you want to change the priority.

b. In the <priority> field, specify the new priority in the range 1 through 255.

The following example sets the priority of routing bridge 12 to 10.

```
<rpc message-id="1207" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <fabric xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
                <route>
                    <mcast>
                        <rbridge-id>
                            <rbridge-id>12</rbridge-id>
                            <priority>10</priority>
                        </rbridge-id>
                    </mcast>
                </route>
            </fabric>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1207" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Obtaining the running configuration

You can use the <get-config> RPC to return fabric route multicast configuration information. The configuration currently effective on the switch is referred to as the running configuration. Any configuration change you make while the switch is online is made to the running configuration. The running configuration is nonpersistent.

NOTE
To save configuration changes, you must save the running-config file to a file, or you can apply the changes by copying the running configuration to the startup configuration.

To obtain the route multicast configuration, issue the <get-config> RPC with a subtree filter that restricts the output to the contents of the <fabric>/</route>/<mcast> node, as show in the following example.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1208" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <fabric xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
                <route>
                    <mcast/>
                </route>
            </fabric>
```

```
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1208" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <fabric xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
        <route>
            <mcast>
                <rbridge-id>
                    <rbridge-id>12</rbridge-id>
                    <priority>10</priority>
                </rbridge-id>
                <rbridge-id>
                    <rbridge-id>13</rbridge-id>
                    <priority>1</priority>
                </rbridge-id>
            </mcast>
        </route>
    </fabric>
</rpc>
```

Configuring the VCS Fabric virtual IP address

A Virtual IP address is assigned for each VCS Fabric. This virtual IP address is tied to the principal switch in the cluster. The management interface of the principal switch can be accessed using this virtual IP address. Because the Virtual IP address is the property of the Fabric Cluster, in the event that the principal switch goes down, the next principal switch is assigned this address.

To configure the Virtual IP address, perform the following steps.

1. Issue the <edit-config> RPC to configure the <vcs> node in the urn:brocade.com:mgmt:brocade-vcs namespace.
2. Under the <vcs> node, include the <virtual>/<ip> hierarchy of network nodes.
3. Under the <ip> node, include the <address> leaf element and set its value to the desired virtual IP address.

NOTE
The virtual IP address must be an IPv4 address.

```
<rpc message-id="1209" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vcs xmlns="urn:brocade.com:mgmt:brocade-vcs">
                <virtual>
                    <ip>
                        <address>10.0.0.23</address>
                    </ip>
                </virtual>
            </vcs>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1209" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <ok/>
</rpc-reply>
```

This operation can be used in Fabric Cluster mode only. When the Virtual IP address is configured for the first time, the current principal switch in the cluster is assigned this IP address.

Virtual IP configuration is global in nature. All the nodes in the cluster are configured with the same virtual IP address, but the address is bound to the current principal switch only. Make sure that the assigned virtual IP address is not a duplicate of an address assigned to any other management port in the cluster or network.

Brocade recommends that you use the same subnet as the IP address of the management interface.

To see the currently configured virtual IP address, issue the <show-vcs> custom RPC located in the urn:brocade.com:mgmt:brocade-vcs namespace as shown in the following example.

```
<message-id="1210" rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <show-vcs xmlns="urn:brocade.com:mgmt:brocade-vcs"/>
</rpc>

<rpc-reply message-id="1210" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <principal-switch-wwn>10:00:00:05:33:52:9F:A0</principal-switch-wwn>
    <co-cordinator-wwn>10:00:00:05:33:4B:0B:8C</co-cordinator-wwn>
    <vcs-cluster-type-info>vcs-fabric-cluster</vcs-cluster-type-info>
    <vcs-guid>01234567890123456789012345678901</vcs-guid>
    <virtual-ip-address>10.37.36.218</virtual-ip-address>
(output truncated)
```

To remove the currently configured virtual IP address, issue the following <edit-config> RPC.

```
<rpc message-id="1211" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vcs xmlns="urn:brocade.com:mgmt:brocade-vcs">
                <virtual>
                    <ip>
                        <address xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete”/>
                    </ip>
                </virtual>
            </vcs>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1211" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

NOTE

You should not disable the IP address when logged in to the switch using the virtual IP address. Use the management port IP address of the principal switch, or the serial console connection of the principal switch.

If you wish to rebind this virtual IP address to this management interface, remove the currently configured virtual IP address and reconfigure it. This situation can arise when the virtual IP address was not bound to the management interface of the principal switch due to duplicate address detection.

A separate gateway cannot be configured for the virtual IP address. The default gateway is the same as the gateway address for the management port of the same switch.

Virtual IP address configuration scenarios

A virtual IP address may be assigned to a switch whenever it is the principal switch in the cluster. Refer to the *Network OS Administrator's Guide* for a list and explanation of the configuration scenarios that may occur.

Fabric ECMP load balancing

Traffic towards ECMP paths is load-balanced using the following eight fields as the Key; VLAN ID, MAC DA, MAC SA, L3_ULP, L3 DA, L3 SA, L4 Dst, and L4 Src. For some pattern of streams, most of the traffic falls into one ECMP path, and the rest of the ECMP paths are underutilized. This situation can result in loss of data traffic, even though more ECMP paths are available to offload the traffic. You can configure the ECMP path selection method within the fabric by configuring the <ecmp-load-balance> element in <ecmp> node, located in the urn:brocade.com:mgmt:brocade-fabric-service namespace. Table 3 list the values you can use.

TABLE 3 ECMP load balancing operands

Operand	Description
dst-mac-vid	Destination MAC address and VID-based load balancing
src-dst-ip	Source and Destination IP address-based load balancing
src-dst-ip-mac-vid	Source and Destination IP, MAC address, and VID-based load balancing
src-dst-ip-mac-vid-port	Source and Destination IP, MAC address, VID, and TCP/UDP port based load balancing
src-dst-ip-port	Source and Destination IP and TCP/UDP port-based load balancing
src-dst-mac-vid	Source and Destination MAC address and VID-based load balancing
src-mac-vid	Source MAC address and VID-based load balancing

Additionally, you can choose to swap adjacent bits of the hash key. This action is useful in cases where a choice of any of the hash key combinations causes the distribution of traffic to not be uniform.

The <ecmp-load-balance-hash-swap> element in the <ecmp> node of the urn:brocade.com:mgmt:brocade-fabric-service namespace is used to configure the swapping of the input fields before feeding them to the hash function. The integer is interpreted as a bitwise control of the 212-bit key. Each bit controls whether the two adjacent bits of the key are to be swapped. This 32-bit control value is written to all four hash swap control registers. This value is replicated in 32-bit block to form a 106-bit value. A value of 0 does not swap any input fields while a value of 4294967295 (hexadecimal ffffffff) swaps all 106 input bit-pairs.

To configure the ECMP load balancing feature, perform the following steps.

1. Issue the <edit-config> RPC to configure the <rbridge> node in the urn:brocade.com:mgmt:brocade-rbridge namespace.
2. Under the <rbridge> node, include the <rbridge-id> leaf element to specify the routing bridge.
3. Under the <rbridge> node, include the <fabric> node in the urn:brocade.com:mgmt:brocade-fabric-service namespace.
4. Under the <fabric> node, include the <ecmp> node element.
5. Under the <ecmp> node, include the following leaf elements.
    a. In the <ecmp-load-balance> element, specify the stream you want to favor.
    b. Optional: In the <ecmp-load-balance-hash-swap> element, specify a value to swap the input fields before feeding them to the hash function.

The following example uses the Destination MAC address and VID-based load balancing flavor and swaps every fourth bit pair of the input fields before feeding them to the hash function.

```
<rpc message-id="1212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>2</rbridge-id>
                <fabric xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
                    <ecmp>
                        <ecmp-load-balance>dst-mac-vid</ecmp-load-balance>
                        <ecmp-load-balance-hash-swap>4</ecmp-load-balance-hash-swap>
                    </ecmp>
                </fabric>
            </rbridge>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To verify the hash field selection configuration and hash swap configuration, issue the <get-config> RPC with a subtree filter to return the <ecmp> configuration node for the desired routing bridge. The following example returns the <ecmp> configuration for routing bridge 2.

```
<rpc message-id="1213" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <rbridge xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>2</rbridge-id>
                <fabric xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
                    <ecmp/>
                </fabric>
            </rbridge>
        </filter>
    </get-config>
```

```
</rpc>

<rpc-reply message-id="1213" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <rbridge xmlns="urn:brocade.com:mgmt:brocade-rbridge">
        <rbridge-id>2</rbridge-id>
        <fabric xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
            <ecmp>
                <ecmp-load-balance>dst-mac-vid</ecmp-load-balance>
                <ecmp-load-balance-hash-swap>4</ecmp-load-balance-hash-swap>
            </ecmp>
        </fabric>
    </rbridge>
</rpc-reply>
```

Chapter

Metro VCS 9

In this chapter

- Metro VCS configuration with NETCONF overview. 97
- Configuring Metro VCS using the long-distance-isl element. 97
- Configuring Metro VCS using standard ISL 99
- Configuring vLAGs for distributed Ethernet Fabrics 99

Metro VCS configuration with NETCONF overview

Metro VCS allows you to interconnect different locations and form clusters of Data Centers (DCs) over long distance in order to provide Disaster Protection/Recovery and load sharing.

Refer to the *Network OS Administrator's Guide* for information on Metro VCS and for the following related information:

- Metro VCS using long distance ISL
- Metro VCS using standard ISL
- Metro VCS and distributed Ethernet VLAGs

Through the NETCONF interface, you can perform the following operations that affect the functioning of Metro VCS:

- Use the <edit-config> RPC to activate, configure, or deactivate the Metro VCS Fabric ISL.
- Use the <edit-config> RPC to activate, configure, or deactivate Metro VCS using long distance ISL on specific 10-Gigabit, 40-Gigabit, or Gigabit Ethernet interfaces.
- Use the <edit-config> RPC to activate, configure, or deactivate Metro VCS using standard ISL on specific 10-Gigabit, 40-Gigabit, or Gigabit Ethernet interfaces.
- Use the <edit-config> RPC to activate, configure, or deactivate Metro VCS and distributed Ethernet VLAGs on specific 10-Gigabit, 40-Gigabit, or Gigabit Ethernet interfaces.
- Use the <get-config> RPC to verify all or part of the global or per-port Metro VCS configuration.

Metro VCS must be enabled globally before it can be enabled on a specific interface.

Metro VCS parameters are defined in the brocade-vcs YANG module. For information about the brocade-vcs YANG module, refer to the *Network OS YANG Reference Manual*.

Configuring Metro VCS using the long-distance-isl element

Each long distance ISL port of a VCS must be connected to a long distance ISL port on the remote VCS. To configure a long distance ISL port, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <tengigabitethernet> node element.
3. Under the <tengigabitethernet> node, include the following leaf element.
    a. In the <name> element, specify the name of the interface you want to configure for long distance operation. Specify the name in [*rbridge-id/*]s*lot/port* format.
    b. In the <long-distance-isl> element, specify the length of the ISL connection in meters.

       Valid values are 2000, 5000, and 10000.

The following example sets port 1/0/2 to be a 5 Km port.

```
<rpc message-id="1203" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/2</name>
                    <long-distance-isl>5000</long-distance-isl>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1203" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling a fabric ISL

Disabling a fabric ISL takes the interface out of the trunk group if this interface is currently part of the trunk. If you know and would like to fix the edge and fabric port assignments on a switch, then this operation allows you to completely turn off ISL formation logic and shorten any link bring-up delays on edge ports.

To disable a fabric ISL, issue the following RPC.

```
<rpc message-id="1204" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/2</name>
                    <fabric xmlns=”urn:brocade.com:mgmt:brocade-fcoe”>
                        <fabric-isl>
                            <fabric-isl-enable
                             xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                             operation="delete"/>
                        </fabric-isl>
                    </fabric>
```

```
            </tengigabitethernet>
          </interface>
       </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1204" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring Metro VCS using standard ISL

In order to deploy Metro VCS using standard ISL, no configuration is required on the standard fabric ISL. The default configuration on the 10 Gbps interface allows ISL formation with other Brocade VDX switches in the same VCS Cluster automatically. BLDP negotiation takes place to form standard ISLs for distances up to 30 m. Refer to the *Network OS Administrator's Guide* for details.

Configuring vLAGs for distributed Ethernet Fabrics

In order to connect two distinct VCS Ethernet Fabrics between data-centers, a third Metro VCS Fabric can be formed and the distinct local VCS Ethernet Fabrics can connect to the Metro VCS Fabric by means of Virtual Link Aggregation Group (vLAG). Refer to the *Network OS Administrator's Guide* for details.

This task needs to be configured on RBridges that connect the two VCS instances.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include a <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element, include the <name> element, and set it to the name of the interface you want to configure.

   Specify the name in *rbridge-id/slot/port* format.
4. Under the <interface> node element, include the <switchport> node element.
5. Under the <switchport> element, include following leaf elements.
   a. In the <shutdown> element, include the delete operation in the opening tag to enable the interface port.
   b. Include the <switchport>/<basic> elements to configure the interface as a layer 2 switch port.
   c. Include the <channel-group> node element.
6. Under the <channel-group> node, specify the following elements to configure the LACP for the DCB interface:
   - In the <port-int> element, provide value to the channel group number.
   - In the <mode> element, specify "active" or "passive"
   - In the <type> element, specify "standard" or "brocade".

7. Repeat for all interfaces that must be part of the port-channel.

   The following example configures physical interface 11/0/2 to port channel 4.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1907" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
           <target>
               <running/>
           </target>
        <config>
        <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
            <tengigabitethernet>
                <name>11/0/2</name>
                <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete"/>
                <switchport>
                    <basic/>
                        <channel-group>
                        <port-int>4</port-int>
                        <mode>active</mode>
                        <type>standard</type>
                        </channel-group>
                </switchport>
            </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="1907" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Retrieving Metro VCS configuration

Use the <get-config> RPC to retrieve the current configuration data and operational state data. Refer to "Retrieving configuration data" on page 11 and "Retrieving operational data" on page 15 for detailed instructions.

Chapter

10

Administering Zones

In this chapter

- Zoning with NETCONF overview 101
- Default zoning access modes. 102
- Zone database size 103
- Zone aliases. 104
- Zoning information 110
- Zone creation and management 115
- Zone configuration management. 119
- Zone configuration scenario 128

Zoning with NETCONF overview

NETCONF interfaces in Network OS provide support for partitioning your network into logical groups of devices or zones for security and for relief from Registered State Change Notification (RSCN) storms. In addition to conventional zones supported on Network OS fabrics, logical SAN (LSAN) zones that span heterogeneous networks of Network OS switches and Fabric OS switches are also supported.

This chapter describes the NETCONF operations that can be performed on zone objects and provides examples. Refer to the *Network OS Administrator's Guide* for conceptual information and general operational guidelines about zones, including:

- General zoning concepts
- LSAN zones
- Explanations of terminology
- Recommended approaches to zoning
- Effects on zoning of adding switches to a fabric or merging fabrics
- Supported firmware and firmware upgrade and downgrade considerations

Through the NETCONF interface, you can perform the following operations on zones:

- Use the <edit-config> RPC to create and manage zone configurations.
- Use the <zoning> action to obtain zoning database size and enabled-configuration information.
- Use the <get-config> RPC to validate configuration settings.

Zoning parameters are defined in the brocade-zone YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Zone configurations

A zone configuration is a group of one or more zones. A zone can be included in more than one zone configuration. When a zone configuration is enabled, all zones that are members of that configuration are in effect.

Several zone configurations can reside on a switch at once, and you can quickly alternate between them. For example, you might want to have one configuration enabled during the business hours and another enabled overnight. However, only one zone configuration can be enabled at a time.

The different types of zone configurations are:

- Defined configuration

  The complete set of all zone objects defined in the fabric.

- Enabled configuration

A single zone configuration that is currently in effect. The enabled configuration is built when you enable a specified zone configuration.

Default zoning access modes

The default zoning mode controls device access if zoning is not implemented or if there is no enabled zone configuration. Default zoning has two access modes:

- All Access—All devices within the fabric can communicate with all other devices.
- No Access—Devices in the fabric cannot access any other device in the fabric.

The default setting is All Access. Changing the default access mode requires committing the ongoing transaction for the change to take effect.

The default zoning mode takes effect when you disable the effective zone configuration. If your default zone has a large number of devices, to prevent RSCN storms from overloading those devices, you should set the default zoning mode to No Access before attempting to disable the zone configuration. If your default zone includes more than 300 devices, the zoning software prevents you from disabling the zoning configuration if the default zoning mode is All Access.

Setting the default zoning mode

This procedure sets the default zoning mode and saves the modified zoning configuration to nonvolatile memory.

1. Issue the <edit-config> RPC to configure the <zoning> node in the urn:brocade.com:mgmt:brocade-zone namespace.
2. Under the <zoning> node, include the <enabled-configuration> node element.
3. Under the <enabled-configuration> node, include the following leaf elements.
   a. In the <default-zone-access> element, specify either “allaccess” or “noaccess”.
   b. In the <cfg-action> element, specify “cfg-save” to save the modified configuration to nonvolatile memory.

The following example sets the default zoning mode to No Access in the enabled configuration, and saves the change to nonvolatile memory.

```
<rpc message-id="601" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
<target>
<running></running>
</target>
<config>
<zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
   <enabled-configuration>
        <cfg-action>cfg-save</cfg-action>
   </enabled-configuration>
   <enabled-configuration>
       <default-zone-access>noaccess</default-zone-access>
   </enabled-configuration>
</zoning>
</config>
</edit-config>
</rpc>

<rpc-reply message-id="601" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Zone database size

The maximum size of a zone database is the upper limit for the defined configuration, and it is determined by the amount of memory available for storing the master copy of the defined configuration in flash memory.

Use the following elements to determine whether there is enough space to complete outstanding transactions:

- db-max—Theoretical maximum size of the zoning database kept in nonvolatile memory
- db-avail—Theoretical amount of free space available
- db-committed—The size of the defined configuration currently stored in nonvolatile memory
- db-transaction—The amount of memory required to commit the current transaction

NOTE
These fields are all measured in bytes.

The supported maximum zone database size is 100 KB. If the outstanding transaction data (db-transaction field) is less than the remaining supported space (100 KB minus db-committed), enough space exists to commit the transaction.

Note that the db-max field shows a theoretical zone database limit of about 1 MB. However, performance might become unacceptable if the zoning database exceeds 150 KB.

Viewing database size information

To retrieve database size information, issue the <show>/<zoning> custom action that resides in the urn:brocade.com:mgmt:brocade-zone namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="602">
    <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <zoning xmlns="urn:brocade.com:mgmt:brocade-zone"/>
                    <operation-info></operation-info>
                </zoning>
            </show>
        </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="602">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <db-max>1045274</db-max>
        <db-avail>1043895</db-avail>
        <db-committed>367</db-committed>
        <db-transaction>373</db-transaction>
        <transaction-token>1</transaction-token>
        <last-zone-changed-timestamp>2011-11-16 16:54:31 GMT-7:00
        </last-zone-changed-timestamp>
        <last-zone-committed-timestamp>2011-11-16 16:23:44 GMT-7:0
        </last-zone-committed-timestamp>
    </zoning>
</rpc-reply>
```

Zone aliases

A zone alias is user-defined name for a logical group of ports or WWNs. You can simplify the process of creating and managing zones by first specifying aliases for zone members. Aliases facilitate tracking and eliminate the need for long lists of individual zone member names. An alias can be a member of a zone, but it cannot be a member of a zoning configuration.

Creating an alias

1. Issue the <show>/<name-server>/<detail> custom action that resides in the urn:brocade.com:mgmt:brocade-nameserver namespace to list the WWNs of devices and targets available in the Brocade VCS Fabric. The available WWNs appear in the <name-server>/<name-server-portname> and <name-server>/<nameserver-nodename> fields in the reply message.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="603">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <name-server xmlns="urn:brocade.com:mgmt:brocade-nameserver">
                    <detail>
                        <rbridge-id>66</rbridge-id>
                    </detail>
```

```
                </name-server>
            </show>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="603">
    <name-server xmlns="urn:brocade.com:mgmt:brocade-nameserver">
        <nameserver-portid>013100</nameserver-portid>
        <nameserver-portname>20:00:00:00:00:00:00:01</nameserver-portname>
        <nameserver-nodename>10:00:00:05:00:00:00:01</nameserver-nodename>
(output truncated)
```

2. Issue the <edit-config> RPC to configure the <zoning> node in the urn:brocade.com:mgmt:brocade-zone namespace, and specify the following elements.

    a. Under the <defined-configuration> node, specify the <alias> node element.

    b. Under the <alias> node, specify the <alias-name> element and set its value to the name of the alias you want to create.

    c. Under the <alias> node, specify the <member-entry> list node.

    d. Under the <member-entry> node, specify the <alias-entry-name> leaf element, and set its value to a WWN returned in the output of the <show>/<name-server>/<detail> action issued in step 1.

    e. Under the <enabled-configuration> node, specify the <cfg-action> node element and set its value to “cfg-save,” to save the configuration to nonvolatile memory.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="604" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <alias>
                        <alias-name>alias1</alias-name>
                        <member-entry>
                            <alias-entry-name>10:00:00:00:00:00:00:01
                            </alias-entry-name>
                        </member-entry>
                    </alias>
                </defined-configuration>
                <enabled-configuration>
                    <cfg-action>cfg-save</cfg-action>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="604" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Adding additional members to an existing alias

1. Issue the <show>/<name-server>/<detail> custom action mechanism that resides in the urn:brocade.com:mgmt:brocade-nameserver namespace to list the WWNs of devices and targets available in the Brocade VCS Fabric. The available WWNs appear in the <name-server>/<name-server-portname> and <name-server>/<nameserver-nodename> fields in the reply message.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="605">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <name-server xmlns="urn:brocade.com:mgmt:brocade-nameserver">
                    <detail>
                        <rbridge-id>66</rbridge-id>
                    </detail>
                </name-server>
            </show>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="605">
    <name-server xmlns="urn:brocade.com:mgmt:brocade-nameserver">
        <nameserver-portid>013200</nameserver-portid>
        <nameserver-portname>20:00:00:00:00:00:00:02</nameserver-portname>
        <nameserver-nodename>10:00:00:05:00:00:00:02</nameserver-nodename>
(output truncated)
    <name-server xmlns="urn:brocade.com:mgmt:brocade-nameserver">
        <nameserver-portid>013300</nameserver-portid>
        <nameserver-portname>20:00:00:00:00:00:00:03</nameserver-portname>
        <nameserver-nodename>10:00:00:05:00:00:00:03</nameserver-nodename>
(output truncated)
```

2. Issue the <edit-config> RPC to configure the <zoning> node in the urn:brocade.com:mgmt:brocade-zone namespace, and specify the following elements.

    a. Under the <zoning> element, specify the <defined-configuration> node element.

    b. Under the <defined-configuration> node, specify the <alias> node element.

    c. Under the <alias> node, specify the <alias-name> element and set its value to the name of the alias to which you want to add a member.

    d. Under the <alias> node, specify the <member-entry> list node.

    e. Under the <member-entry> node, specify the <alias-entry-name> leaf element, and set its value to a WWN returned in the output of the <show>/<name-server>/<detail> action issued in step 1.

    f. Repeat step d and step e for each additional member you want to add to the alias.

    g. Under the <zoning> element, specify the <enabled-configuration> node element.

    h. Under the <enabled-configuration> node. specify the <cfg-action> node element and set its value to “cfg-save”, to save the configuration to nonvolatile memory.

    The following example adds two member nodes to an alias.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="606" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <alias>
                        <alias-name>alias1</alias-name>
                        <member-entry>
                            <alias-entry-name>10:00:00:00:00:00:00:02
                            </alias-entry-name>
                        </member-entry>
                        <member-entry>
                            <alias-entry-name>10:00:00:00:00:00:00:03
                            </alias-entry-name>
                        </member-entry>
                    </alias>
                </defined-configuration>
                <enabled-configuration>
                    <cfg-action>cfg-save</cfg-action>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="606" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Removing a member from an alias

1. Issue the <get-config> RPC to return the member information of the alias for which you want to remove a member. To limit the reply to a specific alias, use a subtree filter to view only the contents of the <zoning>/<defined-configuration>/<alias>/<alias-name> node.

   The following example returns the alias member information for the alias named alias1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="607" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuation>
                    <alias>
                        <alias-name>alias1</alias-name>
                    </alias>
                </defined-configuration>
            </zoning>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="607" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-qos">
```

```
        <defined-configuration>
            <alias>
                <alias-name>alias1</alias-name>
                    <member-entry>
                        <alias-entry-name>10:00:00:00:00:00:00:01
                        </alias-entry-name>
                    </member-entry>
                    <member-entry>
                        <alias-entry-name>10:00:00:00:00:00:00:02
                        </alias-entry-name>
                    </member-entry>
                    <member-entry>
                        <alias-entry-name>10:00:00:00:00:00:00:03
                        </alias-entry-name>
                    </member-entry>
                </alias-name>
            </alias>
        </defined-configuration>
    </zoning>
</rpc-reply>
```

2. Issue the <edit-config> RPC to configure the <zoning> node in the urn:brocade.com:mgmt:brocade-zone namespace, and specify the following elements.

    a. Under the <zoning> node element, include the <defined-configuration> node element.

    b. Under the <defined-configuration> node, include the <alias> node element.

    c. Under the <alias> node element, include the <alias-name> element, and set its value to the name of the alias from which you want to remove a member.

    d. Under the <alias> element, include the <member-entry> node element, and include the delete operation in the element tag.

    e. Under the <member-entry> element, include the <alias-entry-name> leaf element, and include the WWN of the member returned in step 1 that you want to remove.

    f. Repeat step d and step e for each additional member you want to remove from the alias.

    g. Under the <zoning> element, specify the <enabled-configuration> node element.

    h. Under the <enabled-configuration> node, specify the <cfg-action> leaf element and set its value to “cfg-save”, to save the configuration to nonvolatile memory.

    The following example removes WWNs 10:00:00:00:00:00:00:02 and 10:00:00:00:00:00:00:03 from alias1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="608" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <alias>
                        <alias-name>alias1</alias-name>
                        <member-entry xmlns="urn:brocade.com:mgmt:brocade-lldp"
                    xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                            <alias-entry-name>10:00:00:00:00:00:00:02
```

```
                        </alias-entry-name>
                    </member-entry>
                    <member-entry xmlns="urn:brocade.com:mgmt:brocade-lldp"
                xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete"/>
                        <alias-entry-name>10:00:00:00:00:00:00:03
                        </alias-entry-name>
                    </member-entry>
                </alias>
            </defined-configuration>
            <enabled-configuration>
                <cfg-action>cfg-save</cfg-action>
            </enabled-configuration>
        </zoning>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="608" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Deleting an alias

1. Issue the <get-config> RPC to return configuration information about zone aliases in the defined configuration. To limit the reply to alias information, use a subtree filter to view only the contents of the <zoning>/<defined-configuration>/<alias> node in the urn:brocade.com:mgmt:brocade-zone namespace.

   The following example returns zone alias information.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="609" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuation>
                    <alias/>
                </defined-configuration>
            </zoning>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="609" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <defined-configuration>
            <alias>
                <alias-name>alias1</alias-name>
                    <member-entry>
                        <alias-entry-name>10:00:00:00:00:00:00:01
                        </alias-entry-name>
                    </member-entry>
                    <member-entry>
                        <alias-entry-name>10:00:00:00:00:00:00:02
                        </alias-entry-name>
```

```
                    </member-entry>
                    <member-entry>
                        <alias-entry-name>10:00:00:00:00:00:00:03
                        </alias-entry-name>
                    </member-entry>
                </alias-name>
            </alias>
(output truncated)
```

2. Issue the <edit-config> RPC to configure the <zoning> node in the urn:brocade.com:mgmt:brocade-zone namespace, and specify the following elements.

   a. Under the <zoning> node element, include the <defined-configuration> node element.

   b. Under the <defined-configuration> element, include the <alias> node element.

   c. Under the <alias> element, include the <alias-name> element, include the delete operation in the element tag, and set the element value to the name of the alias you want to delete.

   d. Repeat step b and step c for each additional alias you want to delete.

   e. Under the <enabled-configuration> node, specify the <cfg-action> node element and set its value to “cfg-save”, to save the configuration to nonvolatile memory.

   The following example removes alias1 and saves the defined configuration to nonvolatile storage.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="610" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <alias>
                        <alias-name
                        xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                        operation="delete">alias1</alias-name>
                    </alias>
                </defined-configuration>
                <enabled-configuration>
                    <cfg-action>cfg-save</cfg-action>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="610" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Zoning information

The following sections provide procedures for querying the defined zones configuration and the enabled zone configuration:

- "Retrieving the defined configuration" on page 111
- "Retrieving the enabled configuration" on page 113

Retrieving the defined configuration

Use the <get-config> RPC to query the defined configuration. You can retrieve the configuration for the entire defined configuration, query the zone membership details of a specific configuration, query the device membership of a specific zone, or query alias membership. To select the data you want to retrieve, use an appropriate filter.

To retrieve the entire defined configuration, use the following filter.

```
<filter type="subtree">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <defined-configuration/>
    </zoning>
</filter>
```

To retrieve the zone membership details of a specific zone configuration, use a filter such as the following.

```
<filter type="subtree">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <defined-configuration>
            <cfg>
                <cfg-name>cfg2</cfg-name>
            </cfg>
        </defined-configuration>
    </zoning>
</filter>
```

To retrieve the membership details of a specific zone, use a filter such as the following.

```
<filter type="subtree">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <defined-configuration>
            <zone>
                <zone-name>ZoneB</zone-name>
            </zone>
        </defined-configuration>
    </zoning>
</filter>
```

To retrieve alias membership information, use a filter such as the following.

```
<filter type="subtree">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <defined-configuration>
            <alias/>
        </defined-configuration>
    </zoning>
</filter>
```

The following example retrieves the entire defined configuration. For each configuration, the output lists each member zone. For each zone, the output lists the WWN of each member. In this case, the defined configuration contains two zoning configurations (cfg1 and cfg2). cfg1 contains three zones (zoneA, zoneB, and zoneC). cfg2 contains two zones (zoneA and zoneB). Each zone has two members. One device is shared among all three zones. This defined configuration contains no alias definitions.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="611" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration/>
            </zoning>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="611" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <defined-configuration>
            <cfg>
                <cfg-name>cfg1</cfg-name>
                <member-zone>
                    <zone-name>zoneA</zone-name>
                </member-zone>
                <member-zone>
                    <zone-name>zoneB</zone-name>
                </member-zone>
                <member-zone>
                    <zone-name>zoneC</zone-name>
                </member-zone>
            </cfg>
            <cfg>
                <cfg-name>cfg2</cfg-name>
                <member-zone>
                    <zone-name>zoneA</zone-name>
                </member-zone>
                <member-zone>
                    <zone-name>zoneB</zone-name>
                </member-zone>
            </cfg>
            <zone>
                <zone-name>zoneA</zone-name>
                <member-entry>
                    <entry-name>11:22:33:44:55:66:77:80</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>11:22:33:44:55:66:77:81</entry-name>
                </member-entry>
            </zone>
            <zone>
                <zone-name>zoneB</zone-name>
                <member-entry>
                    <entry-name>11:22:33:44:55:66:77:80</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>11:22:33:44:55:66:77:82</entry-name>
                </member-entry>
            </zone>
            <zone>
                <zone-name>zoneC</zone-name>
                <member-entry>
                    <entry-name>11:22:33:44:55:66:77:80</entry-name>
```

```
                </member-entry>
                <member-entry>
                    <entry-name>11:22:33:44:55:66:77:83</entry-name>
                </member-entry>
            </zone>
        </defined-configuration>
    </zoning>
</rpc-reply>
```

Retrieving the enabled configuration

In an effort to improve DCMD zoning performance, the enabled zone configuration is no longer distributed in the DCMD database. This means that the zoning enabled-configuration can no longer be retrieved using the **show running-config zoning enabled-configuration** command. Beginning with Network OS 4.0.0, you must use a new RPC to display the enabled-configuration.

This new RPC includes pagination support with a default setting of 200 lines of config for each zone request operation. You can retrieve the entire enabled zone configuration or retrieve a single enabled zone, which also includes its underlying zone members.

To retrieve the entire enabled zone configuration, do not specify any input parameters and issue the following:

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
   <show-zoning-enabled-configuration
xmlns="urn:brocade.com:mgmt:brocade-zone"></show-zoning-enabled-configuration>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
<enabled-configuration xmlns="urn:brocade.com:mgmt:brocade-zone">
    <cfg-name>cfg1</cfg-name>
        <enabled-zone>
            <zone-name>zone1</zone-name>
                <member-entry>
                    <entry-name>10:00:00:00:00:00:00:01</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>10:00:00:00:00:00:00:02</entry-name>
                </member-entry>
        </enabled-zone>
        <enabled-zone>
            <zone-name>zone2</zone-name>
                <member-entry>
                    <entry-name>10:00:00:00:00:00:00:03</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>10:00:00:00:00:00:00:04</entry-name>
                </member-entry>
        </enabled-zone>
    <has-more>false</has-more>
</enabled-configuration>
</rpc-reply>
```

To retrieve a single zone and its underlying members, specify the zone-name-pattern field and issue the following:

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3">
   <show-zoning-enabled-configuration xmlns="urn:brocade.com:mgmt:brocade-zone">
```

```
      <zone-name-pattern>zone1</zone-name-pattern>
   </show-zoning-enabled-configuration>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3">
   <enabled-configuration xmlns="urn:brocade.com:mgmt:brocade-zone">
      <cfg-name>cfg1</cfg-name>
      <enabled-zone>
         <zone-name>zone1</zone-name>
         <member-entry>
            <entry-name>10:00:00:00:00:00:00:01</entry-name>
         </member-entry>
      </enabled-zone>
      <has-more>false</has-more>
   </enabled-configuration>
</rpc-reply>
```

To support pagination, users must specify the last zone that was received and the zone plugin will return a block of the database immediately following the specified zone object. For example, for a zone configuration containing 200 zones and containing 1 WWN member each, the initial zone request procedure would look like the following:

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
   <show-zoning-enabled-configuration
xmlns="urn:brocade.com:mgmt:brocade-zone"></show-zoning-enabled-configuration>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
   <enabled-configuration xmlns="urn:brocade.com:mgmt:brocade-zone">
      <cfg-name>cfg1</cfg-name>
      <enabled-zone>
         <zone-name>zone1</zone-name>
         <member-entry>
            <entry-name>10:00:00:00:00:00:00:01</entry-name>
         </member-entry>
      </enabled-zone>
..
      <enabled-zone>
         <zone-name>zone100</zone-name>
         <member-entry>
            <entry-name>10:00:00:00:00:00:00:64</entry-name>
         </member-entry>
      </enabled-zone>
      <has-more>true</has-more>
   </enabled-configuration>
</rpc-reply>
```

The next zone request would be:

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
   <show-zoning-enabled-configuration xmlns="urn:brocade.com:mgmt:brocade-zone">
      <last-rcvd-zone-name>zone100</last-rcvd-zone-name >
   </show-zoning-enabled-configuration>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
```

```
   <enabled-configuration xmlns="urn:brocade.com:mgmt:brocade-zone">
      <cfg-name>cfg1</cfg-name>
      <enabled-zone>
         <zone-name>zone101</zone-name>
         <member-entry>
            <entry-name>10:00:00:00:00:00:00:65</entry-name>
         </member-entry>
      </enabled-zone>
..
      <enabled-zone>
         <zone-name>zone200</zone-name>
         <member-entry>
            <entry-name>10:00:00:00:00:00:00:C8</entry-name>
         </member-entry>
      </enabled-zone>
      <has-more>false</has-more>
   </enabled-configuration>
</rpc-reply>
```

Zone creation and management

The following sections describe zoning creation and management.

Creating a zone

The following procedure creates a new zone in the defined configuration and saves the modified zoning configuration to nonvolatile memory. Zones without any zone members cannot exist in volatile memory; they are deleted when the transaction commits successfully. Up to 255 zone member objects are supported for each zone.

The following procedure adds a new zone to the defined configuration.

1. Issue the <edit-config> RPC to configure the <zoning>/<defined-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and specify a new <zone> list element containing the following parameters:
   a. In the <zone-name> element, provide the zone name.
   b. Include a <member-entry> element for each member you want to include in the zone. Each <member-entry> element must contain an <entry-name> element containing the WWN of a new member.

      The WWN can be a node WWN or a port WWN.
2. Issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

The following example adds a new zone to the defined configuration.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="613" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
```

```
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <zone>
                        <zone-name>zoneD</zone-name>
                        <member-entry>
                            <entry-name>11:22:33:44:55:66:77:80</entry-name>
                        </member-entry>
                        <member-entry>
                            <entry-name>11:22:33:44:55:66:77:84</entry-name>
                        </member-entry>
                    </zone>
                </defined-configuration>
                <enabled-configuration>
                    <cfg-action>cfg-save</cfg-action>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="613" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Adding a member to a zone

The following procedure adds a WWN to a zone and saves the modified zoning configuration to nonvolatile memory. Up to 255 zone member objects are supported for each zone.

1. Issue the <edit-config> RPC to configure the <zoning>/<defined-configuration>/<zone> node in the in the urn:brocade.com:mgmt:brocade-zone namespace and specify the following elements:
    a. In the <zone-name> element, provide the name of the zone to which you want to add a WWN.
    b. In a <member-entry> element, provide an <entry-name> element containing the WWN you want to add to the zone.

       The WWN can be a node WWN or a port WWN.
2. Issue the <edit-config> RPC on the <zoning>/<enabled-configuration> node and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

The following example adds a WWN to an existing zone.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="614" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <zone>
                        <zone-name>zoneD</zone-name>
                        <member-entry>
                            <entry-name>11:22:33:44:55:66:77:85</entry-name>
```

```
                    </member-entry>
                </zone>
            </defined-configuration>
            <enabled-configuration>
                <cfg-action>cfg-save</cfg-action>
            </enabled-configuration>
        </zoning>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="614" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Removing a member from a zone

The following procedure removes a WWN from a zone and saves the modified zoning configuration to nonvolatile memory.

NOTE
You can remove only one zone member at a time.

1. Issue the <edit-config> RPC to configure the <zoning>/<defined-configuration>/<zone> node in the urn:brocade.com:mgmt:brocade-zone namespace and specify the following elements:
    a. In the <zone-name> element, specify the zone from which you want to remove a WWN.
    b. In the <member-entry> element, include an <entry-name> element containing the WWN of the member you want to remove from the zone.
    c. In the <member-entry> tag, include the delete operation.
2. Issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

The following example removes WWN 11:22:33:44:55:66:77:84 from zoneD.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="615" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <zone>
                        <zone-name>zoneD</zone-name>
                        <member-entry
                            xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                            operation="delete">
                            <entry-name>11:22:33:44:55:66:77:84</entry-name>
                        </member-entry>
                    </zone>
                </defined-configuration>
                <enabled-configuration>
                    <cfg-action>cfg-save</cfg-action>
```

```
            </enabled-configuration>
        </zoning>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="615" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Deleting a zone

Before deleting a zone, Brocade recommends ensuring the zone is not a member of any zone configuration. Although the deletion will proceed in RAM, you will not be able to save the configuration to nonvolatile memory if a defined zone configuration has the deleted zone as a member.

The following procedure checks whether the zone is a member of an existing configuration, deletes the zone, and saves the modified zoning configuration to nonvolatile memory.

1. Issue the <get-config> RPC with a filter for returning the <cfg> portion of the defined configuration to determine whether the zone you want to remove is a member of a zone configuration. If the zone is a member of an exiting zone configuration, remove it.
2. Issue the <edit-config> RPC to configure the <zoning>/<defined-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and specify a <zone> element with the following information:
    a. In the <zone> tag, specify the delete operation.
    b. Under the <zone> element, include the <zone-name> element, and specify the name of the zone you want to delete.
3. Issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

NOTE
Saving the configuration to nonvolatile memory also deletes the zone configuration if the zone you are removing is the last member zone in the configuration.

The following example deletes zoneD from the defined configuration and saves the defined configuration to nonvolatile storage.

```
<rpc message-id="616" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <zone xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete">
                        <zone-name>zoneD</zone-name>
                    </zone>
                </defined-configuration>
                <enabled-configuration>
```

```
                <cfg-action>cfg-save</cfg-action>
            </enabled-configuration>
        </zoning>
    </config>
</edit-config>
</rpc>
<rpc-reply message-id="616" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Zone configuration management

The following sections describe zoning configuration and management.

Creating a zone configuration

The following procedure adds a new zone configuration to the defined configuration and saves it to nonvolatile memory.

NOTE
Zone configurations without any member zones can exist in volatile memory. They are deleted when the transaction commits successfully.

1. Issue an <edit-config> RPC to configure the <zoning>/<defined-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and add a <cfg> node with the following elements:
    a. Include the <cfg-name> element containing the name of the new zoning configuration.
    b. Include a <member-zone> element for each zone you want to include in the configuration. Each <member-zone> element must contain a <zone-name> element containing the name of a zone.
2. Issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

The following example creates cfg3 with zoneA and zoneD as member zones and saves the defined configuration to nonvolatile memory.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="617" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <cfg>
                        <cfg-name>cfg3</cfg-name>
                        <member-zone>
                            <zone-name>zoneA</zone-name>
                        </member-zone>
                        <member-zone>
                            <zone-name>zoneD</zone-name>
```

```
                    </member-zone>
                </cfg>
            </defined-configuration>
            <enabled-configuration>
                <cfg-action>cfg-save</cfg-action>
            </enabled-configuration>
        </zoning>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="617" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

NOTE
Zone aliases are not valid zone configuration members. Adding an alias to an existing zone configuration will not be blocked. However, the attempt to enable a zone configuration that contains aliases will fail with an appropriate error message.

Adding a zone to a zone configuration

The following procedure adds a zone to a zone configuration and saves the modified zoning configuration to nonvolatile memory.

1. Issue an <edit-config> RPC to configure the <zoning>/<defined-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and add a <cfg> node with the following elements:
    a. Include the <cfg-name> element containing the name of the zoning configuration to which you want to add zones.
    b. Include a <member-zone> element for each zone you want to add to the configuration. Each <member-zone> element must contain a <zone-name> element containing the name of a zone.
2. Issue the <edit-config> RPC on the <zoning>/<enabled-configuration> node and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

The following example adds zoneC to cfg3.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="618" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <cfg>
                        <cfg-name>cfg3</cfg-name>
                        <member-zone>
                            <zone-name>zoneC</zone-name>
                        </member-zone>
                    </cfg>
                </defined-configuration>
```

```
            <enabled-configuration>
                <cfg-action>cfg-save</cfg-action>
            </enabled-configuration>
        </zoning>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="618" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Removing a zone from a zone configuration

The following procedure removes a zone from a zone configuration and saves the modified zoning configuration to nonvolatile memory.

NOTE
You can remove only one zone at a time.

1. Issue an <edit-config> RPC to configure the <zoning>/<defined-configuration>/<cfg> node in the urn:brocade.com:mgmt:brocade-zone namespace and specify the following elements:
    a. Include the <cfg-name> element containing the name of the zoning configuration to which you want to add zones.
    b. Include a <member-zone> element for the zone you want to remove from the configuration. The <member-zone> element must contain a <zone-name> element containing the name of a zone.
    c. Include the delete operation in the <member-zone> tag.
2. Issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

    NOTE
    Saving the configuration to nonvolatile memory deletes the configuration if the zone you are removing is the last member in the configuration.

The following example removes zoneA from cfg3 and saves the configuration to nonvolatile memory.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="619" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <cfg>
                        <cfg-name>cfg3</cfg-name>
                        <member-zone
                         xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete">
                            <zone-name>zoneA</zone-name>
```

```
                    </member-zone>
                </cfg>
            </defined-configuration>
            <enabled-configuration>
                <cfg-action>cfg-save</cfg-action>
            </enabled-configuration>
        </zoning>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="619" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Enabling a zone configuration

Only one zone configuration can be enabled. This procedure selects a configuration from the defined configuration and makes it the enabled configuration. This procedure replaces the currently enabled configuration, if one exists.

In addition to enabling the specified configuration, this procedure also saves any changes made to the zoning database in volatile memory to nonvolatile memory. This saved configuration will persist following reboot.

To enable a zone configuration, issue an <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and specify the configuration you want to enable in the <cfg-name> element.

If the configuration refers to a nonexistent zone or a zone with no members assigned to it, the operation fails and the <rpc-reply> returns an error.

The following example enables cfg3.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="620" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <enabled-configuration>
                    <cfg-name>cfg3</cfg-name>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="620" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

If the configuration you are trying to enable contains a zone with no member, the server will return an <rpc-reply> with an error similar to the following message.

```
<rpc-reply message-id="620" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <rpc-error>
        <error-type>application</error-type>
```

```
        <error-tag>Command Failed</error-tag>
        <error-severity>error</error-severity>
        <error-message xml:lang="en">
            Cfg contains empty zone object "zoneB"
        </error-message>
    </rpc-error>
    </rpc-reply>
```

Disabling a zone configuration

This procedure disables the currently enabled configuration and returns the fabric to nonzoning mode. All devices can then access one another or not at all, depending on the default zone access mode setting.

In addition to disabling the specified configuration, this operation also saves any changes made to the zoning database in volatile memory to nonvolatile memory. This saved configuration will persist following reboot.

CAUTION

For fabrics with many devices, Brocade recommends setting the default zone access mode to No Access before disabling a zone configuration to avoid RSCN storms.

To disable the currently enabled configuration, issue an <edit-config> RPC to configure the <zoning>/<cfg-name> node in the urn:brocade.com:mgmt:brocade-zone namespace and include the delete operation in the opening tag of the <cfg-name> element.

The following example disables the currently enabled configuration.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="621" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <enabled-configuration>
                    <cfg-name xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete">
                    </cfg-name>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="621" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Deleting a zone configuration

This procedure deletes a zone configuration from the defined configuration and saves the modified zoning configuration to nonvolatile memory.

1. Issue an <edit-config> RPC to configure the <zoning>/<defined-configuration>/<zone> node in the urn:brocade.com:mgmt:brocade-zone namespace and include the following elements.
   a. Include the <cfg-name> element containing the name of the zone you want to delete.
   b. Include the delete operation in the <cfg> tag.
2. Issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and set the value of the <cfg-action> element to “cfg-save” to save the modified configuration to nonvolatile memory.

The following example deletes cfg3 and saves the defined configuration to nonvolatile memory.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="622">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
            <defined-configuration>
               <cfg xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
operation="delete">
                  <cfg-name>cfg1</cfg-name>
               </cfg>
            </defined-configuration>
         </zoning>
      </config>
   </edit-config>
</rpc>


<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="622">
   <ok></ok>
</rpc-reply>


<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="623">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
            <enabled-configuration>
               <cfg-action>cfg-save</cfg-action>
            </enabled-configuration>
         </zoning>
      </config>
   </edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="623">
   <ok></ok>
</rpc-reply>
```

Clearing changes to a zone configuration

This procedure removes all uncommitted operations from the database. It returns the configuration in volatile memory to its state the last time a transaction commit operation was performed.

To remove all uncommitted operations from the database, issue an <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and, in the <cfg-action> element, specify “cfg-transaction-abort”.

The following example removes all uncommitted operations from the zoning database.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="623" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <enabled-configuration>
                    <cfg-action>cfg-transaction-abort</cfg-action>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="623" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Clearing all enabled-zone configurations

This procedure clears all zone configurations from the defined configuration and enables the default zone. If there is no enabled-configuration, the default zone is enabled, regardless of whether or not there is a default zone configuration defined.

CAUTION

For fabrics with many devices, Brocade recommends setting the default access mode to No Access before clearing all zone configurations to avoid RSCN storms.

1. Issue an <edit-config> RPC to configure the <zoning>/<cfg-name> node in the urn:brocade.com:mgmt:brocade-zone namespace and, in the <cfg-action> element, specify “cfg-clear”.
2. Issue one of the following RPCs, depending on whether an enabled zone configuration exists:
    - If no enabled zone configuration exists, issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node and, in an <cfg-action> element, specify “cfg-save”.
    - If an enabled zone configuration exists, issue an <edit-config> RPC to configure the <zoning>/<enabled-configuration> node and include the delete operation in the <enabled-configuration> tag.

The following example clears the zoning database and enables the default configuration.

```
<rpc message-id="624" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
    <config>
        <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
            <enabled-configuration>
                <cfg-action>cfg-clear</cfg-action>
            </enabled-configuration>
        </zoning>
    </config>
    </edit-config>
</rpc>

<rpc-reply message-id="624" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>

?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="625" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <cfg-name
                 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
                </cfg-name>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="625" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Saving a copy of the zone configuration

This procedure saves a copy of the running configuration to a file.

CAUTION

Ensure that no transaction is pending before you perform this copy operation, otherwise failures will occur when you attempt to restore configuration entries from the saved file. Any transaction data would cause such a failure, including empty configuration definitions or empty zones.

1. Empty the transaction buffer by either committing the transaction to nonvolatile memory or aborting the transaction.
   - To save the defined configuration to nonvolatile memory, issue the <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and set the value of the <cfg-action> element to “cfg-save”.
   - To remove all uncommitted operations from the database, issue an <edit-config> RPC to configure the <zoning>/<enabled-configuration> node in the urn:brocade.com:mgmt:brocade-zone namespace and, in the <cfg-action> element, specify “cfg-transaction-abort”.
2. Issue the <bna-config-cmd> RPC to copy the running configuration to a specified destination file.

The following example commits the zoning transaction and saves the defined configuration to a remote file.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="626" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <enabled-configuration>
                    <cfg-action>cfg-save</cfg-action>
                </enabled-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="626" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>

<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="212">
   <bna-config-cmd xmlns="urn:brocade.com:mgmt:brocade-ras">
      <src>running-config</src>
      <dest>https://user@brocade.com:passphrase/cfg/archiveMay7.txt</dest>
   </bna-config-cmd>
</rpc>

<rpc-reply message-id="212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <session-id xmlns="urn:brocade.com:mgmt:brocade-ras">6</session-id>
    <status xmlns="urn:brocade.com:mgmt:brocade-ras">in-progress</status>
        </rpc-reply>
```

Restoring a configuration from backup

When you restore a saved configuration to the running configuration, the zone configuration identified in the copied file as the enabled configuration becomes the new enabled configuration.

This operation updates the defined configuration in RAM.

NOTE
This operation adds to the defined configuration. It does not replace the defined configuration.

To add a saved configuration to the running configuration, issue the <bna-config-cmd> RPC and set the input elements as follows:

- In the <src> element, specify the location of the saved configuration you want to restore.
- In the <dest> element, specify “running-config”.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="212">
   <bna-config-cmd xmlns="urn:brocade.com:mgmt:brocade-ras">
      <src>https://user@brocade.com:passphrase/cfg/archiveMay7.txt</src>
      <dest>running-config</dest>
   </bna-config-cmd>
</rpc>

<rpc-reply message-id="212" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <session-id xmlns="urn:brocade.com:mgmt:brocade-ras">6</session-id>
    <status xmlns="urn:brocade.com:mgmt:brocade-ras">in-progress</status>
</rpc-reply>
```

Zone configuration scenario

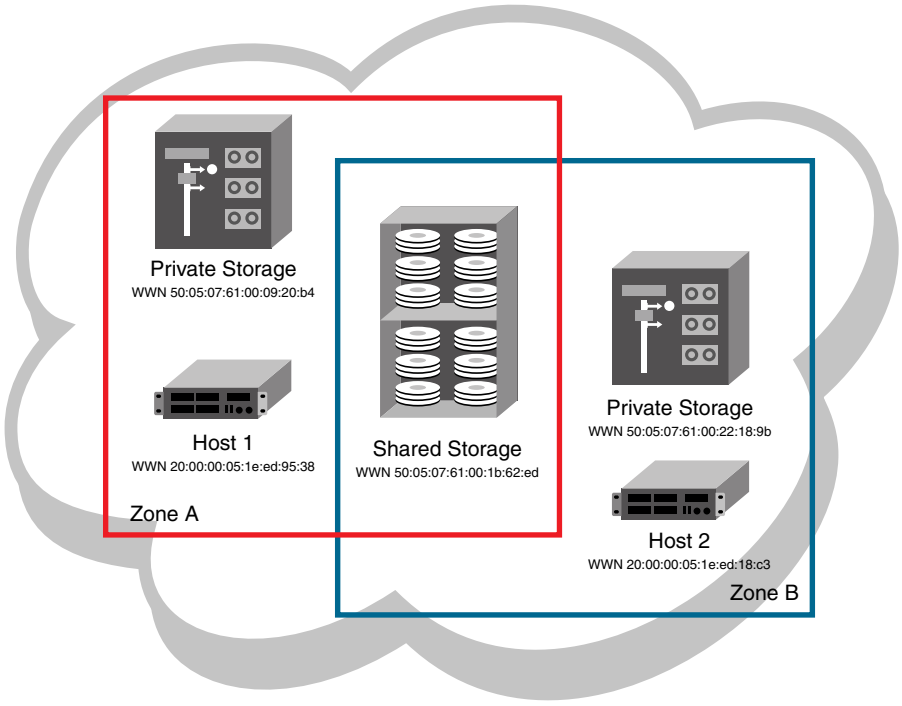

FIGURE 3 Zone configuration example

The following example creates the zone configuration shown in Figure 3. The example assumes that two hosts need access to the same storage device, while each host needs private storage of its own. You create two zones: Zone A contains Host 1, its private storage device, and the shared storage device; Zone B contains Host 2, its private storage device, and the shared storage device. In addition, you create two zone configurations: cfg1 in which only Zone A is effective; cfg2, in which both zones are effective.

This example follows these steps.

1. Connect to any switch on the Brocade VCS Fabric using Secure Shell (SSH).
2. Issue the <name-server> custom action with the <detail> option to retrieve the available WWNs.
3. Use the <edit-config> RPC on the <zoning> node to create the following defined configuration:
   - ZoneA containing WWNs 20:00:00:05:1e:ed:95:38, 50:05:07:61:00:09:20:b4, and 50:05:07:61:00:1b:62:ed
   - ZoneB containing WWNs 20:00:00:05:1e:ed:18:c3, 50:05:07:61:00:22:18:9b, and 50:05:07:61:00:1b:62:ed
   - Cfg1 containing ZoneA only
   - Cfg2 containing ZoneA and ZoneB
4. Use the <get-config> RPC on the <zoning>/<defined-configuration> node to retrieve and verify the defined configuration.
5. Use the <edit-config> RPC on the <zoning>/<enabled-configuration> node to enable Cfg2.
6. Use the <get-config> RPC on the <zoning>/<enabled-configuration> node to retrieve and verify the enabled configuration.

The following example RPC retrieves available WWNs.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="629">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <name-server xmlns="urn:brocade.com:mgmt:brocade-nameserver">
                    <detail>
                        <rbridge-id>66</rbridge-id>
                    </detail>
                </name-server>
            </show>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="629">
    <name-server xmlns="urn:brocade.com:mgmt:brocade-nameserver">
        <nameserver-portid>016400</nameserver-portid>
        <nameserver-portname>10:00:00:05:1E:ED:95:38</nameserver-portname>
        <nameserver-nodename>20:00:00:05:1E:ED:95:38</nameserver-nodename>
(output truncated)
```

The following example RPC creates the defined configuration.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="630" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
```

```
        <target>
            <running/>
        </target>
        <config>
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration>
                    <zone>
                        <zone-name>zoneA</zone-name>
                        <member-entry>
                            <entry-name>20:00:00:05:1e:ed:95:38</entry-name>
                        </member-entry>
                        <member-entry>
                            <entry-name>50:05:07:61:00:09:20:b4</entry-name>
                        </member-entry>
                        <member-entry>
                            <entry-name>50:05:07:61:00:1b:62:ed</entry-name>
                        </member-entry>
                    </zone>
                    <zone>
                        <zone-name>zoneB</zone-name>
                        <member-entry>
                            <entry-name>20:00:00:05:1e:ed:18:c3</entry-name>
                        </member-entry>
                        <member-entry>
                            <entry-name>50:05:07:61:00:22:18:9b</entry-name>
                        </member-entry>
                        <member-entry>
                            <entry-name>50:05:07:61:00:1b:62:ed</entry-name>
                        </member-entry>
                    </zone>
                    <cfg>
                        <cfg-name>cfg1</cfg-name>
                        <member-zone>
                            <zone-name>zoneA</zone-name>
                        </member-zone>
                    </cfg>
                    <cfg>
                        <cfg-name>cfg2</cfg-name>
                        <member-zone>
                            <zone-name>zoneA</zone-name>
                        </member-zone>
                        <member-zone>
                            <zone-name>zoneB</zone-name>
                        </member-zone>
                    </cfg>
                </defined-configuration>
            </zoning>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="630" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The following example RPC retrieves the defined configuration for verification.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="631" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
```

```
        <target>
            <running/>
        </target>
        <filter type="subtree">
            <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
                <defined-configuration/>
            </zoning>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="631" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
        <defined-configuration>
            <cfg>
                <cfg-name>cfg1</cfg-name>
                <member-zone>
                    <zone-name>zoneA</zone-name>
                </member-zone>
            </cfg>
            <cfg>
                <cfg-name>cfg2</cfg-name>
                <member-zone>
                    <zone-name>zoneA</zone-name>
                </member-zone>
                <member-zone>
                    <zone-name>zoneB</zone-name>
                </member-zone>
            </cfg>
            <zone>
                <zone-name>zoneA</zone-name>
                <member-entry>
                    <entry-name>20:00:00:05:1e:ed:95:38</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>50:05:07:61:00:09:20:b4</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>50:05:07:61:00:1b:62:ed</entry-name>
                </member-entry>
            </zone>
            <zone>
                <zone-name>zoneB</zone-name>
                <member-entry>
                    <entry-name>20:00:00:05:1e:ed:18:c3</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>50:05:07:61:00:22:18:9b</entry-name>
                </member-entry>
                <member-entry>
                    <entry-name>50:05:07:61:00:1b:62:ed</entry-name>
                </member-entry>
            </zone>
        </defined-configuration>
    </zoning>
</rpc-reply>
```

The following example RPC enables cfg2.

```
?xml version="1.0" encoding="UTF-8"?>
```

```
<rpc message-id="632" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <zoning xmlns="urn:brocade.com:mgmt:brocade-zone">
            <enabled-configuration>
               <cfg-name>cfg2</cfg-name>
            </enabled-configuration>
         </zoning>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="632" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Chapter

11

Configuring Fibre Channel Ports

In this chapter

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Fibre Channel ports configuration with NETCONF overview

This chapter provides procedures for configuring Fibre Channel ports using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for related conceptual and overview information.

Through the NETCONF interface, you can perform the following operations on Fibre Channel ports:

- Use the <edit-config> RPC to activate and deactivate a Fibre Channel port and set the following port attributes:
  - desire-distance
  - fill-word
  - isl-r_rdy
  - long-distance
  - speed
  - trunk-enable
  - vc-link-init
- Use the <get-config> RPC to view all or part of the Fibre Channel port configuration.
- Use the <show-fibrechannel-interface> custom RPC to return operational information about the interface.

Fibre Channel port parameters are defined in the brocade-interface YANG module. The <show-fibrechannel-interface> RPC is defined in the brocade-fabric-service YANG module. For information about these YANG modules, refer to the *Network OS YANG Reference Manual*.

Fibre Channel port attributes

Network OS v4.0.0 allows you to configure and query the Fibre Channel port attributes listed in Table 4 for an E_Port, using the NETCONF interface. The referenced XML elements that define the attributes values for a specific port reside within an instance of the <fc-port> node, which in turn, resides in the <interface> node in the urn:brocade.com:mgmt:brocade-interface.

TABLE 4 Fibre Channel port attributes

Attribute	Purpose	XML element in <interface>/<fc-port>
Port speed	Defines the speed of the E_Port.	<fc-speed-cfg>
Fill word	Configures the link initialization and fill word primitives for an 8 GB Fibre Channel port.	<fill-word>
Long distance mode	Configures the port for long-distance operations.	<long-distance>
VC link init	Configures the fill-word for long-distance operations.	<vc-link-init>
Desired distance	Configures manually the distance for a long distance connection.	<desire-distance>
Trunk port	Configures the port for trunking.	<trunk-enable>
Buffer credit control	Enables interswitch link receiver ready (ISL R_RDY) mode on the port. If ISL R_RDY is not set, then ISL VC_RDY mode is set by default. We recommend you do not set ISL R_RDY.	<isl-r_rdy-mode>
Port mode configuration	Configure the port mode for the interface.	<config-mode>

The following Fibre Channel port attributes are not supported by Network OS version 3.0.0:

AL_PA offset 13
Compression
Credit Recovery
CSCTL mode
D-Port mode
Disabled E_Port
Encryption
EX_Port
F_Port buffers
Fault Delay
FEC
Frame shooter port
Locked G_Port
Locked L_Port
LOS TOV enable
Mirror Port
NPIV capability
NPIV PP Limit
Persistent Disable
Port Auto Disable
QoS E_Port
Rate limit
RSCN suppressed

Retrieving the Fibre Channel port configuration

Use the <get-config> RPC to query the Fibre Channel port configuration. You can retrieve the configuration for all Fibre Channel ports, specific Fibre Channel ports, or specific attributes of specific Fibre Channel ports. To select the data you want to retrieve, use an appropriate subtree filter.

To retrieve the Fibre Channel configuration for all Fibre Channel interfaces configured on the switch, use the following filter:

```
<filter type="subtree">
   <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
      <fc-port/>
```

```
    </interface>
</filter>
```

To retrieve Fibre Channel configuration data for a specific Fibre Channel interface, use the following filter.

```
<filter type="subtree">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <fc-port>
            <name>8/0/1</name>
        </fc-port>
    </interface>
</filter>
```

To retrieve the settings of specific attributes for a given Fibre Channel port, use a filter such as the following. In this case, just the configured port speed is retrieved.

```
<filter type="subtree">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <fc-port>
            <name>8/0/1</name>
            <fc-speed-cfg/>
        </fc-port>
    </interface>
</filter>
```

The following example retrieves the configuration for the Fibre Channel port 1 on routing bridge 8.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1300" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                </fc-port>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1300" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <fc-port>
            <name>8/0/1</name>
            <fc-speed-cfg>8gbps</fc-speed-cfg>
            <long-distance>ld</long-distance>
            <vc-link-init>arb</vc-link-init>
            <desire-distance>0</desire-distance>
            <trunk-enable></trunk-enable>
            <config-mode>4</config-mode>
        </fc-port>
    </interface>

</rpc-reply>
```

Fibre Channel port activation and deactivation

An FCoE license must be installed on a Brocade VDX 6730 switch to allow Fibre Channel port activation. Brocade VCS Fabric mode must be enabled. Once the FCoE license is installed, all Fibre Channel ports are activated by default. Refer to Chapter 7, “Administering Licenses,” for details about installing the FCoE license.

The <shutdown> element for each <fc-port> instance controls whether the Fibre Channel port is activated. This element is of type empty, so activation is controlled by deleting or inserting this element.

Enabling a Fibre Channel port

Whether a specific Fibre Channel port is enabled is controlled by the <shutdown> element for the specific <fc-port> instance. The <shutdown> element is of type empty. To enable a port, delete the <shutdown> element in the associated <fc-port> instance.

To enable a Fibre Channel port, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <fc-port> node element.
3. Specify values for the following elements in the <fc-port> instance.
    a. In the <name> element, identify the port you want to enable. Identify the port by *rbridge-ID/slot/port*.
    b. In the <shutdown> element, include the delete operation in the element tag.

The following example enables port 4 on routing bridge 8.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                </fc-port>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling a Fibre Channel port

To disable a Fibre Channel port, add the <shutdown> element to the <fc-port> instance using the <edit-config> RPC.

Perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <fc-port> node element.
3. Under the <fc-port> node element, include the following leaf elements.
    a. In the <name> element, identify the port you want to disable. Identify the port by *rbridge-ID/slot/port*.
    b. Specify the <shutdown/> element with no value.

The following example disables port 1 on routing bridge 8.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                    <shutdown/>
                </fc-port>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Setting Fibre Channel port speed

This procedure sets the port speed to 1, 2, 4, or 8 Gbps, or to autonegotiate (the default value).

To set the speed of a Fibre Channel port, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.comn:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <fc-port> node element.
3. Under the <fc-port> node element, include the following leaf elements.
    a. In the <name> element, identify the port you want to configure in *rbridge-ID/slot/port* format.

        This element specifies the instance of the <fc-port> node.

b. In the <fc-speed-cfg> element, specify “auto”, “1gbps”, “2gbps”, “4gbps”, or “8gbps” to set the port speed.

The following example sets the port speed to 4 Gbps for port 1 on routing bridge 8.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                    <fc-port-speed>4gbps</fc-port-speed>
                </fc-port>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring a Fibre Channel port for long distance operation

You can use the NETCONF interface to establish the long distance mode and to allocate full-size frame buffers on a specific port. Network OS supports the Normal Mode (LO), Extended Mode (LE), Dynamic Long-Distance Mode (LD), and Static Long-Distance Mode (LS) long distance link modes. For details about these long distance link modes, refer to the *Network OS Administrator's Guide*.

Before configuring an extended ISL, ensure that the following conditions are met:

- The ports on both ends of the ISL are operating at the same port speed, and can be configured at the same distance level without compromising local switch performance.
- Only qualified Brocade SFPs are used. Only Brocade-branded or certain Brocade-qualified SFPs are supported.

To configure a Fibre Channel port for long distance operation, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.comn:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <fc-port> node element.
3. Under the <fc-port> node element, include the following leaf elements.
    a. In the <name> element, identify the port you want to configure. Identify the port by *routing bridge-ID/slot/port*.
    b. for 8 Gbps only, in the <fill-word> element, set the fill word to the same value as for the remote port.

        Possible values include “idle-idle”, “arbff-arbff”, “idle-arbff”, aa-then-ia”. The default value is “idle-idle”.
    c. In the <long-distance> element, set the long distance mode.

Possible values include “l0”, “le”, “ld”, and “ls”. The default value is “l0”.

d. For LD and LS modes only, in the <desire-distance> element, set the desired distance.

e. For 8 Gbps ports only, in the <vc-link-init> element, set the fill word for the long distance link to the same value as the fill word for the remote port.

Possible values include “idle” and “arb”. The default value is “idle”.

f. On the Fabric OS end of the ISL, configure the Fibre Channel port with the same values set in step b through step e using the Fabric OS **portCfgFillWord** and **portCfgLongDistance** commands.

The following example sets the long distance mode to LS for a distance of 100 km.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1304" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <fc-port>
                    <name>8/0/1</name>
                    <fill-word>arbff-arbff</fill-word>
                    <long-distance>ls</long-distance>
                    <desire-distance>100</desire-distance>
                    <vc-link-init>arb</vc-link-init>
                </fc-port>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1304" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring a Fibre Channel port for trunking

A link can be configured to be part of a trunk group. Two or more links in a port group form a trunk group when they are configured for the same speed, the same distance level, and their link distances are nearly equal.

To enable a Fibre Channel port for trunking, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.comn:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <fc-port> node element.
3. Under the <fc-port> node element, include the following leaf elements.
   a. In the <name> element, identify the port you want to configure. Identify the port by r*bridge-ID/slot/port*.
   b. Include the <trunk-enable/> element with no value.

This element is defined with type empty. To enable the trunking feature, you simply specify the element.

The following example configures the link attached to port 4 on routing bridge 8 to be part of a trunk group.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1305" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface>
                <fc-port>
                    <name>8/0/1</name>
                    <trunk-enable/>
                </fc-port>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1305" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Retrieving Fibre Channel interface information

To retrieve information about a fibre channel interface, issue the <show-fibrechannel-interface-info> custom RPC located in the urn:brocade.com:mgmt:brocade-fabric-service namespace. Using this RPC, you can obtain the port index of the routing bridge, port type (E-port/F-port/U-port), port interface, port address, port WWN, remote port WWN, remote node WWN, port state, port status, port status message, port health, trunk details, licence details, and so on.

NOTE

If you retrieve the <port-index> leaf on a slot without a line card, the value returned is 4294967295, which is actually -1. This leaf is an unsigned integer, and returns -1 when no card is found.

```
<rpc message-id="502" xmlns="urn:ietf:params:xml:ns:NETCONF:base:1.0">
    <show-fibrechannel-interface-info
     xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
        <all/>
    </show-fibrechannel-interface-info>
</rpc>

<rpc-reply message-id="502" xmlns="urn:ietf:params:xml:ns:NETCONF:base:1.0">
    <show-fibrechennel-interface
     xmlns="urn:brocade.com:mgmt:brocade-fabric-service">
        <portsgroup-rbridgeid>24</portsgroup-rbridgid>
        <show-fibrechannel-info>
            <port-interface>24/0/1</port-interface>
            <port-index>1</port-index>
            <port-type>E-Port</port-type
            <port-wwn>20:79:00:05:33:67:26:78</port-wwn>
            <remote-port-wwn>20:79:00:05:22:58:26:73</remote-port-wwn>
```

```
            <remote-node-wwn>10:79:00:05:22:58:26:73</remote-node-wwn>
            <port-state>Online</port-state>
            <port-status>In_Sync</port-status>
            <port-status-message>trunk port</port-status-message>
            <port-health></port-health>
            <port-trunked>True</port-trunked>
            <port-trunk-master>0</port-trunk-master>
            <port-actual-distance>100</port-actual-distance>
            <port-desired-credit>10</port-desired-credit>
            <port-buffer-allocated>0</port-buffer-allocated>
            <port-licensed>True</port-licensed>
            <port-address>427900</port-address>
        </show-fibrechannel-info>
    </show-fibrechennel-interface>
</rpc-reply>
```

Chapter

12

System Monitor Configuration

In this chapter

- System Monitor configuration with NETCONF overview 143
- FRU monitoring 144
- Alert notifications 148
- Resource monitoring 152
- Security monitoring 154
- Interface monitoring 157

System Monitor configuration with NETCONF overview

System Monitor provides customizable monitoring thresholds, which allow you to monitor the health of each fan, power supply, temperature sensor, CID card, small form-factor pluggable (SFP) device, management module (MM), line card, switch fabric module (SFM), or compact flash of the switch.

This chapter provides procedures for configuring System Monitor using NETCONF operations. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of System Monitor
- An explanation and lists of default FRU threshold settings for each supported hardware platform
- An overview of resource monitoring
- SFP thresholds values, including defaults per SFP type
- An overview of monitored interface error types and related concepts
- Procedures for configuring System Monitor with the Network OS command line interface (CLI)

Through the NETCONF interface, you can perform the following operations for configuring System Monitor:

- Use the <edit-config> RPC to configure thresholds and notifications.
- Use the <get-config> RPC to validate configuration settings.
- Use the <show-system-monitor> custom RPC to obtain the health status of the switch.
- Use the <sfp>, <interface>, and <security> custom actions located in the <threshold> node of the urn:brocade.com:mgmt:brocade-threshold-monitor-ext namespace to display SFP, interface, and security default monitoring settings.

System Monitor parameters are defined in the brocade-system-monitor, brocade-system-monitor-ext, brocade-threshold-monitor, and brocade-threshold-monitor-ext YANG modules. For an overview and structural map of the YANG modules, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all user management parameters, refer to the brocade-system-monitor.yang, brocade-system-monitor-ext.yang, brocade-threshold-monitor.yang, and brocade-threshold-monitor-ext.yang files.

FRU monitoring

System Monitor monitors the absolute state of the fans, power supplies, CID card, line cards, and SFPs. For a description of possible states, and hardware platform default threshold settings, refer to the *Network OS Administrator's Guide*.

Setting system thresholds

Each component can be in one of two states, down or marginal, based on factory-defined or user-configured thresholds.

NOTE
You can disable monitoring of each component by setting the down threshold and the marginal threshold to zero.

To set system threshold values, perform the following steps.

1. Issue the <edit-config> RPC to configure the <system-monitor> node in the urn:brocade.com:mgmt:brocade-system-monitor namespace.
2. Under the <system-monitor> node, include a node element for each FRU for which you want to configure the system thresholds.

   Node elements that can have their system thresholds configured include <fan>, <power>, <temp>, <cid-card>, <sfp>, <SFM>, <MM>, <LineCard>, and <compact-flash>.
3. Under the node element designating the FRU, include the <alert> node element.
4. Under the <alert> node element, include the following leaf elements.
   a. In the <marginal-threshold> element, specify a minimum number contributing to the MARGINAL status of the switch.
   b. In the <down-threshold> element, specify the minimum number contributing to the DOWN status of he switch.

The following example sets the MARGINAL and DOWN threshold values for each FRU type.

```
<rpc message-id="1100" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system-monitor xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
                <fan>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>2</down-threshold>
```

```
                    </threshold>
                </fan>
                <power>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>2</down-threshold>
                    </threshold>
                </power>
                <temp>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>2</down-threshold>
                    </threshold>
                </temp>
                <cid-card>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>0</down-threshold>
                    </threshold>
                </cid-card>
                <compact-flash>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>0</down-threshold>
                    </threshold>
                </compact-flash>
                <MM>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>0</down-threshold>
                    </threshold>
                </MM>
                <LineCard>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>0</down-threshold>
                    </threshold>
                </LineCard>
                <SFM>
                    <threshold>
                        <marginal-threshold>1</down-threshold>
                        <down-threshold>0</down-threshold>
                    </threshold>
                </SFM>
            </system-monitor>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1100" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Setting FRU state alerts and actions

You can designate the action to be taken (send an e-mail message or issue a RASlog message) when an FRU changes to a specific state. For example, you can configure the system to issue a RASlog message when a line card is removed.

To set FRU state alerts and actions, perform the following steps.

1. Issue the <edit-config> RPC to configure the <system-monitor> node in the urn:brocade.com:mgmt:brocade-system-monitor namespace.
2. Under the <system-monitor> node, include a node element for each FRU for which you want to configure an alert state or alert action.

   Node elements that can have their alert state and action set include <cid-card>, <sfp>, <LineCard>, <fan>, and <power>.
3. Under the node element designating the FRU, include the <alert> node element.
4. Under the <alert> node element, include the following leaf elements.
   a. In the <state> element, specify the state of the FRU for which you want the system to generate an alert.

      Valid values for <cid-card>, <LineCard>, <fan>, and <power> include “removed,” “inserted,” “on,” “faulty,” “none,” and “all.”

      Valid values for <sfp> include “removed,” “inserted,” “faulty,” “none,” and “all.”
   b. In the <action> element, specify the action to take place when the FRU transitions into the state specified in the <state> element.

      Valid values include “none” (take no action), “email” (send and e-mail message), “raslog” (issue a RASlog message), and “all” (send and e-mail message and issue a RASlog message).

The following example issues a RASlog message if a fan, or power unit, or line card is removed, or sends an e-mail message if the CID card is faulty or inserted.

```
<rpc message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system-monitor xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
                <fan>
                    <alert>
                        <state>removed</state>
                        <action>raslog</action>
                    </alert>
                </fan>
                <power>
                    <alert>
                        <state>removed</state>
                        <action>raslog</action>
                    </alert>
                </power>
                <cid-card>
                    <alert>
                        <state>inserted faulty</state>
                        <action>email</action>
                    </alert>
                </cid-card>
                <sfp>
                    <alert>
                        <state>none</state>
                        <action>none</action>
```

```
                </alert>
            </sfp>
            <LineCard>
                <alert>
                    <state>removed</state>
                    <action>raslog</action>
                </alert>
            </LineCard>
        </system-monitor>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Obtaining the switch health status

To obtain the switch health status, issue the <show-system-monitor> custom RPC located in the urn:brocade.com:mgmt:brocade-system-monitor-ext namespace. To restrict the output to a specific switch, provide the RBridge ID as an input parameter, otherwise the health status of all components on all switches in the Brocade VCS Fabric is returned along with the status of each port.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1102">
    <show-system-monitor
        xmlns="urn:brocade.com:mgmt:brocade-system-monitor-ext">
        <rbridge-id>101</rbridge-id>
    </show-system-monitor>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1102">
    <switch-status xmlns="urn:brocade.com:mgmt:brocade-system-monitor-ext">
        <rbridge-id-out>101</rbridge-id-out>
        <switch-name>prodSwitchB</switch-name>
        <switch-ip>154.56.1.0</switch-ip>
        <report-time></report-time>
        <switch-state>state-healthy</switch-state>
        <switch-state-reason></switch-state-reason>
        <component-status>
            <component-name>fan</component-name>
            <component-state>state-marginal</component-state>
        </component-status>
        <component-status>
(output truncated)
```

Obtaining the system monitoring configuration

To retrieve the system monitor configuration, issue the <get-config> RPC with a subtree filter to retrieve only the information under the <system-monitor> node in the urn:brocade.com:mgmt:brocade-system-monitor namespace. To limit the output to a specific component type, under the <system-monitor> node, include the <fan>, <power>, <temp>, <cid-card>, <compact-flash>, <MM>, or <sfp> node.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1103" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <system-monitor xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
            </system-monitor>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1103" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <system-monitor xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
        <fan>
            <threshold>
                <marginal-threshold>1</down-threshold>
                <down-threshold>2</down-threshold>
            </threshold>
            <alert>
                <state>1</state>
                <action>2</action>
            </alert>
        </fan>
        <power>
            <threshold>
                <marginal-threshold>1</down-threshold>
                <down-threshold>2</down-threshold>
            </threshold>
            <alert>
                <state>1</state>
                <action>2</action>
            </alert>
        </power>
        <temp>
            <threshold>
                <marginal-threshold>1</down-threshold>
                <down-threshold>2</down-threshold>
            </threshold>
        </temp>
        <cid-card>
            <threshold>
                <marginal-threshold>1</down-threshold>
                <down-threshold>0</down-threshold>
            </threshold>
            <alert>
                <state>1</state>
                <action>0</action>
            </alert>
        </cid-card>
(output truncated)
```

Alert notifications

The processes in this section configure the alert notifications.

Configuring e-mail alerts

Use this procedure to configure e-mail recipients of FRU alerts. For an e-mail alert to function correctly, add the IP addresses and host names to the Domain Name System (DNS) and configure the domain name and name servers.

1. Issue the <edit-config> RPC to configure the <system-monitor-mail> node in the urn:brocade.com:mgmt:brocade-system-monitor namespace.
2. Under the <system-monitor-mail> node, include the <fru> node element.
3. Under the <fru> node, include the empty <enable> element.
4. Under the <fru> node, include an <email-list> node element for each intended e-mail recipient of FRU alert notifications.
5. Under each <email-list> node element, include an <email> leaf element and specify the e-mail address of an intended recipient.
6. Under the <system-monitor-mail> node, include the <relay> node element.

The following example configures an e-mail recipient of FRU alert notifications.

```
<rpc message-id="1104" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system-monitor-mail
             xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
               <fru>
                   <enable>
                   <email-list>
                       <email>admin@customer.com</email>
                   </email-list>
               </fru>
            </system-monitor-email>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1104" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Forwarding e-mail messages to a relay server

This procedure allows the sendmail agent on the switch to resolve the domain name and forward all e-mail messages to a relay server.

To create a mapping:

1. Issue the <edit-config> RPC to configure the <system-monitor-mail> node in the urn:brocade.com:mgmt:brocade-system-monitor namespace.
2. Under the <system-monitor-mail> node, include the <fru> node element.
3. Under the <system-monitor-mail> node, include the <relay> node element.
4. Under the <relay> node, include the following leaf elements.
    a. In the <host-ip> field, specify the IP address of the Domain Name System.
    b. In the <domain-name> field, include the domain name of the Domain Name System.

```
<rpc message-id="1105" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system-monitor-mail
             xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
               <relay>
                   <host-ip>1.2.3.4</host-ip>
                   <domain-name>englab.brocade.com</domain-name>
               </relay>
            </system-monitor-email>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1105" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To delete the mapping:

```
<rpc message-id="1106" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system-monitor-mail
             xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
               <relay xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete">
                  <host-ip xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete">1.2.3.4</host-ip>
               </relay>
            </system-monitor-email>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1106" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To change the domain name:

```
<rpc message-id="1107" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system-monitor-mail
             xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
               <relay>
                   <host-ip>1.2.3.4</host-ip>
                   <domain-name>customer.com</domain-name>
               </relay>
            </system-monitor-email>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1107" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To delete the domain name and return to the default:

```
<rpc message-id="1108" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <system-monitor-mail
             xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
               <relay xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete">
                  <host-ip>1.2.3.4</host-ip>
                  <domain-name xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete">customer.com</domain-name>
               </relay>
            </system-monitor-email>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1108" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Resource monitoring

For a conceptual overview of resource monitoring, refer to the *Network OS Administrator's Guide*.

Configuring memory monitoring

NOTE
E-mail is not a supported action for threshold monitoring.

To configure memory monitoring, perform the following steps.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor namespace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<memory> hierarchy of node elements.
3. Under the <memory> node, include the following leaf elements to configure memory monitoring.
    a. In the <poll> element, specify the time in seconds after which the system monitor will poll the resource usage. Range is 10 through 3600. Default is 120.
    b. In the <retry> element, specify the number of retries that the system monitor takes before triggering an action. Range is 1 through 100. Default is 3.
    c. In the <limit> element, specify the usage limit as a percentage of available resources. Range is 0 through 80. Default is 60.
    d. In the <high-limit> element, specify the upper usage limit for memory as a percentage of available memory. Range is 0 through 80. Default is 70.
    e. In the <low-limit> element, specify the lower usage limit for memory as a percentage of available memory. Range is 0 through 80. Default is 40.
    f. In the <actions> element, specify the action the system monitor triggers when a threshold is crossed. Specify "raslog" to send a RASlog message, "snmp" to issue an SNMP trap, "all" to send a RASlog message and issue an SNMP trap, or "none" to do nothing. Default is none.

    The following example configures memory monitoring.

```
<rpc message-id="1109" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <threshold-monitor-hidden
         xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
            <threshold-monitor>
                <memory>
                    <poll>30</poll>
                    <retry>3</retry>
                    <limit>75<limit>
                    <high-limit>80</high-limit>
                    <low-limit>50</high-limit>
                    <actions>raslog</actions>
```

```
            </memory>
          </threshold-monitor>
       </threshold-monitor-hidden>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1109" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring CPU monitoring

To configure CPU monitoring, perform the following steps.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor namespace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<Cpu> hierarchy of node elements.
3. Under the <Cpu> node, include the following leaf elements to configure CPU monitoring.
   a. In the <poll> element, specify the time in seconds after which the system monitor will poll the resource usage. Range is 10 through 3600. Default is 120.
   b. In the <retry> element, specify the number of retries that the system monitor takes before triggering an action. Range is 1 through 100. Default is 3.
   c. In the <limit> element, specify the usage limit as a percentage of available resources. Range is 0 through 80. Default is 60.
   d. In the <actions> element, specify the action the system monitor triggers when a threshold is crossed. Specify “raslog” to send a RASlog message, “snmp” to issue an SNMP trap, “all” to send a RASlog message and issue an SNMP trap, or “none” to do nothing. Default is none.

   The following example configures CPU monitoring.

```
<rpc message-id="1110" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <threshold-monitor-hidden
         xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
           <threshold-monitor>
               <Cpu>
                   <poll>30</poll>
                   <retry>3</retry>
                   <limit>75<limit>
                   <actions>all</actions>
               </Cpu>
           </threshold-monitor>
       </threshold-monitor-hidden>
    </config>
</edit-config>
</rpc>
```

```
    <rpc-reply message-id="1110" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Obtaining the threshold monitoring configuration

To display the threshold monitoring configuration, issue the <get-config> RPC with a subtree filter to restrict the returned configuration information to the <threshold-monitor-hidden>/<threshold-monitor> node in the urn:brocade.com:mgmt:brocade-threshold-monitor namespace. To restrict the output to the memory or CPU monitoring configuration, include the <memory> or <Cpu> element under the <threshold-monitor> node.

The following example returns the CPU threshold monitoring configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1111" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <threshold-monitor-hidden
             xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
               <threshold-monitor>
                   <Cpu>
               </threshold-monitor>
            </threshhold-monitor-hidden>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1111" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <threshold-monitor-hidden
     xmlns="urn:brocade.com:mgmt:brocade-system-monitor">
        <threashold-monitor>
            <Cpu>
                <poll>30</poll>
                <retry>3</retry>
                <limit>75</limit>
                <actions>all</actions>
            </Cpu>
        </threshold-monitor>
    </threshold-monitor-hidden>
</rpc-reply>
```

Security monitoring

System Monitor monitors all attempts to breach your SAN security, helping you fine-tune your security measures. If a security breach occurs, System Monitor sends a RASlog alert. The following Security areas are monitored:

- Telnet Violation, which occurs when a Telnet connection request reaches a secure switch from an unauthorized IP address.
- Login Violation, which occurs when a secure fabric detects a login failure.

Displaying security monitoring default values

To display the default values of security threshold and alert options, issue the <security> custom action located in the <threshold> node in the urn:brocade.com:mgmt:brocade-threshold-monitor namespace. The <threshold> node is, in turn, located by augmentation under the <show>/<defaults> node hierarchy in the urn:brocade.com:mgmt:brocade-common-def namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1116">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <defaults>
                    <threshold
                     xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor-ext"/>
                       <security/>
                    </threshold>
                </defaults>
            </show>
        </nca:data>
    </nca:action>
</rpc>
```

Configuring security monitoring

Use the following procedure to configure security monitoring on a standalone switch. For a Fabric Cluster configuration, you must first identify the routing bridge with the <rbridge-id> element in the urn:brocade.com:mgmt:brocade-rbridge namespace.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor workspace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<security> hierarchy of node elements.
3. Under the <security> node, include the <policy> node element to specify that the system will monitor the security parameters using custom settings rather than the default settings.
4. Under the <policy> node, include the <sec_policy_name> leaf element, and specify “custom.”
5. Under the <policy> node, specify the <area> node element.
6. Under the <area> node, specify the following elements.
    a. In the <sec_area_value> leaf element, specify “telnet-violation,” or “login-violation.”
    b. In the <timebase> element, specify the allotted amount of time that can pass since the previous reading. Polling values are taken at different intervals depending on the configured time base.
    c. Under the <threshold> node element, include the <high-threshold>, <low-threshold>, and <buffer> leaf elements:

        In the <sec-high-threshold> element, specify the high limit for the specified security violation type.

        In the <sec-low-threshold> element, specify the low limit for the specified security violation type.

In the <sec-buffer> element, specify the buffer value for in-range behavior.

d. The <alert> node element.

7. Under the <alert> node element, include the <above> and <below> node elements.
8. Under the <above> node, include the <sec-above-highthresh-action> element and specify the actions to be taken when a the error count rises above the high threshold. Specify “email” to generate an e-mail message when the high threshold is breached, “raslog” to generate a RASlog message, “all” to perform both actions, or “none” to do nothing.
9. Under the <below> node, specify the actions to be taken when a the error count drops below each threshold in the following leaf elements.

   a. In the <sec-below-highthresh-action> element, specify “email,” “raslog,” “all,” or “none.”

   b. In the <sec-above-lowthresh-action> element, specify “email,” “raslog,” “all,” or “none.”

   The following example configures a security policy that generates a RASlog message when a high threshold value of 10 telnet violations is breached.

```
<rpc message-id="1117" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <threshold-monitor-hidden
         xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
            <threshold-monitor>
                <security>
                    <policy>
                        <sec_policy_name>cusotm</sec_policy_name>
                        <area>
                            <sec_area_value>telnet-violation</sec_area_value>
                            <timebase>hour</timebase>
                            <threshold>
                                <sec-high-threshold>10</sec-high-threshold>
                                <sec-buffer>3</sec-buffer>
                            </threshold>
                            <alert>
                                <above>
                                    <sec-above-highthresh-action>raslog
                                     </sec-above-highthresh-action>
                                </above>
                            </alert>
                        </area>
                    </policy>
                </security>
            </threshold-monitor>
        </threshold-monitor-hidden>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1117" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Applying security monitoring policies

This procedure allows you to toggle between default settings and saved custom configuration settings and to apply actions and thresholds separately. For example, you can choose to use default threshold settings together with a customized subset of available actions, or you can modify some of the threshold settings and use the default action settings.

To apply a custom security monitoring policy, perform the following steps.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor workspace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<security> hierarchy of node elements.
3. Under the <security> node, include the <apply> leaf element, and specify the custom policy.

```
switch(config)# threshold-monitor security apply custom
<rpc message-id="1118" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <threshold-monitor-hidden
         xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
           <threshold-monitor>
               <security>
                   <apply>custom</apply>
               </security>
           </threshold-monitor>
        </threshold-monitor-hidden>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1118" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Interface monitoring

System Monitor monitors error statistics on all external Gigabit Ethernet interfaces: 1 Gb, 10 Gb, and 40 Gb. When any monitored error crosses the configured high or low threshold, an alert is generated.

Monitored errors include CRC align errors, RX symbol errors, RX IFG violations, and RX abnormal frame terminations. For details about these interface error types, refer to the *Network OS Administrator's Guide*.

Displaying interface monitoring default values

To display the default values of Interface threshold and alert options, issue the <interface> custom action located in the <threshold> node in the urn:brocade.com:mgmt:brocade-threshold-monitor namespace. The <threshold> node is, in turn, located by augmentation under the <show>/<defaults> node hierarchy in the urn:brocade.com:mgmt:brocade-common-def namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1119">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <defaults>
                    <threshold
                     xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor-ext"/>
                       <interface>
                           <type>Ethernet</type>
                    </threshold>
                </defaults>
            </show>
        </nca:data>
    </nca:action>
</rpc>
```

Configuring interface monitoring

Use the following procedures to configure interface monitoring on a standalone switch. For a Fabric Cluster configuration, you must first identify the routing bridge with the RBridge ID.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor workspace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<interface> hierarchy of node elements.
3. Under the <interface> node, include the <policy> node element to specify that the system will monitor the interface parameters using custom settings rather than the default settings.
4. Under the <policy> node, include the <policy_name> leaf element, and specify “custom.”
5. Under the <policy> node, specify the <area> node element.
6. Under the <area> node, specify the following elements.
    a. In the <type> leaf element, specify the type of interface as “Ethernet.”
    b. In the <area_value> leaf element, specify the interface error type to be monitored:

        CRCAlignErrors—The total number of frames received with either a bad Frame Check Sequence (FCS) or an alignment error.

        SymbolErrors—The number of words received as an unknown (invalid) symbol. Large symbol errors indicate a bad device, cable, or hardware.

        IFG—The minimum-length interframe gap (IFG) between successive frames is violated. The typical minimum IFG is 12 bytes.

        MissingTerminationCharacter—The number of frames that terminated by anything other than the Terminate character.

c. Under the <threshold> node element, include the following leaf elements:

<timebase-value> sets the allotted amount of time since the previous reading. Polling values are taken at different intervals depending on the configured time base.

<high-threshold> specifies the high limit for the specified interface error type.

<low-threshold> specifies the low limit for the specified interface error type.

<buffer> specifies the value of an error on a configured interface that is in the buffer range. The buffer value cannot exceed the average of the high and low threshold value.

d. The <alert> node element.

7. Under the <alert> node element, include the <above> and <below> node elements.
8. Under the <above> node, include the following leaf elements to specify the actions to be taken when a the error count rises above each threshold.

a. In the <above-highthresh-action> element, specify “email” to generate an e-mail message when the high threshold is breached, “raslog” to generate a RASlog message, “fence” to disable the port, “all” to perform all three actions, or “none” to do nothing.

Refer to the *Network OS Administrator’s Guide* for information about port fencing.

b. In the <above-lowthresh-action> element, specify “email,” “raslog,” “all,” or “none.”

9. Under the <below> node, specify the actions to be taken when the error count drops below each threshold in the following leaf elements.

a. In the <below-highthresh-action> element, specify “email,” “raslog,” “all,” or “none.”

b. In the <above-lowthresh-action> element, specify “email,” “raslog,” “all,” or “none.”

The following example disables a port and generates a RASlog message if IFG errors exceed 80 within a one-hour period.

```
<rpc message-id="1120" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <threshold-monitor-hidden
             xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
               <threshold-monitor>
                   <interface>
                       <policy>
                           <policy_name>custom</policy_name>
                           <area>
                               <type>Ethernet</type>
                               <area_value>IFG</area_value>
                               <threshold>
                                   <timebase_value>hour</timebase_value>
                                   <high-threshold>80</high-threshold>
                                   <low-threshold>10<low-threshold>
                                   <buffer>10</buffer>
                               </threshold>
                               <alert>
                                   <above>
                                       <above-highthresh-action>fence raslog
                                        </above-highthresh-action>
                                   </above>
```

```
                            </alert>
                        </area>
                    </policy>
                </interface>
            </threshold-monitor>
        </threshold-monitor-hidden>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1120" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying interface monitoring policies

This procedure allows you to toggle between default settings and saved custom configuration settings and to apply actions and thresholds separately. For example, you can choose to use default threshold settings with a customized subset of available actions, or you can modify some of the threshold settings and use the default action settings.

To apply a custom interface monitoring policy, perform the following steps.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor workspace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<interface> hierarchy of node elements.
3. Under the <interface> node, include the <apply> leaf element, and specify the custom policy.

```
<rpc message-id="1121" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <threshold-monitor-hidden
             xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
                <threshold-monitor>
                    <interface>
                        <apply>custom</apply>
                    </interface>
                </threshold-monitor>
            </threshold-monitor-hidden>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1121" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Pausing interface monitoring

To pause the monitoring of all ports and retain the ability to resume port monitoring at a later time, perform the following steps.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor workspace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<interface> hierarchy of node elements.
3. Under the <interface> node, include the empty <pause> element.

```
rpc message-id="1122" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <threshold-monitor-hidden
             xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
               <threshold-monitor>
                   <interface>
                       <pause/>
                   </interface>
               </threshold-monitor>
            </threshold-monitor-hidden>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1122" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Continuing interface monitoring

To resume port monitoring, perform the following steps.

1. Issue the <edit-config> RPC to configure the <threshold-monitor-hidden> node in the urn:brocade.com:mgmt:brocade-threshold-monitor workspace.
2. Under the <threshold-monitor-hidden> node, include the <threshold-monitor>/<interface> hierarchy of node elements.
3. Under the <interface> node, include the empty <pause> element, and include the delete operation in the element tag.

```
rpc message-id="1123" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <threshold-monitor-hidden
             xmlns="urn:brocade.com:mgmt:brocade-threshold-monitor">
               <threshold-monitor>
                   <interface>
                       <pause xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                        operation="delete"/>
                   </interface>
               </threshold-monitor>
            </threshold-monitor-hidden>
        </config>
    </edit-config>
```

```
</rpc>

<rpc-reply message-id="1123" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

VMware vCenter 13

In this chapter

- vCenter management with NETCONF overview 163
- Configuring vCenter 163

vCenter management with NETCONF overview

This chapter provides procedures and examples for Brocade VCS Fabric management using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of concepts related to Brocade vCenter technology
- Brocade vCenter guidelines and restrictions
- Brocade vCenter discovery principles
- How to perform Brocade vCenter management using the Network OS command line interface (CLI)

Using the NETCONF interface, you can perform the following vCenter configuration operations:

- Use the <edit-config> remote procedure call (RPC) to perform the following operations:
  - Enable and disable vCenter
  - Configure discovery time interval
  - Configure user-triggered vCenter discovery
- Use the <get-config> RPC to verify all or part of the vCenter configuration.
- Use the <show-vcs> custom RPC to return configuration state information about vCenter.

Brocade vCenter parameters are defined in the brocade-vswitch YANG module. For structural maps of this YANG module, refer to the *Network OS YANG Reference Manual*.

Configuring vCenter

The processes in this section configure vCenter.

Step 1: Enabling QoS

You must edit the network resource pool settings and set QoS priorities. Refer to the latest VMware vSphere Networking documentation.

Step 2: Enabling CDP/LLDP

In order for an Ethernet Fabric to detect the ESX/ESXi hosts, you must first enable Cisco Discovery Protocol (CDP) and Link Layer Discovery Protocol (LLDP) on all the virtual switches (vSwitches) and distributed vSwitches (dvSwitches) in the vCenter Inventory.

For more information, refer to the VMware KB article 1003885.

Enabling CDP/LLDP on vSwitches

Complete the following steps to enable CDP/LLDP on virtual switches (vSwitches).

1. Log in as root to the ESX/ESXi Host.
2. Use the following command to verify the current CDP/LLDP settings.

```
[root@server root]# esxcfg-vswitch -b vSwitch1
```

3. Use the following command to enable CDP/LLDP for a given virtual switch. Possible values here are **advertise** or **both**.

```
[root@server root]# esxcfg-vswitch -B both vSwitch1
```

Enabling CDP/LLDP on dvSwitches

Complete the following steps to enable CDP on distributed virtual switches (dvSwitches).

1. Connect to the vCenter server by using the vSphere Client.
2. In the vCenter Server home page, click **Networking**.
3. Right-click the distributed virtual switches (dvSwitches) and click **Edit Settings**.
4. Select **Advanced** under **Properties**.
5. Use the check box and the drop-down list to change the CDP/LLDP settings.

Step 3: Adding and activating vCenter

After enabling CDP on all the vSwitches and dvSwitches in the vCenter, the Network OS-side configuration is a two step process: adding the vCenter and activating the vCenter.

Adding vCenter

You must add the vCenter before initiating any discovery transactions. To authenticate with a specific vCenter, you must first configure the URL, login, and password properties on the VDX switch.

Under the <protocol> node, include the <vcenter> node element from the urn:brocade.com:mgmt:brocade-vswitch namespace to enable vCenter. The <vcenter> node element contains elements that allow you to configure the global vCenter parameters. However, the “presence=true” statement that qualifies the <vcenter> container definition in the brocade-vswitch.yang file allows the <vcenter> node element to also function as a leaf element. you must also configure the <url>, <name>, <password> and <interval> nodes. The following example enables vCenter globally.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
           <target>
              <running/>
           </target>
       <config>
           <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
              <vswitch xmlns="urn:brocade.com:mgmt:brocade-vswitch"/>
                     <vcenter>myvcenter</vcenter>
                     <url>https://10.2.2.2</url>
                     <name>user</name>
                     <password>pass</password>
                     <interval>4</interval>
                 </vcenter>
           </protocol>
       </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

NOTE
By default, the vCenter server accepts only HTTPS connection requests.

Activating the vCenter

After adding the vCenter, you must activate the configured vCenter instance.

NOTE
In VCS mode, you can configure the vCenter by using any node. Discovery is initiated by the primary node.

```
switch(config)# vcenter myvcenter activate
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
           <target>
              <running/>
           </target>
       <config>
           <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
              <vswitch xmlns="urn:brocade.com:mgmt:brocade-vswitch"/>
                     <vcenter>myvcenter</vcenter>
                     </activate>
                 </vcenter>
           </protocol>
       </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Immediately following first-time vCenter activation, Network OS starts the virtual asset discovery process.

When the discovery process completes, the status displays as “Success.” Network OS has performed all the necessary configurations needed for the vCenter Server. Network OS is now ready for CDP transmissions from the virtual switches to identify which ESX/ESXi host is connected to which physical interface in the Ethernet Fabric.

Step 4: Retrieving the discovered virtual assets

Use the <get-config> RPC to retrieve the current configuration data and operational state data. Refer to “Retrieving configuration data” on page 11 and “Retrieving operational data” on page 15 for detailed instructions.

Chapter

14

Configuring Remote Monitoring

In this chapter

- RMON configuration with NETCONF overview 167
- RMON configuration and management 167

RMON configuration with NETCONF overview

This chapter provides procedures for configuring remote monitoring (RMON) events and alarms using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of RMON
- Procedures for configuring RMON using the Network OS command line interface (CLI)

Using the NETCONF interface, you can perform the following RMON configuration operations:

- Use the <edit-config> remote procedure call (RPC) to configure RMON.
- Use the <get-config> RPC to verify all or part of the RMON configuration.

RMON parameters are defined in the brocade-rmon YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all RMON parameters, refer to the brocade-rmon.yang file.

RMON configuration and management

Alarms and events are configurable RMON parameters:

- Events—Determines the action to take when an event is triggered by an alarm. The action can be to generate a log entry, an SNMP trap, or both. You must define the events before an alarm can be configured. If you do not configure the RMON event first, you will receive an error when you configure the alarm settings.
- Alarms—Monitors a specific management information base (MIB) object for a specified interval, triggers an alarm at a specified value (rising threshold), and resets the alarm at another value (falling threshold). Alarms are paired with events; the alarm triggers an event, which can generate a log entry or an SNMP trap.

Default RMON configuration

By default, no RMON alarms and events are configured and RMON collection statistics are not enabled.

Configuring RMON alarm settings

To configure RMON alarms and events, perform the following steps.

1. Issue the <edit-config> RPC to configure the <rmon> node in the urn:brocade.com:mgmt:brocade-rmon workspace.
2. Under the <rmon> node, include the <alarm-entry> node element.
3. Under the <alarm-entry> node, include the following leaf elements to configure the RMON alarm.
    a. In the <alarm-index> element, set the unique index number for the alarm in the range 1 through 65535.
    b. In the <snmp-oid> element, specify a description of the event as a string of up to 35 characters.
    c. In the <alarm-interval> element, specify the RMON alarm sample interval in seconds. The range of valid values is from 1 through 2,147,483,648.
    d. In the <alarm-sample> field, specify “absolute” or “delta”, depending on the sample type.

    Optionally, if you are monitoring a rising threshold:

    e. In the <alarm-rising-threshold> element, specify a number in the range 1 through 2,147,483,648.
    f. In the <alarm-rising-event-index> element, specify the event by its index number in the range 1 through 65535.

    When monitoring a falling threshold:

    g. In the <alarm-falling-threshold> element, specify a number in the range 1 through 2,147,483,648.
    h. In the <alarm-falling-event-index> element, specify the event by its index number in the range 1 through 65535.
4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example shows an alarm that tests every sample for a rising threshold.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <rmon xmlns="urn:brocade.com:mgmt:brocade-rmon">
            <alarm-entry>
               <alarm-index>5</alarm-index>
               <snmp-oid>1.3.6.1.2.1.16.1.1.1.5.65535</snmp-oid>
               <alarm-interval>30</alarm-interval>
               <alarm-sample>absolute</alarm-sample>
               <alarm-rising-threshold>95</alarm-rising-threshold>
               <alarm-rising-event-index>27</alarm-rising-event-index>
               <alarm-owner>john_smith</alarm-owner>
            </alarm-entry>
         </rmon>
      </config>
   </edit-config>
```

```
</rpc>

<rpc-reply message-id="2800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The following example shows an alarm that tests the delta between samples for a falling threshold.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rmon xmlns="urn:brocade.com:mgmt:brocade-rmon">
                <alarm-entry>
                    <alarm-index>5</alarm-index>
                    <snmp-oid>1.3.6.1.2.1.16.1.1.1.5.65535</snmp-oid>
                    <alarm-interval>10</alarm-interval
                    <alarm-sample>delta</alarm-sample>
                    <alarm-falling-threshold>65</alarm-falling-threshold>
                    <alarm-falling-event-index>42</alarm-falling-event-index>
                    <alarm-owner>john_smith</alarm-owner>
                </alarm-entry>
            </rmon>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Section

II

Network OS Security Configuration

This section describes security features, and includes the following chapters:

- Managing User Accounts 173
- External Server Authentication 197
- Fabric Authentication 223

Chapter

15

Managing User Accounts

In this chapter

- Managing user accounts with NETCONF overview 173
- User accounts 173
- Role-based access control 179
- Command access rules. 182
- Password policies 189
- Security event logging 196

Managing user accounts with NETCONF overview

This chapter provides procedures for managing user accounts with the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- Related conceptual overview information
- Procedures and examples for managing user accounts using the Network OS command line interface (CLI)

Through the NETCONF interface, you can perform the following operations for managing user accounts:

- Use the <edit-config> RPC to configure user accounts, role-based access control, command access rules, and password policies.
- Use the <get-config> RPC to validate configuration settings.
- Use the <user>/<unlock> custom action to unlock a user account.

User management parameters are defined in the brocade-aaa YANG module. For an overview and structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all user management parameters, refer to the brocade-aaa.yang file.

User accounts

A user account allows authorized user access to the switch CLI. A user account must be assigned a role to specify the account's access privileges. A user account can be disabled at any point, preventing the user from logging in to the switch. A user can only be unlocked when the account is auto-locked because the user exceeded the configured threshold for failed login attempts. Only an administrator can create, change, unlock, or delete user accounts.

All modules that pertain to security, for example, user and user roles, RBAC, and password attributes (for example, encryption), are globally configurable data entities. This means that if a switch is in logical chassis cluster mode, all switches in the cluster will have a common configuration for all the previously mentioned entities.

Default accounts in the local switch user database

Network OS comes with two predefined user accounts that are part of the factory-default settings. Brocade recommends that you change the password for all default accounts during the initial installation and configuration for each switch.

The default user accounts are “admin” and “user,” and these accounts are associated with the corresponding admin” and “user” roles in the switch-local user database. Only the “admin” and “user” users can access the CLI and, except for the account password, no other attributes can be changed for the default users “admin” and “user.”

By default, all account information is stored in the switch-local user database. User authentication and tracking of logins to the switch is local by default.

NOTE
The maximum number of user accounts, including the default accounts, is 64. The maximum number of roles, including the default roles is 64. For any environment requiring more than 64 users, you should adopt an authentication, authorization, and accounting (AAA) service for user management. Refer to Chapter 16, “External Server Authentication” for more information. The maximum number of active Telnet or CLI sessions supported per switch is 32.

Creating and modifying a user account

When you create a user account you must specify three mandatory attributes: an account login name, a role, and a password. The remaining attributes are optional.

TABLE 5 User account attributes

Parameter	Description
name	The name of the account. The user account name is case-sensitive, must not exceed 40 characters, and must begin with a letter. The text string can contain letters, numbers, underscore (__), and periods (.). If the user name specified already exists, the **username** command modifies the existing role.
role	The role assigned to the user defines the RBAC access privileges for the account.
password	The account password must satisfy all currently enforced password rules. Refer to “Password policies” on page 189 for more information.
encryption-level	The password encryption level. You can choose to encrypt the password (7) or leave it in clear text (0). If you do not specify an encryption level, the default, clear text (0), is the default.
desc	A description of the account. The description can be up to 64 characters long, and can include any printable ASCII character, except for the following characters: single quotation marks (‘), double quotation marks (“), exclamation point (!), colon (:), and semi-colon (;). If the description contains spaces. you must enclose the text in double quotation marks.
enable true | false	Indicates whether the account is enabled or disabled. A user whose account is disabled cannot log in. The default account status is enabled.

Creating a user account

The following example creates a new user account with the minimally required attributes: name, role, and password. The account name “brcdUser” has the default user privilege of accessing commands in the privileged EXEC mode.

1. Issue the <edit-config> RPC to configure the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <username> node, include the <name>, <role>, and <user-password> leaf elements to define the user.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>brcdUser</name>
                <role>user</role>
                <user-password>welcome</user-password>
            </username>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying user account information

The user account information is saved in the switch configuration file.

To verify the user account information, issue the <get-config> RPC with a subtree filter to return information contained under the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <name>brcdUser</name>
        <user-password>San5josE</user-password>
        <role>user</role>
    </username>
    <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
```

```
            <name>brcdUser2</name>
            <user-password>Broom6fielD</user-password>
            <role>user</role>
        </username>
        <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
            <name>brcdUser3</name>
            <user-password>Esoj3naS</user-password>
            <role>user</role>
        </username>
    </rpc-reply>
```

Include the <name> element in the input under the <username> node to return information about a specific user.

To return information about only enabled users, include the <enable>TRUE</enable> element under the <username> node.

Modifying an existing user account

The RPCs for the account *create* and *modify* operations look alike. The difference is that no mandatory parameters exist for modifying an existing account. The system recognizes internally whether a new account is created or an existing account is modified by checking whether the user account is already present in the configuration database.

The following example adds a description to the previously created “brcdUser” account.

1. Issue the <edit-config> RPC to configure the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <username> node, include the following leaf elements.
    a. In the <name> element, identify the user whose account information is to be changed.
    b. In the <desc> element, provide an account description.
    c. In the <date> element, provide an expiration date for the account. The default value is “never”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>brcdUser</name>
                <desc>Brocade guest account</desc>
                <date>never</date>
            </username>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The following example changes the password for the account “testUser”. All active login sessions of a user are terminated if the user’s password or role is changed.

1. Issue the <edit-config> RPC to configure the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <username> node, include the following leaf elements.
    a. In the <name> element, identify the user whose account information is to be changed.
    b. In the <user-password> element, provide the new password.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
            <name>testUser</name>
            <user-password>hellothere</user-password>
         </username>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Disabling a user account

You can disable a user account by setting the enable parameter to “false”. All active login sessions for a user are terminated when a user account is disabled.

1. Issue the <edit-config> RPC to configure the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <username> node, include the following leaf elements.
    a. In the <name> element, identify the user whose account is to be disabled.
    b. In the <enable> element, specify “FALSE”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="804" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
            <name>testUser</name>
            <enable>FALSE</enable>
         </username>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="804" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Deleting a user account

1. Issue the <edit-config> RPC to configure the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. In the <username> element tag, include the delete operation.
3. Under the <username> node, include the <name> element and identify the user you want to delete.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="805" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa"
             xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete">
                <name>testUser</name>
            </username>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="805" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

All active login sessions for a user are terminated when a user account is deleted.

Unlocking a user account

A user account is automatically locked by the system when the configured threshold for repeated failed login attempts has been reached. Refer to "Account lockout policy" on page 192 for more information.

To unlock a locked user account, issue the <user>/<unlock> custom action located in the urn:brocade.com:mgmt:brocade-aaa namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="806">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <user xmlns="urn:brocade.com:mgmt:brocade-ras">
                <unlock>
                    <username>testUser</username>
                </unlock>
            </user>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="806">
    <data>
        <user xmlns="urn:brocade.com:mgmt:brocade-ras">
            <unlock>
                <Result>Success</Result>
            </unlock>
        </user>
```

```
</data>
</rpc-reply>
```

Configuring a user alias

The global alias is accessible across all users. The user-level alias is accessible only when the respective user logs in.

1. Issue the <edit-config> RPC to configure the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <alias-config> node, include the <alias>, <expansion>, and <user> leaf elements to define the alias configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <alias-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <alias>redwood</alias>
                <expansion>engineering</alias>
                <user>john smith</user>
                <expansion>manager</alias>
            </alias-config>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Role-based access control

Network OS uses role-based access control (RBAC) as the authorization mechanism. You can create roles dynamically and associate them with rules to define the permissions applicable to a particular role. Every user account must be associated with a role and only a single role can be associated with any given account.

RBAC specifies access rights to resources. When a user executes a command, privileges are evaluated to determine access to the command based on the role of the user.

In Logical chassis cluster mode, the configuration is applied to all nodes in the cluster.

Default roles

All Brocade VDX switches support two default roles, “user” and “admin.” You cannot modify the attributes of default roles; however, you can assign the default roles to non-default user accounts. The default roles have the following access privileges:

- The user role has limited privileges that are mostly restricted to executing show commands in the Privileged EXEC mode. User accounts associated with the user role cannot access configuration commands that are available only in global configuration mode.

- The admin role has the highest privileges. All commands available in Privileged EXEC mode and in global configuration mode are accessible to the user associated with the admin role.

With a new switch, only the admin user account has access to perform user and role management operations. The admin user can create any roles and configure those roles for access to user and role management operations.

User-defined roles

In addition to the default roles, Network OS supports the creation of user-defined roles. A user-defined role starts from a basic set of privileges which are then refined by adding special rules. When you have created a role, you can assign a name to the role and then associate the role to one or more user accounts. With NETCONF, you can perform the following operations that manage user defined roles:

- Define new roles and delete user-defined roles.
- Specify access rules for specific operations and assign these rules to a given role.
- Associate a given user-defined role with a specific user account.

A user-defined role has a mandatory name and an optional description as shown in Table 6.

TABLE 6 Role attributes

Parameter	Description
name	The role name must be unique, begin with a letter, and can contain alphanumeric characters and underscores. The length of the role name should be between 4 and 32 characters. The name cannot be same as that of an existing user, an existing default role, or an existing user-defined role.
desc	An optional description of the role. The description can be up to 64 characters and can include any printable ASCII character, except for the following characters: single quotation marks (‘), double quotation marks (“), exclamation point (!), colon (:), and semi-colon (;). If the description contains spaces, you must enclose the text in double quotation marks. if the description contains spaces.

The operation of creating a role must satisfy the following criteria to succeed:

- The maximum number of roles supported on a chassis is 64.
- The operation must be run from an account authorized for the operation.
- If the role specified already exists, the operation modifies the existing role.

Creating or modifying a role

1. Issue the <edit-config> RPC to configure the <role> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <role> node, include the <name> node element.
3. Under the <name> node, include the following leaf elements.
    a. In the <name> leaf element, specify the name of the role you are creating or modifying. The name can be up to 32 characters long.
    b. In the <desc> element, specify a description in up to 64 characters.

The following example creates a role named VLANAdmin and provides the description “Manages security.”

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="807" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <role xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>
                    <name>VLANAdmin</name>
                    <desc>Manages security</desc>
                </name>
            </role>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="807" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying a role configuration

To verify a role configuration, issue the <get-config> RPC with a subtree filter to return only the information under the <role> node in the urn:brocade.com:mgmt:brocade-aaa namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="808" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <role xmlns="urn:brocade.com:mgmt:brocade-aaa">
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="808" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <role xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <name>
            <name>VLANAdmin</name>
            <desc>Manages security</desc>
        </name>
        <name>
            <name>NetworkAdmin</name>
            <desc>Manages networks</desc>
        </name>
        <name>
            <name>ClusterAdmin</name>
            <desc>Manages clusters</desc>
        </name>
    </role>
</rpc-reply>
```

Deleting a role

To delete a role, perform the following steps.

1. Issue the <edit-config> RPC to configure the <role> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <role> node, include the <name> node element, and include the delete operation in the element tag.
3. Under the <name> node, include the <name> leaf element and specify the name of the role you want to delete.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="809" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <role xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete">
                    <name>VLANAdmin</name>
                </name>
            </role>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="809" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Command access rules

Command authorization is defined in terms of an ordered set of rules that are associated with a role. Rules define and restrict a role to access modes (*read-only* or *read-write* access), and beyond that can define permit or reject on specified command groups or individual commands. You can associate multiple rules with a given user-defined role, but you can only associate one role with any given user account.

To specify a rule, you must specify at least three mandatory attributes: a rule index number, the role to which the rule should apply, and the command that is defined by the rule. Table 7 describes the rule attribute details.

TABLE 7 Rule attributes

Parameter	Description
index	A numeric identifier of the rule in the range between 1 and 512.
role	The name of the role for which the rule is defined.
command	The command for which access is defined.

TABLE 7 Rule attributes (Continued)

Parameter	Description
operation	Optional. Defines the general access mode granted by the rule. Access can be **read-only** or **read-write** (default).
action	Optional. A modifier restricting the general access mode. The specified access is either accepted (**accept**) or rejected (**reject**). The default value is "reject".

Refer to the *Network OS Administrator's Guide* for details about how rules apply to configuration commands, operational commands, and interface key-based commands.

Configuring a placeholder rule

A rule created to allow the **no-operation** command does not enforce any authorization rules. Instead, you can use this instance as a placeholder for a valid command that is added later, as shown in the following example.

1. Issue the <edit-config> RPC to configure the <rule> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <rule> node, include the <command>/<enumList> hierarchy of node elements.
3. Under the <enumList> node, include the empty <no-operation> element to serve as a placeholder.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="810" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>75</index>
                <action>reject</action>
                <operation>read-write</operation>
                <role>NetworkAdmin</role>
                <command>
                    <enumList>no-operation</enumList>
                </command>
            </rule>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="810" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Rule processing

When a user executes a command, rules are searched in ascending order by index for a match and the action of the first matching rule is applied. If none of the rules match, command execution is blocked. If conflicting permissions exist for a role in different indices, the rule with lowest index number is applied.

The following exception applies. When a match is found for a rule with the *read-only* operation, and the *accept* action, the system seeks to determine if there are any rules with the *read-write* operation and the *accept* action. If such rules are found, the rule with the *read-write* permission is applied.

Adding a rule

When you add a rule to a role, any updates to the authorization rules will not apply to the active sessions of the users. The changes will be applied only when users log out from the current session and log in to a new session.

To add a rule, perform the following steps.

1. Issue the <edit-config> RPC to configure the <rule> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <rule> node, include the following leaf elements.
    a. In the <index> element, specify a numeric value that uniquely identifies the rule.
    b. In the <action> element, specify “accept” or “reject”.
    c. In the <operation> element, specify “read-write” or “read-only”.
    d. In the <role> element, specify the role to which you want to add the rule.
3. Under the <rule> node, include the <command> node element.
4. Under the <command> node, include elements that define the command to be applied in the rule.

The following example creates the rules that authorize the security administrator role to create and manage user accounts. After creating these rules, the user of the SecAdminUser account can log in to the switch and create or modify the user accounts with the **username** command.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="811" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>150</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>SecAdminUser</role>
                <command>
                    <enumList>config</enunList>
                </command>
            </rule>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>155</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>SecAdminUser</role>
                <command>
                    <enumList>username</enumList>
                </command>
            </rule>
        </config>
```

```
    </edit-config>
</rpc>

<rpc-reply message-id="811" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Changing a rule

Changing a rule is like adding a rule, only the rule already exists. The following example changes the previously created rule (index number 155).

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="812" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>155</index>
                <command>
                    <enumList>role</enumList>
                </command>
            </rule>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="812" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

After changing the rule 155, SecAdminUser can log in to the switch and execute the **role** command and not the **username** command.

Deleting a rule

To delete a rule, perform the following steps.

1. Issue the <edit-config> RPC to configure the <rule> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. In the <rule> node element tag, include the delete operation.
3. Under the <rule> node, include the <index> element and specify the rule you want to delete.

The following example deletes rule 155. After you delete rule 155, the SecAdminUser can no longer access the **role** command.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="813" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa"
             xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete">
```

```
            <index>155</index>
          </rule>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="813" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying a rule

Issue the <get-config> RPC with a subtree filter to return information under the <rule> node in the urn:brocade.com:mgmt:brocade-aaa namespace. Include lower-level elements to further filter the output; for example, include the <index> node to return information about a specific rule.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="814" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="814" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <index>30</index>
        <action>accept</action>
        <operation>read-write</operation>
        <role>NetworkSecurityAdmin</role>
        <command>
            <enumList>role</enumList>
        </command>
    </rule>
    <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <index>31</index>
        <action>accept</action>
        <operation>read-write</operation>
        <role>NetworkSecurityAdmin</role>
        <command>
            <enumList>rule</enumList>
        </command>
    </rule>
    <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <index>32</index>
        <action>accept</action>
        <operation>read-write</operation>
        <role>NetworkSecurityAdmin</role>
        <commsand>
            <enumList>username</enumList>
        </command>
    </rule>
</rpc-reply>
```

Configuration examples

The following configuration examples illustrate the step-by-step configuration of two frequently used administrative accounts: Brocade VCS Fabric security administrator, and FCoE Fabric administrator.

Configuring a Brocade VCS Fabric security administrator account

The following example create a role for a Brocade VCS Fabric security administrator, creates a user account and associates it with the newly created role, and creates rules to specify the RBAC permissions for the NetworkSecurityAdmin role.

This example grants the secAdminUser account access to the configuration-level commands **role**, **rule**, **username**, **aaa**, and **radius-server**. Any account associated with the NetworkSecurityAdmin role can now create and modify user accounts, manage roles, and define rules. In addition, the role permits configuring a RADIUS server and setting the login sequence.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="815" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <role xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>
                    <name>NetworkSecurityAdmin</name>
                    <desc>Manages security</desc>
                </name>
            </role>
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>secAdminUser</name>
                <role>NetworkSecurityAdmin</role>
                <user-password>testpassword</user-password>
            </username>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>30</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>NetworkSecurityAdmin</role>
                <command>
                    <enumList>role</enumList>
                </command>
            </rule>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>31</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>NetworkSecurityAdmin</role>
                <command>
                    <enumList>rule</enumList>
                </command>
            </rule>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>32</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>NetworkSecurityAdmin</role>
```

```
                <command>
                    <enumList>username</enumList>
                </command>
            </rule>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>33</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>NetworkSecurityAdmin</role>
                <command>
                    <enumList>aaa</enumList>
                </command>
            </rule>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>34</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>NetworkSecurityAdmin</role>
                <command>
                    <enumList>radius-server</enumList>
                </command>
            </rule>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>35</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>NetworkSecurityAdmin</role>
                <command>
                    <enumList>configure</enumList>
                </command>
            </rule>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="815" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring a Brocade FCoE administrator account

The following example creates an FCOEAdmUser account that is associated with the FCoEAdmin role. It creates the access permissions rules that allow the user to perform FCoE operations.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="816" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <role xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>
                    <name>FCoEAdmin</name>
                    <desc>Manages FCoE</desc>
                </name>
            </role>
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>FCoEAdmUser</name>
```

```
                <role>FCoEAdmin</role>
                <user-password>testpassword</user-password>
            </username>
            <rule xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <index>40</index>
                <action>accept</action>
                <operation>read-write</operation>
                <role>FCoEAdmin</role>
                <command>
                    <interface-fcoe>
                        <interface>
                            <fcoe/>
                        </interface>
                    </interface-fcoe>
                </command>
            </rule>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="816" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Password policies

Password policies define and enforce a set of rules that make passwords more secure by subjecting all new passwords to global restrictions. The password policies described in this section apply to the switch-local user database only. Configured password policies (and all user account attribute and password state information) are synchronized across management modules and remain unchanged after an HA failover.

In Logical chassis cluster mode, the configuration is applied to all the nodes in the cluster.

The following is a list of the configurable password policies:

- Password strength policy
- Password encryption policy
- Account lockout policy

Password strength policy

Table 8 lists configurable password policy parameters.

TABLE 8 Password policy parameters

Parameter	Description
character-restriction lower	Specifies the minimum number of lowercase alphabetic characters that must occur in the password. The maximum value must be less than or equal to the minimum length value. The default value is zero, which means there is no restriction of lowercase characters.
character-restriction upper	Specifies the minimum number of uppercase alphabetic characters that must occur in the password. The maximum value must be less than or equal to the Minimum Length value. The default value is zero, which means there is no restriction of uppercase characters.

TABLE 8 Password policy parameters (Continued)

Parameter	Description
character-restriction numeric	Specifies the minimum number of numeric characters that must occur in the password. The maximum value must be less than or equal to the Minimum Length value. The default value is zero, which means there is no restriction of numeric characters.
character-restriction special-char	Specifies the minimum number of punctuation characters that must occur in the password. All printable, non-alphanumeric punctuation characters except the colon (:) are allowed. The value must be less than or equal to the Minimum Length value. The default value is zero, which means there is no restriction of punctuation characters. Characters added after an exclamation point are dropped. For example, if you use the password “first!second”, the password will become “first!” Special characters, such as backslash (\) and question mark (?), are not counted as characters in a password unless the password is specified within quotes.
min-length	Specifies the minimum length of the password. Passwords must be from 8 through 32 characters in length. The default value is 8. The total of the previous four parameters (lowercase, uppercase, digits, and punctuation) must be less than or equal to the Minimum Length value.
max-retry	Specifies the number of failed password logins permitted before a user is locked out. The lockout threshold can range from 0 through 16. The default value is 0. When a password fails more than one of the strength attributes, an error is reported for only one of the attributes at a time.

NOTE
Passwords can be a maximum of 40 characters in length.

Password encryption policy

Network OS supports encrypting the passwords of all existing user accounts by enabling password encryption at the switch level. By default, the encryption service is disabled and passwords are stored in clear-text.

When you enable password encryption, all existing clear-text passwords will be encrypted, and any passwords that are added subsequently in clear-text will be stored in encrypted format

In the following example, the testuser account password is created in clear-text after password encryption has been enabled. The global encryption policy overrides the account-level encryption settings. The password is stored as encrypted.

1. Issue the <edit-config> RPC to configure the <service> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <service> node, include the empty <password-encryption> element to enforce password encryption.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="817" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <service xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <password-encryption/>
            </service>
```

```
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="817" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. To verify the enforcement of password encryption, issue the <edit-config> RPC with a subtree filter to return information under the <service> node in the urn:brocade.com:mgmt:brocade-aaa namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="818" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <service xmlns="urn:brocade.com:mgmt:brocade-aaa">
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="818" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <service xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <password-encryption/>
    </service>
</rpc-reply>
```

4. Issue the <edit-config> RPC to create the user account with a password.

   In this case, the <encryption-level> element specifies to save the password as clear text (encryption-level = 0).

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="819" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <name>testuser</name>
                <role>testrole</role>
                <desc>Test User</desc>
                <encryption-level>0</encryption-level>
                <user-password>Test User</user-password>
            </username>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="819" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. To verify the form in which the password is stored, issue the <get-config> RPC with a subtree filter to retrieve the information under the <username> node in the urn:brocade.com:mgmt:brocade-aaa namespace.

The output shows the password stored in encrypted form because the switch-level encryption level overrides the account level.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="820" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <username xmlns="urn:brocade.com:mgmt:brocade-aaa"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="820" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <username xmlns="urn:brocade.com:mgmt:brocade-aaa"/>
        <name>testuser</testuser>
        <user-password>cONW1RQ0nTV9Az42/9uCQg==\n</user-password>
        <encryption-level>7</encryption-level>
        <role>userrole</role>
        <desc>Test User</desc>
    </username>
</rpc-reply>
```

When you disable the password encryption service, any new passwords added in clear-text will be stored as clear-text on the switch. Existing encrypted passwords remain encrypted.

Account lockout policy

The account lockout policy disables a user account when the user exceeds a configurable number of failed login attempts. A user whose account has been locked cannot log in. SSH login attempts using locked user credentials are denied without notifying the user of the reason for denial.

The account remains locked until explicit administrative action is taken to unlock the account. A user account cannot be locked manually. An account not locked cannot be unlocked.

Failed login attempts are tracked on the local switch only. in VCS mode, the user account is locked only on the switch where the lockout occurred; the same user can still try to log in on another switch in the VCS Fabric.

The account lockout policy is enforced across all user accounts except for the root account and accounts with the admin role.

Denial of service implications

The account lockout mechanism may be used to create a denial of service condition by repeatedly attempting to log in to an account using an incorrect password. Selected privileged accounts, such as root and admin are exempted from the account lockout policy to prevent them from being locked out by a denial of service attack. However these privileged accounts may then become the target of password guessing attacks. Brocade advises that you periodically examine the Security Audit logs to determine if such attacks are attempted. For information on security audit logging, refer to the *Network OS Message Reference*.

Configuring the account lockout threshold

You can configure the lockout threshold. The lockout threshold is the number of times a user can attempt to log in with an incorrect password before the account is locked. The number of failed login attempts is counted from the last successful login. This value can be set to a value from 0 through 16. A value of 0 disables the lockout mechanism (default).

1. Issue the <edit-config> RPC to configure the <password-attributes> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <password-attributes> node, include the <max-retry> element and set its value to the lockout threshold.

The following example sets the lockout threshold to 4.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="821" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <password-attributes xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <max-retry>4</max-retry>
            </password-attributes>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="821" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

When a user account is locked, it can be unlocked using the procedure described in "Unlocking a user account" on page 178.

Password interaction with remote AAA servers

The password policies apply to local switch authentication only. External AAA servers such as RADIUS, TACACS+, or LDAP provide server-specific password-enforcement mechanisms. The Network OS password management commands operate on the switch-local password database only, even when the switch is configured to use an external AAA service for authentication. When so configured, authentication through remote servers is applied to login only.

When remote AAA server authentication is enabled, an administrator can still perform user and password management functions on the local password database.

For more information on remote AAA server authentication, refer to Chapter 16, "External Server Authentication".

Managing password policies

Configure the <password-attributes> node in the urn:brocade.com:mgmt:brocade-aaa namespace to define or modify existing password policies.

Creating a password policy

The following example defines a password policy that places restrictions on minimum length and enforces character restrictions and account lockout.

1. Issue the <edit-config> RPC to configure the <password-attributes> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <password-attributes> node, provide the elements that define the policy.

The following example defines a password policy that requires passwords to be at least eight characters long, contain at least two lowercase characters, at least one uppercase character, at least one numeric character, and at least one special character. The policy also enforces lockout after four attempts to enter the password. The <admin-lockout-enable> node enables the lockout policy for admin role accounts.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="822" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <password-attributes xmlns="urn:brocade.com:mgmt:brocade-aaa">
            <min-length>8</min-length>
            <max-retry>4</max-retry>
            <character-retriction>
               <lower>2</lower>
               <upper>1</upper>
               <numeric>1</numeric>
               <special-char>1</special-char>
               </admin-lockout-enable>
            </character-restriction>
         </password-attributes>
      </config>
   </edit-config>
</rpc>
```

```
<rpc-reply message-id="822" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Displaying password attributes

To retrieve the current password policy, issue the <edit-config> RPC with a subtree filter to return only information under the <password-attributes> node in the urn:brocade.com:mgmt:brocade-aaa namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="823" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <password-attributes xmlns="urn:brocade.com:mgmt:brocade-aaa"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="823" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <password-attributes xmlns="urn:brocade.com:mgmt:brocade-aaa"/>
        <max-retry>4</max-retry>
        <character-restriction>
            <upper>1</upper>
            <lower>2</lower>
            <numberic>1</numeric>
            <shpecial-char>1</special-char>
        </character-restriction>
    </password-attributes>
</rpc-reply>
```

Restoring the default password policy

To reset all password attributes to default values, perform the following steps.

1. Issue the <edit-config> RPC to configure the <password-attributes> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. In the <password-attributes> element tag, include the delete operation.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="824" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <password-attributes xmlns="urn:brocade.com:mgmt:brocade-aaa"
             xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete"/>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="824" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To restore the default value of just one password attribute, perform the same operation, but include the attribute element under the <password-attributes> node and apply the delete operation to that element instead of to the entire <password-attributes> node. All other password attributes remain unchanged.

Security event logging

Security event logging utilizes the RASlog audit infrastructure to record security-related audit events. Any user-initiated security event generates an auditable event. Audited events are generated for all Management interfaces. In Brocade VCS Fabric mode, for cluster-wide events, the audit is generated on all switches of the cluster. Refer to the *Network OS Message Reference* for information on how to configure and monitor security audit logging.

Chapter

External Server Authentication 16

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Remote server authentication with NETCONF overview

This chapter provides procedures for configuring external AAA servers using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of remote authentication server concepts, including the supported authentication modes:
  - Terminal Access Controller Access Control System Plus (TACACS+)
  - Remote Authentication Dial In User Service (RADIUS)
  - Lightweight Directory Access Protocol (LDAP)
  - Local
- Procedures for configuring remote authentication using the Network OS command line interface (CLI)
- Procedures for configuring server-side RADIUS

Through the NETCONF interface, you can perform the following operations on LDAP:

- Use the <edit-config> RPC to connect to or disconnect from a authentication server, or configure client-side TACACS+, RADIUS, or LDAP parameters.
- Use the <get-config> RPC to validate configuration settings.
- Use the <ldapca> action located in the urn:mgmt:brocade.com:mgmt:brocade-certutil namespace to import or delete an LDAP CA certificate.

Parameters for configure remote authentication are defined in the brocade-aaa YANG module. Refer to the *Network OS YANG Reference Manual* for details.

Login authentication mode

Using the NETCONF interfaces, you can configure primary and secondary authentication modes. The primary mode can be RADIUS, TACACS+, LDAP, or local. The secondary mode is optional and can only be local, and then only if the primary mode is RADIUS, TACACS+, or LDAP.

Setting and verifying the login authentication mode

To configure and verify the login authentication mode, perform the following steps.

1. Issue the <edit-config> RPC to configure the <aaa-config> node in the urn:brocade.com:mgmt:brocade-aaa workspace.
2. Under the <aaa-config> node, include the <aaa>/<authentication>/<login> hierarchy of node elements.
3. Under the <login> node, include the following leaf elements:
   a. In the <first> element, specify “radius”, “tacacs+”, “ldap” or “local” to identify the primary login authentication mode.
   b. Optional: In the <second> element, specify “local” as the secondary authentication mode.

   NOTE
   “local” is the only valid secondary authentication mode and can be used only if the primary mode is radius, tacacs+, or ldap.

   The following example configures TACACS+ as the primary source of authentication and the local user database as the secondary source.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="900" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <authentication>
                        <login>
                            <first>tacacs+</first>
                            <second>local</second>
                        </login>
                    </authentication>
                </aaa>
            </aaa-config>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="900" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. To verify the configuration, issue the <get-config> RPC with a subtree filter to limit the returned information to the contents of the <aaa-config>/<aaa>/<authentication> node.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="901" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <authentication/>
                </aaa>
            </aaa-config>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="901" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <aaa>
            <authentication>
                <login>
                    <first>tacacs+</first>
                    <second>local</second>
                </login>
            </authentication>
        </aaa>
    </aaa-config>
</rpc>
```

5. Log in to the switch using an account with TACACS+ only credentials to verify that TACACS+ is being used to authenticate the user.

Resetting the login authentication mode

When you reset the login authentication mode, primary authentication reverts to local mode, which is the default mode.

1. Issue the <edit-config> RPC to configure the <aaa-config> node in the urn:brocade.com:mgmt:brocade-aaa workspace.
2. Under the <aaa-config> node, include the <aaa>/<authentication>/<login> hierarchy of node elements.
3. In the <login> element tag, include the delete operation.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="902" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <authentication>
                        <login
                         xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    </authentication>
```

```
            </aaa>
        </aaa-config>
    </config>
</edit-config>
</rpc>


<rpc-reply message-id="902" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. To verify the configuration, issue the <get-config> RPC with a subtree filter to limit the returned information to the contents of the <aaa-config>/<aaa>/<authentication> node.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="903" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <authentication/>
                </aaa>
            </aaa-config>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="903" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <aaa>
            <authentication>
                <login>
                    <first>local</first>
                </login>
            </authentication>
        </aaa>
    </aaa-config>
</rpc>
```

5. Log in to the switch using an account with TACACS+ only credentials. The login should fail with an “access denied” error.
6. Log in to the switch using an account with local only credentials. The login should succeed.

Changing the login authentication mode

To change the authentication mode, you must first reset the configuration to the default local mode, and then set the authentication mode as desired. The following example resets the existing TACACS+ mode to local mode and then sets the authentication mode to RADIUS.

1. Reset the configuration to the default value.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="904" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <authentication>
                        <login
                         xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    </authentication>
                </aaa>
            </aaa-config>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="904" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Specify the desired authentication mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="905" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <authentication>
                        <login>
                            <first>radius</first>
                            <second>local</second>
                        </login>
                    </authentication>
                </aaa>
            </aaa-config>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="905" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Verify the configuration with the <get-config> RPC.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="906" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <authentication/>
```

```
                </aaa>
            </aaa-config>
        </filter>
    </get-config>
</rpc>


<rpc-reply message-id="906" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <aaa>
            <authentication>
                <login>
                    <first>radius</first>
                    <second>local</second>
                </login>
            </authentication>
        </aaa>
    </aaa-config>
</rpc>
```

4. Log in to the switch using an account with TACACS+ credentials. The login should fail with an “access denied” error.
5. Log in to the switch using an account with RADIUS credentials. The login should succeed.

RADIUS

The RADIUS protocol manages authentication, authorization, and accounting (AAA) services centrally. The supported management access channels that integrate with RADIUS are serial port, Telnet, and SSH.

This section provides procedures and examples for client side configuration with RADIUS servers using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of authentication, accounting, and authorization with RADIUS servers
- Server-side RADIUS configuration

Each Brocade switch client must be individually configured to use RADIUS servers. You use the NETCONF interface to specify the server IP address, authentication protocols, and other parameters. You can configure a maximum of five RADIUS servers on a Brocade switch for AAA service.

The parameters in Table 9 are associated with a RADIUS server that is configured on the switch.

TABLE 9 RADIUS server parameters

Parameter	Description
hostname	IP address (IPv4 or IPv6) or host name of the RADIUS server. Host name requires prior DNS configuration.
auth-port	The User Datagram Protocol (UDP) port used to connect the RADIUS server for authentication. The port range is 0 through 65535. The default port is 1812.
protocol	The authentication protocol to be used. Options include CHAP, PAP, and PEAP. The default protocol is CHAP. IPv6 hosts are not supported if PEAP is the configured protocol.

TABLE 9 RADIUS server parameters (Continued)

Parameter	Description
key	The shared secret between the switch and the RADIUS server. The default value is “sharedsecret.” The key cannot contain spaces and must be from 8 through 40 characters in length. Empty keys are not supported.
retries	The number of attempts permitted to connect to a RADIUS server. The range is 0 through 100. The default value is 5.
timeout	The wait time in seconds for the RADIUS server to respond. The default is 5 seconds. the range is 1 through 60.

NOTE
If you do not configure the *key* attribute, the authentication session will not be encrypted. The value of the *key* attribute must match the value configured in the RADIUS configuration file; otherwise, the communication between the server and the switch fails.

Adding a RADIUS server to the client’s server list

You must configure the Domain Name System (DNS) server on the switch prior to adding the RADIUS server with a domain name or a host name. Without the DNS server, name resolution of the RADIUS server fails and therefore the add operation fails.

NOTE
When a list of servers is configured on the switch, failover from one server to another server happens only if a RADIUS server fails to respond; it does not happen when user authentication fails.

To add a RADIUS server to the client server list, perform the following steps.

1. Issue the <edit-config> RPC to configure the <radius-server> node in the urn:brocade.com:mgmt:brocade-aaa workspace.
2. Under the <radius-server> node, include the <host> node element.
3. Under the <host> node, include the <name> element, and leaf elements that define the parameters you want to set.

   The following example configures hostname 10.38.37.130 and sets the protocol, key, and timeout values.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="907" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <host-name>10.38.37.180</host-name>
                    <protocol>pap</protocol>
                    <key>new#virgo*secret</key>
                    <timeout>10</timeout>
                </host>
            </radius-server>
        </config>
    </edit-config>
```

```
</rpc>

<rpc-reply message-id="907" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. To validate the new configuration, issue the <get-config> RPC with a subtree filter to limit the returned information to RADIUS server 10.38.37.130.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="908" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>10.38.37.180</hostname>
                </host>
            </radius-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="908" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <host>
            <hostname>10.38.37.180</hostname>
            <auth-port>1812</auth-port>
            <protocol>pap</protocol>
            <key>new#virgo*secret</key>
            <retries>5</retries>
            <timeout>10</timeout>
        </host>
    </radius-server>
</rpc>
```

Modifying the RADIUS server configuration

To modify the RADIUS server configuration on the client, perform the following steps.

1. Determine the configured RADIUS servers by Issuing the <get-config> RPC with a subtree filter to return only information about configured RADIUS servers.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="909" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host/>
            </radius-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="909" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <host>
            <hostname>10.38.37.180</hostname>
            <auth-port>1812</auth-port>
            <protocol>pap</protocol>
            <key>new#virgo*secret</key>
            <retries>5</retries>
            <timeout>10</timeout>
        </host>
        <host>
            <hostname>10.24.65.6</hostname>
            <auth-port>1812</auth-port>
            <protocol>pap</protocol>
            <key>changedesc</key>
            <retries>5</retries>
            <timeout>3</timeout>
        </host>
    </radius-server>
</rpc>
```

2. Issue the <edit-config> RPC to change the configuration of the RADIUS server.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="910" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <host-name>10.38.37.180</host-name>
                    <auth-port>1812</auth-port>
                    <key>changedesc</key>
                    <retries>5</retries>
                    <timeout>3</timeout>
                </host>
            </radius-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="910" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Re-issue the <get-config> RPC with a subtree filter to restrict the output to the modified RADIUS server and verify the configuration change.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="911" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>10.38.37.180</hostname>
                </host>
```

```
            </radius-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="911" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <host>
            <hostname>10.38.37.180</hostname>
            <auth-port>1812</auth-port>
            <protocol>pap</protocol>
            <key>changedesc</key>
            <retries>5</retries>
            <timeout>3</timeout>
        </host>
    </radius-server>
</rpc>
```

Removing a RADIUS server from a client's server list

To remove a RADIUS server from a client's server list, follow these steps.

1. Issue the <edit-config> RPC to configure the <radius-server> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <radius-server> node, include the <host> node element, and include the delete operation in the element tag.
3. Under the <host> node, include the <name> element and specify the domain name, IP address, or IPv6 address of the RADIUS server you want to remove.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="912" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete">
                    <host-name>10.38.37.180</host-name>
                </host>
            </radius-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="912" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the client to use RADIUS for login authentication

After configuring the client-side RADIUS server list, you must set the authentication mode so that RADIUS is used as the primary source of authentication. Refer to "Login authentication mode" on page 198 for information on how to configure the login authentication mode.

TACACS+

TACACS+ is an AAA server protocol that uses a centralized authentication server and multiple Network Access Servers or clients. With TACACS+ support, management of Brocade switches seamlessly integrates into these environments. Once configured to use TACACS+, a Brocade switch becomes a Network Access Server (NAS).

This section provides procedures and examples for client-side configuration for TACACS+ servers. For additional conceptual details about TACACS+ servers, and about server-side configuration, refer to the *Network OS Administrator's Guide*.

Each Brocade switch client must be configured individually to use TACACS+ servers. You can use the NETCONF interface to specify the server IP address, authentication protocols, and other parameters. You can configure a maximum of five TACACS+ servers on a Brocade switch for AAA service.

The parameters in Table 10 are associated with a TACACS+ server that is configured on the switch.

TABLE 10 TACACS+ server parameters

Parameter	Description
hostname	IP address (IPv4 or IPv6) or domain/host name of the TACACS+ server. Host name requires prior DNS configuration.
port	The TCP port used to connect the TACACS+ server for authentication. The port range is 1 through 65535. The default port is 49.
protocol	The authentication protocol to be used. Options include CHAP and PAP. The default protocol is CHAP.
key	The shared secret between the switch and the RADIUS server. The default value is "sharedsecret." The key cannot contain spaces and must be from 8 through 40 characters in length. Empty keys are not supported.
retries	The number of attempts permitted to connect to a RADIUS server. The range is 0 through 100. The default value is 5.
timeout	The maximum amount of time to wait for a server to respond. Options are from 1 through 60 seconds. The default value is 5 seconds.

NOTE
If you do not configure the *key* attribute, the authentication session will not be encrypted. The value of *key* must match with the value configured in the TACACS+ configuration file; otherwise, the communication between the server and the switch fails.

Adding a TACACS+ server to the client's server list

You must configure the Domain Name System (DNS) server on the switch prior to adding the TACACS+ server with a domain name or a host name. Without the DNS server, name resolution of the TACACS+ server fails and therefore the add operation fails. To configure the DNS server, edit the <dns> node in the urn:brocade.com:mgmt:brocade-ip-administration namespace.

NOTE
When a list of servers is configured, failover from one server to another server happens only if a TACACS+ server fails to respond; it does not happen when user authentication fails.

To add a TACACS+ server to the client's server list, perform the following steps.

1. Issue the <edit-config> RPC to configure the <tacacs-server> node in the urn:brocade.com:mgmt:brocade-aaa workspace.
2. Under the <tacacs-server> node, include the <host> node element.
3. Under the <host> node, include the <name> element, and leaf elements that define the parameters you want to set.

   The following example adds a TACACS+ server with an IPv6 address and sets the protocol and key values.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>fec0:60:69bc:94:211:25ff:fec4:6010</hostname>
                    <protocol>chap</protocol>
                    <key>new#hercules*secret</key>
                </host>
            </tacacs-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Issue the <get-config> RPC with a subtree filter to limit the output to information about the TACACS+ server to verify the configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="914" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>fec0:60:69bc:94:211:25ff:fec4:6010</hostname>
                </host>
            </tacacs-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="914" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <host>
            <hostname>fec0:60:69bc:94:211:25ff:fec4:6010</hostname>
            <port>49</port>
            <protocol>chap</protocol>
            <key>new#hercules*secret</key>
            <retries>5</retries>
```

```
            <timeout>5</timeout>
        </host>
    </tacacs-server>
</rpc>
```

Modifying the TACACS+ server configuration

To modify the TACACS+ configuration, perform the following steps.

1. Issue the <get-config> RPC with a subtree filter to return only information about configured TACACS+ servers.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="915" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host/>
            </tacacs-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="915" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <host>
            <hostname>fec0:60:69bc:94:211:25ff:fec4:6010</hostname>
            <port>49</port>
            <protocol>chap</protocol>
            <key>new#hercules*secret</key>
            <retries>5</retries>
            <timeout>5</timeout>
        </host>
    </tacacs-server>
</rpc>
```

2. Issue the <edit-config> RPC to change the configuration of the TACACS+ server.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="916" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>fec0:60:69bc:94:211:25ff:fec4:6010</hostname>
                    <key>changedesc</key>
                    <retries>100</retries>
                </host>
            </tacacs-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="916" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <ok/>
</rpc-reply>
```

3. Issue the <get-config> RPC with a subtree filter to restrict the output to the modified TACACS+ server to verify the configuration change.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="917" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>fec0:60:69bc:94:211:25ff:fec4:6010</hostname>
                </host>
            </tacacs-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="917" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <host>
            <hostname>fec0:60:69bc:94:211:25ff:fec4:6010</hostname>
            <port>49</port>
            <protocol>chap</protocol>
            <key>changedesc</key>
            <retries>100</retries>
            <timeout>5</timeout>
        </host>
    </tacacs-server>
</rpc>
```

Removing a TACACS+ server from a client's server list

To remove a TACACS+ server from a client's server list, follow these steps.

1. Issue the <edit-config> RPC to configure the <tacacs-server> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <tacacs-server> node, include the <host> node element, and include the delete operation in the element tag.
3. Under the <host> node, include the <name> element and specify the domain name, IP address, or IPv6 address of the TACACS+ server you want to remove.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="918" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <tacacs-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete">
                    <host-name>10.54.37.170</host-name>
                </host>
```

```
            </tacacs-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="918" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the client to use TACACS+ for login authentication

After configuring the client-side TACACS+ server list, you must set the authentication mode so that TACACS+ is used as the primary source of authentication. Refer to "Login authentication mode" on page 198 for information on how to configure the login authentication mode.

TACACS+ accounting

This section provides procedures and examples for configuring TACACS+ accounting on the client. For related conceptual information, limitations, information about viewing TACACS+ accounting logs, and firmware downgrade considerations, refer to the *Network OS Administrator's Guide*.

Enabling login accounting

The following procedure enables login accounting on a switch where accounting is disabled.

1. Issue the <edit-config> RPC to configure the <aaa-config> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <aaa-config> node, include the <aaa>/<accounting>/<exec>/<defaultacc>/<start-stop> hierarchy of node elements.
3. Under the <start-stop> node, include the <server-type> element and specify tacacs+ as the server type.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="919" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <accounting>
                        <exec>
                            <defaultacc>
                                <start-stop>
                                    <server-type>tacacs+</server-type>
                                </start-stop>
                            </defaultacc>
                        </exec>
                    </accounting>
                </aaa>
            </aaa-config>
        </config>
```

```
    </edit-config>
</rpc>

<rpc-reply message-id="919" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Issue the <get-config> RPC with a subtree filter to limit the output to information under the <aaa-config>/<aaa>/<accounting> node to verify the configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="920" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <accounting/>
                </aaa>
            </aaa-config>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="920" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <aaa>
            <accounting>
                <exec>
                    <defaultacc>
                        <start-stop>
                            <server-type>taccacs+</server-type>
                        </start-stop>
                    </defaultacc>
                </exec>
            </accounting>
        </aaa>
    </aaa-config>
</rpc>
```

Enabling command accounting

The following procedure enables login accounting on a switch where login accounting is enabled and command accounting is disabled.

1. Issue the <edit-config> RPC to configure the <aaa-config> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <aaa-config> node, include the <aaa>/<accounting>/<command>/<defaultacc>/<start-stop> hierarchy of node elements.
3. Under the <start-stop> node, include the <server-type> element and specify tacacs+ as the server type.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="921" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
```

```
        <target>
            <running/>
        </target>
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <accounting>
                        <commands>
                            <defaultacc>
                                <start-stop>
                                    <server-type>tacacs+</server-type>
                                </start-stop>
                            </defaultacc>
                        </commands>
                    </accounting>
                </aaa>
            </aaa-config>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="921" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Issue the <get-config> RPC with a subtree filter to limit the output to information under the <aaa-config>/<aaa>/<accounting> node to validate the configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="922" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <accounting/>
                </aaa>
            </aaa-config>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="922" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <aaa>
            <accounting>
                <commands>
                    <defaultacc>
                        <start-stop>
                            <server-type>taccacs+</server-type>
                        </start-stop>
                    </defaultacc>
                </commands>
            </accounting>
        </aaa>
    </aaa-config>
</rpc>
```

Disabling accounting

You must perform the disable operation separately for login accounting and for command accounting.

To disable command accounting, perform the following steps.

1. Issue the <edit-config> RPC to configure the <aaa-config> node in the urn:brocade.com:mgmt:brocade-aaa workspace.
2. under the <aaa-config> node, include the <aaa>/<accounting>/<commands>/<defaultacc>/<start-stop> hierarchy of node elements.
3. Under the <start-stop> node, include the <server-type> leaf element and set its value to “none” to disable command accounting.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="923" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <accounting>
                        <commands>
                            <defaultacc>
                                <start-stop>
                                    <server-type>none</server-type>
                                </start-stop>
                            </defaultacc>
                        </commands>
                    </accounting>
                </aaa>
            </aaa-config>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="923" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To disable login accounting, perform the following steps.

1. Issue the <edit-config> RPC to configure the <aaa-config> node in the urn:brocade.com:mgmt:brocade-aaa workspace.
2. Under the <aaa-config> node, include the <aaa>/<accounting>/<exec>/<defaultacc>/<start-stop> hierarchy of node elements.
3. Under the <start-stop> node, include the <server-type> leaf element and set its value to “none” to disable login accounting.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="924" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
```

```
        <config>
            <aaa-config xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <aaa>
                    <accounting>
                        <exec>
                            <defaultacc>
                                <start-stop>
                                    <server-type>none</server-type>
                                </start-stop>
                            </defaultacc>
                        </exec>
                    </accounting>
                </aaa>
            </aaa-config>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="924" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

LDAP

Lightweight Directory Access Protocol (LDAP) is an open-source protocol for accessing distributed directory services that act in accordance with X.500 data and service models. LDAP assumes that one or more servers jointly provide access to a Directory Information Tree (DIT) where data is stored and organized as entries in a hierarchical fashion. Each entry has a name called the distinguished name that uniquely identifies it.

This section provides procedures and examples for client-side configuration of the Lightweight Directory Access Protocol (LDAP). For a conceptual overview of how LDAP authenticates users, and performs server authorization, and for server-side configuration information, refer to the *Network OS Administrator's Guide*.

Server authentication

As a part of user authentication using LDAP, the Brocade switch can be configured to support server certificate authentication. Refer to the *Network OS Administrator's Guide* for additional conceptual details.

Importing a CA certificate

To import a CA certificate, perform the following steps.

1. Issue the <ldapca> action located in the <certutil>/<import> node in the urn:brocade.com:mgmt:brocade-certutil namespace.
2. Under the <ldapca> node, include the following leaf elements to specify the input parameters.
    a. In the <protocol> element, specify either SCP or FTP to identify the protocol to be used for importing the certificate.
    b. In the <user> element, enter the login user name for the remote server where the certificate resides.

c. In the <password> element, enter the password.

d. In the <host> element, enter the IPv4 address of the remote host.

e. In the <directory> element, specify the path to the directory that contains the certificate file on the remote host.

f. In the <file> element, specify the certificate filename.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="925">
   <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
       <data>
           <certutil xmlns="urn:brocade.com:mgmt:brocade-certutil">
               <import>
                   <ldapca>
                       <protocol>SCP</protocol>
                       <user>jane</user>
                       <password>janepasswd</password>
                       <host>10.23.24.56</host>
                       <directory>/usr/ldapcacert</directory>
                       <file>cacert.pam</file>
                   </ldapca>
               </import>
           </certutil>
       </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="925">
    <ok/>
</rpc-reply>
```

Deleting CA certificates

This operation deletes the CA certificates of all the Active Directory (AD) servers.

To delete the CA certificate, issue the <ldapca> action located in the <no>/<certutil> node, where the <no> element resides in the urn:brocade.com:mgmt:brocade-common-def namespace and the <certutil> node resides in the urn:brocade.com:mgmt:brocade-certutil namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="926">
   <action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
       <data>
           <no xmlns="urn:brocade.com:mgmt:brocade-common-def">
               <certutil xmlns="urn:brocade.com:mgmt:brocade-certutil">
                   <ldapca/>
               </certutil>
           </no>
       </data>
    </action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="926">
    <ok/>
</rpc-reply>
```

FIPS compliance

To support FIPS compliance, the CA certificate of the AD server's certificate should be installed on the switch, and the FIPS-compliant TLS ciphers for LDAP should be used.

Client-side Active Directory server configuration

Each Brocade switch client must be individually configured to use AD servers. You can use the NETCONF interfaces to specify the host server, authentication protocols, and other parameters. You can configure a maximum of five AD servers on a Brocade switch for AAA service.

The parameters in Table 11 are associated with an AD server that is configured on the switch.

TABLE 11 AD parameters

Parameter	Description
hostname	IP address (v4) or Fully Qualified Domain name of the AD server. IPv6 is supported for Windows 2008 AD server only.
port	TCP port used to connect the AD server for authentication. The valid port range is 1024 through 65535. The default port is 389.
timeout	Time to wait for a server to respond. The range is 1 through 60 seconds. The default value is 5 seconds.
retries	Number of unsuccessful attempts to be made to connect to an AD server before quitting. The valid range is 1 through 100. The default value is 5.
basedn	Base domain name.

A maximum of five LDAP/AD servers can be configured on a Brocade switch for authentication service.

Adding an LDAP server to the client's server list

This procedure connects the host to the LDAP server, and configures the access attributes.

To add an LDAP server and configure access attributes, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ldap-server> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <ldap-server> node, include the <host> node.
3. Under the <host> node, include the following leaf elements.
   a. In the <hostname> element, specify the LDAP host by its IP address.
   b. In the <basedn> element, specify the base domain name.
   c. *Optional*: In the <port> element, specify the UDP port number (default 389).
   d. *Optional*: In the <timeout> element, specify the amount of time on seconds to wait for the server to respond.
   e. *Optional*: In the <retries> element, specify the number of retries for this server connection.

   The following example configures host 10.23.65.6 as the LDAP server and configures the access attributes.

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<rpc message-id="927" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ldap-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>10.24.65.6</hostname>
                    <basedn>security.brocade.com</basedn>
                    <port>3890</port>
                    <timeout>8</timeout>
                    <retries>3</retries>
                </host>
            </ldap-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="927" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Confirm the LDAP settings by issuing a <get-config> RPC with a subtree filter to return configuration information for the LDAP server.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="928" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <ldap-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>10.24.65.6</hostname>
                </host>
            </ldap-server>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="928" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ldap-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
        <host>
            <hostname>10.24.65.6</hostname>
            <port>3890</port>
            <retries>3</retries>
            <timeout>8</timeout>
            <basedn>security.brocade.com</basedn>
        </host>
    </ldap-server>
</rpc>
```

5. *Optional*: Use the delete operation on an attribute element to set the attribute back to the default value.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="929" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <ldap-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>10.24.65.6</hostname>
                    <retries xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </host>
            </ldap-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="929" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Removing an LDAP server

To delete a connection to an LDAP server, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ldap-server> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <ldap-server> node, include the <host> node, and include the delete operation in the element tag.
3. Under the <host> node, include the <hostname> element, and specify the LDAP host you want to delete.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="930" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ldap-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete">
                    <hostname>10.24.65.6</hostname>
                </host>
            </ldap-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="930" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Active Directory groups

An Active Directory group defines access permissions for the LDAP server similar to Brocade roles.

Mapping an Active Directory group to a switch role

A maximum of 16 AD groups can be mapped to the switch roles.

To map an Active Directory (AD) group to a switch role, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ldap-server> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <ldap-server> node, include the <maprole>/<group> hierarchy of node elements.
3. Under the <group> node, include the following leaf elements.
    a. In the <ad-group> element, use a character string to specify the AD group you want to map to a switch role.
    b. In the <switch-role> element, specify the switch role to which you want to apply the AD group.

In the following example, a Brocade user with the admin role inherits all privileges associated with the Active Directory Administrator group.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="931" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ldap-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <maprole>
                    <group>
                        <ad-group>Administrator</ad-group>
                        <switch-role>admin</switch-role>
                    </group>
                </maprole>
            </ldap-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="931" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Removing the mapping of an Active Directory to a switch role

To remove an AD group mapping from a switch role, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ldap-server> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <ldap-server> node, include the <maprole>/<group> hierarchy of node elements.
3. Under the <group> node, include the following leaf elements.
4. In the <ad-group> element, specify the AD group you want to unmap and include the delete operation in the element tag.

The following example removes the mapping between the Brocade admin role and the Active Directory Administrator group. A Brocade user with the admin role can no longer perform the operations associated with the Active Directory Administrator group.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="932" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ldap-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <maprole>
                    <group>
                        <ad-group xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete">Administrator</ad-group>
                    </group>
                </maprole>
            </ldap-server>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="932" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the client to use LDAP/AD for login authentication

After configuring the switch LDAP server list, you must set the authentication mode so that LDAP is used as the primary source of authentication. Refer to "Login authentication mode" on page 198 for information on how to configure the login authentication mode.

16 LDAP

Chapter

17

Fabric Authentication

In this chapter

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- Device authentication configuration 224
- Switch Connection Control policy configuration 228

Fabric authentication with NETCONF overview

When you connect a Brocade VCS Fabric to a Fabric OS fabric, the Network OS Fibre Channel E_Ports on the Brocade VDX 6730 connect through Interswitch links (ISLs) to EX_Ports on an FC router, which in turn connects to the Fabric OS network. To ensure that no unauthorized devices can access the fabric, Network OS provides support for security policies and protocols capable of authenticating Network OS devices (E_Ports) to the EX_Ports on the FC router that provides access to the SAN storage and services.

This chapter describes how to use NETCONF remote procedure calls (RPCs) to configure fabric authentication and Switch Connection Control (SCC) policies. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of the Diffie Hellman - Challenge Handshake Authentication Protocol (DH-CHAP)
- An overview of how shared secret keys are used
- A overview of authentication policy configuration including details about each possible authentication state and the transitions among them
- An overview of SCC policies, including a discussion about defined and active policy sets
- How to configure fabric authentication and SCC using the Network OS command line interface (CLI)

Through the NETCONF interface, you can perform the following fabric authentication-related operations:

- Use the <edit-config> RPC to set authentication parameters and activate the FC-AUTH protocol.
- Use the <get-config> RPC to validate configuration settings.
- Use the <fcsp>/<auth-secret>/<dhchap> custom action to configure shared DH-CHAP shared secrets.
- Use the <show>/<fcsp>/<dhchap> custom action to return the device (WWN) for which the shared secret is configured.

Through the NETCONF interface, you can perform the following SCC policy-related operations:

- Use the <edit-config> RPC to configure the SCC policy.
- Use the <secpolicy>/<activate> custom action to activate the SCC policy.
- Use the <get-config> RPC to verify SCC policy configuration settings.

FC AUTH and SCC policy parameters are defined in the brocade-fc-auth YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Device authentication configuration

Configuring a Brocade VDX 6730 switch to access a SAN fabric connected through an FC router involves the following steps.

1. Configure the matching shared secret pairs on the VDX 6730 and on the FC router.
2. Configure the authentication policy on the VDX 6730 switch (the FC router configuration is fixed).
3. Activate the authentication policy.

Setting up secret keys can quickly become an administrative challenge as your fabric size increases. As a minimum, key pairs must be installed on all connected fabric entities. However, when connections change, you must install new key pairs to accommodate these changes. If you anticipate this situation, you may install key pairs for all possible connections up front, thus enabling links to change arbitrarily while still maintaining a valid key pair for any new connection.

Configuring DH-CHAP shared secrets

To configure the DH-CHAP shared secrets, issue the <fcsp>/<auth-secret>/<dhchap> custom action, located in the urn:brocade.com:mgmt:brocade-fc-auth namespace. Provide the following information as shown in the example:

- In the <node> element, include the World Wide Name (WWN) of the peer.
- In the <peer-secret> element, specify the secret of the peer that authenticates the peer to the local switch.
- In the <local-secret> element, specify the local secret that authenticates the local switch to the peer.

NOTE
Only the following non-alphanumeric characters are valid for the secret key:
@, $, %, ^, &, *, (,), _, +, -, <, >, {, }, [,], ;, ', and :

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1400">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <auth-sercret>
                    <dhchap>
                        <node>10:00:00:05:1e:7a:c3:00</node>
                        <peer-secret>12345678</peer-secret>
                        <local-secret>87654321</local-secret>
                    </dhchap>
                </auth-secret>
            </fcsp>
        </nca:data>
    </nca:action>
</rpc>
```

```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1400">
    <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
        <auth-secret>
            <dhchap>
                <result>Shared secret is configured successfully.</result>
            </dhchap>
        </auth-secret>
    </fcsp>
</rpc-reply>
```

Returning the device WWN for which a shared secret is configured

To return the device (WWN) for which the shared secret is configured, issue the <show>/<fcsp>/<auth-secret>/<dhchap> action, where the <show> node is located in the urn:brocade.com:mgmt:brocade-common-def namespace, and the <fcsp>/<auth-secret> nodes are located in the urn:brocade.com:mgmt:brocade-fc-auth namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1401">
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                    <auth-sercret>
                        <dhchap/>
                    </auth-secret>
                </fcsp>
            </show>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1401">
    <show xmlns="urn:brocade.com:mgmt:brocade-common-def">
        <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
            <auth-secret>
                <dhchap>
                    <auth-show-secret>
                        <nodeid>10:00:00:05:1e:7a:c3:00</nodeid>
                    </auth-show-secret>
                </dhchap>
            </auth-secret>
        </fcsp>
    </show>
</rpc-reply>
```

Removing shared secrets

To remove the shared secrets, perform the following steps.

1. Issue the <no>/<fcsp>/<auth-secret>/<dhchap> action, where the <no> node is located in the urn:brocade.com:mgmt:brocade-common-def namespace, and the <fcsp> node is located in the urn:brocade.com:mgmt:brocade-fc-auth namespace.
2. Under the <dhchap> node, include the <node> element and specify the WWN of the node for which you want to remove secrets.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1402">
```

```
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <no xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                    <auth-sercret>
                        <dhchap>
                            <node>10:00:00:05:1e:7a:c3:00</node>
                        </dhchap>
                    </auth-secret>
                </fcsp>
            </show>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1402">
    <no xmlns="urn:brocade.com:mgmt:brocade-common-def">
        <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
            <auth-secret>
                <dhchap>
                    <result>Shared secret successfully removed.</result>
                </dhchap>
            </auth-secret>
        </fcsp>
    </show>
</rpc-reply>
```

Setting the authentication policy parameters

To set the authentication policy parameters, perform the following steps.

1. Issue the <edit-config> RPC to configure the <fcsp> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace.
2. Under the <fcsp> node, include the <auth> node element.
3. Under the <auth> node, include the <proto> node element.
4. Under the <proto> node, include the following leaf node elements to configure the protocol-specific configuration parameters.
    a. In the <auth-type> element, specify “dh-chap” (the only option).
    b. In the <group> element, specify a DH-group value in the range 0 through 4 or “*”.
    c. In the <hash> element, specify “md5”, “sha1”, or “all” to identify the hash type.
5. Under the <auth> node, include the <policy> node element.
6. Under the <policy> node, include the <switch> leaf element and specify the switch policy state as on, off, active, or passive.
7. Issue the <get-config> RPC with a subtree filter to return the contents of the <fcsp>/<auth> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace.

The following example configures an authentication policy auth-type DH-CHAP, a DH group of 2, and a hash type of md5. The switch policy is set to “off” until you are ready to explicitly activate the policy.

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<rpc message-id="1403" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <auth>
                    <proto>
                        <auth-type>dh-chap</auth-type>
                        <group>2</group>
                        <hash>md5</hash>
                    </proto>
                    <policy>
                        <switch>off</switch>
                    </policy>
                </auth>
            </fcsp>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1402" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Activating the authentication policy

To activate the authentication policy, set the switch policy state to “on” by performing the following steps.

1. Issue the <edit-config> RPC to configure the <fcsp> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace.
2. Under the <fcsp> node, include the <auth> node element.
3. Under the <auth> node, include the <policy> node element.
4. Under the <policy> node, include the <switch> leaf element and set the switch policy state to “on”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <fcsp xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <auth>
                    <policy>
                        <switch>on</switch>
                    </policy>
                </auth>
            </fcsp>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <ok/>
</rpc-reply>
```

5. Issue the <get-config> RPC with a subtree filter to return the contents of the <fcsp>/<auth>/<policy> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace to return and verify the switch policy state.

Switch Connection Control policy configuration

This section provides procedures to create, modify, activate, and remove a defined Switch Connection Control (SCC) policy.

Creating a defined SCC policy

The following procedure creates an SCC policy, adds members, and verifies the configuration.

1. Issue the <edit-config> RPC to configure the <secpolicy> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace.
2. Under the <secpolicy> node, include the <defined-policy>/<policies> hierarchy of node elements.
3. Under the <policies> node, include the <policy> leaf element and set its value to “SCC_POLICY”.
4. Under the <policies> node, include a <member-entry> node element for each WWN to which you want the SCC_POLICY to apply.
5. Under each <member-entry> node, include a <member> leaf element, and set its value to the WWN of the device to which you want to apply the policy.
6. To verify the configuration, issue a <get-config> RPC with a subtree filter to return only the <defined-policy> node under the <secpolicy> node of the urn:brocade.com:mgmt:brocade-fc-auth namespace.

The following example creates an SCC policy and adds 10:00:00:05:1e:00:69:00 and 22:22:22:22:22:22:22:22 as member nodes.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1405" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <secpolicy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <defined-policy>
                    <policies>
                        <policy>SCC_POLICY</policy>
                        <member-entry>
                            <member>10:00:00:05:1e:00:69:00</member>
                        </member-entry>
                        <member-entry>
                            <member>22:22:22:22:22:22:22:22</member>
                        </member-entry>
                    </policies>
                </defined-policy>
```

```
            </secpolicy>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1405" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Modifying the SCC policy

The same procedure that creates the SCC policy adds members. The defined SCC member entries are cumulative. Use the delete operation in the opening tag of the <member-entry> element to remove members from the policy.

The following example adds member 10:00:00:08:2f:00:79:00 and removes member 22:22:22:22:22:22:22:22.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1406" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <secpolicy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <defined-policy>
                    <policies>
                        <policy>SCC_POLICY</policy>
                        <member-entry>
                            <member>10:00:00:08:2f:00:79:00</member>
                        </member-entry>
                        <member-entry
                         xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete">
                            <member>22:22:22:22:22:22:22:22</member>
                        </member-entry>
                    </policies>
                </defined-policy>
            </secpolicy>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1406" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Activating the SCC policy

To activate an SCC policy and verify activation, perform the following steps.

1. Define an SCC policy as shown in section "Creating a defined SCC policy" on page 228.
2. Issue the <activate> custom action located under the <secpolicy> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1407">
```

```
    <nca:action xmlns:nca="http://tail-f.com/ns/netconf/actions/1.0">
        <nca:data>
            <secpolicy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <action>
                    <activate/>
                </action>
            </secpolicy>
        </nca:data>
    </nca:action>
</rpc>

<rpc-reply message-id="1407" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. To verify the active configuration, issue a <get-config> RPC with a subtree filter to return only the <secpolicy>/<active-policy> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1408" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <secpolicy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <active-policy>
                </active-policy>
            </secpolicy>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1408" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <secpolicy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
        <active-policy>
            <policies>
                <policy>
                <member-entry>
                    <member>10:00:00:05:1e:00:69:00</member>
                </member-entry>
                <member-entry>
                    <member>10:00:00:08:2f:00:79:00</member>
                </member-entry>
            </policies>
        </active-policy>
    </secpolicy>
</rpc-reply>
```

Removing the SCC policy

To remove the SCC policy, perform the following steps.

1. Issue the <edit-config> RPC to configure the <secpolicy> node in the urn:brocade.com:mgmt:brocade-fc-auth namespace.
2. Under the <secpolicy> node, include the <defined-policy>/<policies> hierarchy of node elements, and include the delete operation in the opening tag of the <policies> element.
3. Under the <policies> node, include the <policy> element and specify “SCC_POLICY” to identify the policy you want to remove.

The following example removes the SCC policy.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <secpolicy xmlns="urn:brocade.com:mgmt:brocade-fc-auth">
                <defined-policy>
                    <policies xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete">
                        <policy>SCC_POLICY</policy>
                    </policies>
                </defined-policy>
            </secpolicy>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Section

III

Network OS Layer 2 Switch Features

This section describes the Layer 2 features of Network OS, and includes the following chapters:

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Chapter

18

Administering Edge-Loop Detection

In this chapter

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- Configuring edge-loop detection. 235
- Edge-loop detection troubleshooting 238

Edge-loop detection overview

This chapter provides procedures for configuring edge-loop detection using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for a conceptual overview of edge-loop detection (ELD) and how ELD detects loops.

Configuring edge-loop detection

Edge-loop detection (ELD) requires configuration at the global level and at the interface level. For global level configuration, you must set the number of PDUs that the Brocade VCS Fabric cluster receives on any port before determining that a loop exists. This value is the *pdu-rx-limit*. You must also set the interval between sending PDUs, known as the *hello-interval*. The combination of pdu-rx-limit and hello-interval timer determines the time it takes for ELD to detect and break a loop.

At the interface level, you must enable ELD on each port on which you want it to run and set the port priority. You should also specify a VLAN on which ELD is enabled.

Set the pdu-rx-limit to a different number on each Brocade VCS Fabric cluster so that only one Brocade VCS Fabric cluster disables a port. We recommend setting this value in the increment of two to prevent race conditions which might disable ports on two Brocade VCS Fabric clusters that are incrementally only one apart.

Set the hello-interval to the same value on all Brocade VCS Fabric clusters for which ELD is configured, otherwise the results of edge-loop detection become unpredictable.

Optionally, set the *shutdown-time* to configure ports to be re-enabled after a specified period of time (range 0 minutes to 24 hours). A typical use for this feature is in environments in which reconfiguration is common, such as in a typical lab environment. Typical use is to allow the default value of zero, which does not allow ports to be re-enabled automatically.

NOTE

Any change to the shutdown-time takes effect only for the ports that are disabled by ELD after the configuration change. Any ports that were already disabled by ELD before the shutdown-time change continue to follow the old shutdown-time value. These ports start to follow the new shutdown-time after the currently running timer expires and ELD still detects the loop and shuts down the port again.

For each interface on which ELD runs, enable the edge-loop detection protocol to enable ELD. You must also specify the ELD-port priority.

Global-level ELD configuration variables are defined in the brocade-eld module. Interface-level ELD configuration variables are defined in the brocade-interface module. Refer to the *Network OS YANG Reference Manual* for information about these modules.

Setting global ELD for a Brocade VCS fabric cluster

Perform this procedure on every Brocade VCS Fabric cluster where you configure ELD.

To configure global ELD parameters, connect to any switch in a Brocade VCS Fabric cluster, and perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <edge-loop-detection> node element located in the urn:brocade.com:mgmt:brocade-eld namespace to enable the edge-loop-detection protocol.
3. Under the <edge-loop-detection> node, include the following leaf elements:
    a. In the <pdu-rx-limit> element, set the number of PDUs that will be received before breaking the loop.

        The value must be in the range1 through 5. The default value is 1.

    b. In the <hello-interval> element, set the interval in milliseconds between PDUs.

        The value must be an integer in the range 100 through 5,000. The default value is 1,000.

    c. In the <shutdown-time> element, set the number of minutes after which the port is re-enabled.

        The value must be 0 through 1440 (0 minutes through 24 hours). The default value is 0, indicating that the port is not automatically re-enabled.

The following example configures the Brocade VCS Fabric cluster to detect and break loops on receipt of 5 PDUs. Because the PDU interval is set to 2000 ms (2 seconds), any loop breaks after 10 seconds. The selected port will remain disabled for 24 hours, after which it is automatically re-enabled.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <edge-loop-detection xmlns=”urn:brocade.com:mgmt:brocade-eld”>
                    <pdu-rx-limit>5</pdu-rx-limit>
                    <hello-interval>2000</hello-interval>
                    <shutdown-time>1440</shutdown-time>
                </edge-loop-detection>
            </protocol>
        </config>
    </edit-config>
</rpc>
<rpc-reply message-id="800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
```

```
</rpc-reply>
```

Setting interface parameters on a port

Perform this procedure for every port you want monitored by ELD.

To set interface parameters on a port, connect to any switch in a Brocade VCS Fabric cluster, and perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include a <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the <name> element, and set it to the name of the interface you want to configure.

   Specify the name in *rbridge-id/slot/port* format or port-channel number.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the <edge-loop-detection> node element.
5. Under the <edge-loop-detection> element, include following leaf elements.
   a. In the <eldprio> element, specify the ELD port priority of the specified port for the selected VLAN.

      The value must be in the range 0 through 255. The default value is 128.
   b. In the <eldvlan> element, specify the VLAN you want ELD to monitor on this port.

      If you do not specify a VLAN, the operation fails.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

This example sets the ELD port priority on two port/VLAN pairs: port 1/0/7 VLAN 10 and port 4/0/6 VLAN 10. If both these ports are detected in the same loop, ELD shuts down port 4/0/6 when the pdu-rx-limit for the Brocade VCS Fabric cluster is reached. Port 4/0/6 is chosen for shut down because it has been assigned the lower priority (higher number) than port 1/0/7.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/7</name>
                    <edge-loop-detection>
                        <eldprio>5</eldprio>
                        <eldvlan>10</eldvlan>
                    </edge-loop-detection>
                </tengigabitethernet>
                <tengigabitethernet>
                    <name>4/0/6</name>
                    <edge-loop-detection>
```

```
                    <eldprio>7</eldprio>
                    <eldvlan>10</eldvlan>
                </edge-loop-detection>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Edge-loop detection troubleshooting

To re-enable a port that was disabled by ELD, perform the following steps.

1. Shut down the port disabled by ELD.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/7</name>
                    <shutdown/>
                </tegigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

2. Re-enable the port disabled by ELD.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/7</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>
```

```
    <rpc-reply message-id="803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <ok/>
    </rpc-reply>
```

NOTE

If an edge-port becomes an ISL port because the VCS ID of the remote port was changed, a port that was already shut down by ELD must be shut down and re-enabled to be detected as an ISL port.

To re-enable all ports disabled by ELD, disable the edge-loop detection protocol, as shown in the following example.

```
<rpc message-id="804" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <edge-loop-detection xmlns=”urn:brocade.com:mgmt:brocade-eld”
                xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete">
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="804" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

19

Configuring AMPP

In this chapter

- AMPP configuration with NETCONF overview 241
- Configuring AMPP port-profiles. 241
- Obtaining the AMPP operational data 261
- Configuring a port-profile-port 264
- Configuring port-profile-domains 266

AMPP configuration with NETCONF overview

This chapter describes procedures for configuring and monitoring port-profiles using NETCONF interfaces. Refer to the *Network OS Administrator's Guide* for the following information:

- Conceptual information about how AMPP port-profiles work
- Conceptual information about how AMPP port-profile-domains work
- How AMPP port-profiles work with vLAG and Switched Port Analyzer (SPAN)
- Scalability information
- What a port-profile contains
- Definitions of port-profile states

Through the NETCONF interface, you can perform the following operations on AMPP:

- Use the <edit-config> RPC to configure AMPP port-profiles.
- Use the <edit-config> RPC to configure the port-profile-domain.
- Use the <get-config> RPC to validate configuration settings.
- Use the <get-port-profile-status> custom RPC to return the current status of AMPP profiles.
- Use the <get-port-profile-for-inf> custom RPC to return information about port-profiles to which interfaces are applied.

The AMPP configuration model is defined in the brocade-port-profile.yang module and the AMPP custom RPC is defined in the brocade-port-profile-ext YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Configuring AMPP port-profiles

This section contains procedures for configuring AMPP port-profiles using NETCONF interfaces.

Configuring a new port-profile

To support VM MAC address learning, the default port-profile is employed. The default profile is different from the other user-defined AMPP profiles:

- The port-profile ID (ppid) of the profile cannot be changed.
- The VLAN subprofile cannot be modified.
- The QoS subprofile and security-profile cannot be added.
- The default port-profile cannot be activated.
- When there are no port-profile-ports in the system, the default port-profile can be added with the FCoE profile.

Brocade recommends that you create a new port-profile to accommodate your requirements. To configure a new port-profile, perform the following steps. The following steps create and activate a port-profile and associate it with the MAC address of each host.

1. Configure the physical interface before creating the port-profile.
2. Put the port under "port-profile-port" mode, using the <edit-config> element defined in brocade-interface.yang
3. Create the <vm1-port-profile> profile.
4. Create the VLAN subprofile under the <vm1-port-profile>.
5. Under the VLAN subprofile, configure the <switchport> and <switchport mode trunk> attributes.
6. Issue an <edit-config> RPC to create and configure a new port-profile name.

   This step configures the <port-profile> node in the urn:brocade.com:mgmt:brocade-port-profile namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1701" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>vm1-port-profile</name>
                <vlan-profile>
                    <switchport>
                        <trunk>
                            <native-vlan>300</native-vlan>
                            <allowed>
                                <vlan>
                                    <add>300</add>
                                </vlan>
                            </allowed>
                        </trunk>
                    </switchport>
                </vlan-profile>
            </port-profile>
        </config>
    </edit-config>
</rpc>
```

```
<rpc-reply message-id="1701" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

7. Activate the profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1702" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <port-profile>
                   <name>vm1-port-profile</name>
                   <activate/>
               </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1702" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

8. Associate the profile with the MAC address for each host.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1703" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
                       <mac-address>0050.56bf:0001</mac-address>
                   </static>
               </port-profile>
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
                       <mac-address>0050.56bf:0002</mac-address>
                   </static>
               </port-profile>
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
                       <mac-address>0050.56bf:0003</mac-address>
                   </static>
               </port-profile>
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
```

```
                    <mac-address>0050.56bf:0004</mac-address>
                </static>
            </port-profile>
            <port-profile>
                <name>vm1-port-profile</name>
                <static>
                    <mac-address>0050.56bf:0005</mac-address>
                </static>
            </port-profile>
        </port-profile-global>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1703" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring VLAN profiles

The VLAN profile defines the VLAN membership of the overall port-profile, which includes both the tagged and untagged VLANs.

NOTE
Private VLAN port mode commands are not available for AMPP VLAN profiles.

To configure the VLAN profile, perform the following steps.

1. Deactivate the port-profile before modifying the VLAN profile.

   AMPP profiles cannot be modified while active.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1704" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
                    <activate xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1704" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Issue the <edit-config> RPC to configure the <port-profile> node in the urn:brocade.com:mgmt:brocade-port-profile namespace and configure the following entities.

a. Under the <port-profile> node, specify the name of the port-profile:

```
<name>vm1-port-profile</name>
```

b. Under the <port-profile> node, use the <vlan-profile> element to specify the VLAN subprofile.

c. Under the <vlan-profile> node, specify the <switchport> node to change the mode to Layer 2 and set the switching characteristics.

d. Under the <switchport> node, access the VLAN profile mode for the correct VLAN.

```
<switchport>
    <access>
        <vlan>
            <name>200</name>
        </vlan>
    </access>
</switchport>
```

e. Under the <switchport> node, configure the trunk mode for the allowed VLAN IDs.

```
<switchport>
    <trunk>
        <allowed>
            <vlan>
                <add>10,20,30-40</add>
            </vlan>
        </allowed>
    </trunk>
</switchport>
```

f. Under the <switchport> node, configure the trunk mode to be a native VLAN.

```
<switchport>
    <trunk>
        <native-vlan>300</native-vlan>
    </trunk>
</switchport>
```

The following example configures the VLAN profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1705" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>vm1-port-profile</name>
                <vlan-profile>
                    <switchport>
                        <access>
                            <vlan>
                                <name>200</name>
                            </vlan>
                        </access>
                        <trunk>
                            <allowed>
                                <vlan>
                                    <add>10,20,30-40</add>
                                </vlan>
```

```
                        </allowed>
                        <native-vlan>300</native-vlan>
                    </trunk>
                </switchport>
            </vlan-profile>
        </port-profile>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1705" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Activate the profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1706" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
                    <activate/>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1706" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Associate the profile with the MAC address for each host.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1707" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-adddress>0050.56bf:0001</mac-address>
                    </static>
                </port-profile>
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0002</mac-address>
                    </static>
                </port-profile>
```

```
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0003</mac-address>
                    </static>
                </port-profile>
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0004</mac-address>
                    </static>
                </port-profile>
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0005</mac-address>
                    </static>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1707" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Adding a C-TAG classification to trunk VLAN port-profile

This tasks demonstrates adding a C-TAG range to an existing trunk VLAN port-profile. In this example, the trunk VLAN port-profile named “PROFILE_1”.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-port-profile namespace.
2. Under the <port-profile> node, specify the <name> element.
3. Under the <vlan-profile> element, include the following elements:
    a. In the <name> element, specify the profile name.
    b. Include the <switchport> elements to configure the profile as a trunk VLAN using the <trunk> element.
    c. Add the <trunk-vlan-classification> element and include the <allowed> and <vlan> elements.
    d. Specify the <trunk-vlan-id> value and the <trunk-ctag-range> value.

    The following example configures a trunk VLAN with a C-TAG range.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
    <edit-config>
        <target>
            <running/>
        </target>
    <config>
        <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
            <name>PROFILE_1</name>
                <vlan-profile>
```

```
            <switchport>
                <trunk>
                    <trunk-vlan-classification>
                    <allowed>
                    <vlan>
                    <add>
                        <trunk-vlan-id>5111</trunk-vlan-id>
                        <trunk-ctag-id>111</trunk-ctag-id>
                    </add>
                    </vlan>
                    </allowed>
                    </trunk-vlan-classification>
                </trunk>
            </switchport>
        </vlan-profile>
    </port-profile>
</config>
</edit-config>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Adding a C-TAG classification to a native VLAN

This tasks demonstrates adding a C-TAG range to an existing native VLAN port-profile. In this example, the native VLAN port-profile named “PROFILE_1”.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-port-profile namespace.
2. Under the <port-profile> node, specify the <name> element.
3. Under the <vlan-profile> element, include the following elements:
    a. In the <name> element, specify the profile name.
    b. Include the <switchport> elements to configure the profile as a trunk VLAN using the <trunk> element.
    c. Add the <native-vlan-classification> element and include the <allowed> and <vlan> elements.
    d. Specify the <native-vlan-id> value and the <native-ctag-range> value.

    The following example configures a native VLAN with a C-TAG range.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <name>PROFILE_1</name>
                   <vlan-profile>
               <switchport>
                   <trunk>
                       <native-vlan-classification>
```

```
                    <native-vlan-id>5112</native-vlan-id>
                    <native-vlan-ctag-id>112</native-vlan-ctag-id>
                    </native-vlan-classification>
                </trunk>
            </switchport>
        </vlan-profile>
    </port-profile>
</config>
</edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring FCoE profiles

Only the FCoE profile of the default profile can be modified. The FCoE profile can only be part of the default profile. When it is part of the default profile, FCoE is enabled globally and all the profiled ports automatically become FCoE ports.

In the absence of the FCoE profile in the default AMPP profile, you can configure FCoE on a per-interface basis, based on the profiled ports. Refer to "Configuring FCoE interfaces" on page 272 for details.

To globally configure the FCoE profile, perform the following steps.

1. Issue the <edit-config> RPC to configure the <fcoe> node in the urn:brocade.com:mgmt:brocade-fcoe namespace.
2. Under the <fcoe> node, include the <fcoe-map> node element.
3. Under the <fcoe-map> node, define the <fcoe-map-name> value for the FCoE fabric map.

```
<fcoe-map>
    <fcoe-map-name>OE:FC:00</fcoe-map-name>
</fcoe-map>
```

The following example configures the FCoE profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1708" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <fcoe xmlns="urn:brocade.com:mgmt:brocade-fcoe">
                <fcoe-map>
                    <fcoe-map-name>default</fcoe-map-name>
                </fcoe-map>
            </fcoe>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1708" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. In the <port-profile> node in the urn:brocade.com:mgmt:brocade-port-profile namespace, activate the FCoE port profile.

   An FCoE map cannot be applied on interfaces that already have a CEE map applied to them.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1709" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>default</name>
                <fcoe-profile>
                    <fcoeport>
                        <fcoe-map-name>default</fcoe-map-name>
                    </fcoeport>
                </fcoe-profile>
            </port-profile>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1709" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring QoS profiles

QoS profiles define the following values:

- Incoming 802.1p priority is set to internal queue priority. If the port is in QoS untrusted mode, all incoming priorities will be mapped to default best effort priority.
- Incoming priority is set to outgoing priority.
- Mapping of incoming priorities is set to strict or WRR traffic classes.
- Enabling of flow control on a strict or a WRR traffic class.

The QoS profile has two flavors: CEE QoS and Ethernet QoS. The QoS profile may contain either CEE QoS or Ethernet QoS. Server-side ports typically are carrying converged traffic.

To configure the QoS profile, perform the following steps.

1. Deactivate the port-profile before modifying the VLAN profile.

   AMPP profiles cannot be modified while active.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1710" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
```

```
                    <activate xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1710" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Issue the <edit-config> RPC to configure the <port-profile>/<qos-profile> node in the urn:brocade.com:mgmt:brocade-port-profile namespace. Under the <qos-profile> node, configure the following entities.

    a. Apply the CEE map.

    ```
    <cee>default</cee>
    ```

    b. Set the default CoS value.

    ```
    <qos>
        <cos>7</cos>
    </qos>
    ```

    c. Set the QoS trust attribute for CoS

    ```
    <qos>
        <trust>
            <trust-cos/>
        </trust>
    </qos>
    ```

    d. Apply a map to the profile. You may either apply the existing CoS-to-CoS mutation map, or apply the existing CoS-to-Traffic-Class map.

    The following code snippet applies the existing CoS-to-CoS mutation map:

    ```
    <qos>
        <cos-mutation>vm1-cos2cos-map</cos-mutation>>
    </qos>
    ```

    The following code snippet applies the existing CoS-to-Traffic-Class map:

    ```
    <qos>
        <cos-traffic-class>vm1-cos2traffic-map</cos-traffic-class>
    </qos>
    ```

    e. Enable pause generation with or without PFC.

    The following code snippet enables pause generation without PFC:

    ```
    <qos>
        <flowcontrol>
            <flowcontrolglobal>
                <tx>on</tx>
                <rx>on</rx>
            </flowcontrolglobal>
        </flowcontrol>
    </qos>
    ```

The following code snippet enables pause generation with PFC:

```
<qos>
    <flowcontrol>
        <pfc>
            <pfc-cos>1</pfc-cos>
            <pfc-tx>on</pfc-tx>
            <pfc-rx>on</pfc-rx>
        </pfc>
        <pfc>
            <pfc-cos>2</pfc-cos>
            <pfc-tx>on</pfc-tx>
            <pfc-rx>on</pfc-rx>
        </pfc>
    </flowcontrol>
</qos>
```

The following example configures the QoS profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1711" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>vm1-port-profile</name>
                <qos-profile>
                    <cee>default</cee>
                    <qos>
                        <cos>7</cos>
                        <trust>
                            <trust-cos/>
                        </trust>
                        <cos-mutation>vm1-cos2cos-map</cos-mutation>
                        <cos-traffic-calss>vm1-cos2traffic-map
                         </cos-traffic-class>
                        <flowcontrol>
                            <pfc>
                                <pfc-cos>1</pfc-cos>
                                <pfc-tx>on</pfc-tx>
                                <pfc-rx>on</pfc-rx>
                            </pfc>
                            <pfc>
                                <pfc-cos>2</pfc-cos>
                                <pfc-tx>on</pfc-tx>
                                <pfc-rx>on</pfc-rx>
                            </pfc>
                        </flowcontrol>
                    </qos>
                </qos-profile>
            </port-profile>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1711" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Activate the profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1712" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <port-profile>
                   <name>vm1-port-profile</name>
                   <activate/>
               </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1712" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Associate the profile with the MAC address for each host.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1713" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
                       <mac-address>0050.56bf:0001</mac-address>
                   </static>
               </port-profile>
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
                       <mac-address>0050.56bf:0002</mac-address>
                   </static>
               </port-profile>
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
                       <mac-address>0050.56bf:0003</mac-address>
                   </static>
               </port-profile>
               <port-profile>
                   <name>vm1-port-profile</name>
                   <static>
                       <mac-address>0050.56bf:0004</mac-address>
                   </static>
               </port-profile>
               <port-profile>
                   <name>vm1-port-profile</name>
```

```
                    <static>
                        <mac-address>0050.56bf:0005</mac-address>
                    </static>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>
<rpc-reply message-id="1713" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring security profiles

A security profile defines all the security rules needed for the server port. A typical security profile contains attributes for MAC-based standard and extended ACLs. Security profiles are applied to the ACLs based on the profile or PolicyID. Therefore, multiple security profiles can be applied to the same profiled port.

To configure the security profile, perform the following steps.

1. AMPP profiles cannot be modified while active. Deactivate the port-profile before modifying the security profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1714" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
                    <activate xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1714" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Under the <port-profile> node, specify the <security-profile> element and modify the ACL security attributes.

   The following example shows how to apply an ACL to the security profile. Refer to Chapter 28, “Configuring ACLs” for details about modifying the ACL security attributes.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1716" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
```

```
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>vm1-port-profile</name>
                <security-profile>
                    <mac>
                        <access-group>
                            <access-group-name>vm1-acl</access-group-name>
                            <in/>
                        </access-group>
                    </mac>
                </security-profile>
            </port-profile>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1716" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Activate the profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1717" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
                    <activate/>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1717" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Associate the profile with the MAC address for each host.

```
<rpc message-id="1718" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0001</mac-address>
                    </static>
                </port-profile>
                <port-profile>
                    <name>vm1-port-profile</name>
```

```
                    <static>
                        <mac-address>0050.56bf:0002</mac-address>
                    </static>
                </port-profile>
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0003</mac-address>
                    </static>
                </port-profile>
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0004</mac-address>
                    </static>
                </port-profile>
                <port-profile>
                    <name>vm1-port-profile</name>
                    <static>
                        <mac-address>0050.56bf:0005</mac-address>
                    </static>
                </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1718" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disassociating a port-profile from a MAC address

A significant step in creating a port-profile is associating the port-profile with the MAC address of host. In the event a MAC address must be changed, perform this task for the port profile, and then repeat the steps for associating the port-profile to the MAC address. Refer to "Configuring VLAN profiles", "Configuring FCoE profiles", "Configuring QoS profiles", and "Configuring security profiles".

NOTE
You may delete multiple MAC addresses from a single port-profile in a NETCONF cal.

1. Issue the <edit-config> RPC to configure the <port-profile-global> node in the urn:brocade.com:mgmt:brocade-port-profile namespace.
2. In the <name> element, specify the port-profile you want to modify,
3. In the <static> element, include the delete operation in the opening tag.
4. Specify <mac-address> you want to delete.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1719" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
```

```
            xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <port-profile>
                  <name>vm1-port-profile</name>
                  <static xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete"/>
                     <mac-address>0050.56bf:0001</mac-address>
                  </static>
               </port-profile>
               <port-profile>
                  <name>vm1-port-profile</name>
                  <static xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete"/>
                     <mac-address>0050.56bf:0002</mac-address>
                  </static>
               </port-profile>
               <port-profile>
                  <name>vm1-port-profile</name>
                  <static xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete"/>
                     <mac-address>0050.56bf:0003</mac-address>
                  </static>
               </port-profile>
               <port-profile>
                  <name>vm1-port-profile</name>
                  <static xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete"/>
                     <mac-address>0050.56bf:0004</mac-address>
                  </static>
               </port-profile>
               <port-profile>
                  <name>vm1-port-profile</name>
                  <static xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete"/>
                     <mac-address>0050.56bf:0005</mac-address>
                  </static>
               </port-profile>
            </port-profile-global>
         </config>
      </edit-config>
   </rpc>

   <rpc-reply message-id="1719" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
      <ok/>
   </rpc-reply>
```

Deleting a port-profile

You cannot delete the default port-profile.

To delete a port-profile, perform the following steps.

1. Deactivate the port-profile—Issue an <edit-config> RPC to configure the <port-profile> node in the urn:brocade.com:mgmt:brocade-port-profile namespace. Under the <port-profile> node, specify the following leaf elements.

   a. In the <name> element, specify the subprofile you want to delete,

   b. In the <activate> element, include the delete operation in the opening tag.

   The following example deactivates the port-profile named vm1-port-profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1722" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <port-profile>
                   <name>vm1-port-profile</name>
                   <activate xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
               </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1722" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Delete the port-profile—Issue an <edit-config> RPC to configure the <port-profile-global>/<port-profile> node in the urn:brocade.cpm:mgmt:brocade-port-profile namespace and specify the following leaf elements.

   a. In the <port-profile> node element, include the delete operation in the opening element tag.

   b. In the <name> element, specify the port-profile for you want to delete.

   The following example deletes the port-profile named vm1-port-profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1723" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
               <port-profile
                xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                operation="delete">
                  <name>vm1-port-profile</name>
               </port-profile>
            </port-profile-global>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1723" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Deleting a subprofile

To delete a subprofile, perform the following steps.

1. Deactivate the port-profile—Issue an <edit-config> RPC to configure the <port-profile> node in the urn:brocade.com:mgmt:brocade-port-profile namespace. Under the <port-profile> node, specify the following leaf elements.

   a. In the <name> element, specify the subprofile you want to delete,

   b. In the <activate> element, include the delete operation in the opening tag.

   The following example deactivates the port-profile named vm1-port-profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1724" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile-global
             xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <port-profile>
                    <name>vm1-port-profile</name>
                    <activate xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </port-profile>
            </port-profile-global>
        </config>

    </edit-config>
</rpc>

<rpc-reply message-id="1724" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. To delete the VLAN subprofile, issue an <edit-config> RPC to configure the <port-profile> node in the urn:brocade.cpm:mgmt:brocade-port-profile namespace. Under the <port-profile> node, specify the following leaf elements.

   a. In the <name> element, specify the port-profile for which you want to delete the VLAN subprofile.

   b. In the <vlan-profile> element, include the delete operation in the opening element tag.

   The following example deletes the VLAN subprofile from the port-profile named vm1-port-profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1725" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>vm1-port-profile</name>
                <vlan-profile
                 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
```

```
            </port-profile>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1725" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. To delete the security subprofile, issue an <edit-config> RPC to configure the <port-profile> node in the urn:brocade.cpm:mgmt:brocade-port-profile namespace. Under the <port-profile> node, specify the following leaf elements.

    a. In the <name> element, specify the port-profile for which you want to delete the security subprofile.

    b. In the <security-profile> element, include the delete operation in the opening element tag.

    The following example deletes the security subprofile from the port-profile named vm1-port-profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1726" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>vm1-port-profile</name>
                <security-profile
                 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
            </port-profile>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1726" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. To delete the FCoE subprofile, issue an <edit-config> RPC to configure the <port-profile> node in the urn:brocade.cpm:mgmt:brocade-port-profile namespace. Under the <port-profile> node, specify the following leaf elements.

    a. In the <name> element, specify the port-profile for which you want to delete the FCoE subprofile.

    b. In the <fcoe-profile> element, include the delete operation in the opening element tag.

    The following example deletes the FCoE subprofile from the port-profile named default.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1727" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
```

```
                <name>default</name>
                <fcoe-profile
                 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
            </port-profile>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1727" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. To delete the QoS subprofile, issue an <edit-config> RPC to configure the <port-profile> node in the urn:brocade.cpm:mgmt:brocade-port-profile namespace. Under the <port-profile> node, specify the following leaf elements.

   a. In the <name> element, specify the port-profile for which you want to delete the QoS subprofile.

   b. In the <qos-profile> element, include the delete operation in the opening element tag.

   The following example deletes the QoS subprofile from the port-profile named vm1-port-profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1728" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                <name>vm1-port-profile</name>
                <qos-profile
                 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
            </port-profile>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1728" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Obtaining the AMPP operational data

This section contains procedures for obtaining AMPP port-profiles operational data using NETCONF interfaces.

Obtaining the port-profile status

Issue the <get-port-profile-status> custom RPC located in the urn:brocade.com:mgmt:brocade-port-profile-ext namespace to return the current status of AMPP profiles.

With no input parameters, the <get-port-profile-status> RPC returns information about all AMPP profiles in all states. Alternatively, you can specify the <port-profile-name> element in the input to restrict the returned information to one port-profile. You can also specify the <port-profile-status> parameter to restrict the returned information to port-profiles in a specific state; applied, activated, or associated.

One invocation of the <get-port-profile-status> RPC returns information for one MAC association for a given port-profile. To return multiple MAC associations, you must issue the RPC multiple times, and make use of the <last-received-port-profile-info> input parameter, which has two leaf elements: <port-profile-name> and <port-profile-mac>.

On the first invocation of the <get-port-profile-status> RPC, set the <last-received-port-profile>/<port-profile-mac> element to 00:00:00:00:00:00. If the <has-more> element in the reply is true, use the MAC address returned in the <mac> element in the output as the <last-received-port-profile-info>/<port-profile-mac> element in the input of the next call to the <get-port-profile-status> RPC. All port-profile information has been returned when the <has-more> output element returns false.

The following example returns status for the auto-VM_Network port-profile for all MAC associations in the activated state. In the first call, the <last-received-port-profile>/<profile-mac> element is set to 00:00:00:00:00:00. The output returns the first associated MAC address and the <has-more> element is set to true.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1730">
    <get-port-profile-status
     xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
        <port-profile-name>auto-VM_Network</port-profile-name>
        <port-profile-status>activated</port-profile-status>
        <last-received-port-profile-info>
            <profile-name>auto-VM_Network</port-profile-name>
            <profile-mac>00:00:00:00:00:00</port-profile-mac>
        </last-received-port-profile-info>
    </get-port-profile-status>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1730">
    <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
        <name>auto-VM_Network</name>
        <ppid>9</ppid>
        <is-active>true</is-active>
        <mac-association>
            <mac>00:50:56:b3:00:01</mac>
            <applied-interface>
                <interface-type>tengigabitethernet</interface-type>
                <interface-name>9/0/53</interface-name>
            </applied-interface>
        </mac-association>
        <has-more>true</has-more>
    </port-profile>
</rpc-reply>
```

The following example takes as input the MAC association returned by the previous call. The output returns the next MAC association for this port-profile.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1731">
    <get-port-profile-status
     xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
        <port-profile-name>auto-VM_Network</port-profile-name>
        <port-profile-status>activated</port-profile-status>
```

```
        <last-received-port-profile-info>
            <profile-name>auto-VM_Network</port-profile-name>
            <profile-mac>00:50:56:b3:00:01</port-profile-mac>
        </last-received-port-profile-info>
    </get-port-profile-status>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1731">
    <port-profile xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
        <name>auto-VM_Network</name>
        <ppid>9</ppid>
        <is-active>true</is-active>
        <mac-association>
            <mac>00:50:56:b3:00:02</mac>
            <applied-interface>
                <interface-type>tengigabitethernet</interface-type>
                <interface-name>9/0/53</interface-name>
            </applied-interface>
        </mac-association>
        <has-more>true</has-more>
    </port-profile>
</rpc-reply>
```

Obtaining interface to port-profile mapping

Issue the <get-port-profile-for-intf> custom RPC to return information about port-profiles to which interfaces are applied. Include the <interface-type> and <interface-name> input parameters for the first interface for which you want port profiling information. Check the <has-more> element in the output to determine whether such information exists for more interfaces. If <has-more> returns true, re-issue the RPC and include the <last-received-interface-info> node element. Under <last-received-interface-info>, include the <interface-type> and <interface-name> elements from the previous invocation of the RPC. Repeat until <has-more> returns false.

```
    <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1732">
        <get-port-profile-for-intf
         xmlns="urn:brocade.com:mgmt:brocade-interface-ext"/>
            <interface-type>tengigabitethernet</interface-type>
            <interface-name>9/0/53</interface-name>
        </get-port-profile-for-intf>
    </rpc>

    <rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1732">
        <interface xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
            <interface-type>tengigabitethernet</interface-type>
            <interface-name>9/0/53</interface-name>
            <port-profile>
                <name>auto-VM_Network</name>
            </port-profile>
        </interface>
        <has-more>true</has-more>
    </rpc-reply>

    <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1732">
        <get-port-profile-for-intf
         xmlns="urn:brocade.com:mgmt:brocade-interface-ext"/>
            <last-recevied-interface-info>
                <interface-type>tengigabiethernet</interface-type>
                <interface-name>9/0/53</interface-name>
```

```
        </last-recevied-interface-info>
    </get-port-profile-for-intf>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1732">
    <interface xmlns="urn:brocade.com:mgmt:brocade-port-profile-ext">
        <interface-type>tengigabitethernet</interface-type>
        <interface-name>9/0/54</interface-name>
        <port-profile>
            <name>auto-for_iscsi</name>
        </port-profile>
    </interface>
    <has-more>false</has-more>
</rpc-reply>
```

Configuring a port-profile-port

This section describes the tasks for configuring a port-profile-port on a physical interface.

Configure the port-profile-port on the physical interface.

To configure a port-profile-port assignment on an interface, issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace and specify the following elements.

1. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> element, depending on the type of interface you want to work on.
2. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> element, use the <name> element to specify the interface for which you want to add the association with a port-profile.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> element, specify the <port-profile-port> element tag.

The following example configures the port-profile assignment from interface 1/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1720" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/1</name>
                    <port-profile-port/>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1720" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <ok/>
</rpc-reply>
```

Association of multiple port-profiles with an interface

The port-profile-port command allows a user to associate a profiled-port to a single port-profile or to a port-profile domain that contains multiple port-profiles. The result is that all VLANs specified therein are configured onto the port.

When neither the profile nor the domain keyword is used, the default is to apply only the 802.1Q VLANs that exist in any port-profile that is configured on the switch. This is shown the following example.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1720" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>domain vDC1</name>
                    <port-profile-port/>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1720" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Deleting a port-profile-port

To delete a port-profile-port assignment from an interface, issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace and specify the following elements.

1. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> element, depending on the type of interface you want to work on.
2. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> element, use the <name> element to specify the interface for which you want to remove the association with a port-profile.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> element, specify the <port-profile-port> element and include the delete operation in the opening element tag.

The following example deletes the port-profile assignment from interface 1/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1721" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/1</name>
                    <port-profile-port
                     xmlns="urn:brocade.com:mgmt:brocade-port-profile"
                     xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1721" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Configuring port-profile-domains

This section describes the tasks for creating and configuring port-profile-domains.

Configuring the basic port-profile-domain

This task creates the port-profile-domain which is the basis for all port-profile-domain options.

1. Activate the port-profile-domain—Issue an <edit-config> RPC to configure the <port-profile-domain> node in the urn:brocade.com:mgmt:brocade-port-profile namespace. Under the <port-profile-domain> node, specify the following leaf elements.
2. Specify the name for the <port-profile-domain-name> element.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
    <edit-config>
        <target>
            <running/>
        </target>
    <config>
        <port-profile-domain mlns="urn:brocade.com:mgmt:brocade-port-profile">
            <port-profile-domain-name>TENANT_1</port-profile-domain-name>
                </port-profile-domain>
    </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Adding the port-profile to the port-profile-domain

This task adds the AMPP port-profile to the port-profile-domain. Refer to “Configuring AMPP port-profiles” on page 241.

1. Activate the port-profile-domain—Issue an <edit-config> RPC to configure the <port-profile-domain> node in the urn:brocade.com:mgmt:brocade-port-profile namespace. Under the <port-profile-domain> node, specify the following leaf elements.
2. Specify the name for the <port-profile-domain-name> element for modification.
3. Specify the <profile-name> element for the AMPP profile name to add to the port-profile-domain.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
<edit-config>
    <target>
        <running/>
    </target>
<config>
    <port-profile-domain xmlns="urn:brocade.com:mgmt:brocade-port-profile">
        <port-profile-domain-name>TENANT_1</port-profile-domain-name>
        <profile>
            <profile-name>PROFILE_1</profile-name>
        </profile>
    </port-profile-domain>
</config>
</edit-config>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Deleting a port-profile from the port-profile-domain

This task deletes the AMPP port-profile from the port-profile-domain. Refer to "Configuring AMPP port-profiles" on page 241. This does not delete the AMPP port-profile from the switch.

1. Activate the port-profile-domain—Issue an <edit-config> RPC to configure the <port-profile-domain> node in the urn:brocade.com:mgmt:brocade-port-profile namespace. Under the <port-profile-domain> node, specify the following leaf elements.
2. Specify the name for the <port-profile-domain-name> element for modification.
3. Include the <profile> element with the delete option.
4. Specify the <profile-name> element for the AMPP profile name to remove from the port-profile-domain.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <port-profile-domain
xmlns="urn:brocade.com:mgmt:brocade-port-profile">
            <port-profile-domain-name>TENANT_1</port-profile-domain-name>
        <profile xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0"
nc:operation="delete">
            <profile-name>PROFILE_1</profile-name>
        </profile>
```

```
        </port-profile-domain>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Deleting a port-profile-domain

This task deletes the port-profile-domain. Any associated AMPP port-profiles are not deleted from the switch.

1. Activate the port-profile-domain—Issue an <edit-config> RPC to configure the <port-profile-domain> node in the urn:brocade.com:mgmt:brocade-port-profile namespace. Under the <port-profile-domain> node, specify the following leaf elements.
2. Specify the name for the <port-profile-domain-name> element. include the delete option.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <port-profile-domain xmlns="urn:brocade.com:mgmt:brocade-port-profile"
operation="delete">
            <port-profile-domain-name>TENANT_1</port-profile-domain-name>
        </port-profile-domain>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Obtaining the port-profile-domain status

Use the <get-config> RPC to retrieve the current configuration data and operational state data. Refer to "Retrieving configuration data" on page 11 and "Retrieving operational data" on page 15 for detailed instructions.

The following example retrieves the status from the TENANT_1 port-profile-domain.

```
<?xml version="1.0" encoding="UTF-8"?>
    <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
        <get-config>
            <source>
                <running></running>
            </source>
            <filter type="subtree">
                <port-profile-domain
                   xmlns="urn:brocade.com:mgmt:brocade-port-profile">
                    <port-profile-domain-name>TENANT_1</port-profile-domain-name>
                </port-profile-domain>
```

```
            </filter>
        </get-config>
    </rpc>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <data>
        <port-profile-domain xmlns="urn:brocade.com:mgmt:brocade-port-profile">
            <port-profile-domain-name>TENANT_1</port-profile-domain-name>
        </port-profile-domain>
    </data>

</rpc-reply>
```

Chapter

20

Configuring FCoE Interfaces

In this chapter

- FCoE configuration with NETCONF overview 271
- Configuring FCoE interfaces 272
- Obtaining FCoE status 275

FCoE configuration with NETCONF overview

This chapter provides procedures for assigning a Fibre Channel over Ethernet (FCoE) map to port interfaces or port-channel interfaces, and for retrieving status information about FCoE interfaces and logins.

For a procedure for configuring an FCoE profile, refer to "Configuring FCoE profiles" on page 249.

Refer to the *Network OS Administrator's Guide* for conceptual information about FCoE including:

- An overview of what FCoE is and its purpose
- FCoE end-to-end operations
- How Network OS Layer 2 Ethernet supports FCoE through Layer 2 forwarding, VLAN tagging, incoming frame classification, congestion control and queueing, access control, trunking, and flow control
- How the FCoE Initialization Protocol (FIP) works
- How FCoE queueing works
- Configuring FCoE over LAG
- Operational guidelines for applying an FCoE map to a VLAG
- xSTP reconvergence

Through the NETCONF interface, you can perform the following operations on FCoE interfaces:

- Use the <edit-config> RPC to assign an FCoE map to an interface or LAG.
- Use the <get-config> RPC to validate configuration settings.
- Use the <fcoe-get-interface> custom RPC to return information about FCoE port interfaces.
- Use the <fcoe-get-login> custom RPC to return information about logged in FCoE devices.

NOTE
FCoE parameters are defined in the brocade-fcoe YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Configuring FCoE interfaces

FCoE maps are used to configure FCoE properties on interfaces. An FCoE map is a placeholder for an FCoE VLAN and a CEE map. You will assign FCoE maps on to physical interfaces using the **fcoeport** command. Once the FCoE map is assigned onto an interface:

- The corresponding FCoE VLAN 1002 is applied to the interface.
- The corresponding CEE map is applied to the interface.
- The FCoE/FIP VLAN classifiers are applied to the interface.

In short, the interface becomes capable of carrying FCoE traffic. The FCoE map can be applied on an interface only if the FCoE map is complete in all aspects. That is, it should have an FCoE VLAN and a CEE map associated with it.

NOTE
Brocade does not support non-FCoE traffic over the FCoE VLAN. The FCoE VLAN should not carry any mixed traffic.

Only a single FCoE map is allowed, which is created automatically with the name “default.” You are not able to delete or rename this map. By default, the FCoE VLAN associated to the FCoE map is FCoE VLAN (1002) and the CEE map associated is the default CEE map (also called “default”).

Assigning an FCoE map onto an interface

The FCoE map cannot be edited if it is associated with any interfaces.

The FCoE map can be applied, irrespective of whether or not the interface is in “switchport” mode. However, the FCoE map cannot be applied on an interface if the same interface already has a CEE map assigned to it.

To assign the FCoE map onto an interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface>/<tengigabitethernet> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <tengigabitethernet> node, in the <name> leaf element, specify the name of the interface to which you want to apply the FCoE map.
3. Under the <tengigabitethernet> node, specify the <fcoeport> node in the urn:brocade.com:mgmt:brocade-fcoe namespace.
4. Under the <fcoeport> node, specify the <fcoeport-map> leaf element, and set its value to “default”.

   The following example applies the default FCoE map to the 1/0/1 interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/1</name>
                    <fcoeport xmlns="urn:brocade.com:mgmt:brocade-fcoe">
```

```
                    <fcoeport-map>default</fcoeport-map>
                </fcoeport>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. Confirm the changes to the interface using the <get-config> RPC with a subtree filter to return only the <fcoeport> node information of the 1/0/1 interface.

   The output returns the FCoE mapping association for the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/1</name>
                    <fcoeport xmlns="urn:brocade.com:mgmt:brocade-fcoe"/>
                </tengigabitethernet>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <name>1/0/1</name>
            <fcoe:fcoeport>
                <fcoe:fcoeport-map>default<fcoe:fcoeport-map>
            </fcoe:fcoeport>
        </tengigabitethernet>
    </interface>
</rpc-reply>
```

6. Repeat this procedure for any additional interfaces.

Assigning an FCoE map onto a LAG member

You can assign an FCoE map to a LAG that connects an FCoE Forwarder (FCF) to a Data Center Bridging (DCB) switch or a FIP Snooping Bridge (FSB) switch. After applying the FCoE map, all member ports of the LAG carry FCoE traffic.

NOTE
You cannot assign an FCoE map to a vLAG or to redundant LAGs connecting different FCFs from different VCS Fabrics.

To assign an FCoE map to a LAG, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface>/<port-channel> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <port-channel> node, in the <name> leaf element, specify the port-channel number of the LAG to which you want to apply the FCoE map.
3. Under the <port-channel> node, specify the <fcoeport> node in the urn:brocade.com:mgmt:brocade-fcoe namespace.
4. Under the <fcoeport> node, specify the <fcoeport-map> leaf element, and set its value to “default”.

   The following example applies the default FCoE map to port channel 5.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <port-channel>
                    <name>5</name>
                    <fcoeport xmlns="urn:brocade.com:mgmt:brocade-fcoe">
                        <fcoeport-map>default</fcoeport-map>
                    </fcoeport>
                </port-channel>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. Confirm the changes to the interface using the <get-config> RPC with a subtree filter to return only the <fcoeport> node information for a specific port channel.

   The output returns the FCoE mapping association for the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <port-channel>
                    <name>5</name>
                    <fcoeport xmlns="urn:brocade.com:mgmt:brocade-fcoe"/>
                </port-channel>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
        <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
            <port-channel>
                <name>5</name>
                <fcoe:fcoeport>
                    <fcoe:fcoeport-map>default<fcoe:fcoeport-map>
                </fcoe:fcoeport>
            <port-channel>
        </interface>
    </rpc-reply>
```

Obtaining FCoE status

The following custom RPCs exist for returning FCoE information:

- <fcoe-get-interface> returns information about FCoE port interfaces
- <fcoe-get-login> returns information about logged in FCoE devices

Obtaining FCoE port interface information

To obtain information about FCoE port interfaces, issue the <fcoe-get-interface> custom RPC located in the urn:brocade.com:mgmt:brocade-fcoe-ext namespace.

By default, the <fcoe-get-interface> RPC returns information about all interfaces to which an FCoE map is applied. To restrict the output to one FCoE interface, include the <fcoe-intf-name> input parameter and supply the interface name, for example 1/0/1. To restrict the output to FCoE interfaces on a specific routing bridge, include the <fcoe-intf-rbridge-id> input parameter. To include statistical data in the output, include the <fcoe-intf-include-stats> input parameter and set its value to “true.” To omit the statistic data from the output, set <fcoe-intf-include-stats> to “false”.

The following example returns FCoE port interface information for port 1/0/1 and requests statistical information be shown in the output.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1804">
    <fcoe-get-interface xmlns="urn:brocade.com:mgmt:brocade-fcoe-ext">
        <fcoe-intf-name>1/0/1</fcoe-intf-name>
        <fcoe-intf-include-stats>true</fcoe-intf-include-stats>
    </fcoe-get-interface>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1804">
    <fcoe-intf-list xmlns="urn:brocade.com:mgmt:brocade-fcoe-ext">
        <fcoe-intf-fcoe-port-id>1/0/1</fcoe-intf-fcoe-port-id>
        <fcoe-intf-port-type>VF</fcoe-intf-port-type>
    (output truncated)
```

Obtaining FCoE login information

To obtain log in information on FCoE devices, issue the <fcoe-get-login> custom RPC located in the urn:brocade.com:mgmt:fcoe-ext namespace.

To provide log in information for all FCoE devices logged in to a specific interface, Virtual Fabric, VLAN, or routing bridge, include the <fcoe-login-interface>, <fcoe-login-vfid>, <fcoe-login-vlan>, or <fcoe-login-rbridge-id> input parameter, respectively.

The following example returns information for all FCoE devices logged into routing bridge 13.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1805">
    <fcoe-get-login xmlns="urn:brocade.com:mgmt:brocade-fcoe-ext">
        <fcoe-login-rbridge-id>13</fcoe-login-rbridge-id>
    </fcoe-get-login>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1805">
    <fcoe-login-list xmlns="urn:brocade.com:mgmt:brocade-fcoe-ext">
        <fcoe-login-session-mac>00:50:56:b3:00:01</fcoe-login-session-mac>
        <fcoe-login-fcoe-interface-name>1/0/1</fcoe-login-fcoe-interface-name>
    (output truncated)
```

Chapter

21

Configuring VLANs

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- VLAN configuration and management 277
- Configuring protocol-based VLAN classifier rules 289
- Configuring the MAC address table 297
- Private VLANs 298

VLAN configuration with NETCONF overview

This chapter provides procedures for configuring VLANs using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of VLANs
- An explanation of how ingress VLAN filtering works
- Conceptual information about VLAN classifications
- VLAN configuration guidelines and restrictions
- The default VLAN configuration
- Overview of Private VLANs

Through the NETCONF interface, you can perform the following operations on VLANs:

- Use the <edit-config> RPC to configure VLANs.
- Use the <get-config> RPC to validate configuration settings.
- Use the <get-interface-detail> custom RPC to return information about a VLAN-associated port interface.
- Use the <get-vlan-brief> custom RPC to return information about a specific VLAN.

VLAN parameters are defined in the brocade-interface and brocade-vlan YANG modules. For structural maps of these YANG modules, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all VCS Fabric management parameters, refer to the brocade-interface.yang, and brocade-vlan.yang files.

VLAN configuration and management

NOTE
Use the <bna-config-cmd> RPC to save your configuration changes.

Enabling and disabling an interface port

NOTE
DCB interfaces are disabled by default in standalone mode, but enabled by default in Brocade VCS Fabric mode.

NOTE
DCB interfaces do not support auto-negotiation of Ethernet link speeds. The DCB interfaces support 100-Gigabit Ethernet, 40-Gigabit Ethernet, 10-Gigabit Ethernet, and Gigabit Ethernet.

To enable an interface port, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, specify the following elements.
   a. In the <name> element, specify the port name in [*rbridge-id/*]*slot/port* format.
   b. In the <shutdown> element, include the delete operation in the element opening tag.

   The following example enables port 22/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1901" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1901" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

   To disable the interface, include the <shutdown> element without the delete operation.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1902" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
```

```
                    <name>22/0/1</name>
                    <shutdown/>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1902" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the MTU on an interface port

To configure the maximum transmission unit (MTU) on an interface port, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> element, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements.
    a. In the <name> element, specify the port name in [*rbridge-id/*]s*lot/port* format.
    b. In the <shutdown> element, include the delete operation in the opening tag to enable the interface port.
    c. In the <mtu> element, set the new MTU value for the interface port.

The following example enables port 22/0/1 and sets its MTU value to 4200.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1903" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                    <mtu>4200</mtu>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1903" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Creating a VLAN interface

On Brocade VDX hardware, VLANs are treated as interfaces from a configuration viewpoint.

By default, all the DCB ports are assigned to VLAN 1 (VLAN ID equals 1). The VLAN ID can be 1 through 8192, but VLAN IDs 3584 through 4094 are internally-reserved VLAN IDs. VLAN 8191 is the largest VLAN ID that can be assigned.

To create a VLAN interface, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace,
2. Under the <interface-vlan> element, specify the <interface>/<vlan> hierarchy of node elements.
3. Under the <vlan> node, specify the <name> element containing the new VLAN ID.

The following example creates VLAN 1010.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1904" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <vlan>
                        <name>1010</name>
                    </vlan>
                </interface>
            </interface-vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1904" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling STP on a VLAN

When all of the interface ports have been configured for a VLAN, you can enable Spanning Tree Protocol (STP) for all members of the VLAN with a single RPC. Whichever protocol is currently selected is used by the VLAN. Only one type of STP can be active at a time.

A physical interface port can be a member of multiple VLANs. For example, a physical port can be a member of VLAN 1002 and VLAN 55 simultaneously. In addition, VLAN 1002 can have STP enabled and VLAN 55 can have STP disabled, simultaneously.

To enable STP for a VLAN, select the type of STP for the VLAN, and then enable spanning tree on that VLAN.

To enable spanning tree on a VLAN, perform the following steps.

1. To select the type of STP, issue an <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace, and specify the following elements.
    a. Under the <protocol> node, specify the <spanning-tree> node element in the urn:brocade.com:mgmt:brocade-xstp namespace.
    b. Under the <spanning-tree> node element, specify the <mstp> node element.
    c. Under the <mstp> node, specify the <shutdown> leaf element, and include the delete operation in the opening tag to enable MSTP.
2. To enable spanning tree on the VLAN, issue an <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace, and specify the following elements:
    a. Under the <interface-vlan> node, specify the <interface>/<vlan> hierarchy of node elements.
    b. Under the <vlan> element, specify the <name> element and set it to the VLAN ID.
    c. Under the <vlan> element, specify the <spanning-tree> node element in the urn:brocade.com:mgmt:brocade-xstp namespace.
    d. Under the <spanning-tree> node, include the <stp-shutdown> element, and include the delete operation in the opening tag to enable STP on the VLAN.

The following example enables MSTP on VLAN 1002 using one RPC.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1905" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns=”urn:brocade.com:mgmt:brocade-xstp”>
                    <mstp>
                        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    </mstp>
                </spanning-tree>
            </protocol>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <vlan>
                        <name>1002</name>
                        <spanning-tree xmlns=”urn:brocade.com:mgmt:brocade-xstp”/>
                            <stp-shutdown
                             xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                             operation="delete"/>
                        </spanning-tree>
                    </vlan>
                </interface>
            </interface-vlan>
        </config>
    </edit-config>
</rpc>
<rpc-reply message-id="1905" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling STP on a VLAN

Once all of the interface ports have been configured for a VLAN, you can disable STP for all members of the VLAN with a single RPC.

To disable STP for a VLAN, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface-vlan> node, specify the <interface>/<vlan> hierarchy of node elements.
3. Under the <vlan> node element, include the following leaf elements:
    a. In the <name> element, specify the VLAN ID.
    b. Include the <spanning-tree>/<stp-shutdown> elements to disable spanning tree on the specified VLAN.

The following example disables STP on VLAN 1002.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1906" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <vlan>
                        <name>1002</name>
                        <spanning-tree xmlns=”urn:brocade.com:mgmt:brocade-xstp”>
                            <stp-shutdown/>
                        </spanning-tree>
                    </vlan>
                </interface>
            </interface-vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1906" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring an interface port as a Layer 2 switch port

To configure the interface as a Layer 2 switch port, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element, specify the following elements:

a. In the <name> element, specify the interface port in [*rbridge-id/*]*slot/port* format.

b. In the <shutdown> element, include the delete operation in the opening tag to enable the interface port.

c. Include the <switchport>/<basic> elements to configure the interface as a layer 2 switch port.

The following example configures 10-Gigabit Ethernet port 22/0/1 as a Layer 2 switch port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1907" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
<config>
     <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
       <tengigabitethernet xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
         <name>1/0/1</name>
         <switchport-basic><basic/></switchport-basic>
         <switchport>
           <mode>
             <vlan-mode>trunk</vlan-mode>
           </mode>
         </switchport>
       </tengigabitethernet>
     </interface>
  </config></edit-config>
</rpc>

<rpc-reply message-id="1907" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. To confirm the status of the DCB interface, issue the <get-interface-detail> custom RPC from the urn:brocade.com:mgmt:brocade-interface-ext namespace and include the following input parameters.

a. In the <interface-type> element located in the urn:brocade.com:mgmt:brocade-interface namespace, specify the type of interface, for example “Tengigabitethernet”.

b. In the <interface-name> element located in the urn:brocade.com:mgmt:brocade-interface namespace, specify the interface name in the [*rbridge-id/*]*slot/port* format.

The following example returns status details about port 22/0/1.

```
<rpc message-id="1908" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-interface-detail xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            TenGigabitEthernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">
            22/0/1</interface-name>
    </get-interface-detail>
</rpc>

rpc-reply message-id="1908" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            TenGigabitEthernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">1/0/1
            </interface-name>
```

```
        <ifindex
         xmlns="urn:brocade.com:mgmt:brocade-interface">67174401</ifindex>
        <mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</mtu>
        <ip-mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</ip-mtu>
        <if-name xmlns="urn:brocade.com:mgmt:brocade-interface"></if-name>
        <if-state xmlns="urn:brocade.com:mgmt:brocade-interface">up</if-state>
        <line-protocol-state xmlns="urn:brocade.com:mgmt:brocade-interface">up
           </line-protocol-state>
(output truncated)
```

Configuring an interface port as an access interface

Each DCB interface port supports admission policies based on whether the frames are untagged or tagged. Access mode admits only untagged and priority-tagged frames.

To configure the interface as an access interface requires two RPCs. The first RPC configures the port as a Layer 2 interface; the second RPC configures the interface port as an access interface.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:
   a. In the <name> element, specify the port name in [*rbridge-id/*]*slot/port* format.
   b. Include the <switchport>/<basic> elements to configure the port as a Layer 2 interface.

   The following example configures 10-Gigabit Ethernet port 1/0/1 as an access interface port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1909" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
<config>
     <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
       <tengigabitethernet xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
         <name>1/0/1</name>
         <switchport-basic><basic/></switchport-basic>
       </tengigabitethernet>
     </interface>
  </config>
</rpc>

<rpc-reply message-id="1909" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Issue another <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
5. Under the <interface> node, specify the same interface type you specified in step 2; that is, <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>.

6. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:
   a. In the <name> element, specify the same port name you specified in step 3.
   b. Include the <switchport>/<access> hierarchy of node elements.
7. Under the <access> node element, specify the <access-vlan> leaf element containing the VLAN ID to configure a layer 2 switch port as an access interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1910" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <switchport>
                        <access>
                            <accessvlan>20</accessvlan>
                        </access>
                    </switchport>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1910" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring an interface port as a trunk interface

Each DCB interface port supports admission policies based on whether the frames are untagged or tagged. Trunk mode admits only VLAN-tagged frames.

This procedure performs the following functions:

- Enables the interface.
- Specifies trunk mode.
- Specifies whether one, all, or none of the VLAN interfaces are allowed to transmit and receive through the DCB interface.

To configure the interface as a trunk interface requires two RPCs. The first RPC configures the port as a Layer 2 interface; the second RPC configures the interface port as a trunk interface.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:

a. In the <name> element, specify the port name in [*rbridge-id*/]s*lot*/*port* format.

b. In the <shutdown> element, include the delete operation in the element opening tag to enable the interface port.

c. Include the <switchport>/<basic> elements to configure the port as a Layer 2 interface.

The following example configures 10-Gigabit Ethernet port 1/0/1 as a Layer 2 switch port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1911" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
<config>
     <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
       <tengigabitethernet xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
         <name>1/0/1</name>
         <switchport-basic><basic/></switchport-basic>
       </tengigabitethernet>
     </interface>
  </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1911" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Issue another <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.

5. Under the <interface> node, specify the same interface type element you specified in step 2 (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).

6. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element, include the following elements:

   a. In the <name> element, specify the same port name you specified in step 3.

   b. Include the <switchport>/<mode> hierarchy of node elements. Under the <mode> element, specify the <vlan-mode> element as “trunk” to specify trunk mode.

   c. Include the <trunk>/<allowed> node elements containing further XML elements that define which VLAN interfaces are allowed to transmit and receive through the DCB interface.

      The following example XML fragment allows VLAN 30 to transmit and receive through the DCB interface:

```
<trunk>
    <allowed>
        <vlan>
            <add>30</add>
        </vlan>
    </allowed>
</trunk
```

      The following XML fragment allows all VLANs to transmit and receive through the DCB interface.

```
<trunk>
    <allowed>
        <vlan>
            <all/>
        </vlan>
    </allowed>
</trunk
```

The following fragment allows all VLANs except VLAN 11 to transmit and receive through the DCB interface.

```
<trunk>
    <allowed>
        <vlan>
            <except>11</except>
        </vlan>
    </allowed>
</trunk>
```

The following fragment allows no VLAN to transmit or receive through the DCB interface.

```
<trunk>
    <allowed>
        <vlan>
            <none/>
        </vlan>
    </allowed>
</trunk>
```

The following complete example <edit-config> RPC enables trunk mode on port 22/0/1 and allows only VLAN 30 to transmit and receive through the DCB interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1912" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <switchport>
                        <mode>
                            <vlan-mode>trunk</vlan-mode>
                        </mode>
                        <trunk>
                            <allowed>
                                <vlan>
                                    <add>30</add>
                                </vlan>
                            </allowed>
                        </trunk>
                    </switchport>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1912" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
```

```
</rpc-reply>
```

Disabling a VLAN on a trunk interface

To disable a VLAN on a trunk interface, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements.
   a. In the <name> element, specify the port name in [*rbridge-id/*]*slot/port* format.
   b. In the <shutdown> element, include the delete operation in the element opening tag to enable the interface port.
   c. Include the <switchport>/<mode> hierarchy of node elements.
   d. Under the <mode> node, specify the <vlan-mode> element, and specify “trunk” to place the interface into trunk mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                    <switchport>
                        <mode>
                            <vlan-mode>trunk</vlan-mode>
                        </mode>
                    </switchport>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="1913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. Issue an additional RPC to remove the VLAN ranges from the trunk port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1914" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
```

```
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                    <switchport>
                        <trunk>
                            <allowed>
                                <vlan>
                                    <remove>30</remove>
                                </vlan>
                            </allowed>
                        </mode>
                    </switchport>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1914" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring protocol-based VLAN classifier rules

You can configure VLAN classifier rules to define specific rules for classifying frames to selected VLANs based on protocol and MAC addresses. Sets of rules can be grouped into VLAN classifier groups (refer to "Creating a VLAN classifier group and adding rules" on page 291).

VLAN classifier rules (1 through 256) are a set of configurable rules that reside in one of these categories:

- 802.1Q protocol-based classifier rules
- Source MAC address-based classifier rules
- Encapsulated Ethernet classifier rules

NOTE
Multiple VLAN classifier rules can be applied per interface provided the resulting VLAN IDs are unique for the different rules.

802.1Q protocol-based VLANs apply only to untagged frames, or frames with priority tagging.

With both Ethernet-II and 802.2 SNAP encapsulated frames, the following protocol types are supported:

- Ethernet hexadecimal (0x0000 through 0xffff)
- Address Resolution Protocol (ARP)
- Fibre Channel over Ethernet (FCoE)
- FCoE Initialization Protocol (FIP)
- IP version 6 (IPv6)

NOTE
For complete information on all available VLAN classifier rule options, refer to the *Network OS Command Reference*.

Configuring a VLAN classifier rule

To configure an ARP-based VLAN classifier rule, perform the following steps.

1. Issue an <edit-config> RPC to configure the <vlan> node in the urn:brocade.com:mgmt:brocade-vlan namespace.
2. Under the <vlan> node, include the <classifier>/<rule> hierarchy of node elements.
3. Under the <rule> node, include the <ruleid> element, and set it to an integer representing the rule ID.
4. Under the <rule> element, specify the <proto> node element.
5. Under the <proto> node element, include the <proto-val> leaf element and set its value to “arp” to specify ARP.
6. Under the <proto> node element, include the <encap> element and set its value to “ethv2”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1915" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vlan xmlns="urn:brocade.com:mgmt:brocade-vlan">
                <classifier>
                    <rule>
                        <ruleid>5</ruleid>
                        <proto>
                            <proto-val>arp</proto-val>
                            <encap>ethv2</encap>
                        </proto>
                    </rule>
                </classifier>
            </vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1915" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

NOTE
Refer to the *Network OS Command Reference* for complete information on all the protocols available for specifying VLAN classifier rules.

Configuring MAC address-based VLAN classifier rules

To configure a MAC address-based VLAN classifier rule, perform the following steps.

1. Issue an <edit-config> RPC to configure the <vlan> node in the urn:brocade.com:mgmt:brocade-vlan namespace.
2. Under the <vlan> node, specify the <classifier>/<rule> hierarchy of node elements.
3. Under the <rule> element, specify the <ruleid> element, and give it an integer representing the rule ID.
4. Under the <rule> element, specify the <mac> node element.
5. Under the <mac> node element, include an <address> element and assign it a MAC address.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1916" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vlan xmlns="urn:brocade.com:mgmt:brocade-vlan">
                <classifier>
                    <rule>
                        <ruleid>5</ruleid>
                        <mac>
                            <address>0008.744c.7fid</address>
                        </mac>
                    </rule>
                </classifier>
            </vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1916" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Creating a VLAN classifier group and adding rules

VLAN classifier groups (1 through 16) can contain any number of VLAN classifier rules.

To configure a VLAN classifier group and add a VLAN classifier rule, perform the following steps.

1. Issue an <edit-config> RPC to configure the <vlan> node in the urn:brocade.com:mgmt:brocade-vlan namespace.
2. Under the <vlan> element, specify the <classifier>/<group> hierarchy of node elements.
3. Under the <group> element, specify the following leaf elements.
    a. In the <group-id> element, set an integer value to identify the classifier group.
    b. In the <oper> element, specify the value “add” to add the specified rule.
    c. In the <rule-name> element, specify the value “Rule”.
    d. In the <ruleid> element, set to an integer value that identifies the rule you want to add.

The following example creates classifier group 1 and adds rule 1 to it.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1917" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
```

```
        <target>
            <running/>
        </target>
        <config>
            <vlan xmlns="urn:brocade.com:mgmt:brocade-vlan">
                <classifer>
                    <group>
                        <groupid>1</groupid>
                        <oper>add</oper>
                        <rule-name>Rule</rule-name>
                        <ruleid>1</ruleid>
                    </group>
                </classifier>
            </vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1917" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Deleting a VLAN classifier rule

VLAN classifier groups (1 through 16) can contain any number of VLAN classifier rules.

To remove a VLAN classifier rule from a VLAN classifier group, perform the following steps.

1. Issue an <edit-config> RPC to configure the <vlan> node in the urn:brocade.com:mgmt:brocade-vlan namespace.
2. Under the <vlan> node, specify the <classifier>/<group> hierarchy of node elements.
3. Under the <group> element, specify the following leaf elements.
    a. In the <group-id> element, specify an integer value to identify the classifier group from which you want to remove a rule.
    b. In the <oper> element, specify “delete” to delete the specified rule.
    c. In the <rule-name> element, specify the value “Rule”.
    d. In the <ruleid> element, set an integer value that identifies the rule you want to delete.

The following example deletes rule 1 from classifier group 1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1918" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vlan xmlns="urn:brocade.com:mgmt:brocade-vlan">
                <classifier>
                    <group>
                        <groupid>1</groupid>
                        <oper>delete</oper>
                        <rule-name>Rule</rule-name>
                        <ruleid>1</ruleid>
                    </group>
```

```
            </classifier>
          </vlan>
       </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1918" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Activating a VLAN classifier group with an interface port

To associate a VLAN classifier group with an interface port, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, specify the following elements.
    a. In the <name> element, specify the port name in [*rbridge-id/*]s*lot/port* format.
    b. In the <shutdown> element, include the delete operation in the opening element tag to enable the port.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the <vlan> node element from the urn:brocade.cam:mgmt:brocade-vlan namespace.
5. Under the <vlan> node, include the <classifier>/<activate>/<group> hierarchy of node elements.
6. Under the <group> element, specify the following leaf elements to activate the interface and associate it with a VLAN interface.
    a. In the <group-id> element, set an integer value to identify the classifier group you want to associate with the interface.
    b. In the <vlan-name> element, specify the value “Rule”.
    c. In the <vlan> element, set an integer value that identifies the VLAN.

Group 1 and VLAN 2 are used in the following example. The example assumes that VLAN 2 already exists.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1919" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/10</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                    <vlan xmlns="urn:brocade.com:mgmt:brocade-vlan">
```

```
                        <classifier>
                            <activate>
                                <group>
                                    <groupid>1</groupid>
                                    <vlan-name>vlan</vlan-name>
                                    <vlan>2</vlan>
                                </group>
                            </activate>
                        </classifier>
                    </vlan>
                <tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1919" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Obtaining VLAN information

The following custom RPCs return information about VLANs:

- <get-interface-detail> returns information about the associated port interface.
- <get-vlan-brief> returns information about a specific VLAN.

Obtaining port interface information for one port

To return information about an associated port interface, issue the <get-interface-detail> custom RPC from the urn:brocade.com:mgmt:brocade-interface-ext namespace and specify the following input elements:

- In the <interface-type> element in the urn:brocade.com:mgmt:brocade-interface namespace, specify the interface type—For example “tengigabitethernet”.
- In the <interface-name> element from the urn:brocade.com:mgmt:brocade-interface namespace, specify the port name in the [*rbridge-id/*]*slot/port* format.

```
<rpc message-id="1920" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-interface-detail xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            tengigabitethernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">
            1/0/1</interface-name>
    </get-interface-detail>
</rpc>

rpc-reply message-id="1920" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            TenGigabitEthernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">1/0/1
            </interface-name>
        <ifindex xmlns="urn:brocade.com:mgmt:brocade-interface">67174401</ifindex>
        <mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</mtu>
        <ip-mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</ip-mtu>
        <if-name xmlns="urn:brocade.com:mgmt:brocade-interface"></if-name>
```

```
        <if-state xmlns="urn:brocade.com:mgmt:brocade-interface">up</if-state>
        <line-protocol-state xmlns="urn:brocade.com:mgmt:brocade-interface">up
            </line-protocol-state>
(output truncated)
```

Obtaining port information for a sequence of ports

To retrieve information for a sequence ports, issue the <get-interface-detail> RPC multiple times and use the <last-received-interface> node element on input.

Before issuing the <get-interface-detail> RPC, check the output of the previous invocation to determine whether the <has-more> boolean element is set to “true”. If so, information is available for additional interfaces; proceed as follows:

1. Issue the <get-interface-detail> RPC in the urn:brocade.com:mgmt:brocade-interface-ext namespace.
2. Under the <get-interface-detail> node, include the <last-received-interface> node element.
3. Under the <last-received-interface> node, include the following leaf elements.
    a. In the <interface-type> element in the urn:brocade.com:mgmt:brocade-interface namespace, specify the interface type—For example “tengigabitethernet”.
    b. In the <interface-name> element from theurn:brocade.com:mgmt:brocade-interface namespace, specify the port name in the [*rbridge-id/*]s*lot/port* format of the port for which information was returned in the last invocation of the <get-interface-detail> RPC.

       The <get-interface-detail> RPC returns information about the next port.
4. Check the <has-more> element in the output to determine whether information is available for additional port interfaces.
5. Repeat the procedure until the <has-more> element returns “false”.

```
<rpc message-id="1921" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-interface-detail xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            tengigabitethernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">
            1/0/1</interface-name>
    </get-interface-detail>
</rpc>

rpc-reply message-id="1921" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <interface-type xmlns="urn:brocade.com:mgmt:brocade-interface">
            tengigabitethernet</interface-type>
        <interface-name xmlns="urn:brocade.com:mgmt:brocade-interface">1/0/1
            </interface-name>
        <ifindex xmlns="urn:brocade.com:mgmt:interface">67174401</ifindex>
        <mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</mtu>
        <ip-mtu xmlns="urn:brocade.com:mgmt:brocade-interface">2500</ip-mtu>
        <if-name xmlns="urn:brocade.com:mgmt:brocade-interface"></if-name>
        <if-state xmlns="urn:brocade.com:mgmt:brocade-interface">up</if-state>
        <line-protocol-state xmlns="urn:brocade.com:mgmt:brocade-interface">up
            </line-protocol-state>
(output truncated)
    </interface>
    <has-more>true</has-more>
</rpc-reply>
```

Obtaining VLAN information for one VLAN

To return information about a specific VLAN, issue the <get-vlan-brief> custom RPC from the urn:brocade.com:mgmt:brocade-interface-ext namespace and specify the VLAN in the <vlan-id> input parameter.

```
<rpc message-id="1922" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-vlan-brief xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <vlan-id>20</vlan-id>
    </get-vlan-brief>
</rpc>

rpc-reply message-id="1922" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <vlan xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <vlanid>20</vlanid>
        <vlan-type>static</vlan-type>
        <vlan-name>vlan-20</vlan-name>
        <vlan-state>active</valan-state>
        <interface>
            <interface-type>tengigabitethernet</interface-type>
            <interfce-name>66/0/10</interface-name>
            <tag>tagged</tag>
        </interface>
    </vlan>
    <last-vlan-id>20</last-vlan-id>
    <has-more>true</has-more>
</rpc>
```

Obtaining VLAN information for multiple VLANs

To retrieve information for a sequence of VLANs, issue the <get-vlan-brief> RPC multiple times and specify the last received vlan ID on input.

Before issuing the <get-vlan-brief> RPC, check the output of the previous invocation to determine whether the <has-more> boolean element is set to “true”. If so, information about additional VLANs is available; proceed as follows.

1. Issue the <get-vlan-brief> RPC from the urn:brocade.com:mgmt:brocade-interface-ext namespace
2. Under the <get-vlan-brief> node, include the <last-received-vlan-id> input parameter and set its value to the VLAN ID returned in the <last-vlan-id> element of the previous invocation of the <get-vlan-brief> RPC.
3. Check the <has-more> element in the output to determine whether information is available for additional VLANs.
4. Repeat the procedure until the <has-more> element returns “false”.

```
<rpc message-id="1923" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-vlan-brief xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <last-received-vlan-id>20</last-recevied-vlan-id>
    </get-vlan-brief>
</rpc>

<rpc-reply message-id="1923" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <vlan xmlns="urn:brocade.com:mgmt:brocade-interface-ext">
        <vlanid>30</vlanid>
        <vlan-type>static</vlan-type>
        <vlan-name>vlan-30</vlan-name>
```

```
        <vlan-state>active</vlan-state>
        <interface>
            <interface-type>tengigabitethernet</interface-type>
            <interface-name>66/0/10</interface-name>
            <tag>tagged</tag>
        </interface>
    </vlan>
    <last-vlan-id>30</last-vlan-id>
    <has-more>true</has-more>
    </rpc-reply>
```

Configuring the MAC address table

Each DCB port has a MAC address table. The MAC address table stores a number of unicast and multicast address entries without flooding any frames. Brocade VDX hardware has a configurable aging timer. If a MAC address remains inactive for a specified number of seconds, it is removed from the address table.

Specifying or disabling the aging time for MAC addresses

You can set the length of time that a dynamic entry remains in the MAC address table after the entry is used or updated. Static address entries are never aged or removed from the table. You can also disable the aging time. The default is 300 seconds.

NOTE
To disable the aging time for MAC addresses, specify an aging time value of 0.

To specify an aging time or disable the aging time for MAC addresses, issue an <edit-config> RPC to configure the <mac-address-table> node in the urn:brocade.com:mgmt:brocade-mac-address-table namespace, and specify the aging time in the <aging-time> element.

The following example sets the aging time to 600 seconds.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1924" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac-address-table
            xmlns="urn:brocade.com:mgmt:brocade-mac-address-table">
                <aging-time>600</aging-time>
            </mac-address-table>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1924" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Adding static addresses to the MAC address table

To add a static address to the MAC address table, perform the following steps.

1. Issue an <edit-config> RPC to configure the <mac-address-table> node in the urn:brocade.com:mgmt:brocade-mac-address-table namespace.
2. Under the <mac-address-table> node, specify the <static> node element.
3. Under the <static> node element, specify the following leaf elements.
    a. In the <mac-address> element, specify a MAC address in the format nnnn.nnnn.nnnn.
    b. In the <forward> element, specify “forward”.
    c. In the <interface-type> element, specify the type of interface—For example “tengigabitethernet”.
    d. In the <interface-name> element, specify the name of the interface in the form [*rbridge-id/*]s*lot/port*.
    e. In the <vlan> element, specify “vlan”.
    f. In the <vlan-id> element, set an integer that identifies the VLAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1925" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac-address-table
            xmlns="urn:brocade.com:mgmt:brocade-mac-address-table">
                <static>
                    <mac-address>0011.2222.3333</mac-address>
                    <forward>forward</forward>
                    <interface-type>tengigabitethernet</interface-type>
                    <interface-name>66/0/1</interface-name>
                    <vlan>vlan</vlan>
                    <vlan-id>100</vlan-id>
                </static>
            </mac-address-table>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1925" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Private VLANs

A private VLAN (PVLAN) domain is built with at least one pair of VLAN IDs; one (and only one) primary VLAN ID plus one or more secondary VLAN IDs. A primary VLAN is the unique and common VLAN identifier of the whole private VLAN domain and of all its VLAN ID pairs. Secondary VLANs can be configured as one of two types; either isolated VLANs or community VLANs. Only one isolated VLAN can be part of one PVLAN domain.

An isolated VLAN is a secondary VLAN whose distinctive characteristic is that all hosts connected to its ports are isolated at Layer 2. A community VLAN is a secondary VLAN that is associated to a group of ports that connect to a designated community of end devices with mutual trust relationships.

Configuring a private VLAN

This procedure configures the PVLAN and associates the secondary VLAN with the primary VLAN.

1. Issue an <edit-config> RPC to configure the <vlan> node in the urn:brocade.com:mgmt:brocade-vlan namespace.
2. Under the <vlan> node, specify the <private-vlan>/<pvlan-type-leaf> hierarchy of node elements.
3. Under the <pvlan-type-leaf> element, give it the string value “primary”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
        <interface>
          <vlan>
            <name>200</name>
       <private-vlan>
           <pvlan-type-leaf>primary</pvlan-type-leaf>
       </private-vlan>
          </vlan>
        </interface>
      </interface-vlan>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring a community PVLAN

This procedure configures a community PVLAN.

1. Issue an <edit-config> RPC to configure the <vlan> node in the urn:brocade.com:mgmt:brocade-vlan namespace.
2. Under the <vlan> node, specify the <private-vlan>/<pvlan-type-leaf> hierarchy of node elements.
3. Under the <pvlan-type-leaf> element, give it the string value “community”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="55"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
```

```
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
        <interface>
          <vlan>
            <name>200</name>
        <private-vlan>
           <pvlan-type-leaf>community</pvlan-type-leaf>
        </private-vlan>
           </vlan>
         </interface>
      </interface-vlan>
    </config>
  </edit-config>
</rpc>>

<rpc-reply message-id="55" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring an isolated PVLAN

This procedure configures an isolated PVLAN.

1. Issue an <edit-config> RPC to configure the <vlan> node in the urn:brocade.com:mgmt:brocade-vlan namespace.
2. Under the <vlan> node, specify the <private-vlan>/<pvlan-type-leaf> hierarchy of node elements.
3. Under the <pvlan-type-leaf> element, give it the string value “isolated”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="55"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
        <interface>
          <vlan>
            <name>200</name>
        <private-vlan>
           <pvlan-type-leaf>isolated</pvlan-type-leaf>
        </private-vlan>
           </vlan>
         </interface>
      </interface-vlan>
    </config>
  </edit-config>
</rpc>>

<rpc-reply message-id="55" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Displaying PVLAN information

Use the <get-config> RPC to retrieve the current configuration data and operational state data. Refer to "Retrieving configuration data" on page 11 and "Retrieving operational data" on page 15 for detailed instructions.

Chapter

Configuring VXLANs

22

In this chapter

- VXLAN configuration with NETCONF overview 303
- VXLAN configuration and management 303

VXLAN configuration with NETCONF overview

This chapter provides procedures for configuring VXLANs using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of VXLANs
- An explanation of how VXLAN tunnel endpoints work
- Conceptual information about high-level communication in a VXLAN environment
- VXLAN configuration guidelines and restrictions
- Information to provide to virtual network administrators
- Scaling information

Through the NETCONF interface, you can perform the following operations on VXLANs:

- Use the <edit-config> RPC to configure VXLANs and NSX controllers.
- Use the <get-config> RPC to validate configuration settings.

VXLAN parameters are defined in the brocade-interface and brocade-VXLAN YANG modules. For structural maps of these YANG modules, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all VCS Fabric management parameters, refer to the brocade-interface.yang, and brocade-VXLAN.yang files.

VXLAN configuration and management

NOTE
Use the <bna-config-cmd> RPC to save your configuration changes.

High-level communication in a VXLAN environment

Figure 4 provides a basic view of the interaction of components in a VXLAN environment.

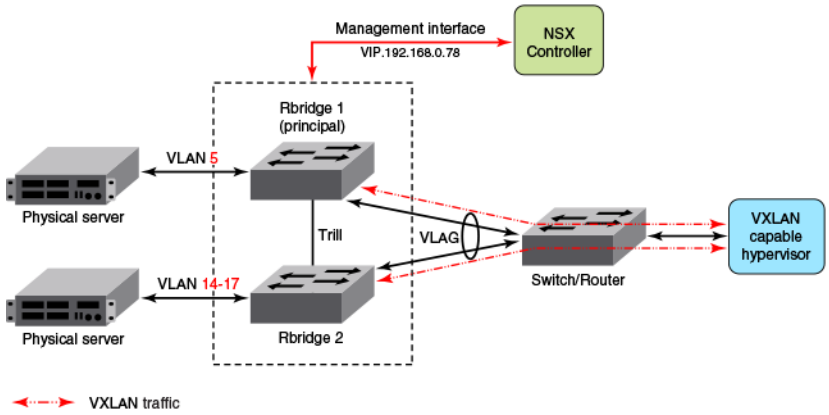

FIGURE 4 High-level communication for VXLAN gateway

VXLAN gateways must be part of a two-node virtual switching cluster. In the example shown in Figure 4, RBridge 1 and RBridge 2 make up the two-node cluster. These two RBridges combine to form the VXLAN gateway.

The current principal switch of the VXLAN gateway always communicates with the NSX controller. This communication occurs over what is known as the management interface (depicted by the red line in Figure 4).

VLXLAN gateways are supported only on the Brocade VDX 6740, 6740T, and 6740T-1G.

NOTE
VXLAN gateways must be in logical chassis cluster mode. This allows the VCS to present itself as a single device to the NSX Controller.

Configuring the VXLAN Gateway

Prerequisite steps:

- Before you configure the VXLAN gateway, you need to be sure that the RBridges are configured as part of a virtual-router-extended group.
- Ensure that you configure the identical VE and VRRP-E group on all the RBridges for the VXLAN gateway.
- Create a SPAN <session> element named **1**. This SPAN session must be pre-configured. Refer to Chapter 32, "Configuring Switched Port Analyzer".

The steps that follow show example VRRP-Extended group configuration for the RBridges shown in Figure 4.

The following steps illustrate how to configure a VXLAN gateway and point it to the NSX controller. This procedure uses data shown in Figure 4.

1. Establish a NETCONF session with the principal switch (Rbridge 1 in Figure 4).
2. Access the <overlay-gateway> container within the brocade-tunnels RPC to create the name for the VXLAN gateway.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <overlay-gateway xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>name1</name>
      </overlay-gateway>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Within the <overlay-gateway> container, include the <name> element and <attach> node to attach existing RBridge IDs to this VXLAN gateway instance. Set the <rb-add> element to 1-2. This adds RBridge IDs 1 and 2.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <overlay-gateway xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>name1</name>
        <attach>
          <rbridge-id>
            <rb-add>1,2</rb-add>
          </rbridge-id>
        </attach>
      </overlay-gateway>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. The <vlan> nodes need to be included in the <attach> node of the <overlay-gateway> container. Since multiple VLANs cannot be specified at one time using NETCONF. Multiple such requests needs to be sent for attaching multiple VLANs. For this example, you must repeat this step for VLANs 5, 14, 15, 16, and 17.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <overlay-gateway xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>name1</name>
        <attach>
          <vlan>
            <vid>5</vid>
            <mac>0000.0000.0000</mac>
```

```
          </vlan>
        </attach>
      </overlay-gateway>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="3" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

All the MAC addresses that the VXLAN gateway learns on these VLANs are shared with the NSX controller. When a MAC address ages out in VCS, the MAC address is removed from the NSX.

5. Within the <overlay-gateway> container, include the <ip>, <interface>, and set the <ve> node name and set the name for the <vrrp-extended-group> element to **100**.

   The VRRPE virtual IP configured for this VE and VRRP-E group are used as VXLAN gateway IP address.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="4">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <overlay-gateway xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>name1</name>
        <ip>
          <interface>
            <ve>
              <ve-id>10</ve-id>
              <vrrp-extended-group>100</vrrp-extended-group>
            </ve>
          </interface>
        </ip>
      </overlay-gateway>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="4" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

6. (optional) Within the <overlay-gateway> container, include the <enable> and <statistics> node so that you can set the <stats-direction> element value to **both** and the <vlan-action> element to **add**. Refer to the Network OS YANG Reference for additional options on these options.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="6">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <overlay-gateway xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>name1</name>
        <enable>
          <statistics>
            <stats-direction>both</stats-direction>
```

```
            <vlan-action>add</vlan-action>
            <vlan-list>5,15-17</vlan-list>
          </statistics>
        </enable>
      </overlay-gateway>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="6" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

7. (optional) Within the <overlay-gateway> container, include the <monitor> node. Set the element values for the <monitor> node as listed below:

   - Set the <session> element to **1**. This SPAN session must be pre-configured. Refer to Chapter 32, “Configuring Switched Port Analyzer”.
   - Set the <direction> element to both.Set the <remote-endpoint> element to **any**.
   - Set the <vlan-add-remove> element to **41-43**.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="7">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <overlay-gateway xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>name1</name>
        <monitor>
          <session>1</session>
          <direction>both</direction>
          <remote-endpoint>any</remote-endpoint>
          <vlan-add-remove>add</vlan-add-remove>
          <vlan-range>5,14-17</vlan-range>
        </monitor>
      </overlay-gateway>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="7" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

8. Within the <overlay-gateway> container, include the <activate/> element. The presence of this element activates the VXLAN gateway.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="8">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <overlay-gateway xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>name1</name>
        <activate></activate>
      </overlay-gateway>
    </config>
  </edit-config>
```

```
</rpc>

<rpc-reply message-id="8" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the NSX Controller

Prerequisite steps

Before you configure the NSX controller, complete the task in "Configuring the VXLAN Gateway" on page 304. The purpose of this task is to generate the security certificate for the VXLAN gateway. This procedure uses data shown in Figure 4.

1. Issue the <edit-config> RPC to edit the running configuration.
2. Access the <nsx-controller> container within the brocade-tunnels RPC with the name **controller1**.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="9">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <nsx-controller xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>controller1</name>
      </nsx-controller>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="9" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Within the <nsx-controller> container and the <name> node, set the element values for the <connection-addr> container as listed below:
   - Set the <address> element to the IP address for one of the NSX controllers in the control cluster, in this case **10.30.5.74**.
   - Set the <method> element to **ssl.**
   - Set the <port> element to **6632**.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="11">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <nsx-controller xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>controller1</name>
        <connection-addr>
          <address>10.30.5.74</address>
          <port>6632</port>
          <method>ssl</method>
        </connection-addr>
      </nsx-controller>
    </config>
```

```
  </edit-config>
</rpc>

<rpc-reply message-id="11" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

4. (optional) Within the <nsx-controller> container, include the <reconnect-interval> element to change the reconnect interval between the NSX controller and the VCS fabric in case the connection is lost. The default is 10 seconds, meaning that a reconnection is attempted every 10 seconds.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="12">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <nsx-controller xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>controller1</name>
        <reconnect-interval>7</reconnect-interval>
      </nsx-controller>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="12" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. Within the <nsx-controller> container, include the <activate/> element. The presence of this element activates the NSX controller profile.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="13">
  <edit-config>
    <target>
      <running></running>
    </target>
    <config>
      <nsx-controller xmlns="urn:brocade.com:mgmt:brocade-tunnels">
        <name>controller1</name>
        <activate></activate>
      </nsx-controller>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="13" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Displaying VXLAN information

Use the <get-config> RPC to retrieve the current configuration data and operational state data from the brocade-tunnels.YANG RPC module. Refer to “Retrieving configuration data” on page 11 for detailed instructions.

Chapter

23

Configuring Virtual Fabrics

In this chapter

- Virtual Fabric configuration with NETCONF overview 311

Virtual Fabric configuration with NETCONF overview

This chapter provides procedures for configuring a Virtual Fabric using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of Virtual Fabrics
- An explanation of how Virtual Fabrics work
- Virtual Fabric configuration guidelines and restrictions
- Virtual Fabric operations
- Virtual Fabric instance configurations
- Enabling Virtual Fabrics
- Configuring Layer 3 Virtual Fabric features
- Troubleshooting configuration failures
- Upgrading and downgrading firmware

Through the NETCONF interface, you can perform the following operations on Virtual Fabrics:

- Use the <edit-config> RPC to configure Virtual Fabrics.
- Use the <get-config> RPC to validate configuration settings.

Virtual Fabric parameters are defined in the brocade-interface and brocade-mac-address-table YANG modules. For structural maps of these YANG modules, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all VCS Fabric management parameters, refer to the brocade-interface.yang and brocade-vlan.yang files.

Configuring a Virtual Fabric instance

Configuring a Virtual Fabric instance consists of enabling Virtual Fabric configuration in the fabric, and then configuring a Virtual Fabric VLAN ID instance that is equal to or greater than 4096. Virtual Fabric supports up through 8192 VLANs, with 8191 being the largest VLAN ID that can be assigned.

Enabling Virtual Fabric configuration

Virtual Fabric is enabled by activating the <vfab-enable> node from the brocade-vcs.yang module.

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<rpc message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <vcs xmlns="urn:brocade.com:mgmt:brocade-vcs">
        <virtual-fabric><vfab-enable></vfab-enable></virtual-fabric>
      </vcs>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <ok/>
</rpc-reply>
```

Creating a Virtual Fabric instance

Under the <vlan> node, specify the <name> element containing the new VLAN ID, where vlan_id <name> element is a number equal to or greater than 4096 through 8191, and is not a reserved VLAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <edit-config>
              <target>
                  <running/>
              </target>
          <config>
          <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
              <interface>
                  <vlan>
                      <name>5000</name>
                  </vlan>
              </interface>
          </interface-vlan>
          </config>
       </edit-config>
</rpc>

<rpc-reply message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <ok/>
</rpc-reply>
```

Configuring additional Layer 2 Virtual Fabric features

This section addresses additional features that are available on trunk ports once a Virtual Fabric is established.

Configuring Virtual Fabrics and defining and associating PVLANs

The private VLANs (PVLANs) for a Virtual Fabric can be configured in the following three types:

- Primary VLAN
- Isolated VLAN

- Community VLAN

At least two of these three types of VLANS must be configured to create a Virtual Fabric.

1. Under the <vlan> node, specify the <name> element containing the new VLAN ID to create VLAN instances that are equal to or greater than 4096, through 8191. Repeat this command for three Virtual Fabrics: 5000, 6000, and 7000.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1110" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <edit-config>
              <target>
                  <running/>
              </target>
           <config>
           <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
              <interface>
                  <vlan>
                      <name>5000</name>
                  </vlan>
              </interface>
           </interface-vlan>
           </config>
       </edit-config>
</rpc>

<rpc-reply message-id="1110" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <ok/>
</rpc-reply>


<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1111" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <edit-config>
              <target>
                  <running/>
              </target>
           <config>
           <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
              <interface>
                  <vlan>
                      <name>6000</name>
                  </vlan>
              </interface>
           </interface-vlan>
           </config>
       </edit-config>
</rpc>

<rpc-reply message-id="1111" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <ok/>
</rpc-reply>


<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1112" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <edit-config>
              <target>
                  <running/>
              </target>
```

```
          <config>
          <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
              <interface>
                  <vlan>
                      <name>7000</name>
                  </vlan>
              </interface>
          </interface-vlan>
          </config>
       </edit-config>
</rpc>

<rpc-reply message-id="1112" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <ok/>
</rpc-reply>
```

2. Use the <pvlan-type-leaf> node to create the three types of PVLAN: primary, isolated, and community.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
        <interface>
          <vlan>
            <name>5000</name>
        <private-vlan>
           <pvlan-type-leaf>primary</pvlan-type-leaf>
        </private-vlan>
           </vlan>
        </interface>
      </interface-vlan>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>

<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="55"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
        <interface>
          <vlan>
            <name>6000</name>
        <private-vlan>
           <pvlan-type-leaf>isolated</pvlan-type-leaf>
```

```
        </private-vlan>
           </vlan>
         </interface>
       </interface-vlan>
     </config>
   </edit-config>
</rpc>

<rpc-reply message-id="55" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>


<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="55"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
        <interface>
          <vlan>
            <name>7000</name>
        <private-vlan>
           <pvlan-type-leaf>isolated</pvlan-type-leaf>
        </private-vlan>
           </vlan>
         </interface>
       </interface-vlan>
     </config>
   </edit-config>
</rpc>

<rpc-reply message-id="55" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

3. Using the <private-vlan>/<association> node, associate the secondary PVLANs (isolated and community) with the primary PVLAN using the <sec-assoc-add> node.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1104" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <edit-config>
              <target>
                  <running/>
              </target>
          <config>
          <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
              <interface>
                  <vlan>
                      <name>5000</name>
                          <private-vlan>
                              <association>
                                  <sec-assoc-add>6000</sec-assoc-add>
                              </association>
                          </private-vlan>
              </vlan>
       </interface>
```

```
            </interface-vlan>
            </config>
        </edit-config>
</rpc>

<rpc-reply message-id="1104" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <ok/>
</rpc-reply>


<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1105" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <edit-config>
                <target>
                    <running/>
                </target>
            <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <vlan>
                        <name>5000</name>
                            <private-vlan>
                                <association>
                                    <sec-assoc-add>7000</sec-assoc-add>
                                </association>
                            </private-vlan>
                </vlan>
                </interface>
            </interface-vlan>
            </config>
        </edit-config>
</rpc>

<rpc-reply message-id="1105" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <ok/>
</rpc-reply>
```

Configuring physical interfaces

The physical interfaces can be configured in the following five types:

- Switchport-private-vlan-host mapped to isolated or community VLANs associated on the access port.
- Switchport-private-vlan-trunk-host mapped to isolated or community VLANs associated on the trunk port.
- Switchport-private-vlan-promiscuous mapped to primary VLANs associated on the access port.
- Switchport-private-vlan-trunk-promiscuous mapped to primary VLANs associated on the trunk port.
- Switchport-private-vlan-trunk mapped to primary, isolated, community, or standard VLANs associated on the trunk port.

The following task is one possible example of configuring the physical interface. For additional examples, refer to "Configuring a trunk Virtual Fabric with a range of C-TAGs" on page 319, "Configuring native Virtual Fabric on interfaces" on page 322, and "Configuring access Virtual Fabric on interfaces" on page 324.

1. Create classification rules for the primary and isolated or community VLANs at the respective primary and host ports.

   a. Use the <private-vlan-trunk> and <trunk-promiscuous/> nodes to configure interface tengigabitethernet 11/0/1 as the primary promiscuous trunk port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
           <tengigabitethernet>
               <name>11/0/1</name>
                   <switchport-basic>
                    <basic/>
                   </switchport-basic>
               <switchport>
                    <mode>
                        <private-vlan>
                            <private-vlan-trunk>
                                <trunk-promiscuous/>
                            </private-vlan-trunk>
                        </private-vlan>
                    </mode>
               </switchport>
           </tengigabitethernet>
           </interface>
       </interface-vlan>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

   b. Use the <private-vlan-trunk> and <trunk-host/> nodes to configure interface tengigabitethernet 11/0/2 as the isolated trunk port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="5"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
           <tengigabitethernet>
               <name>11/0/2</name>
               <switchport-basic>
                    <basic/>
               </switchport-basic>
               <switchport>
                    <mode>
                        <private-vlan>
```

```
                        <private-vlan-trunk>
                            <trunk-host/>
                        </private-vlan-trunk>
                    </private-vlan>
                </mode>
            </switchport>
        </tengigabitethernet>
        </interface>
    </interface-vlan>
  </config>
 </edit-config>
</rpc>

<rpc-reply message-id="5" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

c. Use the <private-vlan-trunk> and <trunk-host/> nodes to configure interface tengigabitethernet 11/0/3 as the community trunk port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="7"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
    <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
          <tengigabitethernet>
              <name>11/0/3</name>
                  <switchport-basic>
                      <basic/>
                  </switchport-basic>
                  <switchport>
                      <mode>
                          <private-vlan>
                              <private-vlan-trunk>
                                  <trunk-host/>
                              </private-vlan-trunk>
                          </private-vlan>
                      </mode>
                  </switchport>
          </tengigabitethernet>
          </interface>
        </interface-vlan>
    </config>
  </edit-config>
</rpc>

<rpc-reply message-id="7" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

2. Use the <vfabric-trunk-vlan-id> and <vfabric-trunk-ctag-range> nodes to configure the PVLAN association on the promiscuous trunk port with C-TAG 10. You must also add 6000 and 7000 to the mapping using the <oper> node. The <promis-pri-pvlan> node sets 5000 to be the promiscuous trunk port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
 <target>
  <running/>
 </target>
 <config>
 <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
  <tengigabitethernet>
   <name>1/0/1</name>
   <switchport>
    <trunk>
     <trunk-vlan-classification>
      <allowed>
       <vlan>
        <add>
         <trunk-vlan-id>5000</trunk-vlan-id>
         <trunk-ctag-range>10</trunk-ctag-range>
        </add>
       </vlan>
      </allowed>
     </trunk-vlan-classification>
    </trunk>
    <private-vlan>
     <mapping>
      <promis-pri-pvlan>5000</promis-pri-pvlan>
      <oper>add</oper>
      <promis-sec-pvlan-range>6000,7000</promis-sec-pvlan-range>
     </mapping>
    </private-vlan>
   </switchport>
  </tengigabitethernet>
 </interface>
 </config>
</edit-config>
</rpc>

<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring a trunk Virtual Fabric with a range of C-TAGs

When configuring a trunk Virtual Fabric with a range of C-TAGs on the interface, it is important to remember that the range of C-TAGs is applicable only for a trunk Virtual Fabric.

To configure the trunk Virtual Fabric requires two RPCs. The first RPC configures the port as a Layer 2 interface; the second RPC configures the Virtual Fabric with a trunk classification.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:

a. In the <name> element, specify the port name in [*rbridge-id/*]s*lot/port* format.

b. Include the <switchport>/<basic> elements to configure the port as a trunk Virtual Fabric using the <vlan-mode> element.

c. Add the <trunk-vlan-classification> element and include the <vlan> element.

d. Specify the <trunk-vlan-id> value and the <trunk-ctag-range> value.

The following example configures 10-Gigabit Ethernet port 1/0/1 as a trunk VLAN with a C-TAG range.

```
<?xml version="1.0" encoding="UTF-8"?>
    <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
        xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
         <edit-config>
             <target>
                <running/>
              </target>
              <config>
                 <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                  <tengigabitethernet
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
                   <name>1/0/1</name>
                   <switchport-basic> <basic/></switchport-basic>
                   <switchport>
                     <mode>
                      <vlan-mode>trunk</vlan-mode>
                     </mode>
                     <trunk>
                      <trunk-vlan-classification>
                       <allowed>
                        <vlan>
                         <add>
                           <trunk-vlan-id>6011</trunk-vlan-id>
                           <trunk-ctag-range>51-68</trunk-ctag-range>
                          </add>
                        </vlan>
                       </allowed>
                     </trunk-vlan-classification>
                  </trunk>
                 </switchport>
              </tengigabitethernet>
            </interface>
          </config>
         </edit-config>
       </rpc>
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring a trunk Virtual Fabric with a single C-TAG.

When configuring a trunk Virtual Fabric with a single C-TAG on the interface, it is important to remember that the C-TAG is applicable only for a trunk VLAN.

Configuring the trunk Virtual Fabric requires two RPCs. The first RPC configures the port as a Layer 2 interface; the second RPC configures the Virtual Fabric with a trunk classification and the C-TAG.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:
   a. In the <name> element, specify the port name in [*rbridge-id/*]s*lot/port* format.
   b. Include the <switchport>/<basic> elements to configure the port as a trunk Virtual Fabric using the <vlan-mode> element.
   c. Add the <trunk-vlan-classification> element and include the <vlan> element.
   d. Specify the <trunk-vlan-id> value and the <trunk-ctag-range> value.

   The following example configures 10-Gigabit Ethernet port 1/0/1 as a trunk VLAN with a C-TAG range.

```
<?xml version="1.0" encoding="UTF-8"?>
    <rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
        xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
         <edit-config>
             <target>
                <running/>
              </target>
              <config>
                 <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                  <tengigabitethernet
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
                    <name>1/0/1</name>
                    <switchport-basic> <basic/></switchport-basic>
                    <switchport>
                      <mode>
                       <vlan-mode>trunk</vlan-mode>
                      </mode>
                      <trunk>
                       <trunk-vlan-classification>
                        <allowed>
                         <vlan>
                          <add>
                            <trunk-vlan-id>5001</trunk-vlan-id>
                            <trunk-ctag-range>10</trunk-ctag-range>
                           </add>
                         </vlan>
                        </allowed>
                      </trunk-vlan-classification>
                    </trunk>
                  </switchport>
                </tengigabitethernet>
              </interface>
            </config>
          </edit-config>
        </rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring native Virtual Fabric on interfaces

To configure the native Virtual Fabric classifications requires two RPCs. The first RPC configures the port as a Layer 2 interface; the second RPC configures the native VLAN classification.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:
   a. In the <name> element, specify the port name in [*rbridge-id/*]s*lot/port* format.
   b. Include the <switchport>/<basic> elements to configure the port as a trunk VLAN using the <vlan-mode> element.
   c. Add the <native-vlan-classification> element and include the <vlan> element.
   d. Specify the <native-vlan-id> value.

   The following example configures 10-Gigabit Ethernet port 1/0/1 as a native VLAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
          <name>1/0/1</name>
          <switchport>
            <trunk>
              <native-vlan-classification>
                <native-vlan-id>300</native-vlan-id>
              </native-vlan-classification>
            </trunk>
          </switchport>
        </tengigabitethernet>
      </interface>
    </config>
  </edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

4. The following NETCONF xml request configures the native-vlan-xtagged on an Layer 2 interface in trunk-no-default-native mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
```

```
        <running/>
    </target>
    <config>
        <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet
        xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
            <name>1/0/1</name>
            <switchport>
            <trunk>
            <native-vlan-xtagged-config>
                <native-vlan-id-xtagged>5000</native-vlan-id-xtagged>
                <native-vlan-ctag-id-xtagged>50</native-vlan-ctag-id-xtagged>
                <native-vlan-egress-type-xtagged>tagged
                       </native-vlan-egress-type-xtagged>
            </native-vlan-xtagged-config>
            </trunk>
            </switchport>
        </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

5. The following NETCONF xml request configured the native-vlan-untagged on an L2 interface in trunk-no-default-native mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <name>1/0/1</name>
        <switchport>
        <trunk>
        <native-vlan-untagged-config>
            <native-vlan-id-untagged>5001</native-vlan-id-untagged>
        </native-vlan-untagged-config>
        </trunk>
        </switchport>
    </tengigabitethernet>
    </interface>
</config>
</edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring access Virtual Fabric on interfaces

To configure the interface as an access Virtual Fabric interface requires two RPCs. The first RPC configures the port as a Layer 2 interface; the second RPC configures the interface port as an access Virtual Fabric with a MAC address.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:
   a. In the <name> element, specify the port name in [*rbridge-id/*]s*lot/port* format.
   b. In the <shutdown> element, include the delete operation in the element opening tag to enable the interface port.
   c. Include the <switchport>/<basic> elements to configure the port as a Layer 2 interface.
   d. Add the <access-mac-vlan-classification> element and include the <vlan> element.
   e. Specify the <access-vlan-id> value and the <access-mac-address> value.

   The following example configures 10-Gigabit Ethernet port 1/0/1 as an access VLAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet
            xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
          <name>1/0/1</name>
          <switchport-basic>
            <basic/>
        </switchport-basic>
          <switchport>
             <access-mac-vlan-classification>
              <access>
                <vlan>
                  <access-vlan-id>5002</access-vlan-id>
                  <access-mac-address>000a.000b.0002</access-mac-address>
                </vlan>
              </access>
            </access-mac-vlan-classification>
          </switchport>
        </tengigabitethernet>
      </interface>
    </config>
  </edit-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
```

```
</rpc-reply>
```

Configuring an access Virtual Fabric with a MAC group

To configure the interface as an access Virtual Fabric interface requires two RPCs. The first RPC configures the port as a Layer 2 interface; the second RPC configures the interface port as an access Virtual Fabric with a MAC group.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the interface type element (<gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet>).
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> element, include the following elements:
   a. In the <name> element, specify the port name in [*rbridge-id/*]*slot/port* format.
   b. In the <shutdown> element, include the delete operation in the element opening tag to enable the interface port.
   c. Include the <switchport>/<basic> elements to configure the port as a Layer 2 interface.
   d. Add the <access-mac-group-classification> element and include the <vlan> element.
   e. Specify the <access-vlan-id> value and the <access-mac-group> value.

   The following example configures 10-Gigabit Ethernet port 1/0/1 as an access VLAN with a MAC group.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
      <running/>
    </target>
    <config>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
          <name>1/0/1</name>
          <switchport-basic>
            <basic/>
         </switchport-basic>
          <switchport>
             <access-mac-group-vlan-classification>
                <access>
                  <vlan>
                    <access-vlan-id>5001</access-vlan-id>
                    <access-mac-group>1</access-mac-group>
                  </vlan>
                </access>
             </access-mac-group-vlan-classification>
          </switchport>
        </tengigabitethernet>
      </interface>
    </config>
  </edit-config>
</rpc>
```

```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring MAC groups

You can create a group of Virtual Machine (VM) MAC addresses to support Virtual Fabrics at an access port. You can specify the list of MAC addresses in the <mac-group> element and then associate the list with a VLAN on an interface.

Creating a MAC group instance and assigning MAC addresses

Create a MAC group instance to define the MAC addresses of end stations by using the <mac-group> node. The value of <mac-group-id> ranges from 1 through 500. Use the <entry_address> node to add one or more addresses in hexadecimal notation.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac-group xmlns="urn:brocade.com:mgmt:brocade-mac-address-table">
                 <mac-group-id>1</mac-group-id>
                    <mac-group-entry>
                        <entry-address>000a.0001.0001</entry-address>
                    </mac-group-entry>
                    <mac-group-entry>
                        <entry-address>000a.0001.0002</entry-address>
                    </mac-group-entry>
                </mac-group>
            <mac-group xmlns="urn:brocade.com:mgmt:brocade-mac-address-table">
                 <mac-group-id>2</mac-group-id>
                    <mac-group-entry>
                        <entry-address>000a.0002.0001</entry-address>
                    </mac-group-entry>
                    <mac-group-entry>
                        <entry-address>000a.0002.0002</entry-address>
                    </mac-group-entry>
                </mac-group>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Deleting a MAC group

Use the standard NETCONF process to delete a MAC group using the <mac-group-id> node.

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <mac-group xmlns="urn:brocade.com:mgmt:brocade-mac-address-table">
            <mac-group-id xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                   operation="delete"/>
        </mac-group>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Transport service

This section describes tasks for configuring the transport service for Virtual Fabrics.

Configuring transport service ID on a VLAN

NOTE
Spanning tree must be shutdown on this VLAN before executing this procedure. Refer to "Disabling STP on a VLAN" on page 282.

On Brocade VDX hardware, VLANs are treated as interfaces from a configuration viewpoint.

By default, all the DCB ports are assigned to VLAN 1 (VLAN ID equals 1). The VLAN ID can be 1 through 8192, but VLAN IDs 3584 through 4094 are internally-reserved VLAN IDs. VLAN 8191 is the largest VLAN ID that can be assigned.

To create a VLAN interface, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace,
2. Under the <interface-vlan> element, specify the <interface>/<vlan> hierarchy of node elements.
3. Under the <vlan> node, specify the <name> element containing the new VLAN ID.
4. Under the <vlan> node, specify the <transport-service> element containing the new transport service ID.

The following example creates VLAN 6011 with transport service 21. Multiple VLANs can be created in one NETCONF call.

```
<?xml version="1.0" encoding="UTF-8"?> - not throeing error
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
```

```
      <running/>
    </target>
    <config>
      <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
        <interface>
           <vlan>
             <name>6011</name>
             <transport-service>21</transport-service>
           </vlan>
        </interface>
       </interface-vlan>
     </config>
   </edit-config>
</rpc>

<?xml version="1.0" encoding="UTF-8"?>
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"><ok/></rpc-reply>]]>]]>
```

Chapter

24

Configuring Spanning Tree Protocols

In this chapter

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- Configuring STP 330
- Configuring RSTP 332
- Configuring MSTP 335
- Configuring PVST and Rapid PVST 337
- Spanning tree configuration and management 338
- Retrieving spanning tree-related information 355
- Configuring all xSTP on DCB interface ports 356

Spanning tree configuration with NETCONF overview

This chapter provides procedures for configuring STP, RSTP, MSTP, PVST, and Rapid PVST using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- Overviews of STP, RSTP, MSTP, PVST, and Rapid PVST
- Configuration guidelines and restrictions
- A summary of spanning tree configuration default values
- How to perform spanning tree operations using the Network OS command line interface
- Spanning Tree Protocol and VCS mode
- Spanning Tree Protocol and DiST

Through the NETCONF interface, you can perform the following operations on STP, RSTP, MSTP, PVST, and Rapid PVST:

- Use the <edit-config> RPC to configure spanning tree globally and on each interface.
- Use the <get-stp-brief-info> custom RPC to obtain operational information about the spanning tree protocols.
- Use the <get-config> RPC to validate configuration settings.
- STP, RSTP, MSTP, PVST, and Rapid PVST parameters are defined in the brocade-xstp YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Configuring STP

To configure STP, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp> node element to configure global STP parameters.

   Refer to "Enabling STP, RSTP, MSTP, PVST, or Rapid PVST" on page 338 for details.
4. Under the STP node, designate the root switch using the <bridge-priority> leaf node.

   For details, refer to "Specifying the bridge priority for all xSTP" on page 340. The range is 0 through 61440 and the priority values can be set only in increments of 4096. The default value is 32768.

```
<protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
    <spanning-tree>
        <stp>
            <bridge-priority>28672</bridge-priority>
        </stp>
    </spanning-tree>
</protocol>
```

5. *Optional*: Enable the port fast feature on switch ports that connect directly to workstations or PCs.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <name>22/0/10</name>
        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete"/>
        <spanning-tree>
            <portfast>
                <portfastbasic/>
            </portfast>
        </spanning-tree>
    </tengigabitethernet>
</interface>
```

   For details, refer to "Enabling port fast (STP and PVST)" on page 366.
6. Repeat step 5 for every port connected to a workstation or PC.

NOTE
Do not enable port fast on ports that connect to other switches.

Enabling port fast on ports can cause temporary bridging loops, in both trunking and non-trunking mode.

7. To influence selection of the root port, set the port priority.

   The range is 0 through 240 in increments of 16. The default is 128. A lower number designates a higher priority.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <name>22/0/13</name>
        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete"/>
        <spanning-tree>
            <priority>32</priority>
        </spanning-tree>
    </tengigabitethernet>
</interface>
```

For details, refer to "Specifying the port priority" on page 367.

8. *Optional:* Enable the guard root feature on a port.

   All other switch ports connected to other switches and bridges are automatically placed in blocking mode.

   Do not apply the guard root to ports connected to workstations or PCs: these ports remain in the forwarding state.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <name>22/0/1</name>
        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete"/>
        <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
            <guard>
                <root/>
            </guard>
        </spanning-tree>
    </tengigabitethernet>
</interface>
```

   For detailed information, refer to "Enabling the guard root (STP and RSTP)" on page 360.

9. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example enables STP, designates a root switch, enables port fast on two ports, and establishes the root port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2000" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree>
                    <stp>
                        <bridge-priority>28672</bridge-priority>
                    </stp>
                </spanning-tree>
            </protocol>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/10</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree>
                        <portfast>
```

```
                        <portfastbasic/>
                    </portfast>
                </spanning-tree>
            </tengigabitethernet>
            <tengigabitethernet>
                <name>22/0/11</name>
                <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                <spanning-tree>
                    <portfast>
                        <portfastbasic/>
                    </portfast>
                </spanning-tree>
            </tengigabitethernet>
            <tengigabitethernet>
                <name>22/0/13</name>
                <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                <spanning-tree>
                    <priority>32</priority>
                </spanning-tree>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2000" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

When the spanning tree topology is completed, the network switches send and receive data only on the ports that are part of the spanning tree. Data received on ports that are not part of the spanning tree is blocked.

NOTE
Brocade recommends leaving other STP variables at their default values.

For more information on STP, refer to "Spanning tree configuration and management" on page 338.

Configuring RSTP

The basic process for configuring RSTP is as follows.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <rstp> node element.

   Refer to "Enabling STP, RSTP, MSTP, PVST, or Rapid PVST" on page 338 for details.
4. Under the <rstp> node, designate the root switch using the <bridge-priority> leaf node.

For details, refer to "Specifying the bridge priority for all xSTP" on page 340. The range is 0 through 61440 and the priority values can be set only in increments of 4096. The default value is 32768.

```
<protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
    <spanning-tree>
        <stp>
            <bridge-priority>28672</bridge-priority>
        </stp>
    </spanning-tree>
</protocol>
```

5. Under the <rstp> node, set other RSTP parameters including the bridge forward delay, maximum aging time, error disable timeout period, port channel path cost, and hello time.

```
<protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
    <spanning-tree>
        <rstp>
            <forward-delay>20</forward-delay>
            <max-age>25<max-age>
            <error-disabled-timeout>
                <enable/>
                <interval>60</interval>
            </error-disabled-timeout>
            <port-channel>
                <path-cost>custom</path-cost>
            </port-channel>
            <hello-time>5</hello-time>
        </rstp>
    </spanning-tree>
</protocol>
```

6. *Optional*: Enable the edge port feature on switch ports that connect directly to a workstations or PC.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <name>22/0/10</name>
        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete"/>
        <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
            <edgeport>
                <edgeportbasic/>
            </edgeport>
        </spanning-tree>
    </tengigabitethernet>
</interface>
```

For details, refer to "Enabling a port (interface) as an edge port" on page 359.

7. Repeat step 6 for every port connected to workstations or PCs.

NOTE
Do not enable port fast on ports that connect to other switches.

Enabling port fast on ports can cause temporary bridging loops, in both trunking and non-trunking mode.

8. To influence selection of the root port, set the port priority.

The port priority range is 0 through 240 in increments of 16. The default is 128. A lower number designates a higher priority.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <name>22/0/13</name>
        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete"/>
        <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
            <priority>32</priority>
        </spanning-tree>
    </tengigabitethernet>
</interface>
```

For details, refer to "Specifying the port priority" on page 367.

9. *Optional:* Enable the guard root feature on a port.

   All other switch ports connected to other switches and bridges are automatically placed in blocking mode.

   Do not apply the guard root to ports connected to workstations or PCs: these ports remain in the forwarding state.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <name>22/0/1</name>
        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
             operation="delete"/>
        <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
            <guard>
                <root/>
            </guard>
        </spanning-tree>
    </tengigabitethernet>
</interface>
```

   For detailed information, refer to "Enabling the guard root (STP and RSTP)" on page 360.

10. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example enables RSTP, configures RSTP parameters, configures two interfaces as edge ports, and designates one interface the root port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree>
                    <rstp>
                        <bridge-priority>28582</bridge-priority>
                        <forward-delay>20</forward-delay>
                        <max-age>25<max-age>
                        <error-disabled-timeout>
                            <enable/>
                            <interval>60</interval>
                        </error-disabled-timeout>
                        <port-channel>
```

```
                        <path-cost>custom</path-cost>
                    </port-channel>
                    <hello-time>5</hello-time>
                </rstp>
            </spanning-tree>
        </protocol>
        <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
            <tengigabitethernet>
                <name>22/0/10</name>
                <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <edgeport>
                        <edgeportbasic/>
                    </edgeport>
                </spanning-tree>
            </tengigabitethernet>
            <tengigabitethernet>
                <name>22/0/11</name>
                <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <edgeport>
                        <edgeportbasic/>
                    </edgeport>
                </spanning-tree>
            </tengigabitethernet>
            <tengigabitethernet>
                <name>22/0/13</name>
                <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <priority>32</priority>
                </spanning-tree>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring MSTP

The basic process for configuring MSTP is as follows.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <mstp> node element to access the MSTP mode parameters.

   For more details, refer to "Enabling STP, RSTP, MSTP, PVST, or Rapid PVST" on page 338.

4. Under the <mstp> node, include the <region> node element and specify an MSTP region.

   For more details, refer to "Specifying a name for an MSTP region" on page 353.

5. Under the <mstp> node, include the <revision> element and specify a revision number for the MSTP configuration.

   For more details, refer to "Specifying a revision number for MSTP configuration" on page 354.

6. Under the <mstp> node, specify an <instance> node for each MSTP instance you want to configure.

7. Under each <instance> node, specify the following leaf nodes.

   a. In the <id> element, specify the instance ID.

   b. In the <vlan> element, specify the VLANs to be included in this MSTP instance.

   c. In the <priority> element, specify the instance priority.

   For more details, refer to "Mapping a VLAN to an MSTP instance" on page 352.

8. Under the <mstp> node, include the <max-hops> leaf element and specify the maximum hops for a BPDU to prevent the messages from looping indefinitely on the interface.

   For more details, refer to "Specifying the maximum number of hops for a BPDU (MSTP)" on page 353.

9. Issue the <bna-config-cmd> RPC to save the *running config* file to the *startup config* file and save the configuration changes.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2002" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
            <spanning-tree>
               <mstp>
                  <region>brocade1</region>
                  <revision>1</revision>
                  <instance>
                     <id>1</id>
                     <vlan>2,3</vlan>
                     <priority>4096</priority>
                  </instance>
                  <instance>
                     <id>2</id>
                     <vlan>4-6</vlan>
                  </instance>
                  <max-hops>25</max-hops>
               </mstp>
            </spanning-tree>
         </protocol>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="2002" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Configuring PVST and Rapid PVST

The basic process for configuring PVST or Rapid PVST is as follows.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <pvst> or <rpvst> node element to access the PVST or Rapid PVST mode parameters.

   For more details, refer to "Enabling STP, RSTP, MSTP, PVST, or Rapid PVST" on page 338.
4. Under the <pvst> or <rpvst> node, include the <bridge-priority> node element and specify the priority.

   A lower priority is more likely to designate the root switch. For more details, refer to "Specifying the bridge priority for all xSTP" on page 340.
5. Under the <pvst> or <rpvst> node, include the <forward-delay> element and specify how long an interface remains in the listening and learning states before the interface begins forwarding all spanning tree instances.

   For more details, refer to "Specifying the bridge forward delay for all xSTP" on page 342.
6. Under the <pvst> or <rpvst> node, specify a <hello-time> element to specify how often the switch interface broadcasts hello Bridge Protocol Data Units (BPDUs) to other devices.

   For more details, refer to "Specifying the bridge hello time for all xSTP" on page 348.
7. Under the <pvst> or <rpvst> node, include the <max-age> leaf element and control the maximum length of time that passes before an interface saves its Bridge Protocol Data Unit (BPDU) configuration information.

   For more details, refer to "Specifying the bridge maximum aging time for all xSTP" on page 344.
8. Issue the <bna-config-cmd> RPC to save the *running config* file to the *startup config* file and save the configuration changes.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2003" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree>
                    <pvst>
                        <bridge-priority>4096</bridge-priority>
                        <forward-delay>4</forward-delay>
                        <hello-time>2</hello-time>
                        <max-age>7</max-age>
                    </pvst>
                </spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
            </protocol>
        </config>
    </edit-config>
```

```
</rpc>

<rpc-reply message-id="2003" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Spanning tree configuration and management

This section provides procedures for setting global spanning tree parameters.

NOTE
Issue the <bna-config-cmd> RPC to save your configuration changes.

Enabling STP, RSTP, MSTP, PVST, or Rapid PVST

You enable STP to detect or avoid loops. STP is not required in a loop-free topology. You must turn off one form of STP before turning on another form. By default, STP, RSTP, MSTP, PVST, and Rapid PVST are not enabled.

To enable STP, RSTP, MSTP, PVST, or Rapid PVST, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2004" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp”>
                    <rstp/>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2004" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling STP, RSTP, MSTP, PVST, or Rapid PVST

NOTE
This procedure deletes the context and all the configurations defined within the context or protocol for the interface.

By default, STP, RSTP, MSTP, PVST, and Rapid PVST are not enabled.

To disable STP, RSTP, MSTP, PVST, or Rapid PVST, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace, and include the delete operation in the element tag.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2005" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp”
                 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2005" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Stopping STP, RSTP, MSTP, PVST, or Rapid PVST globally

To shut down STP, RSTP, MSTP, PVST, or Rapid PVST, globally, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the empty <shutdown> leaf element to shut down the spanning tree mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2006" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
```

```
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <rstp>
                        <shutdown/>
                    </rstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2006" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the bridge priority for all xSTP

For any spanning tree mode (STP, RSTP, MSTP, PVST, or Rapid PVST), use this procedure to specify the priority of the switch. After you decide on the root switch, set the appropriate values to designate the switch as the root switch. If a switch has a bridge priority that is lower than all the other switches, the other switches automatically select the switch as the root switch.

The root switch should be centrally located and not in a “disruptive” location. Backbone switches typically serve as the root switch because they often do not connect to end stations. All other decisions in the network, such as which port to block and which port to put in forwarding mode, are made from the perspective of the root switch.

Bridge Protocol Data Units (BPDUs) carry the information exchanged between switches. When all the switches in the network are powered up, they start the process of selecting the root switch. Each switch transmits a BPDU to directly connected switches on a per-VLAN basis. Each switch compares the received BPDU to the BPDU that the switch sent. In the root switch selection process, if switch 1 advertises a root ID that is a lower number than the root ID that switch 2 advertises, switch 2 stops the advertisement of its root ID, and accepts the root ID of switch 1. The switch with the lowest bridge priority becomes the root switch.

The priority range is 0 through 61440 and the priority values can be set only in increments of 4096. The default priority is 32678.

To specify the bridge priority, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the <bridge-priority> leaf element, and specify the bridge priority.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2007" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
```

```
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <bridge-priority>20480</bridge-priority>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2007" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the bridge priority on a per-VLAN basis

Using PRVT or Rapid-PVST, you may specify the bridge-priority for a specific VLAN. If the VLAN parameter is not provided, the priority value is applied globally for all per-VLAN instances. But for the VLANs which have been configured explicitly, the per-VLAN configuration takes precedence over the global configuration.

The VLAN ID value can be 1 through 3583. VLAN IDs 3584 through 4094 are internally-reserved VLAN IDs.

To specify a bridge priority for a specific VLAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <pvst>, or <rpvst> node element.
4. Under the <pvst>, or <rpvst> node, include the <vlan> node element.
5. Under the <vlan> node element, include the following leaf elements.
    a. In the <id> element, specify the VLAN ID.
    b. In the <priority> element, specify the bridge priority.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2008" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <pvst>
                        <vlan>
                            <id>100</id>
                            <priority>20480</priority>
                    </pvst>
                </spanning-tree>
            </protocol>
        </config>
```

```
    </edit-config>
</rpc>

<rpc-reply message-id="2008" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the bridge forward delay for all xSTP

For any spanning tree mode (STP, RSTP, MSTP, PVST, or Rapid PVST), use this procedure to specify how long an interface remains in the listening and learning states before the interface begins forwarding all spanning tree instances.

The range is 4 through 30 seconds. The default is 15 seconds. The following relationship should be kept:

2*(forward_delay - 1)>=max_age>=2*(hello_time + 1)

To specify the bridge forward delay, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the <forward-delay> leaf element, and specify the bridge forward delay.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2009" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <forward-delay>20</forward-delay>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2009" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying bridge forward delay on a per-VLAN basis

Using PVST or Rapid PVST, you may specify the forward delay for a specific VLAN. If the VLAN parameter is not provided, the priority value is applied globally for all per-VLAN instances. But for the VLANs which have been configured explicitly, the per-VLAN configuration takes precedence over the global configuration.

The VLAN ID value can be 1 through 3583. VLAN IDs 3584 through 4094 are internally-reserved VLAN IDs.

The range is 4 through 30 seconds. The default is 15 seconds. The following relationship should be kept:

2*(forward_delay - 1)>=max_age>=2*(hello_time + 1)

To specify the bridge forward delay for a specific VLAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <pvst>, or <rpvst> node element.
4. Under the <pvst>, or <rpvst> node, include the <vlan> node element.
5. Under the <vlan> node, include the following leaf elements.
    a. In the <id> element, specify the VLAN ID.
    b. In the <forward-delay> leaf element, and specify the bridge forward delay.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2010" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <rpvst>
                        <vlan>
                            <id>200</id>
                            <forward-delay>20</forward-delay>
                        </vlan>
                    </rpvst>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2010" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the bridge maximum aging time for all xSTP

For any spanning tree mode (STP, RSTP, MSTP, PVST, or Rapid PVST), use this procedure to control the maximum length of time that passes before an interface saves its Bridge Protocol Data Unit (BPDU) configuration information.

When configuring the maximum aging time, the max-age setting must be greater than the hello-time setting. The range is 6 through 40 seconds. The default is 20 seconds. The following relationship should be kept:

2*(forward_delay - 1)>=max_age>=2*(hello_time + 1)

To specify the bridge maximum aging time, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the <max-age> leaf element, and specify the bridge maximum aging limit.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2011" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <stp>
                        <max-age>25</max-age>
                    </stp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2011" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the bridge maximum aging time

Using PVST, or Rapid PVST, use this procedure on a per VLAN basis to control the maximum length of time that passes before an interface saves its Bridge Protocol Data Unit (BPDU) configuration information. For the VLANs which have been configured explicitly, the per-VLAN configuration takes precedence over the global configuration.

When configuring the maximum aging time, the max-age setting must be greater than the hello-time setting. The range is 6 through 40 seconds. The default is 20 seconds. The following relationship should be kept:

2*(forward_delay - 1)>=max_age>=2*(hello_time + 1)

To specify the bridge maximum aging time for a VLAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <pvst>, or <rpvst> node element.
4. Under the <pvst>, or <rpvst> node, include the <vlan> node element.
5. Under the <vlan> node, include the following leaf elements.
    a. In the <id> element, specify the VLAN ID.
    b. In the <max-age> leaf element, specify the bridge maximum aging limit for the specified VLAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2012" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <pvst>
                        <vlan>
                            <id>200</id>
                            <max-age>25</max-age>
                        </vlan>
                    </pvst>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2012" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling the error disable timeout timer for all xSTP

For any spanning tree mode (STP, RSTP, MSTP, PVST, or Rapid PVST), use this procedure to enable the timer to bring a port out of the disabled state. When the STP BPDU guard disables a port, the port remains in the disabled state unless the port is enabled manually. The <error-disable-timeout> node allows you to enable the port from the disabled state. For details on configuring the error disable timeout interval, refer to "Specifying the error disable timeout interval for all xSTP" on page 346.

By default, the timeout feature is disabled.

To enable the error disable timeout timer, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the <error-disable-timeout> node element.
5. Under the <error-disable-timeout> node, include the empty <enable> leaf element to enable the error disable timeout.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2013" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <error-disable-timeout>
                            <enable/>
                        </error-disable-timeout>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2013" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the error disable timeout interval for all xSTP

For any spanning tree mode (STP, RSTP, MSTP, PVST, or Rapid PVST), use this procedure to specify the time in seconds it takes for an interface to timeout. The range is 10 through 1000000 seconds. The default is 300 seconds. By default, the timeout feature is disabled.

To specify the time in seconds it takes for an interface to timeout, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the <error-disable-timeout> node element.

5. Under the <error-disable-timeout> node, include the <interval> element and specify the time in seconds it takes for an interface to timeout.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2014" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <error-disable-timeout>
                            <interval>60</interval>
                        </error-disable-timeout>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2014" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the port-channel path cost for all xSTP

For STP, RSTP, MSTP, PVST, or Rapid PVST, use this procedure to specify the port-channel path cost. The default port cost is **standard**. The path cost options are:

- **custom**—Specifies that the path cost changes according to the port-channel's bandwidth.
- **standard**—Specifies that the path cost does not change according to the port-channel's bandwidth.

To specify the port-channel path cost, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the <port-channel> node element
5. Under the <port-channel> node, include the <path-cost> leaf element and specify "custom" or "standard" to specify the port channel path cost.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2015" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
```

```
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <port-channel>
                            <path-cost>custom</path-cost>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2015" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the bridge hello time for all xSTP

For STP, RSTP, PVST, or Rapid PVST, use this procedure to configure the bridge hello time. The hello time determines how often the switch interface broadcasts BPDUs to other devices. The range is 1 through 10 seconds. The default is 2 seconds.

When configuring the hello time, the max-age setting must be greater than the hello-time setting. The following relationship should be kept:

2*(forward_delay - 1)>=max_age>=2*(hello_time + 1)

To specify the bridge hello time, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <stp>, <rstp>, <pvst>, or <rpvst> node element.
4. Under the <stp>, <rstp>, <mstp>, <pvst>, or <rpvst> node, include the <hello-time> leaf element and specify the time range in seconds for the interval between the hello BPDUs sent on an interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2016" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <pvst>
                        <hello-time>5</hello-time>
                    </pvst>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2016" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <ok/>
</rpc-reply>
```

Specifying the bridge hello time per VLAN (PVST or RPVST)

For PVST or Rapid PVST, use this procedure to configure the bridge hello time on a per VLAN basis. The hello time determines how often the switch interface broadcasts BPDUs to other devices. The range is 1 through 10 seconds. The default is 2 seconds. For the VLANs which have been configured explicitly, the per-VLAN configuration takes precedence over the global configuration.

When configuring the hello time, the max-age setting must be greater than the hello-time setting. The following relationship should be kept:

2*(forward_delay - 1)>=max_age>=2*(hello_time + 1)

To specify the bridge hello time for a specific VLAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <pvst>, or <rpvst> node element.
4. Under the <pvst>, or <rpvst> node, include the <vlan> node element.
5. Under the <vlan> node, include the following leaf elements.
    a. In the <id> element, specify the VLAN ID.
    b. In the <hello-time> leaf element and specify the time range in seconds for the interval between the hello BPDUs sent on an interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2017" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <pvst>
                        <vlan>
                            <id>200</vlan>
                            <hello-time>5</hello-time>
                        </vlan>
                    </pvst>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2017" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the transmit hold count

Use this procedure to configure the BPDU burst size by specifying the transmit hold count value. The <transmit-holdcount> node configures the maximum number of BPDUs transmitted per second for RSTP, MSTP, and Rapid PVST before pausing for 1 second. The range is 1 through 10. The default is 6.

To specify the transmit hold count, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <rstp>, <mstp>, or <rpvst> node element.
4. Under the <rstp>, <mstp>, or <rpvst> node, include the <transmit-holdcount> element and specify a value to configure the transmit hold count.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2018" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <transmit-holdcount>10</transmit-holdcount>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2018" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling Cisco interoperability (MSTP)

Use the this procedure to enable or disable the ability to interoperate with certain legacy Cisco switches. If Cisco interoperability is required on any switch in the network, then all switches in the network must be compatible, and therefore enabled using this procedure. The default is Cisco interoperability is disabled.

NOTE
The <cisco-interoperability> element is necessary because the “version 3 length” field in the MSTP BPDU on some legacy Cisco switches does not conform to current standards.

To enable interoperability with certain legacy Cisco switches, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <mstp> node element.
4. Under the <mstp> node, include the <cisco-interoperability> element and specify “enable” to enable interoperability with certain legacy Cisco switches.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2019" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <cisco-interoperability>enable</cisco-interoperability>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2019" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling Cisco interoperability (MSTP)

If you no longer require the ability to interoperate with certain Cisco legacy switches, use this procedure to deactivate this feature. By default, this ability is deactivated.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <mstp> node element.
4. Under the <mstp> node, include the <cisco-interoperability> element and specify “disable” to disable interoperability with certain legacy Cisco switches.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2020" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
```

```
                    <cisco-interoperability>disable</cisco-interoperability>
                </mstp>
            </spanning-tree>
        </protocol>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2020" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Mapping a VLAN to an MSTP instance

Use the this procedure to map a VLAN to an MTSP instance. You can group a set of VLANs to an instance. This <mstp> element can be mapped only after the VLAN is created. Refer to "Creating a VLAN interface" on page 280. VLAN instance mapping is removed from the configuration if the underlying VLANs are deleted.

To map a VLAN to an MSTP instance, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <mstp> node element.
4. Under the <mstp> node element, include the <instance> node element.
5. Under the <instance> node, include the following leaf elements.
    a. In the <id> element, specify the MSTP instance ID.
    b. In the <vlan> element, specify a VLAN to map to the MSTP instance.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2021" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <instance>
                            <id>5</id>
                            <vlan>300</vlan>
                        </instance>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="2021" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
```

```
</rpc-reply>
```

Specifying the maximum number of hops for a BPDU (MSTP)

Use this procedure to configure the maximum number of hops for a BPDU in an MSTP region. Specifying the maximum hops for a BPDU prevents the messages from looping indefinitely on the interface. When you change the number of hops, it affects all spanning tree instances. The range is 1 through 40. The default is 20 hops.

To configure the maximum number of hops for a BPDU in an MSTP region, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <mstp> node element.
4. Under the <mstp> node, include the <max-hops> element and specify the maximum number of hops for a BPDU in an MSTP region.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2022" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <max-hops>30</max-hops>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2022" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying a name for an MSTP region

Use this procedure to assign a name to an MSTP region. The region name has a maximum length of 32 characters and is case-sensitive.

To assign a name to an MSTP region, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <mstp> node element.

4. Under the <mstp> node, include the <region> element and specify an MSTP region.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2023" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <region>sydney</region>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2023" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying a revision number for MSTP configuration

Use this procedure to specify a revision number for an MSTP configuration. The range is 0 through 255. The default is 0.

To specify a revision number for an MSTP configuration, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <spanning-tree> node from the urn:brocade.com:mgmt:brocade-xstp namespace.
3. Under the <spanning-tree> node, include the <mstp> node element.
4. Under the <mstp> node, include the <revision> element and specify a revision number for an MSTP configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2024" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <mstp>
                        <revision>17</revision>
                    </mstp>
                </spanning-tree>
            </protocol>
        </config>

    </edit-config>
</rpc>
```

```
<rpc-reply message-id="2024" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Retrieving spanning tree-related information

Use the <get-stp-brief-info> custom RPC to display STP, RSTP, MSTP, PVST, or Rapid-PVST-related information.

Issue the <get-stp-brief-info> custom RPC located in the urn:brocade.com:mgmt:brocade-xstp-ext namespace without any input parameters to retrieve the first spanning tree instance. If multiple spanning tree instances exist, the <has-more> element in the output returns “true”. If the <has-more> element returns true, you can retrieve the next spanning tree instance by specifying the value returned in the <instance-id> element of the output as an input parameter in the <,last-rcvd-instance>/<instance-d> field of the next invocation of the <get-stp-brief-info> RPC.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2025">
    <get-stp-brief-info xmlns="urn:brocade.com:mgmt:brocade-xstp-ext"/>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2025">
    <get-stp-brief-info xmlns="urn:brocade.com:mgmt:brocade-xstp-ext">
        <spanning-tree-info>
            <stp-mode>STP</stp-mode>
                <stp>
                    <route-bridge>
                        <priority>32768<priority>
                        <bridge-id>22<bridge-id>
                        <hello-time>2<hello-time>
                        <max-age>20</max-age>
                        <forward-delay>15</forward-delay>
                    </route-bidge>
                    <bridge>
                        <priority>32768</priority>
                        <bridge-id>22</bridge-id>
                        <hello-time>2<hello-time>
                        <max-age>20</max-age>
                        <forward-delay>15</forward-delay>
                    <transmit-hold-count>6</transit-hold-count>
                    <migrate-time>3</migrate-time>
                    <port>
                        <interface-type>Tengigabitethernet</interface-type>
                        <interface-name>22/0/1</interface-name>
                        <spanningtree-enabled>true<spanningtree-enabled>

(output truncated)

        </spanning-tree-info>
        <has-more>true</has-more>
        <last-instance>
            <instance-id>91</instance-id>
        </last-instance>
    </get-stp-brief-info>
</rpc-reply>
```

Reissue the RPC, using the value returned in the <instance-id> element as an input parameter to return the next spanning tree instance. You can continue to repeat the RPC until <has-more> returns false.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2026">
    <get-stp-brief-info xmlns="urn:brocade.com:mgmt:brocade-xstp-ext">
        <last-rcvd-instance>
            <instance-id>91</instance-id>
        </last-rcvd-instance>
    </get-stp-brief-info>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2026">
    <get-stp-brief-info xmlns="urn:brocade.com:mgmt:brocade-xstp-ext">
        <spanning-tree-info>

(output truncated)

        </spanning-tree-info>
        <has-more>false</has-more>
        <last-instance>
            <instnace-id>92</instance-id>
        </last-instance>
    </get-stp-brief-info>
</rpc-reply>
```

Configuring all xSTP on DCB interface ports

This section details the procedures for enabling and configuring STP, RSTP, MSTP, PVST, or Rapid PVST on individual 10-Gigabit, 1-Gigabit, and 40-Gigabit Ethernet DCB interface ports and port channels.

NOTE
In Brocade VCS Fabric mode, all STP options are disabled. Only when the switch is in standalone mode does it support STP, RSTP, MSTP, PVST and rapid PVST on interface ports.

NOTE
Issue the <bna-config-cmd> RPC to save your configuration changes.

Enabling automatic edge detection (RSTP, MSTP, or RPVST)

Use this procedure to automatically identify the edge port. The port can become an edge port if no BPDU is received. By default, automatic edge detection is disabled.

To enable automatic edge detection on the DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.

a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.

b. In the <shutdown> element, include the delete operation in the element tag to enable the port.

c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.

4. Under the <spanning-tree> node, include the empty <autoedge> leaf element to enable automatic edge detection on the DCB interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2027" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <autoedge/>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2027" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the path cost for all xSTP

Use this procedure to configure the path cost for spanning tree calculations. The lower the path cost means there is a greater chance of the interface becoming the root port. The range is 1 through 200000000. The default path cost is 2000 for a 10 Gbps interface.

To configure the path cost for spanning tree calculations on the DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.

a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.

b. In the <shutdown> element, include the delete operation in the element tag to enable the port.

c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.

4. Under the <spanning-tree> node element, include the <cost> leaf element and specify the path cost for spanning tree calculations on the DCB interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2028" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <cost>10000</cost>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2028" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the path cost per VLAN (PVST or Rapid PVST)

Use this procedure to configure the path cost for spanning tree calculations on a per VLAN basis. The lower the path cost means there is a greater chance of the interface becoming the root port. The range is 1 through 200000000. The default path cost is 2000 for a 10 Gbps interface. For the VLANs which have been configured explicitly, the per-VLAN configuration takes precedence over the global configuration.

The VLAN ID value can be 1 through 3583. VLAN IDs 3584 through 4094 are internally-reserved VLAN IDs.

To configure the path cost for spanning tree calculations on the DCB interface for a specific VLAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.

c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.

4. Under the <spanning-tree> node element, include the <vlan> node element.
5. Under the <vlan> node element, include the following leaf elements.
   a. In the <id> element, specify the VLAN ID.
   b. In the <cost> element, specify the path cost for spanning tree calculations on the DCB interface for the specified VLAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2029" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <vlan>
                            <id>200</id>
                            <cost>10000</cost>
                        </vlan>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2029" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling a port (interface) as an edge port

Use this procedure to enable the port as an edge port to allow the port to quickly transition to the forwarding state. To configure a port as an edge port, follow these guidelines:

- A port can become an edge port if no BPDU is received.
- When an edge port receives a BPDU, it becomes a normal spanning tree port and is no longer an edge port.
- Because ports that are directly connected to end stations cannot create bridging loops in the network, edge ports transition directly to the forwarding state and skip the listening and learning states.
- This procedure is only for RSTP, MSTP, and Rapid PVST. Use the <spanning-tree>/<portfast> element for STP and PVST (refer to "Enabling port fast (STP and PVST)" on page 366).

To enable the DCB interface as an edge port, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the <edgeport> node element.
5. Under the <edgeport> node, include the empty <edgeportbasic> leaf element to enable the DCB interface as an edge port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2030" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <edgeport>
                            <edgeportbasic/>
                        </edgeport>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2030" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling the guard root (STP and RSTP)

Use this procedure to enable the guard root on the switch. The guard root feature provides a way to enforce the root bridge placement in the network. With the guard root enabled on an interface, the switch is able to restrict which interface is allowed to be the spanning tree root port or the path to the root for the switch. The root port provides the best path from the switch to the root switch. By default, guard root is disabled.

Guard root protects the root bridge from malicious attacks and unintentional misconfigurations in which a bridge device that is not intended to be the root bridge becomes the root bridge. Such attacks can cause severe bottlenecks in the data path. Guard root ensures that the port on which it is enabled is a designated port. If the guard root-enabled port receives a superior BPDU, it goes to a discarding state.

To enable the guard root on a DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node element, include the <guard> node element.
5. Under the <guard> node, include the empty <root> element to enable the guard root on the DCB interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2031" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <guard>
                            <root/>
                        </guard>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>

    </edit-config>
</rpc>

<rpc-reply message-id="2031" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling the guard root per LAN (PVST and Rapid PVST)

Use this procedure to enable the guard root on the switch for a specific VLAN. For the VLANs which have been configured explicitly, the per-VLAN configuration takes precedence over the global configuration.

The guard root feature provides a way to enforce the root bridge placement in the network. With the guard root enabled on an interface, the switch is able to restrict which interface is allowed to be the spanning tree root port or the path to the root for the switch. The root port provides the best path from the switch to the root switch. By default, guard root is disabled.

Guard root protects the root bridge from malicious attacks and unintentional misconfigurations in which a bridge device that is not intended to be the root bridge becomes the root bridge. Such attacks can cause severe bottlenecks in the data path. Guard root ensures that the port on which it is enabled is a designated port. If the guard root-enabled port receives a superior BPDU, it goes to a discarding state.

The VLAN ID value can be 1 through 3583. VLAN IDs 3584 through 4094 are internally-reserved VLAN IDs.

To enable the guard root on a DCB interface for a specific VLAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node element, include the <vlan> node element.
5. Under the <vlan> node, include the <id> element and specify the VLAN ID.
6. Under the <vlan> node, specify the <guard> node element.
7. Under the <guard> node, include the empty <root> element to enable the guard root on the DCB interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2032" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
```

```
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <vlan>
                        <id>100</id>
                        <guard>
                            <root/>
                        </guard>
                    </vlan>
                </spanning-tree>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2032" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the MSTP hello time

Use this procedure to set the time interval between BPDUs sent by the root switch. Changing the hello time affects all spanning tree instances.

The <max-age> setting must be greater than the <hello-time> setting (refer to "Specifying the bridge maximum aging time for all xSTP" on page 344). The range is 1 through 10 seconds. The default is 2 seconds.

To specify the MSTP hello time on a DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the <hello-time> leaf element and specify the hello time on the DCB interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2033" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
```

```
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <hello-time>5</hello-time>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2033" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying restrictions for an MSTP instance

Use this procedure to specify restrictions on the interface for an MSTP instance.

To specify restrictions for an MSTP instance on a DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the <instance> node element.
5. Under the <instance> node element, specify the following leaf elements.
    a. In the <id> element, set the instance ID.
    b. Include the empty <restricted-tcn> leaf element to specify the restrictions for the MSTP instance on a DCB interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2034" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
```

```
                    <instance>
                        <id>5</id>
                        <retricted-tcn/>
                    </instance>
                </spanning-tree>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2034" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying a link type

Use this procedure to specify a link type. Specifying a point-to-point link type enables rapid spanning tree transitions to the forwarding state. Specifying the shared link type disables spanning tree rapid transitions. The default setting is point-to-point.

To specify a link type on a DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node element, include the <link-type> leaf element and specify a value of “point-to-point” or “shared”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2035" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <link-type>shared</link-type>
                    </spanning-tree>
                </tengigabitethernet>
```

```
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2035" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling port fast (STP and PVST)

Use this procedure to enable port fast on an interface to allow the interface to quickly transition to the forwarding state. Port fast immediately puts the interface into the forwarding state without having to wait for the standard forward time. This procedure applies to STP and PVST only.

NOTE

If you enable the **portfast bpdu-guard** option on an interface and the interface receives a BPDU, the software disables the interface and puts the interface in the ERR_DISABLE state.

Enabling port fast on ports can cause temporary bridging loops, in both trunking and non-trunking mode.

Use the edge port feature for MSTP, RSTP, and Rapid PVST (refer to "Enabling a port (interface) as an edge port" on page 359).

To enable port fast on the DCB interface for STP, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]*slot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the <portfast> node element.
5. Under the <portfast> node, include the following leaf elements.
    a. Include the empty <portfastbasic> element to enable basic port fast functionality.
    b. Include the empty <bpdu-guard> element to guard the port against the reception of BPDUs.
    c. Include the empty <bpdu-filter> element to set the port fast BPDU filter for the port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2036" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <portfast>
                            <portfastbasic/>
                        </portfast>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2036" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the port priority

Use this procedure to specify the port priority. The range is 0 through 240 in increments of 16. The default is 128. A lower number designates a higher priority.

To specify the port priority on the DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the <priority> leaf element and specify the port priority.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2037" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
```

```
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <priority>32</priority>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2037" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the port priority per VLAN (PVST and Rapid PVST)

Use this procedure to specify the port priority on a per VLAN basis. The range is 0 through 240 in increments of 16. The default is 128. A lower number designates a higher priority. For the VLANs which have been configured explicitly, the per-VLAN configuration takes precedence over the global configuration.

The VLAN ID value can be 1 through 3583. VLAN IDs 3584 through 4094 are internally-reserved VLAN IDs.

To specify the port priority on the DCB interface for a specific VLAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the <vlan> node element.
5. Under the <vlan> node element, include the following leaf elements.
    a. In the <id> element, specify the VLAN ID.
    b. In the <priority> element, specify the port priority for the specified VLAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2038" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
```

```
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <vlan>
                            <id>100</id>
                            <priority>32</priority>
                        </vlan>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2038" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Restricting the port from becoming a root port (MSTP)

Use this procedure to restrict a port from becoming a root port. The default is to allow the DCB interface to become a root port. This procedure affects MSTP only.

To restrict the DCB interface from becoming a root port, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the empty <restricted-role> leaf element.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2039" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
```

```
                    operation="delete"/>
                <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                    <restricted-role/>
                </spanning-tree>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2039" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Restricting the topology change notification (MSTP)

Use this procedure to restrict the topology change notification BPDUs sent on the interface. By default, the restriction is disabled. This procedure affects MSTP only.

To restrict the topology change notification BPDUs sent on the DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the empty <restricted-tcn> leaf element.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2040" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <restricted-tcn/>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
```

```
    </edit-config>
</rpc>

<rpc-reply message-id="2040" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling spanning tree

To enable spanning tree on the DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the empty <shutdown> leaf element, and include the delete operation in the element tag to enable spanning tree on the port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2041" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2041" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling spanning tree

By default, spanning tree is disabled.

To disable spanning tree on the DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the interface node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element, include the following elements.
    a. In the <name> element, specify the interface name in [*rbridge-id/*]s*lot/port* format or port-channel number.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the port.
    c. Include the <spanning-tree> node element, which resides in the urn:brocade.com:mgmt:brocade-xstp namespace.
4. Under the <spanning-tree> node, include the empty <shutdown> leaf element to disable spanning tree on the port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2042" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    <spanning-tree xmlns="urn:brocade.com:mgmt:brocade-xstp">
                        <shutdown/>
                    </spanning-tree>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2042" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

25

Configuring UDLD

In this chapter

- Overview of UDLD and NETCONF 373
- Configuring UDLD 373

Overview of UDLD and NETCONF

This chapter provides procedures for configuring unidirectional Link Detection (UDLD) using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for information on UDLD and how it works.

Through the NETCONF interface, you can perform the following operations that affect the functioning of UDLD:

- Use the <edit-config> RPC to activate, configure, or deactivate the UDLD protocol globally.
- Use the <edit-config> RPC to activate, configure, or deactivate UDLD on specific 100-Gigabit, 10-Gigabit, 40-Gigabit, or Gigabit Ethernet interfaces.
- Use the <get-config> RPC to verify all or part of the global or per-port UDLD configuration.

UDLD must be enabled globally before it can be enabled on a specific interface.

UDLD parameters are defined in the brocade-udld YANG module. For information about the brocade-udld YANG module, refer to the *Network OS YANG Reference Manual*.

Configuring UDLD

To enable UDLD globally, perform the following steps.

1. Under the <protocol> node, include the <UDLD> node element from the urn:brocade.com:mgmt:brocade-udld namespace to enable UDLD. The <UDLD> node element contains elements that allow you to configure the global UDLD parameters. However, the "presence=true" statement that qualifies the <udld> container definition in the brocade-udld.yang file allows the <udld> node element to also function as a leaf element. The following example enables UDLD globally.

    a. Optionally, in the <hello> element, specify for the interface the maximum number of seconds between successive PDU transmissions. This value overrides the globally configured value for the interface.

    b. Optionally, in the <multiplier> element, specify the UDLD protocol timeout, which is the product of multiplier and hello interval. If no UDLD PDU is received over a link during timeout period, the link is deemed unidirectional. Default multiplier value is 5. This value overrides the globally configured value for the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
           <target>
               <running/>
           </target>
       <config>
           <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
               <udld xmlns="urn:brocade.com:mgmt:brocade-udld"/>
                      <hello>20</hello>
                      <multiplier>8</multiplier>
           </protocol>
       </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Under the <interface> node, specify the <fortygigabitethernet>, <tengigabitethernet>, or <gigabitethernet> node, include the <udld> node element from the urn:brocade.com:mgmt:brocade-udld namespace to an enabled UDLD on an interface.
3. Under the <udld> node, enable UDLD for the port interface with the <udld-enable/> leaf element to an enabled UDLD on an interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2407" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
           <target>
               <running/>
           </target>
       <config>
           <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
               <tengigabitethernet>
                   <name>22/0/1</name>
                       <udld xmlns="urn:brocade.com:mgmt:brocade-udld">
                       <udld-enable/>
                       </udld>
               </tengigabitethernet>
           </interface>
       </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2407" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

NOTE

When the UDLD protocol is enabled on one end of a link, the timeout period might elapse before the UDLD protocol is enabled on the other end of the link. In this case, the link becomes temporarily blocked. When the UDLD protocol is enabled at the other end of the link and a UDLD PDU is received, UDLD automatically unblocks the link.

Disabling UDLD

To disable UDLD, perform the following steps.

1. 1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the shutdown for the <udld> node element from the urn:brocade.com:mgmt:brocade-udld namespace.
3. Under the <udld> node element, include the <disable> leaf element. The following example disables UDLD.

```
<?xml version="1.0" encoding="UTF-8"?>
    <rpc message-id="1103" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <edit-config>
            <target>
                <running/>
            </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <udld xmlns="urn:brocade.com:mgmt:brocade-UDLD">
                    <shutdown/>
                </udld>
            </protocol>
        </config>
        </edit-config>
    </rpc>

<rpc-reply message-id="1103" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Retrieving UDLD statistics

Use the <get-config> RPC to retrieve the current configuration data and operational state data. Refer to “Retrieving configuration data” on page 11 and “Retrieving operational data” on page 15 for detailed instructions.

Chapter

26

Configuring Link Aggregation

In this chapter

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- Configuring a vLAG 377
- Configuring the vLAG ignore split option 380
- LACP configuration and management 384

Link aggregation with NETCONF overview

This chapter provides procedures for configuring Link Aggregation Group (LAG) and Virtual Link Aggregation Group (vLAG) using NETCONF interfaces. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of what link aggregation is and how it works
- Guidelines for configuring link aggregation groups
- How the Link Aggregation Control Protocol (LACP) works
- An explanation of the supported types of link aggregation: static, dynamic, Brocade proprietary
- An overview of virtual link aggregation
- Configuration guidelines and restrictions
- Troubleshooting tips

Through the NETCONF interface, you can perform the following operations on LAGs and vLAGs:

- Use the <edit-config> RPC to configure a vLAG and LACP.
- Use the <get-port-channel-detail> and <get-portchannel-info-by-intf> custom RPCs to obtain operational state information about port channels.
- Use the <get-config> RPC to validate configuration settings.

  LAG parameters are defined in the brocade-lag YANG module. LACP parameters are defined in the brocade-lacp YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Configuring a vLAG

To configure a vLAG, you must configure a port-channel interface on each of the member nodes of the vLAG. Perform the following steps on each node.

1. Create a LAG that uses two switches within the Brocade VCS Fabric.

   When the Brocade VCS Fabric detects that the LAG configuration spans multiple switches, the LAG automatically becomes a vLAG.

2. Configure each vLAG to treat FCoE MAC addresses as being multi-homed hosts, similar to LAN traffic.

The default configuration is to treat FCoE traffic as non-vLAG traffic. This operation must be performed on every switch in the vLAG.

The following example configures port channel interface 10.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <port-channel>
                    <name>10</name>
                </port-channel>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Use the <get-port-channel-detail> custom RPC defined in the urn:brocade.com:mgmt:brocade-lag namespace to verify the port channel details for the local switch.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1002">
    <get-port-channel-detail xmlns="urn:brocade.com:mgmt:brocade-lag">
    </get-port-channel-detail>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1002">
    <get-port-channel-detail xmlns="urn:brocade.com:mgmt:brocade-lag">
        <lacp>
            <aggregator-id>27</aggregator-id>
            <aggregator-type>standard</aggregator-type>
            <isvlag>false</isvlag>
            <aggregator-mode>none</aggregator-mode>
            <admin-key>0027</admin-key>
            <oper-key>0027</oper-key>
            <actor-system-id>00-05-33-6f-18-18</actor-system-id>
            <partner-system-id>00-05-1e-cd-6e-9f</partner-system-id>
            <system-priority>32768</system-priority>
            <partner-oper-priority>32768</partner-oper-priority>
            <rx-link-count>4</rx-link-count>
            <tx-link-count>4</tx-link-count>
            <individual-agg>0</individial-agg>
            <ready-agg>1</ready-agg>
            <partner-oper-key>0027</partner-oper-key>
            <aggr-member>
                <rbridge-id>231</rbridge-id>
                <interface-type>tengigabitethernet</interface-type>
                <interface-name>231/0/22</interface-name>
                <actor-port>0xE718160201</actor-port>
                <sync>1</sync>
            </aggr-member>
            <aggr-member>
```

```
                <rbridge-id>231</rbridge-id>
                <interface-type>tengigabitethernet</interface-type>
                <interface-name>231/0/23</interface-name>
                <actor-port>0xE718170202</actor-port>
                <sync>1</sync>
            </aggr-member>
            <aggr-member>
                <rbridge-id>231</rbridge-id>
                <interface-type>tengigabitethernet</interface-type>
                <interface-name>231/0/36</interface-name>
                <actor-port>0xE718240305</actor-port>
                <sync>1</sync>
            </aggr-member>
            <aggr-member>
                <rbridge-id>231</rbridge-id>
                <interface-type>tengigabitethernet</interface-type>
                <interface-name>231/0/37</interface-name>
                <actor-port>0xE718250306</actor-port>
                <sync>1</sync>
            </aggr-member>
        </lacp>
        <has-more>true</has-more>
    </get-port-channel-detail>
</rpc-reply>
```

4. To obtain details of additional port channels configured on this switch, reissue the <get-port-channel-detail> RPC, include the <last-aggregator-id> input parameter, and set its value to the value returned in the <aggregator-id> element of the previous call.

   You should reissue the <get-port-channel-detail> RPC only if the <has-more> element returned “true” in the previous call.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1003">
    <get-port-channel-detail xmlns="urn:brocade.com:mgmt:brocade-lag">
        <last-aggregator-id>27</last-aggregator-id>
    </get-port-channel-detail>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1003">
    <get-port-channel-detail xmlns="urn:brocade.com:mgmt:brocade-lag">
        <lacp>
            <aggregator-id>28</aggregator-id>
            <aggregator-type>standard</aggregator-type>
(output truncated)

        <has-more>false</has-more>
    </get-port-channel-detail>
</rpc-reply>
```

5. Use the <get-portchannel-info-by-intf> custom RPC defined in the urn:brocade.com:mgmt:brocade-lag namespace to verify the port-channel interface details.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1004">
    <get-port-channel-info-by-intf xmlns="urn:brocade.com:mgmt:brocade-lag">
        <interface-type>tengigabitethernet></interface-type>
        <interface-name>1/0/21</interface-name>
    </get-port-channel-info-by-intf>
</rpc>
```

```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1004">
    <get-port-channel-info-by-intf xmlns="urn:brocade.com:mgmt:brocade-lag">
        <lacp>
            <interface-type>tengigabitethernet</interface-type>
            <interface-name>1/0/21</interface-name>
            <actor-port>0x18150014</actor-port>
            <admin-key>10</admin-key>
            <oper-key>0</oper-key>
            <actor-system-id>01-e0-52-00-01-00</actor-system-id>
            <partner-system-id>01-80-c2-00-00-01</partner-system-id>
            <system-priority>32768</system-priority>
            <partner-oper-priority>32768</partner-oper-priority>
            <actor-priority>32768</actor-priority>
            <receive-machine-state>current</recieve-machine-state>
            <periodic-transmission-machine-state>slow-periodic
                </periodic-transmission-machine-state>
            <mux-machine-state>collecting-distributing</mux-machine-state>
            <admin-state>activity aggregation defaulted</admin-state>
            <oper-state>activity aggregation synchronization collecting
                 distributing</oper-state>
            <partner-oper-state>activity aggregation synchronization collecting
                 distributing</partner-oper-state>
            <partner-oper-port>100</partner-oper-port>
        </lacp>
    </get-port-channel-info-by-intf>
</rpc-reply>
```

Configuring the vLAG ignore split option

This procedure is for LACP-based vLAGs. The scope of this configuration is per port-channel. In scenarios where the vLAG spans more than one node, it minimizes the extent of packet loss in the event of one of the nodes in the vLAG going down.

In a case where connectivity between nodes is lost due to a fabric split (as opposed to one of its members going down), duplication of multicast/broadcast packets will occur.

Brocade recommends that you build redundancy in the fabric so that individual links are not single points of failure.

Figure 5 displays a dual vLAG configuration with three legs of RB2, RB3, and RB4. If RB2, RB3, or RB4 reboots while Host-1 is communicating to Host-2 or Host3, a momentary traffic disruption may occur.

NOTE
With ignore-split active, a vLAG node reboot can result in a more than one second loss while interoperating with a Linux server/nic-team/CNA, due to premature egress of traffic from the server.

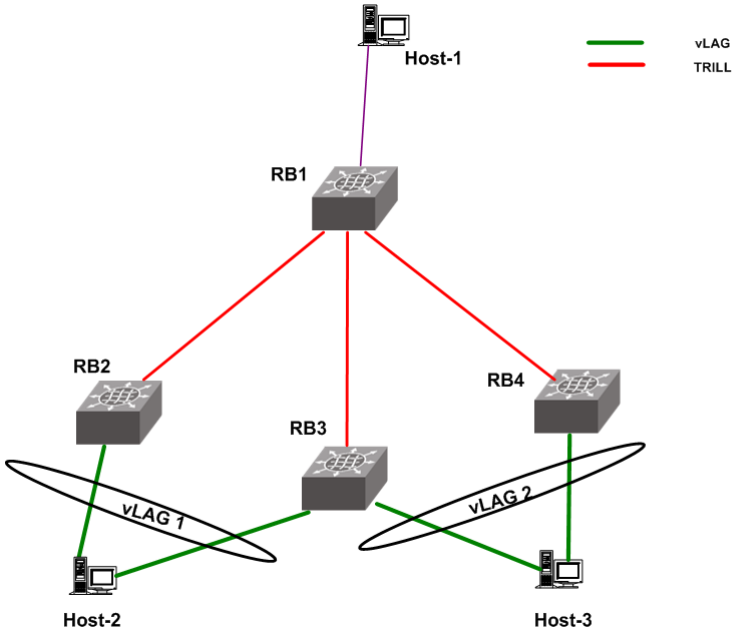

FIGURE 5 vLAG configuration of the ignore split

To reduce vLAG failover downtime, you must set the ignore split option on all of the legs in the vLAG (RB2, RB3, and RB4, in this case).

To configure the vLAG ignore split, perform the following steps.

1. Start a NETCONF session with RB2.
2. Activate vLAG ignore split for the first leg.

   The <name> element in the following example identifies the port-channel number.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1005" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <port-channel>
                    <name>1</name>
                    <vlag>
                        <ignore-split/>
                    </vlag>
                </port-channel>
            </interface>
        </config>
    </edit-config>
</rpc>
```

```
<rpc-reply message-id="1005" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Start a NETCONF session with RB3.
4. Activate vLAG ignore split for the second leg.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1006" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <port-channel>
                    <name>2</name>
                    <vlag>
                        <ignore-split/>
                    </vlag>
                </port-channel>
                <port-channel>
                    <name>3</name>
                    <vlag>
                        <ignore-split/>
                    </vlag>
                </port-channel>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1006" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. Start a NETCONF session with RB4.
6. Activate vLAG ignore split for the third leg.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1007" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <port-channel>
                    <name>4</name>
                    <vlag>
                        <ignore-split/>
                    </vlag>
                </port-channel>
            </interface>
        </config>
    </edit-config>
</rpc>
```

```
<rpc-reply message-id="1007" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the load balancing feature

This feature allows you to configure the load balancing feature on a remote routing bridge which is not a member of the vLAG (also known as a non-local routing bridge), to forward traffic to a vLAG. To distribute the traffic among the possible paths towards the vLAG, you can configure the vLAG load-balancing flavor on RB2. Available flavors are listed in Table 12.

TABLE 12 Load balance flavor

Flavor	Definition
dst-mac-vid	Destination MAC address and VID-based load balancing.
src-mac-vid	Source MAC address and VID-based load balancing.
src-dst-mac-vid	Source and Destination MAC address and VID-based load balancing.
src-dst-ip	Source and Destination IP address-based load balancing.
src-dst-ip-mac-vid	Source and Destination IP and MAC address and VID-based load balancing.
src-dst-ip-port	Source and Destination IP and TCP/UDP port-based load balancing.
src-dst-ip-mac-vid-port	Source and Destination IP, MAC address, VID and TCP/UDP port-based load balancing.

Additionally, a routing bridge can be set to a different flavor for different vLAGs present in the cluster. This feature is available for each routing bridge and each vLAG, so different load-balance flavors can be set for traffic directed towards different vLAGs.

The following example sets the flavor to “destination MAC address and VID-based load balancing.”

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1008" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>2</rbridge-id>
                <fabric xmlns=”urn:brocade.com:mgmt:brocade-fabric-service”>
                    <port-channel>
                        <name>20</name>
                        <vlag-load-balance>dst-mac-vid</vlan-load-balance>
                    </port-channel>
                </fabric>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>
<rpc-reply message-id="1008" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The following example shows use of the <get-config> RPC to retrieve the configuration by displaying the contents of the <rbridge-id> node.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1009" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge-id"/>
                <rbridge-id>2</rbridge-id>
            </rbridge-id>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="1009" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge-id">
        <rbridge-id>2</rbridge-id>
        <interface-nodespecific>
            <ns-vlan>10</ns-vlan>
            <ns-ethernet>100</ns-ethernet>
        </interface-nodespecific>
        <fabric xmlns=”urn:brocade.com:mgmt:brocade-fabric-service”>
            <port-channel>
                <name>10</name>
                <vlag-load-balance>src-dst-mac-vid</vlan-load-balance>
            </port-channel>
        </fabric>
        <fabric xmlns=”urn:brocade.com:mgmt:brocade-fabric-service”>
            <port-channel>
                <name>20</name>
                <vlag-load-balance>dst-mac-vid</vlan-load-balance>
            </port-channel>
        </fabric>
    </rbridge-id>
</rpc-reply>
```

LACP configuration and management

NOTE
To save the configuration, use the <bna-config-cmd> RPC to copy the running configuration to the startup configuration.

Enabling LACP on a DCB interface

To add interfaces to an existing LAG, repeat this procedure using the same LAG group number for the new interfaces.

To enable LACP on a DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node defined in the urn:brocade.com:mgmt:brocade-interface namespace, and specify the following elements.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.

3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, specify the following elements:
    a. In the <name> element, provide the name of the interface you want to add to the LAG.
    b. In the <shutdown> element, include the delete operation in the element tag to enable the interface.
    c. Include the <channel-group> node element.
4. Under the <channel-group> node, specify the following elements to configure the LACP for the DCB interface:
    a. In the <port-int> element, provide value to the channel group number.
    b. In the <mode> element, specify “active” or “passive”
    c. In the <type> element, specify “standard” or “brocade”.

The following example adds port 8/0/1 to channel group 4 in active mode, standard type.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1010" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>8/0/1</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                    <channel-group>
                        <port-int>4</port-int>
                        <mode>active</mode>
                        <type>standard</type>
                    </channel-group>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1010" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the LACP system priority

Configure an LACP system priority on each switch running LACP. LACP uses the system priority with the switch MAC address to form the system ID and also during negotiation with other switches.

The system priority value must be a number in the range of 1 through 65535. The higher the number, the lower the priority. The default priority is 32768.

To configure the global LACP system priority, issue the <edit-config> RPC to configure the <lacp> node in the urn:brocade.com:mgmt:brocade-lacp namespace and provide a value in the <system-priority> leaf element.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1011" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <lacp xmlns="urn:brocade.com:mgmt:brocade-lacp">
                <system-priority>25000</system-priority>
            </lacp>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1011" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the LACP timeout period on a DCB interface

The LACP timeout period indicates how long LACP waits before timing out the neighboring device. The short timeout period is 3 seconds and the long timeout period is 90 seconds. The default is long.

To configure the LACP timeout period on a DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, specify the <name> element and set its value to the interface name in [*rbridge-id/*]s*lot/port* format.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, specify the <lacp> node, which resides in the urn:brocade.com:mgmt:brocade-lacp namespace.
5. Under the <lacp> node, specify the <timeout> leaf element and set its value to either “short” or “long”.

The following example sets the LACP timeout period to three seconds for the 1/0/1 interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1012" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/0/1</name>
                    <lacp xmlns="urn:brocade.com:mgmt:brocade-lacp">
                        <timeout>short</timeout>
                    </lacp>
                </tengigabitethernet>
            </interface
```

```
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1012" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

Configuring LLDP

27

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LLDP configuration with NETCONF overview

This chapter provides procedures for configuring the Link Layer Discovery Protocol (LLDP) using NETCONF interfaces. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of LLDP explaining what it is and how it works
- An explanation of Layer 2 topology mapping
- An overview of the Data Center Bridging Capability Exchange Protocol (DCBX), including Enhanced Transmission Selection (ETS) and Process Flow Control (PFC)
- How DCBX interacts with devices from other vendors
- A summary of configuration guidelines and restrictions
- A summary of configuration default values

Using the NETCONF interface, you can perform the following LLDP configuration operations:

- Use the <edit-config> remote procedure call (RPC) to configure LLDP.
- Use the <get-config> RPC to verify all or part of the LLDP configuration.

LLDP parameters are defined in the brocade-lldp YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all LLDP parameters, refer to the brocade-lldp.yang file.

Enabling and disabling LLDP

NOTE
Use the <bna-config-cmd> RPC to save your configuration changes.

Enabling LLDP globally

This procedure enables LLDP globally on all interfaces unless it has been specifically disabled on an interface. LLDP is enabled globally by default.

To enable LLDP globally, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element from the urn:brocade.com:mgmt:brocade-lldp namespace to enable LLDP.

   The <lldp> node element contains elements that allow you to configure the global LLDP parameters. However, the “presence=true” statement that qualifies the <lldp> container definition in the brocade-lldp.yang file allows the <lldp> node element to also function as a leaf element.

The following example enables LLDP globally.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp"/>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1101" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling and resetting LLDP globally

Resetting LLDP globally returns all configuration settings made under the <protocol>/<lldp> node to their default settings. LLDP is enabled globally by default.

Disabling LLDP disables LLDP globally.

To reset LLDP globally, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element from the urn:brocade.com:mgmt:brocade-lldp namespace, and include the delete operation in the element tag.

The following example resets LLDP globally.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1102" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp"
                    xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
```

```
                operation="delete"/>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1102" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To disable LLDP globally, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element from the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node element, include the <disable> leaf element.

The following example disables LLDP globally.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1103" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <disable/>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1103" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring LLDP global options

The global LLDP configuration options are located under the <protocol>/<lldp> node in the urn:brocade.com:mgmt:brocade-lldp namespace.

Specifying a system name and LLDP description

The global system name for LLDP is useful for differentiating among switches. By default, the “host-name” from the chassis/entity MIB is used. By specifying a descriptive system name, you will find it easier to configure the switch for LLDP.

The system description is seen by neighboring switches.

NOTE
Brocade recommends you use the operating system version for the description or use the description from the chassis/entity MIB. Do not use special characters, such as #, $, !, @, as part of the system name and description.

To specify a global system name and system description for the Brocade VDX hardware, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <system-name> leaf element, and set its value to a descriptive name for the DCB switch.
4. Under the <lldp> node, include the <system-description> leaf element, and set its value to a text string that provides additional information about the DCB switch.

The following example specifies a global system name and global system description.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1104" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <system-name>Brocade_Alpha</system-name>
                    <system-description>IT_1.6.2_LLDP_01</system-description>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1104" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying a user description for LLDP

The user description is for network administrative purposes and is not seen by neighboring switches.

To specify a user description for LLDP, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <description> leaf element containing a user description.

The following example specifies a user description for LLDP.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1105" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <description>Brocade-LLDP-installed-july-25</description>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1105" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the transmission of LLDP frames

By default both transmission and reception of LLDP frames are enabled.

To enable only reception (rx) of LLDP frames, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <mode> leaf element, and set its value to “rx”.

The following example sets the value of the <mode> element to “rx” to enable only reception of LLDP frames.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1106" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <mode>rx</mode>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1106" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The following example sets the value of the <mode> element to “tx” to enable only transmission of LLDP frames.

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<rpc message-id="1107" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <mode>tx</mode>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1107" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To enable both transmit and receive modes, delete the <mode> element by including the delete operation in its tag.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1108" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <mode xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1108" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the transmit frequency of LLDP frames

The default transmit frequency is 30 seconds. The valid range is 4 through 180 seconds.

To configure the transmit frequency of LLDP frames, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <hello> leaf element, and set its value to the number of seconds between the transmission of LLDP frames.

The following example sets the transmit frequency to 45 seconds.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1109" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <hello>45</hello>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1109" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the hold time for receiving devices

This procedure configures the number of consecutive LLDP hello packets that can be missed before declaring the neighbor information as invalid. The default value is 4. The valid range is 2 through 10.

To configure the hold time for receiving devices, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <multiplier> leaf element, and set its value to the number of consecutive packets that can be missed before declaring the neighbor information to be invalid.

The following example configures the number of consecutive LLDP packets that can be missed before declaring the neighbor information as invalid to 6 packets.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1110" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <multiplier>6</multiplier>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1110" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
```

```
</rpc-reply>
```

Advertising the optional LLDP TLVs

To configure the optional LLDP type-length-value (TLV) fields, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <advertise> node element.
4. Under the <advertise> node, include the <optional-tlv> node element.
5. Under the <optional-tlv> node, include leaf elements enabling the desired optional LLDP TLVs. These TLVs may include:
    - <management-address>
    - <port-description>
    - <system-capabilities>
    - <adv-tlv-system-description>
    - <adv-tlv-system-name>

The following example advertises all the optional TLVs.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1111" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <advertise>
                        <optional-tlv>
                            <management-address/>
                            <port-description/>
                            <system-capabilities/>
                            <adv-tlv-system-description/>
                            <adv-tlv-system-name/>
                        </optional-tlv>
                    </advertise>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1111" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the advertisement of LLDP DCBX-related TLVs

For a switch in standalone mode, only the DCBX TLV is advertised by default.

For a switch in Brocade VCS Fabric mode, the following TLVs are advertised by default:

- dcbx-tlv
- dcbx-fcoe-app-tlv
- dcbx-fcoe-logical-link-tlv

To configure the LLDP DCBX-related TLVs to be advertised, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <advertise> node element.
4. Under the <advertise> node, include elements that specify the TLVs you want advertised:
    - <dcbx-fcoe-app-tlv>
    - <dcbx-fcoe-logical-link-tlv>
    - <dcbx-tlv>
    - <dot1-tlv>
    - <dot3-tlv>

The following example advertises all the DCBX-related TLVs.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1112" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <advertise>
                        <dcbx-fcoe-app-tlv/>
                        <dcbx-fcoe-logical-link-tlv/>
                        <dcbx-tlv/>
                        <dot1-tlv/>
                        <dot3-tlv/>
                    </advertise>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1112" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring iSCSI priority

The iSCSI priority setting is used to configure the priority that will be advertised in the DCBX iSCSI TLV.

The iSCSI TLV is used only to advertise the iSCSI traffic configuration parameters to the attached CEE-enabled servers and targets. No verification or enforcement of the usage of the advertised parameters by the iSCSI server or target is done by the switch. The default iSCSI priority is 4. The valid range is 0 through 7.

To configure the iSCSI priority, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <iscsi-priority> leaf element, and set its value to the desired priority.
4. Under the <lldp> node, include the <advertise> node element.
5. Under the <advertise> node, include the <dcbx-iscsi-app-tlv> leaf element to advertise the TLV.

The following example sets the iSCSI priority to 4 and advertises this value in the DCBX iSCSI TLV.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1113" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <iscsi-priority>4</iscsi-priority>
                    <advertise>
                        <dcbx-iscsi-app-tlv/>
                    </advertise>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1113" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring LLDP profiles

You can configure up to 384 profiles on a switch.

To configure an LLDP profile, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <profile> node element.
4. Under the <profile> node, include the following leaf elements:
    a. In the <profile-name> element, specify the name of the profile.
    b. In the <description> element, specify a description for the profile.
    c. In the <mode> element, include the delete operation in the element tag to allow transmission and reception of LLDP frames. Otherwise, set the value to “tx” (for transmission only) or “rx” (for reception only).
    d. In the <hello> element, specify the transmission frequency of LLDP frames in seconds.
    e. In the <multiplier> element, specify the hold time for receiving devices.
5. Under the <profile> node, include the <advertise> node.
6. Under the <advertise> node, include the <optional-tlv> node element to advertise the TLV.
7. Under the <optional-tlv> node, include leaf elements enabling the desired optional LLDP TLVs. These TLVs may include:
    - <management-address>
    - <port-description>
    - <system-capabilities>
    - <adv-tlv-system-description>
    - <adv-tlv-system-name>
8. Under the <advertise> node, include the following elements to advertise the LLPD DCBX-related TLVs:
    - <dot1-tlv>
    - <dot3-tlv>
    - <dcbx-tlv>
    - <dcbx-fcoe-logical-link-tlv>
    - <dcbx-fcoe-app-tlv>
    - <dcbx-iscsi-app-tlv>

NOTE
Brocade recommends against advertising dot1.tlv and dot3.tlv LLDPs if your network contains CNAs from non-Brocade vendors. This configuration may cause functionality problems.

The following example configures an LLDP profile named UK_LLDP_IT. It allows transmission and reception of LLDP frames, provides a transmit frequency of 10 seconds, specifies a hold time of 20 seconds, and advertises optional and DCBX-related TLVs.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1114" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
```

```
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <profile>
                        <profile-name>UK_LLDP_IT</profile-name>
                        <description>Standard profile by Jane</description>
                        <mode xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                        operation="delete"/>
                        <hello>10</hello>
                        <multiplier>2</multiplier>
                        <advertise>
                            <optional-tlv>
                                <management-address/>
                                <port-description/>
                                <system-capabilities/>
                                <adv-tlv-system-description/>
                                <adv-tlv-system-name/>
                            <dot1-tlv/>
                            <dot3-tlv/>
                            <dcbx-tlv/>
                            <dcbx-fcoe-logical-link-tlv/>
                            <dcbx-fcoe-app-tlv/>
                            <dcbx-iscsi-app-tlv/>
                        </advertise>
                    </profile>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1114" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the iSCSI profile

You can configure an iSCSI profile to be applied to individual interfaces. However, the priority bit must be set explicitly for each interface.

To configure iSCSI profiles, you must first configure the CEE map, if one has not already been created, configure the iSCSI profile, and then apply that profile to the interfaces.

To configure the CEE map, perform the following steps.

1. Issue an <edit-config> RPC to configure the <cee-map> node in the urn:brocade.com:mgmt:brocade-cee-map namespace.
2. Under the <cee-map> node, include the <name> element and set it to “default”—the only currently supported name.
3. Under the <cee-map> node, include the <priority-group-table> list element once for each priority-group table entry.
4. Under each <priority-group-table> node, include the following leaf elements:

a. In the <PGID> element, specify the priority group ID.

b. In the <weight> element, map a weight to a Deficit Weighted Round Robin (DWRR) scheduler queue.

c. In the <pfc> element, specify “on” to enable priority-based flow control.

5. Under the <cee-map> node, provide the priority table in the <priority-table> node element.
6. Under the <priority-table> node, include an element entry for each CoS level to define the mapping to a priority group.

   For example, <map-cos4-pgid>2</map-cos4-pgid> maps CoS 4 to priority group 2.

To configure the iSCSI profiles, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node in the urn:brocade.com:mgmt:brocade-lldp namespace to enable and configure LLDP.
3. Under the <lldp> node, include the <profile> node element.
4. Under the <profile> node, include the following leaf elements:

   a. In the <profile-name> element, assign a name to the profile.

   b. Include the <advertise>/<dcbx-iscsi-app-tlv/> hierarchy of elements to advertise the TLV.

To assign the iSCSI profile to an interface, under the top-level <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace, include a <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.

1. Under the <hundredgigabitethernet>, <gigabitethernet>, <tengigabitethernet>, or <fortygigabitethernet> node, include a <name> element to identify the interface in [*rbridge-id/*]s*lot/port* format.
2. Under the <hundredgigabitethernet>, <gigabitethernet>, <tengigabitethernet>, or <fortygigabitethernet> node, include an <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <cee> node element.
4. Under the <cee> node, include the <lldp-cee-on-off> leaf element and set its value to “on” to apply the CEE provisioning map to the interface.
5. Under the <lldp> node, include the <profile> element to apply the LLDP profile you created for iSCSI.
6. Under the <lldp> node, include the <iscsi-priority> element to set the iSCSI priority bits for the interface.
7. Repeat the <hundredgigabitethernet>, <gigabitethernet>, <tengigabitethernet>, or <fortygigabitethernet> node element for each additional interface.

The following example configures a CEE map, configures an iSCSI profile using that map, and applies the profile to an interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1115" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
```

```
            </target>
            <config>
                <cee-map xmlns="urn:brocade.com:mgmt:brocade-cee-map">
                    <name>default<name/>
                    <priority-group-table>
                        <PGID>1</PGID>
                        <weight>50</weight>
                        <pfc>on</pfc>
                    </priority-group-table>
                    <priority-group-table>
                        <PGID>2</PGID>
                        <weight>30</weight>
                        <pfc>on</pfc
                    </priority-group-table>
                    <priority-group-table>
                        <PGID>3</PGID>
                        <weight>20</weight>
                        <pfc>on</pfc
                    </priority-group-table>
                    <priority-table>
                        <map-cos0-pgid>1</map-cos0-pgid>
                        <map-cos1-pgid>1</map-cos1-pgid>
                        <map-cos2-pgid>1</map-cos2-pgid>
                        <map-cos3-pgid>1</map-cos3-pgid>
                        <map-cos4-pgid>2</map-cos4-pgid>
                        <map-cos5-pgid>3</map-cos5-pgid>
                        <map-cos6-pgid>1</map-cos6-pgid>
                        <map-cos7-pgid>1</map-cos7-pgid>
                    </priority-table>
                </cee-map>
                <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                        <profile>
                            <profile-name>iscsi_config</profile-name>
                            <advertise>
                                <dcbx-iscsi-app-tlv/>
                            </advertise>
                        </profile>
                    </lldp>
                </protocol>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <tengigabitethernet>
                        <name>1/0/1</name>
                        <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                            <cee>
                                <lldp-cee-on-off>on</lldp-cee-on-off>
                            </cee>
                            <profile>iscsi_config</profile>
                            <iscsi-priority>4</iscsi-priority>
                        </lldp>
                    </tengigabitethernet>

                        (more interfaces go here)

                </interface>
            </config>
        </edit-config>
    </rpc>
```

```
<rpc-reply message-id="1115" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Deleting an LLDP profile

To delete an LLDP profile, perform the following steps.

1. Issue the <edit-config> RPC to configure the <protocol> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <protocol> node, include the <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
3. Under the <lldp> node, include the <profile> node element, and include the delete operation in the element tag.
4. Under the <profile> node, include the <profile-name> element and set its value to the name of the profile you want to delete.

The following example deletes an LLDP profile.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1116" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                    <profile xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                        operation="delete">
                        <profile-name>UK_LLDP_IT</profile-name>
                    </profile>
                </lldp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1116" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring LLDP interface-level options

Only one LLDP profile can be assigned to an interface. If you do not configure the LLDP profile options at the interface level, the global configuration is used on the interface. If there are no global configuration values defined, the global default values are used.

To configure LLDP interface-level options, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include a <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.
3. Under the <hundredgigabitethernet>, <gigabitethernet>, <tengigabitethernet>, or <fortygigabitethernet> node, include a <name> element to identify the interface in [*rbridge-id/*]s*lot/port* format.
4. Under the <hundredgigabitethernet>, <gigabitethernet>, <tengigabitethernet>, or <fortygigabitethernet> node, include an <lldp> node element, which resides in the urn:brocade.com:mgmt:brocade-lldp namespace.
5. Under the <lldp> node, include the <profile> element and specify the name of the LLDP profile you want to apply to the interface.
6. Under the <lldp> node, include the <dcbx-version> element to configure the DCBX version for an interface for DCB. For detailed information on these version keywords, refer to the *Network OS Administrator's Guide*. The default is to automatically detect the DCBX version.

The following example applies an LLDP profile named network_standard to interface 22/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1117" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <lldp xmlns="urn:brocade.com:mgmt:brocade-lldp">
                        <profile>network_standard</profile>
                        <dcbx-version>cee</dcbx-version>
                    </lldp>
                </tengigabitethernet>

                (more interfaces go here)

            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1117" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

28

Configuring ACLs

In this chapter

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- ACL configuration and management 406
- IP ACL 414

ACL configuration with NETCONF overview

This chapter provides procedures for configuring MAC access control lists (ACLs) and IP ACLs using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of ACLs
- Configuration guidelines and restrictions

Through the NETCONF interface, you can perform the following operations on ACLs:

- Use the <edit-config> remote procedure call (RPC) to configure an ACL.
- Use the <get-mac-acl-for-intf> custom RPC to obtain MAC ACLs applied to an interface.
- Use the <get-config> RPC to validate configuration settings.

MAC ACL parameters are defined in the brocade-mac-access-list YANG module. IP ACL parameters are defined in the brocade-ip-access-list YANG module. IPv6 ACL parameters are defined in the brocade-ipv6-access-list YANG module. For a structural overview of these YANG modules, refer to the *Network OS YANG Reference Manual*. For an explanation of each parameter, refer to the brocade-mac-access-list.yang file, the brocade-ip-access-list.yang file, and the brocade-ipv6-access-list.yang file.

Default ACL configuration

When none of the policies is enforced on the switch, these default ACL rules are effective in Network OS:

- seq 0 permit tcp any any eq 22
- seq 1 permit tcp any any eq 23
- seq 2 permit tcp any any eq 897
- seq 3 permit tcp any any eq 898
- seq 4 permit tcp any any eq 111
- seq 5 permit tcp any any eq 80

- seq 6 permit tcp any any eq 443
- seq 7 permit udp any any eq 161
- seq 8 permit udp any any eq 111
- seq 9 permit tcp any any eq 123
- seq 10 permit tcp any any range 600 65535
- seq 11 permit udp any any range 600 65535

Refer to the *Network OS Administrator's Guide* for an explanation of ACL rules.

ACL configuration and management

NOTE
Issue the <bna-config-cmd> RPC to save your configuration changes.

Two types of MAC ACL exist:

- Standard—Permit and deny traffic according to the source MAC address in the incoming frame. Use standard MAC ACLs if you only need to filter traffic based on source addresses.
- Extended—Permit and deny traffic according to the source and destination MAC addresses in the incoming frame, as well as EtherType.

Creating a standard MAC ACL and adding rules

A MAC ACL does not take effect until it is applied to a Layer 2 interface. Refer to "Applying a MAC ACL to a DCB interface" on page 409 and "Applying a MAC ACL to a VLAN interface" on page 410.

To create a standard MAC ACL and add rules, perform the following steps.

1. Issue the <edit-config> RPC to configure the <mac> node in the urn:brocade.com:mgmt:brocade-mac-access-list namespace.
2. Under the <mac> node, include the <access-list>/<standard> hierarchy of node elements to create a standard ACL.
3. Under the <standard> node, include the <name> leaf node, and specify the name of the ACL to which you want to create or add rules.
4. Under the <standard> node, specify a <seq> node element for each rule you want to configure.
5. Under each <seq> node, specify the following leaf elements.
    a. In the <seq-id> element, set a sequence number for the rule to identify the rule and determine the sequence in which rules are applied (lowest <seq-id> first).
    b. In the <action> element, specify "deny" to create a rule in the MAC ACL to drop traffic with the source MAC address, "permit" to create a rule in the MAC ACL to permit traffic with the source MAC address, or "hard-drop" to create a rule in the MAC ACL to force drop traffic.
    c. In the <source> field, specify a MAC address from which traffic is permitted or denied.
    d. In the <src-mac-addr-mask> field, specify a MAC address mask.

    For a complete list of <seq> node leaf elements, refer to the brocade-mac-access-list.yang file.

6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example creates a standard MAC ACL named test_01 and adds two rules to it:

- Rule 100 drops traffic from source MAC address 0011.2222.3333 and maintains a count of packets dropped.
- Rule 1000 allows traffic from source MAC address 0022.1111.2222 and maintains a count of packets allowed.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2400" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
                <access-list>
                    <standard>
                        <name>test_01</name>
                        <seq>
                            <seq-id>100</seq-id>
                            <action>deny</action>
                            <source>0011.2222.3333</source>
                            <src-mac-addr-mask>ffff.ffff.ffff</src-mac-addr-mask
                            <count/>
                        </seq>
                        <seq>
                            <seq-id>1000</seq-id>
                            <action>permit</action>
                            <source>0022.1111.2222</source>
                            <src-mac-addr-mask>ffff.ffff.ffff</src-mac-addr-mask
                            <count/>
                        </seq>
                    </standard>
                </access-list>
            </mac>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2400" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Creating an extended MAC ACL and adding rules

The MAC ACL name length is limited to 64 characters. A MAC ACL does not take effect until it is applied to a Layer 2 interface. Refer to "Applying a MAC ACL to a DCB interface" on page 409 and "Applying a MAC ACL to a VLAN interface" on page 410.

To create an extended MAC ACL and add rules, perform the following steps.

1. Issue the <edit-config> RPC to configure the <mac> node in the urn:brocade.com:mgmt:brocade-mac-access-list namespace.
2. Under the <mac> node, include the <access-list>/<extended> hierarchy of node elements to create an extended ACL.

3. Under the <extended> node, include the <name> leaf node, and specify the name of the ACL you want to create or modify.
4. Under the <extended> node, specify a <seq> node element for each rule you want to configure.
5. Under each <seq> node, specify the following leaf elements.
    a. In the <seq-id> element, set a sequence number for the rule.
    b. In the <action> element, specify “deny” to create a rule in the MAC ACL to drop traffic with the source or destination MAC address, “permit” to create a rule in the MAC ACL to permit traffic with the source or destination MAC address, or “hard-drop” to create a rule in the MAC ACL to force drop traffic.
    c. Additional elements that define the source or destination devices or ports for which the action is applied.

    For a complete list of <seq> node leaf elements, refer to the brocade-mac-access-list.yang file.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example creates an extended MAC access list named test_02 with the following rules:

- Rule 5 allows traffic from MAC address 0022.3333.4444 destined for MAC address 0022.333.555 and maintains a count of accepted packets.
- Rule 1000 allows traffic from MAC address 0022.1111.2222 and maintains a count of accepted packets.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <mac xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
            <access-list>
               <extended>
                  <name>test_02</name>
                  <seq>
                     <seq-id>5</seq-id>
                     <action>permit</action>
                     <source>0022.3333.4444</source>
                     <src-mac-addr-mask>ffff.ffff.ffff</src-mac-addr-mask>
                     <dst>0022.3333.5555</dst>
                     <dst-mac-addr-mask>ffff.ffff.ffff</dst-mac-addr-mask>
                     <count/>
                  </seq>
                  <seq>
                     <seq-id>1000</seq-id>
                     <action>permit</action>
                     <source>0022.1111.2222</source>
                     <src-mac-addr-mask>ffff.ffff.ffff</src-mac-addr-mask>
                     <count/>
                  </seq>
               </extended>
            </access-list>
         </mac>
      </config>
```

```
    </edit-config>
</rpc>

<rpc-reply message-id="2401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying a MAC ACL to a DCB interface

Ensure that the ACL that you want to apply exists and is configured to filter traffic in the manner that you need for a specific DCB interface. An ACL does not take effect until it is expressly applied to an interface. Frames can be filtered as they enter an interface (ingress direction).

NOTE
The DCB interface must be configured as a Layer 2 switchport before an ACL can be applied as an access-group to the interface.

To apply a MAC ACL to a DCB interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <hundredgigabitethernet>, <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet> or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and specify the name of the interface in [r*bridge-id/*]s*lot/port* format or port-channel number.
4. Under the <hundredgigabitethernet>, <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet> or <port-channel> node, include the <switchport> node element to configure the DCB interface as a layer 2 switch port.
5. Under the <switchport> node, include the empty <basic> leaf element.
6. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <mac> node element from the urn:brocade.com:mgmt:brocade-mac-access-list namespace.
7. Under the <mac> node, include the <access-group> node element.
8. Under the <access-group> node, include the following leaf elements:
    a. In the <mac-access-list> element, specify the name of the MAC access list you want to apply to the DCB port.
    b. *Optional*: In the <mac-direction> element, specify “in” or “out” to associate the ACL with the port ingress traffic or egress traffic, respectively.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2402" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
```

```
                    <switchport>
                        <basic/>
                    </switchport>
                    <mac xmlns="urn:brocade.com:mmgmt:brocade-mac-access-list">
                        <access-group>
                            <mac-access-list>test_02</mac-access-list>
                            <mac-direction>in</mac-direction>
                        </access-group>
                    </mac>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2402" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying a MAC ACL to a VLAN interface

Ensure that the ACL that you want to apply exists and is configured to filter traffic in the manner that you need for a specific VLAN interface. An ACL does not take effect until it is expressly applied to an interface. Frames can be filtered as they enter an interface (ingress direction).

To apply a MAC ACL to a VLAN interface, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface-vlan> node, specify the <interface>/<vlan> hierarchy of node elements.
3. Under the <vlan> node, include the <name> element and specify the VLAN-ID of the VLAN to which you want to assign an access list.
4. Under the <vlan> node, specify the <mac> node that resides in the urn:brocade.com:mgmt:brocade-mac-access-list namespace.
5. Under the <mac> node, include the <access-group> node element.
6. Under the <access-group> node, include the <mac-access-list> leaf element, and set its value to the name of the MAC access list you want to apply to the VLAN.
7. *Optional*: Under the <access-group> node, include the <mac-direction> leaf element, and set its value to “in” or “out” to associate the ACL with ingress traffic or egress traffic, respectively.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2403" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <vlan>
                        <name>50</name>
                        <mac xmlns="urn:brocade.com:mmgmt:brocade-mac-access-
                         list">
                            <access-group>
```

```
                        <mac-access-list>test_02</mac-access-list>
                        <mac-direction>in</mac-direction>
                    </access-group>
                </mac>
            </vlan>
        </interface>
    </interface-vlan>
  </config>
</edit-config>
</rpc>

<rpc-reply message-id="2403" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Modifying MAC ACL rules

You cannot modify the existing rules of a MAC ACL. However, you can remove the rule and then recreate it with the desired changes.

Use a sequence number to specify the rule you wish to modify. Without a sequence number, a new rule is added to the end of the list, and existing rules are unchanged.

Using the **permit** and **deny** keywords, you can create many different rules. The examples in this section provide the basic knowledge needed to modify MAC ACLs.

To modify a MAC ACL, perform the following steps.

1. Issue the <edit-config> RPC to configure the <mac> node in the urn:brocade.com:mgmt:brocade-mac-access-list workspace.
2. Under the <mac> node, include the <access-list>/<extended> or <access-list>/<standard> hierarchy of node elements.
3. Under the <extended> or <standard> node, include the <name> element and specify the name of the ACL you want to modify.
4. Under the <extended> or <standard> node, include the <seq> node and include the delete operation in the element tag.
5. Under the <seq> node, include the <seq-id> leaf element, and specify the sequence ID of the rule you want to change.

   This action deletes the rule. The following example deletes rule 100. It assumes that test_02 contains an existing rule number 100 with the “deny any any” options.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
                <access-list>
                    <extended>
                        <name>test_02</name>
                        <seq xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                             operation="delete">
                        <seq-id>100</seq-id>
```

```
                    </seq>
                </extended>
            </access-list>
        </mac>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

6. Issue another <edit-config> RPC to replace rule 100.

   Refer to "Creating an extended MAC ACL and adding rules" on page 407 for details.

   The following example creates a new rule 100.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2405" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
                <access-list>
                    <extended>
                        <name>test_02</name>
                        <seq >
                            <seq-id>100</seq-id>
                            <action>permit</action>
                            <source>any</source>
                            <dst>any</dst>
                        </seq>
                    </extended>
                </access-list>
            </mac>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2405" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Removing a MAC ACL

A MAC ACL cannot be removed from the system unless the access-group applying the MAC ACL to a DCB or a VLAN interface is first removed.

To remove a MAC ACL, perform the following steps.

1. Issue the <edit-config> RPC to configure the <mac> node in the urn:brocade.com:mgmt:brocade-mac-access-list namespace.
2. Under the <mac> node, include the <access-list>/<extended> hierarchy of node elements, and include the delete operation in the opening element tag of the <extended> element.

3. Under the <extended> node, include the <name> element, and specify the name of the standard ACL you want to delete.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2406" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <mac xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
                <access-list>
                    <extended xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete">
                        <name>test_02</name>
                    </extended>
                </access-list>
            </mac>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2406" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Obtaining the MAC ACL applied to an interface

You can query the MAC ACL applied to an interface using the <get-mac-acl-for-intf> custom RPC. By omitting all input parameters, you can obtain the results for all interfaces, but only in the ingress direction. If you specify an interface, you can request results for the ingress direction, the egress direction, or both the ingress and egress directions.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2407">
    <get-mac-acl-for-intf xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
        <interface-type>l2vlan</interface-type>
        <interface-name>50</interface-name>
        <direction>all</direction>
    </get-mac-acl-for-intf>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2407">
    <get-mac-acl-for-intf xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
        <interface>
            <interface-type>l2vlan</interface-type>
            <interface-name>50</interface-name>
            <ingress-policy>
                <policy-name>test_02</policy-name>
            </ingress-policy>
            <egress-policy>
                <policy-name>test_01</egress-policy>
            </egress-policy>
        </interface>
    </get-mac-acl-for-intf>
    </rpc-reply>
```

IP ACL

The IP ACLs control access to the switch. The policies do not control the egress and outbound management traffic initiated from the switch. The IP ACLs support both IPv4 and IPv6 simultaneously.

An IP ACL is a set of rules that are applied to the interface as a packet filtering firewall. Each rule defines whether traffic of a combination of source and destination IP address, protocol, or port, is to be denied or permitted.

Each ACL must have a unique name, but there is no limit to the number of ACLs to be defined. An ACL can contain rules for only one version of IP (either IPv4 or IPv6). Only one ACL by the version of IP can be active on the interface at a time. In other words, one ACL for IPv4 addresses and one ACL for IPv6 address on the interface for packet filtering can be active at the same time.

For filtering the traffic, each rule of the ACL applied to the interface is checked in the ascending order of their sequence numbers. A maximum of 2048 rules can be added to an access list. When the ACL is applied to an interface, only the 256 lowest-numbered rules are applied. If an ACL does not contain any rules and is applied to the interface, it becomes “no-op” and all ingress traffic is denied through the interface. For Layer 2 ACL, if there are no rules applied to the interface then the action is permitted through that interface. But in Layer 3 ACL or IP ACL, it is denied.

After an IP ACL rule is created, it is not possible to modify any of its options.

The default configuration of the switch consists of two ACLs: one IPv4 ACL and one IPv6 ACL is applied to the interface.

There are two types of IP access lists:

- Standard: Contains rules for only the source IP address. The rules are applicable to all ports of that source IP address.
- Extended: Contains rules for a combination of IP protocol, source IP address, destination IP address, source port, and destination port.

Creating a standard IP or IPv6 ACL

To create an extended IP or IPv6 ACL, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ip-acl> or <ipv6-acl> node in the urn:brocade.com:mgmt:brocade-ip-access-list or urn:brocade.com:mgmt:brocade-ipv6-access-list namespace, respectively.
2. Under the <ip-acl> or <ipv6-acl> node, include the <ip> or <ipv6> node.
3. Under the <ip> or <ipv6> node, include the <access-list>/<standard> hierarchy of node elements.
4. Under the <standard> node, include the <name> leaf element and set its value to the name of the ACL you want to create.
5. Under the <standard> node, specify a <seq> list element node for each rule that you want to add to the access list.
6. Under each <seq> node, include the following leaf elements.

a. In the <seq-id> element, set a sequence number for the rule to identify the rule and determine the sequence in which rules are applied (lowest <seq-id> first).

b. In the <action> element, specify “deny” to create a rule in the IP ACL to drop traffic with the source IP address, “permit” to create a rule in the IP ACL to permit traffic with the source IP address, or “hard-drop” to create a rule in the IP ACL to force drop traffic.

c. In the <src-host-any-sip> element, specify “any” to permit or deny traffic from any source IP address, or “host” to permit or deny traffic from a specific IP address.

d. In the <src-host-ip> element, specify the IP address of source traffic to be permitted or denied if “host” is specified in the <src-host-any-sip> element.

For a complete list of <seq> node leaf elements, refer to the brocade-ip-access-list.yang file or the brocade-ipv6-access-list.yang file.

The following example creates an extended IP ACL named stdACL3 that includes the following rules:

- Rule 5 permits traffic from host 10.20.33.4.
- Rule 15 denies traffic from any source.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2408" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ip-acl xmlns="urn:brocade.com:mgmt:brocade-ip-access-list">
                <ip>
                    <access-list>
                        <standard>
                            <name>stdACL3</name>
                            <seq>
                                <seq-id>5</seq-id>
                                <action>permit</action>
                                <src-host-any-sip>host</src-host-any-sip>
                                <src-host-ip>10.20.33.4</src-host-ip>
                            </seq>
                            <seq>
                                <seq-id>15</seq-id>
                                <action>deny</action>
                                <src-host-any-sip>any</src-host-any-sip>
                            </seq>
                        </standard>
                    </access-list>
                </ip>
            </ip-acl>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2408" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Creating an extended IP or IPv6 ACL

To create an extended IP ACL, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ip-acl> or <ipv6-acl> node in the urn:brocade.com:mgmt:brocade-ip-access-list or urn:brocade.com:mgmt:brocade-ipv6-access-list namespace, respectively.
2. Under the <ip-acl> or <ipv6-acl> node, include the <ip> or <ipv6> node element.
3. Under the <ip> or <ipv6> node, include the <access-list>/<extended> hierarchy of node elements.
4. Under the <extended> node, include the <name> leaf element and set its value to the name of the ACL you want to configure.
5. Under the <extended> element, specify a <seq> list element node for each rule you want to add to the access list.
6. Under each <seq> node, include the following leaf elements.
    a. In the <seq-id> element, set a sequence number for the rule to identify the rule and determine the sequence in which rules are applied (lowest <seq-id> first).
    b. In the <action> element, specify “deny” to create a rule in the IP ACL to drop traffic when the rule conditions are met, “permit” to create a rule in the IP ACL to permit traffic, or “hard-drop” to create a rule in the IP ACL to force drop traffic.
    c. Additional elements that specify the source and destination switch or source and destination ports for which traffic is permitted or denied.

    For a complete list of <seq> node leaf elements, refer to the brocade-ip-access-list.yang file or the brocade-ipv6-access-list.yang file.

The following example creates an extended IP ACL named extdACL5 that includes the following rules:

- Rule 5 denies TCP traffic from host 10.24.26.145 or bound for port 23 on any destination host.
- Rule 7 denies TCP traffic from any source host on port 80 of any destination port.
- Rule 10 denies UDP traffic from any source host to ports in the range 10 through 25 on any destination host.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ip-acl xmlns="urn:brocade.com:mgmt:brocade-ip-access-list">
                <ip>
                    <access-list>
                        <extended>
                            <name>extdACL5</name>
                            <seq>
                                <seq-id>5</seq-id>
                                <action>deny</action>
                                <protocol-type>tcp</protocol-type>
                                <src-host-any-sip>host</src-host-any-sip>
                                <src-host-ip>10.24.26.145</src-host-ip>
                                <dst-host-any-dip>any</dst-host-any-dip>
```

```
                                <dport>eq</dport>
                                <dport-number-eq-neq-tcp>23
                                 </dport-number-eq-neq-tcp>
                            </seq>
                            <seq>
                                <seq-id>7</seq-id>
                                <action>deny</action>
                                <protocol-type>tcp</protocol-type>
                                <src-host-any-sip>any</src-host-any-sip>
                                <dst-host-any-dip>any</dst-host-any-dip>
                                <dport>eq</dport>
                                <dport-number-eq-neq-tcp>80
                                 </dport-number-eq-neq-tcp>
                            </seq>
                            <seq>
                                <seq-id>10</seq-id>
                                <action>deny</action>
                                <protocol-type>udp</protocol-type>
                                <src-host-any-sip>any</src-host-any-sip>
                                <dst-host-any-dip>any</dst-host-any-dip>
                                <dport>range</dport>
                                <dport-number-range-lower-upd>10
                                 </dport-number-range-lower-udp>
                                <dport-number-range-higher-udp>25
                                 <dport-number-range-higher-udp>
                            </seq>
                        </extended>
                    </access-list>
                </ip>
            </ip-acl>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying an IP or IPv6 ACL to a management interface

NOTE
Applying a permit or deny UDP ACL to the management interface enacts an implicit deny for TCP and vice versa.

To apply the IP ACLs to a management interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <management> node element to configure the management interface.
3. Under the <management> node, include the <name> node and specify the name of the management interface in *rbridge-id/port* format.
4. Under the <management> node, include either the <ip> node element or the <ipv6> node element.

5. Under the <ip> or <ipv6> node, include the <access-group> node element located in either the urn:brocade.com:mgmt:brocade-ip-access-list or urn:brocade.com:mgmt:brocade-ipv6-access-list namespace, respectively.
6. Under the <access-group> node, include the <mgmt-ip-access-list> or <mgmt-ipv6-access-list> leaf node, and specify the name of the access list.

The following example applies stdV6ACL1 to the management interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2410" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <management>
                    <name>3/1</name>
                    <ipv6>
                        <access-group
                         xmlns="urn:brocade.com:mgmt:brocade-ipv6-access-list">
                            <mgmt-ipv6-access-list>stdV6ACL1</mgmt-ipv6-access-list>
                        </access-group>
                    </ipv6>
                </management>
            </interface>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="2410" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying an IP ACL to a data interface

To apply the IP ACLs to a data interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element to configure the data interface.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> node and specify the name of the data interface in [*rbridge-id/*]*slot/port* format, or *port-number* format for a port-channel interface.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <ip-acl-interface><ip> hierarchy node elements located in the urn:brocade.com:mgmt:brocade-ip-access-list namespace, respectively.
5. Under the <ip> node, include the <access-group> node element.

6. Under the <access-group> node, include the <ip-access-list> or <ipv6-access-list> leaf node, and specify the name of the access list.

The following example applies stdV6ACL1 to the 101/0/1 interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2410" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>101/0/1</name>
                    <ip-acl-interface>
                        <access-group
                         xmlns="urn:brocade.com:mgmt:brocade-ipv6-access-list">
                            <ipv6-access-list>stdV6ACL1</ipv6-access-list>
                        </access-group>
                    </ip-acl-interface>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2410" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Binding an ACL in standalone mode or fabric cluster mode

In standalone or fabric cluster mode, an ACL can be applied to any node present in the cluster by specifying its RBridge ID. One ACL per IPv4 and one ACL per IPv6 can be applied to the management interface. Applying a new ACL replaces the ACL that was previously applied. Removing the active ACL results in default behavior of “permit any.”

You can bind an IP ACL in the ingress direction for the management interface, and you are not required to create an ACL before binding it to the management interface.

On a management interface, the default action of “permit any” is inserted at the end of an ACL that has been bound.

NOTE
Before downgrading firmware, you must unbind any ACLs on the management interface, or the downgrade will be blocked.

Obtaining the IP or IPv6 ACL configuration

To obtain the IP or IPv6 ACL configuration, issue the <get-config> RPC to retrieve the access list. Set up the filter to restrict the output to the part of the configuration you want to retrieve.

The following example returns the entire IP ACL configuration.

```
?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2411">
```

```
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <ip-acl xmlns="urn:brocade.com:mgmt:brocade-ip-access-list>
                <ip>
                    <access-list/>
                </ip>
            </ip-acl>
        </filter>
    </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2411">
    <ip-acl xmlns="urn:brocade.com:mgmt:brocade-ip-access-list">
        <ip>
            <access-list>
                <name>stdACL3</name>
                <seq>
                    <seq-id>5</seq-id>
                    <action>deny</action>
                    <protocol-type>tcp</protocol-type>
                    <src-host-any-sip>host</src-host-any-sip>
                    <src-host-ip>10.24.26.145</src-host-ip>
                    <dst-host-any-dip>any</dst-host-any-dip>
                    <dport>eq</dport>
                    <dport-number-eq-neq-tcp>23
                     </dport-number-eq-neq-tcp>
                </seq>
                <seq>
                    <seq-id>7</seq-id>
                    <action>deny</action>
    (output truncated)
```

Chapter

29

Configuring QoS

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QoS configuration under NETCONF overview

This chapter provides procedures for configuring QoS and Auto QOS using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for an explanation of related concepts and presentation of default values.

Standalone QoS

Standalone Quality of Service (QoS) provides you with the capability to control how the traffic is moved from switch to switch. In a network that has different types of traffic with different needs (also known as CoS), the goal of QoS is to provide each traffic type with a virtual pipe. FCoE uses traffic class mapping, scheduling, and flow control to provide quality of service.

The "Queueing", "Congestion control", "Multicast rate limiting", "Scheduling", and "Data Center Bridging map configuration" sections of this chapter provide procedures for configuring and managing QoS in standalone mode. Refer to the *Network OS Administrator's Guide* for explanations of these standalone QoS concepts.

Rewriting

Rewriting a frame header field is typically performed by an edge device. Rewriting occurs on frames as they enter or exit a network because the neighboring device is untrusted, unable to mark the frame, or is using a different QoS mapping.

The frame rewriting rules set the Ethernet CoS and VLAN ID fields. Egress Ethernet CoS rewriting is based on the user-priority mapping derived for each frame as described later in the queueing section.

Queueing

Queue selection begins by mapping an incoming frame to a configured user priority, and then each user-priority mapping is assigned to one of the switch's eight unicast traffic class queues or one of the eight multicast traffic class queues.

User-priority mapping

For a description of user priority mapping default values, refer to the *Network OS Administrator's Guide*.

Configuring the QoS trust mode

The QoS trust mode controls user priority mapping of incoming traffic. The Class of Service (CoS) mode sets the user priority based on the incoming CoS value. If the incoming packet is not priority tagged, then fallback is to the Interface Default CoS value.

NOTE
When a CEE map is applied on an interface, QoS trust mode is not allowed. The CEE map always puts the interface in the CoS trust mode.

To configure the QoS trust mode, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and set its value to the name of the interface for which you want to configure QoS trust mode.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <qos> element located in the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <trust>/<trust-cos> element hierarchy to set the interface mode to CoS "trust".
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example sets the trust mode on interface 22/0/2.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <trust>
                            <trust-cos/>
                        </trust>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying QoS trust

To verify that QoS trust has been applied to the interface, issue the <get-config> RPC with a subtree filter to query the <qos>/<trust> element of the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <trust/>
                    </qos>
                </tengigabitethernet>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <name>22/0/2</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <trust>
                    <trust-cos/>
                </trust>
            </qos>
        </tengigabitethernet>
```

```
    </interface>
</rpc>
```

Configuring user-priority mappings

To configure user-priority mappings, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and set its value to the name of the interface for which you want to configure user-priority mappings.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <qos> element located in the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, to set the user-priority mapping, include the <default-cos> element, and set its value to the desired priority.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example sets the user priority mapping to 3 on 10-gigabit interface 22/0/2.

```
<rpc message-id="2303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <default-cos>3</default-cos>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Creating a CoS-to-CoS mutation QoS map

To create a CoS-to-CoS mutation QoS map, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <map> node element.
3. Under the <map> node, include the <cos-mutation> node element.

4. Under the <cos-mutation> node, include the following elements.
    a. In the <name> element, assign a name to the map.
    b. In each successive <cos*n*> element, associate each inbound CoS value to an output CoS value.

       For example, the following element maps outbound CoS value to 3 for all packets with inbound CoS value of 3.

       <cos3>3</cos3>
5. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example creates a CoS-to-CoS mutation QoS map named “test.”

```
<rpc message-id="2304" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <map>
                    <cos-mutation>
                        <name>test</name>
                        <cos0>0</cos0>
                        <cos1>1</cos1>
                        <cos2>2</cos2>
                        <cos3>3</cos3>
                        <cos4>4</cos4>
                        <cos5>5</cos5>
                        <cos6>6</cos6>
                        <cos7>7</cos7>
                    </cos-mutation>
                </map>
            </qos>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2304" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying a CoS-to-CoS mutation QoS map to an interface

To apply a CoS-to-CoS mutation QoS map, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include a node element to specify the interface type; <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel>.
3. Under the node element designating the interface type, include the <name> leaf element and specify the name of the interface to which you want to apply the map.
4. Under the node element designating the interface type, include the <qos> node element, which is located in the urn:brocade.com:mgmt:brocade-qos namespace.

5. Under the <qos> node, include the <cos-mutation> leaf element and specify the CoS-to-CoS mutation QoS map to activate and apply changes made to the map.
6. Under the <qos> node, include the <trust> node element.
7. Under the <trust> node element, include the empty <trust-cos> leaf element to specify the trust mode for incoming traffic.

   This step specifies the interface ingress QoS trust mode, which controls user priority mapping of incoming traffic. The untrusted mode overrides all incoming priority markings with the Interface Default CoS. The CoS mode sets the user priority based on the incoming CoS value. If the incoming packet is not priority tagged, then fallback is to the interface default CoS value.
8. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example activates a map named “test” on 10-gigabit interface 22/0/2, and establishes trust mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2305" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <cos-mutation>test</cos-mutation>
                        <trust>
                            <trust-cos/>
                        </trust>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2305" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying CoS-to-CoS mutation QoS mapping

To verify a CoS-to-CoS mutation mapping, issue the <get-config> RPC to retrieve the CoS-to-CoS mutation QoS map and the interface names to which a map is bound.

1. Verify a CoS-to-CoS mutation QoS map using a subtree filter to view only the contents of the <qos>/<map>/<cos-mutation> node. To limit the returned information to a specific QoS map, refine the content match node with the QoS map name.

   The following example returns the CoS-to-CoS mutation QoS map for a map named “test.”

   ```
   <?xml version="1.0" encoding="UTF-8"?>
   <rpc message-id="2306" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <get-config>
           <source>
               <running/>
   ```

```
        </source>
        <filter type="subtree">
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <map>
                    <cos-mutation>
                        <name>test</name>
                    </cos-mutation>
                </map>
            </qos>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2306" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
        <map>
            <cos-mutation>
                <name>test</name>
                <cos0>0</cos0>
                <cos1>1</cos1>
                <cos2>2</cos2>
                <cos3>3</cos3>
                <cos4>4</cos4>
                <cos5>5</cos5>
                <cos6>6</cos6>
                <cos7>7</cos7>
            </cos-mutation>
        </map>
    </qos>
</rpc-reply>
```

2. Return a list of interfaces that are bound to a CoS-to-CoS mutation QoS map using an xpath filter.

   You must use an xpath filter and not a subtree filter in this case, because the element to be used for the selection criteria (<cos-mutation>*name*</cos-mutation>) resides at a lower level in the hierarchy than the information to be retrieved (the interface name).

   The following example returns the interface names to which the CoS-to-CoS mutation QoS map named “test” is bound. In this case, the map named “test” is bound to interfaces 0/59 and 0/60.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2307">
    <get-config>
        <source>
            <running></running>
        </source>
        <filter type="xpath"
            select="/interface/tengigabitethernet/qos[cos-mutation='test']">
        </filter>
   </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2607">
   <data>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
         <tengigabitethernet>
            <name>0/59</name>
```

```
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <cos-mutation>test</cos-mutation>
            </qos>
         </tengigabitethernet>
         <tengigabitethernet>
            <name>0/60</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <cos-mutation>test</cos-mutation>
            </qos>
         </tengigabitethernet>
      </interface>
   </data>
</rpc-reply>
```

Configuring the DSCP trust mode

Like QoS trust mode, the Differentiated Services Code Point (DSCP) trust mode controls the user-priority mapping of incoming traffic. The user priority is based on the incoming DSCP value. When this feature is not enabled, DSCP values in the packet are ignored.

When DSCP trust is enabled, Table 13 shows default mapping of DSCP values to user priority.

TABLE 13 Default DSCP priority mapping

DSCP values	User priority
0–7	0
8–15	1
16–23	2
24–31	3
32–39	4
40–47	5
48–55	6
56–63	7

To configure DCSP trust mode, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and set its value to the name of the interface for which you want to configure QoS trust mode.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <qos> element located in the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <trust>/<trust-dscp> element hierarchy to set the interface mode to DSCP “trust”.

6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example sets the trust mode on interface 22/0/2.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2308" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <trust>
                            <trust-dscp/>
                        </trust>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2308" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Verifying DSCP trust

To verify that DSCP trust has been applied to the interface, issue the <get-config> RPC with a subtree filter to query the <qos>/<trust> element of the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2309" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <trust/>
                    </qos>
                </tengigabitethernet>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2309" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <name>22/0/2</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <trust>
                    <trust-dscp/>
```

```
            </trust>
          </qos>
       </tengigabitethernet>
   </interface>
</rpc>
```

Creating a DSCP mutation map

NOTE
This feature is only supported on Brocade VDX 8770-4, VDX 8770-8, and later models.

To create a DSCP mutation and remap the incoming DSCP value of the ingress packet to other DSCP values, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <map> node element.
3. Under the <map> node, include the <dscp-mutation> node element.
4. Under the <dscp-mutation> node, include the following elements.
    a. In the <dscp-mutation-map-name> element, assign a name to the map.
    b. A <mark> node element for each DSCP egress value.
5. Under each <mark> node, include the following leaf elements.
    a. In the <dscp-in-values> element, list the DSCP values to be mapped to a single DSCP value.
    b. In the <to> element, specify the DSCP value.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example creates a DSCP mutation map named “test,” which performs the following mapping of DSCP values:

- DSCP values 1, 3, 5, and 7 are set to output as DSCP number 9.
- DSCP values 11, 13, 15, and 17 are set to output as DSCP number 19.
- DSCP values 12, 14, 16, and 18 are set to output as DSCP number 20
- DSCP values 2, 4, 6, and 8 are set to output as DSCP number 10.

```
<rpc message-id="2310" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
            <map>
               <dscp-mutation>
                  <dscp-mutation-map-name>test</dscp-mutation-map-name>
                  <mark>
                     <dscp-in-values>1,3,5,7</dscp-in-values>
                     <to>9</to>
                  </mark>
                  <mark>
                     <dscp-in-values>11,13,15,17</dscp-in-values>
```

```
                        <to>19</to>
                    </mark>
                    <mark>
                        <dscp-in-values>12,14,16,18</dscp-in-values>
                        <to>20</to>
                    </mark>
                    <mark>
                        <dscp-in-values>2,4,6,8</dscp-in-values>
                        <to>10</to>
                    </mark>
                </dscp-mutation>
            </map>
        </qos>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2310" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying a DSCP mutation map to an interface

To apply a DSCP mutation QoS map, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include a node element to specify the interface type; <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel>.
3. Under the node element designating the interface type, include the <name> leaf element and specify the name of the interface to which you want to apply the map.
4. Under the node element designating the interface type, include the <qos> node element, which is located in the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <dscp-mutation> leaf element and specify the DSCP mutation QoS map to activate and apply changes made to the map.
6. Under the <qos> node, include the <trust> node element.
7. Under the <trust> node element, include the empty <trust-dscp> leaf element to specify the trust mode for incoming traffic.
8. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example activates a map named “test” on 10-gigabit interface 22/0/2, and establishes DSCP trust mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2311" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
```

```
                <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                    <dscp-mutation>test</dscp-mutation>
                    <trust>
                        <trust-dscp/>
                    </trust>
                </qos>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2311" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying DSCP mutation mapping

To verify a DSCP mutation mapping, issue the <get-config> RPC to retrieve the DSCP mutation QoS map and the interface names to which a map is bound.

1. Verify a DSCP mutation QoS map using a subtree filter to view only the contents of the <qos>/<map>/<dscp-mutation> node. To limit the returned information to a specific QoS map, refine the content match node with the QoS map name.

   The following example returns the DSCP mutation QoS map for a map named “test.”

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2312" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <map>
                    <dscp-mutation>
                        <dscp-mutation-map-name>test</dscp-mutation-map-name>
                    </dscp-mutation>
                </map>
            </qos>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2312" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
        <map>
            <dscp-mutation>
                <name>test</name>
                <dscp-mutation-map-name>test</dscp-mutation-map-name>
                <mark>
                    <dscp-in-values>1,3,5,7</dscp-in-values>
                    <to>9</to>
                </mark>
                <mark>
                    <dscp-in-values>11,13,15,17</dscp-in-values>
                    <to>19</to>
                </mark>
                <mark>
```

```
                <dscp-in-values>12,14,16,18</dscp-in-values>
                <to>20</to>
            </mark>
            <mark>
                <dscp-in-values>2,4,6,8</dscp-in-values>
                <to>10</to>
            </mark>
        </dscp-mutation>
    </map>
</qos>
</rpc-reply>
```

2. Return a list of interfaces that are bound to a DSCP mutation QoS map using an xpath filter.

   You must use an xpath filter and not a subtree filter in this case because the element to be used for the selection criteria (<dscp-mutation>*name*</dscp-mutation>) resides at a lower level in the hierarchy than the information to be retrieved (the interface name).

   The following example returns the interface names to which the DSCP mutation QoS map named “test” is bound. In this case, the map named “test” is bound to interfaces 0/59 and 0/60.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2313">
    <get-config>
        <source>
            <running></running>
        </source>
        <filter type="xpath"
            select="/interface/tengigabitethernet/qos[dscp-mutation='test']">
        </filter>
   </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2613">
   <data>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
         <tengigabitethernet>
            <name>0/59</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <dscp-mutation>test</dscp-mutation>
            </qos>
         </tengigabitethernet>
         <tengigabitethernet>
            <name>0/60</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <dscp-mutation>test</dscp-mutation>
            </qos>
         </tengigabitethernet>
      </interface>
   </data>
</rpc-reply>
```

Creating a DSCP-to-CoS mutation map

You can use the incoming DSCP value of ingress packets to remap the outgoing 802.1P CoS priority values by configuring a DSCP-to-CoS mutation map on the ingress interface. Perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <map> node element.
3. Under the <map> node, include the <dscp-cos> node element.
4. Under the <dscp-cos> node, include the following elements.
    a. In the <dscp-cos-map-name> element, assign a name to the map.
    b. A <mark> node element for each outgoing CoS priority value.
5. Under each <mark> node, include the following leaf elements.
    a. In the <dscp-in-values> element, list the DSCP values to be mapped to a single CoS value.
    b. In the <to> element, specify the CoS value.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example creates a DSCP -to-CoS map named “test,” which performs the following mapping of DSCP values to CoS priorities:

- DSCP values 1, 3, 5, and 7 are set to output as CoS priority 3.
- DSCP values 11, 13, 15, and 17 are set to output as CoS priority 5.
- DSCP values 12, 14, 16, and 18 are set to output as CoS priority 6.
- DSCP values 2, 4, 6, and 8 are set to output as CoS priority 7.

```
<rpc message-id="2314" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
            <map>
               <dscp-cos>
                  <dscp-cos-map-name>test</dscp-cos-map-name>
                  <mark>
                     <dscp-in-values>1,3,5,7</dscp-in-values>
                     <to>3</to>
                  </mark>
                  <mark>
                     <dscp-in-values>11,13,15,17</dscp-in-values>
                     <to>5</to>
                  </mark>
                  <mark>
                     <dscp-in-values>12,14,16,18</dscp-in-values>
                     <to>6</to>
                  </mark>
                  <mark>
                     <dscp-in-values>2,4,6,8</dscp-in-values>
                     <to>7</to>
                  </mark>
```

```
                </dscp-cos>
            </map>
        </qos>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2314" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying a DSCP-to-CoS map to an interface

To apply a DSCP-to-CoS map to an interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include a node element to specify the interface type; <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel>.
3. Under the node element designating the interface type, include the <name> leaf element and specify the name of the interface to which you want to apply the map.
4. Under the node element designating the interface type, include the <qos> node element, which is located in the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <dscp-cos> leaf element and specify the DSCP-to-CoS mutation map to activate and apply changes made to the map.
6. Under the <qos> node, include the <trust> node element.
7. Under the <trust> node element, include the empty <trust-dscp> leaf element to specify the trust mode for incoming traffic.
8. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example activates a map named “test” on 10-gigabit interface 22/0/2, and establishes DSCP trust mode.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2315" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <dscp-cos>test</dscp-cos>
                        <trust>
                            <trust-dscp/>
                        </trust>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
```

```
</rpc>

<rpc-reply message-id="2315" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying a DSCP-to-CoS mutation map

To verify a DSCP-to-CoS mapping, issue the <get-config> RPC to retrieve the DSCP-to-CoS map and the interface names to which a map is bound.

1. Verify a DSCP-to-CoS map using a subtree filter to view only the contents of the <qos>/<map>/<dscp-cos> node. To limit the returned information to a specific QoS map, refine the content match node with the QoS map name.

   The following example returns the DSCP mutation QoS map for a map named “test.”

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2316" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <map>
                    <dscp-cos>
                        <dscp-cos-map-name>test</dscp-cos-map-name>
                    </dscp-cos>
                </map>
            </qos>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2316" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
        <map>
            <dscp-cos>
                <dscp-cos-map-name>test</dscp-cos-map-name>
                <mark>
                    <dscp-in-values>1,3,5,7</dscp-in-values>
                    <to>3</to>
                </mark>
                <mark>
                    <dscp-in-values>11,13,15,17</dscp-in-values>
                    <to>5</to>
                </mark>
                <mark>
                    <dscp-in-values>12,14,16,18</dscp-in-values>
                    <to>6</to>
                </mark>
                <mark>
                    <dscp-in-values>2,4,6,8</dscp-in-values>
                    <to>7</to>
                </mark>
            </dscp-cos>
        </map>
    </qos>
</rpc-reply>
```

2. Return a list of interfaces that are bound to a DSCP-to-CoS map using an xpath filter.

   You must use an xpath filter and not a subtree filter in this case, because the element to be used for the selection criteria (<dscp-cos>*name*</dscp-cos>) resides at a lower level in the hierarchy than the information to be retrieved (the interface name).

   The following example returns the interface names to which the DSCP-to-CoS map named "test" is bound. In this case, the map named "test" is bound to interfaces 0/59 and 0/60.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2317">
    <get-config>
        <source>
            <running></running>
        </source>
        <filter type="xpath"
            select="/interface/tengigabitethernet/qos[dscp-cos='test']">
        </filter>
   </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2317">
   <data>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
         <tengigabitethernet>
            <name>0/59</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <dscp-cos>test</dscp-cos>
            </qos>
         </tengigabitethernet>
         <tengigabitethernet>
            <name>0/60</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <dscp-cos>test</dscp-cos>
            </qos>
         </tengigabitethernet>
      </interface>
   </data>
</rpc-reply>
```

Traffic class mapping

The Brocade switch supports eight unicast traffic classes for isolation and to control servicing for different priorities of application data. Traffic classes are numbered from 0 through 7, with higher values designating higher priority.

Refer to the *Network OS Administrator's Guide* for an explanation of default user-priority to traffic class mappings for unicast traffic and for multicast traffic.

Mapping CoS-to-Traffic-Class

NOTE
Creating a CoS-to-Traffic-Class map is available only in standalone mode.

To map a CoS to a Traffic-Class, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <map> node element.
3. Under the <map> node, include the <cos-traffic-class> node element.
4. Under the <cos-traffic-class> node, include the following leaf elements.
    a. In the <name> element, give a name to the map.
    b. In each successive <cos*n*> element, set a traffic-class value for each outbound CoS class.

       For example, the following element maps a traffic class value of 3 for all packets with outbound CoS value of 3.

       <cos3>3</cos3>
5. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example specifies a CoS-to-traffic-class mapping for a map named “test.”

```
<rpc message-id="2318" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <map>
                    <cos-traffic-class>
                        <name>test</name>
                        <cos0>1</cos0>
                        <cos1>0</cos1>
                        <cos2>2</cos2>
                        <cos3>3</cos3>
                        <cos4>4</cos4>
                        <cos5>5</cos5>
                        <cos6>6</cos6>
                        <cos7>7</cos7>
                    </cos-traffic-class>
                </map>
            </qos>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2318" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying a CoS-to-Traffic-Class mapping to an interface

To apply a CoS-to-traffic class mapping, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.

3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the interface on which you want to activate the mapping in the <name> leaf element.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <qos> node element from the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <cos-traffic-class> element, and specify the name of the CoS-to-Traffic-class map you want to activate.
6. Under the <qos> node, include the <trust> node element.
7. Under the <trust> node element, include the empty <trust-cos> element to activate the mapping.
8. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example activates a CoS-to-Traffic-Class mapping named “test” on 10-gigabit Ethernet interface 22/0/2.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2319" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <cos-traffic-class>test</cos-traffic-class>
                        <trust>
                            <trust-cos/>
                        </trust>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2319" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying a CoS-to-Traffic-Class mapping

To verify a CoS-to-Traffic-Class QoS mapping, issue the <get-config> RPC to retrieve the CoS-to-Traffic-Class QoS map and the interface names to which a map is bound.

1. Verify a CoS-to-Traffic-Class QoS map using a subtree filter to view only the contents of the <qos>/<map>/<cos-traffic-class> node. To limit the returned information to a specific map, refine the content match node with the QoS map name.

   The following example returns the CoS-to-Traffic-Class QoS map for a map named “test.”

   ```
   <?xml version="1.0" encoding="UTF-8"?>
   <rpc message-id="2320" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <get-config>
   ```

```
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <map>
                    <cos-traffic-class>
                        <name>test</name>
                    </cos-traffic-class>
                </map>
            </qos>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2320" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
        <map>
            <cos-traffic-class>
                <name>test</name>
                <cos0>0</cos0>
                <cos1>1</cos1>
                <cos2>2</cos2>
                <cos3>3</cos3>
                <cos4>4</cos4>
                <cos5>5</cos5>
                <cos6>6</cos6>
                <cos7>7</cos7>
            </cos-traffic-class>
        </map>
    </qos>
</rpc-reply>
```

2. Return a list of interfaces that are bound to a CoS-to-Traffic-Class QoS map using an xpath filter.

   You must use an xpath filter and not a subtree filter in this case, because the element to be used for the selection criteria (<cos-traffic-class>*name*</cos-traffic-class>) resides at a lower level in the hierarchy than the information to be retrieved (the interface name).

   The following example returns the interface names to which the CoS-to-Traffic Class QoS map named “test” is bound. In this case, the map named “test” is bound to interfaces 0/51 and 0/52.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2321">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="xpath
         select="/interface/tengigabitethernet/qos[cos-traffic-class='test']">
        </filter>
   </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2321">
   <data>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
```

```
            <tengigabitethernet>
               <name>0/51</name>
               <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                  <default-cos>0</default-cos>
                  <cos-traffic-class>test</cos-traffic-class>
               </qos>
            </tengigabitethernet>
            <tengigabitethernet>
               <name>0/52</name>
               <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                  <default-cos>0</default-cos>
                  <cos-traffic-class>test</cos-traffic-class>
               </qos>
            </tengigabitethernet>
         </interface>
      </data>
   </rpc-reply>
```

Mapping DSCP-to-Traffic-Class

Ingress DSCP values can be used to classify traffic for the ingress interface into a specific traffic class using a DSCP-to-Traffic Class map. To map a DSCP-to-Traffic-Class, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <map> node element.
3. Under the <map> node, include the <dscp-traffic-class> node element.
4. Under the <dscp-traffic-class> node, include the following elements.
    a. In the <dscp-traffic-class-map-name> element, assign a name to the map.
    b. A <mark> node element for each traffic class for which you want to map DSCP values.
5. Under each <mark> node, include the following leaf elements.
    a. In the <dscp-in-values> element, list the DSCP values to be mapped to a single traffic class.
    b. In the <to> element, specify the traffic class.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example creates a DSCP-to-Traffic-Class map named “test,” which performs the following mapping of DSCP values to traffic classes:

- DSCP values 1, 3, 5, and 7 are mapped to traffic class 3.
- DSCP values 11, 13, 15, and 17 are mapped to traffic class 5.
- DSCP values 12, 14, 16, and 18 are mapped to traffic class 6.
- DSCP values 2, 4, 6, and 8 are mapped to traffic class 7.

```
<rpc message-id="2322" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
```

```
                <map>
                    <dscp-traffic-class>
                        <dscp-traffic-class-map-name>test
                         </dscp-traffic-class-map-name>
                        <mark>
                            <dscp-in-values>1,3,5,7</dscp-in-values>
                            <to>3</to>
                        </mark>
                        <mark>
                            <dscp-in-values>11,13,15,17</dscp-in-values>
                            <to>5</to>
                        </mark>
                        <mark>
                            <dscp-in-values>12,14,16,18</dscp-in-values>
                            <to>6</to>
                        </mark>
                        <mark>
                            <dscp-in-values>2,4,6,8</dscp-in-values>
                            <to>7</to>
                        </mark>
                    </dscp-traffic-class>
                </map>
            </qos>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2322" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Applying DSCP-to-Traffic-Class mapping to an interface

To apply a CoS-to-Traffic Class mapping to an interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <hundredgigabitethernet>, <fortygigabitethernet>, <tengigabitethernet>, <gigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the interface on which you want to activate the mapping in the <name> leaf element.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <qos> node element from the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <dscp-traffic-class> element, and specify the name of the DSCP-to-Traffic-class map you want to activate.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example activates a CoS-to-Traffic-Class mapping on 10-gigabit Ethernet interface 22/0/2.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2323" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
```

```
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <dscp-traffic-class>test</dscp-traffic-class>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2323" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

Verifying DSCP-to-Traffic-Class mapping

To verify a DSCP-to-Traffic-Class mapping, you can use one or both of the following options from global configuration mode.

1. Verify a DSCP-traffic-class map using a subtree filter to view only the contents of the <qos>/<map>/<dscp-traffic-class> node. To limit the returned information to a specific QoS map, refine the content match node with the QoS map name.

   The following example returns the DSCP-to-traffic class map named “test.”

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2324" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <map>
                    <dscp-traffic-class>
                        <dscp-traffic-class-map-name>test
                         </dscp-traffic-class-map-name>
                    </dscp-traffic-class>
                </map>
            </qos>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2324" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
        <map>
            <dscp-traffic-class>
                <dscp-traffic-class-map-name>test</dscp-traffic-class-map-name>
                <mark>
                    <dscp-in-values>1,3,5,7</dscp-in-values>
                    <to>3</to>
                </mark>
                <mark>
```

```
                    <dscp-in-values>11,13,15,17</dscp-in-values>
                    <to>5</to>
                </mark>
                <mark>
                    <dscp-in-values>12,14,16,18</dscp-in-values>
                    <to>6</to>
                </mark>
                <mark>
                    <dscp-in-values>2,4,6,8</dscp-in-values>
                    <to>7</to>
                </mark>
            </dscp-traffic-class>
        </map>
    </qos>
</rpc-reply>
```

2. Return a list of interfaces that are bound to a DSCP-to-traffic class map using an xpath filter.

   You must use an xpath filter and not a subtree filter in this case, because the element to be used for the selection criteria (<dscp-traffic-clsss>*name*</dscp-traffic-class>) resides at a lower level in the hierarchy than the information to be retrieved (the interface name).

   The following example returns the interface names to which the DSCP-to-CoS map named “test” is bound. In this case, the map named “test” is bound to interfaces 0/59 and 0/60.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2325">
    <get-config>
        <source>
            <running></running>
        </source>
        <filter type="xpath"
        select="/interface/tengigabitethernet/qos[dscp-traffic-class='test']">
        </filter>
   </get-config>
</rpc>

<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2325">
   <data>
      <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
         <tengigabitethernet>
            <name>0/59</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <dscp-traffic-class>test</dscp-traffic-class>
            </qos>
         </tengigabitethernet>
         <tengigabitethernet>
            <name>0/60</name>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
               <default-cos>0</default-cos>
               <dscp-traffic-class>test</dscp-traffic-class>
            </qos>
         </tengigabitethernet>
      </interface>
   </data>
</rpc-reply>
```

Congestion control

For conceptual information about the various congestion control methods supported in Network OS, including IEEE 802.3x Ethernet Pause, Tail Drop, and Ethernet Priority Flow Control (PFC), refer to the *Network OS Administrator's Guide*.

Tail drop

This section provides procedures for configuring tail drop congestion control.

Changing the multicast tail drop threshold

To change the Tail Drop threshold, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <rcv-queue>/<multicast>/<threshold> hierarchy of node elements.
3. Under the <threshold> node, include a <traffic-class*n*> element for each class of traffic, and assign each traffic class a Tail Drop threshold value.
4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example sets the threshold value for each traffic class to 1000. When this limit is reached for a given traffic class, newly arriving frames for that class are dropped.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2326" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <rcv-queue>
                    <multicast>
                        <threshold>
                            <traffic-class0>1000</traffic-class0>
                            <traffic-class1>1000</traffic-class1>
                            <traffic-class2>1000</traffic-class2>
                            <traffic-class3>1000</traffic-class3>
                            <traffic-class4>1000</traffic-class4>
                            <traffic-class5>1000</traffic-class5>
                            <traffic-class6>1000</traffic-class6>
                            <traffic-class7>1000</traffic-class7>
                        </threshold>
                    </multicast>
                </rcv-queue>
            </qos>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2326" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring CoS thresholds

To configure CoS thresholds, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <tengigabitethernet> or <gigabitethernet> node element.
3. Under the <tengigabitethernet> or <gigabitethernet> node, include the <name> leaf element and specify the interface name for which you want to configure CoS thresholds ([*rbridge-id*/]s*lot*/*port* format).
4. Under the <tengigabitethernet> or <gigabitethernet> node, include the <qos> node element from the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <rcv-queue>/<cos-threshold> node element hierarchy.
6. Under the <cos-threshold> node, specify percentage values for each CoS value in a <cos*n*-threshold> element.
7. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example uses the priorities 5, 5, 5, 5, 50, 20, 2, and 8, which adds up to 100%.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2327" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <rcv-queue>
                            <cos-threshold>
                                <cos0-threshold>5</cos0-threshold>
                                <cos1-threshold>5</cos1-threshold>
                                <cos2-threshold>5</cos2-threshold>
                                <cos3-threshold>5</cos3-threshold>
                                <cos4-threshold>50</cos4-threshold>
                                <cos5-threshold>20</cos5-threshold>
                                <cos6-threshold>2</cos6-threshold>
                                <cos7-threshold>8</cos7-threshold>
                            </cos-threshold>
                        </rcv-queue>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2327" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>

</rpc-reply>
```

Random Early Detection

Procedures for configuring and applying Random Early Detection (RED) profiles follow. For conceptual information about RED profiles and for operational considerations, refer to the *Network OS Administrator's Guide*.

Configuring RED profiles

To configure an egress RED profile, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace
2. Under the <qos> node, include the <red-profile> node element.
3. Under the <red-profile> node, include the following leaf elements.
    a. In the <profile-id> field, specify an integer in the range 0 through 383 to uniquely identify the RED profile.
    b. In the <min-threshold> element, specify as a percentage the minimum threshold of queue size below which no packet is dropped.
    c. In the <max-threshold> element, specify as a percentage the maximum threshold of queue size to stay under.
    d. In the <drop-probability> element, specify as a percentage the probability that packets should be dropped.

       The higher the probability set, the more likely packets will be dropped when reaching the minimum percentage.
4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

```
<rpc message-id="2328" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <red-profile>
                    <profile-id>10
                    <min-threshold>10</min-threshold>
                    <max-threshold>80</max-threshold>
                    <drop-probability>80</drop-probability>
                </red-profile>
            </qos>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2328" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling a RED profile to use CoS priority

To map a CoS priority value on a per-port basis to the RED profile created under "Configuring RED profiles" on page 447, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include a node element to specify the interface type; <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel>.
3. Under the node element designating the interface type, include the <name> leaf element and specify the name of the interface on which you want to enable a RED profile.
4. Under the node element designating the interface type, include the <qos> node element, which is located in the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <random-detect>/<cos> hierarchy of node elements.
6. Under the <cos> node element, include the following leaf elements.
   a. In the <red-cos-value> element, specify the CoS priority.
   b. In the <red-profile-id> element, specify the ID of the RED profile you want to apply.
7. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example applies CoS priority 3 on port 22/0/2 to RED profile 10.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2329" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <random-detect>
                            <cos>
                                <red-cos-value>3</red-cos-value>
                                <red-profile-id>10</red-profile-id>
                            </cos>
                        </random-detect>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2329" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Ethernet Pause

This section provides procedures for configuring Ethernet Pause congestion control.

Enabling Ethernet Pause

To enable Ethernet Pause, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> leaf element and specify the name in of the interface for which you want to enable Ethernet Pause ([*rbridge-id/*]*slot/port* format or port-channel number).
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <qos> node element in the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <flowcontrol>/<link-level-flowcontrol> node element hierarchy.
6. Under the <link-level-flowcontrol> node, include the <flowcontrol-tx> and <flowcontrol-rx> elements, and set their values to “on” or “off,” as desired.
7. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example enables Ethernet Pause for transmit and receive directions on 10-gigabit Ethernet interface 22/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2330" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                        <flowcontrol>
                            <link-level-flowcontrol>
                                <flowcontrol-tx>on</flowcontrol-tx>
                                <flowcontrol-rx>on</flowcontrol-rx>
                            </link-level-flowcontrol>
                        </flowcontrol>
                    </qos>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2330" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Ethernet Priority Flow Control

This section provides procedures for configuring Ethernet Priority-based Flow Control (PFC) for congestion control.

Enabling Ethernet PFC

To enable Ethernet PFC, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> leaf element and set its value to the name of the interface for which you want to enable Ethernet PFC ([*rbridge-id/*]*slot/port* format or port channel number).
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <qos> node element from the urn:brocade.com:mgmt:brocade-qos namespace.
5. Under the <qos> node, include the <flowcontrol>/<pfc> node element hierarchy.
6. Under the <pfc> node, include the following leaf elements.
   a. In the <pfc-cos> element, specify the CoS value.
   b. In the <pfc-flowcontrol-rx> element, specify “on” to enable Ethernet PFC for the receive direction.
   c. In the <pfc-flowcontrol-tx> element, specify “on” to enable Ethernet PFC for the transmit direction.
7. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example enables Ethernet PFC for CoS 3 on 10-gigabit Ethernet interface 22/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2331" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
            <tengigabitethernet>
               <name>22/0/1</name>
               <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                  <flowcontrol>
                     <pfc>
                        <pfc-cos>3</pfc-cos>
                        <pfc-flowconftrol-tx>on</pfc-flowcontrol-tx>
                        <pfc-flowconftrol-rx>on</pfc-flowcontrol-rx>
                     </pfc>
                  </flowcontrol>
               </qos>
            </tengigabitethernet>
         </interface>
```

```
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2331" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>

</rpc-reply>
```

Multicast rate limiting

Multicast rate limiting provides a mechanism to control multicast frame replication and cap the effect of multicast traffic. For additional information, refer to the *Network OS Administrator's Guide*.

NOTE
Multicast rate limiting is not supported on VDX 8770-4 and VDX 8770-8 platforms. For these products, refer to "Broadcast, unknown unicast, and multicast storm control" on page 452.

Creating a receive queue multicast rate-limit

To create the receive queue multicast rate-limit, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <rcv-queue>/<multicast>/<rate-limit> hierarchy of node elements.
3. Under the <rate-limit> node, include the <limit> leaf node and set its value to the rate limit in packets per second.
4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example sets the multicast rate limit to 10000 packets per second.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2332" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <rcv-queue>
                    <multicast>
                        <rate-limit>
                            <limit>10000</limit>
                        </rate-limit>
                    </multicast>
                </rcv-queue>
            </qos>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2332" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
```

```
</rpc-reply>
```

Broadcast, unknown unicast, and multicast storm control

Broadcast, unknown unicast, and multicast (BUM) storm control can be configured for the following physical interface types:

- gigabitethernet
- tengigabitethernet
- fortygigabitethernet
- hundredgigabitethernet

For conceptual information about BUM storm control and operational considerations, refer to the *Network OS Administrator's Guide*.

Configuring BUM storm control

To configure storm control on a physical interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <name> leaf element and specify the interface name in [*rbridge-id/*]s*lot/port* format for which you want to configure BUM storm control.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <storm-control> node element in the urn:brocade.com:mgmt:brocade-bum-storm-control namespace.
5. Under the <storm-control> node, include the <ingress> node element.
6. Under the <ingress> node, include the following leaf elements.
    a. In the <protocol-type> element, specify “broadcast”. “multicast”, or “unknown-unicast”.
    b. In the <rate-format> element, specify “limit-bps” or “limit-percent”, depending on whether you want to specify the rate-limit in bps or as a percentage of the line rate.
    c. In the <rate-bps> element, specify the rate limit in bps if the <rate-format> element specifies “limit-bps”. Omit this element if the <rate-format> element specifies “limit-percent”.
    d. In the <rate-percent> element, specify the rate limit as a percentage of the line speed if the <rate-format> element specifies “limit-percent”. Omit this element if the <rate-format> element specifies “limit-bps”.
    e. In the <bum-action> element, specify the action to be taken in case the rate-limit is violated. Valid values are “monitor”, which monitors the port in case of violation, or “shutdown”, which shuts the port down in case of violation.

The following example rate-limits the broadcast traffic type on interface 101/0/1 to 1,000,000 bps, and shuts the port down if the rate limit is violated.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2333" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>101/0/2</name>
                    <storm-control
                     xmlns="urn:brocade.com:mgmt:brocade-bum-storm-control">
                       <ingress>
                           <protocol>broadcast</protocol>
                           <rate-format>limit-bps</rate-format>
                           <rate-bps>1000000</rate-bps>
                           <action>shutdown</action>
                       </ingress>
                    </storm-control>
                </tengigabitethernet>
            </interface>
        <config>
    </edit-config>
</rpc>

<rpc-reply message-id="2333" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Scheduling

Scheduling arbitrates among multiple queues waiting to transmit a frame. The Brocade switch supports both Strict Priority (SP) and Deficit Weighted Round Robin (DWRR) scheduling algorithms. Also supported is the flexible selection of the number of traffic classes using SP-to-DWRR. When there are multiple queues for the same traffic class, then scheduling takes these equal priority queues into consideration.

For an overview of the supported scheduling algorithms, refer to the *Network OS Administrator's Guide*.

Scheduling the QoS queue

To specify the schedule used, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Under the <qos> node, include the <queue>/<scheduler>/<strict-priority> hierarchy of element nodes.
3. Under the <strict-priority> node, include the following leaf elements.
    a. In the <priority-number> element, set the number of traffic classes to be part of the strict priority Traffic Class. For example, if the priority number is 3, the strict priority Traffic Class contains Traffic Classes 7, 6, and 5.
    b. In the <scheduler-type> element, specify “dwrr” for deficit weighted round robin queues.

c. In the <dwrr-traffic-class*n*> element, set the percentage of bandwidth to be allocated to the specific queue.

4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example assigns Traffic Classes 4 through 7 to the strict priority Traffic Class, and allocates percentage bandwidth to each Traffic Class.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2334" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <queue>
                    <scheduler>
                        <strict-priority>
                            <priority-number>4</priority-number>
                            <scheduler-type>dwrr</scheduler-type>
                            <dwrr-traffic-class4>10</dwrr-traffic-class4>
                            <dwrr-traffic-class5>20</dwrr-traffic-class5>
                            <dwrr-traffic-class6>30</dwrr-traffic-class6>
                            <dwrr-traffic-class-last>40</dwrr-traffic-class-last>
                        </strict-priority>
                    </scheduler>
                </queue>
            </qos>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2334" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Multicast queue scheduling

The multicast traffic classes are numbered from 0 to 7; higher numbered traffic classes are considered higher priority. A fixed mapping from multicast traffic class to equivalent unicast traffic class is applied to select the queue scheduling behavior. For additional information, refer to the *Network OS Administrator's Guide*

Scheduling the QoS multicast queue

To schedule the QoS multicast queue, perform the following steps.

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace with the schedule to use and the traffic class bandwidth mapping.
2. Under the <qos> node, include the <queue>/<multicast>/<scheduler> hierarchy of element nodes.
3. Under the <scheduler> node, include the <dwrr> node element to configure deficit weighted round robin queues.

4. Under the <dwrr> node, include a <dwrr-traffic-class*n*> node for each traffic class, and set each such element to a percentage bandwidth.
5. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example schedules the QoS multicast queue with bandwidth percentages 5, 10, 15, 20, 5, 10, 15, and 20 for Traffic Classes 0 through 7, respectively.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2335" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <qos xmlns="urn:brocade.com:mgmt:brocade-qos">
                <queue>
                    <multicast>
                        <scheduler>
                            <dwrr>
                                <dwrr-traffic-class0>5</dwrr-traffic-class0>
                                <dwrr-traffic-class1>10</dwrr-traffic-class1>
                                <dwrr-traffic-class2>15</dwrr-traffic-class2>
                                <dwrr-traffic-class3>20</dwrr-traffic-class3>
                                <dwrr-traffic-class4>5</dwrr-traffic-class4>
                                <dwrr-traffic-class5>10</dwrr-traffic-class5>
                                <dwrr-traffic-class6>15</dwrr-traffic-class6>
                                <dwrr-traffic-class7>20</dwrr-traffic-class7>
                            </dwrr>
                        </scheduler>
                    </multicast>
                </queue>
            </qos>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="2335" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Data Center Bridging map configuration

For an overview of Data Center Bridging map configuration and applicable default values, refer to the *Network OS Administrator's Guide*.

Creating a CEE map

To create a CEE map, perform the following steps.

1. Issue the <edit-config> RPC to configure the <cee-map> node in the urn:brocade.com:mgmt:brocade-cee-map namespace, and set the <name> element to "default," which is the only allowed name.
2. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example creates a CEE map named “default.”

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2336" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <cee-map xmlns="urn:brocade.com:mgmt:brocade-cee-map">
                <name>default</name>
            </cee-map>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2336" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Defining a priority group table

To define a priority group table, perform the following steps.

1. Issue the <edit-config> RPC to configure the <cee-map> node in the urn:brocade.com:mgmt:brocade-cee-map namespace.
2. Under the <cee-map> node, include the <name> element and set its value to “default,” which is the name of the CEE map.
3. Under the <cee-map> node, include the <priority-group-table> node once for each priority group ID (PGID).
4. Under each <priority-group-table> node, include the PGID, configure the bandwidth for the priority group by associating a weight with a DWRR scheduler queue, and enable priority-based flow control (PFC).
5. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example defines two priority groups, assigns 50% bandwidth to each, enables PFC for the first priority group, and disables PFC for the second priority group.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2337" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <cee-map xmlns="urn:brocade.com:mgmt:brocade-cee-map">
                <name>default</name>
                <priority-group-table>
                    <PGID>0</PGID>
                    <weight>50</weight>
                    <pfc>on</pfc>
                </priority-group-table>
                <priority-group-table>
                    <PGID>1</PGID>
                    <weight>50</weight>
                    <pfc>off</pfc>
```

```
            </priority-group-table>
        </cee-map>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2337" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Defining a priority-table map

To define a priority-table map, perform the following steps.

1. Issue the <edit-config> RPC to configure the <cee-map> node in the urn:brocade.com:mgmt:brocade-cee-map namespace.
2. Under the <cee-map> node, identify the CEE map in the <name> element.

   The only value map name is “default.”
3. Under the <cee-map> node, include the <priority-table> node.
4. Under the <priority-table> node, include a <map-cos*n*-pgid> element for each Class of Service, and set the value of the element to the ID of the priority group table to which you want to map the Class of Service.
5. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example maps CoS 0 through CoS 2 and CoS 4 through CoS 6 to PGID 1, CoS 3 to PGID 0, and CoS 7 to PGID 15.0.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2338" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <cee-map xmlns="urn:brocade.com:mgmt:brocade-cee-map">
                <name>default</name>
                <priority-table>
                    <map-cos0-pgid>1</map-cos0-pgid>
                    <map-cos1-pgid>1</map-cos1-pgid>
                    <map-cos2-pgid>1</map-cos2-pgid>
                    <map-cos3-pgid>0</map-cos3-pgid>
                    <map-cos4-pgid>1</map-cos4-pgid>
                    <map-cos5-pgid>1</map-cos5-pgid>
                    <map-cos6-pgid>1</map-cos6-pgid>
                    <map-cos7-pgid>15.0</map-cos7-pgid>
                </priority-table>
            </cee-map>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2338" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Applying a CEE provisioning map to an interface

To apply a CEE provisioning map to an interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the following leaf elements.
    a. In the <name> element, specify the name of the interface to which you want to apply the CEE map. Specify the name in the format [*rbridge-id/*]s*lot/port* or port-channel number.
    b. In the <cee> element, specify the name of the CEE map. The only valid CEE map name is "default."
4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2339" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <cee>default</cee>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2339" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying the CEE maps

To verify the CEE map, issue the <get-config> RPC with a subtree filter to return the CEE default map information.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2340" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <cee-map xmlns="urn:brocade.com:mgmt:brocade-cee-map">
                <name>default</name>
            </cee-map>
        </filter>
    </get-config>
</rpc>
```

```
<rpc-reply message-id="2341" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <cee-map xmlns="urn:brocade.com:mgmt:brocade-interface">
        <name>default</name>
        <priority-group-table>
            <PGID>0</PGID>
            <weight>50</weight>
            <pfc>on</pfc>
        </priority-group-table>
        <priority-group-table>
            <PGID>1</PGID>
            <weight>50</weight>
            <pfc>off</pfc>
        </priority-group-table>
        <priority-table>
            <map-cos0-pgid>1</map-cos0-pgid>
            <map-cos1-pgid>1</map-cos1-pgid>
            <map-cos2-pgid>1</map-cos2-pgid>
            <map-cos3-pgid>0</map-cos3-pgid>
            <map-cos4-pgid>1</map-cos4-pgid>
            <map-cos5-pgid>1</map-cos5-pgid>
            <map-cos6-pgid>1</map-cos6-pgid>
            <map-cos7-pgid>15.0</map-cos7-pgid>
        </priority-table>
        <remap>
            <fabric-priority>
                <fabric-remapped-priority>2</fabric-remapped-priority>
            </fabric-priority>
            <lossless-prioroty>
                <lossless-remapped-priority>2</lossless-remapped-priority>
            </lossless-priority>
        </remap>
    </cee-map>
</rpc-reply>
```

Brocade VCS Fabric QoS

Brocade VCS Fabric QoS requires very little user configuration. The only options to modify are the fabric priority and the lossless priority.

Brocade VCS Fabric reserves a mapping priority and fabric priority of seven (7). Any traffic that enters the Brocade VCS Fabric cluster from upstream that is using the reserved priority value is automatically remapped to a lower priority.

Changing the mapping or fabric priority is not required. By default the values are set to zero (0) for both of the re-mapped priorities.

In Brocade VCS Fabric mode:

- All incoming priority 7 tagged packets are dropped on the edge ports.
- Untagged control frames are counted in queue 7 (TC7).

All switches in the Brocade VCS Fabric cluster must have matching re-mapping priority values and the same priority-group-table values.

Configuring Brocade VCS Fabric QoS

To configure the remapping priorities for the Brocade VCS Fabric, perform the following steps.

1. Issue the <edit-config> RPC to configure the <cee-map> node in the urn:brocade.com:mgmt:brocade-cee-map namespace, and specify the following elements.
    a. Under the <cee-map> node, include the <name> element and specify the default CEE map.
    b. Under the <cee-map> node, include the <remap> node element.
    c. Under the <remap> node, include the <lossless-priority> node element.
    d. Under the <lossless-priority> node, include the <lossless-remapped-priority> leaf element, and set its value to the desired priority.

       The default lossless-priority value is 0.
    e. Under the <remap> node, include the <fabric-priority> node element.
    f. Under the <fabric-priority> node, include the <fabric-remapped-priority> leaf element, and set its value to the desired priority.

       The default fabric-priority value is 0.
2. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
    a. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
    b. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> leaf element, and set its value to the name of the interface to which you want to apply the CEE map.
    c. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <cee> leaf element, and set its value to “default” to apply the CEE provisioning map to the interface.
3. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example remaps the lossless priority and fabric priority values to 2.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2342" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <cee-map xmlns="urn:brocade.com:mgmt:brocade-cee-map">
            <name>default</name>
            <remap>
               <lossless-priority>
                  <lossless-remapped-priority>2</lossless-remapped-priority>
               </lossless-priority>
               <fabric-priority>
                  <fabric-remapped-priority>2</fabric-remapped-priority>
               </fabric-priority>
            </remap>
         </cee-map>
         <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
```

```
                <name>22/0/1</name>
                <cee>default</cee>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2342" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Restrictions for Layer 3 features in VCS mode

For an overview of Layer 3 restrictions in VCS mode, refer to the *Network OS Administrator's Guide*.

Port-based Policier

For an overview of port-based Policer and associated policing parameters, binding rules, limitations, and other considerations, refer to the *Network OS Administrator's Guide*.

Configuring Policer functions

To configure port-based Policer functions, perform the following steps.

1. Configure a class map to classify traffic according to traffic properties that you will configure with the policing parameters while adding the class map to a policy map. Refer to "Configuring a class map" on page 461.
2. Configure a police priority map to add color-based priority mapping. Refer to "Configuring a police priority map" on page 462.
3. Configure a policy map to associate QoS and policing parameters to traffic belonging to specific classification maps. Each policy map can contain multiple classification maps. This is an optional step if you want to change the default CoS values for color-based priority mapping. Refer to "Configuring the policy map" on page 464.
4. Bind the policy map to a specific interface. Refer to "Binding the policy map to an interface" on page 466.

Configuring a class map

The classification map or "class map" classifies traffic based on match criteria that you can configure. If traffic matches this criteria, it belongs to the class. Currently, the only match criteria is "match any." With a "match any" criteria, traffic with any MAC address, IP address, VLAN ID, IP precedence, Access Control List (ACL) security, or other identification belongs to the class.

When you add the class map to a Policy Map, the traffic defined by the class is subject to actions of the QoS and policer parameters configured in the Policy Map. For more information on policer parameters, refer to the *Network OS Administrator's Guide*.

To configure a class map, perform the following steps.

1. Issue the <edit-config> RPC to configure the <class-map> node in the urn:borcade.com:mgmt:brocade-policer namespace.
2. Under the <class-map> node, include the <name> leaf element and specify a name for the class map.

   The name for the class map must be a character string up to 64 characters.

   To delete the class map, include the delete operation in the <class-map> node and specify the class map you want to delete in the <name> element.
3. Under the <class-map> node, include the <match> node element.
4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2343" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <class-map xmlns="urn:brocade.com:mgmt:brocade-policer">
                <name>default</name>
                <access-group>
                    <access-group-name/>
                </access-group>
            </class-map>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2343" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring a police priority map

Add color-based priority CoS mapping by configuring a police priority map. A police priority map remaps frame class of service CoS values (802.1p priority bits in VLAN tag) to conform color or exceed color values when rates conform or exceed limits set in a classification map.

The police priority map will remark CoS values according to color-based green (conform), yellow (exceed), and red (violate) priorities. Creating a police priority map is optional. If you do not define priority mapping for a color, the map defaults to priorities of 0, 1, 2, 3, 4, 5, 6, and 7; that is, no modifications. You can configure a maximum of 32 priority maps (one reserved as a default), but only one map can be associated with a policer.

NOTE
You can set a priority map when creating a policy map using appropriate policing attributes.

To configure a priority map, perform the following steps. For a complete description of all the priority map attributes, refer to the brocade-policer YANG module and the *Network OS Administrator's Guide*.

1. Issue the <edit-config> RPC to configure the <police-priority-map> in the urn:brocade.com:mgmt:brocade-policer namespace.
2. Under the <police-priority-map> node, include the <name> leaf element, and specify the priority map name.

   The name for the priority map can be a character string up to 64 characters.
3. Under the <police-priority-map> node, include the <conform> and <exceed> node elements.
4. Under the <conform> node, include <map-pri*n*-conform> leaf elements to configure the color-based mapping for CIR for each class of service.

   To delete a priority map, include the delete operation in the <conform> element tag.
5. Under the <exceed> node, include <map-pri*n*-exceed> leaf elements to configure the color-based mapping for EIR for each class of service.

   To delete a priority map, include the delete operation in the <exceed> element tag.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2344" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <police-priority-map xmlns="urn:brocade.com:mgmt:brocade-policer">
                <name>pmap1</name>
                <conform>
                    <map-pri0-conform>1</map-pri0-conform>
                    <map-pri1-conform>1</map-pri1-conform>
                    <map-pri2-conform>2</map-pri2-conform>
                    <map-pri3-conform>1</map-pri3-conform>
                    <map-pri4-conform>2</map-pri4-conform>
                    <map-pri5-conform>2</map-pri5-conform>
                    <map-pri6-conform>1</map-pri6-conform>
                    <map-pri7-conform>1</map-pri7-conform>
                </conform>
                <exceed>
                    <map-pri0-exceed>1</map-pri0-exceed>
                    <map-pri1-exceed>1</map-pri1-exceed>
                    <map-pri2-exceed>1</map-pri2-exceed>
                    <map-pri3-exceed>1</map-pri3-exceed>
                    <map-pri4-exceed>1</map-pri4-exceed>
                    <map-pri5-exceed>1</map-pri5-exceed>
                    <map-pri6-exceed>1</map-pri6-exceed>
                    <map-pri7-exceed>1</map-pri7-exceed>
                </exceed>
            </police-priority-map>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2344" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
```

```
</rpc-reply>
```

Configuring the policy map

A policy map can contain multiple classification maps. Configure a policy map to associate QoS and policing parameters to traffic belonging to these classification maps. You can apply only one policy map per interface per direction (ingress and egress).

To configure a policy map, add a class map, and configure QoS and policing parameters for the class map, perform the following steps. For a complete description of all the policy map attributes, refer to the brocade-policer YANG module and the *Network OS Administrator's Guide*.

1. Issue the <edit-config> RPC to configure the <policy-map> node in the urn:brocade.com:mgmt:brocade-policer namespace.
2. Under the <policy-map> node, include the <po-name> leaf element and specify a name for the policy map.

   The name for the policy map must be a character string up to 64 characters.

   To delete a policy map, include the delete operation in the <policy-map> element tag.
3. Under the <policy-map> node, include a <class> node element for each policy map you want to configure.
4. Under the <class> node, include the <cl-name> node and specify a name for the class.

   Note that the class map name in the following example matches the name provided when you create the class map (refer to "Configuring a class map" on page 461).
5. Under the <police> node, configure the QoS and policing attributes for the class map using the following leaf node elements:
   a. In the <cir> element, specify the committed information rate (CIR).
   b. In the <cbs> element, specify the committed burst size (CBS).
   c. In the <eir> element, specify the exceeded information rate (EIR).
   d. In the <ebs> element, specify the exceeded burst size (EBS).
   e. In the <set-priority> element, specify the police priority map name.
   f. In the <conform-set-dscp> element, specify the DSCP priority for conforming traffic.
   g. In the <conform-set-prec> element, specify the IP precedence value for conforming traffic.
   h. In the <conform-set-tc> element, specify the traffic class value for conforming traffic.
   i. In the <exceed-set-dscp> element, specify the DCSP priority for exceeded traffic.
   j. In the <exceed-set-prec> element, specify the IP precedence value for exceeded traffic.
   k. In the <exceed-set-tc> element, specify the traffic class value for exceeded traffic.

   To delete any parameter include the delete operation in the element tag.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2345" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
```

```
        </target>
        <config>
            <policy-map xmlns="urn:brocade.com:mgmt:brocade-policer">
                <po-name>pmap1</po-name>
                <class>
                    <cl-name>default</cl-name>
                    <police>
                        <cir>1000</cir>
                        <cbs>5000</cbs>
                        <eir>1000</eir>
                        <ebs>3000</ebs>
                        <set-priority>pmap1</set-priority>
                        <conform-set-dscp>61</conform-set-dscp>
                        <conform-set-tc>7</exceed-set-tc>
                        <exceed-set-dscp>63</exceed-set-dscp>
                        <exceed-set-tc>3</exceed-set-tc>
                    </police>
                </class>
            </policy-map>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2345" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Attaching a port shaper to the policy map

You can specify the shaping rate per port attached to the class for the policy map. You can use this command to smooth out the traffic egressing an interface.

A policy map can contain multiple classification maps. Configure a policy map to associate QoS and policing parameters to traffic belonging to these classification maps. You can apply only one policy map per interface per direction (ingress and egress). The <port-shape> element is allowed for the egress direction. Refer to "Configuring the policy map" on page 464.

The <port-shape> element is mutually exclusive of the scheduler and police elements.

1. Issue the <edit-config> RPC to configure the <policy-map> node in the urn:brocade.com:mgmt:brocade-policer namespace.
2. Under the <policy-map> node, include the <po-name> leaf element and specify a name for the policy map.

   The name for the policy map must be a character string up to 64 characters.

   To delete a policy map, include the delete operation in the <policy-map> element tag.
3. Under the <policy-map> node, include a <class> node element for each policy map you want to configure.
4. Under the <class> node, include the <cl-name> node and specify a name for the class.

   Note that the class map name in the following example matches the name provided when you create the class map (refer to "Configuring a class map" on page 461).
5. Under the <class> node, include the <shaping-rate> node for the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2345" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <policy-map xmlns="urn:brocade.com:mgmt:brocade-policer">
                <po-name>pmap1</po-name>
                <class>
                    <cl-name>default</cl-name>
                    <port-shape>3000</port-shape>
                </class>
            </policy-map>
        </config>
    </edit-config>
    </rpc>

    <rpc-reply message-id="2345" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Binding the policy map to an interface

To associate a policy map to an interface and apply policing parameters, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface workspace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <name> leaf element and specify the interface in [*rbridge-id/*]s*lot/port* format to identify the interface you want to configure.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <shutdown> leaf element, and include the delete operation in the element tag to enable the interface.
5. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <service-policy> node element located in the urn:brocade.com:mgmt:brocade-policer namespace.
6. Under the <service-policy> node, include the following leaf elements:
    a. In the <in> leaf element, specify the name of the policy map to bind to the interface for ingress traffic.
    b. In the <out> leaf element, specify the name of the policy to bind to the interface for egress traffic.
7. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example binds policymap1 to both ingress and egress traffic on 10 Gb Ethernet interface 22/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2346" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
```

```
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/2</name>
                    <shutdown xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                    <service-policy xmlns=”urn:brocade.com:mgmt:brocade-policer”>
                        <in>policymap1</in>
                        <out>policymap1</out>
                    </service-policy>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2346" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Retrieving policing settings and policy maps

Use the following RPCs to display policies configured in policy, class, and priority maps.

Policy maps

The following example returns the running Policer policies and parameters set for the 10 Gb Ethernet interface 22/0/1. It uses the <get-config> RPC and a subtree filter to restrict the output to <service-policy> node for port 22/0/1 under the <interface>/<tengigabitethernet> node in the urn:brocade.com:mgmt:brocade-interface namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2347" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <service-policy
                     xmlns="urn:brocade.com:mgmt:brocade-policer"/>
                </tengigabitethernet>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2347" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <name>22/0/1</name>
            <service-policy xmlns="urn:brocade.com:mgmt:brocade-policer">
                <in>policymap1</in>
                <out>policymap1</out>
```

```
            </service-policy>
        </tengigabitethernet>
    </interface>
</rpc-reply>
```

The following example returns the running configured policy map. It uses the <get-config> RPC and a subtree filter to restrict the output to the contents of the <policy-map> node in the urn:brocade.com:mgmt:brocade-policer namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2348" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <policy-map xmlns="urn:brocade.com:mgmt:brocade-policer"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2349" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <policy-map xmlns="urn:brocade.com:mgmt:brocade-policer">
        <po-name>pmap1</po-name>
        <class>
            <cl-name>default</cl-name>
            <police>
                <cir>1000</cir>
                <cbs>5000</cbs>
                <eir>1000</eir>
                <ebs>3000</ebs>
                <set-priority>pmap1</set-priority>
                <conform-set-dscp>61</conform-set-dscp>
                <conform-set-tc>7</exceed-set-tc>
                <exceed-set-dscp>63</exceed-set-dscp>
                <exceed-set-tc>3</exceed-set-tc>
            </police>
        </class>
    </policy-map>
</rpc-reply>
```

Class maps

The following example displays the running configured class map name and configured match attribute. It uses the <get-config> RPC and a subtree filter to restrict the output to the contents of the <class-map> node in the urn:brocade.com:mgmt:brocade-policer namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2350" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <class-map xmlns="urn:brocade.com:mgmt:brocade-policer"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2350" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <class-map xmlns="urn:brocade.com:mgmt:brocade-policer">
        <name>pmap1</name>
        <match>
            <any/>
        </match>
    </class-map>
</rpc-reply>
```

Priority maps

The following example displays the running configured police priority map name and mapping of CoS values for conform and exceed color priorities. It uses the <get-config> RPC with a subtree filter to limit the output to the contents of the <police-priority-map> node in the urn:brocade.com:mgmt:brocade-policer namespace.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <police-priority-map xmlns="urn:brocade.com:mgmt:brocade-policer"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <police-priority-map xmlns="urn:brocade.com:mgmt:brocade-qos">
        <name>pmap1</name>
        <conform>
            <map-pri0-conform>1</map-pri0-conform>
            <map-pri1-conform>1</map-pri1-conform>
            <map-pri2-conform>2</map-pri2-conform>
            <map-pri3-conform>1</map-pri3-conform>
            <map-pri4-conform>2</map-pri4-conform>
            <map-pri5-conform>2</map-pri5-conform>
            <map-pri6-conform>1</map-pri6-conform>
            <map-pri7-conform>1</map-pri7-conform>
        </conform>
        <exceed>
            <map-pri0-exceed>1</map-pri0-exceed>
            <map-pri1-exceed>1</map-pri1-exceed>
            <map-pri2-exceed>1</map-pri2-exceed>
            <map-pri3-exceed>1</map-pri3-exceed>
            <map-pri4-exceed>1</map-pri4-exceed>
            <map-pri5-exceed>1</map-pri5-exceed>
            <map-pri6-exceed>1</map-pri6-exceed>
            <map-pri7-exceed>1</map-pri7-exceed>
        </exceed>
    </police-priority-map>
</rpc-reply>
```

Configuring Auto-QOS

Auto QoS (Quality of Service) for NAS creates a minimum bandwidth guarantee for Network Attached Storage traffic. Auto QoS for NAS is disabled by default; you must enable Auto QoS to allow NAS packets to have the correct service levels.

The **cee-map** priority group and priority-map settings must be their default values.

Enabling Auto QoS for NAS:

- Changes the CoS value of NAS packets to 2
- Reduces the weight of PGID 2 from 60 to 40
- Creates a new PGID 3 with a weight of 20
- Modifies the priority table to include PGID 3 for the user-configured NAS CoS, or the default NAS CoS if the CoS has not been otherwise modified

1. Issue the <edit-config> RPC to configure the <qos> node in the urn:brocade.com:mgmt:brocade-qos namespace.
2. Enable Auto QoS for all NAS traffic with the NAS <auto-qos> node under the <nas> container. The presence of the node activates Auto-QOS.

```
<?xml version="1.0">
<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <nas>
            <nas xmlns="urn:brocade.com:mgmt:brocade-qos">
            </auto-qos>
        </nas>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

3. Set the CoS value for all NAS traffic by entering a value for the <cos> node.

```
<?xml version="1.0">
<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <nas xmlns="urn:brocade.com:mgmt:brocade-qos">
            <auto-qos>
                <set>
                    <cos>4</cos>
                </set>
            </auto-qos>
        </nas>
    </config>
</edit-config>
```

```
</rpc>

<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

4. Set the DSCP value for all NAS traffic by entering a value for the <dscp> node.

   The Differentiated Services Code Point (DSCP) value affects how Auto-QoS operates by specifying the priority value for Network Attached Storage traffic on IP networks. Higher numbers provide a higher level of priority.

```
<?xml version="1.0">
<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <nas xmlns="urn:brocade.com:mgmt:brocade-qos">
            <auto-qos>
                <set>
                    <dscp>56</dscp>
                </set>
            </auto-qos>
        </nas>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

5. Identify the IPv4 network addresses (either origination or destination) used by the NAS devices by adding the <server-ip> node, followed by either the <vlan-number> node or the <vrf-name> node.

```
<?xml version="1.0">
<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <nas xmlns="urn:brocade.com:mgmt:brocade-qos">
            <server-ip>
                <server-ip>1.1.1.1/32</server-ip>
                    <vrf>
                        <vrf-name>bruce</vrf-name>
                    </vrf>
            </server-ip>
        </nas>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2351" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Chapter

Configuring 802.1x Port Authentication 30

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802.1x port authentication with NETCONF overview

This chapter provides procedures for configuring 802.1x authentication using NETCONF interfaces. Refer to the *Network OS Administrator's Guide* for the following related information:

- Conceptual and overview information about the 802.1x port authentication and the 802.1x protocol
- Configuring 802.1x port authentication using the Network OS command line interface (CLI)

Through the NETCONF interface, you can perform the following operations related to 802.1x port authentication:

- Use the <edit-config> RPC to configure 802.1x port authentication globally and on a per-interface basis.
- Use the <get-config> RPC to verify all or part of the global or per-port 802.1x port authentication configuration.

802.1x port authentication parameters are defined in the brocade-dot1x YANG module. For information about the brocade-dot1x YANG module, refer to the *Network OS YANG Reference Manual*.

802.1x authentication configuration tasks

The tasks in this section describe the common 802.1x operations that you may need to perform. For complete configuration options using the NETCONF interface, refer to the *Network OS YANG Reference Manual* and the brocade-dot1x.yang source file.

Configuring authentication between the switch and CNA or NIC

To configure authentication, you must add a RADIUS server to perform the authentication, and then enable 802.1x authentication globally. The authentication process attempts to connect to the first RADIUS server. If the RADIUS server is not reachable, the next RADIUS server is contacted. However, if the RADIUS server is contacted and the authentication fails, the authentication process does not check for the next server in the sequence.

To add a RADIUS server and enable 802.1x authentication globally, perform the following steps.

1. Issue the <edit-config> RPC to configure the <radius-server> node in the urn:brocade.com:mgmt:brocade-aaa namespace.
2. Under the <radius-server> node, include the <host> node element.
3. Under the <host> node, include the <hostname> element and specify the RADIUS server.
4. Configure the <dot1x> node in the urn:brocade.com:mgmt:brocade-dot1x namespace.
5. Under the <dot1x> node, include the <enable> node to enable 802.1x authentication globally.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example specifies 10.0.0.5 as a RADIUS server and enables 802.1x authentication globally.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2400" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <radius-server xmlns="urn:brocade.com:mgmt:brocade-aaa">
                <host>
                    <hostname>10.0.0.5</hostname>
                </host>
            </radius-server>
            <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x>
                <enable/>
            </dot1x>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2400" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Setting a global timeout value for performing readiness checks

The 802.1x readiness check monitors 802.1x activity on all the switch ports and displays information about the devices connected to the ports that support 802.1x. You can use this feature to determine if the devices connected to the switch ports are 802.1x-capable.

Before running the readiness check, you can set a timeout value in seconds. The default timeout value is 10 seconds. To configure a readiness check timeout value, perform the following steps.

1. Issue the <edit-config> RPC to configure the <dot1x> node in the urn:brocade.com:mgmt:brocade-dot1x namespace.
2. Under the <dot1x> node, include the <test> node element.
3. Under the <test> node, include the <timeout> leaf element and set a value in seconds for the readiness check timeout.
4. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
                <test>
                    <timeout>40</timeout>
                </test>
            </dot1x>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling 802.1x globally

To disable 802.1x authentication globally, perform the following steps.

1. Issue the <edit-config> RPC to configure the <dot1x> node in the urn:brocade.com:mgmt:brocade-dot1x namespace.
2. Under the <dot1x> node, include the <enable> element, and include the delete operation in the <enable> element tag.
3. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2402" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
                <enable xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
            </dot1x>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2402" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <ok/>
</rpc-reply>
```

Interface-specific administrative tasks for 802.1x

It is essential to configure the 802.1x port authentication protocol globally on the Brocade VDX hardware, and then enable 802.1x and make customized changes for each interface port. Because 802.1x was enabled and configured in "802.1x authentication configuration tasks", use the administrative tasks in this section to make any necessary customizations to specific interface port settings.

802.1x readiness check

Before configuring 802.1x for specific interface ports, Brocade recommends that you perform a readiness check to ensure the port is 802.1x-capable. You cannot perform this check from the NETCONF interface. The check can be performed only from the command line interface of the device by issuing the **dot1x test eapol-capable** command. Refer to the *Network OS Administrator's Guide* for details.

Configuring 802.1x on specific interface ports

To configure 802.1x port authentication on a specific interface port, perform the following steps. Repeat this task for each interface port you wish to modify.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.

NOTE
You cannot configure 802.1x authentication on a port-channel.

3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <name> leaf element and specify the name of the interface on which you want to configure 802.1x authentication. Specify the interface in [*rbridge-id/*]*slot/port* format.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <dot1x> node element from the urn:brocade.com:mgmt:brocade-dot1x namespace.
5. Under the <dot1x> node, include the empty <authentication> leaf element to configure 802.1x authentication for the port interface.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example configures 802.1x authentication on 10-gigabit Ethernet port 22/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2403" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
```

```
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
                        <authentication/>
                    </dot1x>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2403" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring 802.1x timeouts on specific interface ports

NOTE
While you are free to modify the timeouts, Brocade recommends that you leave timeouts set to their default values.

You can configure the following timeout values:

- <re-authperiod>—Configures the time in seconds between reauthentication attempts. The value must be in the range 1 through 4,294,967,295. The default is 3600.
- <server-timeout>—Configures a timeout interval in seconds for the 802.1x server. This period is the amount of time the switch waits for a reply before retransmitting the response to the server, when relaying the response from the client to the authentication server. The value must be in the range 1 through 65535. The default value is 30.
- <supp-timeout>—Configures a timeout interval in seconds for the 802.1x supplicant. This period is the amount of time the switch waits for a response before retransmitting the request to the client when relaying a request from the authentication server to client. The value must be in the range 1 through 65535. The default value is 30.
- <tx-period>—Configures the transmission timeout. This value specifies the number of seconds the switch waits for a response to an EAP request/identity from the client before retransmitting the request. The value must be in the range 1 through 65535. The default value is 30.

To configure 802.1x timeout attributes on a specific interface port, perform the following steps. Repeat this task for each interface port you wish to modify.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.

   NOTE
   You cannot configure 802.1x authentication on a port-channel.

3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <name> leaf element and specify the name of the interface on which you want to configure 802.1x authentication timers. Specify the interface in [*rbridge-id/*]*slot/port* format.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <dot1x> node element from the urn:brocade.com:mgmt:brocade-dot1x namespace.
5. Under the <dot1x> node, include the <timeout> node element.
6. Under the <timeout> node, include the <re-authperiod>, <server-timeout>, <supp-timeout>, or <tx-period> leaf element and specify a new timeout value.
7. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example changes the supplicant timeout value to 40 seconds.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
                        <timeout>
                            <supp-timeout>40</supp-timeout>
                        </timeout>
                    </dot1x>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2404" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring 802.1x re-authentication on interface ports

To configure 802.1x port re-authentication on a specific interface port, perform the following steps. Repeat this task for each interface port you wish to modify.

The default re-authentication period is 3600 seconds.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.

NOTE
You cannot configure 802.1x authentication on a port-channel.

3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <name> leaf element and specify the name of the interface on which you want to configure 802.1x re-authentication. Specify the interface in [*rbridge-id/*]s*lot/port* format.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <dot1x> node element from the urn:brocade.com:mgmt:brocade-dot1x namespace.
5. Under the <dot1x> node, include the empty <authentication> leaf element to enable 802.1x authentication on the interface.
6. Under the <dot1x> node, include the empty <reauthentication/> leaf element to enable 802.1x re-authentication on the interface.
7. *Optional*: Under the <dot1x> element, include the <timeout> node element.
8. *Optional*: Under the <timeout> node, include the <re-authperiod>, and specify a new timeout value.
9. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example sets reauthorization for the 10 gigabit Ethernet 22/0/1 interface and sets the reauthorization timer to 4000 seconds.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2405" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
                        <authentication/>
                        <reauthentication/>
                        <timeout>
                            <re-authperiod>4000</re-authperiod>
                        </timeout>
                    </dot1x>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2405" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring 802.1x port-control on specific interface ports

You can set 802.1x port-control on an interface to one of the following states:

- auto—802.1x authentication is enabled. The port moves to the authorized state only after successful authentication. “auto” is the default value.

- force-authorized—802.1x authentication is disabled and the port moves to the authorized state.
- force-unauthorized—802.1x authentication is disabled and the port moves to the unauthorized state.

NOTE
If you globally disable 802.1x, all interface ports with 802.1x authentication enabled automatically switch to force-authorized port-control mode.

To configure 802.1x port-control on a specific interface port, perform the following steps. Repeat this task for each interface port you wish to modify.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.

   NOTE
   You cannot configure 802.1x authentication on a port-channel.

3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <name> leaf element and specify the name of the interface on which you want to configure 802.1x authentication port-control. Specify the interface in [*rbridge-id/*]s*lot/port* format.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <dot1x> node element from the urn:brocade.com:mgmt:brocade-dot1x namespace.
5. Under the <dot1x> node, include the empty <authentication> leaf element to enable 802.1x authentication on the interface.
6. Under the <dot1x> node, include the <port-control> leaf element and set its value to “auto”, “force-authorized”, or “force-unauthorized”.

The following example sets port-control on 10 gigabit Ethernet interface 22/0/1 to “force-authorized”.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2406" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
                        <authentication/>
                        <port-control>force-authorized</port-control>
                    </dot1x>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>
```

```
<rpc-reply message-id="2406" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Disabling 802.1x on specific interface ports

To disable 802.1x authentication on a specific interface port, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node element.

NOTE
You cannot configure 802.1x authentication on a port-channel.

3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <name> leaf element and specify the name of the interface on which you want to disable 802.1x authentication. Specify the interface in [*rbridge-id/*]s*lot/port* format.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, or <hundredgigabitethernet> node, include the <dot1x> node element from the urn:brocade.com:mgmt:brocade-dot1x namespace.
5. Under the <dot1x> node, include the empty <authentication> leaf element, and include the delete operation in the element tag to disable 802.1x authentication for the port interface.
6. Issue the <bna-config-cmd> RPC to save the *running-config* file to the *startup-config* file.

The following example disables 802.1x authentication on interface 22/0/1.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2407" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
                        <authentication
                         xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete">
                    </dot1x>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2407" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Checking 802.1x configurations

You cannot obtain 802.1x authentication operational data using the NETCONF interface. To obtain information about dot1x statistical and diagnostic information requires the CLI. Refer to the *Network OS Administrator's Guide* for details.

To retrieve running configuration information for global 802.1x authentication, issue the <get-config> RPC with a subtree filter to return the <dot1x> portion of the configuration, as shown in the following example. The <enable/> node is returned in the reply if dot1x is configured globally. The readiness timeout value is also returned.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2408" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2408" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x">
        <enable/>
        <test>
            <timeout>20</timeout>
        </test>
    </dot1x>
</rpc-reply>
```

To obtain dot1x configuration information for a specific interface, issue the <get-config> RPC with a subtree filter to restrict the output to the <dot1x> node under a specific interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>22/0/1</name>
                    <dot1x xmlns="urn:brocade.com:mgmt:brocade-dot1x"/>
                </tengigabitethernet>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2409" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <name>22/0/1</name>
            <dot1x>
                <authentication/>
                <port-control>auto</port-control>
```

```
                <protocol-version>2<protocol-version>
                <quiet-period>120</quiet-period>
                <reauthMax>5</reauthMax>
                <reauthentication/>
                <timeout>
                    <re-authperiod>25</re-authperiod>
                    <server-timeout>40</server-timeout>
                    <supp-timeout>40</supp-timeout>
                    <tx-period>34</tx-period>
                </timeout>
            </dot1x>
        </tengigabitethernet>
    </interface>
</rpc-reply>
```

Chapter

Configuring sFlow 31

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- Flow-based sFlow. 489

sFlow configuration with NETCONF overview

This chapter provides procedures for configuring sFlow using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for related conceptual and overview information about the sFlow protocol.

Through the NETCONF interface, you can perform the following operations that affect the functioning of sFlow:

- Use the <edit-config> RPC to activate, configure, or deactivate the sFlow protocol globally.
- Use the <edit-config> RPC to activate, configure, or deactivate sFlow on specific 10-Gigabit, 40-Gigabit, or Gigabit Ethernet interfaces.
- Use the <get-config> RPC to verify all or part of the global or per-port sFlow configuration.

sFlow must be enabled globally before it can be enabled on a specific interface.

sFlow parameters are defined in the brocade-sflow YANG module. For information about the brocade-sflow YANG module, refer to the *Network OS YANG Reference Manual*.

Configuring the sFlow protocol globally

Brocade recommends that you configure sFlow globally on the Brocade switch first, and then enable sFlow on specific interface ports and make custom alterations, because sFlow parameters at the interface level can differ from those at the global level. For details, refer to "Interface-specific administrative tasks for sFlow" on page 487.

Enabling sFlow globally does not enable it on interface ports. sFlow must be explicitly enabled on all the required interface ports. Refer to "Enabling and customizing sFlow on specific interfaces" on page 487.

NOTE

On the Brocade VDX 8770, Switched Port Analyzer (SPAN), and sFlow can be enabled at the same time. However, on the Brocade VDX 6720, SPAN and sFlow cannot be enabled at the same time.

To configure sFlow globally, perform the following steps.

1. Issue an <edit-config> RPC to configure the <sflow> node in the urn:brocade.com:mgmt:brocade-sflow namespace.
2. Under the <sflow> node, include the following elements.
    a. Include the empty <enable> leaf element to enable the sFlow protocol globally.
    b. In the <polling-interval> element, set the maximum number of seconds between successive samples of counters to be sent to the collector.

       The valid range is 1 through 165535. The default value is 20.
    c. In the <sample-rate> element, set the number of packets to be skipped before the next sample is taken.

       The valid range is 2 through 16777215. The default value is 32768.
    d. Include the <collector> node element.
3. Under the <collector> node, include the following elements.
    a. In the <collector-ip-address> leaf element, specify the IP address of the collector.
    b. Optional: In the <collector-port-number> element, specify the UDP port number on the collector.

       The default value is 6343.

The following example enables sFlow globally, designates 102.10.128.176 as the sFlow collector, sets the polling interval to 35, and the sample rate to 4096.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2500" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <sflow xmlns="urn:brocade.com:mgmt:brocade-sflow">
            <enable/>
            <collector>
                <collector-ip-address>192.10.138.176</collector-ip-address>
            </collector>
            <polling-interval>35</polling-interval>
            <sample-rate>4096</sample-rate>
        </sflow>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2500" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Interface-specific administrative tasks for sFlow

After the global sFlow configuration, sFlow must be explicitly enabled on all the required interface ports.

NOTE
When sFlow is enabled on an interface port, it inherits the sampling rate and polling interval from the global sFlow configuration.

Enabling and customizing sFlow on specific interfaces

NOTE
On the Brocade VDX 8770, SPAN and sFlow can be enabled at the same time. However, on the Brocade VDX 6710, VDX 6720, or VDX 6730, SPAN and sFlow cannot be enabled at the same time.

To enable and customize sFlow on an interface, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <tengigabitethernet>, <hundredgigabitethernet>, <fortygigabitethernet>, or <gigabitethernet> node element.

   NOTE
   You cannot configure sFlow on a port-channel. Configure sFlow on each individual physical port instead.

3. Under the <hundredgigabitethernet>, <fortygigabitethernet>, <tengigabitethernet>, or <gigabitethernet> node, include the <name> leaf element and specify the interface on which you want to enable sFlow. Specify the interface in the [*rbridge-id/*]s*lot/port* format.
4. Under the <hundredgigabitethernet>, <fortygigabitethernet>, <tengigabitethernet>, or <gigabitethernet> node, include the <sflow> node element located in the urn:brocade.com:mgmt:brocade-sflow namespace and include the following leaf elements.
   a. The empty <enable> element to enable sFlow on the specified interface.
   b. Optionally, in the <polling-interval> element, specify for the interface the maximum number of seconds between successive samples of counters to be sent to the collector. This value overrides the globally configured value for the interface.
   c. Optionally, in the <sample-rate> element, specify the interface the number of packets to be skipped before the next sample is taken. This value overrides the globally configured value for the interface.

   The following example enables sFlow on 10-gigabit Ethernet port 1/0/16 and sets port-specific values for the polling interval and sample rate.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2501" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
```

```
            <tengigabitethernet>
                <name>1/0/16</name>
                <sflow xmlns="urn:brocade.com:mgmt:brocade-sflow">
                    <enable/>
                    <polling-interval>35</polling-interval>
                    <sample-rate>8192</sample-rate>
                </sflow>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2501" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Disabling sFlow on specific interfaces

NOTE
Disabling sFlow on the interface port does not completely shut down the network communication on the interface port.

To disable sFlow on a specific interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <hundredgigabitethernet>, <fortygigabitethernet>, <tengigabitethernet>, or <gigabitethernet> node element.
3. Under the <hundredgigabitethernet>, <fortygigabitethernet>, <tengigabitethernet>, or <gigabitethernet> node, include the <name> leaf element and specify the interface on which you want to disable sFlow. Specify the interface in the [*rbridge-id/*]*slot/port* format.
4. Under the <hundredgigabitethernet>, <fortygigabitethernet>, <tengigabitethernet>, or <gigabitethernet> node, include the <sflow> node element located in the urn:brocade.com:mgmt:brocade-sflow namespace.
5. Under the <sflow> node, include the empty <enable> element and specify the delete operation in the element tag to disable sFlow on the interface.

   The following example disables sFlow on 10-gigabit Ethernet port 1/0/16.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2502" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
            <tengigabitethernet>
                <name>1/0/16</name>
                <sflow xmlns="urn:brocade.com:mgmt:brocade-sflow">
                    <enable xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete"/>
                </sflow>
            </tengigabitethernet>
```

```
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2502" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Flow-based sFlow

Refer to the *Network OS Administrator's Guide* for related conceptual and overview information about flow-based sFlow.

Configuring flow-based sFlow

Flow-based sFlow is used to analyze a specific type of traffic (flow based on access control lists, or ACLs). This involves configuring an sFlow policy map and binding it to an interface.

NOTE
The "deny ACL" rule is not supported for flow-based sflow. Only the permit action is supported.

Perform the following steps, beginning in global configuration mode.

1. Create an sFlow profile.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="9">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <sflow-profile xmlns="urn:brocade.com:mgmt:brocade-sflow">
            <profile-name>new_sflow_profile</profile-name>
            <profile-sampling-rate>512</profile-sampling-rate>
         </sflow-profile>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="9" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

2. Create a standard MAC ACL.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="10">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <mac xmlns="urn:brocade.com:mgmt:brocade-mac-access-list">
            <access-list>
               <standard>
                  <name>new_acl</name>
               </standard>
```

```
            </access-list>
         </mac>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="10" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

3. Create a class map and attach the ACL to the class map.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="11">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <class-map xmlns="urn:brocade.com:mgmt:brocade-policer">
            <name>new_class_map</name>
         </class-map>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="11" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>

<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="12">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <class-map xmlns="urn:brocade.com:mgmt:brocade-policer">
            <name>new_class_map</name>
            <match>
               <access-group>
                  <access-group-name>new_acl</access-group-name>
               </access-group>
            </match>
         </class-map>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="12" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

4. Create a policy map and attach the class map to the policy map.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="13">
   <edit-config>
      <target>
        <running></running>
      </target>
      <config>
         <policy-map xmlns="urn:brocade.com:mgmt:brocade-policer">
```

```
            <po-name>new_policy_map</po-name>
         </policy-map>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="13" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>

<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="14">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <policy-map xmlns="urn:brocade.com:mgmt:brocade-policer">
            <po-name>new_policy_map</po-name>
            <class>
               <cl-name>new_class_map</cl-name>
            </class>
         </policy-map>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="14" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

5. Add an sFlow profile name by using the **map** command.

   This example assigns the profile name “new_sflow_profile.”

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="15">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <policy-map xmlns="urn:brocade.com:mgmt:brocade-policer">
            <po-name>new_policy_map</po-name>
            <class>
               <cl-name>new_class_map</cl-name>
               <map>
                  <sflow>new_sflow_profile</sflow>
               </map>
            </class>
         </policy-map>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="15" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

6. Bind the policy map to an interface.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="16">
   <edit-config>
```

```
      <target>
         <running></running>
      </target>
      <config>
         <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
            <tengigabitethernet>
               <name>1/0/1</name>
               <service-policy xmlns="urn:brocade.com:mgmt:brocade-policer">
                  <in>new_policy-map</in>
               </service-policy>
            </tengigabitethernet>
         </interface>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="16" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Disabling flow-based sFlow on specific interfaces

NOTE
Disabling sFlow on the interface port does not completely shut down the network communication on the interface port.

To disable sFlow on a specific interface, perform the following steps in interface configuration mode.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <sflow> node, include the empty <enable> element and specify the delete operation in the element tag to disable sFlow on the interface.

```
switch# show sflow interface tengigabitethernet 0/12
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="13">
   <edit-config>
      <target>
         <running></running>
      </target>
        <config>
              <sflow xmlns="urn:brocade.com:mgmt:brocade-sflow">
                 <enable xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete"/>
              </sflow>
       </config>
   </edit-config>
</rpc>

<rpc-reply message-id="2502" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Retrieving flow-based sFlow statistics

Use the <get-config> RPC to retrieve the current configuration data and operational state data. Refer to "Retrieving configuration data" on page 11 and "Retrieving operational data" on page 15 for detailed instructions.

Chapter

Configuring Switched Port Analyzer 32

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SPAN configuration with NETCONF overview

This chapter provides procedures for configuring Switched Port Analyzer (SPAN) monitoring sessions using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of SPAN
- General guidelines for using SPAN
- Procedures for configuring SPAN using the Network OS command line interface (CLI)
- Conceptual overview of RSPAN
- General guidelines for using RSPAN

Using the NETCONF interface, you can perform the following SPAN configuration operations:

- Use the <edit-config> remote procedure call (RPC) to configure SPAN.
- Use the <get-config> RPC to verify all or part of the SPAN configuration.

SPAN parameters are defined in the brocade-span YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all SPAN parameters, refer to the brocade-span.yang file.

Configuring ingress SPAN, egress SPAN, or bidirectional SPAN

Repeat the following procedure for each source port you want to monitor. A monitor session can have only one source port. For additional ports you must create additional monitor sessions.

To configure SPAN, perform the following steps.

1. Issue the <edit-config> RPC to configure the <monitor> node in the urn:brocade.com:mgmt:brocade-span namespace.
2. Under the <monitor> node, include the <session> node element.
3. Under the <session> node, include the following leaf elements.
    a. In the <session-number> field, identify the session with a unique session number.
    b. *Optional:* In the <description> field, provide a descriptive text for the session.
4. Under the <session> node, include the <span-command> node element.
5. Under the <span-command> node, include the following leaf elements.
    a. In the <source> element, specify “source” to designate subsequent parameters as pertaining to the source port.
    b. In the <src-tengigabitethernet> element, specify “tengigabitethernet”, “fortygigabitethernet”, or “gigabitethernet”, depending on the source port type.
    c. In the <src-tengigabitethernet-val> element, specify the source port in [*rbridge-id/*]s*lot/port* format.
    d. In the <destination> element, specify “destination” to designate subsequent parameters as pertaining to the destination port.
    e. In the <dest-tengigabitethernet> element, specify “tengigabitethernet”, “fortygigabitethernet”, or “gigabitethernet”, depending on the destination port type.
    f. In the <dest-tengigabitethernet-val> element, specify the destination port in [*rbridge-id/*]s*lot/port* format.
    g. In the <direction> element, specify “rx” to configure ingress SPAN, “tx” to configure egress SPAN, or “both” to configure bidirectional SPAN.

The following example configures an ingress SPAN session. It designates 1/0/15 as the source port and 1/0/18 as the destination port.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <monitor xmlns="urn:brocade.com:mgmt:brocade-span">
            <session>
               <session-number>1</session-number>
               <description>Hello World</description>
               <span-command>
                  <source>source</source>
                  <src-tengigabitethernet>tengigabitethernet
                   </src-tengigabitethernet>
                  <src-tengigabitethernet-val>1/0/15
                   </src-tengigabitethernet-val>
                  <destination>destination</destination>
                  <dest-tengigabitethernet>tengigabitethernet
                   </dest-tengigabitethernet>
                  <dest-tengigabitethernet-val>1/0/18
                   </dest-tengigabitethernet-val>
                  <direction>rx</direction>
               </span-command>
```

```
            </session>
         </monitor>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="2800" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Deleting a SPAN connection from a session

To remove a single connection from a SPAN session, perform the following steps.

1. Issue the <edit-config> RPC to configure the <monitor> node in the urn:brocade.com:mgmt:brocade-span namespace.
2. Under the <monitor> node, include the <session> node.
3. Under the <session> node, include the following leaf elements.
   a. In the <session-number> field, identify the session with a unique session number.
   b. *Optional*: In the <description> field, provide a descriptive text for the session.
4. Under the <session> node, include the <span-command> node element and include the delete operation in the element tag.
5. Under the <span-command> element, provide the parameters of the existing command.
   a. In the <source> element, specify “source” to designate subsequent parameters as pertaining to the source port.
   b. In the <src-tengigabitethernet> element, specify “tengigabitethernet”, “fortygigabitethernet”, or “gigabitethernet”, depending on the source port type.
   c. In the <src-tengigabitethernet-val> element, specify the source port in [*rbridge-id/*]s*lot/port* format.
   d. In the <destination> element, specify “destination” to designate subsequent parameters as pertaining to the destination port.
   e. In the <dest-tengigabitethernet> element, specify “tengigabitethernet”.
   f. In the <dest-tengigabitethernet-val> element, specify the destination port in [*rbridge-id/*]s*lot/port* format.
   g. In the <direction> element, specify “rx” to configure ingress SPAN.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
      <target>
         <running/>
      </target>
      <config>
         <monitor xmlns="urn:brocade.com:mgmt:brocade-span">
            <session>
               <session-number>1</session-number>
               <description>Hello Wrold</description>
               <span-command
```

```
                    xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                    operation="delete">
                       <source>source</source>
                       <src-tengigabitethernet>tengigabitethernet
                        </src-tengigabitethernet>
                       <src-tengigabitethernet-val>1/0/15
                        </src-tengigabitethernet-val>
                       <destination>destination</destination>
                       <dest-tengigabitethernet>tengigabitethernet
                        </dest-tengigabitethernet>
                       <dest-tengigabitethernet-val>1/0/18
                        </dest-tengigabitethernet-val>
                       <direction>both</direction>
                    </span-command>
                </session>
            </monitor>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2801" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Deleting a SPAN session

To remove a SPAN session, perform the following steps.

1. Issue the <get-config> RPC with a subtree filter to restrict the output to the <monitor> node in the urn:brocade.com:mgmt:brocade-span namespace.

   This step returns configuration information about existing monitoring sessions.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <monitor xmlns="urn:brocade.com:mgmt:brocade-span"/>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="2802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <monitor xmlns="urn:brocade.com:mgmt:brocade-span">
        <session>
            <session-number>1</session-number>
            <description>Hello World</description>
            <span-command>
                <source>source</source>
                <src-tengigabitethernet>tengigabitethernet
                 </src-tengigabitethernet>
                <src-tengigabitethernet-val>1/0/15
                 </src-tengigabitethernet-val>
                <destination>destination</destination>
                <dest-tengigabitethernet>tengigabitethernet
```

```
                </dest-tengigabitethernet>
               <dest-tengigabitethernet-val>1/0/18
                </dest-tengigabitethernet-val>
               <direction>both</direction>
            </span-command>
        </session>
        <session>
            <session-number>2</session-number>
(output truncated)
```

2. Issue the <edit-config> RPC to configure the <monitor> node in the urn:brocade.com:mgmt:brocade-span namespace.
3. Under the <monitor> node, include the <session> node element and include the delete operation in the element tag.
4. Under the <session> node, include the <session-number> leaf element and specify the session number you want to delete.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <monitor xmlns="urn:brocade.com:mgmt:brocade-span">
                <session xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                 operation="delete">
                    <session-number>1</session-number>
                </session>
            </monitor>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2803" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

5. Reissue the <get-config> RPC used in step 1 to check that the session configuration information has been removed.

SPAN in management cluster

SPAN in management cluster supports mirroring of a source port to a destination port lying on a different switch in the management cluster. SPAN in management cluster is configured in the same manner, with the exception of the <source> leaf.

The <source> leaf controls the source and destination switches in the management cluster by the interface designation. The source and destination port can be anywhere in the management cluster. In this example, the <source> leaf is set as the third switch in the management cluster by the 3/0/15 leaf. However the destination is set to the fifth switch in the management cluster by the 5/0/18 leaf.

```
<rpc-reply message-id="2802" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <monitor xmlns="urn:brocade.com:mgmt:brocade-span">
        <session>
```

```
            <session-number>1</session-number>
            <description>Hello World</description>
            <span-command>
                <source>source</source>
                <src-tengigabitethernet>tengigabitethernet
                 </src-tengigabitethernet>
                <src-tengigabitethernet-val>3/0/15
                 </src-tengigabitethernet-val>
                <destination>destination</destination>
                <dest-tengigabitethernet>tengigabitethernet
                 </dest-tengigabitethernet>
                <dest-tengigabitethernet-val>5/0/18
                 </dest-tengigabitethernet-val>
                <direction>both</direction>
            </span-command>
        </session>
```

This configuration rule applies to ingress, egress, and both directions of SPAN. Otherwise, configure SPAN as you would in standalone mode. Refer to "SPAN configuration with NETCONF overview" on page 495.

Configuring RSPAN

The principal difference between configuring SPAN and RSPAN is that RSPAN requires a remote VLAN to be created first. This example demonstrates the configuration of a bidirectional RSPAN.

To create a VLAN interface, perform the following steps.

1. Issue an <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace,
2. Under the <interface-vlan> element, specify the <interface>/<vlan> hierarchy of node elements.
3. Under the <vlan> node, specify the <name> element containing the new VLAN ID.

   The following example creates VLAN 1010.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="1904" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
            <interface>
                <vlan>
                    <name>1010</name>
                </vlan>
            </interface>
        </interface-vlan>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1904" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

4. Under the <vlan> node, set the value to <remote-span> to make the VLAN remote.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="11">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
            <interface>
               <vlan>
                  <name>1010</name>
               <remote-span xmlns="urn:brocade.com:mgmt:brocade-span">
               </remote-span>
                </vlan>
            </interface>
         </interface-vlan>
      </config>
   </edit-config>
</rpc>

<rpc-reply message-id="11" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

5. Issue the <edit-config> RPC to configure the <monitor> node in the urn:brocade.com:mgmt:brocade-span namespace.
6. Under the <monitor> node, include the <session> node element.
7. Under the <session> node, include the following leaf elements.
   a. In the <session-number> field, identify the session with a unique session number.
   b. *Optional:* In the <description> field, provide a descriptive text for the session.
8. Under the <session> node, include the <span-command> node element.
9. Under the <span-command> node, include the following leaf elements.
   a. In the <source> element, specify “source” to designate subsequent parameters as pertaining to the source port.
   b. In the <src-tengigabitethernet> element, specify “tengigabitethernet”, “fortygigabitethernet”, or “gigabitethernet”, depending on the source port type.
   c. In the <src-tengigabitethernet-val> element, specify the source port in [*rbridge-id/*]s*lot/port* format.
   d. In the <destination> element, specify “destination” to designate subsequent parameters as pertaining to the destination port.
   e. In the <dest-tengigabitethernet> element, specify “tengigabitethernet”, “fortygigabitethernet”, or “gigabitethernet”, depending on the destination port type.
   f. In the <dest-vlan-val> element, specify the destination port in VLAN format.
   g. In the <direction> element, specify “both” to configure bidirectional SPAN.

The following example configures an RSPAN session. It designates 1/0/11 as the source port and VLAN 1010 as the destination.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
   <edit-config>
      <target>
         <running></running>
      </target>
      <config>
         <monitor xmlns="urn:brocade.com:mgmt:brocade-span">
            <session>
               <session-number>1</session-number>
               <span-command>
                  <source>source</source>
                  <src-tengigabitethernet>tengigabitethernet
                  </src-tengigabitethernet>
                  <src-tengigabitethernet-val>1/0/11
                  </src-tengigabitethernet-val>
                   <destination>destination</destination>
                 <dest-tengigabitethernet>rspan-vlan</dest-tengigabitethernet>
                   <dest-vlan-val>1010</dest-vlan-val>
                   <direction>both</direction>
               </span-command>
            </session>
         </monitor>
      </config>
   </edit-config>
</rpc>
```

Section

IV

Network OS Layer 3 Routing Features

This section describes Layer 3 routing features of Network OS, and includes the following chapters:

- IP Route Policy 505
- IP Route Management 513
- Configuring OSPF 519
- Configuring VRRP 533
- Configuring VRF 553
- Configuring BGP 557
- Configuring IGMP 563
- Configuring DHCP Relay 567

Chapter

32

IP Route Policy

In this chapter

- IP route policy configuration with NETCONF overview. 505
- Configuring an IP prefix list. 505
- Configuring a route map 506
- Configuring and activating an IP route policy 508

IP route policy configuration with NETCONF overview

IP route policy controls how routes or IP subnets are transported from one subsystem to another subsystem. The IP route policy may perform “permit” or “deny” actions so that matched routes may be allowed or denied to the target subsystem accordingly. Additionally, an IP route policy may be used to modify the characteristics of a matched route and IP subnet pair.

Two types of IP route policies are supported; prefix-list and route-map.

This chapter provides procedures for configuring IP prefix lists and route maps. For conceptual details about IP route policies, refer to the *Network OS Administrator’s Guide*.

Through the NETCONF interface, you can perform the following operations on route policies:

- Use the <edit-config> RPC to configure and activate route policies.
- Use the <get-config> RPC to view all or part of the route policy configuration.

Route policy parameters are defined in the brocade-ip-policy YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Configuring an IP prefix list

An IP prefix list consists of a set of instances, each of which specifies match conditions. Refer to the *Network OS Administrator’s Guide* for a conceptual description of IP prefix lists.

To configure an IP prefix list, perform the following steps.

1. Issue the <edit-config> RPC to configure the <ip> node in the urn:brocade.com:mgmt:brocade-common-def namespace (for standalone mode) or the urn:brocade.com:mgmt:brocade-rbridge namespace (for VCS Fabric mode).
2. Under the <ip> node, include the <hide-prefix-holder> node element in the urn:brocade.com:mgmt:brocade-ip-policy namespace.
3. Under the <hide-prefix-holder> node, include a <prefix-list> node element for each instance of the prefix list.
4. Under the <prefix-list> node, include the following leaf elements.

a. In the <name> element, specify the IP prefix list name.

b. In the <instance> element, specify the instance ID.

c. In the <action-ipp> element, specify “permit” or “deny”.

d. In the <prefix-ipp> element, specify the prefix IP4 address.

e. *Optional*: In the <ge-ipp> element, specify the lower limit of the mask length,

f. *Optional*: In the <le-ipp> element, specify the upper limit of the mask length.

The following example configures an IP prefix list named test with two instances. A route is considered a match for instance 1 if this route is inside subnet 1.2.0.0/16 and has a mask length between 17 and 30. That is, route 1.2.1.0/24 matches, but route 1.2.1.1/32 does not, due to mask length.

```
<rpc message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ip xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <hide-prefix-holder
                 xmlns="urn:brocade.com:mgmt:brocade-ip-policy>
                    <prefix-list>
                        <name>test</name>
                        <instance>1</instance>
                        <action-ipp>deny</action-ipp>
                        <prefix-ipp>1.2.0.0/16</prefix-ipp>
                        <ge-ipp>17</ge-ipp>
                        <le-ipp>30</le-ipp>
                    </prefix-list>
                    <prefix-list>
                        <name>test</name>
                        <instance>2</instance>
                        <action-ipp>permit</action-ipp>
                        <prefix-ipp>1.1.0.0/16</prefix-ipp>
                    </prefix-list>
                </hide-prefix-holder>
            </ip>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring a route map

A route map is a policy mechanism that allows or denies entry to a subsystem based on the next hop interface. Refer to the *Network OS Administrator’s Guide* for a conceptual description of route maps.

To configure a route map, perform the following steps.

1. Issue the <edit-config> RPC to configure the <hide-routemap-holder> node in the urn:brocade.com:mgmt:brocade-ip-policy namespace.
2. Under the <hide-routemap-holder> node, include a <route-map> node element for each instance of the route map.
3. Under the <route-map> node, include the following elements.
   a. In the <name> element, specify the route map name.
   b. In the <action-rm> element, specify “permit” or “deny”.
   c. In the <instance> element, specify the instance ID.
   d. Specify the <content>/<match> hierarchy of node elements.
4. Under the <match> node, specify one of the following:
   - An <interface> node element, containing a leaf element that defines the interface next-hop interface to be used for matching. For example:

     ```
     <interface>
         <tengigabitethernet-rmm>0/1</tengigabitethernet=rmm>
     <interface
     ```

   - <ip>/<next-hop> node elements, containing a leaf element that specifies an IP prefix list to be used for next-hop matching. For example:

     ```
     <ip>
         <next-hop>
             <prefix-list-rmm-n>pre-test</prefix-list-rmm-n>
         </next-hop>
     </ip>
     ```

The following example configures a route-map named *test* that comprises two instances; instance 1 denies entry for any routes whose next-hop interface is te 0/1, and instance 2 allows entry for routes whose next-hop matches the IP subnets specified in the prefix-list pre-test (not shown). Additionally, each matched route has its tag set to 5000.

```
<rpc message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <hide-routemap-holder xmlns="urn:brocade.com:mgmt:brocade-ip-policy>
                <route-map>
                    <name>test</name>
                    <action-rm>deny</action-rm>
                    <instance>1</instance>
                    <content>
                        <match>
                            <interface>
                                <tengigabitethernet-rmm>0/1</tengigabitethernet-rmm>
                            </interface>
                        </match>
                    </content>
                </route-map>
                <route-map>
                    <name>test</name>
                    <action-rm>permit</action-rm>
                    <instance>2</instance>
                    <content>
```

```
                        <match>
                            <ip>
                                <next-hop>
                                    <prefix-list-rmm-n>pre-test</prefix-list-rmm-n>
                                </next-hop>
                            </ip>
                        </match>
                        <set>
                            <tag>
                                <tag-rms>5000</tag-rms>
                            </tag>
                        </set>
                    </content>
                </route-map>
            </hide-prefix-holder>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
       <ok/>
</rpc-reply>
```

NOTE
The maximum number of OSPF networks that can be advertised and processed in a single area in a router is limited to 600.

Configuring and activating an IP route policy

Similar to ACLs, a route-map and IP prefix must be applied for their specified policy to take effect. The following example applies a route-map to the redistribution of static routes in an OSPF domain.

To set an IP route policy, configure the route policy, define static routes, and then apply the policy to the protocol.

In the following example, when route map test is applied, only static route 1.1.1.0/24 is exported into the OSPF domain because no matching rule exists in the IP prefix-list named pretest for route 11.11.11.0/24. The default action of prefix list is deny (no match), thus route 11.11.11.0/24 is not exported into the OSPF domain.

1. Define the route policy.
    a. Configure the IP prefix instance.

       This example configures instance 2 an IP prefix named pretest that permits routes that match 1.1.1.0/24.

       NOTE
       The following example is for a standalone router and therefore configures the <ip> node in the urn:brocade.com:mgmt:brocade-common-def namespace. For a node in a Brocade VCS Fabric, configure the <ip> node in the urn:brocade.com:mgmt:brocade-rbridge namespace instead.

```
<rpc message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
```

```
        <target>
            <running/>
        </target>
        <config>
            <ip xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <hide-prefix-holder
                 xmlns="urn:brocade.com:mgmt:brocade-ip-policy>
                    <prefix-list>
                        <name>pretest</name>
                        <instance>2</instance>
                        <action-ipp>permit</action-ipp>
                        <prefix-ipp>1.1.0.0/24</prefix-ipp>
                    </prefix-list>
                </hide-prefix-holder>
            </ip>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="913"
 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

b. Create the route map instance.

The following example provides a route-map that permits routes allowed by the prefix list named pretest.

```
<rpc message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <hide-routemap-holder
             xmlns="urn:brocade.com:mgmt:brocade-ip-policy>
                <route-map>
                    <name>test</name>
                    <action-rm>permit</action-rm>
                    <instance>1</instance>
                    <content>
                        <match>
                            <ip>
                                <next-hop>
                                    <prefix-list-rmm-n>pre-test
                                     </prefix-list-rmm-n>
                                </next-hop>
                            </ip>
                        </match>
                    </content>
                </route-map>
            </hide-routemap-holder>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="913"
 xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. Create the prefix and next hop for each static route.

NOTE
The following example is for a standalone router and therefore configures the <ip> node in the urn:brocade.com:mgmt:brocade--common-def namespace. For a node in a Brocade VCS Fabric, configure the <ip> node in the urn:brocade.com:mgmt:brocade-rbridge namespace instead.

```
<rpc message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <ip xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <route xmlns="urn:brocade.com:mgmt:brocade-rtm>
                    <static-route-nh>
                        <static-route-dest>11.11.11.0/24</static-route-dest>
                        <static-route-next-hop>2.2.2.1</static-route-next-hop>
                    </static-route-nh>
                    <static-route-nh>
                        <static-route-dest>11.11.11.0/24</static-route-dest>
                        <static-route-next-hop>2.2.2.2</static-route-next-hop>
                    </static-route-nh>
                </route>
            </ip>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Apply the route map to the OSPF protocol to redistribute the static routes.

NOTE
The following example is for a standalone router and therefore configures the <router> node in the urn:brocade.com:mgmt:brocade--common-def namespace. For a node in a Brocade VCS Fabric, configure the <router> node in the urn:brocade.com:mgmt:brocade-rbridge namespace instead.

```
<rpc message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <router xmlns="urn:brocade.com:mgmt:brocade-common-def">
                <hide-ospf-holder
                 xmlns="urn:brocade.com:mgmt:brocade-ospf>
                    <ospf>
                        <redistribute>
                            <static>
                                <static-route-map>test<static-route-map>
                            </static>
                        </redistribute>
                        <area>
```

```
                        <area-id>0</area-id>
                    </area>
                </ospf>
            </hide-ospf-holder>
        </router>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="913" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

You can configure the router to explicitly permit or deny specific IP addresses. The router permits all IP addresses by default. If you want permit to remain the default behavior, define individual filters to deny specific IP addresses. If you want to change the default behavior to deny, define individual filters to permit specific IP addresses. Once you define a filter, the default action for addresses that do not match a filter is “deny”. To change the default action to “permit”, configure the last filter as “permit any any”.

Chapter

IP Route Management 33

In this chapter

- IP route management with NETCONF overview 513
- Configuring static routes 513
- Other routing operations 516

IP route management with NETCONF overview

IP route management is the term used in this chapter to refer to software that manages routes and next hops from different sources in a routing table, from which your Brocade device selects the best routes for forwarding IP packets. This route management software automatically gets activated at system bootup and does not require pre-configuration.

This chapter provides procedures and examples for configuring static routes using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of route management, including a discussion about how route management determines the best route among dynamic, static, and directly connected routes
- Procedures and examples for configuring static routes using the Network OS command line interface

Using the NETCONF interface, you can perform the following operations:

- Use the <edit-config> remote procedure call (RPC) to configure static routes and perform other IP route management operations.
- Use the <get-config> RPC to verify all or part of the route management configuration.

Static route parameters are defined in the brocade-rtm YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. The brocade-rtm.yang file provides definitions and explanations of all route management parameters.

NOTE
IP route management supports both IPv4 and IPv6 routes.

Configuring static routes

You can add a static route to IP route management using NETCONF operations. You can specify either the next-hop gateway or egress interface to add the route.

Specifying the next hop gateway

To specify the next hop gateway, perform the following steps.

1. Issue the <edit-config> RPC to configure the <rbridge-id> node in the urn:brocade.com:mgmt:brocade-rbridge namespace.
2. Under the <rbridge-id> node, include the <rbridge-id> leaf node, and specify the ID of the routing bridge on which you want to configure static routes.
3. Under the <rbridge-id> node, include the <ip>/<rtm-config>/<route>/<static-route-nh> hierarchy of node elements.

   The <rtm-config> and subsequent nodes are located in the urn:brocade.com:mgmt:brocade-rtm namespace.
4. Under the <static-route-nh> node, include the following leaf nodes.
   a. In the <static-route-dest> element, specify the destination IP address.
   b. In the <static-route-next-hop> element, specify the next hop IP address.

The following example configures a static route to 207.95.7.0, using 207.95.6.157 as the next-hop gateway.

```
<rpc message-id="3300" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>30</rbridge-id>
                <ip>
                    <rtm-config xmlns="urn:brocade.com:mgmt:brocade-rtm">
                        <route>
                            <static-route-nh>
                                <static-route-dest>207.95.7.0/24</static-route-dest>
                                <static-route-next-hop>207.95.6.157
                                 </static-route-next-hop>
                            </static-route-nh/>
                        </route>
                    </rtm-config>
                </ip>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3300" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Specifying the egress interface

To configure a static IP route with a physical interface port or port-channel, perform the following steps.

1. Issue the <edit-config> RPC to configure the <rbridge-id> node in the urn:brocade.com:mgmt:brocade-rbridge namespace.
2. Under the <rbridge-id> node, include the <rbridge-id> leaf node, and specify the ID of the routing bridge on which you want to configure static routes.
3. Under the <rbridge-id> node, include the <ip>/<rtm-config>/<route>/static-route-oif> hierarchy of node elements.

   The <rtm-config> and subsequent nodes are located in the urn:brocade.com:mgmt:brocade-rtm namespace.
4. Under the <static-route-oif> node, include the following leaf nodes.
   a. In the <static-route-dest> element, specify the destination IP address.
   b. In the <static-route-oif-type> element, specify the interface type of the egress interface.

      Possible values are “tengigabitethernet”, “gigabitethernet”, “fortygigabitethernet”, “port-channel”, and “null”.
   c. In the <static-route-oif-name> element, specify the name of the interface in [*rbridge-id/*]s*lot/port* or port-channel number format.

The following example configures a static IP route for destination network 192.128.2.0/24. Because an Ethernet port is specified instead of a gateway IP address as the next hop, the Brocade device forwards traffic for the 192.128.2.0/24 network to the tengigabitethernet port 101/4/1.

```
<rpc message-id="3301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>30</rbridge-id>
                <ip>
                    <rtm-config xmlns="urn:brocade.com:mgmt:brocade-rtm">
                        <route>
                            <static-route-oif>
                                <static-route-dest>192.128.2.0/24
                                 </static-route-dest>
                                <static-route-oif-type>tengigabitethernet
                                 </tengigabitethernet>
                                <static-route-oif-name>101/4/1
                                 </static-route-oif-name>
                            </static-route-oif/>
                        </route>
                    </rtm-config>
                </ip>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>


<rpc-reply message-id="3301" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the default route

The default route is configured with an all zeros prefix/netmask (that is, 0.0.0.0/0). This default route gets installed in the ASIC. All traffic that does not have other matching routes is forwarded using the default route.

The following example configures a default route with a next hop of 207.95.6.157.

```
<rpc message-id="3302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>30</rbridge-id>
                <ip>
                    <rtm-config xmlns="urn:brocade.com:mgmt:brocade-rtm">
                        <route>
                            <static-route-nh>
                                <static-route-dest>0.0.0.0/0</static-route-dest>
                                <static-route-next-hop>207.95.6.157
                                 </static-route-next-hop>
                            </static-route-nh/>
                        </route>
                    </rtm-config>
                </ip>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3302" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Other routing operations

This section describes some other commonly used route management operations. Refer to the *Network OS YANG Reference Manual* for a list of all IP routing-related parameters.

Specifying route attributes

When specifying a route, include leaf elements under the <route-attributes> node that let you:

- Specify a tag value of a route to use for route filtering with a route map (<tag> element).
- Specify a cost metric of a route (<metric> element).

The following example sets the cost of a route to 10 and specifies a tag value of 5 for route filtering.

```
rpc message-id="3303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
```

```
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>30</rbridge-id>
                <ip>
                    <rtm-config xmlns="urn:brocade.com:mgmt:brocade-rtm">
                        <route>
                            <static-route-nh>
                                <static-route-dest>207.95.7.0/24
                                 </static-route-dest>
                                <static-route-next-hop>207.95.6.157
                                 </static-route-next-hop>
                                <route-attributes>
                                    <tag>5</tag>
                                    <metric>10</metric>
                                </route-attributes>
                            </static-route-nh/>
                        </route>
                    </rtm-config>
                </ip>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3303" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling IP load sharing

Use the <load-sharing> element to balance IP traffic across up to eight equal paths.

```
<rpc message-id="3304" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>30</rbridge-id>
                <ip>
                    <rtm-config xmlns="urn:brocade.com:mgmt:brocade-rtm">
                        <load-sharing/>
                    </rtm-config>
                </ip>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3304" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Resolving the next hop using an OSPF route

Use the <next-hop> element to allow a Brocade device to use routes learned from OSPF to resolve a configured static route.

```
<rpc message-id="3305" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>30</rbridge-id>
                <ip>
                    <rtm-config xmlns="urn:brocade.com:mgmt:brocade-rtm">
                        <route>
                            <next-hop>
                                <proto>ospf</proto>
                            </next-hop>
                        </route>
                    </rtm-config>
                </ip>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3305" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Using recursion to resolve the next hop

Use the <next-hop-recursion> element to allow a Brocade device to resolve a route by using up to 10 recursive-level lookups of other routes.

```
<rpc message-id="3306" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>30</rbridge-id>
                <ip>
                    <rtm-config xmlns="urn:brocade.com:mgmt:brocade-rtm">
                        <route>
                            <next-hop-recursion/>
                        </route>
                    </rtm-config>
                </ip>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3306" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Chapter

34

Configuring OSPF

In this chapter

- OSPF configuration with NETCONF overview 519
- OSPF over VRF 520
- OSPF in a VCS environment 520
- Performing basic OSPF configuration 523

OSPF configuration with NETCONF overview

Open Shortest Path First (OSPF) is a link-state routing protocol that uses link-state advertisements (LSAs) to update neighboring routers about its interfaces. Each router maintains an identical area-topology database to determine the shortest path to any neighboring router.

This chapter provides procedures and examples for configuring OSPF using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of OSPF
- An overview of Designated routers
- Conceptual details about key configurable entities, such as stubs, stubby areas, not so stubby areas, totally stubby areas, and virtual links
- Procedures for configuring the Ethernet management interface

  You need an Ethernet management interface before you can configure a Secure Shell (SSH) connection. As a result, you cannot begin a NETCONF session until this interface is configured.
- Procedures and examples for configuring OSPF using the Network OS command line interface

Using the NETCONF interface, you can perform the following OSPF configuration operations:

- Use the <edit-config> remote procedure call (RPC) to activate and deactivate OSPF globally, set global OSPF parameters, activate and deactivate OSPF on a port, and to set interface parameters on a specific port.
- Use the <get-config> RPC to verify all or part of the OSPF configuration.

OSPF parameters are defined in the brocade-ospf YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all OSPF parameters, refer to the brocade-ospf.yang file.

OSPF over VRF

With Network OS 4.0 and later, OSPF can run over multiple Virtual Forwarding and Routing (VRF) mechanisms. OSPF maintains multiple instances of the routing protocol to exchange route information among various VRFs. A multi-VRF-capable router maps an input interface to a unique VRF, based on user configuration. These input interfaces can be physical or SVIs. By default, all input interfaces are attached to the default VRF. All OSPF commands supported in Network OS 4.0 and later are available over default and non-default OSPF instances.

NOTE
For more information about OSPF over VRF, refer to Chapter 36, "Configuring VRF".

OSPF in a VCS environment

Figure 6 shows one way in which OSPF can be used in a VCS Fabric cluster environment. Routers RB1 and RB2, as well as the MLX switches, are configured with OSPF. Switches RB3, RB4, and RB5 are Layer 2 switches.

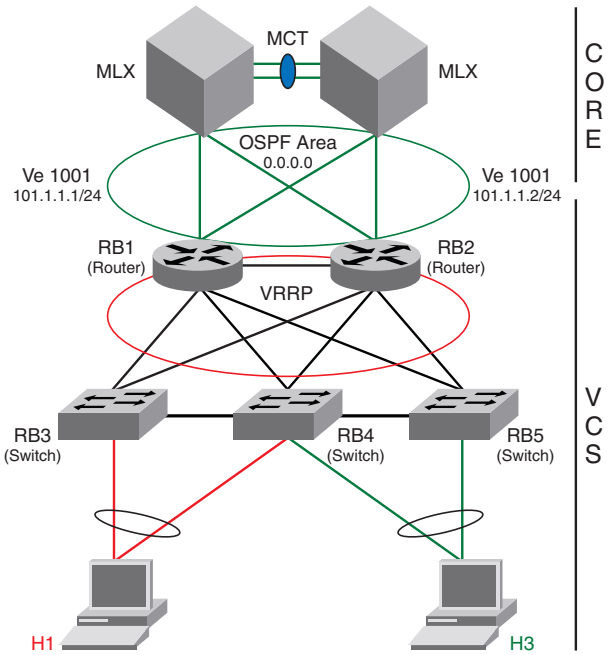

FIGURE 6 OSPF example in a VCS environment

1. On Router RB1, issue an <edit-config> RPC to perform the following tasks:
   a. Configure a VLAN for the router.
   b. Enable OSPF for the RB1.
   c. Create an OSPF area on RB1.
   d. Configure a virtual Ethernet (VE) interface using the VLAN number created in step a.
   e. Configure an IP address for the VE interface.

f. Assign the VE interface to the area created in step c.

g. Enable the VE interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2600" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface-vlan>
                    <interface>
                        <vlan>
                            <name>1001</name>
                        </vlan>
                    </interface>
                </interface-vlan>
            </interface>
            <rbridge-id xmlns xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>1</rbridge-id>
                <router>
                    <ospf/>
                    <area>0.0.0.0</area>
                </router>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <ve>
                        <name>1001</name>
                        <ip xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                            <ip-config>
                                <address>
                                    <address>101.1.1.1/24</address>
                                </address>
                            </ip-config>
                            <interface-vlan-ospf-conf
                             xmlns="urn:brocade.com:mgmt:brocade-ospf">
                                <ospf1>
                                    <area>0.0.0.0</area>
                                </ospf1>
                            </interface-vlan-ospf-conf>
                        </ip>
                        <shutdown
                         xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    </ve>
                </interface>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2600" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

2. On Router RB2, issue an <edit-config> RPC to perform the following tasks.

a. Configure a VLAN for Router RB2.

b. Enable OSPF for Router RB2.

c. Create an OSPF area on Router RB2.

d. Configure a virtual Ethernet (VE) interface using the VLAN number created in step a.

e. Configure an IP address for the VE.

f. Assign the interface to the area created in step c.

g. Enable the VE interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2601" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface-vlan>
                    <interface>
                        <vlan>
                            <name>1001</name>
                        </vlan>
                    </interface>
                </interface-vlan>
            </interface>
            <rbridge-id xmlns xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>2</rbridge-id>
                <router>
                    <ospf/>
                    <area>0.0.0.0</area>
                </router>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <ve>
                        <name>1001</name>
                        <ip xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                            <ip-config>
                                <address>
                                    <address>101.1.1.2/24</address>
                                </address>
                            </ip-config>
                            <interface-vlan-ospf-conf
                             xmlns="urn:brocade.com:mgmt:brocade-ospf">
                                <ospf1>
                                    <area>0.0.0.0</area>
                                </ospf1>
                            </interface-vlan-ospf-conf>
                        </ip>
                        <shutdown
                         xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                         operation="delete"/>
                    </ve>
                </interface>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2601" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

3. Assign VLAN 1001 to a VLAG.

Performing basic OSPF configuration

To begin using OSPF on the router, perform these steps.

1. Follow the rules in the "OSPF configuration rules" on page 523.
2. Enable OSPF on the router. Refer to "Enabling and disabling OSPF on the router" on page 523.
3. Assign the areas to which the router will be attached. Refer to "Assigning OSPF areas" on page 525.
4. Assign individual interfaces to the OSPF areas. Refer to "Assigning interfaces to an area" on page 529.
5. Assign a virtual link to any Area Border Router (ABR) that does not have a direct link to the OSPF backbone area. Refer to "Assigning virtual links" on page 530.
6. Refer to "Changing other settings" on page 532.

OSPF configuration rules

- If a router is to operate as an Autonomous System Boundary Router (ASBR), you must enable the ASBR capability at the system level.
- Redistribution must be enabled on routers configured to operate as ASBRs.
- All router ports must be assigned to one of the defined areas on an OSPF router. When a port is assigned to an area, all corresponding subnets on that port are automatically included in the assignment.

Enabling and disabling OSPF on the router

When you enable OSPF on the router, the protocol is automatically activated and you can assign areas and modify OSPF global parameters.

If you disable OSPF, the device removes all the configuration information for the disabled protocol from the running configuration. Moreover, when you save the configuration to the startup configuration file after disabling one of these protocols, all the configuration information for the disabled protocol is removed from the startup configuration file.

If you are testing an OSPF configuration and are likely to disable and re-enable the protocol, you might want to make a backup copy of the startup configuration file containing the protocol's configuration information. This way, if you remove the configuration information by saving the configuration after disabling the protocol, you can restore the configuration by copying the backup copy of the startup configuration file onto the flash memory.

Enabling OSPF on the router

OSPF can be activated only in the RBridge ID context. To enable OSPF on the router, perform the following steps.

1. Issue the <edit-config> RPC to configure the <rbridge-id> node in the urn:brocade.com:mgmt:brocade-rbridge namespace.
2. Under the <rbridge-id> node, include the <rbridge-id> leaf element and specify the switch for which you want to enable OSPF.
3. Under the <rbridge-id> node, include the <router> node element.
4. Under the <router> node, include the <ospf> node element to enable OSPF.

   The <ospf> node element contains elements that allow you to configure the global OSPF parameters. However, the “presence=true” statement that qualifies the <ospf> container definition in the brocade-ospf.yang file allows the <ospf> node element to also function as a leaf element.

The following example enables OSPF on routing bridge 101.

```
<rpc message-id="2602" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
       <target>
          <running/>
       </target>
       <config>
          <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
              <rbridge-id>101</rbridge-id>
              <router>
                  <ospf xmlns="urn:brocade.com:mgmt:brocade-ospf/>
              </router>
           </rbridge-id>
       </config>
   </edit-config>
</rpc>

<rpc-reply message-id="2602" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Disabling OSPF on the router

To disable OSPF, include the delete operation in the <ospf> header tag, as shown in the following example RPC.

```
<rpc message-id="2603" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101</rbridge-id>
                <router>
                    <ospf xmlns="urn:brocade.com:mgmt:brocade-ospf
                     xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                     operation="delete"/>
                </router>
```

```
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2603" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Assigning OSPF areas

Once OSPF is enabled on the system, you can assign areas. Assign an IP address or number as the area ID for each area. The area ID is representative of all IP addresses (subnets) on a router port. Each port on a router can support one area.

An area can be normal, a stub, a totally stubby area, or a Not-So-Stubby Area (NSSA). For a detailed explanation of these terms, refer to the *Network OS Administrator's Guide*.

The following example RPC sets up the backbone area (0.0.0.0).

```
<rpc message-id="2604" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <vlan>
                        <name>1001</name>
                    </vlan>
                </interface>
            </interface-vlan>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>10</rbridge-id>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <ve>
                        <name>1001</name>
                        <ip xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                            <ip-config>
                                <address>
                                    <address>101.1.1.1/24</address>
                                </address>
                            </ip-config>
                            <interface-vlan-ospf-conf
                             xmlns="urn:brocade.com:mgmt:brocade-ospf">
                                <ospf1>
                                    <area>0.0.0.0</area>
                                </ospf1>
                            </interface-vlan-ospf-conf>
                        </ip>
                    </ve>
                </interface>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2604" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
```

```
    <ok/>
</rpc-reply>
```

Assigning a totally stubby area

By default, the device sends summary LSAs (type 2 LSAs) into stub areas. You can further reduce the number of link state advertisements (LSAs) sent into a stub area by configuring the device to stop sending summary LSAs (type 3 LSAs) into the area. This is called assigning a *totally stubby area*. You can disable the summary LSAs when you are configuring the stub area or later after you have configured the area.

This feature disables origination of summary LSAs, but the device still accepts summary LSAs from OSPF neighbors and floods them to other neighbors.

When you disable the summary LSAs, the change takes effect immediately. If you apply the option to a previously configured area, the device flushes all of the summary LSAs it has generated (as an ABR) from the area.

NOTE
This feature applies only when the device is configured as an Area Border Router (ABR) for the area. To completely prevent summary LSAs from being sent to the area, disable the summary LSAs on each OSPF router that is an ABR for the area.

The following example RPC configures OSPF area 1.1.1.1 as a totally stubby area. That is, it disables summary LSAs for the stub area. The <stub> node element designates a stub area. The <stub-value> element determines the cost of entering or leaving the area. The empty <no-summary> element disables summary LSAs and renders the stub area a totally stubby area.

```
<rpc message-id="2605" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101</rbridge-id>
                <router>
                    <ospf xmlns="urn:brocade.com:mgmt:brocade-ospf>
                        <area>
                            <area-id>1.1.1.1</area-id>
                            <stub>
                                <metric>
                                    <stub-value>99</stub-value>
                                    <no-summary/>
                                </metric>
                            </stub>
                        </area>
                    </ospf>
                </router>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2605" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Assigning a Not-So-Stubby Area

The OSPF Not-So-Stubby-Area (NSSA) feature enables you to configure OSPF areas that provide the benefits of stub areas, but that also are capable of importing external route information. OSPF does not flood external routes from other areas into an NSSA, but does translate and flood route information from the NSSA into other areas such as the backbone. Refer to the *Network OS Administrator's Guide* for details.

The following example RPC configures OSPF area 1.1.1.1 as an NSSA. The <nssa> node designates a not-so-stubby area. The <nssa-value> element determines the cost of entering or leaving the area.

```
<rpc message-id="2606" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101</rbridge-id>
                <router>
                    <ospf xmlns="urn:brocade.com:mgmt:brocade-ospf>
                        <area>
                            <area-id>1.1.1.1</area-id>
                            <nssa>
                                <metric>
                                    <nssa-value>1</nssa-value>
                                </metric>
                            </nssa>
                        </area>
                    </ospf>
                </router>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2606" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring a summary-address for the NSSA

If you want the ABR that connects the NSSA to other areas to summarize the routes in the NSSA before translating them into Type-5 LSAs and flooding them into the other areas, configure a summary-address. The ABR creates an aggregate value based on the summary-address. The aggregate value becomes the address that the ABR advertises instead of advertising the individual addresses represented by the aggregate. You can configure up to 32 ranges in an OSPF area.

To configure a summary-address in NSSA 1.1.1.1, issue the following RPC. (This example assumes that you have already configured NSSA 1.1.1.1.)

```
<rpc message-id="2607" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
```

```
                <rbridge-id>101</rbridge-id>
                <router>
                    <ospf xmlns="urn:brocade.com:mgmt:brocade-ospf">
                        <area>
                            <area-id>1.1.1.1</area-id>
                            <nssa>
                                <metric>
                                    <nssa-value>10</nssa-value>
                                </metric>
                            </nssa>
                        </area>
                        <summary-address>
                            <sum-address>209.157.1.0</sum-address>
                            <sum-address-mask>255.255.255.0</sum-address-mask>
                        </summary-address>
                    </ospf>
                </router>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2607" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Assigning an area range (optional)

You can assign a range for an area, but it is not required. Ranges allow a specific IP address and mask to represent a range of IP addresses within an area, so that only that reference range address is advertised to the network, instead of all the addresses within that range. Each area can have up to 32 range addresses.

If you do assign a range for an area, you must also specify a range effect, which can be “advertise” or “not-advertise”.

The following example RPC defines an area range for subnets on 0.0.0.10 and 0.0.0.20.

```
<rpc message-id="2608" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101</rbridge-id>
                <router>
                    <ospf xmlns="urn:brocade.com:mgmt:brocade-ospf">
                        <area>
                            <area-id>0.0.0.10</area-id>
                            <normal/>
                            <range>
                                <range-address>193.45.0.0</range-address>
                                <range-mask>255.255.0.0</range-mask>
                                <range-effect>not-advertise</range-effect>
                            </range>
                        </area>
                        <area>
                            <area-id>0.0.0.20</area-id>
```

```
                        <normal/>
                        <range>
                            <range-address>193.45.0.0</range-address>
                            <range-mask>255.255.0.0</range-mask>
                            <range-effect>not-advertise</range-effect>
                        </range>
                    </area>
                </ospf>
            </router>
        </rbridge-id>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="2608" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Assigning interfaces to an area

Once you define OSPF areas, you can assign interfaces to the areas. All router ports must be assigned to one of the defined areas on an OSPF router. When a port is assigned to an area, all corresponding subnets on that port are automatically included in the assignment.

For example, to assign interface 7/1/8 of a router area whose area ID is 192.5.0.0, and then save the changes, issue the following RPC.

```
<rpc message-id="2609" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>7/1/8</name>
                    <ip>
                        <interface-te-ospf-conf
                         xmlns="urn:brocade.com:mgmt:brocade-ospf">
                            <ospf1>
                                <area>192.5.0.0</area>
                            </ospf1>
                        </interface-te-ospf-conf>
                    </ip>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2609" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

If you want to set an interface to passive mode, use the empty <passive/> leaf element instead of the <area> leaf element in the previous example.

If you want to block flooding of outbound LSAs on specific OSPF interfaces, instead of the <area> element in the previous example, using the following elements:

```
<database-filter>
    <all-out/>
</database-filter>
```

Assigning virtual links

All ABRs must have either a direct or indirect link to the OSPF backbone area (0.0.0.0 or 0). If an ABR does not have a physical link to the area backbone, the ABR can configure a virtual link to another router within the same area, which has a physical connection to the backbone area. Refer to the *Network OS Administrator's Guide* for details.

Figure shows an OSPF area border router, Device A, that is cut off from the backbone area (area 0). To provide backbone access to Device A, you can add a virtual link between Device A and Device C using area 1 as a transit area. To configure the virtual link, you define the link on the router that is at each end of the link. No configuration for the virtual link is required on the routers in the transit area.

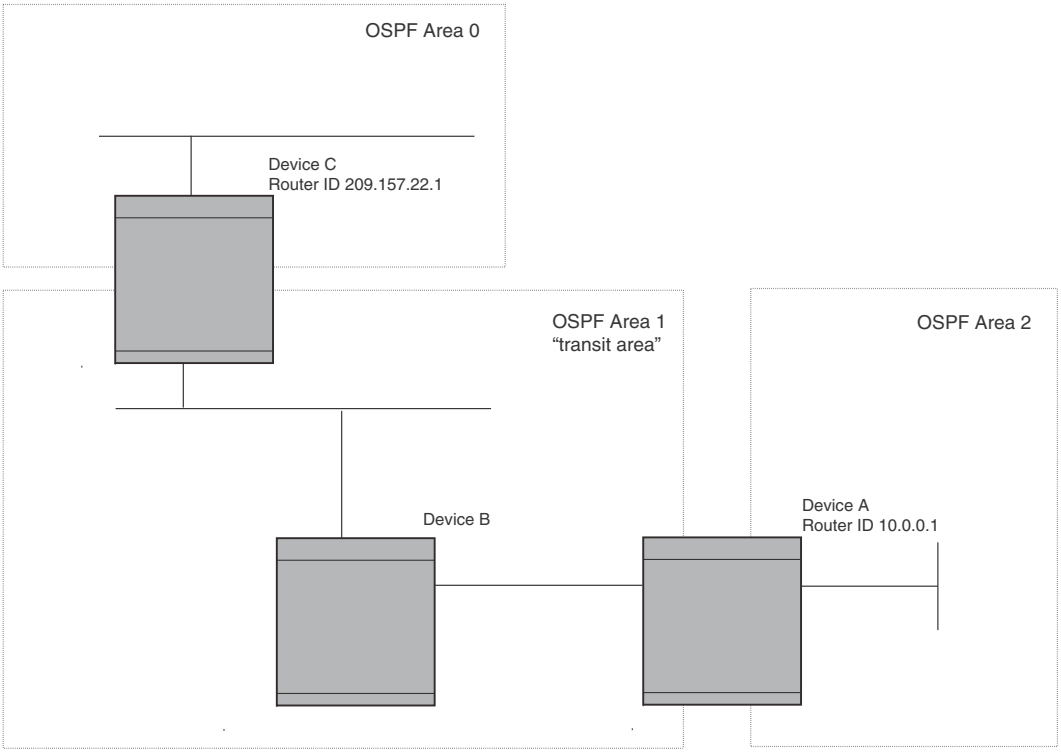

FIGURE 7 Defining OSPF virtual links within a network

To define the virtual link on Device A, establish a NETCONF session with Device A, and issue the following <edit-config> RPC. The RPC configures both areas in which the router participates (area 2 and area 1). For the transition area (area 1), the <area> node element also includes the <virt-link-neighbor> element, which specifies the router address of the ABR that connects the transition area to the backbone area.

```
<rpc message-id="2610" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
```

```
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101<rbridge-id>
                <router>
                    <ospf xmlns="urn:brocade.com:mgmt:brocade-ospf>
                        <area>
                            <area-id>2</area-id>
                        </area>
                        <area>
                            <area-id>1</area-id>
                            <virtual-link>
                                <virt-link-neighbor>209.157.22.1
                                 </virt-link-neighbor>
                            </virtual-link>
                        </area>
                    </ospf>
                </router>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2610" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

To configure the virtual link on Device C, establish a NETCONF session with Device C and issue the following <edit-config> RPC.

```
<rpc message-id="2611" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101</rbridge-id>
                <router>
                    <ospf>
                        <area>
                            <area-id>0</area-id>
                        </area>
                        <area>
                            <area-name>1</area-name>
                            <virtual-link>
                                <virt-link-neighbor>10.0.0.1</virt-link-neighbor>
                            </virtual-link>
                        </area>
                    </ospf>
                </router>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2611" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Changing other settings

Refer to the *Network OS YANG Reference Manual* for other global and interface-level parameters you can use to change default OSPF settings. Refer to the brocade-ospf.yang file for descriptions of each parameter. Some commonly configured items include:

- Changing reference bandwidth to change interface costs by using the <auto-cost> node.
- Defining redistribution filters for the Autonomous System Boundary Router (ASBR) by editing the <redistribute> node.

Chapter

Configuring VRRP

35

In this chapter

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- VRRP basic configuration example 535
- Enabling preemption 539
- Configuring the track priority 541
- Enabling short-path forwarding (VRRP-E only) 544
- Configuring a multigroup virtual router cluster 545
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VRRP and VRRP-E configuration with NETCONF overview

This chapter provides procedures for configuring the Virtual Router Redundancy Protocol (VRRP) using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of VRRP
- General guidelines
- An overview of VRRP and VRRP-E packet behavior
- Procedures for configuring VRRP using the command line interface

Through the NETCONF interface, you can perform the following operations on VRRP and VRRP-E:

- Use the <edit-config> RPC to configure VRRP and VRRP-E.
- Use the <get-config> RPC to validate configuration settings.

VRRP parameters are defined in the brocade-vrrp YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Figure 8 shows an example of a basic VRRP setup to illustrate some basic VRRP concepts. Router 1 and Router 2 are two physical routers that can be configured to compose one virtual router. This virtual router would provide redundant network access for Host 1. If Router 1 were to fail, Router 2 could provide the default gateway out of the subnet.

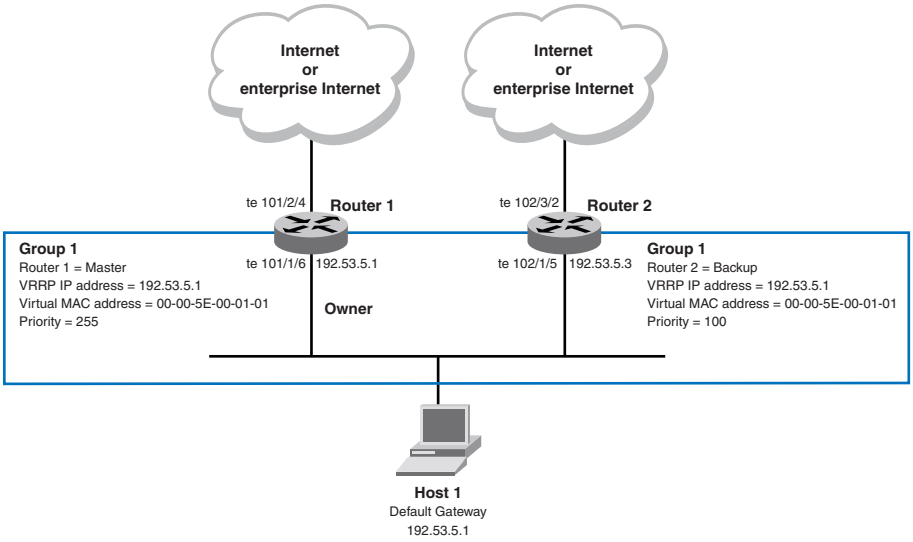

FIGURE 8 Basic VRRP configuration example

The procedures that follow show how to implement this basic configuration using NETCONF operations. The procedure is for VRRP. Refer to "VRRP-E differences for basic configuration" on page 539 for variations for VRRP-E.

Before configuring VRRP or VRRP-E, consider the following terms:

- Virtual Router—A collection of physical routers that can use either VRRP or VRRP-E to provide redundancy to routers within a LAN.
- Virtual Router Group—A group of physical routers that are assigned to the same virtual router.
- Virtual Router Address—The address you are backing up:
  - For VRRP: The virtual router IP address must belong to the same subnet as a real IP address configured on the VRRP interface, and can be the same as a real IP addresses configured on the VRRP interface. The virtual router whose virtual IP address is the same as a real IP address is the IP address *owner* and the default *master*.
  - For VRRP-E: The virtual router IP address must belong to the same subnet as a real IP address configured on the VRRP-E interface, but cannot be the same as a real IP address configured on the VRRP-E interface.
- Owner—This term applies only to VRRP, not to VRRP-E. The owner is the physical router whose real interface IP address is the IP address that you assign to the virtual router. The owner responds to packets addressed to any of the IP addresses in the corresponding virtual router. The owner, by default, is the master (refer to "Master") and has the highest priority (255).
- Master—The physical router that responds to packets addressed to any of the IP addresses in the corresponding virtual router. For VRRP, if the physical router whose real interface IP address is the IP address of the virtual router, then this physical router is always the master. For VRRP-E, the router with the highest priority becomes the master. If two routers have the same priority, the router with the highest IP address becomes the master.

- Backup—Routers that belong to a virtual router but are not the master. Then, if the master becomes unavailable, the backup router with the highest priority (a configurable value) becomes the new master. By default, backup routers are given a priority of 100. You can assign a backup a priority value of 3 through 254.

VRRP basic configuration example

The following procedures configure the basic configuration shown in Figure 8 on page 534 for VRRP.

NOTE
The interface links used in this example are all 10 Gigabit Ethernet. For VRRP, these links could also be Gigabit Ethernet, 40 Gigabit Ethernet, 100 Gigabit Ethernet, port-channel, or VE interface.

Configuring the master router

To create a basic master router configuration for Router 1 in Figure 8 on page 534, perform the following steps.

1. Establish a NETCONF session with Router 1.
2. Issue the <edit-config> RPC to edit the running configuration.
3. Ensure VCS Fabric mode is enabled.

```
<vcsmode xmlns="urn:brocade.com:mgmt:brocade-vcs">
    <vcs-mode>true</vcs-mode>
</vcsmode>
```

4. Globally enable VRRP and VRRP-E for the local routing bridge.

NOTE
The <vrrp/> leaf element enables both VRRP and VRRP-E globally.

```
<rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
    <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
        <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
            <vrrp/>
        </hide-vrrp-holder>
    </protocol>
</rbridge-id>
```

5. Configure the tengigabitethernet interface link for Router 1.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <name>101/1/6</name>
```

6. Configure the IP address of the Ethernet link interface for Router 1.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <ip>
            <ip-config
             xmlns="urn:brocade.com:mgmt:brocade-ip-config">
               <address>
                   <address>192.53.5.1</address>
```

```
                </address>

            </ip-config>
        </ip>
```

7. Assign Router 1 to a group. and assign the group a virtual router IP address.

   These assignments are done in the <vrrp> node in the urn:brocade.com:mgmt:brocade-vrrp namespace. The group is identified by group number in the <vrid> element and has a range of 1 through 255. The virtual router IP address is identified in the <virtual-ip>/<virtual-ipaddr> element.

   For VRRP, the physical router whose IP address is the same as the virtual router group IP address becomes the owner and master.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
            <vrid>1</vrid>
            <virtual-ip>
                <virtual-ipaddr>192.53.5.1</virtual-ipaddr>
            </virtual-ip>
        </vrrp>
```

The following example configures the basic master router shown in Figure 8 on page 534.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3500" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
            <config>
            <vcsmode xmlns="urn:brocade.com:mgmt:brocade-vcs">
                <vcs-mode>true</vcs-mode>
                <vcs-cluster-mode>false</vcs-cluster-mode>
            </vcsmode>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101</rbridge-id>
                <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrrp/>
                    </hide-vrrp-holder>
                </protocol>
            </rbridge-id>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>101/1/6</name>
                    <ip>
                        <ip-config
                         xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                            <address>
                                <address>192.53.5.1</address>
                            </address>
                        </ip-config>
                    </ip>
                    <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrid>1</vrid>
                        <virtual-ip>
                            <virtual-ipaddr>192.53.5.1</virtual-ipaddr>
                        </virtual-ip>
```

```
                </vrrp>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="3500" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the backup router

To create a basic backup router configuration for Router 2 in Figure 8 on page 534, perform the following steps.

1. Establish a NETCONF session with Router 2.
2. Issue the <edit-config> RPC to edit the running configuration.
3. Ensure that VCS Fabric mode is enabled on Router 2.

```
<vcsmode xmlns="urn:brocade.com:mgmt:brocade-vcs">
    <vcs-mode>true</vcs-mode>
</vcsmode>
```

4. Globally enable VRRP and VRRP-E for the local routing bridge (Router 2).

NOTE
The <vrrp/> leaf element enables both VRRP and VRRP-E globally.

```
<rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
    <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
        <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
            <vrrp/>
        </hide-vrrp-holder>
    </protocol>
</rbridge-id>
```

5. Configure the tengigabitethernet interface link for Router 2.

```
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <name>102/1/5</name>
```

6. Configure the IP address of the Ethernet link interface for Router 2.

```
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <ip>
                <ip-config
                 xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                    <address>
                        <address>192.53.5.3</address>
                    </address>
                </ip-config>
            </ip>
```

This router will become the backup router to Router 1.

7. Assign Router 2 to the same VRRP group as Router 1 and give the group the same virtual IP address.

   The assignment is done in the <vrrp> node in the urn:brocade.com:mgmt:brocade-vrrp namespace. The group is identified by group number in the <vrid> element, and the virtual router IP address in the <virtual-ip>/<virtual-ipaddr> element.

   For VRRP, the physical router IP address and the virtual router group IP address are different. Thus Router 2 is not the master.

```
<interface xmlns="urn:brocade.com:mgmt:brocade-interface">
    <tengigabitethernet>
        <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
            <vrid>1</vrid>
            <virtual-ip>
                <virtual-ipaddr>192.53.5.1</virtual-ipaddr>
            </virtual-ip>
        </vrrp>
        <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
            <vrid>1</vrid>
            <virtual-ip>
                <virtual-ipaddr>192.53.5.1</virtual-ipaddr>
            </virtual-ip>
        </vrrp>
```

The following example configures the basic backup router shown in Figure 8 on page 534

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <vcsmode xmlns="urn:brocade.com:mgmt:brocade-vcs">
                <vcs-mode>true</vcs-mode>
                <vcs-cluster-mode>false</vcs-cluster-mode>
            </vcsmode>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>102</rbridge-id>
                <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrrp/>
                    </hide-vrrp-holder>
                </protocol>
            </rbridge-id>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>102/1/5</name>
                    <ip>
                        <ip-config
                         xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                            <address>
                                <address>192.53.5.3</address>
                            </address>
                        </ip-config>
                    </ip>
                    <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrid>1</vrid>
                        <virtual-ip>
                            <virtual-ipaddr>192.53.5.1</virtual-ipaddr>
```

```
                    </virtual-ip>
                </vrrp>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="3401" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
    </rpc-reply>
```

VRRP-E differences for basic configuration

If you were to configure the two routers shown in Figure 8 on page 534, you must consider the following items specific to VRRP-E:

- Specifying the <vrrp> element in the urn:brocade.com:mgmt:brocade-vrrp namespace enables VRRP-E as well as VRRP.
- VRRP-E virtual routers ca be configured on VE interfaces only.
- VRRP and VRRP-E cannot be simultaneously enabled on the VDX 6740 or 6740T.
- The group ID and the virtual router IP address are specified under the <vrrpe> node instead of the <vrrp> node.

```
<vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
    <vrid>1</vrid>
    <virtual-ip>
        <virtual-ipaddr>192.56.7.25</virtual-ipaddr>
    </virtual-ip>
</vrrpe>
```

- Specification of the master router is done by giving the master a higher priority than the backup router. The priority is also specified under the <vrrpe> node.

```
<vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
    <priority>110</priority>
    <vrid>1</vrid>
    <virtual-ip>
        <virtual-ipaddr>192.56.7.25</virtual-ipaddr>
    </virtual-ip>
</vrrpe>
```

- For VRRP-E, you cannot assign the same IP address to the physical interface and to the virtual router.

Enabling preemption

You can allow a backup router that is acting as the master to be preempted by another backup router with a higher priority value.

By default, preemption is enabled for VRRP, or disabled for VRRP-E.

NOTE
If preemption is disabled for VRRP, the owner router is not affected because the owner router always preempts the active master.

The procedure for enabling pre-emption differs depending on the Ethernet link interface type, which for VRRP can be a physical Ethernet link (10 Gigabit Ethernet, Gigabit Ethernet, 40 Gigabit Ethernet), port-channel, or VE. For VRRP-E, the Ethernet link interface type must be VE.

Enabling preemption for physical Ethernet or port-channel

To enable preemption for a physical or port-channel router interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, depending on the Ethernet link interface type.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and specify the name of the backup router interface.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <vrrp> node element located in the urn:brocade.com:mgmt:brocade-vrrp namespace.
5. Under the <vrrp> node, include the following leaf elements.
    a. In the <vrid> element, specify the group ID of the VRRP router group.
    b. Include the empty <preempt-mode> element to enable preemption.

The following example enables preemption.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3502" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>101/1/6</name>
                    <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrid>1</vrid>
                        <preempt-mode/>
                    </vrrp>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3502" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling preemption for a VE interface

To enable preemption for a VE interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface-vlan> node, include the <interface>/<ve> hierarchy of node elements,
3. Under the <ve> node, include the <name> element, and specify the VE name.
4. Under the <ve> node, include the <vrrp> or <vrrpe> node element located in the urn:brocade.com:mgmt:brocade-vrrp namespace.
5. Under the <vrrp> or <vrrpe> node, include the following leaf elements.
    a. In the <vrid> element, specify the group ID of the VRRP router group.
    b. Include the empty <preempt-mode> element to enable preemption.

The following example enables preemption.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3502" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <ve>
                        <name>5</name>
                        <vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                            <vrid>1</vrid>
                            <preempt-mode/>
                        </vrrpe>
                    </ve>
                </interface>
            </interface-vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3502" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring the track priority

The track priority is a priority that adjusts an Ethernet link interface when the physical uplink port that it is tracking fails. In this way, a lower track priority can force a different router to take over as master should the tracked uplink port fail.

For additional conceptual information about track ports and track priorities, refer to the *Network OS Administrator's Guide*.

The procedure for configuring track priority differs depending on the Ethernet link interface type, which for VRRP can be a physical Ethernet link (10 Gigabit Ethernet, Gigabit Ethernet, 40 Gigabit Ethernet), port-channel, or VE. For VRRP-E, the Ethernet link interface type must be VE.

Configuring track priority for physical Ethernet or port-channel

To configure the track priority for a physical Ethernet link or port-channel, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, specify the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, depending on the Ethernet link interface type.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and specify the name of the backup router interface.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <vrrp> node element located in the urn:brocade.com:mgmt:brocade-vrrp namespace.
5. Under the <vrrp> node, include the <vrid> element and specify the group ID of the VRRP router group.
6. Under the <vrrp> node, include the <track> node element.
7. Under the <track> node, include the following leaf elements.
    a. In the <interface-type> element, specify the type of interface to be tracked. This type can be gigabitethernet, tengigabitethernet, fortygigabitethernet, hundredgigabitethernet, or port-channel.
    b. In the <interface-name> element, specify the name of the interface to be tracked in [*rbridge-id/*]*slot/port* format or port-channel number.
    c. In the <track-priority> element, specify the reduction in priority that the interface specified in step 3 will have if the tracked interface goes down.

The following example reduces the priority of interface 101/1/6 by 60 if interface 2/4 goes down.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3503" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <edit-config>
       <target>
           <running/>
       </target>
       <config>
           <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
              <tengigabitethernet>
                  <name>101/1/6</name>
                  <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                      <vrid>1</vrid>
                      <track>
                          <interface>
                              <interface-type>tengigabitethernet</interface-type>
                              <interface-name>2/4</interface-name>
                              <track-priority>60</track-priority>
```

```
                        </interface>
                    </track>
                </vrrp>
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="3503" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring track priority for a VE link interface

To configure the track priority for a VE interface, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface-vlan> node, include the <interface>/<ve> hierarchy of node elements,
3. Under the <ve> node, include the <name> element, and specify the VE name.
4. Under the <ve> node, include the <vrrp> or <vrrpe> node element located in the urn:brocade.com:mgmt:brocade-vrrp namespace.
5. Under the <vrrp> or <vrrpe> node, include the <vrid> element and specify the group ID of the VRRP router group.
6. Under the <vrrp> or <vrrpe> node, include the <track> node element.
7. Under the <track> node, include the following leaf elements.
    a. In the <interface-type> element, specify the type of interface to be tracked. This type can be tengigabitethernet, gigabitethernet, fortygigabitethernet, or port-channel.
    b. In the <interface-name> element, specify the name of the physical uplink interface to be tracked in [*rbridge-id/*]s*lot/port* format or port-channel number.
    c. In the <track-priority> element, specify the reduction in priority that the interface specified in step 3 will have if the tracked interface goes down.

The following example reduces the priority of interface 101/1/6 by 60 if physical interface 2/4 goes down.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3503" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <ve>
                        <name>6</name>
                        <vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                            <vrid>1</vrid>
                            <track>
                                <interface>
```

```
                                    <interface-type>tengigabitethernet
                                     </interface-type>
                                    <interface-name>2/4</interface-name>
                                    <track-priority>60</track-priority>
                                </interface>
                            </track>
                        </vrrpe>
                    </ve>
                </interface>
            </interface-vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3503" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Enabling short-path forwarding (VRRP-E only)

For conceptual information about short-path forwarding, refer to the *Network OS Administrator's Guide*.

To enable short-path forwarding, perform the following steps.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <interface-vlan>/<interface>/<ve> hierarchy of node elements.
3. Under the <ve> node, include the <name> element, and specify the VE name.
4. Under the <ve> node, include the <vrrpe> node element from the urn:brocade.com:mgmt:brocade-vrrp namespace.
5. Under the <vrrpe> node, include the following leaf elements.
    a. In the <vrid> element, specify the group ID of the VRRP router group.
    b. Include the empty <short-path-forwarding> element to enable short-path forwarding.

The following example enables short-path forwarding on VE interface 5.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3504" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <ve>
                        <name>5</name>
                        <vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                            <vrid>100</vrid>
                            <short-path-forwarding/>
                        </vrrpe>
                    </ve>
```

```
            </interface>
          </interface-vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3504" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring a multigroup virtual router cluster

Figure 9 shows a commonly employed virtual router setup. This setup introduces redundancy by configuring two virtual router groups. The first group has Router 1 as the master and Router 2 as the backup. The second group has Router 2 as the master and Router 1 as the backup. This type of configuration is sometimes called Multigroup VRRP.

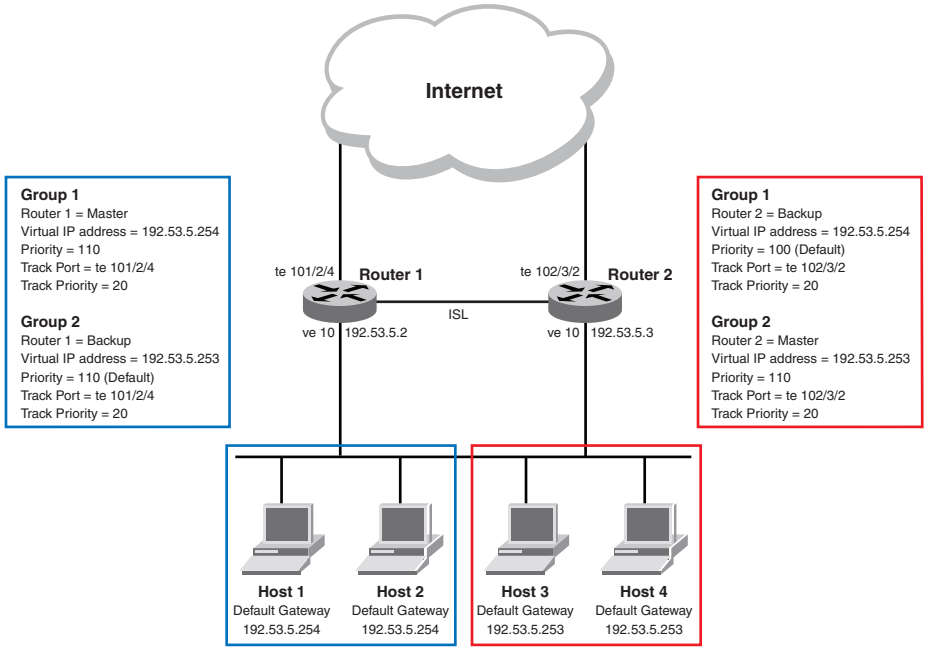

FIGURE 9 Dual redundant network access

In this example, Router 1 and Router 2 use VRRP-E to load share as well as provide redundancy to the hosts. The load sharing is accomplished by creating two VRRP-E groups. Each group has its own virtual IP address. Half of the clients point to Group 1's virtual IP address as their default gateway and the other half point to Group 2's virtual IP address as their default gateway. This arrangement will enable some of the outbound Internet traffic to go through Router 1 and the rest to go through Router 2.

NOTE
Load sharing is supported by VRRP as well as VRRP-E.

Router 1 is the master for Group 1 (master priority = 110) and Router 2 is the backup for Group 1 (backup priority = 100). Router 1 and Router 2 both track the uplinks to the Internet. If an uplink failure occurs on Router 1, its backup priority is decremented by 20 (track priority = 90), so that all traffic destined to the Internet is sent through Router 2 instead.

Similarly, Router 2 is the master for Group 2 (master priority = 110) and Router 1 is the backup for Group 2 (backup priority = 100). Router 1 and Router 2 are both tracking the uplinks to the Internet. If an uplink failure occurs on Router 2, its backup priority is decremented by 20 (track priority = 90), so that all traffic destined to the internet is sent through Router 1 instead.

To implement the configuration shown in Figure 9 on page 545, configure one VRRP-E router to act as a master in the first virtual router group and a backup in the second virtual group, and then configure the second VRRP-E router to act as a backup in the first virtual group and master in the second virtual group.

NOTE
The procedures assume VRRP-E.

Configuring Router 1 as master for first virtual router group

The following example <edit-config> RPC configures Router 1 as the master router for the first router group. Make sure VCS Fabric mode is enabled, and then perform the following steps.

1. Establish a NETCONF session with Router 1.
2. Configure VRRP globally on routing bridge 101 (the local routing bridge).
3. To configure the VE interface link for Router 1, enable configuration of VE interface port 10.
4. Configure 192.53.5.2/24 as the IP address of the Ethernet link for Router 1.
5. Assign Router 1 to VRRP group 1.
6. Configure ethernet port 2/4 as the tracking port for VE port 10, with a track priority of 20.

   VE port 10 will have its priority reduced to 20 should port 2/4 fail.
7. Configure 192.53.5.254 as the virtual IP address for group 1.

   NOTE
   For VRRP-E only, the virtual IP address cannot be the same as a real IP address configured on the interface.
8. To configure Router 1 as the master, set the priority to 110; that is, a number greater than the default value of 100.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3505" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
        <config>
        <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
            <rbridge-id>101</rbridge-id>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                    <vrrp/>
                </hide-vrrp-holder>
```

```
            </protocol>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <ve>
                    <name>10</name>
                    <ip>
                        <ip-config
                         xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                           <address>
                               <address>192.53.5.2/24</address>
                           </address>
                        </ip-config>
                    </ip>
                    <vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrid>1</vrid>
                        <virtual-ip>
                            <virtual-ipaddr>192.53.5.1</virtual-ipaddr>
                        </virtual-ip>
                        <track>
                            <interface>
                                <interface-type>tengigabitethernet
                                 </interface-type>
                                <interface-name>2/4</interface-name>
                                <track-priority>20</track-priority>
                            </interface>
                        </track>
                        <priority>110</priority>
                    </vrrpe>
                </ve>
            </interface>
        </rbridge-id>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="3505" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Configuring Router 1 as backup for second virtual router group

The following example <edit-config> RPC configures Router 1 as a backup for the second router group. Make sure VCS Fabric mode is enabled, and then perform the following steps.

1. Establish a NETCONF session with Router 1.
2. To configure the VE interface link for Router 1, enable configuration of VE interface port 10.
3. Assign Router 1 to VRRP group 2.
4. Configure the Ethernet port 2/4 as the tracking port for VE port 10, with a track priority of 20.

   VE port 10 will have its priority reduced to 20 should port 2/4 fail.
5. Configure 192.53.5.253 as the virtual IP address for group 2.

NOTE
For VRRP-E only, the virtual IP address cannot be the same as a real IP address configured on the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<rpc message-id="3506" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
            <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>101</rbridge-id>
                <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrrp/>
                    </hide-vrrp-holder>
                </protocol>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <ve>
                        <name>5</name>
                        <vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                            <vrid>2</vrid>
                            <virtual-ip>
                                <virtual-ipaddr>192.53.5.253</virtual-ipaddr>
                            </virtual-ip>
                            <track>
                                <interface>
                                    <interface-type>tengigabitethernet
                                     </interface-type>
                                    <interface-name>2/4</interface-name>
                                    <track-priority>20</track-priority>
                                </interface>
                            </track>
                        </vrrpe>
                    </ve>
                </interface>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3506" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring Router 2 as backup for first virtual router group

The following example <edit-config> RPC configures Router 2 as the backup router for the first router group. Ensure that VCS Fabric mode is enabled, and then perform the following steps.

1. Establish a NETCONF session with Router 2.
2. Configure VRRP globally on routing bridge 102 (Router 2).
3. To configure the Ethernet interface link for Router 2, enable configuration of VE interface 15.
4. Configure 192.53.5.3/24 as the IP address of the Ethernet link for Router 2.
5. Assign Router 2 to group 1.
6. Configure Ethernet port 3/2 as the tracking port for VE interface 15, with a track priority of 20.

   VE interface 15 will have its priority reduced to 20 should 3/2 fail.
7. Configure 192.53.5.254 as the virtual IP address for group 1.

NOTE
(For VRRP-E only) The virtual IP address cannot be the same as a real IP address configured on the interface.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3507" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
            <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>102</rbridge-id>
                <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrrp/>
                    </hide-vrrp-holder>
                </protocol>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <ve>
                        <name>15</name>
                        <ip>
                            <ip-config
                             xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                               <address>
                                   <address>192.53.5.3/24</address>
                               </address>
                            </ip-config>
                        </ip>
                        <vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                            <vrid>1</vrid>
                            <virtual-ip>
                                <virtual-ipaddr>192.53.5.254</virtual-ipaddr>
                            </virtual-ip>
                            <track>
                                <interface>
                                    <interface-type>tengigabitethernet
                                     </interface-type>
                                    <interface-name>3/2</interface-name>
                                    <track-priority>20</track-priority>
                                </interface>
                            </track>
                        </vrrpe>
                    </ve>
                </interface>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3507" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring Router 2 as master for second virtual router group

The following example <edit-config> RPC configures Router2 as the master for the second router group. Ensure that VCS Fabric mode is enabled, and then perform the following steps.

1. Establish a NETCONF session with Router 2.
2. To configure the Ethernet interface link for Router 2, enable configuration of VE interface 15.
3. Assign Router 2 to group 2.
4. Configure Ethernet port 3/2 as the tracking port for VE interface 15, with a track priority of 20.

   VE interface 15 will have its priority reduced to 20 should port 3/2 fail.
5. Configure 192.53.5.253 as the virtual IP address for group 2.

   NOTE
   (For VRRP-E only) The virtual IP address cannot be the same as a real IP address configured on the interface.
6. To establish Router 2 as the master, set the priority to 110; that is, a higher value than the default value of 100.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3508" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
            <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>102</rbridge-id>
                <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <hide-vrrp-holder xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrrp/>
                    </hide-vrrp-holder>
                </protocol>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <ve>
                        <name>15</name>
                        <vrrpe xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                            <vrid>2</vrid>
                            <virtual-ip>
                                <virtual-ipaddr>192.53.5.253</virtual-ipaddr>
                            </virtual-ip>
                            <track>
                                <interface>
                                    <interface-type>tengigabitethernet
                                     </interface-type>
                                    <interface-name>3/2</interface-name>
                                    <track-priority>20</track-priority>
                                </interface>
                            </track>
                            <priority>110</priority>
                        </vrrpe>
                    </ve>
                </interface>
            </rbridge-id>
        </config>
```

```
    </edit-config>
</rpc>

<rpc-reply message-id="2508" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying VRRP and VRRP-E configuration

To obtain configuration information about VRRP or VRRP-E for a specific interface, issue the <get-config> RPC with a subtree filter to limit the output to VRRP information, VRRP-E information, or information about a specific VRRP or VRRP-E group.

The following example uses a subtree filter to return information about VRRP group 1. To return information about all VRRP groups configured on this interface, remove the <vrid> element. To request configuration information about VRRP-E, replace the <vrrp> node with the <vrrpe> node.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3509" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <get-config>
        <source>
            <running/>
        </source>
        <filter type="subtree">
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>101/1/6</name>
                    <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                        <vrid>2</vrid>
                    </vrrp>
                </tengigabitethernet>
            </interface>
        </filter>
    </get-config>
</rpc>

<rpc-reply message-id="3509" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
        <tengigabitethernet>
            <name>102/5/1</name>
            <vrrp xmlns="urn:brocade.com:mgmt:brocade-vrrp">
                <priority>110</priority>
                <vrid>2</vrid>
                <virtual-ip>
                    <virtual-ipaddr>192.53.5.253</virtual-ipaddr>
                </virtual-ip>
                <track>
                    <interface>
                        <interface-type>tengigabitethernet</interface-type>
                        <interface-name>3/2</interface-name>
                        <track-priority>20</track-priority>
                    </interface>
                </track>
            </vrrp>
        </tengigabitethernet>
    </interface>
</rpc-reply>
```

Chapter

Configuring VRF

36

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- Configuring VRF 554

VRF configuration with NETCONF overview

VRF (Virtual Routing and Forwarding) is a technology that controls information flow within a network by isolating the traffic by partitioning the network into different logical VRF domains. Every VRF-capable router supports one routing table for each VRF instance. Each VRF-capable router can function as a group of multiple virtual routers on the same physical router. VRF, in conjunction with virtual private network (VPN) solutions, guarantees privacy of information and isolation of traffic within its logical VRF domain.

This chapter provides procedures and examples for configuring VRF using the NETCONF interface. Refer to the *Network OS Administrator's Guide* for the following related information:

- A conceptual overview of VRF
- An example of a VRF configuration
- A description of VRF-lite for customer edge routers
- Procedures and examples for configuring VRF using the Network OS command line interface
- Procedures and examples for configuring Inter-VRF Route Leaking using the Network OS command line interface
- A procedure for enabling VRF for VRRP

Using the NETCONF interface, you can perform the following VRF configuration operations:

- Use the <edit-config> remote procedure call (RPC) to activate and deactivate VRF globally, set global VRF parameters, activate and deactivate VRF on a port, and to set interface parameters on a specific port.
- Use the <get-config> RPC to verify all or part of the VRF configuration.

VRF parameters are defined in the brocade-vrf YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all VRF parameters, refer to the brocade-vrf.yang file.

Configuring VRF

Typical full-blown implementations of VRFs are designed to support BGP/MPLS VPNs, whereas VRF-lite implementations typically are much simpler with moderate scalability (as compared to BGP/MPLS VPNs). These two flavors share a lot in common but differ in the interconnect schemes, routing protocols used over the interconnect, and also in the VRF classification mechanisms. Brocade Network OS v4.1.1 supports the VRF-lite implementation. All references to VRF in this document implicitly indicate VRF-lite. Figure 10 shows a typical single VCS comprising Customer Edge 1, Provider Edge, and Customer Edge 2 routers.

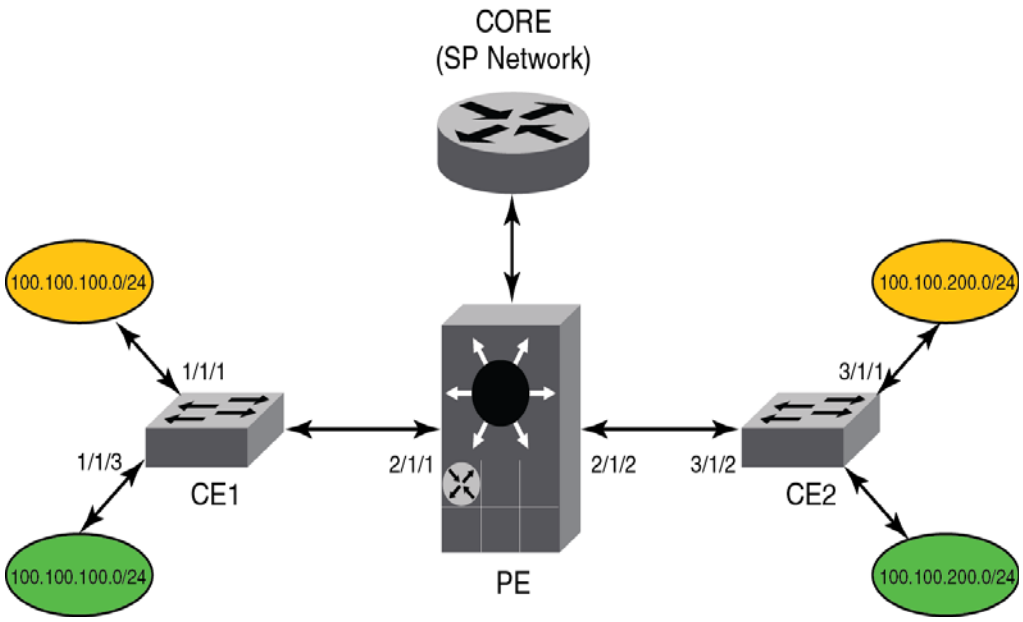

FIGURE 10 VRF configuration diagram

ORANGE (v11) and GREEN (v12) are the two VPNs supporting two different customer sites. Both of them have overlapping IP subnets; 100.100.100.0/24 and 100.100.200.0/24.

VRF is supported on the Brocade VDX 8770 and VDX 6740, supporting up to 32 VRFs.

This configuration gives an example of a typical VRF-lite use case and is not meant to give an ideal configuration.

The examples in this section are based on the network diagram in Figure 10.

1. Configure the edge routers by enabling OSPF protocol in VRF configuration mode.

   Example of enabling routing and configuring VRF on the ORANGE edge router. Repeat this example for the GREEN edge router.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2600" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
        <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
             <rbridge-id>1</rbridge-id>
                 <vrf xmlns="urn:brocade.com:mgmt:brocade-vrf">
```

```
                    <vrf-name>orange</vrf-name>
                    <route-distiniguisher>19:1</route-distiniguisher>
                    <address-family>
                        <ipv4>
                            <max-route>399</max-route>
                        </ipv4>
                    </address-family>
                   <ip>
                       <vrf-router-id>11.1.1.1</vrf-router-id>
                   </ip>
            </vrf>
        </rbridge-id>

<rpc-reply message-id="2600" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

2. Configure VRF on the interface.

NOTE
Once VRF is configured on an interface, all Layer 3 configurations on the interface are removed, and you must configure them again.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="2607" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>1</rbridge-id>
                <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                    <ve>
                        <name>128</name>
                            <vrf xmlns="urn:brocade.com:mgmt:brocade-ip-config">
                                <forwarding>red</forwarding>
                            </vrf>
                            </ve>
                </interface>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="2607" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

3. Configure the static routes. The static route and ARP must be configured under address family mode.

```
<route>
    <static-route-nh-vrf>
        <static-route-next-vrf-dest>44.4.4.4/32</static-route-next-vrf-dest>
            <next-hop-vrf>default-vrf</next-hop-vrf>
        <static-route-next-hop>2.2.2.2</static-route-next-hop>
    </static-route-nh-vrf>
</route>
```

4. Configure the static ARP for the interface. The static route and ARP must be configured under address family mode.

```
<arp-entry xmlns="urn:brocade.com:mgmt:brocade-arp">
    <arp-ip-address>3.3.3.3</arp-ip-address>
    <mac-address-value>4.4.4</mac-address-value>
    <interfacename>interface</interfacename>
    <TenGigabitEthernet>2/0/9</TenGigabitEthernet>
</arp-entry>
```

The following example configures all commands under the VRF submode. This configuration is non-default VRF.

```
<vrf xmlns="urn:brocade.com:mgmt:brocade-vrf">
    <vrf-name>red</vrf-name>
        <route-distiniguisher>10:1</route-distiniguisher>
        <address-family>
            <ipv4>
                <max-route>1200</max-route>
        <ip xmlns="urn:brocade.com:mgmt:brocade-rtm">
            <route>
                <static-route-nh-vrf>
                    <static-route-next-vrf-dest>44.4.4.4/32
                    </static-route-next-vrf-dest>
                    <next-hop-vrf>default-vrf</next-hop-vrf>
                    <static-route-next-hop>2.2.2.2
                    </static-route-next-hop>
                </static-route-nh-vrf>
            </route>
        </ip>
            <arp-entry xmlns="urn:brocade.com:mgmt:brocade-arp">
                <arp-ip-address>3.3.3.3</arp-ip-address>
                <mac-address-value>4.4.4</mac-address-value>
                <interfacename>interface</interfacename>
                <TenGigabitEthernet>2/0/9</TenGigabitEthernet>
            </arp-entry>
            </ipv4>
        </address-family>
    <ip>
        <vrf-router-id>6.7.8.9</vrf-router-id>
    </ip>
</vrf>
```

Enabling VRRP for VRF

To enable the Virtual Router Redundancy Protocol (VRRP) or VRRP-Extended (VRRP-E) for a Virtual Routing and Forwarding (VRF) region, an interface should be assigned to a VRF region before enabling VRRP or VRRP-E. VRRP is enabled or disabled globally on the switch under RBridge ID configuration mode; it cannot be enabled or disabled on a specific VRF instance. For more information on VRRP on Brocade switches, refer to Chapter 35, “Configuring VRRP”.

Chapter

37

Configuring BGP

In this chapter

- BGP configuration with NETCONF overview 557
- Configuring BGP 557

BGP configuration with NETCONF overview

Border Gateway Protocol (BGP) is an exterior gateway protocol that can do inter-domain and intra-domain routing. It peers to other BGP-speaking systems over TCP to exchange network reachability and routing information.

Refer to the *Network OS Administrator's Guide* for information on BGP and for the following related information:

- BGP Peering
- BGP Attributes
- Best-Path Algorithm
- Device ID
- Neighbor configuration
- Configuration fundamentals and optimization.

Through the NETCONF interface, you can perform the following operations that affect the functioning of BGP:

- Use the <edit-config> RPC to activate, configure, or deactivate BGP for an RBridge.
- Use the <edit-config> RPC to add, delete, or edit IPV4 address-family specific configurations.
- Use the <get-config> RPC to verify all or part of the BGP configuration.

BGP parameters are defined in the brocade-bgp YANG module. For information about the brocade-bgp YANG module, refer to the *Network OS YANG Reference Manual*.

Configuring BGP

Configuring BGP can be divided into three separate phases:

- "Enabling BGP on an RBridge" on page 558
- "Configuring BGP global mode" on page 559
- "Configuring IPv4 unicast address family" on page 560

Enabling BGP on an RBridge

To enable BGP on an RBridge, configure BGP with the default vrf-name for that RBridge.

1. Issue the <edit-config> RPC to configure the <bgp> node in the urn:brocade.com:mgmt:brocade-bgp namespace.
2. Under <bgp> node, set the value of <vrf-name> to 'default'

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3500">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>188</rbridge-id>
                     <router xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                        <bgp xmlns="urn:brocade.com:mgmt:brocade-bgp">
                            <vrf-name>default</vrf-name>
                        </bgp>
                     </router>
            </rbridge-id>
        </config>
    </edit-config>
</rpc>

<?xml version="1.0" ?>
<rpc-reply message-id="3500" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
   <ok/>
</rpc-reply>
```

Disabling BGP on an RBridge

To disable BGP on an RBridge, enter RBridge ID configuration mode and delete the <bgp> node. The following examples disables BGP on the RBridge by deleting the node.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3500">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>188</rbridge-id>
                    <router xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                        <bgp xmlns="urn:brocade.com:mgmt:brocade-bgp"
operation="delete">
                            <vrf-name>default</vrf-name>
                        </bgp>
                    </router>
            </rbridge-id>
        </config>
   </edit-config>
</rpc>
<?xml version="1.0" ?>
```

```
<rpc-reply message-id="3500" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <ok/>
</rpc-reply>
```

Configuring BGP global mode

Configurations that are not specific to address-family configuration are available in the BGP global configuration mode. The nodes supporting BGP global configuration mode are:

- always-compare-med—Allow comparing MED from different neighbors
- as-path-ignore—Ignore AS_PATH length for best route selection
- capability—Set capability
- cluster-id—Configure Route-Reflector Cluster-ID
- compare-med-empty-aspath—Allow comparing MED from different neighbors even with empty as-path attribute.
- compare-routerid—Compare router-id for identical BGP paths
- default-local-preference—Configure default local preference value
- distance—Define an administrative distance
- enforce-first-as—Enforce the first AS for EBGP routes
- fast-external-fallover—Reset session if link to EBGP peer goes down
- install-igp-cost—Install IGP cost to next hop instead of MED value as BGP route cost
- local-as—Configure local AS number
- log-dampening-debug—Log dampening debug messages
- maxas-limit—Impose limit on number of ASes in AS-PATH attribute
- med-missing-as-worst—Consider routes missing MED attribute as least desirable
- neighbor—Specify a neighbor router
- timers—Adjust routing timers

For complete information on all of these nodes, refer to the BGP parameters defined in the brocade-bgp YANG module. For information about the brocade-bgp YANG module, refer to the *Network OS YANG Reference Manual*.

The following illustrates the configuration of remote AS number for neighbor 1.1.1.1.

1. Issue the <edit-config> RPC to configure the <bgp> node in the urn:brocade.com:mgmt:brocade-bgp namespace.
2. Under the <vrf-name> node, open the <router-bgp-cmds-holder> node.
3. Under the <router-bgp-cmds-holder> node, open the <router-bgp-attributes> node.
4. Under the <router-bgp-attributes> node, configure the nodes for global BGP configuration.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3500">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
```

```
                    <rbridge-id>188</rbridge-id>
                        <router xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                            <bgp xmlns="urn:brocade.com:mgmt:brocade-bgp">
                                <vrf-name>default</vrf-name>
                                <router-bgp-cmds-holder>
                                   <router-bgp-attributes>
                                       <neighbor-ips>
                                        <neighbor-addr>
                                           <router-bgp-neighbor-address>1.1.1.1
                                               </router-bgp-neighbor-address>
                                            <remote-as>20</remote-as>
                                        </neighbor-addr>
                                    </neighbor-ips>
                                    </router-bgp-attributes>
                                </router-bgp-cmds-holder>
                            </bgp>
                        </router>
                </rbridge-id>
            </config>
        </edit-config>
</rpc>

<?xml version="1.0" ?>
<rpc-reply message-id="3500" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <ok/>
</rpc-reply>
```

Configuring IPv4 unicast address family

Currently only the IPv4 unicast address family is supported.

The following configurations are allowed under BGP IPv4 address-family mode:

- Network (including static networks)
- Route aggregation
- Route redistribution
- Route reflection
- Dampening
- Default route origination
- Multipathing (including maximum paths)
- Address-family-specific neighbor configuration
- Explicit specification of networks to advertise

Nodes that are specific to address-family configuration are:

- aggregate-address—Configure BGP aggregate entries
- always-propagate—Allow readvertisement of best BGP routes not in IP Forwarding table
- bgp-redistribute-internal—Allow redistribution of iBGP routes into IGPs
- client-to-client-reflection—Configure client to client route reflection
- dampening—Enable route-flap dampening
- default-information-originate—Originate Default Information

- default-metric—Set metric of redistributed routes
- maximum-paths—Forward packets over multiple paths
- multipath—Enable multipath for iBGP or EBGP neighbors only
- neighbor—Specify a neighbor router
- network—Specify a network to announce via BGP
- next-hop-enable-default—Enable default route for BGP next-hop lookup
- next-hop-recursion—Perform next-hop recursive lookup for BGP route
- redistribute—Redistribute information from another routing protocol
- rib-route-limit—Limit BGP rib count in routing table
- static-network—Special network that do not depends on IGP and always treat as best route in BGP
- table-map—Map external entry attributes into routing table
- update-time—Configure IGP route update interval

For complete information on all of these nodes, refer to the BGP parameters are defined in the brocade-bgp YANG module. For information about the brocade-bgp YANG module, refer to the *Network OS YANG Reference Manual*.

This configuration example configures the neighbor with a weight of 20.

1. Issue the <edit-config> RPC to configure the <bgp> node in the urn:brocade.com:mgmt:brocade-bgp namespace.
2. Under the <vrf-name> node, open the <router-bgp-cmds-holder> node.
3. Under the <router-bgp-cmds-holder> node, open the <address-family> node.
4. Under the <address-family> node, open the <ipv4> node.
5. Under the <ipv4> node, open the <ipv4-unicast> node.
6. Under the <ipv4-unicast> node, configure the nodes for IPv4 unicast address configuration.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="3501">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <rbridge-id xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                <rbridge-id>188</rbridge-id>
                    <router xmlns="urn:brocade.com:mgmt:brocade-rbridge">
                        <bgp xmlns="urn:brocade.com:mgmt:brocade-bgp">
                            <vrf-name>default</vrf-name>
                            <router-bgp-cmds-holder>
                            <address-family>
                            <ipv4>
                                <ipv4-unicast>
                                <af-ipv4-neighbor-address-holder>
                                    <af-ipv4-neighbor-address>
                                        <af-ipv4-neighbor-address>1.1.1.1
                                          </af-ipv4-neighbor-address>
                                        <af-nei-weight>20</af-nei-weight>
                                    </af-ipv4-neighbor-address>
                                </af-ipv4-neighbor-address-holder>
                                </ipv4-unicast>
```

```
                                </ipv4>
                                </address-family>
                                </router-bgp-cmds-holder>
                            </bgp>
                        </router>
                    </rbridge-id>
                </config>
            </edit-config>
</rpc>
<?xml version="1.0" ?>

<rpc-reply message-id="3501" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
        <ok/>
</rpc-reply>
```

Chapter

38

Configuring IGMP

In this chapter

- IGMP configuration with NETCONF overview 563
- Configuring IGMP snooping 563
- Configuring IGMP snooping querier 565
- Monitoring IGMP snooping 566

IGMP configuration with NETCONF overview

This chapter provides procedures for configuring Internet Group Management Protocol (IGMP) using NETCONF RPCs. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of IGMP, including descriptions of how active IGMP snooping works, how IGMP mitigates the effects of multicast routing, and how IGMP is handled over a LAG or vLAG
- How to monitor IGMP snooping. (You cannot monitor IGMP snooping using the NETCONF interface.)
- Scalability information about IGMP in standalone and fabric cluster modes

Using the NETCONF interface, you can perform the following IGMP-related operations:

- Use the <edit-config> remote procedure call (RPC) to configure IGMP snooping and the IGMP snooping querier.
- Use the <get-config> RPC to verify all or part of the IGMP configuration.

IGMP parameters are defined in the brocade-igmp-snooping YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*. For definitions and explanations of all IGMP parameters, refer to the brocade-igmp-snooping.yang file.

Configuring IGMP snooping

By default, IGMP snooping is globally disabled on all VLAN interfaces.

Use the following procedure to configure IGMP on a DCB/FCoE switch.

1. Issue the <edit-config> RPC to configure the <igmp-snooping> node in the urn:brocade.com:mgmt:brocade-igmp-snooping workspace.
2. Under the <igmp-snooping> node, include the <ip> node.
3. Under the <ip> node, include the <igmp> node in the urn:brocade.com:mgmt:brocade-igmp-snooping workspace.
4. Under the <igmp> node, include the <snooping> node element.

5. Under the <snooping> node, include the empty <qenable> node.
6. Issue the <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface namespace.
7. Under the <interface-vlan> node, include the <interface>/<vlan> hierarchy of node elements.
8. Under the <vlan> node, include the <name> leaf element, and set it to the VLAN number for which you want to enable IGMP snooping.
9. Under the <vlan> node, include the <ip> node.
10. Under the <ip> node, include the <igmp> node element from the urn:brocade.com:mgmt:brocade-igmp-snooping namespace.
11. Under the <igmp> node, include the <querier> node.
12. Under the <querier> node, include the empty <qenable> node to activate the IGMP querier functionality for the VLAN.

The following example enables IGMP snooping for VLAN 10.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3000" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <igmp-snooping xmlns="urn:brocade.com:mgmt:brocade-igmp-snooping">
                <ip>
                    <igmp>
                        <snooping>
                            <enable/>
                        </snooping>
                    </igmp>
                </ip>
            </igmp-snooping>
            <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
                <interface>
                    <vlan>
                        <name>10</name>
                            <ip>
                                <igmp
                            xmlns="urn:brocade.com:mgmt:brocade-igmp-snooping">
                                        <snooping>
                                            <querier>
                                                <qenable/>
                                            </querier>
                                        </snooping>
                                    </igmp>
                                </ip>
                    </vlan>
                </interface>
            </interface-vlan>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="3000" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Configuring IGMP snooping querier

If your multicast traffic is not routed because Protocol Independent Multicast (PIM) and IGMP are not configured, use the IGMP snooping querier in a VLAN.

IGMP snooping querier sends out IGMP queries to trigger IGMP responses from switches that wish to receive IP multicast traffic. IGMP snooping listens for these responses to map the appropriate forwarding addresses.

Use the following procedure to map forwarding addresses to the appropriate interfaces.

1. Issue the <edit-config> RPC to configure the <interface-vlan> node in the urn:brocade.com:mgmt:brocade-interface workspace.
2. Under the <interface-vlan> node, include the <interface>/<vlan> hierarchy of node elements.
3. Under the <vlan> node, include the <name> leaf element, and set it to the VLAN number whose members you want to query.
4. Under the <vlan> node, include the <ip> node.
5. Under the <ip> node, include the <igmp> node element from the urn:brocade.com:mgmt:brocade-igmp-snooping namespace.
6. Under the IGMP node, specify the following leaf elements to configure the IGMP snooping querier. Because only one attribute can be configured in one request, you must make separate requests for each attribute.
   a. In the <query-interval> element, specify a value in seconds in the range of 1 through 18000.

      The default value is 125.

   b. In the <last-member-query-interval> element, specify a value in milliseconds in the range 1000 through 25500.

      The default value is 1000.

   c. In the <query-max-response-time> element, specify a value in seconds in the range 1 through 25.

      The default value is 10.
7. Under the <igmp> node, include the <querier> node.
8. Under the <querier> node, include the empty <enable> node to activate the IGMP snooping querier functionality for the VLAN.

   In this example, this basic NETCONF request would be repeated for each of the attributes. This example sets the <query-interval> value.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="3001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<edit-config>
    <target>
        <running/>
    </target>
    <config>
        <interface-vlan xmlns="urn:brocade.com:mgmt:brocade-interface">
            <interface>
                <vlan>
                    <name>25</name>
```

```
                    <ip>
                        <igmp
                         xmlns="urn:brocade.com:mgmt:brocade-igmp-snooping">
                            <query-interval>125</query-interval>
                        </igmp>
                    </ip>
                </vlan>
            </interface>
        </interface-vlan>
    </config>

</edit-config>
</rpc>

<rpc-reply message-id="3001" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
<ok/>
</rpc-reply>
```

Monitoring IGMP snooping

Monitoring the performance of your IGMP traffic allows you to diagnose any potential issues on your switch. This helps you utilize bandwidth more efficiently by setting the switch to forward IP multicast traffic only to connected hosts that request multicast traffic.

Use the <get-config> RPC to validate configuration settings. IGMP parameters are defined in the brocade-igmp-snooping YANG module. For details, refer to the *Network OS YANG Reference Manual*.

Chapter

39

Configuring DHCP Relay

In this chapter

- DHCP Relay configuration with NETCONF overview 567
- Configuring DHCP Relay 567
- Removing the DHCP Relay address 570
- Verifying configuration information 570

DHCP Relay configuration with NETCONF overview

This chapter provides procedures for configuring DHCP Relay using NETCONF RPCs. Refer to the *Network OS Administrator's Guide* for the following related information:

- An overview of DHCP Relay, including descriptions of how active DHCP Relay functions
- How to monitor DHCP Relay

Using the NETCONF interface, you can perform the following DHCP Relay-related operations:

- Use the <edit-config> remote procedure call (RPC) to configure DHCP Relay.
- Use the <get-config> RPC to verify all or part of the DHCP Relay configuration.

DHCP Relay parameters are defined in the brocade-dhcp YANG module. For a structural map of the YANG module, refer to the *Network OS YANG Reference Manual*.

Configuring DHCP Relay

The following are considerations and limitations when configuring the IP DHCP Relay agent:

- You can configure the feature in standalone mode (applicable switches only) or VCS mode.
- You can configure up to four DHCP server IP addresses per interface. When multiple addresses are configured, the relay agent relays the packets to all server addresses.
- The DHCP server and clients it communicates with can be attached to different Virtual Forwarding and Routing (VRF) instances. When clients and the DHCP server are on different VRF instances, use the <server-vrf-name> node with the <relay-ip-addr> node, where <server-vrf-name> is the VRF where the DHCP server is located. For more information on VRF support for the IP DHCP Relay, refer to Chapter 36, "Configuring VRF".

The following is an example of configuring an IP DHCP Relay address on a 10-gigabit Ethernet interface. The 10-gigabit Ethernet interface is modified with the DHCP Relay container's <relay-ip-addr> node to set the IP address.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and set its value to the name of the interface for which you want to configure user-priority mappings.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <dhcp> element located in the urn:brocade.com:mgmt:brocade-dhcp namespace.
5. Set the <relay-ip-addr> node to the IP address for the DHCP server.

```
<rpc message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/3/1</name>
                    <dhcp xmlns=”urn:brocade.com:mgmt:brocade-dhcp”>
                        <dhcp>
                            <relay>
                                <relay-ip-addr>100.1.1.2</relay-ip-addr>
                        </fabric-isl>
                    </fabric>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

The following is an example of configuring the same IP DHCP Relay address, except this time on VE interface 100.

```
<rpc message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <ve>
                    <name>100</name>
                    <dhcp xmlns=”urn:brocade.com:mgmt:brocade-dhcp”>
                        <dhcp>
                            <relay>
                                <relay-ip-addr>100.1.1.2</relay-ip-addr>
                        </fabric-isl>
                    </fabric>
```

```
            </tengigabitethernet>
        </interface>
    </config>
</edit-config>
</rpc>

<rpc-reply message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

DHCP server and client interface on different VRF instances

If the DHCP server is on a different Virtual Routing and Forwarding (VRF) instances than the interface where the client is connected, use the <server-vrf-name> node.

NOTE
If the <server-vrf-name> node is not used, it is assumed that the DHCP server and client interface are on the same VRF instance.

1. Issue the <edit-config> RPC to configure the <interface> node in the urn:brocade.com:mgmt:brocade-interface namespace.
2. Under the <interface> node, include the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node element.
3. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <name> element and set its value to the name of the interface for which you want to configure user-priority mappings.
4. Under the <gigabitethernet>, <tengigabitethernet>, <fortygigabitethernet>, <hundredgigabitethernet>, or <port-channel> node, include the <dhcp> element located in the urn:brocade.com:mgmt:brocade-dhcp namespace.
5. Set the <relay-ip-addr> node to the IP address for the DHCP server.
6. Set the <server-vrf-name> node to the VRF name.

```
<rpc message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <interface xmlns="urn:brocade.com:mgmt:brocade-interface">
                <tengigabitethernet>
                    <name>1/3/1</name>
                    <dhcp xmlns=”urn:brocade.com:mgmt:brocade-dhcp”>
                        <dhcp>
                            <relay>
                                <relay-ip-addr>100.1.1.2</relay-ip-addr>
                                <server-vrf-name>blue</server-vrf-name>
                        </fabric-isl>
                    </fabric>
                </tengigabitethernet>
            </interface>
        </config>
    </edit-config>
</rpc>
```

```
<rpc-reply message-id="1202" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Removing the DHCP Relay address

To remove the IP DHCP Relay address, use the standard delete process for NETCONF.

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc message-id="211" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <edit-config>
        <target>
            <running/>
        </target>
        <config>
            <protocol xmlns="urn:brocade.com:mgmt:brocade-interface">
                <dhcp xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
                        operation="delete"/></dhcp>
            </protocol>
        </config>
    </edit-config>
</rpc>

<rpc-reply message-id="211" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
    <ok/>
</rpc-reply>
```

Verifying configuration information

For detailed information on retrieving configuration information, refer to “Retrieving configuration data” on page 11.

Section

V

Appendixes

This section contains the following appendix:

- Managing NETCONF 573

Appendix

Managing NETCONF

A

In this appendix

- Viewing NETCONF client capabilities 573
- Viewing NETCONF statistics and session information 574

Viewing NETCONF client capabilities

You can view the NETCONF client capabilities for all active sessions through the NETCONF interface or using the Network OS CLI. The session-ID, logon name of the user of the NETCONF client session, host IP address, and login time are always returned. The application vendor name, application product name, version number, and identity of the client are also returned if these values were advertized in the client capabilities at the start of the session.

To view NETCONF client capabilities using the CLI, in privilege-exec mode, enter the **show netconf client-capabilities** command.

The following example shows two client sessions. The first client session has provided client capabilities in its <hello> message to the server at the start of the session. The second client has not provided this information.

```
switch# show netconf client-capabilities
Session Id     : 10
User name      : root
Vendor         : Brocade
Product        : Brocade Network Advisor
Version        : 9.1.0 Build 123
Client user    : admin-user
Host IP        : 10.24.65.8
Login time     : 2011-08-18T08:54:24Z

Session Id     : 11
User name      : root
Vendor         : Not Available
Product        : Not Available
Version        : Not Available
Client user    : Not Available
Host IP        : 10.24.65.8
Login time     : 2011-08-18T08:54:24Z
```

To obtain NETCONF client capabilities using the NETCONF interface, issue the <get-netconf-client-capabilities> custom RPC located in the urn:brocade.com:mgmt:brocade-netconf-ext namespace.

```
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="206">
    <get-netconf-client-capabilities
        xmlns="urn:brocade.com:mgmt:brocade-netconf-ext"/>
</rpc>
```

```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="206">
    <session xmlns="urn:brocade.com:mgmt:brocade-netconf-ext">
        <session-id>10</session-id>
        <user-name>root</user-name>
        <vendor>Brocade</vendor>
        <product>Brocade Network Advisor</product>
        <version>9.1.0 Build 123</version>
        <identity>admin-user</identity>
        <host-ip>10.24.65.8</host-ip>
        <time>2011-08-18T08:54:24Z</time>
    </session>
    <session xmlns="urn:brocade.com:mgmt:brocade-netconf-ext">
        <session-id>11</session-id>
        <user-name>root</user-name>
        <host-ip>10.24.65.8</host-ip>
        <time>2011-08-18T08:54:24Z</time>
    </session>
</rpc-reply>
```

Viewing NETCONF statistics and session information

To view NETCONF statistics and session information, use the **show netconf-state** command. Using this command, you can view the following kinds of information:

- Capabilities
- Datastores
- Schemas
- Sessions
- Statistics

NOTE
You cannot view NETCONF statistics and session information using the NETCONF interface.

To view NETCONF capabilities provided by the server, in privileged-EXEC mode, enter the **show netconf-state capabilities** command.

```
switch# show netconf-state capabilities
netconf-state capabilities capability urn:ietf:params:netconf:base:1.0
netconf-state capabilities capability
urn:ietf:params:netconf:capability:writable-running:1.0
netconf-state capabilities capability
urn:ietf:params:netconf:capability:startup:1.0
netconf-state capabilities capability
urn:ietf:params:netconf:capability:xpath:1.0
netconf-state capabilities capability
urn:ietf:params:netconf:capability:validate:1.0
netconf-state capabilities capability http://tail-f.com/ns/netconf/actions/1.0
netconf-state capabilities capability
http://tail-f.com/ns/aaa/1.1?revision=2010-06-17&module=tailf-aaa
netconf-state capabilities capability
urn:brocade.com:mgmt:brocade-aaa?revision=2010-10-21&module=brocade-aaa
(output truncated)
```

To view the NETCONF datastores on the NETCONF server and related locking information, enter the **show netconf-state datastores** command.

```
switch# show netconf-state datastores
         LOCKED                  LOCKED
         BY       LOCKED  LOCK   BY       LOCKED           LOCKED
NAME     SESSION  TIME    ID     SESSION  TIME     SELECT  NODE
-----------------------------------------------------------------
running  -        -
startup  -        -
```

To view the data models supported by the NETCONF server, enter the **show netconf-state schemas** command.

```
switch# show netconf-state schemas
```

To view the currently active NETCONF sessions, enter the **show netconf-state sessions** command.

```
switch# show netconf-state sessions
netconf-state sessions session 6
transport cli-console
username admin
source-host 127.0.0.1
login-time 2011-09-05T11:29:31Z
netconf-state sessions session 9
transport netconf-ssh
username root
source-host 172.21.132.67
login-time 2011-09-05T11:50:33Z
in-rpcs 0
in-bad-rpcs 0
out-rpc-errors 0
out-notifications 0
```

To view NETCONF server statistics, enter the **show netconf-state statistics** command.

```
switch# show netconf-state statistics
netconf-state statistics netconf-start-time 2012-04-27T09:12:09Z
netconf-state statistics in-bad-hellos 0
netconf-state statistics in-sessions 94
netconf-state statistics dropped-sessions 78
netconf-state statistics in-rpcs 800
netconf-state statistics in-bad-rpcs 59
netconf-state statistics out-rpc-errors 59
netconf-state statistics out-notifications 0
```

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