MCX in Virtual Controller Environments

HOW TO GUIDE

October 2012

Revision 1.0

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1. Overview

Zebra best practices for deploying a MeshConnex (MCX) network details the use of AP-mode profile types, specifically a profile for “root” nodes and a profile for “non-root” nodes. There are a number of reasons for this suggestion:

- It lends to a hierarchical flow and organization of the master configuration
- It provides a means to ensure that non-root devices do not assume RF-Domain Manager responsibilities by disabling the “RF-Domain Manager Capable” parameter or by establishing a lower priority for these devices
- It aids in the change-control process within an organization
    - Delineates between devices types, mitigating potential misconfiguration issues
    - Allows for granularity in process recording

However, in a virtual controller setting, this is not possible as there is only a single device-type profile. The Virtual Controller function does not allow for multiple profiles as it only serves to manage *like devices*.

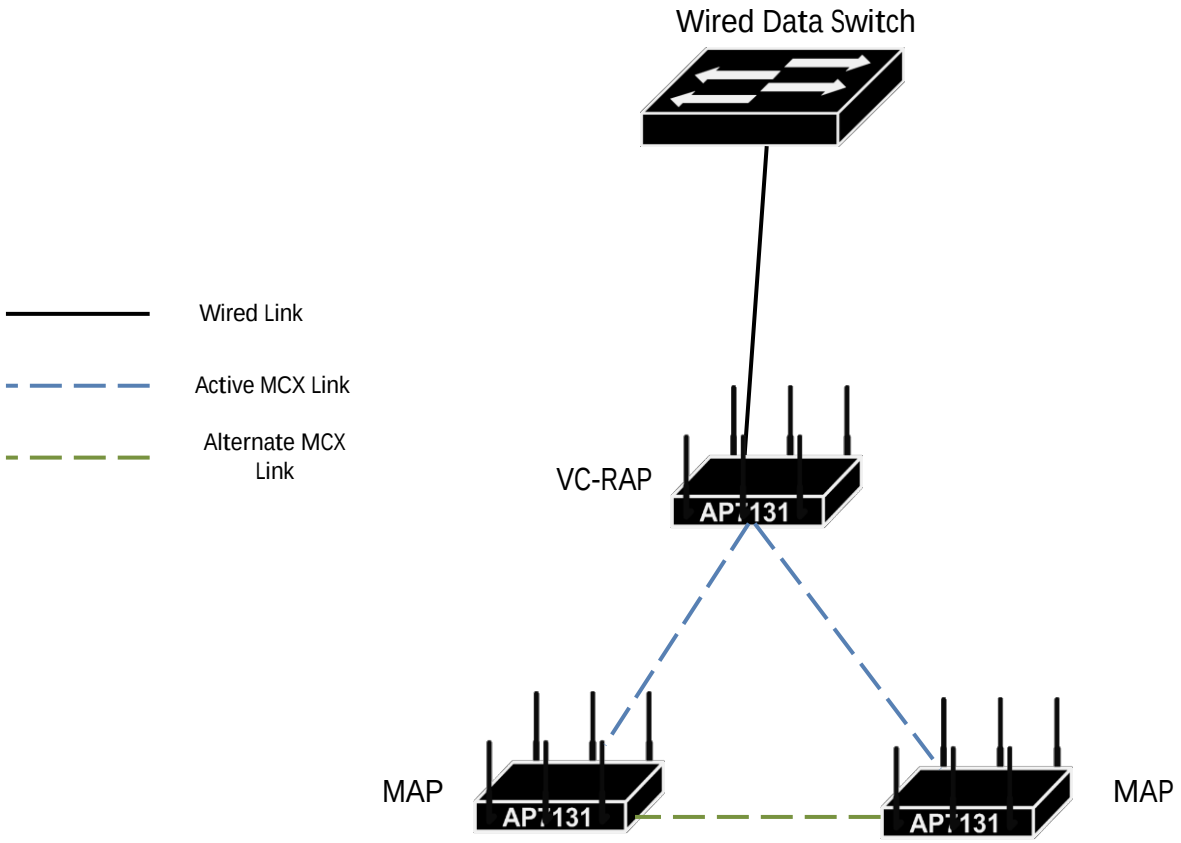
The purpose of this guide is to outline the configuration of a Virtual Controller MeshConnex™ environment.

1.1 Technical Requirements

Listed are the components used in creating this document:

- WiNG 5.4.0.0-047R
- (3x) – AP7131 Access Points

2. Topology



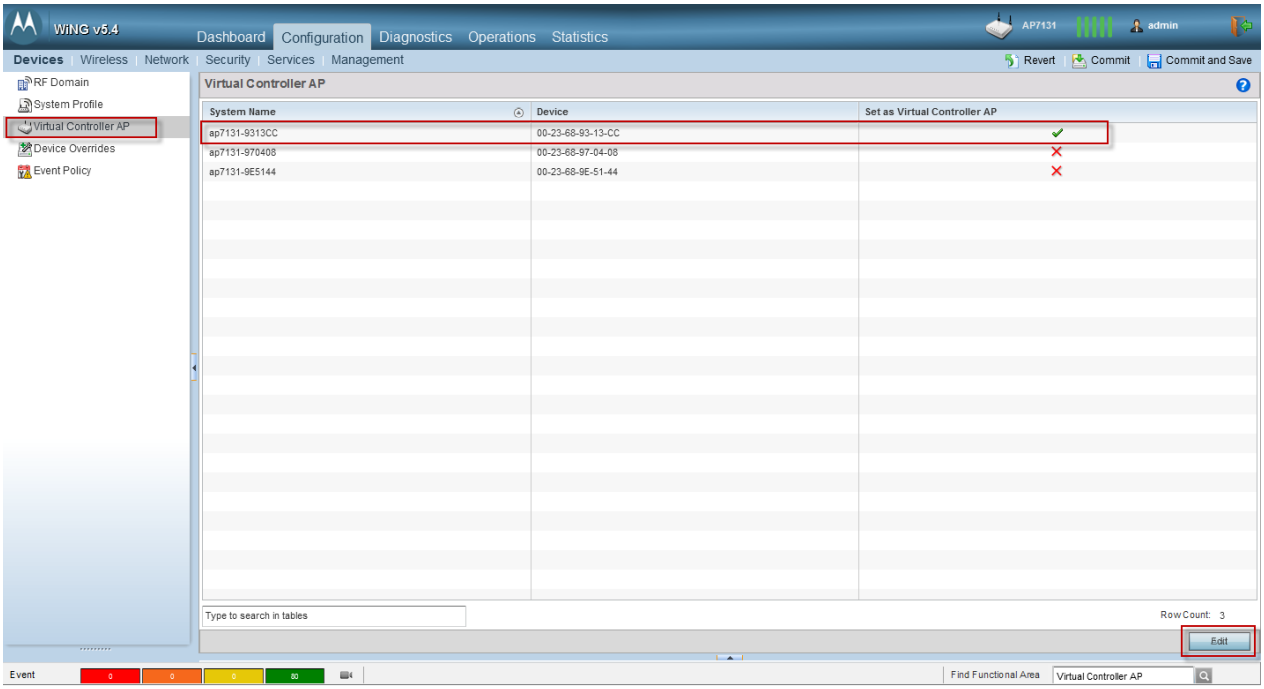
2.1 Configuration

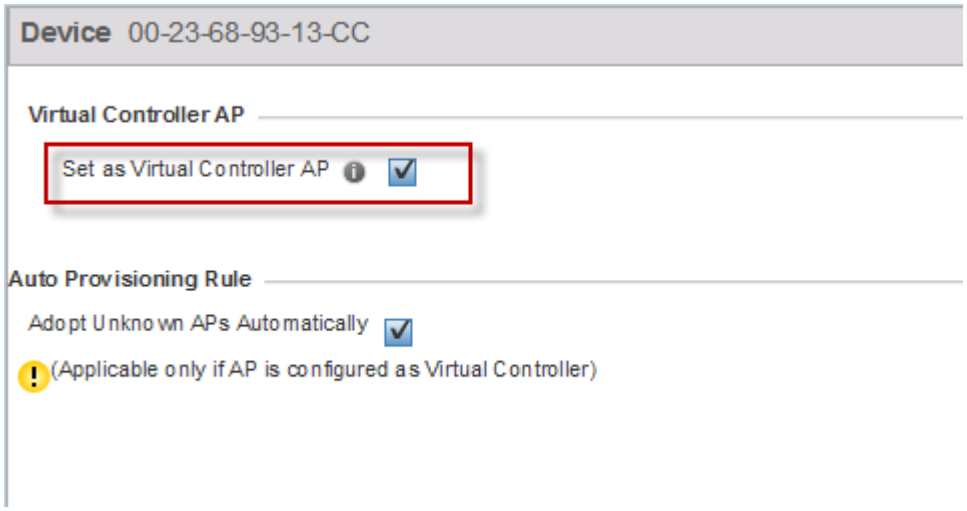
The steps involved with configuring a Virtual Controller based MeshConnex network are listed below. Full configuration of WLAN's and other parameters are beyond the scope of this document:

1. Configure Virtual Controller AP
2. Configure Smart-RF policy or establish static channels
3. Configure Meshpoint (MeshConnex WLAN)
4. Tune the system profile for MCX AP types

2.1.1 Configure Virtual Controller

A single AP will act as the adopting device for the other AP's that are of the same hardware type; i.e. all AP7131's or AP6532's, etc. Establishing the VC is simply a check box on the designated device, which is found at ***Configuration > Devices > Virtual Controller AP > System Name:***





At the command line, enter configuration mode on the device you wish to act as Virtual Controller:

Enter “self” configuration mode:

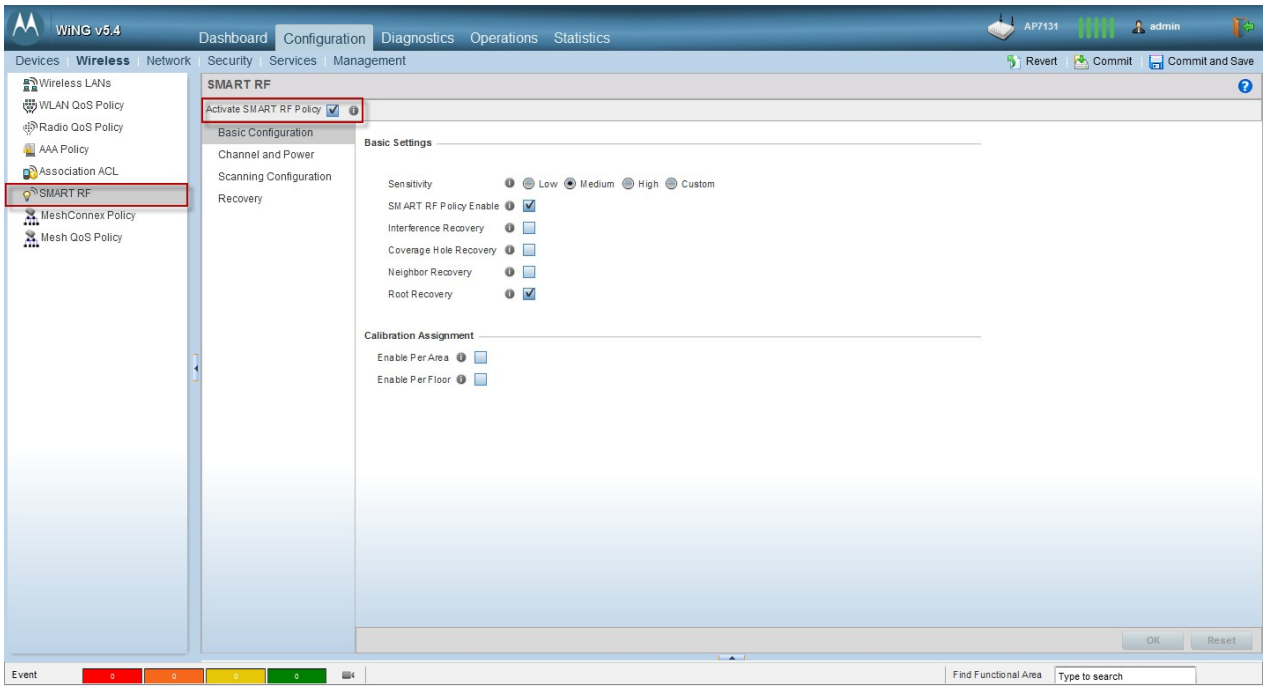
```
ap7131-9313CC#self
Enter configuration commands, one per line.  End with CNTL/Z.
ap7131-9313CC(config-device-00-23-68-93-13-CC)#
```

Execute the virtual controller command:

```
ap7131-9313CC(config-device-00-23-68-93-13-CC)#virtual-controller
ap7131-9313CC(config-device-00-23-68-93-13-CC)#commit write
[OK]
ap7131-9313CC(config-device-00-23-68-93-13-CC)#show context
ap71xx 00-23-68-93-13-CC
 use profile MCX-APs
 use rf-domain default
 hostname ap7131-9313CC
 interface vlan10
  ip address dhcp
  no shutdown
 virtual-controller
 logging on
 no logging console
 logging buffered warnings
ap7131-9313CC(config-device-00-23-68-93-13-CC)#
```

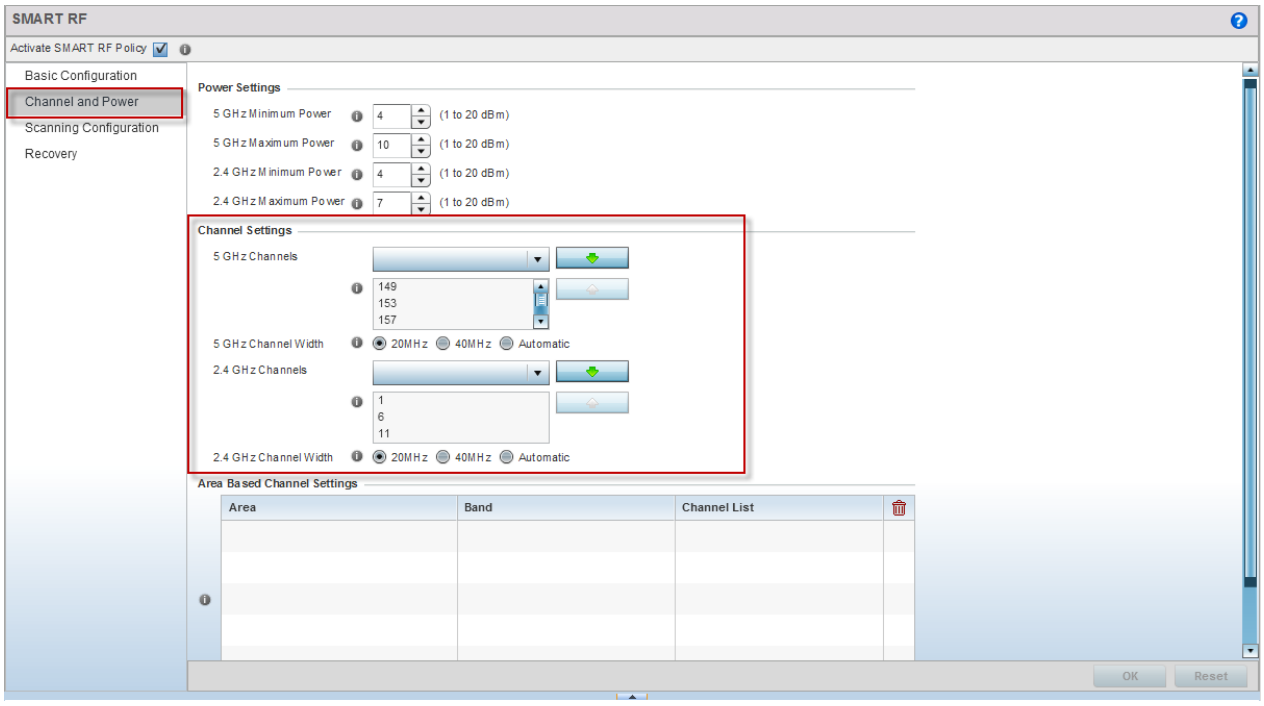
2.1.2 Smart-RF Configuration

If Smart-RF will be used, then care should be taken to determine if indoor or outdoor channels are utilized as well as if DFS is to be avoided or not. The Smart-RF policy can be found by navigating to: ***Configuration > Wireless > Smart-RF***:

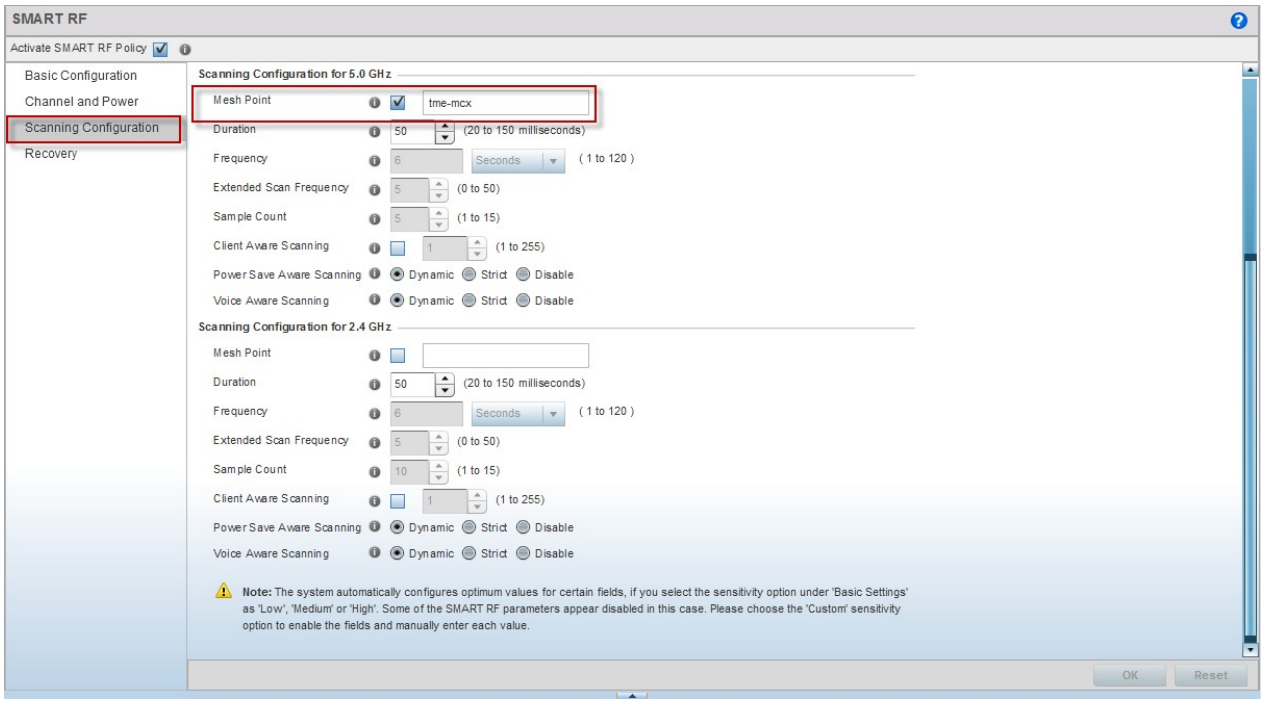


Enable Smart-RF by checking "***Activate SMART RF Policy".***

- Disable the three recovery modes, as these are generally not applicable for MCX links and may cause inadvertent performance issues. (Under Basic Configuration)



- MCX should generally be limited to the 5GHz band. Specify the Smart-RF channel list per the regulations for the country it is being configured in. (Under Channel and Power)



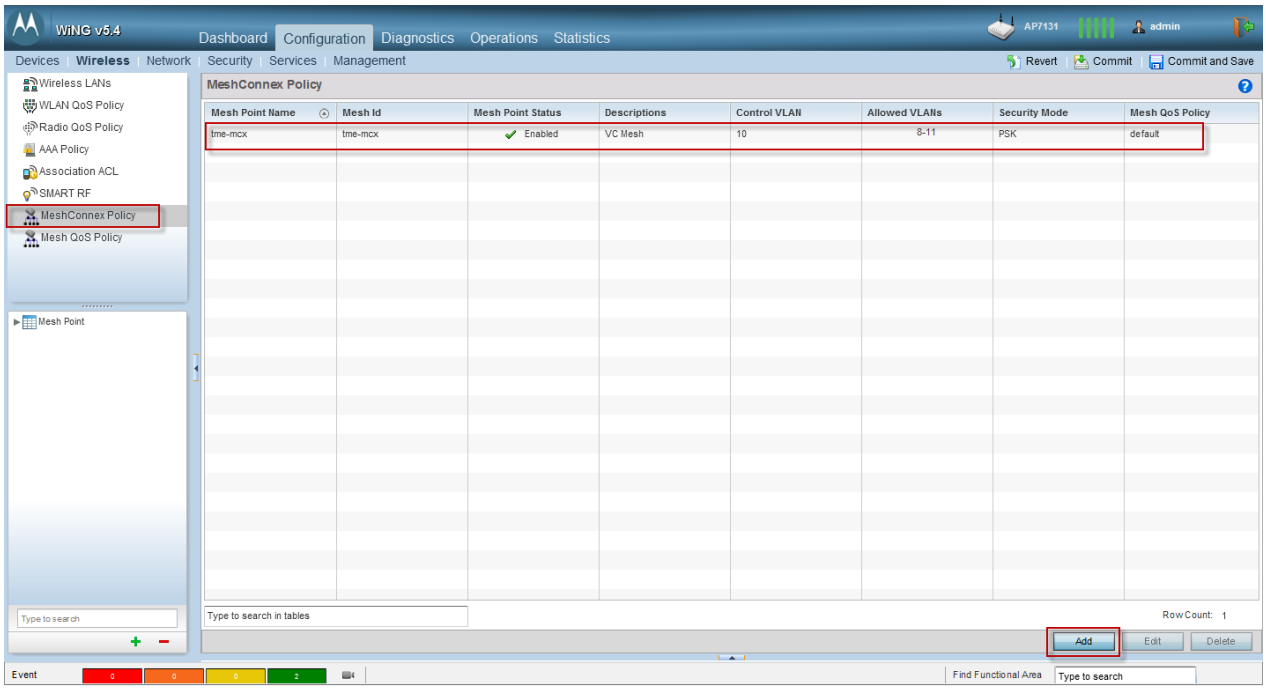
- Remember to specify your MCX ID, binding the meshpoint to Smart-RF.
- The channel-list settings shown are an example only. In this case, US outdoor channels that avoid DFS frequencies were selected.

Smart-RF Configuration:

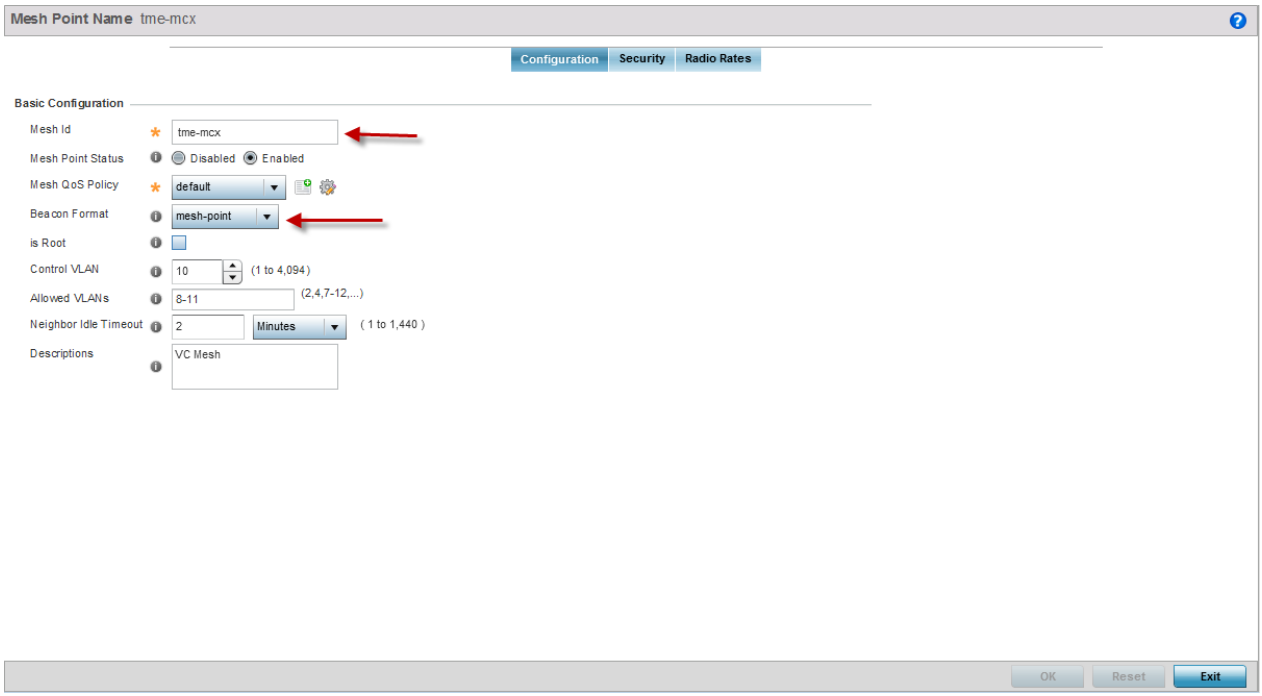
```
ap7131-9313CC#show run smart-rf-policy tme-smart-rf
smart-rf-policy tme-smart-rf
 assignable-power 5GHz max 10
 assignable-power 2.4GHz max 7
 channel-list 5GHz 149,153,157,161,165
 smart-ocs-monitoring meshpoint 5GHz tme-mcx
 no interference-recovery
 no neighbor-recovery
 no coverage-hole-recovery
ap7131-9313CC#
```

2.1.3 Create MCX Meshpoint

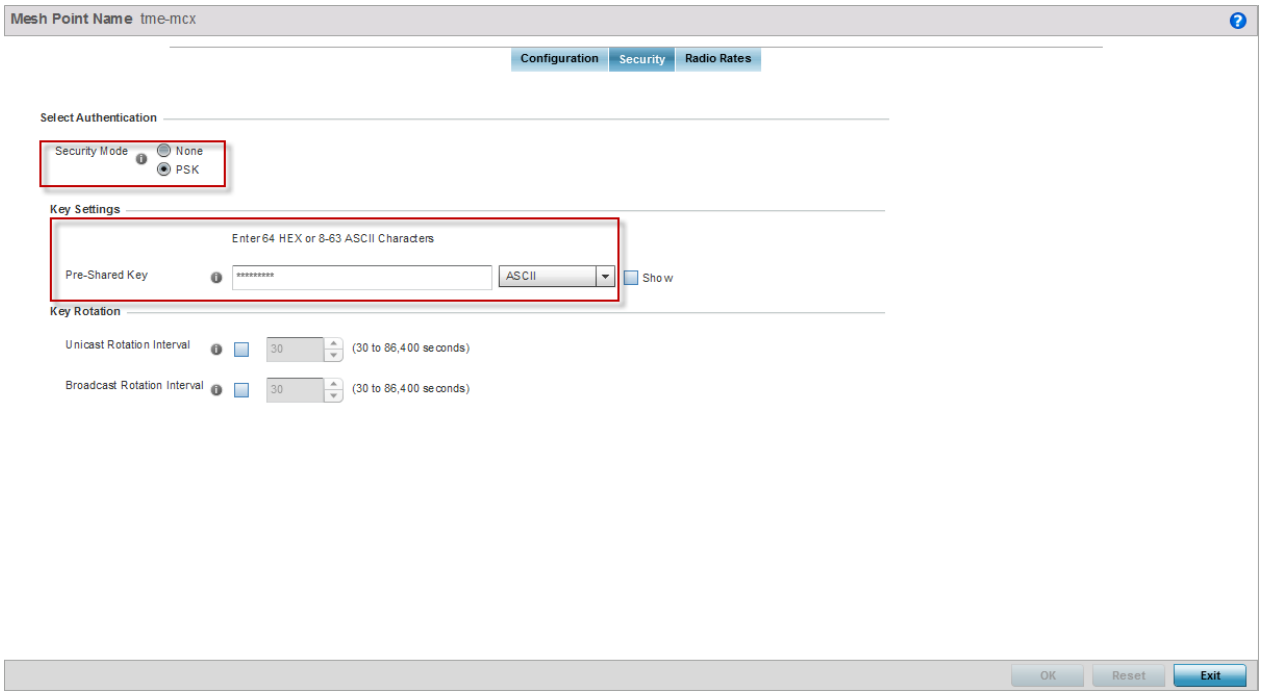
The meshpoint is similar to a WLAN, only dedicated to the communication of the mesh AP's with one another. Navigate to ***Configuration > Wireless > MeshConnex Policy*** and create a new policy:



The Mesh ID identifies the links to the AP's; like an SSID. Beacon format should be set to "mesh-point" to include the information element to the APs.



Under the ***Security*** tab is where the PSK will be defined if encryption of the mesh links is desired.



Under the “Radio Rates” tab, the defaults can be left, as the rates will be adjusted within the device profile.

Meshpoint configuration at the command line is similar to that of creating a WLAN:

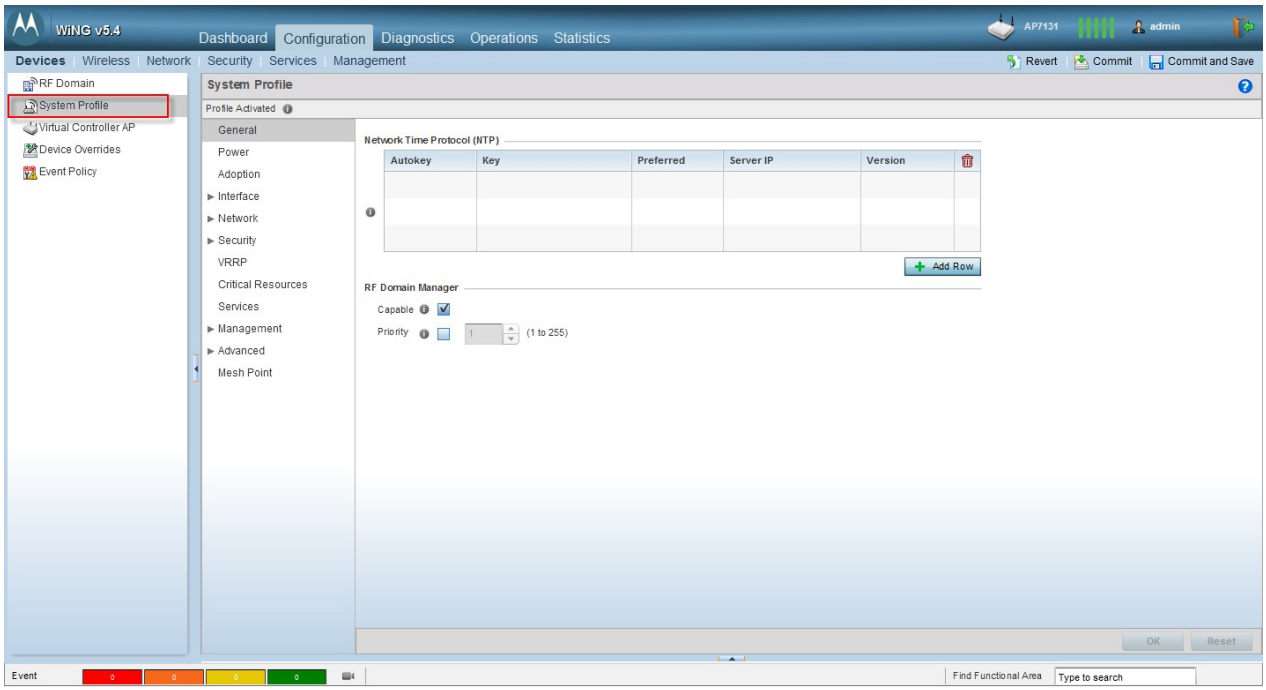
Meshpoint Configuration:

```
ap7131-9313CC#show run meshpoint tme-mcx
meshpoint tme-mcx
 description VC Mesh
 meshid tme-mcx
 beacon-format mesh-point
 control-vlan 10
 allowed-vlans 8-11
 security-mode psk
 wpa2 psk 0 hellomoto
 no root
ap7131-9313CC#
```

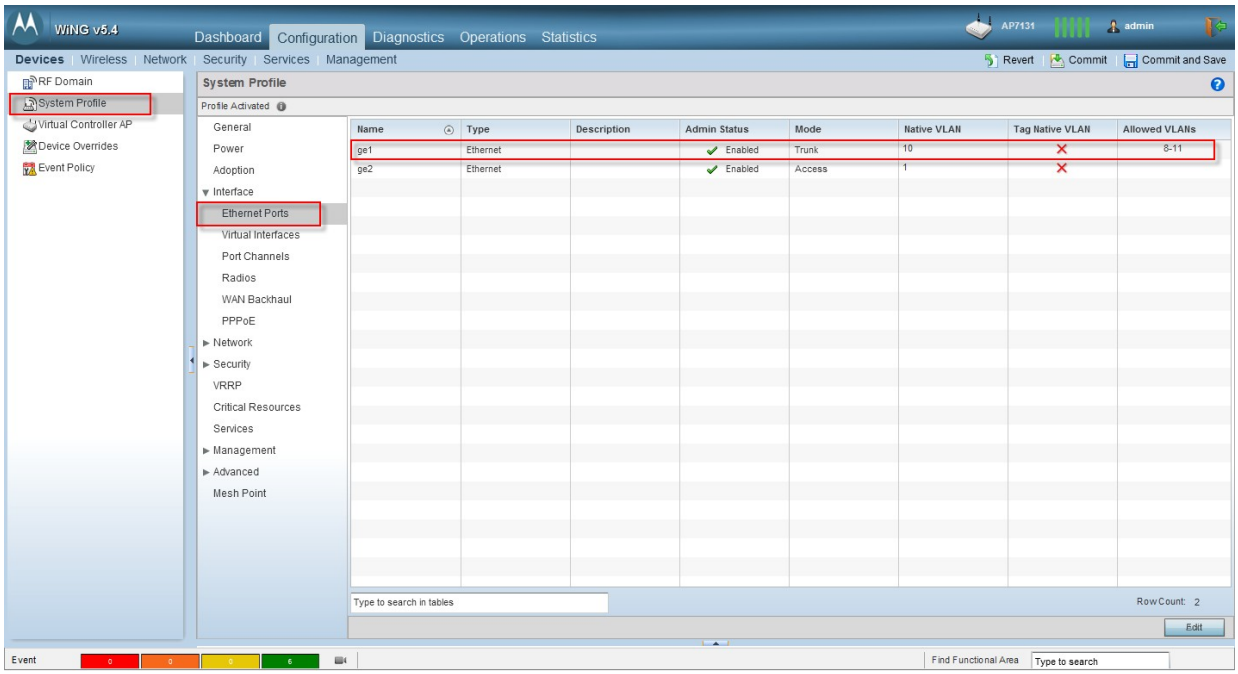
2.1.4 Tune System Profile

The system profile is the profile that is used by the devices within the Virtual Controller domain, whether you have selected to use the default or create another (as to stick with a naming

convention, for example). The profile parameters herein will ensure that MCX is optimized for mesh links. Navigate to ***Configuration > Devices > System Profile***

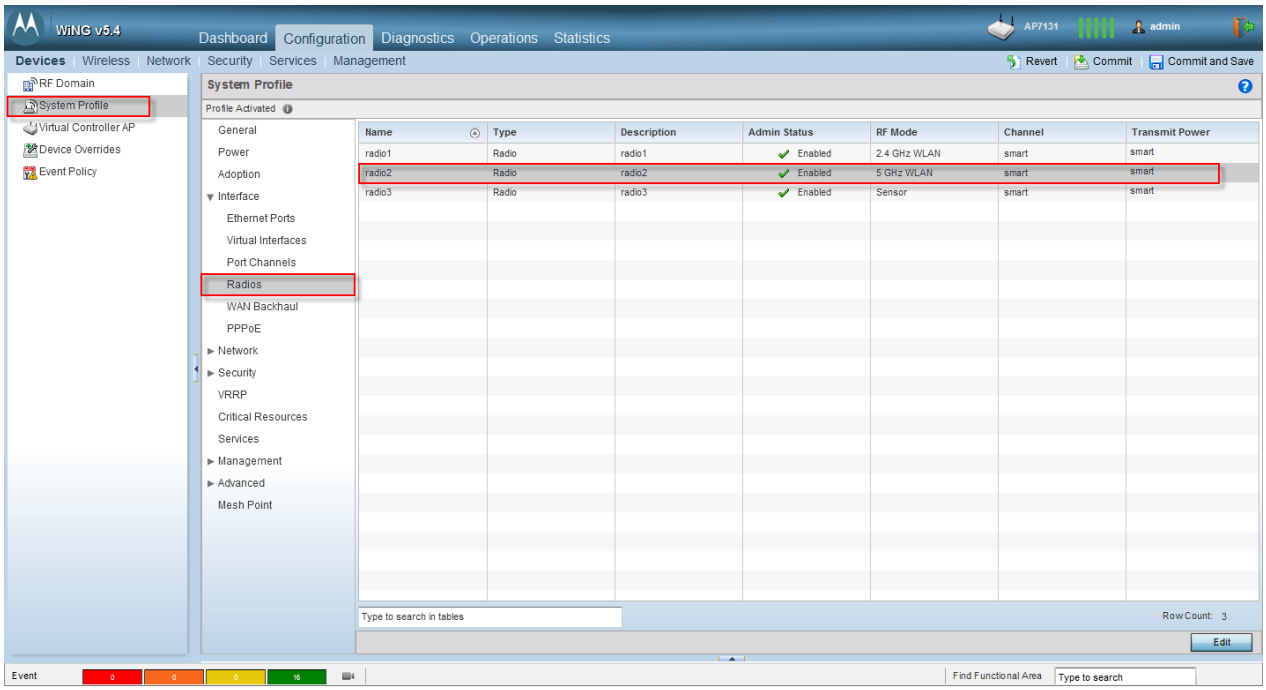


As there is only a single profile supporting both root and non-root AP's, configure the profile for root parameters. Port link monitoring will determine if the device ends up as a root or a non-root device.



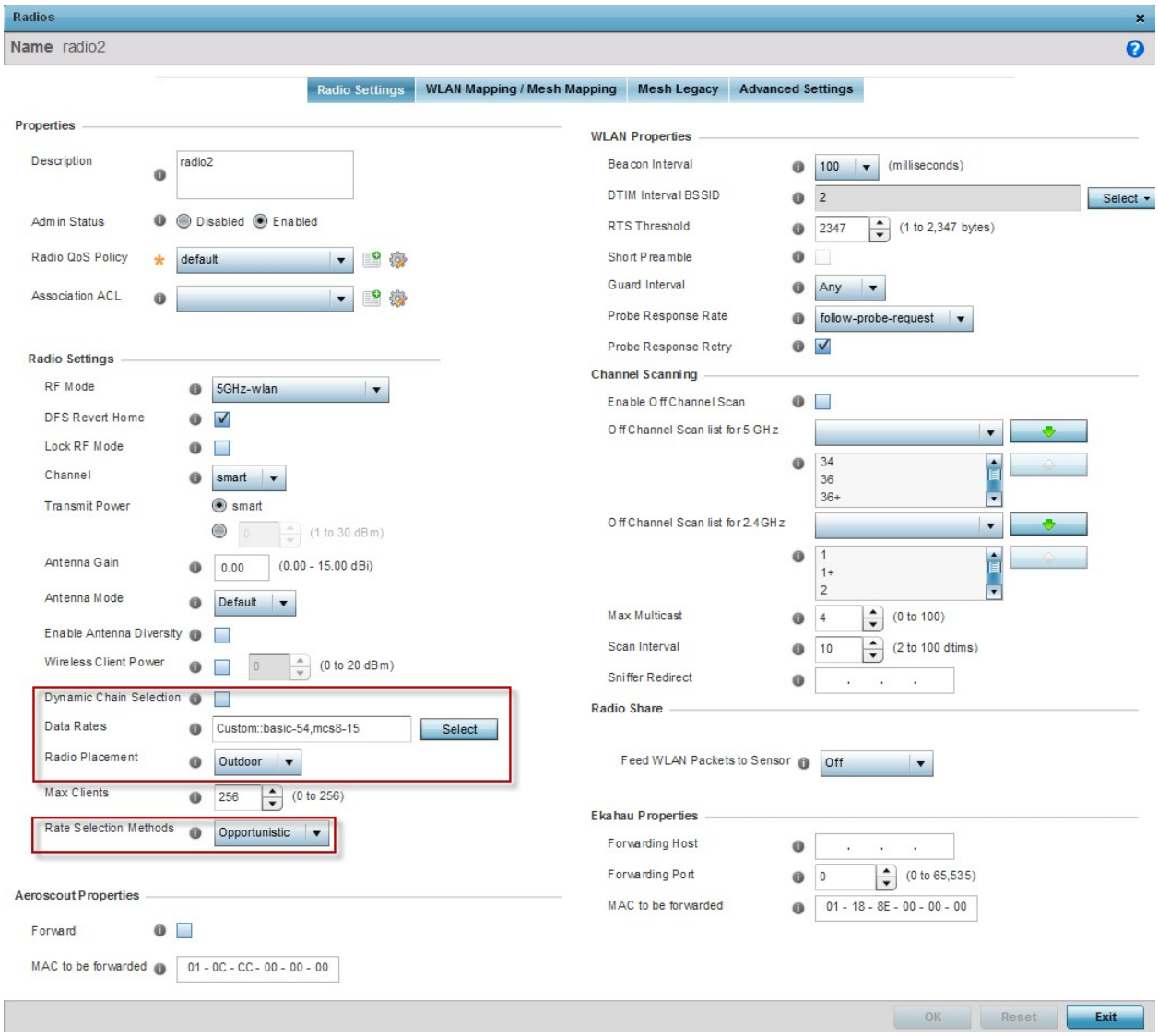
Within this example, there will be no devices connected to Ge2. Scenarios may exist in which an IP camera (video surveillance), electric utility cap-bank (Smart Grid) or other device may utilize the Ge2 port. On the AP7161 and AP7181 devices, this port can also provide PoE (802.3af) for those devices.

For purposes of this document, the “radio2” interface configuration, specifically will be covered as it is used for the mesh links between nodes.



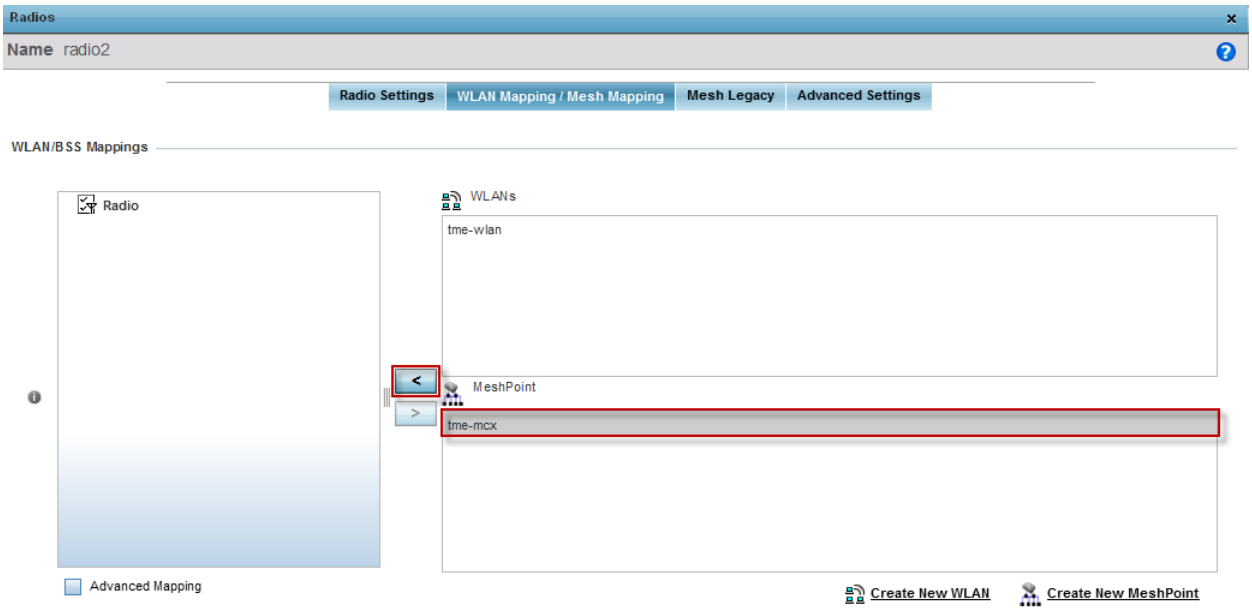
The settings within this document represent those specific to the AP7131. Remember that within a mesh network, typically all devices participating in a particular meshpoint will be the same model. Thus the parameters can be hard-coded for optimal performance, rather than accepting the typical default, client-friendly settings.

- Dynamic Chain Selection: un-checked
- Data Rates: “an” – as we are specifically using the 5GHz radio for mesh and want the best throughput on the mesh links
- Radio Placement: depends on application
- Rate Selection: always set for Opportunistic

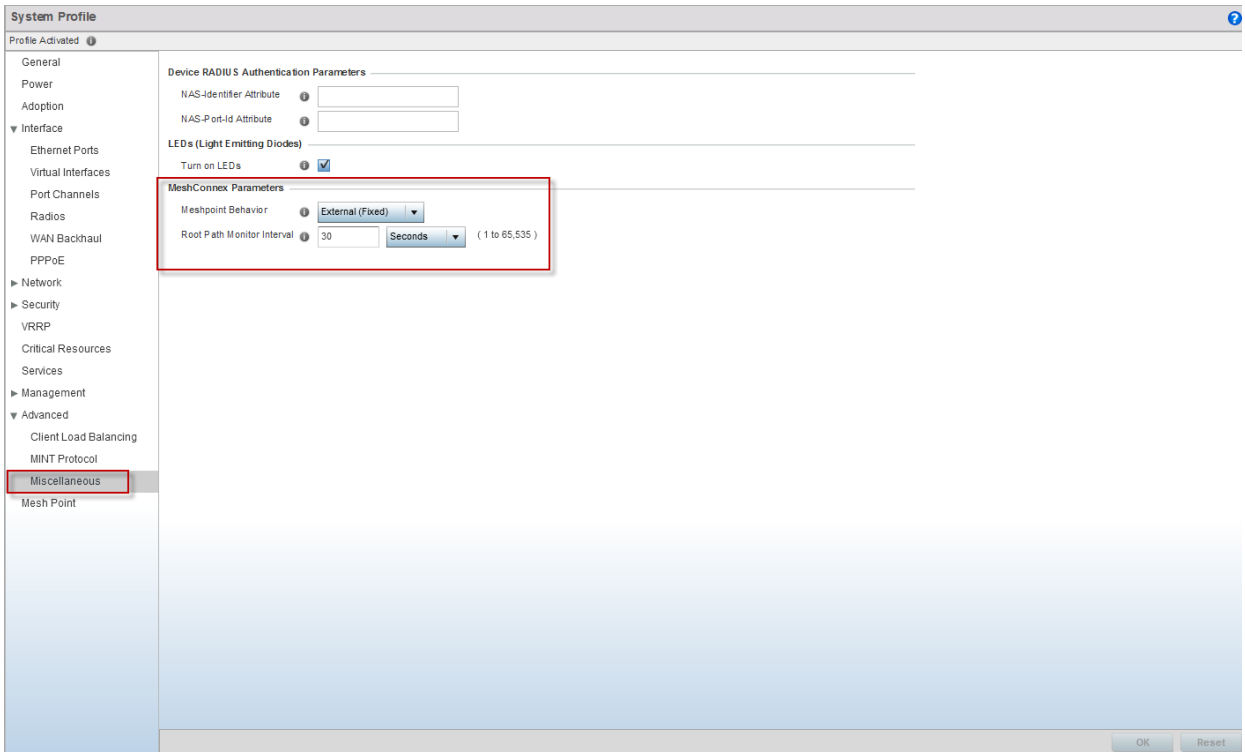


Next we must map the meshpoint to the radio, similar in the way that we map a WLAN to a radio:

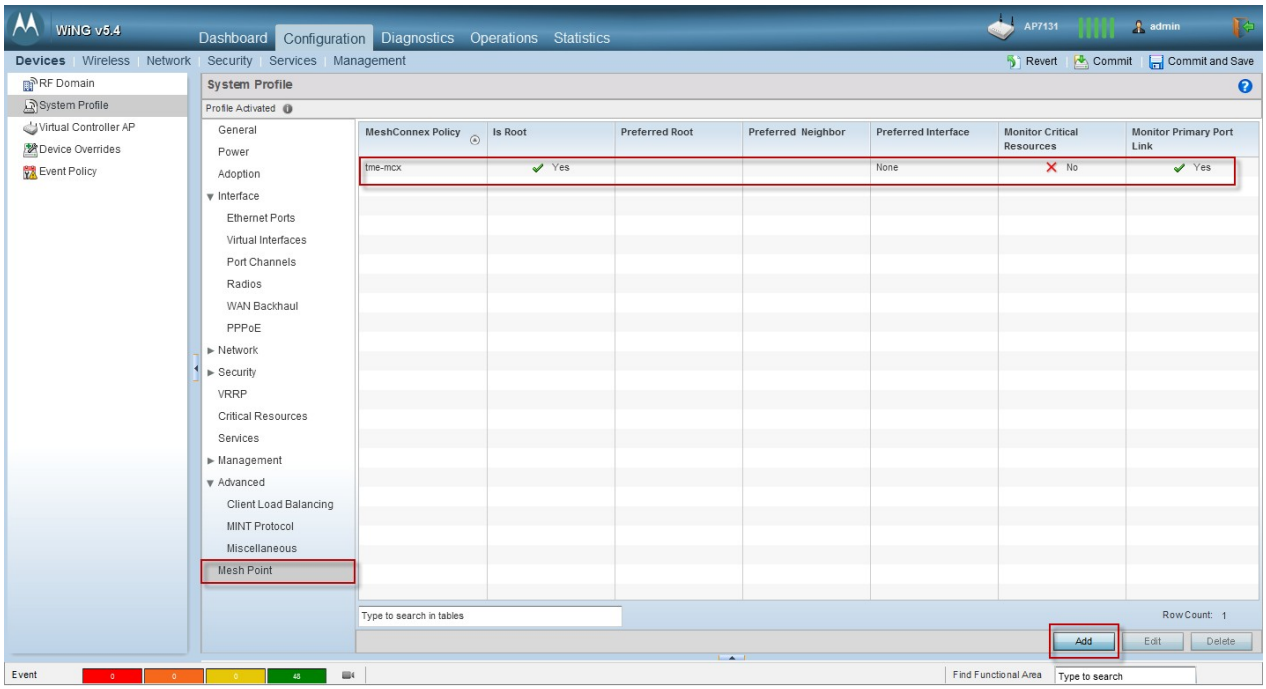
Under the ***WLAN Mapping / Mesh Mapping*** tab, select the MeshPoint and click the "**<**" to move the meshpoint to the radio, as seen below:



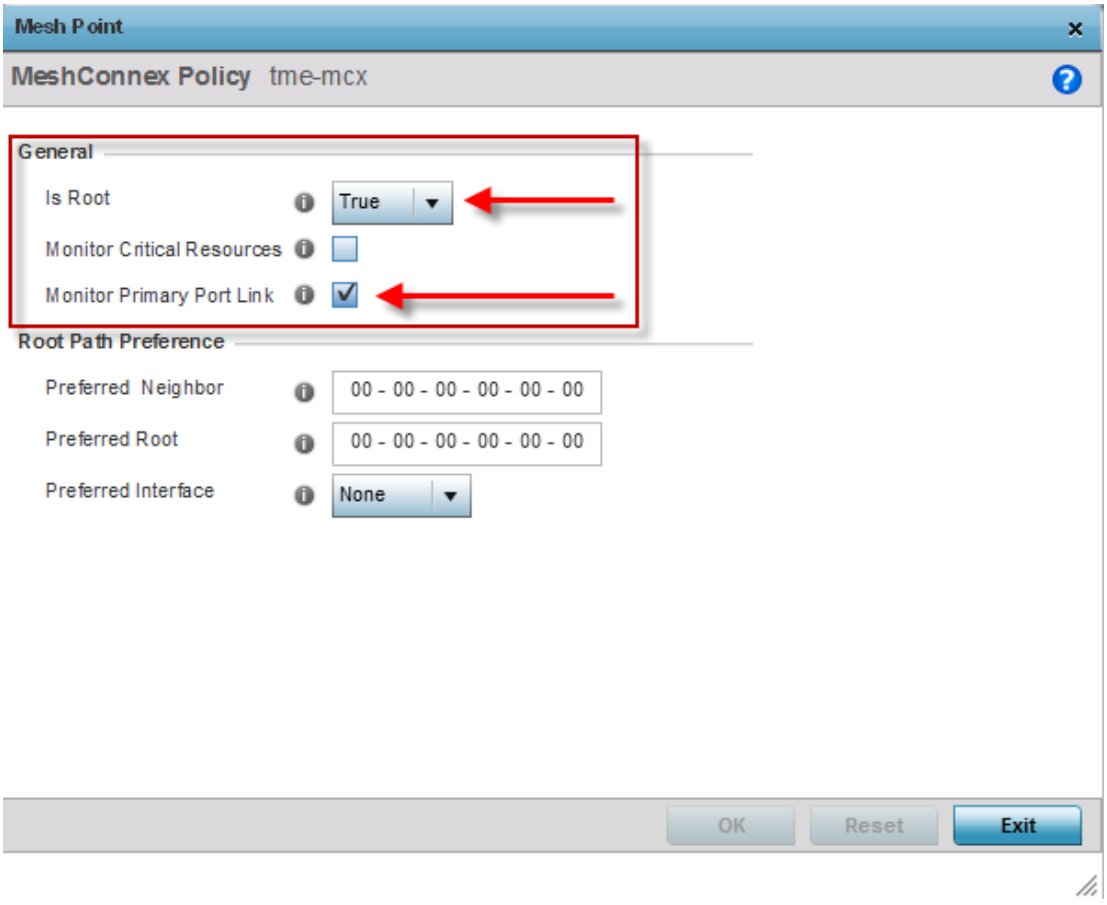
Under ***Advanced / Miscellaneous*** is where one finds the MeshPoint Behavior setting, dependent on whether the device is a *Vehicle Mounted Modem* (VMM) or not. Generally this parameter will be left at its default setting of “External (Fixed)”, unless a VMM is in use.



Finally, navigate to ***Mesh Point*** within the System Profile. Here you will add the meshpoint that was created earlier, defining the device profile as that of a meshpoint device and specify that the profile will always set the device as a “root” AP.



Under ***General*** set “Is Root” to true and then check the “Monitor Primary Port Link” box, as shown below:



By monitoring the primary (Ge1) port, MCX can determine if the device should be a root AP or a non-root; if there is no data link detected on Ge1, the device will fallback to non-root, thus utilizing a single hardware profile and automatically provisioning our device type.

There are caveats with this method of provisioning in a regular MCX environment where you may support multiple device types and profiles. Please see the MCX How-To guide for details on provisioning the device mode in those cases.

System Profile Configuration:

```
ap7131-9313CC#show run profile ap71xx MCX-APs
profile ap71xx MCX-APs
 no autoinstall configuration
 no autoinstall firmware
 crypto ikev1 policy ikev1-default
  isakmp-proposal default encryption aes-256 group 2 hash sha
 crypto ikev2 policy ikev2-default
  isakmp-proposal default encryption aes-256 group 2 hash sha
 crypto ipsec transform-set default esp-aes-256 esp-sha-hmac
 crypto ikev1 remote-vpn
 crypto ikev2 remote-vpn
 crypto auto-ipsec-secure
 interface radio1
  wlan tme-wlan bss 1 primary
 interface radio2
  data-rates custom basic-54 mcs8-15
  rate-selection opportunistic
  placement outdoor
  meshpoint tme-mcx bss 1
  aggregation ampdu none
  antenna-mode 2x2
  no dynamic-chain-selection
 interface radio3
 interface ge1
  switchport mode trunk
  switchport trunk native vlan 10
  no switchport trunk native tagged
  switchport trunk allowed vlan 8-11
  ip dhcp trust
  qos trust dscp
  qos trust 802.1p
```

```
 interface ge2
  ip dhcp trust
  qos trust dscp
  qos trust 802.1p
 interface vlan10
  ip address dhcp
  ip dhcp client request options all
 interface wwan1
 interface pppoe1
 use firewall-policy default
 service pm sys-restart
 router ospf
 meshpoint-device tme-mcx
  name tme-mcx
  root
  monitor primary-port-link action no-root
ap7131-9313CC#
```

2.1.5 Misconfiguration Recovery

There is a parameter known as "*misconfiguration-recovery-time"* only found (as of 5.4.0.0-047R) at the CLI. This parameter essentially affords a failsafe in the event of a misconfiguration that causes the mesh to fail.

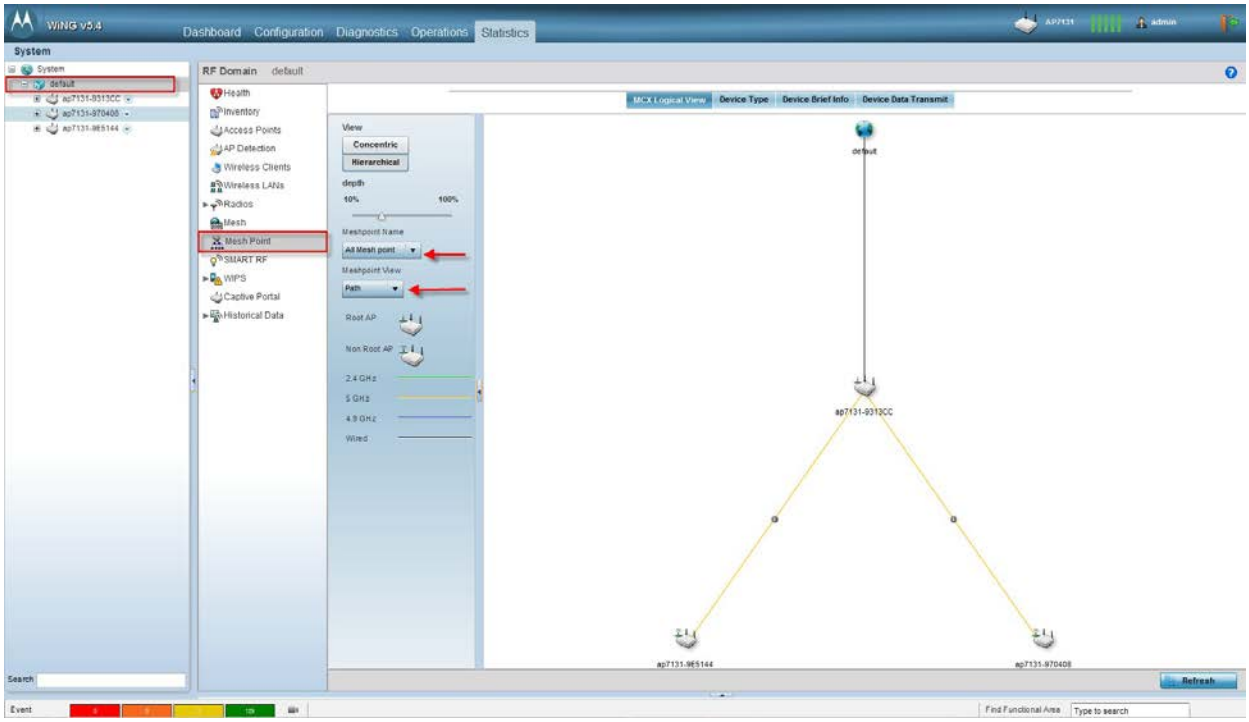
The default misconfiguration-recovery-time is 180 seconds. Once the mesh network has been deployed and functional, this should be set to 300 seconds. This will ensure that once a configuration change has been applied, it will have up to 5 minutes to settle and re-form links; otherwise the previous configuration will be reinstated. Enter config mode and go into the device profile to modify the parameter:

Misconfiguration-recovery-time

```
ap7131-9313CC#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
ap7131-9313CC(config)#profile ap71xx MCX-APs
ap7131-9313CC(config-profile-MCX-APs)#misconfiguration-recovery-time 300
ap7131-9313CC(config-profile-MCX-APs)#commit write
[OK]
ap7131-9313CC(config-profile-MCX-APs)#end
ap7131-9313CC#
```

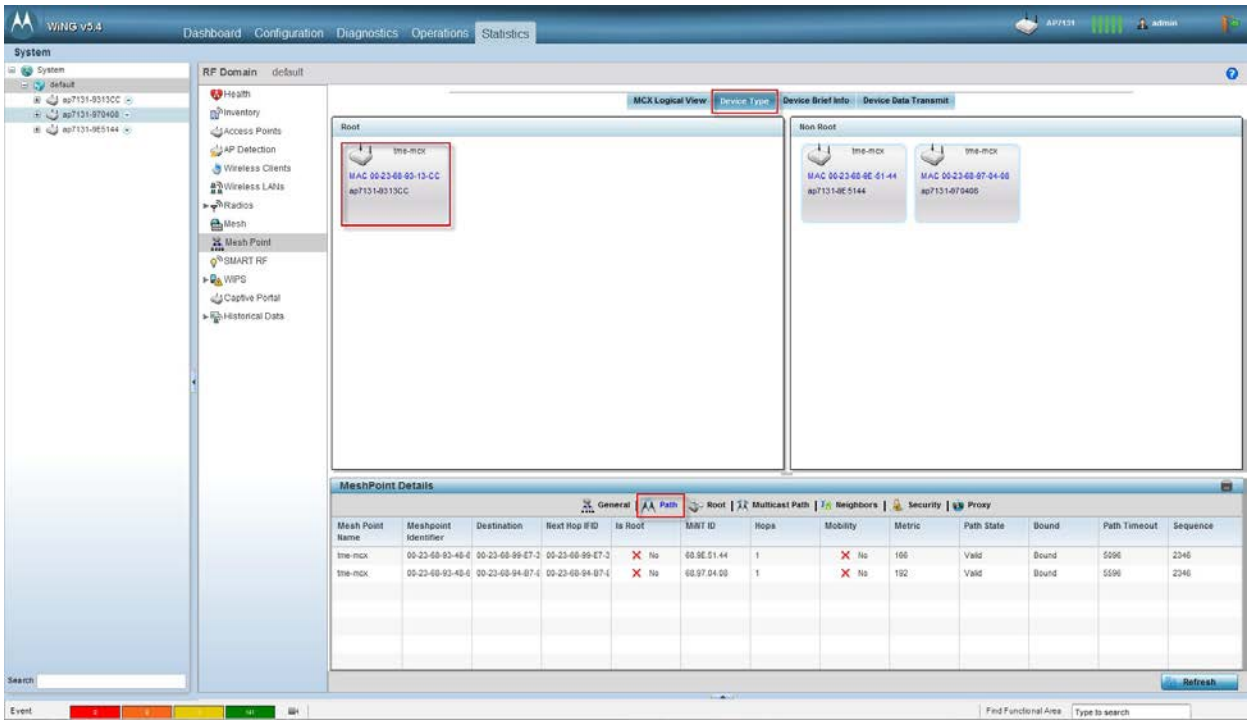
3. Troubleshooting

First, a good summary is necessary to establish just where we're at. Navigate to ***Statistics*** and select your RF-Domain name (***Default*** if left unchanged), then ***Mesh Point.*** At this top-level view you can determine what links exists for all meshpoints or by selecting a specific meshpoint.



Pay attention to the drop-downs that allow you to select a specific meshpoint and whether you would like to view *Paths* or *Neighbors*. The color coded legend will discern the link types.

Under the ***Device Types*** tab, you can select the individual devices to obtain other information such as the Paths as seen by the selected device:



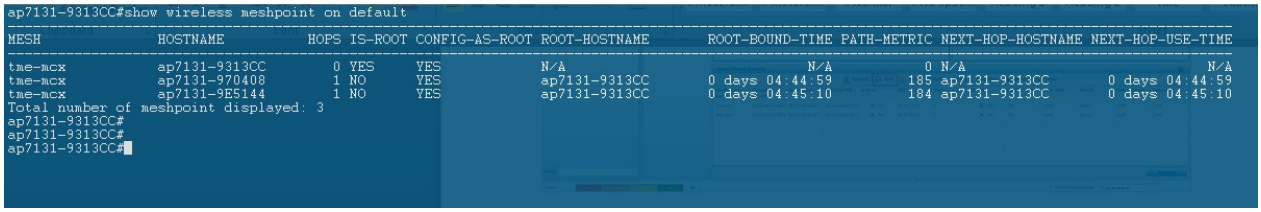
Of course, there is the power of the CLI to get more information:

***Show wireless meshpoint on <rf-domain>*:**

```
ap7131-9313CC#show wireless meshpoint on default

-------------------------------------------------------------------------------------------------
-------------------------------------------------------

MESH              HOSTNAME          HOPS IS-ROOT CONFIG-AS-ROOT ROOT-HOSTNAME       ROOT-
BOUND-TIME PATH-METRIC NEXT-HOP-HOSTNAME NEXT-HOP-USE-TIME

-------------------------------------------------------------------------------------------------
-------------------------------------------------------

tme-mcx           ap7131-9313CC        0 YES     YES            N/A
N/A           0 N/A                          N/A

tme-mcx           ap7131-970408        1 NO      YES            ap7131-9313CC       0 days
04:44:59        185 ap7131-9313CC       0 days 04:44:59

tme-mcx           ap7131-9E5144        1 NO      YES            ap7131-9313CC       0 days
04:45:10        184 ap7131-9313CC       0 days 04:45:10

Total number of meshpoint displayed: 3
```

The above command will give a good reference point as to the number of hops for the devices, who is acting as root, etc.

And an example of the formatting if you expand your terminal client to full screen (a much better view of the information):

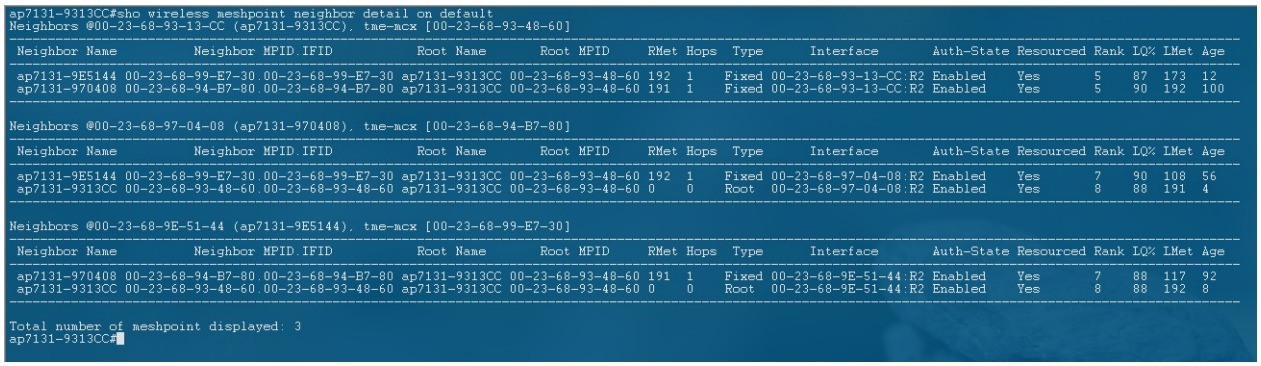


***Show wireless meshpoint neighbor detail on <rf-domain>*:**

```
ap7131-9313CC#sho wireless meshpoint neighbor detail on default

Neighbors @00-23-68-93-13-CC (ap7131-9313CC), tme-mcx [00-23-68-93-48-60]

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------

 Neighbor Name          Neighbor MPID.IFID           Root Name       Root MPID     RMet
Hops  Type      Interface       Auth-State Resourced Rank LQ% LMet Age

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------

 ap7131-9E5144 00-23-68-99-E7-30.00-23-68-99-E7-30 ap7131-9313CC 00-23-68-93-48-60 192
1    Fixed 00-23-68-93-13-CC:R2 Enabled    Yes       5    87  173  12

 ap7131-970408 00-23-68-94-B7-80.00-23-68-94-B7-80 ap7131-9313CC 00-23-68-93-48-60 191
1    Fixed 00-23-68-93-13-CC:R2 Enabled    Yes       5    90  192  100

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------


Neighbors @00-23-68-97-04-08 (ap7131-970408), tme-mcx [00-23-68-94-B7-80]

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------

 Neighbor Name          Neighbor MPID.IFID           Root Name       Root MPID     RMet
Hops  Type      Interface       Auth-State Resourced Rank LQ% LMet Age

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------

 ap7131-9E5144 00-23-68-99-E7-30.00-23-68-99-E7-30 ap7131-9313CC 00-23-68-93-48-60 192
1    Fixed 00-23-68-97-04-08:R2 Enabled    Yes       7    90  108  56

 ap7131-9313CC 00-23-68-93-48-60.00-23-68-93-48-60 ap7131-9313CC 00-23-68-93-48-60 0
0    Root  00-23-68-97-04-08:R2 Enabled    Yes       8    88  191  4

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------


Neighbors @00-23-68-9E-51-44 (ap7131-9E5144), tme-mcx [00-23-68-99-E7-30]

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------

 Neighbor Name          Neighbor MPID.IFID           Root Name       Root MPID     RMet
Hops  Type      Interface       Auth-State Resourced Rank LQ% LMet Age

-------------------------------------------------------------------------------------------
-------------------------------------------------------------------------

 ap7131-970408 00-23-68-94-B7-80.00-23-68-94-B7-80 ap7131-9313CC 00-23-68-93-48-60 191
```

```
1    Fixed 00-23-68-9E-51-44:R2 Enabled    Yes       7    88  117  92

 ap7131-9313CC 00-23-68-93-48-60.00-23-68-93-48-60 ap7131-9313CC 00-23-68-93-48-60 0
0    Root  00-23-68-9E-51-44:R2 Enabled    Yes       8    88  192  8

-------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------

Total number of meshpoint displayed: 3
```

And with formatting:



To get a good view of the tree structure of your meshpoint; that is – the various paths through your devices, use the following:

Show wireless meshpoint tree on <*rf-domain*>:

```
ap7131-9313CC#show wireless meshpoint tree on default
1:tme-mcx [3 MPs(1 roots, 2 bound)]
|-ap7131-9313CC
  |-ap7131-9E5144
  |-ap7131-970408

Total number of meshes displayed: 1
ap7131-9313CC#
```

Below is the output of the "*debug wireless meshpoint on <rf-domain>*" command, which shows a device as it lost power and then came back into the mesh:

debug wireless meshpoint on <*rf-domain*>:

```
ap7131-9313CC#debug wireless meshpoint on default
ap7131-9313CC#
```

```
ap7131-9313CC#logging monitor debug

ap7131-9313CC#Jan 02 04:19:14 2012: DOT11: meshpoint:sending mint rem_link message to
dpd for meshpoint 00-23-68-94-B7-80 (mesh.c:1370)

Jan 02 04:19:14 2012: ap7131-9313CC : %AP-6-UNADOPTED: Access Point('ap7131-
970408'/'ap71xx'/00-23-68-97-04-08) at rf-domain:'default' unadopted. Radios: Count=2,
Bss: 00-23-68-96-28-70|00-23-68-94-B7-80|

Jan 02 04:20:18 2012: ap7131-9313CC : %NSM-6-DHCPDEFRT: Default route with gateway
172.16.10.1 learnt via DHCP

Jan 02 04:20:18 2012: ap7131-9313CC : %NSM-6-DHCPIP: Interface vlan10 acquired IP
address 172.16.10.100/24 via DHCP

Jan 02 04:20:18 2012: %AUTHPRIV-4-WARNING: pluto[1488]: Handling received interface
related netlink message address [0]

Jan 02 04:21:01 2012: ap7131-9E5144 : %NSM-6-DHCPDEFRT: Default route with gateway
172.16.10.1 learnt via DHCP

Jan 02 04:21:01 2012: ap7131-9E5144 : %NSM-6-DHCPIP: Interface vlan10 acquired IP
address 172.16.10.101/24 via DHCP

Jan 02 04:21:34 2012: DOT11: meshpoint:sending mint new_link message to dpd for
meshpoint 00-23-68-94-B7-80 (mesh.c:1356)

Jan 02 04:21:38 2012: ap7131-9313CC : %AP-6-ADOPTED: Access Point('ap7131-
970408'/'ap71xx'/00-23-68-97-04-08) at rf-domain:'default' adopted and configured.
Radios: Count=2, Bss: 00-23-68-96-28-70|00-23-68-94-B7-80|

Jan 02 04:21:39 2012: ap7131-9313CC : %AP-6-AP_AUTOUP_NO_NEED: AUTOUPGRADE: ap71xx mac
00-23-68-97-04-08 ver 5.4.0.0-047R Autoupgrade not required or not available

Jan 02 04:21:49 2012: ap7131-970408 : %DIAG-6-NEW_LED_STATE: LED state message adopted-
event from module cfgd
```

3.1 MCX Status / Troubleshooting Command Reference

Listed are some commands that will be effective in troubleshooting MCX from the CLI:

MCX troubleshooting command reference:

```
show wireless meshpoint on <rf-domain>

show wireless meshpoint neighbor detail on <rf-domain>

show wireless meshpoint path <meshpoint>

show wireless meshpoint tree on <rf-domain>

debug wireless meshpoint on <rf-domain>
```