Ethernet Routing Switch
45XX, 48XX, 55xx, 56xx, 59xx

Virtual Services Platform
7000

**Engineering**

# > Ethernet Routing Switch Simplified QoS Configuration Using Traffic Profile Filter Sets Technical Configuration Guide

**Avaya Networking**

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# Acronym Key

Throughout this guide the following acronyms will be used:

| | |
|---|---|
| ACL | Access Control List |
| AF | Assured Forwarding PHB |
| CLI | Command Line Interface |
| CS | Class Selector Code Point |
| DSCP | Differentiated Services Code Point |
| EF | Expedited Forwarding PHB |
| ERS | Ethernet Routing Switch |
| HTTP | Hypertext Transfer Protocol |
| ICMP | Internet Control Message Protocol |
| IETF | Internet Engineering Task Force |
| MIB | Management Information Base |
| NMS | Network Management Station |
| NSNA | Nortel Secure Network Access |
| PHB | Per Hop Behavior |
| PDU | Protocol Data Unit |
| QoS | Quality of Service |

# Revision Control

| No | Date | Version | Revised By | Remarks |
|---|---|---|---|---|
| 1 | May 2011 | 1.0 | PRMGT | Update to Avaya format |
| 2 | December 2011 | 2.0 | John Vant Erve | Update to include traffic meters and shaping |
| 3 | August 2014 | 3.0 | John Vant Erve | Added VSP 7000 and Cisco IOS ACL equivalents |
| 4 | September 2015 | 4.0 | John Vant Erve | Added ERS 5900 and updated QoS precedence levels supported on ERS 4800 |
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# Conventions

This section describes the text, image, and command conventions used in this document.

## Symbols

Tip – Highlights a configuration or technical tip.

Note – Highlights important information to the reader.

Warning – Highlights important information about an action that may result in equipment damage, configuration or data loss.

## Text

**Bold** text indicates emphasis.

***Italic*** text in a Courier New font indicates text the user must enter or select in a menu item, button or command:

```
ERS5520-48T# show running-config
```

Output examples from Avaya devices are displayed in a Lucida Console font:

```
ERS5520-48T# show sys-info

Operation Mode:          Switch
MAC Address:             00-12-83-93-B0-00
PoE Module FW:           6370.4
Reset Count:             83
Last Reset Type:         Management Factory Reset
Power Status:            Primary Power
Autotopology:            Enabled
Pluggable Port 45:       None
Pluggable Port 46:       None
Pluggable Port 47:       None
Pluggable Port 48:       None
Base Unit Selection:     Non-base unit using rear-panel switch
sysDescr:                Ethernet Routing Switch 5520-48T-PWR
                         HW:02       FW:6.0.0.10  SW:v6.2.0.009
                         Mfg Date:12042004    HW Dev:H/W rev.02
```

# 1. Introduction

The defining characteristic of the Quality of Service (QoS) support on the Ethernet Routing Switch (ERS) stackable platforms and Virtual Services Platform 7000 has always been flexibility. Hardware capabilities have been fully exposed and exploited to give the user a plethora of knobs with which to manipulate the system's QoS capabilities. Over time, this has resulted in a sometimes dizzying array of options being made available. This, in turn, has steepened the learning curve, making it more time-consuming to initiate even the most basic of QoS operations.

While there will always be a demand for comprehensive and advanced configuration options, a streamlined and easy-to-learn QoS configuration mechanism has become a necessity. The support must provide a reasonable amount of filtering and action options while requiring no more than a few intuitive configuration steps to achieve the desired result. The Traffic-Profile Filter Set support has been introduced to satisfy this need.

# 2. Background

The process of defining filters, meters, actions and policies using the standard set of Command Line Interface (CLI) commands and advanced web pages is tedious at best. Developed nearly a decade ago in accordance with the emerging IETF standards and closely aligned to the QoS Management Information Base (MIB) data model, the command set is quite flexible but bulky and onerous to use. Access Control List (ACL) support was introduced to provide some process improvement in this area. Unfortunately, the ACL support by definition lacks the flexibility necessary for it to assume the role of a general-purpose configuration mechanism.

Filter set templates were introduced to support Nortel Secure Network Access (NSNA) and User Based Policy (UBP) applications. Based on the templates, filter set data (i.e., a named collection of filters, actions, meters and policies) is associated with a port under the direction of a non-QoS application (e.g., NSNA, UBP). Allowing the customer to leverage this functionality directly, in a fashion similar to ACL usage, could provide the flexibility and ease-of-use necessary of the configuration mechanism being sought.

## 2.1 Benefits

Traffic-profile filter set support offers several advantages over the standard QoS CLI support, as well as the deployed ACL functionality:

- Streamlined command set: filter set definition and installation can be completed in as few as 2 commands, replacing potentially 7 standard CLI QoS commands.
- Combined IP and L2 options: deployed ACL support forces the user to define IP or L2 ACLs. Filter set classifier options include both IP and L2 data.
- Meter availability: a filter set may be associated with metering criteria that is applied to all filter set policies (individual filters or blocks of filters). Metering is currently not supported with ACLs.
- No implicit drop: an ACL is terminated by an implicit 'drop all' prohibiting ACL layering on a port. This limitation is eliminated with filter sets.
- Addition/deletion support: filter set classifier elements (i.e., filters/actions) may be added/deleted while the filter set is in-use (i.e., associated with a port). This type of manipulation is not supported with ACLs.
- Additional filtering options: latest IP/L2 filters options are available in conjunction with filter sets.

# 3. Filter Set Anatomy

Before delving into the specifics of the traffic-profile filter set support, an understanding of the components that comprise a filter set is needed. As a starting point, a quick review of QoS essentials is warranted.

## 3.1 QoS Primer

The most basic QoS operation is that of identifying traffic and manipulating it in some way. To accomplish this task, classifiers, actions and policies must be defined. Classifiers (a.k.a. filters) are used to identify traffic by specifying which protocol fields need to be examined and what these fields must contain for a filter match to occur. A single classifier can target one or more fields to be matched. If multiple fields are targeted, all of the fields being examined must contain the specified data for the packet being inspected to match the filter.

Multiple classifiers may be combined into a block (i.e., a classifier block) so that they may be referenced as a unit. Only classifiers that are compatible (e.g., match the same or compatible protocol fields) may be combined into a block.

Actions specify the treatment packets matching a classifier are to receive. Typically this involves dropping the packets or remarking certain fields that are used to dictate traffic treatment both internally (as the packet egresses the switch) and downstream as the packet is processed by other switching equipment.

A policy acts as a coupling that ties together the various QoS components. A policy identifies a classifier (or classifier block) for traffic identification and an action to be initiated when packets matching the classification criteria are encountered. Ports on which to install the filter data are included in the policy specification. A policy also includes a precedence value which dictates the order in which policies (i.e., classifiers and actions) are applied when multiple policies target the same port. A limited number of precedence levels (a.k.a. masks) are available per port. This limit dictates the number of policies that can be applied to a given port at the same time.

A policy specification may also include metering criteria, to control ingress traffic, and statistics support to keep track of the traffic processed by the policy.

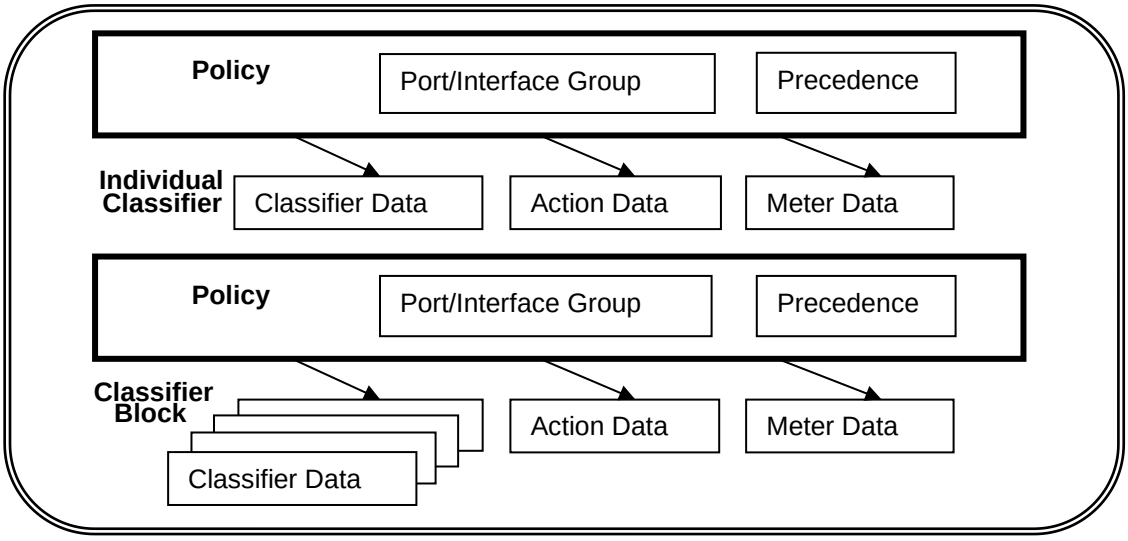



**Figure 1: QoS Policy Components**

## 3.2 Filter Set Essentials

At the most basic level, a filter set is a collection of policies that are identified as a single, named unit. Each policy references classifier and action criteria for identifying and processing traffic. The policies within a set are ordered, meaning that they are applied to ingress traffic in a specific order. This evaluation order is important because, once a policy "hit" occurs (i.e., traffic matching the policy's filter criteria is identified) and actions are initiated, policies with a higher evaluation order may not be enforced even if they match the traffic being processed.

A filter set is associated with a port. The same filter set can be applied to multiple ports but can only be applied once to any given port. When a filter set is installed, limited resources are consumed (e.g., filter/meter/counter resources and precedence levels/masks). If the necessary resources are not available, the filter set installation will fail. Partial installation is not supported. Active (a.k.a. in-use) filter sets can be modified. Classifier elements can be added and deleted, pending resource availability. In-use filter set modification may impact traffic processing as the installed data is being updated.

Let us consider each of these items in more detail.

**Filter Set Classifier Elements**: a filter set classifier element identifies the protocol fields and their content that are to be used for traffic identification. Actions to be initiated for traffic matching the specified filter data are included as well. Elements are "named" such that all classifier elements that comprise a filter set share the same name (i.e., the filter set name). Elements have a specific type as well (e.g., NSNA, UBP, traffic-profile) though this is set automatically during configuration and, for the most part, is transparent to the user. Each element also contains an evaluation order value and filter block information, if appropriate.

**Filter Set Element Evaluation Order**: each filter set classifier element contains an evaluation order. This value dictates the order in which classifier elements associated with the same filter set (i.e., elements with the same filter set name) are applied. Elements with a low evaluation order are applied before elements with a higher evaluation order. The evaluation order can determine the actions initiated when a packet matches multiple classifier elements in a filter set (see Table 1).

An evaluation order must be unique within a filter set. The evaluation order for a classifier block is determined by the lowest evaluation order of the elements that are members of the block. Members of a classifier block may be assigned the same evaluation order, though this will impact the evaluation order of block member classifier data on platforms that honor classifier block member precedence.

| Element Evaluation Order | Action Criteria | Action Initiated |
|---|---|---|
| 1 | Update DSCP: 20 | |
| 2 | Drop Packet | Drop Packet |
| **Reason: no action conflicts – both performed (drop overrides remarking)** | | |
| | | |
| 1 | Update DSCP: 46 | Update DSCP: 46 |
| 2 | Update 802.1p: 6 | Update 802.1p: 6 |
| **Reason: no action conflicts – both performed (complimentary actions)** | | |
| 1 | Don't Drop Packet | Don't Drop Packet |
| 2 | Drop Packet | |

| | | |
|---|---|---|
| **Reason: conflicting actions – resolve conflict using evaluation order** | | |
| | | |
| 1 | Update DSCP: 46 | Update DSCP: 46 |
| 2 | Update DSCP: 0 | |
| **Reason: conflicting actions – resolve conflict using evaluation order** | | |

**Table 1: Filter Set Element Evaluation Order and Action Selection**

**Filter Set Element Block Definition:** filter set classifier elements can be combined into a block to make better use of scarce resources. When installed, a single filter set classifier element consumes one precedence level (i.e., resource usage equivalent to a policy referencing a single filter). A block containing any number of filter set classifier elements still only consumes one precedence level (i.e., resource usage equivalent to a policy referencing a filter block) when installed. Combining compatible filter set classifier elements into blocks can substantially impact resource usage.

Which filter set elements can be combined into a block? As a general rule, classifiers matching the exact same protocol fields or the exact same portions thereof (e.g., same IP address bits) are compatible. On the ERS stackable platforms (i.e., 4XXX/56XX/59XX) and VSP7000 these restrictions have been eased quite a bit. Classifiers matching the same protocol fields, regardless of the whether full or partial field matches are specified, are compatible. Furthermore, filters matching different but compatible fields (i.e., fields from a hardware-defined set of compatible fields) can be combined into a block. Table 2 contains a few examples of classifier content that is compatible and non-compatible for blocking purposes.

| Filter Content | | Blocking Compatible | |
|---|---|---|---|
| **Filter A** | **Filter B** | **ERS55XX** | **ERS56XX/ERS4XXX/ERS59XX VSP7000** |
| Source IP 1.2.3.4/32 | Source IP 5.6.7.8/32 | Yes | Yes |
| DSCP 23, Protocol TCP | DSCP 38, Protocol UDP | Yes | Yes |
| Src MAC 11:22:33/FF:FF:FF | Src MAC 44:55:66/FF:FF:FF | Yes | Yes |
| Dst L4 Port Min/Max 0/31 | Dst L4 Port Min/Max 0/31 | Yes | Yes |
| Destination IP 1.2.3.4/32 | Destination IP 5.6.0.0/16 | No | Yes |
| DSCP | TCP_Ctrl | No | Yes |
| Src L4 Port Min/Max 123/161 | Src L4 Port Min/Max 20/30 | No | Yes |
| Dst MAC 08:81/FF:FF | Src MAC 01:00:81/FF:FF:FF | No | Yes |
| Destination MAC | Source IP | No | No |

**Table 2: Filter Content and Block Compatibility Examples**

**Filter Set Resource Usage:** as previously noted, a filter set is essentially a named collection of policies that reference classifier and action criteria for identifying and processing traffic. Policies, filters and related QoS components (e.g., meters, counters) consume hardware resources when applied to a port. A filter set therefore requires hardware resources equivalent to the sum of the resources required to support the individual policies, filters, etc. that comprise the filter set.

When installed, a single filter set classifier element or a classifier block consumes one precedence mask (i.e., resource usage equivalent to a policy referencing a single filter or a filter block). Thus the number of precedence levels/masks required for filter set installation equals the number of classifiers and unique classifier blocks included in the filter set. To ensure deterministic behavior, the required number of precedence levels must be available and consecutive for a filter set installation to be successful. Consider the following filter set:

```
qos traffic-profile classifier name fivePrecs dst-ip 1.2.3.4/32 drop-action enable
eval-order 1

qos traffic-profile classifier name fivePrecs dst-ip 1.2.3.5/32 drop-action enable
eval-order 2

qos traffic-profile classifier name fivePrecs dst-ip 1.2.3.6/32 drop-action enable
eval-order 3

qos traffic-profile classifier name fivePrecs ds-field 23 drop-action enable block
dscpBlk eval-order 10

qos traffic-profile classifier name fivePrecs ds-field 24 drop-action enable block
dscpBlk eval-order 11

qos traffic-profile classifier name fivePrecs protocol 111 drop-action enable block
protoBlk eval-order 20

qos traffic-profile classifier name fivePrecs protocol 112 drop-action enable block
protoBlk eval-order 21

qos traffic-profile set port 1-2 name fivePrecs track-statistics aggregate
```

Filter set “fivePrecs” contains 3 classifiers and 2 unique classifier blocks requiring that 5 consecutive precedence levels be available on ports to which the filter set is applied. There is no requirement regarding which precedence levels are available. The highest suitable starting precedence will be selected automatically when the filter set is installed. For example, under a default configuration scenario, “fivePrecs” would consume precedence masks 9 – 13 if installed on port 1 and 2 of a 5698:

```
5650TD(config)#show qos diag

Unit/Port                       Mask Precedence Usage
            16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
---------  ---------------------------------------------------------------
1/1          AR  DR  DH  Q   Q   Q   Q   Q                           Q   Q
1/2          AR  DR  DH  Q   Q   Q   Q   Q                           Q   Q

AR=ARP DH=DHCP Q=QoS
```

On an ERS 4500 switch, we could not apply the above traffic profile as by default, only precedence levels 3 – 6 are available. However, we could disable DHCP-Relay freeing up precedence level 7 or we could ether assign an interface group of trusted or unrestricted to free up both precedence levels 1 and 2. For example, assuming we disable DHPC-Relay, “fivePrecs” would consume precedence masks 3 - 7 if installed on port 1 and 2 of a 4526:

```
no ip dhcp-relay

qos traffic-profile classifier name fivePrecs dst-ip 1.2.3.4/32 drop-action enable
eval-order 1
```

```
qos traffic-profile classifier name fivePrecs dst-ip 1.2.3.5/32 drop-action enable
eval-order 2

qos traffic-profile classifier name fivePrecs dst-ip 1.2.3.6/32 drop-action enable
eval-order 3

qos traffic-profile classifier name fivePrecs ds-field 23 drop-action enable block
dscpBlk eval-order 10

qos traffic-profile classifier name fivePrecs ds-field 24 drop-action enable block
dscpBlk eval-order 11

qos traffic-profile classifier name fivePrecs protocol 111 drop-action enable block
protoBlk eval-order 20

qos traffic-profile classifier name fivePrecs protocol 112 drop-action enable block
protoBlk eval-order 21

qos traffic-profile set port 1-2 name fivePrecs track-statistics aggregate

4526GTX-60pwr(config)#show qos diag

Unit/Port          Mask Precedence Usage
            8   7   6   5   4   3   2   1
--------- ------------------------------
1/1         AR  Q   Q   Q   Q   Q   Q   Q
1/2         AR  Q   Q   Q   Q   Q   Q   Q
```

Please note that with the ERS 4800 using release 5.8 or higher increases the number of QoS filter precedences from 8 to 16. Starting at release 5.8, support for the ERS4500 series is no longer supported.

If QoS or non-QoS applications are consuming resources on the target port, a different starting precedence will be selected if one is available. In the following example, precedence 10 is consumed by the IPSG application and 5 consecutive precedence levels are only available starting at precedence 9:

```
5650TD(config)#show qos diag
Unit/Port                      Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ------------------------------------------------------------------
1/1         AR  DH                  IS  Q   Q   Q   Q   Q           Q   Q
1/2         AR  DH                                                  Q   Q

AR=ARP DH=DHCP Q=QoS IS=IPSG
```

Aside from precedence masks, filter set installation consumes filter (one per classifier element) and potentially meter and counter resources. The availability of these resources, tracked on a per-port (ERS55XX) or per-port cluster (ERS4XXX/ERS56XX/59XX/ERS59XX) basis, may limit whether a filter set can be applied to a port. It is also important to remember that adding classifier elements to an in-use filter set impacts resource requirements by changing the precedence mask requirements and/or the filter, meter, etc. resource requirements.

**Filter Set Port Assignment:** filter sets are associated with a port in different ways. Non-QoS applications, such as NSNA and UBP, use filter sets as a template. The filter set, when defined, is not associated with port but an instance of the filter set is created and installed based on application operation. Traffic-profile filter sets are associated with a port when defined by the user. A valid, QoS-enabled port must be provided by the administrator for the filter set installation to succeed.

**Filter Set Metering:** the ability to meter traffic processed by a filter set is currently limited. Metering data may be defined for the filter set overall but not for the individual classifiers. When metering data is specified, a meter is associated with each classifier and unique classifier block. Each meter has the same characteristics (e.g., committed rate, burst size) and is independently evaluated (i.e., there is no relationship between meters associated with different filter set classifiers/blocks). Conforming (i.e., in-profile) traffic is processed based on the action criteria associated with the individual classifier or block

member with the lowest evaluation order. Non-conforming (i.e., out-of-profile traffic) traffic is processed based on the out-of-profile action criteria associated with the overall filter set.

**Filter Set Statistics Tracking:** by default, a counter is associated with each filter set classifier element and unique classifier block. For a classifier element, the counter tracks matches of the specified classification criteria. For classifier blocks, the counter tracks the total filter data hits across all the classifiers in the block. Different statistics tracking modes are available. The default mode is referred to as 'aggregate' mode because of the way counts are totaled, or aggregated, across all the filters referenced by a policy. Should the user wish to track statistics for each classifier block member, the 'individual' mode should be specified. Note that counter resource availability determines whether either 'aggregate' or 'individual' statistics tracking modes can be used. If statistics tracking is not necessary or a filter set can only be installed with statistics tracking disabled (i.e., counter resources are exhausted), the statistics tracking mode 'disabled' can be specified.

# 4. Traffic-Profile Filter Set Usage

With the filter set essentials covered, it is time to specifically examine traffic-profile filter set usage. Configuration and display command syntax will be presented first. Next a series of usage examples will be presented, followed by a discussion of the areas in which configuration issues more commonly arise.

## 4.1 Traffic-Profiles Filter Set Configuration

Traffic-profile filter set configuration begins with specifying the classifier criteria used to identify the traffic being targeted and with specifying the actions to be taken when matching traffic is identified. The 'qos traffic-profile classifier' CLI command is used for this purpose:

- Command: ***qos traffic-profile classifier name [filterSetName] {classifierData} {actionData} {elemData}***
    - name [filterSetName] – mandatory command variable that associates the element with a label. Name labels are used to identify elements belonging to the same traffic-profile filter set (i.e., members of a given filter set share the same name label). A 16 character (maximum) name string is supported.
    - classifierData – optional command variables used for traffic identification purposes.
    - actionData – optional command variables used to specify actions to be performed when traffic matching the classifier data is identified.
    - elemData – optional command variables that facilitate filter set element ordering and efficient resource utilization.

A large number of classifier options are available to facilitate traffic identification. Zero (i.e., a fully defaulted element), one or more classifier options can be specified in a single filter set classifier element. Certain combinations of classifier options may be prohibited based on the ERS stackable platform and the underlying QoS hardware.

| Classifier Option | Description |
|---|---|
| addr-type <addrtype> | IP address type (IPv4/IPv6) classifier criteria |
| src-ip <src-ip-info> | Source IP address (or portion thereof) classifier criteria |
| dst-ip <dst-ip-info> | Destination IP address (or portion thereof) classifier criteria |
| ds-field <dscp> | DiffServ code point classifier criteria |
| protocol <protocoltype> | IPv4 protocol classifier criteria |
| next-header <headertype> | IPv6 next-header classifier criteria |
| src-port-min <port><br>src-port-max <port> | Minimum and maximum Layer 4 source port classifier criteria. Both values must be specified. |
| dst-port-min <port><br>dst-port-max <port> | Minimum and maximum Layer 4 destination port classifier criteria. Both values must be specified |
| flow-id <flowid> | IPv6 flow identifier classifier criteria |
| ip-flag <ip-flags> | IPv4 fragment flag classifier criteria |
| ipv4-options <no-opt \| with-opt> | IPv4 option status classifier criteria |
| tcp-control <tcp-flags> | TCP control flag classifier criteria – <Urg \| Ack \| Psh \| Rst \| Syn \| Fin> |
| src-mac <src-mac> | Source MAC address (or portion thereof) classifier criteria |
| src-mac-mask <src-mac-mask> | Source MAC address mask |
| dst-mac <dst-mac> | Destination MAC address (or portion thereof) classifier criteria |
| dst-mac-mask <dst-mac-mask> | Destination MAC address mask |
| pkt-type <etherII \| llc \| snap> | Layer 2 packet format classifier criteria |
| vlan-min <vid-min><br>vlan-max <vid-max> | Minimum and maximum (outer) VLAN ID classifier criteria. Both values must be specified |
| ivlan-min <vid-min><br>ivlan-max <vid-max> | Minimum and maximum inner VLAN ID classifier criteria. Both values must be specified |
| vlan-tag <vtag> | VLAN tag status classifier criteria |
| ethertype <etype> | EtherType value classifier criteria |
| priority <ieee1p-seq> | 802.1p user priority value classifier criteria |

**Table 3: Traffic-Profile Classifier Command Classifier Options**

Zero (i.e., leave traffic unchanged), one or more action options can be specified in a single filter set classifier element. Certain options may not be allowed if they are inappropriate for the traffic being targeted. For example, updating the DSCP value in a non-IP packet is not allowed for obvious reasons.

| Action Option | Description |
|---|---|
| drop-action <drop \| pass> | Drop or pass (do not drop) targeted traffic |
| update-dscp <0-63> | Update DSCP value in IP packets in targeted traffic |
| update-1p <0-7> | Update 802.1p user priority value in targeted traffic |
| set-drop-prec <high-drop \| low-drop> | Set the drop precedence value associated with targeted traffic. Potentially impacts egress queuing |

**Table 4: Traffic-Profile Classifier Command Action Operation**

Optional command variables that facilitate filter set element ordering and efficient resource utilization may be specified as well. The evaluation order value dictates the order in which filter set elements are applied, potentially impacting action selection. A unique evaluation order value is required when more than one element is included in the filter set. Multiple filter set elements may be combined into a block by labeling block members with the same block name. As previously noted, filter set elements must contain compatible classifier criteria (determined by the ERS stackable platform and underlying QoS hardware) to be members of the same block. A 16 character (maximum) block name string is supported.

| Element Option | Description |
|---|---|
| block <block-name> | Label used to identify block members in the context of the filter set |
| eval-order <1-255> | Element evaluation order in the context of the filter set |

**Table 5: Traffic-Profile Classifier Command Element Options**

Traffic-profile filter set classifier criteria can be deleted. The 'no qos traffic-profile classifier' CLI command is used for this purpose:

- Command: ***no qos traffic-profile classifier name [filterSetName] {elemData}***
  - name [filterSetName] – mandatory command variable that identifies the filter set being targeted by the deletion operation.
  - elemData – optional command variables that facilitate filter set element identification.

All of the classifier elements associated with a filter set may be deleted at once or individual filter set classifier elements may be deleted. All filter set classifier elements may be deleted by providing the target filter set name with no additional options. If the filter set is in-active (i.e., not currently applied to any ports in the system), all related classifier elements will be deleted. The operation is rejected if the filter set is currently active. The optional command variable 'eval-order' (Table 5) can be used to target an individual filter set classifier element for deletion. Note that empty filter sets are not supported meaning that the last classifier element in an active filter set cannot be deleted.

Once the classifier data has been defined, the traffic-profile filter set needs to be instantiated and applied to a port. Metering options and additional action options, applied to the filter set as a whole, can be specified as well. The 'qos traffic-profile set' CLI command is used for this purpose:

- Command: ***qos traffic-profile set port [port] name [filterSetName] {meterData} {actionData}***

- port [port] – mandatory command variable the identifies the port to which the filter set will be applied. A valid, QoS-enabled port must be provided.
- name [filterSetName] – mandatory command variable that associates the filter set with a label. Name labels are used to identify classifier elements belonging to the same traffic-profile filter set (i.e., members of a given filter set share the same name label). A 16 character (maximum) name string is supported.
- meterData – optional command variables used to specify metering criteria.
- actionData – optional command variables used to specify additional actions to be performed.

As previously discussed, the ability to meter traffic processed by a traffic-profile filter set is currently limited. Metering data may be defined for the filter set overall using the options presented in Table 6. When metering data is specified, a meter is associated with each classifier and unique classifier block. Each meter has the same characteristics (determined by the command options) and is independently evaluated (i.e., there is no relationship between meters associated with different filter set classifiers/blocks). Conforming (i.e., in-profile) traffic is processed based on the action criteria associated with the individual classifier or block member with the lowest evaluation order. Non-conforming (i.e., out-of-profile traffic) traffic is processed according to the out-of-profile action options.

| Meter Option | Description |
|---|---|
| committed-rate <64-10230000> Kbps | Committed rate metering criteria |
| committed-burst-size <burst-size-options> | Committed burst size metering criteria |
| max-burst-rate <64-4294967295> Kbps | Maximum burst rate metering criteria |
| max-burst-duration <1-4294967295> ms | Maximum burst duration metering criteria |
| drop-out-action <enable \| disable> | Drop (enable) or pass (disable) out-of-profile packets |
| update-dscp-out-action <0-63> | Update DSCP value in out-of-profile IP packets |

**Table 6: Traffic-Profile Set Command Metering Options**

Optional command variables can be used to initiate actions that are applied to the overall filter set. The ability to specify the statistics tracking mode is one such action. Statistics tracking is enabled by default for all traffic-profile filter sets using the ‘aggregate’ mode. Statistics may be tracked at a finer level of granularity (i.e., per classifier) using the ‘individual’ statistics tracking mode. Statistics tracking can be bypassed and no counter resources consumed using the ‘disable’ mode.

| Action Option | Description |
|---|---|
| track-statistics <disable \| aggregate \| individual> | Statistics tracking mode (default mode: aggregate) |

**Table 7: Traffic-Profile Set Command Action Options**

Active traffic-profile filter sets can be deleted based on name and/or the associated port. The ‘no qos traffic-profile set’ CLI command is used for this purpose:

- Command: ***no qos traffic-profile set [name [filterSetName] | port [port] name [filterSetName]]***

- name [filterSetName] – optional command variable that identifies the filter set being targeted for the deletion operation.
- port [port] - optional command variable that identifies the port being targeted for the filter set deletion operation. A filter set name must also be provided if a port value is specified.

Filter set deletion requires a filter set name be provided to identify the target filter set. A port value may be provided as well. If a port value is specified, the instance of the filter set associated with the port will be deleted. If only a filter set name is provided (i.e., no port value is specified), all instances of the filter set will be deleted regardless of port.

An active traffic-profile filter set may be modified. New classifier elements may be defined, pending determination of resource availability, and existing elements may be deleted. The aforementioned traffic-profile classifier commands (i.e., ***'[no] qos traffic-profile classifier*** […]') are used for this purpose. No other commands are required.

# 4.2 Displaying Traffic-Profile Filter Set Data

Traffic-profile filter set data can be displayed in a number of different ways. Traffic-profile filter set classifier elements can be displayed based on a filter set name or all defined classifier elements can be displayed:

- Command: ***show qos traffic-profile classifier {name [filterSetName]}***
  - name [filterSetName] – optional command variable that identifies the filter set being targeted for the display operation. Only classifier elements associated with the identified filter set will be displayed.

Active (i.e., in-use) filter set data can be displayed based on filter set name (i.e., display all instances of a filter set) or based on port and name data (i.e., display all instances of a filter set associated with the specified port):

- Command: ***show qos traffic-profile set name [filterSetName]***
  - name [filterSetName] – mandatory command variable that identifies the filter set being targeted for the display operation. All instances of the filter set will be displayed.
- Command: ***show qos traffic-profile set port [port] name [filterSetName]***
  - port [port] – mandatory command variable the identifies the port being targeted for the display operation.
  - name [filterSetName] – mandatory command variable that identifies the filter set being targeted for the display operation. All instances of the filter set associated with the specified port will be displayed.

An abbreviated display, presenting just the traffic-profile filter set to port associations, is available as well:

- Command: ***show qos traffic-profile interface***

Filter set statistics can be displayed on a per-port or on a per-port and precedence basis. The port-based display presents in-profile and out-of-profile (if metering is requested) counts for all precedence values consumed by the filter set instance. Providing a specific precedence target causes the individual counts associated with classifier elements installed with the identified precedence to be displayed. This can be used to display counts for classifier block members.

- Command: ***show qos traffic-profile statistics port [port] name [filterSetName] {precedence [prec]}***
  - port [port] – mandatory command variable the identifies the port being targeted for the display operation.

- name [filterSetName] – mandatory command variable that identifies the filter set being targeted for the display operation.
- precedence [prec] – optional command variable used to identify a specific precedence target for the display operation.

To assist with filter set installation and related potential issues, filter set diagnostic information can be displayed. Precedence mask, filter, meter and counter requirements can be displayed in-total and on a per-precedence basis. Interface capabilities that are required for successfully filter set installation are presented as well:

- Command: ***show qos traffic-profile diags name [filterSetName]***
  - name [filterSetName] – mandatory command variable that identifies the filter set being targeted for the display operation.

# 4.3 Traffic-Profile Filter Set Usage Example

To help fill in any blanks regarding the traffic-profile commands that have been covered, a usage example will now presented. Consider a scenario where there is a need to monitor, and perhaps prioritize, management traffic on the network. As a first step, management traffic needs to be identified (some command abbreviations used for brevity):

```
qos traffic-profile classifier name mgmtTraf protocol 17 dst-port-min 161 dst-port-
max 161 drop-action disable eval-order 10

qos traffic-profile classifier name mgmtTraf protocol 6 dst-port-min 80 dst-port-
max 80 drop-action disable eval-order 20

qos traffic-profile classifier name mgmtTraf protocol 6 dst-port-min 23 dst-port-
max 23 drop-action disable eval-order 21

qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.15/32 drop-action
disable eval-order 30

qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.47/32 drop-action
disable eval-order 31

qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.48/32 drop-action
disable eval-order 32

qos traffic-profile classifier name mgmtTraf protocol 1 drop-action disable eval-
order 40
```

Traffic-profile filter set “mgmtTraf” targets SNMP and HTTP PDUs, telnet traffic, ping (ICMP Echo) traffic and all communication from specific Network Management Systems (NMSs). Prior to filter set installation, switch resource usage is as follows:

```
5650TD(config)#show qos diag

Unit/Port                    Mask Precedence Usage
          16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ---------------------------------------------------------------
1/1         AR  DH                                  IS                Q   Q
1/2         AR  DH                                                    Q   Q

AR=ARP DH=DHCP Q=QoS IS=IPSG

                                        Non QoS Non QoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter   Filter Meter Cntr  RngChk
                 Used  Used  Used  Used    Used   Total  Total Total  Used
```

```
----------- ---- ------ ----- ---- ------- ------- ------ ----- ----- ------
1 /1 -24,49 16   0      0     0    25      25      256    128   128
            15   0      0     0    50      25      256    128   128
            14   0      0     0    0       0       256    128   128
            13   0      0     0    0       0       256    128   128
            12   0      0     0    0       0       256    128   128
            11   0      0     0    0       0       256    128   128
            10   0      0     0    0       0       256    128   128
            9    0      0     0    0       0       256    128   128
            8    0      0     0    0       0       256    128   128
            7    0      0     0    0       0       256    128   128
            6    0      0     0    1       0       256    128   128
```

For this example, switch port 1 has been designated by the system administrator as the preferred network management traffic port:

```
qos traffic-profile set port 1 name mgmtTraf
```

After filter set installation, switch resource usage reflects the resources consumed by “mgmtTraf” (7 precedence levels/masks and 7 filters/counters):

```
5650TD(config)#show qos diag

Unit/Port                       Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ---------------------------------------------------------------

1/1         AR  DH  Q   Q   Q   Q   Q   Q   Q       IS              Q   Q
1/2         AR  DH                                                  Q   Q

AR=ARP DH=DHCP Q=QoS IS=IPSG

                                      Non QoS Non QoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter   Filter Meter Cntr  RngChk
                 Used  Used  Used  Used    Used    Total  Total Total  Used
----------- ---- ------ ----- ---- ------- ------- ------ ----- ----- ------
1 /1 -24,49 16   0      0     0    25      25      256    128   128
            15   0      0     0    50      25      256    128   128
            14   1      0     1    0       0       256    128   128
            13   1      0     1    0       0       256    128   128
            12   1      0     1    0       0       256    128   128
            11   1      0     1    0       0       256    128   128
            10   1      0     1    0       0       256    128   128
            9    1      0     1    0       0       256    128   128
            8    1      0     1    0       0       256    128   128
            7    0      0     0    0       0       256    128   128
            6    0      0     0    1       0       256    128   128
```

Suppose the administrator decides that port 1 is to be used exclusively for network management traffic. All non-management traffic should be dropped. This is easily accomplished by adding a catch-all filter at the end of the filter set to match and drop all non-network management traffic. Note that the evaluation order dictates where in the filter set the new classifier element will be placed (i.e., last to be evaluated). All filter set classifier elements with an evaluation order lower than the “drop-all” filter need to ensure that the identified network management traffic is ‘passed’ (action: drop disable) so that the new classifier doesn’t accidentally impact the wrong flows:

```
qos traffic-profile classifier name mgmtTraf drop-action enable eval-order 100
```

A new NMS has been purchased and it requires access to the network:

```
qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.49/32 drop-action
disable eval-order 33
```

**// ERROR// % Traffic Prof filter set elem count exceeds available resources**

An issue was encountered while trying to add an element to the filter set. The error message indicates a resource availability issue. A check of the system resource usage levels exposes the issue:

```
5650TD(config)#show qos diag

Unit/Port                       Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ---------------------------------------------------------------

1/1         AR  DH  Q   Q   Q   Q   Q   Q   Q   Q   IS                  Q   Q
1/2         AR  DH                                                      Q   Q

AR=ARP DH=DHCP Q=QoS IS=IPSG

                                        Non QoS Non QoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter   Filter Meter Cntr  RngChk
                 Used  Used  Used  Used    Used    Total  Total Total  Used
----------- ---- ------ ----- ---- ------- ------- ------ ----- ----- ------
1 /1 -24,49 16   0      0     0    25      25      256    128   128
            15   0      0     0    50      25      256    128   128
            14   1      0     1    0       0       256    128   128
            13   1      0     1    0       0       256    128   128
            12   1      0     1    0       0       256    128   128
            11   1      0     1    0       0       256    128   128
            10   1      0     1    0       0       256    128   128
            9    1      0     1    0       0       256    128   128
            8    1      0     1    0       0       256    128   128
            7    1      0     1    0       0       256    128   128
            6    0      0     0    1       0       256    128   128
```

Adequate precedence mask resources are not available to support the filter set expansion. A maximum of 8 consecutive precedence levels can currently be consumed by the filter set on port 1. Traffic-profile filter set “mgmtTraf” already consumes 8 precedence levels. Filter set optimization is necessary. Several of the classifier elements can be combined into blocks to improve resource usage. First the elements being replaced are deleted. Next the elements are redefined with a ‘block’ component:

```
no qos traffic-profile classifier name mgmtTraf eval-order 20

no qos traffic-profile classifier name mgmtTraf eval-order 21

qos traffic-profile classifier name mgmtTraf protocol 6 dst-port-min 80 dst-port-
max 80 drop-action disable block tcp eval-order 20

qos traffic-profile classifier name mgmtTraf protocol 6 dst-port-min 23 dst-port-
max 23 drop-action disable block tcp eval-order 21

no qos traffic-profile classifier name mgmtTraf eval-order 30

no qos traffic-profile classifier name mgmtTraf eval-order 31

no qos traffic-profile classifier name mgmtTraf eval-order 32

qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.15/32 drop-action
disable block nmsCluster eval-order 30
```

```
qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.47/32 drop-action
disable block nmsCluster eval-order 31

qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.48/32 drop-action
disable block nmsCluster eval-order 32

qos traffic-profile classifier name mgmtTraf src-ip 10.30.31.49/32 drop-action
disable block nmsCluster eval-order 33
```

Post filter set optimization, the resource utilization level is much improved:

```
5650TD(config)#show qos diag

Unit/Port                       Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ---------------------------------------------------------------

1/1         AR  DH  Q   Q   Q   Q   Q               IS              Q   Q
1/2         AR  DH                                                  Q   Q

AR=ARP DH=DHCP Q=QoS IS=IPSG

                                                        Non QoS Non QoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter   Filter Meter Cntr  RngChk
                  Used  Used  Used  Used    Used   Total  Total Total  Used
----------- ---- ------ ----- ---- ------- ------- ------ ----- ----- ------
1 /1 -24,49 16   0      0     0    25      25      256    128   128
            15   0      0     0    50      25      256    128   128
            14   1      0     1    0       0       256    128   128
            13   2      0     1    0       0       256    128   128
            12   4      0     1    0       0       256    128   128
            11   1      0     1    0       0       256    128   128
            10   1      0     1    0       0       256    128   128
            9    0      0     0    0       0       256    128   128
            8    0      0     0    0       0       256    128   128
            7    0      0     0    0       0       256    128   128
            6    0      0     0    1       0       256    128   128
```

It may prove useful to pay closer attention to the NMS cluster and bandwidth consumption. Which NMS is generating the most traffic? Is too much bandwidth being consumed by the NMS cluster or by any of the other network management streams? Adding metering criteria and improving statistics tracking granularity should provide some answers:

```
no qos traffic-profile set port 1 name mgmtTraf

qos traffic-profile set port 1 name mgmtTraf committed-rate 64 committed-burst
16384 drop-action enable track-statistics individual
```

Meter usage and additional counter consumption is reflected in the resource usage data:

```
5650TD(config)#show qos diag

Unit/Port                       Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ---------------------------------------------------------------

1/1         AR  DH  Q   Q   Q   Q   Q               IS              Q   Q
1/2         AR  DH                                                  Q   Q
```

```
AR=ARP DH=DHCP Q=QoS IS=IPSG

                                                    Non QoS Non QoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter   Filter Meter Cntr  RngChk
                  Used  Used  Used  Used    Used    Total  Total Total  Used
----------- ---- ------ ----- ---- ------- ------- ------ ----- ----- ------
1 /1 -24,49 16   0      0     0    25      25      256    128   128
            15   0      0     0    50      25      256    128   128
            14   1      1     1    0       0       256    128   128
            13   2      1     2    0       0       256    128   128
            12   4      1     4    0       0       256    128   128
            11   1      1     1    0       0       256    128   128
            10   1      1     1    0       0       256    128   128
            9    0      0     0    0       0       256    128   128
            8    0      0     0    0       0       256    128   128
            7    0      0     0    0       0       256    128   128
            6    0      0     0    1       0       256    128   128
```

The administrator has decided to designate another port as a secondary network management traffic interface. The “mgmtTraf” filter set thus needs to be applied to this interface (e.g., port 2). Management traffic on this port should be given less priority however. Remark network management traffic that is inappropriately prioritized (i.e., remark traffic with DSCP values CS7, CS6, EF and CS5 to AF41) to an acceptable value:

```
qos traffic-profile classifier name dscpChk ds-field 56 update-dscp 34 block
dscpRemark eval-order 1

qos traffic-profile classifier name dscpChk ds-field 48 update-dscp 34 block
dscpRemark eval-order 2

qos traffic-profile classifier name dscpChk ds-field 46 update-dscp 34 block
dscpRemark eval-order 3

qos traffic-profile classifier name dscpChk ds-field 40 update-dscp 34 block
dscpRemark eval-order 4

qos traffic-profile set port 2 name dscpChk

qos traffic-profile set port 2 name mgmtTraf committed-rate 64 committed-burst
16384 drop-action enable track-statistics individual
```

Traffic-profile filter sets are now installed on port 1 (“mgmtTraf”) and port 2 (“dscpChk”, “mgmtTraf”). Filter set details, as well as the port associations, can be queried using the ‘**show qos traffic-profile**’ commands:

```
5650TD(config)#show qos traffic-profile interface

  Id  Unit Port Filter Set Name
_____ ____ ____ _________________
1     1    1    mgmtTraf
2     1    2    dscpChk
3     1    2    mgmtTraf


5650TD(config)#show qos traffic-profile set

Id: 1
Name: mgmtTraf
Unit/Port: 1/1
```

```
Commit Rate: 64 Kbps
Commit Burst: 16777216 Bytes
Out-Profile Drop Action: Drop
Out-Profile Remark DSCP Action: None
Non-Match Action: Defer
Storage Type: NonVolatile

Id: 2
Name: dscpChk
Unit/Port: 1/2
Non-Match Action: Defer
Storage Type: NonVolatile

Id: 3
Name: mgmtTraf
Unit/Port: 1/2
Commit Rate: 64 Kbps
Commit Burst: 16777216 Bytes
Out-Profile Drop Action: Drop
Out-Profile Remark DSCP Action: None
Non-Match Action: Defer
Storage Type: NonVolatile
```

The current filter set assignments are, of course, reflected in the resource usage data. Filter set "dscpChk" consumes 1 precedence mask (precedence 14 on port 2) and 4 filters/counters while each instance of filter set "mgmtTraf" consumes 5 precedence masks (precedence values 10 – 14 on port 1 and 9 – 13 on port 2), 5 meters and 9 filters/counters:

```
5650TD(config)#show qos diag

Unit/Port                       Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ---------------------------------------------------------------

1/1         AR  DH  Q   Q   Q   Q   Q                   IS                  Q   Q
1/2         AR  DH  Q   Q   Q   Q   Q   Q                                   Q   Q

AR=ARP DH=DHCP Q=QoS IS=IPSG

                                        Non QoS Non QoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter   Filter Meter Cntr  RngChk
                 Used  Used  Used  Used    Used    Total  Total Total  Used
----------- ---- ------ ----- ---- ------- ------- ------ ----- ----- ------
1 /1 -24,49 16   0      0     0    25      25      256    128   128
            15   0      0     0    50      25      256    128   128
            14   5      1     5    0       0       256    128   128
            13   3      2     3    0       0       256    128   128
            12   6      2     6    0       0       256    128   128
            11   5      2     5    0       0       256    128   128
            10   2      2     2    0       0       256    128   128
            9    1      1     1    0       0       256    128   128
            8    0      0     0    0       0       256    128   128
            7    0      0     0    0       0       256    128   128
            6    0      0     0    1       0       256    128   128
```

Traffic-profile filter set statistics confirm the presence of the targeted management traffic:

```
5650TD(config)#show qos traffic-profile statistics port 1 name mgmtTraf

Name: mgmtTraf
IfIndex: 1

   Mask           In-Profile               Out-Profile
Precedence          Packets                  Packets
            (Overflow)               (Overflow)
----------  ----------------------  ----------------------
14                       414                      0
13                       110                      0
12                       316                      0
11                       399                      0
10                       11                       0
```

Statistics for individual members of a classifier block may be displayed as well:

```
5650TD(config)#show qos traffic-profile statistics port 1/1 name mgmtTraf
precedence 12

Name: mgmtTraf
IfIndex: 1
Precedence: 12

Eval     In-Profile Packets       Out-Profile Packets
Order  (Overflow)               (Overflow)
-----  ----------------------  ----------------------
31                  219                      0
32                  29                       0
34                  68                       0
```

Only non-zero values are displayed for efficiency purposes.

## 4.4 Troubleshooting

Special consideration should be given to a few areas where issues are more commonly encountered during traffic-profile filter set construction and installation.

### 4.4.1 Resource Exhaustion

Filter set installation consumes precedence levels/masks and filter/meter/counter resources. There is a finite amount of these resources. Furthermore, these resources are shared by QoS and non-QoS applications and may also shared across ports in a cluster. For these reasons, resource exhaustion is one of the more common issues that are encountered. Troubleshooting resource exhaustion issues is generally straightforward. Error messages are generated when the requested resources are not available during filter set construction:

```
% Evaluation precedence conflict (Traffic Prof filter set data)
% Traffic Prof filter set rule count exceeds limit
% Traffic Prof filter set policy count exceeds limit
```

Resource-related error messages are generated during filter set installation as well:

```
% Traffic Prof filter set elem count exceeds available resources
% Traffic Prof filter set install operation failed
% Traffic Prof filter set update operation failed
```

Issues encountered during filter set construction are relatively easy to diagnose based on the provided error message. Filter set installation issues require a bit more effort to understand. The first step is always to perform an inventory of the filter set components to determine the precedence and filter/meter/counter resources that are needed. Next the resources available on the target port need to be considered. Are the required consecutive precedence levels available? Are there enough filter/meter/counter resources available to support an instance of the filter set? The '***show qos diag***' output can be used to answer these questions.

The different types of QoS hardware complicate resource issue diagnosis. With legacy ERS stackable platforms (ERS55XX), resources are allocated on a per-port basis. With the newer platforms (ERS4XXX/ERS56XX/ERS59XX/VSP7000), resources are allocated from a central pool that serves a collection of ports (referred to in this document as a "port cluster"). With a centralized resource scheme, resources consumed on one port can impact resource availability for all other ports in the same cluster. Once again, the '***show qos diag***' output can be consulted for cluster-wide resource utilization information.

### 4.4.2 Classifier Block Formation

As with resource issue diagnosis, different types of QoS hardware complicate classifier block formation. Classifier elements matching the exact same protocol fields or the exact same portions thereof (i.e., the fields are masked with the same bit-mask) are always block-compatible. On the ERS stackable platforms (i.e., ERS4XXX/56XX/59XX/VSP7000) these restrictions have been eased. Filter criteria matching the same protocol fields, regardless of the whether full or partial field matches are specified, can be combined into a block. Furthermore, classifier elements matching different but compatible fields (i.e., fields from a hardware-defined set of compatible fields) may also be combined into a block. This last class of potential block members, however, is sometimes difficult to determine.

The QoS hardware on the ERS stackable platforms (ERS4XXX/ERS56XX/ERS59XX/VSP7000) builds a 'key' which represents the classification criteria that is used to identify traffic. The same classification data can be represented several different ways (i.e., different keys can be built to match the same protocol fields). If the keys representing different classifiers are the same, the classifiers may be combined into a

block. If they aren't, they can't. If there is flexibility regarding which protocol fields can be matched to achieve the desired result, it may be beneficial to try different filter variations to see which, if any, can be combined into a block (particularly if resources are scarce). Following are some of the more common sets of fields that can be used by members of the same block:

- VLAN ID (outer), Inner VLAN ID
- Source IPv4 address, Destination IPv4 address, IP protocol, L4 source port (exact match), L4 destination port (exact match), DSCP, IP flags, TCP control flags
- Source IPv4 address, Destination IPv4 address, IP protocol, L4 source/destination range check, L4 source/destination port (exact match), DSCP, IP flags, TCP control flags
- Destination MAC address, Source MAC address, EtherType, VLAN ID (outer)
- Source MAC address, Source IPv4 address, EtherType, VLAN ID (outer)
- Destination MAC address, Destination IPv4 address, EtherType, VLAN ID (outer)

### 4.4.3 Interface Capabilities

Several different types of platforms can be combined into an ERS stack. Across the different platforms there are several variations of QoS hardware present. This translates into ports with different QoS capabilities. These differences, some of which have already been discussed, include:

- Classifier capabilities – certain protocol fields (e.g., IP flags, TCP control flags, inner VLAN ID) can only be matched on specific types of ports (deemed QoS Version 2 ports)
- Metering capabilities – supported rates, burst sizes and granularity differ across platforms/ports
- Range check support – true (random, not bit-mask constrained) range check support is not available on legacy platforms (deemed QoS Version 1 only ports)
- Classifier block flexibility – block member selection is more restrictive on legacy platforms
- Action support – IPv6 remarking is not supported on certain legacy platforms

When constructing a filter set, the target port capabilities should be kept in mind. Filter set content should be restricted to the lowest common denominator in terms of the capabilities supported by the target ports. Otherwise the filter set installation request will be rejected:

```
% Filter set requirements incompatible with target interface
```

Interface capabilities can be displayed with the 'show qos capability meter' and the 'show qos if-assign' commands.

# 5. QoS Egress Queue Shaping

You can use QoS Egress Queue Shaping to configure egress shaping on a port by port and queue by queue basis.

QoS shaper rate queue servicing on the Avaya ERS 4000, ERS 5600, ERS 5900, and VSP 7000 uses a weighted round robin algorithm to shape traffic. With egress queue shaping, you can specify the maximum and minimum egress shaping rates on an individual port and queue basis. You can configure shaping criteria for any or all egress queues associated with a switch port. The number of egress queues available for a port is determined by the QoS agent egress queue set value.

You can use queue shaping in conjunction with interface shaping.

Bandwidth allocation for queues is done according to Strict Priority and WRR algorithm. When shapers on queues with minimum rate are configured, the system first tries to assure minimum rate for all queues. Then the system uses the remaining bandwidth according to Strict Priority, WRR and shape maximum rate configured for each queue. In case the sum of shape minimum rates configured (queue shapers) exceeds the line rate, minimum shape rate will be assured for queue 1 and then remaining bandwidth will be distributed to the rest of the queues using WRR algorithm in order to assure the minimum rates for the rest of queues. For the same scenario ERS5600 switches may use strict priority, WRR and RR algorithms, depending on the active queue set.

## 5.1 Configuring QoS Interface Shaper

Use the following procedure to configure the interface shaping parameters for a set of ports.

To configure parameters, use the following command from Interface Configuration mode:

```
[no] qos if-shaper [name <WORD>] [shape-rate <64-10230000>] [burst-size <burst-size>] [max-burst-rate <64-4294967295>] [max-burst-duration <1-4294967295>]
```

Use the no form of this command to disable interface shaping for a set of ports.

| Action Option | Description |
|---|---|
| <WORD> | Specify name for if-shaper; maximum is 16 alphanumeric characters. |
| shape-rate <64-10230000> | Shaping rate in kilobits/sec; range is 64-10230000 kilobits/sec. |
| burst-size <burst-size> | Committeed burst size in Kilobytes. The value range is: 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384. |
| max-burst-rate <64-4294967295> | Maximum burst rate in kilobits/sec; range is 64-4294967295Kbits/sec. |
| max-burst-duration <1-4294967295> | Maximum burst duration in milliseconds; range is 1–4294967295 ms. |

## 5.2 Configuring QoS interface queue shaper

Use the following procedure to create an egress queue shaper for one or more interfaces.

To create an egress queue shaper, use the following command from the Interface Configuration mode:

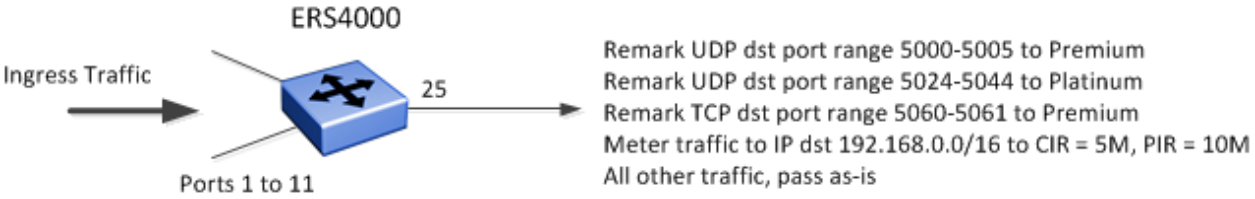
```
interface ethernet <port list or ALL>
qos if-queue-shaper [port <portlist>] [queue <1-8>] [name <WORD>] shape-rate
<0-10230000> shape-min-rate <0-10230000>
```

If you configure the shape rate to 0 for a specific queue or port, shaping is not performed on that queue or port.

| Action Option | Description |
|---|---|
| <WORD> | Specifies an alphanumeric label used to identify the QoS interface queue shaper. Value is a character string ranging from 1–16 characters in length. |
| port <portlist> | Specifies the port or list of ports for which to apply egress queue shaping. |
| queue <1-8> | Specifies the queue for the selected interface port or ports, on which traffic is shaped. The range of available values is determined by the OoS agent default queue configuration. |
| shape-min-rate <0-10230000> | Specifies the minimum QoS interface queue shaping rate, in kilobits per second (Kbps). Values range from 0 to10230000 Kbps. |
| shape-rate <0-10230000> | Specifies the QoS interface queue shaping rate, in kilobits per second (Kbps). Values range from 0 to10230000 Kbps. |

# 5.3 Configuration Examples using Meters and Shaper

## 5.3.1 ERS 4000 switch: UDP/TCP Port Range to remark traffic and dst-IP to Meter traffic




Assuming we wish to accomplish the following:

- Traffic with a destination UDP port range of 5000 to 5005, remark to Premium (DSCP = 46, p-bit = 6)
- Traffic with a destination UDP port range of 5024 to 5044, remark to Platinum (DSCP = 34, p-bit = 4)
- Traffic with a destination TCP port range of 5060 to 5061, remark to Premium (DSCP = 46, p-bit = 6)
- Traffic with a destination of 192.168.0.0/16, traffic metered to a maximum of 5 Mbps burstable to 10M Mbps for a period of 1 second
- All other traffic, pass as-is

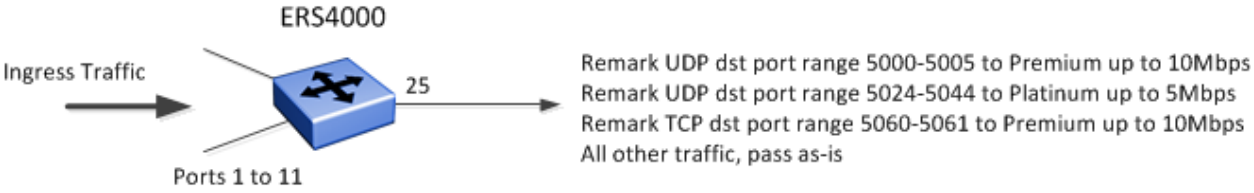
**1 Traffic classifier configuration using name of *one* and add the UDP range filter to a block also named *one* to save a precedence level**

```
qos traffic-profile classifier name one protocol 17 dst-port-min 5000 dst-port-max
5005 update-dscp 46 update-1p 6 block one eval-order 5

qos traffic-profile classifier name one protocol 17 dst-port-min 5024 dst-port-max
5044 update-dscp 34 update-1p 4 block one eval-order 6

qos traffic-profile classifier name one protocol 6 dst-port-min 5060 dst-port-max 5061
update-dscp 46 update-1p 6 eval-order 10

qos traffic-profile classifier name one  dst-ip 192.168.0.0/16 eval-order 20
committed-rate 5000 max-burst-rate 10000 max-burst-duration 1000 drop-out-action
enable
```

**2 Assign traffic classifier to ingress ports 1 to 11**

```
qos traffic-profile set port 1-11 name one meter-mode classifier
```

## 5.3.2 ERS 4000 switch: UDP/TCP Port Range using meter to remark traffic




Assuming we wish to accomplish the following:

- Traffic with a destination UDP port range of 5000 to 5005, remark to Premium up to 10 Mbps, then remark to Silver
- Traffic with a destination UDP port range of 5024 to 5044, remark to Platinum up to 5 Mbps, then remark to Bronze
- Traffic with a destination TCP port range of 5060 to 5061, remark to Premium up to 10 Mbps, then remark to Silver
- All other traffic, pass as-is

**1 Traffic classifier configuration using name of *one***

```
qos traffic-profile classifier name one protocol 17 dst-port-min 5000 dst-port-max
5005 update-dscp 46 update-1p 6 block one eval-order 5 committed-rate 10000 committed-
burst-size 4 drop-out-action disable update-dscp-out-action 16

qos traffic-profile classifier name one protocol 17 dst-port-min 5024 dst-port-max
5044 update-dscp 34 update-1p 4 block one eval-order 6 committed-rate 5000 committed-
burst-size 4 drop-out-action disable update-dscp-out-action 10

qos traffic-profile classifier name one protocol 6 dst-port-min 5060 dst-port-max 5061
update-dscp 46 update-1p 6  eval-order 20 committed-rate 10000 committed-burst-size 4
drop-out-action disable update-dscp-out-action 16
```

**2 Assign traffic classifier to ingress ports 1 to 11**

```
qos traffic-profile set port 1-11 name one meter-mode classifier
```

### 5.3.3 Port Shaper

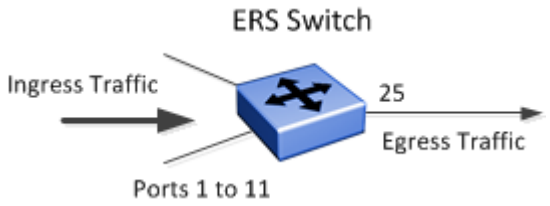
Assuming we wish to accomplish the following:

- Setup up a port shaper to 40 Mbps with a burst of 80 Mbps for 10 seconds on egress port 25

**1 Traffic classifier configuration using name of *one***

```
interface fastEthernet 25
qos if-shaper name 40M shape-rate 40000 max-burst-rate 80000 max-burst-duration 10000
exit
```

## 5.3.4 Per Queue Shaper




Assuming we wish to accomplish the following assuming we are using egress port 25:

- Setup queue set 4 where we wish to steer certain ingress traffic to a specific queue so that we can shape the traffic
  - Traffic with destination to 10.0.0.0/24, 10.0.1.0/24, and 10.0.2.0/24 remark with p-bit 5, DSCP 32
    - Force traffic to Queue 3 with shaper set to 10M via Traffic Profile that remarks p-bit to 5 and DSCP to 32
  - All other traffic remark with p-bit 0, DSCP 0
    - Force traffic to Queue 4 with shaper set to 5M via Traffic Profile that remark p-bit to 0
- Default mapping for queue set 4
  - Queue 3: p-bit 5, DSCP 32, 34, 36, 38
  - Queue 4: p-bit 0 to 4, DSCP 0, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28

The following commands can be used to view the queue set details.

```
4550T-10#show qos queue-set 4
Set Queue        General          Bandwidth Absolute  Bandwidth  Service  Size
ID   ID         Discipline          (%)    Bandwidth Allocation  Order  (Bytes)
                                    (Kbps)
___ _____ _____________________ _________ _________ __________ _______ _______
4   1     Priority Queuing      100       0         Relative   1       61440
4   2     Weighted Round Robin  65        0         Relative   2       50688
4   3     Weighted Round Robin  26        0         Relative   2       45056
4   4     Weighted Round Robin  9         0         Relative   2       39424
```

```
4550T-10#show qos queue-set-assignment
queue-set 4

Queue Set 4
802.1p Priority Queue

_______________ _____
0               4
1               4
2               4
3               4
4               4
5               3
6               1
```

```
4550T-10(config)#show qos egressmap
DSCP 802.1p Priority Drop Precedence New DSCP       Name
____ _______________ _______________ ________ _________________
0    0              High Drop       0        Standard Service
8    2              High Drop       8        Bronze Service
10   2              Low Drop        10       Bronze Service
16   3              High Drop       16       Silver Service
18   3              Low Drop        18       Silver Service
24   4              High Drop       24       Gold Service
26   4              Low Drop        26       Gold Service
32   5              High Drop       32       Platinum Service
34   5              Low Drop        34       Platinum Service
40   6              Low Drop        40       Premium Service
46   6              Low Drop        46       Premium Service
48   7              Low Drop        48       Network Service
56   7              Low Drop        56       Critical Service
```

## 1 Change default queue set from 2 to 4 and reboot switch

```
qos agent queue-set 4

QoS queue setting isn't effective until after reset.

boot

Reboot the unit(s) (y/n) ? y
```

## 2 Traffic classifier configuration using name of *remark* and add the dst-IP filters to a block named *one* to save a precedence level

```
interface FastEthernet ALL

qos if-queue-shaper port 25 queue 3 name 10M shape-rate 10000 shape-min-rate 10000

qos if-queue-shaper port 25 queue 4 name 5M shape-rate 5000 shape-min-rate 5000

exit

qos traffic-profile classifier name remark dst-ip 10.0.0.0/24 update-dscp 32 update-1p
5 block one eval-order 5

qos traffic-profile classifier name remark dst-ip 10.0.1.0/24 update-dscp 32 update-1p
5 block one eval-order 6

qos traffic-profile classifier name remark dst-ip 10.0.2.0/24 update-dscp 32 update-1p
5 block one eval-order 7

qos traffic-profile classifier name remark update-1p 0 eval-order 250
```

## 3 Assign traffic classifier to ingress ports 1 to 11

```
qos traffic-profile set port 1-11 name remark qos
```

# 6. Appendix

## 6.1 Command Output: ‘show qos traffic-profile classifier’

The following represents the output from the ‘show qos traffic-profile classifier’ command for the example filter set “***mgmtTraf***”:

```
5650TD(config)#show qos traffic-profile classifier

Id: 1
Name: mgmtTraf
Block:
Eval Order: 10
Address Type: IPv4
Destination Addr/Mask: Ignore
Source Addr/Mask: Ignore
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: UDP
Destination L4 Port Min: 161
Destination L4 Port Max: 161
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile

Id: 2
Name: mgmtTraf
Block: tcp
Eval Order: 20
Address Type: IPv4
Destination Addr/Mask: Ignore
Source Addr/Mask: Ignore
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: TCP
Destination L4 Port Min: 80
Destination L4 Port Max: 80
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
```

```
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile

Id: 3
Name: mgmtTraf
Block: tcp
Eval Order: 21
Address Type: IPv4
Destination Addr/Mask: Ignore
Source Addr/Mask: Ignore
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: TCP
Destination L4 Port Min: 23
Destination L4 Port Max: 23
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile

Id: 4
Name: mgmtTraf
Block: nmsCluster
Eval Order: 30
Address Type: IPv4
Destination Addr/Mask: Ignore
Source Addr/Mask: 10.30.31.15/32
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: Ignore
Destination L4 Port Min: Ignore
```

```
Destination L4 Port Max: Ignore
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile

Id: 5
Name: mgmtTraf
Block: nmsCluster
Eval Order: 31
Address Type: IPv4
Destination Addr/Mask: Ignore
Source Addr/Mask: 10.30.31.47/32
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: Ignore
Destination L4 Port Min: Ignore
Destination L4 Port Max: Ignore
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile

Id: 6
Name: mgmtTraf
Block: nmsCluster
Eval Order: 32
Address Type: IPv4
```

```
Destination Addr/Mask: Ignore
Source Addr/Mask: 10.30.31.48/32
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: Ignore
Destination L4 Port Min: Ignore
Destination L4 Port Max: Ignore
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile

Id: 7
Name: mgmtTraf
Block:
Eval Order: 40
Address Type: IPv4
Destination Addr/Mask: Ignore
Source Addr/Mask: Ignore
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: ICMP
Destination L4 Port Min: Ignore
Destination L4 Port Max: Ignore
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile
```

```
Id: 8
Name: mgmtTraf
Block:
Eval Order: 100
Address Type: Ignore
Destination Addr/Mask: Ignore
Source Addr/Mask: Ignore
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: Ignore
Destination L4 Port Min: Ignore
Destination L4 Port Max: Ignore
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: Ignore
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: Yes
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile

Id: 9
Name: mgmtTraf
Block: nmsCluster
Eval Order: 33
Address Type: IPv4
Destination Addr/Mask: Ignore
Source Addr/Mask: 10.30.31.49/32
DSCP: Ignore
IPv4 Protocol / IPv6 Next Header: Ignore
Destination L4 Port Min: Ignore
Destination L4 Port Max: Ignore
Source L4 Port Min: Ignore
Source L4 Port Max: Ignore
IPv6 Flow Id: Ignore
IP Flags: Ignore
TCP Control Flags: Ignore
IPv4 Options: Ignore
Destination MAC Addr: Ignore
Destination MAC Mask: Ignore
Source MAC Addr: Ignore
Source MAC Mask: Ignore
VLAN: Ignore
VLAN Tag: Ignore
EtherType: 0x0800
802.1p Priority: All
Packet Type: Ignore
Inner VLAN: Ignore
Action Drop: No
```

```
Action Update DSCP: Ignore
Action Update 802.1p Priority: Priority 8
Action Set Drop Precedence: Low Drop
Storage Type: NonVolatile
```

## 6.2 Legacy CLI Command Comparison

For those familiar with QoS configuration using the legacy CLI commands, it may be a useful exercise to compare configuration command sequences using legacy commands and the new traffic-profile filter set support. Revisiting an earlier example, suppose an administrator wishes to remark traffic that is inappropriately prioritized (i.e., remark traffic with the highest priority DSCP values CS7 and CS6 to AF41) on a specific VLAN. Using the traffic-profile filter set support, the following commands are required:

```
qos traffic classifier name dscpChk ds-field 56 vlan-min 5 vlan-max 5 update-dscp
34 block dsRem eval-order 1

qos traffic classifier name dscpChk ds-field 48 vlan-min 5 vlan-max 5 update-dscp
34 block dsRem eval-order 2

qos traffic set port 8 name dscpChk committed-rate 64 committed-burst 16384 drop
enable track-statistics individual
```

Using the legacy QoS CLI commands, a more expansive list of commands must be executed to initiate the same traffic treatment:

```
qos ip-element 1 ds-field 56

qos ip-element 2 ds-field 48

qos l2-element 1 vlan-min 5 vlan-max 5 ethertype 0x0800

qos classifier 1 set-id 1 element-type ip element-id 1

qos classifier 2 set-id 1 element-type l2 element-id 1

qos classifier 3 set-id 2 element-type ip element-id 2

qos classifier 4 set-id 2 element-type l2 element-id 1

qos classifier-block 1 block-number 1 set-id 1

qos classifier-block 2 block-number 1 set-id 2

qos action 10 update-dscp 34

qos meter 1 committed-rate 64 burst-size 16384 in-profile-action 10 out-profile-
action 1

qos policy 1 port 8 clfr-type block clfr-id 1 meter 1 precedence 14 track-
statistics individual
```

# 7. Default QoS Settings

## 7.1 Default Settings: ERS 4000

***Default Settings prior to release 5.8***

- Precedence level 1, 2, 7, and 8 are used by default
    - Precedence levels 1 and 2 are used by default untrusted if-group (allQoSPolicyIfcs)
        - Can be cleared up if ports are re-assigned to QoS class of either trusted or unrestricted
    - Precedence level 7 is used by DHCP Relay
        - Can be cleared up if IP DHCP Relay is disabled – on by default
    - Precedence level 8 is used by ARP
    - Certain features if enabled can take up one or more precedence levels
        - Please see Appendix for list of precedence levels used by various features
- 128 maximum filters are available per BCM chip where each BCM chip contains 24-26 ports
    - For example, 8 ports with 16 filters would consume all 128 filters via one BCM
- Default Queue set is 2 with buffering set to large

***Default Settings release 5.8 or higher – only ERS4800 series, ERS 4500 is not supported***

- Precedence level 1, 2, 14, 15 and 16 are used by default
    - Precedence levels 1 and 2 are used by default untrusted if-group (allQoSPolicyIfcs)
        - Can be cleared up if ports are re-assigned to QoS class of either trusted or unrestricted
    - Precedence level 14 is used by DHCP Relay
        - Can be cleared up if IP DHCP Relay is disabled – on by default
    - Precedence levels 15 and 16 are permanently occupied
        - Precedence level 15 is used by SPB
        - Precedence level 16 is used by ARP
    - Certain features if enabled can take up one or more precedence levels
        - Please see Appendix for list of precedence levels used by various features
    - For the ERS 4850
        - Up to 512 classifiers for each mask precedence
        - Up to 256 meters for each mask precedence for each ASIC
        - Up to 256 counters for each mask precedence for each ASIC
    - For the ERS 4826
        - Up to 256 classifiers for each mask precedence
        - Up to 128 meters for each mask precedence for each ASIC
        - Up to 128 counters for each mask precedence for each ASIC

- Default Queue set is 2 with buffering set to large

The following table describes the ports supported by each ASIC for each ERS 4000 model:

| Model | ASIC Device 1 | ASIC Device 2 |
|---|---|---|
| 4526FX | Port 1 - 26 | |
| 4550T | Port 1 - 24 | Port 25 – 50 |
| 4550T-PWR | Port 1 - 24 | Port 25 – 50 |
| 4548GT | Port 1 - 24 | Port 25 – 48 |
| 4548GT-PWR | Port 1 - 24 | Port 25 – 48 |
| 4526T | Port 1 – 26 | |
| 4526T-PWR | Port 1 – 26 | |
| 4526GT | Port 1 – 24 | |
| 4526GT-PWR | Port 1 – 24 | |
| 4526GT-PWR | Port 1 – 24 | |
| 4526GTX | Port 1 – 26 | |
| 4526GTX-PWR | Port 1 – 26 | |
| 4526T-PWR+ | Port 1 – 26 | |
| 4550T-PWR+ | Port 1 – 24 | Port 25-50 |
| 4826GTS | Port 1 – 26 | |
| 4826GTS-PWR+ | Port 1 – 26 | |
| 4850GTS | Port 1 – 50 | |
| 4850GTS-PWR+ | Port 1 - 50 | |

***Verification***

## 1 Verify QoS queue set and buffer:

```
4850GTS-PWR+#show qos agent
QoS Operational Mode: Enabled
QoS NVRam Commit Delay: 10 seconds
QoS Current Queue Set: 2
QoS Next Boot Queue Set: 2
QoS Current Buffering: Large
QoS Next Boot Buffering: Large
QoS UBP Support Level: Disabled
QoS Default Statistics Tracking: Aggregate
Auto QoS Mode: Disabled
```

## 2 Verify QoS interface group and assignments

```
4850GTS-PWR+#show qos if-group
       Role             Interface       Capabilities     Statistics   Storage
    Combination           Class                            Tracking     Type
_____________________ _______________ _____________________ __________ ___________
allQoSPolicyIfcs     Untrusted      Input 802, Input IP Aggregate  ReadOnly
$qosDisabledIfcs     Unrestricted   Input 802, Input IP Disabled   Other

4850GTS-PWR+#show qos if-assign
Unit Port IfIndex Role Combination Queue Set Capability
____ ____ _______ __________________ _________ ___________
1    1    1       allQoSPolicyIfcs 2         Version 1,2
1    2    2       allQoSPolicyIfcs 2         Version 1,2
|
|
1    49   49      allQoSPolicyIfcs 2         Version 1,2
1    50   50      allQoSPolicyIfcs 2         Version 1,2
```

## 3 Verify QoS precedence levels and filters / meters used

```
4850GTS-PWR+#show qos diag
Unit/Port                       Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ------------------------------------------------------------------
1/1         AR  SB  DH                                                  Q   Q
1/2         AR  SB  DH                                                  Q   Q
1/3         AR  SB  DH                                                  Q   Q
|
|
1/49        AR  SB  DH                                                  Q   Q
1/50        AR  SB  DH                                                  Q   Q

AR=ARP DH=DHCP EA=EAP Q=QoS SB=SPB

                                      NonQoS NonQoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter Filter Meter Cntr  RngChk
                 Used  Used  Used  Used   Used  Total  Total Total  Used
----------- ---- ------ ----- ---- ------ ------ ------ ----- ----- ------
1 /1 -50    16   0      0     0    51     51     512    256   256
            15   0      0     0    50     0      512    256   256
            14   0      0     0    200    50     512    256   256
            13   0      0     0    1      0      512    256   256
            12   0      0     0    0      0      512    256   256
            11   0      0     0    0      0      512    256   256
            10   0      0     0    0      0      512    256   256
            9    0      0     0    0      0      512    256   256
            8    0      0     0    0      0      512    256   256
            7    0      0     0    0      0      512    256   256
            6    0      0     0    0      0      512    256   256
            5    0      0     0    0      0      512    256   256
            4    0      0     0    0      0      512    256   256
            3    0      0     0    0      0      512    256   256
            2    50     0     50   0      0      512    256   256
            1    50     0     50   0      0      512    256   256
                                                                0 /32
```

# 7.2 Default Settings: ERS 5000

***Default Settings***

- Precedence level 1, 2, 15, and 16 are used by default
    - Precedence levels 1 and 2 are used by default untrusted if-group (allQoSPolicyIfcs)
        - Can be cleared up if ports are re-assigned to QoS class of either trusted or unrestricted
    - Precedence level 15 is used by DHCP Relay
        - Can be cleared up if IP DHCP Relay is disabled – on by default
    - Certain features if enabled can take up one or more precedence levels
        - Please see Appendix for list of precedence levels used by various features
- Up to 256 filter components per precedence per hardware device group
- Up to 128 meters per precedence per hardware device group
- Up to 128 counters per precedence per hardware device group
- Up to 16 TCP/UDP port range checkers per hardware device group
- Default Queue set is 2 with buffering set to large

When using an ERS 5500 series, it has the following limiations:

- You can configure up to 15 policies per interface (port).
- You can configure up to 63 meters per interface (port).
- You can configure up to 125 filter components per interface (port).
- When you enable tracking statistics for the policies, the switch uses one counter for each classifier for each interface (port) of the policy or a counter for each policy. You can assign up to 32 counters to an interface (port).

***Verification***

**1 Verify QoS queue set and buffer:**

```
5698-1#show qos agent
QoS Operational Mode: Enabled
QoS NVRam Commit Delay: 10 seconds
QoS Queue Set: 2
QoS Buffering: Large
QoS UBP Support Level: Disabled
QoS Default Statistics Tracking: Aggregate
QoS DoS Attack Prevention: Disabled
    Minimum TCP Header Length: 20
    Maximum IPv4 ICMP Length: 512
    Maximum IPv6 ICMP Length: 512
Auto QoS Mode: Disabled
```

```
QoS Trusted Processing Mode: Partial
```

## 2 Verify QoS interface group and assignments

```
5698-1#show qos if-group
       Role            Interface      Capabilities     Statistics   Storage
    Combination          Class                          Tracking     Type
____________________ _____________ ____________________ __________ __________
allQoSPolicyIfcs     Untrusted     Input 802, Input IP Aggregate  ReadOnly
$qosDisabledIfcs     Unrestricted  Input 802, Input IP Disabled   Other
$NsnaIfcs            Unrestricted  Input 802, Input IP Disabled   Other

5698-1#show qos if-assign
Unit Port IfIndex Role Combination Queue Set Capability  DAPP Support
____ ____ _______ ________________ _________ ___________ ___________
1    1    1       allQoSPolicyIfcs 42        Version 1,2 Yes
1    2    2       allQoSPolicyIfcs 42        Version 1,2 Yes
|
|
1    97   97      allQoSPolicyIfcs 50        Version 1,2 Yes
1    98   98      allQoSPolicyIfcs 50        Version 1,2 Yes
```

## 3 Verify QoS precedence levels and filters / meters used

```
5698-1# show qos diag


Unit/Port                       Mask Precedence Usage
            16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ------------------------------------------------------------------
1/1          AR  DH                                                     Q   Q
1/2          AR  DH                                                     Q   Q
|
|
1/97         AR  DH                                                     Q   Q
1/98         AR  DH                                                     Q   Q

AR=ARP DH=DHCP AD=ADAC Q=QoS

                                        Non QoS Non QoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter   Filter Meter Cntr  RngChk
                 Used  Used  Used  Used    Used    Total  Total Total  Used
----------- ---- ------ ----- ---- ------- ------- ------ ----- ----- ------
1 /1 -24,97 16   0      0     0    25      25      256    128   128
            15   0      0     0    50      25      256    128   128
            14   0      0     0    75      0       256    128   128
            13   0      0     0    1       0       256    128   128
            12   0      0     0    0       0       256    128   128
            11   0      0     0    0       0       256    128   128
            10   0      0     0    0       0       256    128   128
            9    0      0     0    0       0       256    128   128
            8    0      0     0    0       0       256    128   128
            7    0      0     0    0       0       256    128   128
            6    0      0     0    0       0       256    128   128
            5    0      0     0    0       0       256    128   128
            4    0      0     0    0       0       256    128   128
            3    0      0     0    0       0       256    128   128
            2    25     0     25   0       0       256    128   128
            1    25     0     25   0       0       256    128   128
                                                                   0
1 /25-48,98 16   0      0     0    25      25      256    128   128
```

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 15 | 0 | 0 | 0 | 50 | 25 | 256 | 128 | 128 |
| | 14 | 0 | 0 | 0 | 75 | 0 | 256 | 128 | 128 |
| | 13 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 12 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 11 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 10 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 9 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 8 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 7 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 6 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 5 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 2 | 25 | 0 | 25 | 0 | 0 | 256 | 128 | 128 |
| | 1 | 25 | 0 | 25 | 0 | 0 | 256 | 128 | 128 |
| | | | | | | | | | 0 |
| 1 /49-72 | 16 | 0 | 0 | 0 | 24 | 24 | 256 | 128 | 128 |
| | 15 | 0 | 0 | 0 | 48 | 24 | 256 | 128 | 128 |
| | 14 | 0 | 0 | 0 | 72 | 0 | 256 | 128 | 128 |
| | 13 | 1 | 0 | 1 | 0 | 0 | 256 | 128 | 128 |
| | 12 | 1 | 0 | 1 | 0 | 0 | 256 | 128 | 128 |
| | 11 | 1 | 0 | 1 | 0 | 0 | 256 | 128 | 128 |
| | 10 | 1 | 0 | 1 | 0 | 0 | 256 | 128 | 128 |
| | 9 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 8 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 7 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 6 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 5 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 2 | 24 | 0 | 24 | 0 | 0 | 256 | 128 | 128 |
| | 1 | 24 | 0 | 24 | 0 | 0 | 256 | 128 | 128 |
| | | | | | | | | | 0 |
| 1 /73-96 | 16 | 0 | 0 | 0 | 24 | 24 | 256 | 128 | 128 |
| | 15 | 0 | 0 | 0 | 48 | 24 | 256 | 128 | 128 |
| | 14 | 0 | 0 | 0 | 72 | 0 | 256 | 128 | 128 |
| | 13 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 12 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |
| | 11 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 9 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 8 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 7 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 6 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 5 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 4 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 3 | 0 | 0 | 0 | 0 | 0 | 256 | 128 | 128 | |
| 2 | 24 | 0 | 24 | 0 | 0 | 256 | 128 | 128 | |
| 1 | 24 | 0 | 24 | 0 | 0 | 256 | 128 | 128 | |
| | | | | | | | | | 0 |

# 7.3 Default Settings: ERS 5900

***Default Settings***

- Precedence level 1, 2, 14, 15 and 16 are used by default
    - Precedence levels 1 and 2 are used by default untrusted if-group (allQoSPolicyIfcs)
        - Can be cleared up if ports are re-assigned to QoS class of either trusted or unrestricted
    - Precedence level 14 is used by DHCP Relay
        - Can be cleared up if IP DHCP Relay is disabled – on by default
    - Precedence levels 15 and 16 are permanently occupied
        - Precedence level 15 is used by SPB
        - Precedence level 16 is used by ARP
    - Certain features if enabled can take up one or more precedence levels
        - Please see Appendix for list of precedence levels used by various features
    - Up to 256 classifiers for each precedence for each ASIC
    - Up to 256 meters for each precedence for each ASIC, usable on a maximum of 8 out of the 16 available precedences
    - Up to 128 counters for each precedence for each ASIC
    - Up to 256 counters for each mask precedence for each ASIC
- Default Queue set is 2 with buffering set to large

| Model | ASIC Device 1 |
|---|---|
| 5928GTS | Port 1–28 |
| 5928GTS-PWR+ | Port 1–28 |
| 5952GTS | Port 1–52 |
| 5952GTS-PWR+ | Port 1–52 |

***Verification***

## 1 Verify QoS queue set and buffer:

```
5928GTS-PWR+#show qos agent
QoS Operational Mode: Enabled
QoS NVRam Commit Delay: 10 seconds
QoS Current Queue Set: 2
QoS Next Boot Queue Set: 2
QoS Current Buffering: Large
QoS Next Boot Buffering: Large
QoS UBP Support Level: Disabled
QoS Default Statistics Tracking: Aggregate
QoS DoS Attack Prevention: Disabled
    Minimum TCP Header Length: 20
    Maximum IPv4 ICMP Length: 512
    Maximum IPv6 ICMP Length: 512
Auto QoS Mode: Disabled
```

## 2 Verify QoS interface group and assignments

```
5928GTS-PWR+#show qos if-group
       Role             Interface       Capabilities     Statistics   Storage
    Combination           Class                            Tracking     Type

____________________ _____________ ____________________ __________ ___________
allQoSPolicyIfcs     Untrusted      Input 802, Input IP Aggregate  ReadOnly
$qosDisabledIfcs     Unrestricted   Input 802, Input IP Disabled   Other

5928GTS-PWR+#show qos if-assign
Unit Port IfIndex Role Combination Queue Set Capability  DAPP Support

____ ____ _______ _________________ _________ ___________ ___________
1    1    1       allQoSPolicyIfcs 2         Version 1,2 Yes
1    2    2       allQoSPolicyIfcs 2         Version 1,2 Yes
|
|
1    27   27      allQoSPolicyIfcs 2         Version 1,2 Yes
1    28   28      allQoSPolicyIfcs 2         Version 1,2 Yes
```

## 3 Verify QoS precedence levels and filters / meters used

```
5928GTS-PWR+#show qos diag
Unit/Port                       Mask Precedence Usage
           16  15  14  13  12  11  10   9   8   7   6   5   4   3   2   1
--------- ------------------------------------------------------------------
1/1         AR  SB  DH                                                  Q   Q
1/2         AR  SB  DH                                                  Q   Q
1/3         AR  SB  DH                                                  Q   Q
|
|
1/27        AR  SB  DH                                                  Q   Q
1/28        AR  SB  DH                                                  Q   Q

AR=ARP DH=DHCP EA=EAP Q=QoS SB=SPB

                                      NonQoS NonQoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter Filter Meter Cntr  RngChk
                 Used  Used  Used  Used   Used  Total  Total Total  Used
----------- ---- ------ ----- ---- ------ ------ ------ ----- ----- ------
1 /1 -28    16   0      0     0    29     29     256    256   128
            15   0      0     0    28     0      256    256   128
            14   0      0     0    112    28     256    256   128
            13   0      0     0    3      0      256    256   128
            12   0      0     0    0      0      256    256   128
            11   0      0     0    0      0      256    256   128
            10   0      0     0    0      0      256    256   128
            9    0      0     0    0      0      256    256   128
            8    0      0     0    0      0      256    256   128
            7    0      0     0    0      0      256    256   128
            6    0      0     0    0      0      256    256   128
            5    0      0     0    0      0      256    256   128
            4    0      0     0    0      0      256    256   128
            3    0      0     0    0      0      256    256   128
            2    28     0     28   0      0      256    256   128
            1    28     0     28   0      0      256    256   128
                                                                0 /32
```

# 7.4 Default Settings: VSP 7000

***Default Settings***

- The VSP 7000 supports 10 precedences used by QoS and non-QoS
  - Precedence levels 1 to 7 are not used by default
  - Precedence level 8 is used by DHCP Relay
    - Can be cleared up if IP DHCP Relay is disabled – on by default
  - Precedence levels 9 and 10 are permanently occupied
    - Precedence level 9 is used by SPB
    - Precedence level 10 is used by ARP
  - Certain features if enabled can take up one or more precedence levels
    - Please see Appendix for list of precedence levels used by various features
  - Up to 128 filter components for precedences 1–4 and 256 filter components for precedences 5–10
  - Up to 128 meters per precedence per hardware device group, usable on a maximum of 8 out of the 10 available precedences
  - Up to 64 counters for precedences 1–4 and 128 counters for precedences 5–10.
  - Up to 32 TCP/UDP port range checkers
- Default Queue set is 2 with buffering set to large

***Verification***

**1 Verify QoS queue set and buffer:**

```
7024XLS#show qos agent
QoS Operational Mode: Enabled
QoS NVRam Commit Delay: 10 seconds
QoS Current Queue Set: 2
QoS Next Boot Queue Set: 2
QoS Current Buffering: Large
QoS Next Boot Buffering: Large
QoS Default Statistics Tracking: Aggregate
```

**2 Verify QoS interface group and assignments**

```
7024XLS#show qos if-group
       Role            Interface       Capabilities     Statistics   Storage
    Combination          Class                            Tracking     Type
____________________ _____________ ____________________ __________ ___________
allQoSPolicyIfcs     Trusted       Input 802, Input IP Aggregate  ReadOnly
$qosDisabledIfcs     Unrestricted  Input 802, Input IP Disabled   Other
```

```
7024XLS#show qos if-assign
Unit Port IfIndex Role Combination Queue Set Capability
____ ____ _______ _________________ _________ ___________
1    1    1       allQoSPolicyIfcs 2         Version 1,2
1    2    2       allQoSPolicyIfcs 2         Version 1,2
|
|
1    31   31      allQoSPolicyIfcs 2         Version 1,2
1    32   32      allQoSPolicyIfcs 2         Version 1,2
```

## 3 Verify QoS precedence levels and filters / meters used

```
7024XLS#show qos diag
Unit/Port            Mask Precedence Usage
           10   9   8   7   6   5   4   3   2   1
--------- ----------------------------------------
1/1          AR  SB  DH
1/2          AR  SB  DH
|
|
1/31         AR  SB  DH
1/32         AR  SB  DH
AR=ARP DH=DHCP SB=SPB

                                    NonQoS NonQoS
 Unit/Port  Prec Filter Meter Cntr Filter  Meter Filter Meter Cntr  RngChk
                 Used  Used  Used  Used   Used  Total  Total Total  Used
----------- ---- ------ ----- ---- ------ ------ ------ ----- ----- ------
1 /1 -32    10   0      0     0    32     32     256    256   128
            9    0      0     0    32     0      256    256   128
            8    0      0     0    128    32     256    256   128
            7    0      0     0    0      0      256    256   128
            6    0      0     0    0      0      256    256   128
            5    0      0     0    0      0      256    256   128
            4    0      0     0    0      0      128    256   64
            3    0      0     0    0      0      128    256   64
            2    0      0     0    0      0      128    256   64
            1    0      0     0    0      0      128    256   64
                                                                0 /32
```

## 7.5 QoS Precedence Levels – Masks used by various applications

| Masks | Rules | Application | Code |
|---|---|---|---|
| 1 | 1 | Broadcast ARP / ARP Inspection | AR |
| 2 | 2 | QoS (default untrusted policy) | Q |
| 2 | 10 | IGMP | na |
| 1 | 2 | Port Mirroring | PM |
| 1 | 2 | DHCP Replay / DHCP Snooping / NSNA DHCP | DH |
| 1 | 32 | BaySecure (port) | na |
| 1 | 10 | BaySecure (MAC-DA) | BS |
| 1 | 32 | EAP MHMA Allowed Cients | EA |
| 1 | 1 | IPFIX | IF |
| 1 | 32 | NSNA MAC | NS |
| 5 | 8 | NSNA (R/Y/G filters) | Q |
| 1 | 1 | ADAC | AD |
| 1 | 1 | RIP | RI |
| 1 | 1 | UDP Bcast | UB |
| 1 | 3 | VRRP | DR |
| 1 | 3 | OSPF | DR |
| 1 | 10 | IP Source Guard | IS |
| 1 | 3 | PIM | DR |
| 1 | 1 | PIM | PI |
| 3 | 1 | Content-based Forwarding | CF |

# 8. Cisco to Avaya Comparison

This section compares various Cisco IOS ACL commands into their Avaya equivalents.

| Config Task Description | Cisco IOS | Avaya ACLI |
|---|---|---|
| Deny src-ip 192.168.1.0/24<br>Allow everyone else | access-list <1> deny <192.168.1.0> <0.0.0.255><br>access-list <1> permit any | qos traffic-profile classifier name <one> src-ip <192.168.1.0/24> drop-action <enable> block <one> |
| Apply ACLs to interfaces | interface range <gi1/0/1 - 20><br>ip access-group <1> in<br>exit | qos traffic-profile set port <1-20> name <one><br>show qos traffic-profile set |
| Permit SMTP connection from any host to mail server | access-list <100> permit tcp any host <10.1.1.1> eq smtp | qos traffic-profile classifier name <one> dst-ip <10.1.1.1/32> protocol <6> dst-port-min <25> dst-port-max <25> block <one> |
| Permit TCP connections to port range between 1024 and 2024 to subnet 10.1.1.0/24 | access-list <100> permit tcp any <10.1.1.0> <0.0.0.255> range <1024> <2024> | qos traffic-profile classifier name <one> src-ip 10.1.1.1/32> protocol <6> src-port-min <1024> src-port-max <2048> block <one> |
| Permit UDP connections to port range between 1024 and 2024 to subnet 10.1.1.0/24 | access-list <100> permit udp any <10.1.1.0> <0.0.0.255> range <1024> <2024> | qos traffic-profile classifier name <one> src-ip 10.1.1.1/32> protocol <17> src-port-min <1024> src-port-max <2048> block <one> |
| Bootps | 10 permit udp any any eq bootps | qos traffic-profile classifier name <one> addr-type <ipv4> protocol <17> dst-port-min <67> dst-port-max <67> block one |
| Bootpc | 20 permit udp any any eq bootpc | qos traffic-profile classifier name <one> addr-type <ipv4> protocol <17> dst-port-min <68> dst-port-max <68> block one |
| IP Range | 30 deny ip 10.57.240.0 0.0.1.255 host 128.1.0.1 | qos traffic-profile classifier name <one> src-ip <10.57.240.0/24> dst-ip <128.1.0.2/32> drop-action enable block <one><br>qos traffic-profile classifier name <one> src-ip <10.57.241.0/24> dst-ip <128.1.0.2/32> drop-action enable block <one> |
| IP Range | 110 permit ip host 10.57.240.1 10.0.0.0 0.255.255.255 | qos traffic-profile classifier name <one> src-ip <10.57.240.1/32> dst-ip <10.0.0.0/8> block <one> |

# 9. Reference Documentation

| Document Title | Publication Number | Description |
|---|---|---|
| Shortest Path Bridging (802.1aq) for ERS 8800 and VSP 9000 Technical Configuration Guide | NN48500-617 | |
| Basic SPBM Configuration | NN48500-632 | |
| Migrating to a Virtual Services Fabric using Shortest Path Bridging Technical Configuration Guide | NN48500-622 | |
| Avaya Virtual Services Platform 7000 Series Configuration - SPBM | NN46202-510 | |
| Configuring Quality of Service on Avaya Ethernet Routing Switch 5900 Series | NN47211-504 | |
| | | |