



Proactive Network Management

This document describes how to configure the Proactive Network Management on the Cisco cBR Series Converged Broadband Router.

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Hardware Compatibility Matrix for the Cisco cBR Series Routers



Note The hardware components that are introduced in a given Cisco IOS-XE release are supported in all subsequent releases unless otherwise specified.

Table 1: Hardware Compatibility Matrix for the Cisco cBR Series Routers

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	<p>Cisco IOS-XE Release 3.15.0S and Later Releases</p> <p>Cisco cBR-8 Supervisor:</p> <ul style="list-style-type: none"> • PID—CBR-CCAP-SUP-160G • PID—CBR-CCAP-SUP-60G¹ • PID—CBR-SUP-8X10G-PIC 	<p>Cisco IOS-XE Release 3.15.0S and Later Releases</p> <p>Cisco cBR-8 CCAP Line Cards:</p> <ul style="list-style-type: none"> • PID—CBR-CCAP-LC-40G-R • PID—CBR-CCAP-LC-80G-R

- ¹ Effective with Cisco IOS-XE Release 3.17.0S, CBR-CCAP-SUP-60G supports 8 cable line cards. The total traffic rate is limited to 60 Gbps. The total number of downstream service flows is limited to 72268, and downstream unicast low-latency flow does not count against the limits.

Fast Fourier Transform

Table 2: Feature History

Feature Name	Release Information	Feature Description
Fast Fourier Transform (FFT) Enhancements	Cisco IOS XE Dublin 17.12.1x	In this release, we have optimized legacy periodical FFT for both cBR-8 and RPD which helps in reducing system memory and CPU resources. Use the cable rpd period-fft [start stop] command to start or stop RPD periodical FFT polling.

In releases before Cisco IOS XE Dublin 17.12.1x, IOSd CLC sends periodical FFT polling requests to CDMAN every 300 milliseconds for an upstream channel. CDMAN then sends this poll request to RPHYMAN and RPHYMAN sends this poll request to RPD. Huge IPC messages between CDMAN and RPHYMAN, and GCP messages transactions between cBR-8 and RPD consume most of RPHYMAN memory and CPU resources. In a large-scale environment, RPDs drop offline during LCHA and SUPHA.

To solve the FFT consuming resource issue, we have optimized legacy periodical FFT for both cBR8 and RPD.

- cBR-8 send whole FFT configuration for all upstream channel to RPD side at the beginning bulk config and period FFT polling on IOSd CLC side is removed.
- CDMAN inserts the **sm-rng** interval in each map message for all upstream channels on CLC. After every 1-second interval, RPD reports FFT sample data to cBR-8, every 1 second for one upstream channel.
- When upstream channel state changes, from up to down, or down to up, or when upstream channel mac domain binding state changes, from bind to unbind, or unbind to bind, RPD is notified about the changes with different TLV operation: WRITE or DELETE.
- You can run multiple FFTs by configuring one port on the RPD to run CM MAC FFT while the other port on this RPD and other RPDs on this line card continue periodical FFT and other types FFT.

Fast Fourier Transform Enhancements

The following changes are implemented in FFT to reduce memory and CPU resource consumption.

- The period FFT polling on the IOSd CLC side is removed. cBR-8 send whole FFT configuration for all upstream channels to the RPD side at the beginning bulk config.
- CDMAN inserts the **sm-rng** interval in each map message for all upstream channels on CLC. After every 1-second interval, RPD reports FFT sample data to cBR-8, every 1 second for one upstream channel.

- When upstream channel state changes, from up to down, or down to up, or when upstream channel mac domain binding state changes, from bind to unbind, or unbind to bind, RPD is notified about the changes with different TLV operation: WRITE or DELETE.
- In previous releases, if any RPD on the line card is running CM MAC FFT, then all other types of FFT are stopped for all RPDs on this line card. Starting with Cisco IOS XE Dublin 17.12.1x, you can configuring one port on RPD to run CM MAC FFT while the other port on this RPD and other RPDs on this line card continue periodical FFT and other types FFT.

Priority of Different FFT Types

There are several types of FFT, and they are prioritized in the following order:

1. CM MAC
2. One Time FFT Request (CLI and SNMP)
3. Periodical FFT polling
 - When CM MAC is running on one upstream controller, one time FFT request and periodical FFT polling on the upstream channel of this controller is disabled.
 - When a one-time FFT request is issued, periodical FFT polling on the same upstream channel is disabled. When a one-time FFT response is received, periodical FFT polling on this upstream channel is enabled again.

CM MAC Affection

As CM MAC has the highest priority, in previous releases, if any RPD on the line card is running CM MAC FFT, then all other types of FFT are stopped for all RPDs on this line card.

Starting with Cisco IOS XE Dublin 17.12.1x, we can make one port on RPD run CM MAC FFT while the other port on this RPD and other RPDs on this line card continue periodical FFT and other types FFT.

If multiple RPDs share the same upstream controller, and one RPD is running CM MAC on this controller, then all other RPDs sharing the same upstream controller must stop periodical FFT and one time FFT on the corresponding port using the same upstream controller.

CLIs

• Periodical FFT Show Command

```
router#show cable signal-quality cable 2/0/1 cmts
I/F          CNiR          Expected Received      Device ID
              (dB)          Signal Power (dBmV)   US Sharing
Cable2/0/1/U0  57.0          0.0                    0
Cable2/0/1/U0  -----          -----                1
Cable2/0/1/U0  -----          -----                2
Cable2/0/1/U0  -----          -----                3
Cable2/0/1/U0  -----          -----                4
Cable2/0/1/U0  -----          -----                5
Cable2/0/1/U0  -----          -----                6
Cable2/0/1/U0  -----          -----                7
Cable2/0/1/U1  58.0          0.0                    0
Cable2/0/1/U1  -----          -----                1
Cable2/0/1/U1  -----          -----                2
Cable2/0/1/U1  -----          -----                3
Cable2/0/1/U1  -----          -----                4
```

```

Cable2/0/1/U1      -----      -----      5
Cable2/0/1/U1      -----      -----      6
Cable2/0/1/U1      -----      -----      7
Cable2/0/1/U2      55.0        0.0          0
Cable2/0/1/U2      -----      -----      1
Cable2/0/1/U2      -----      -----      2
Cable2/0/1/U2      -----      -----      3
Cable2/0/1/U2      -----      -----      4
Cable2/0/1/U2      -----      -----      5
Cable2/0/1/U2      -----      -----      6
Cable2/0/1/U2      -----      -----      7
Cable2/0/1/U3      56.0        0.0          0
Cable2/0/1/U3      -----      -----      1
Cable2/0/1/U3      -----      -----      2
Cable2/0/1/U3      -----      -----      3

```

• One Time FFT Command – Spectrum Analyze Data

```

router#show cable spectrum-analysis cable 2/0/28 upstream 0 sid 14 devID 0
Spectrum Analysis Measurements for Cable2/0/28: Upstream 0 Sid 14
Device ID: 0
Channel Center Frequency: 11400 kHz
Frequency Span:          6400 kHz
Number of Bins:         257
Bin Spacing:            25.0 kHz
Resolution Bandwidth:   42.750 kHz
Amplitude Data:
  Bin  1: -35.00 dBmV
  Bin  2: -40.00 dBmV
  Bin  3: -32.00 dBmV
  Bin  4: -37.00 dBmV
  Bin  5: -30.00 dBmV
  Bin  6: -38.00 dBmV
  Bin  7: -28.00 dBmV
  Bin  8: -34.00 dBmV
  Bin  9: -27.00 dBmV
  Bin 10: -33.00 dBmV
  Bin 11: -30.00 dBmV
  Bin 12: -26.00 dBmV
  Bin 13: -25.00 dBmV
  Bin 14: -24.00 dBmV
  Bin 15: -22.00 dBmV
  Bin 16: -24.00 dBmV
  Bin 17: -26.00 dBmV
  .....
  Bin 249: -33.00 dBmV
  Bin 250: -34.00 dBmV
  Bin 251: -38.00 dBmV
  Bin 252: -43.00 dBmV
  Bin 253: -60.00 dBmV
  Bin 254: -60.00 dBmV
  Bin 255: -60.00 dBmV
  Bin 256: -60.00 dBmV
  Bin 257: -60.00 dBmV

```

• One Time FFT Command – CM CNR

```

router#scm c0c6.87ff.cdd0 cnr
Load for five secs: 47%/4%; one minute: 57%; five minutes: 59%
Time source is NTP, 17:33:07.936 CST Fri Nov 17 2023
MAC Address      IP Address      I/F           MAC           State          Prim  ExPwr  RxPwr  cnr
                  (dBmV)         (dBmV)        (dB)
c0c6.87ff.cdd0  116.1.26.204  C1/0/0/U8    w-online(pt)  22    0.0    0.00  > 40
c0c6.87ff.cdd0  116.1.26.204  C1/0/0/U9    w-online(pt)  22    0.0    0.00  > 40
c0c6.87ff.cdd0  116.1.26.204  C1/0/0/U10   w-online(pt)  22    0.0    0.00  > 40

```

```

c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U11 w-online(pt) 22 0.0 0.00 > 40
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U12 w-online(pt) 22 0.0 0.00 > 40
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U13 w-online(pt) 22 0.0 0.00 3
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U14 w-online(pt) 22 0.0 0.00 12
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U15 w-online(pt) 22 0.0 0.00 > 40

```



Note In new design, after one time CLI issued, we must wait 1s before sending the FFT request to RPD for each Upstream channel to make sure what we got is not periodical FFT packet.

So for the following command, for example, this modem has 8 upstream channels, the CLI response waiting time is at least 8s

```

router#scm c0c6.87ff.cdd0 cnr
Load for five secs: 47%/4%; one minute: 57%; five minutes: 59%
Time source is NTP, 17:33:07.936 CST Fri Nov 17 2023
MAC Address      IP Address      I/F      MAC      Prim
ExpWr  RxPwr  cnr
State      Sid
(dBmV) (dBmV) (dB)
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U8 w-online(pt) 22
0.0 0.00 > 40
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U9 w-online(pt) 22
0.0 0.00 > 40
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U10 w-online(pt) 22
0.0 0.00 > 40
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U11 w-online(pt) 22
0.0 0.00 > 40
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U12 w-online(pt) 22
0.0 0.00 > 40
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U13 w-online(pt) 22
0.0 0.00 3
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U14 w-online(pt) 22
0.0 0.00 12
c0c6.87ff.cdd0 116.1.26.204 C1/0/0/U15 w-online(pt) 22
0.0 0.00 > 40

```

• Periodical FFT Start/Stop Command

```

router#cable rpd all period-fft ?
start Start periodical FFT polling
stop Stop periodical FFT polling

router#cable rpd all period-fft stop
Confirm to continue? [no]: yes

router#cable rpd slot 1 period-fft ?
start Start periodical FFT polling
stop Stop periodical FFT polling
router#cable rpd slot 1 period-fft start
Confirm to continue? [no]: yes

router#cable rpd 0004.9f32.0019 period-fft ?
start Start periodical FFT polling
stop Stop periodical FFT polling

router#cable rpd 0004.9f32.0019 period-fft stop
Confirm to continue? [no]: yes

router#cable rpd 3.160.10.17 period-fft ?
start Start periodical FFT polling

```

```

stop    Stop periodical FFT polling

router#cable rpd 3.160.10.17 period-fft start
Confirm to continue? [no]: yes

```

Debug Commands

FFT Debug Command –CBR side

On SUP IOSd, enable upstream controller or channel debug:

```

L02#debug upstream-Cable 9/0 controller 32 ?
us-channel  US channel
<cr>        <cr>

```

On line card IOSd, enable specsvl debug:

```
Slot-9-0#test cable specsvl set dbg_cdm debug
```

Access the line card linux/tmp directory, which contains a file that is named as specsvl_fft_log which record the debug logs of CDMAN.

```
[L02_SIP_9:/tmp]$ ls specsvl_fft_log
```

For line card IOSd debug, use the following command.

```
Slot-9-0#debug cable specsvl
```

Use the following command to check CM MAC packet status, the countdown should keep decreasing.

```

router#show cable card 2/0 us-triggered-spectrum uts-common
Port 32 Dev 0 configuration
      UTSCOM event      START
      client_id         1
      test_id           1
      port              32
      dev               0
      phys_chan         8126466
      logi_chan         3
      sac_index         1
      trigger-mode      6
      frequency         24200000
      span              6400000
      bins              4096
      window            4
      output            1
      repeat-period     50000
      duration          1000
      trigger-count     10000
      qual-center-freq  0
      qual-bw           5120000
      qual-threshld    -100
WBFFT Dev    port, devId, trig-mode,data-ready, packets on WBFFT dev, countdown:
wbfft dev 0: 32    0 6      1      8      9992
wbfft dev 1: 64    8 0      0      0      0
wbfft dev 2: 64    8 0      0      0      0
wbfft dev 3: 64    8 0      0      0      0
wbfft dev 4: 64    8 0      0      0      0
wbfft dev 5: 64    8 0      0      0      0
wbfft dev 6: 64    8 0      0      0      0
wbfft dev 7: 64    8 0      0      0      0
total packets:      8

```

FFT Debug Command –CBR side

Use the following command to check whether FFT packet is increasing.

```
RPD#show bcm-register fft all 0 -----port number
FFT Start Ctrl [02060000] : 61
In Control [02060001] : 0246
Out Control[02060003] : 99
Timing Ctrl [02060004] : 00
Minislot Cnt [02060005] : 00000000
FFT SID [02060009] : 1FFF
LC_BYTE [0206000b] : 04
FFT MXR CTL [0206000c] : 8600
FFT FIRST WDW CF [0206000e] : 0920
FFT SCND WDW CF [02060010] : C660
FFT MIDL WDW CF [02060012] : 61E0
FFT Status [02060016] : 0206

FFT Chan Control [05180000] : 00000008
FFT Packet Count [05180004] : 00014A9C ----- capture cnt

increased means okay
FFT Error Count [05180008] : 00000017
FFT Overflow Cnt [0518000c] : 00000017
SCFFTS In Ctrl [d0000040] : 00000004
```



Note

- In the command, **show bcm-register fft all 0**,
0 indicated the port number.
- In the output line, In Control [02060001] : 0246 ,
02 indicates channel Number, and 46 indicates legacy FFT if 32 means CM MAC.
- In the output line, FFT Packet Count [05180004] : 00014A9C
this value indicates the capture count. If it has increased, it indicates it is fine.

Use the following command to check whether CM MAC is running and whether periodical FFT is disabled or not.

```
RPD#show bcm-register fft configuration 0
* NOTE: CM MAC configuration *

Enable CMMAC : True
SAC Index : 1
Channel Index : 0
Sid : 2
Trigger Count : 30000

RPD#show bcm-register fft configuration 1
* NOTE: legacy fft db configuration *

Port ID Chan ID Sid Frequency IUC Disable
1 0 8191 11400000 4 N
1 1 8191 17800000 4 N
1 2 8191 24200000 4 N
1 3 8191 30600000 4 N
```

Information about Proactive Network Management

Proactive Network Management (PNM) enables you to measure and report conditions in the network. The PNM detects, identifies, and quantifies undesired impacts to the network, such as cable faults and ingress noise. The DOCSIS 3.1 PHY specification defines the different types of tests and measurements that can be performed at CCAP and CM. You can leverage this information to make the necessary modifications that can improve conditions and monitor networking trends to detect when network improvements are needed.

The PNM tests and receives data output from the CMTS using the Simple Network Management Protocol (SNMP) objects. The PNM feature is supported on RPHY.

Proactive Network Management for Supervisor High Availability, Line Card High Availability and containers

PNM Supervisor High Availability support ensures that all captures are stopped and all the captures states in the Line Card and Supervisor client are cleaned up when Supervisor High Availability happens. You can create new capture configurations and initiate tests on the newly active supervisor through SNMP.

cBR supports Line Card High Availability and Line Card Process Restart for Proactive Network Management, and will support the restart of any test in progress.

Active syncing of capture data between active and standby SUP is not supported for Proactive Network Management. After switchover, all new captures must be configured by the user/client again.

Bulk Data Transfer MIBs enables configuration of the following parameters for PNM:

- TFTP server bulk data transfer IP address
- TFTP server bulk data transfer path

Proactive Network Management Using Upstream Triggered Spectrum Capture

Cisco cBR-8 supports Upstream Triggered Spectrum Capture (UTSC). The upstream triggered spectrum analysis measurement provides a wideband spectrum analyzer in the CCAP which can be triggered to examine upstream transmissions and underlying noise or interference during a quiet period.

The Cisco cBR-8 supports the following Upstream Triggered Spectrum Capture objects:

- `UsTriggeredSpectrumCaptureFile`
- `UsTriggeredSpectrumCaptureCfg`
- `UsTriggeredSpectrumCaptureCtrl`
- `UsTriggeredSpectrumCaptureStatus`
- `UsTriggeredSpectrumCaptureCapabilities`
- `CCAPBulkDataControl`

The Cisco cBR-8 router enables you to trigger a spectrum sample capture and perform spectrum-analysis using the FreeRun mode. FreeRun mode is a continuous-mode with a maximum of 10 samples per second stacked on each capture file).

The CCAP supports one client configuration per port on a line card. Create a capture configuration entry before attempting to start or stop the capture tests. The interface index key for the `UsTriggeredSpectrumCaptureCfg` object defines the one capture configuration for the FreeRun trigger mode.

The Cisco cBR-8 supports only one capture per end-user client per port simultaneously. Hence, the CCAP sets the Upstream Triggered Spectrum Capture configuration index to 1. The Cisco cBR-8 does not support a PNM MIB query for an Upstream Triggered Spectrum Capture configuration index other than 1. The Cisco cBR-8 supports a maximum of eight captures on upstream ports per line card. The Cisco cBR-8 supports a maximum of 20 captures per router for RPHY.

The Cisco cBR-8 does not support the following scenarios:

- `UsTriggeredSpectrumCaptureResult` MIB
- Simultaneous captures on adjacent ports on CLC
- RPD support captures only one us-port per RPD at a given time.
- `docsPnmCmtsUtscCfgFilename` OID



Note The `UsTriggeredSpectrumCaptureConfiguration` MIB is supported. The `docsPnmCmtsUtscCfgFilename` OID under this MIB is not supported only for UTSC capture mode for PNM.

The PNM IOX container is used for the TFTP transfer of capture files to a user configured destination server. The **guestshell** IOX container for TFTP transfer of PNM files is supported. The PNM executable is built into the guestshell that is packaged as part of cbr8 image. This executable must be installed on both active and standby SUP manually.

Starting with Cisco IOS XE Dublin 17.12.1, the guestshell supports multiple BDTs. You can configure guestshell for IPv4 in all UTSC modes. For UTSC Other trigger mode, you can configure only in IPv6.

Step 1 Ensure that the guestshell container is running before the captures are started to ensure successful TFTP operation. Use the **show app-hosting list** command to check if the guestshell container is running.

Example:

```
Router# show app-hosting list
App id                               Stat
-----
guestshell                            RUNNING
```

Step 2 The app-hosting CLI is used to install, deploy, start, and stop the IOX container.

Example:

```
Router# show run | begin app-hosting
app-hosting appid guestshell
app-vnic gateway0 virtualportgroup 4 guest-interface 0
guest-ipaddress 9.32.254.2 netmask 255.255.255.0
app-default-gateway 9.32.254.1 guest-interface
```

Step 3 Ensure that the python is running on the guestshell container.

Example:

```
cBR8#guestshell run python -V
Python 2.7.5
```

Step 4 Ensure that the PNM TFTP process is active and running on the guestshell container.

Example:

```
cBR8#guestshell run systemctl status pnm
pnm.service - cbr pnm telemetry delivery system
   Loaded: loaded (/etc/systemd/system/pnm.service; disabled; vendor preset: disabled)
   Active: active (running) since Wed 2019-01-09 15:13:40 UTC; 9min ago
```

The PNM capture tests generate files to report measurements or test results. The results file includes header information that is common to all types of PNM tests and fields. The file also includes data that is specific to the type of PNM test. The abstract `PnmCaptureFile` object defines the attributes and format of the header information common to all PNM test files. File header fields are right-justified within the field and left-padded with zero values if necessary.

The following fields define the header for the `PnmCaptureFile` object for Upstream Spectrum Triggered Capture tests.

- **FileType** - A four-byte hexadecimal identifier specific to the type of PNM test that generated the data file.
For Upstream Triggered Spectrum Capture, the file type is 0x504e4e6a.
- **Major Version** - This attribute represents the file header version. This value is incremented by one when the header format is modified by this specification.
For Upstream Triggered Spectrum Capture, major version is 0x1.
- **Minor Version** - This attribute is reserved for vendor-specific and vendor-defined version information.
For Upstream Triggered Spectrum Capture, minor version is 0x0.
- **CaptureTime** - This attribute represents the epoch time (also known as 'UNIX time') which is the number of seconds that have elapsed since midnight Coordinated Universal Time (UTC), Thursday, 1 January 1970.
- **IfIndex** - This attribute represents the ifIndex of the upstream RF port sampled.
- **UniqueCcapId** - A 256-byte hexadecimal field representing a unique CCAP identifier (either a loopback address (IPv4 or IPv6) or FQDN). This value is a null-terminated string.
For Upstream Triggered Spectrum Capture, this value is the 'hostname' of the CMTS.

Proactive Network Management Interface Index

To determine which slot/subslot/port of an ifindex translates to that of RPHY, see the mapping in the running configuration.

Before you begin

The Upstream Triggered Spectrum Capture – The Cisco cBR-8 router supports multiple RPDs per line card with multiple US-ports. However, on RPDs, you can configure only one US-port and initiate the captures anytime.

For RPHY, it is not mandatory that the US port is bound to a MAC domain. If it is configured under an RPD, it can be configured for PNM.

The SNMP ifindex for MIB objects can be obtained using the show CLI:

```
Router# show snmp mib ifmib ifindex | i 0053.0013.2be0
RPD(0053.0013.2be0)-usport0: Ifindex = 435564
```

where 0053.0013.2be0 is the RPD identifier.

Step 1 Run the following show command to identify the SNMP ifindex value:

```
Router# show snmp mib ifmib ifindex | i 435564
RPD(0053.0013.2be0)-usport0: Ifindex = 435564
```

Step 2 Run the following command to identify the slot/subslot/port an ifindex that translates to RPHY:

```
Router# show run | b 0053.0013.2be0
identifier 0053.0013.2be
core-interface Tel1/1/0
principal
rpd-ds 0 downstream-cable 1/0/2 profile 2
rpd-us 0 upstream-cable 1/0/2 profile 21
```

The slot/subslot/port is upstream-cable 1/0/2 profile 21.



Note Cisco IOS XE Gibraltar 16.10.1g introduces an RPHY ifIndex change. Ensure that you have gone through the following updates to enable the changes:

- The RPHY ifIndex feature removes the Cisco private ifIndex for RPHY channels (ifIndex starting from 41,000). The ifIndex are not created manually. All the ifIndex are created automatically when configuring RPD. It is applicable for ifIndex starting from 41w for US (if-type 205) and DS (if-type 128). The RPHY ifIndex feature does not work for ifIndex values that are greater than 41w.

Before the ifIndex feature, in 16.10.1f and earlier releases:

```
Router# show snmp mib ifmib ifindex | i RPD
Upstream-Cable3/0/63:0-RPD(0053.0013.420c)-usport0: Ifindex = 421224
.....
RPD(0053.0013.420c)-usport0: Ifindex = 435560
RPD(0053.0013.420c)-dsport0: Ifindex = 436584
Downstream-Cable3/0/31:0-RPD(0053.0013.420c)-dsport0: Ifindex = 437608
Downstream-Cable3/0/31:1-RPD(0053.0013.420c)-dsport0: Ifindex = 437609
```

With the ifIndex feature, in 16.10.1g:

```
Router# show snmp mib ifmib ifindex | s RPD
RPD(0053.0013.420c)-usport0: Ifindex = 415080
RPD(0053.0013.420c)-dsport0: Ifindex = 416104
```

- The RPHY ifIndex reimplement CoreToRpdMap/RpdToCoreMap tables to keep them aligned with DOCS-RPHY-MIB-2018-07-26 definition.

You do not need to create a new ifIndex for US (if-type 205) and DS (if-type 128) channels when they are configured to RPD. For versions before Cisco IOS XE Gibraltar 16.10.1g, it was required to create a new ifIndex (>41k) for US (if-type 205) and DS (if-type 128) channels when they are configured to RPD:

```
[CBR]#show snmp mib ifmib ifindex | s RPD
RPD(0053.0013.420c)-usport0: Ifindex = 415080
RPD(0053.0013.420c)-dsport0: Ifindex = 416104
```

With the Cisco cBR-8 16.10.1g RPHY ifIndex feature, you do not need to manually populate any extra item in legacy MIBs.

With the Cisco cBR-8 16.10.1g RPHY ifIndex feature, you must reimplement docsRphyRpdIfCoreToRpdMapTable / docsRphyRpdIfRpdToCoreMapTable, not mapping to ifIndex (>41k) for US (if-type 205) and DS (if-type 128). See the following:

```
/* docsRphyRpdIfCoreToRpdMapRpdRfChanType OID :1.3.6.1.4.1.4491.2.1.30.1.2.6.1.5
   Table Index: docsRphyRpdIfCoreToRpdMapRpdCoreIndex, docsRphyRpdIfCoreToRpdMapRpdUniqueId,
   docsRphyRpdIfCoreToRpdMapRpdRfPortDirection, docsRphyRpdIfCoreToRpdMapRpdRfPortIndex*/
SNMPv2-SMI::enterprises.4491.2.1.30.1.2.6.1.5.403561.0.4.159.51.0.145.2.0 = INTEGER:
usAtdma(5)
SNMPv2-SMI::enterprises.4491.2.1.30.1.2.6.1.5.322358.0.4.159.51.0.145.1.0 = INTEGER:
dsScQam(1)
IF-MIB::ifType.403561 = INTEGER: docsCableUpstream(129)
IF-MIB::ifType.322358 = INTEGER: other(1)
```

```
[CBR]#show snmp mib ifmib ifindex
Cable9/0/0-upstream1: Ifindex = 403561
Downstream-Cable9/0/4-downstream14: Ifindex = 322358
```

- If RfChanType is usAtdma(5), ifType of docsRphyRpdIfCoreToRpdMapRpdCoreIndex is ifType docsCableUpstream(129)
- If RfChanType is dsScQam(1), ifType of docsRphyRpdIfCoreToRpdMapRpdCoreIndex is other(1).

Upstream Triggered Spectrum Capture Configuration Parameters

The following configuration parameters for Upstream Triggered Spectrum Capture are supported. Examples of using the MIBs are also included.



Note PNM capture configuration on cBR8 is supported only through SNMP user interface. Configuration examples for MIB commands for PNM are provided in the following sections with examples using both snmpr (setany/getone commands) as well as net-snmp tools (snmpset/snmpget commands).

Upstream Triggered Spectrum Capture Configuration Objects

The following Upstream Triggered Spectrum Capture configuration objects are supported:

- PNM UTSC OBJECTS OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10
- PNM UTSC CAPTURE CONFIGURATION OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.X.Y.Z

Where X is the capture config parameter, Y is Ifindex, and Z is the PNM UTSC Config Index – Which is always 1. Currently only one capture configuration per upstream port is supported.

- The following capture configuration parameters are supported, and the corresponding MIB OID value is listed.

Table 3: Supported capture configuration parameters and the corresponding MIB OID value

Capture configuration parameters	Corresponding MIB OID value
I_docsPnmCmtsUtscCfgTriggerMode	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3
I_docsPnmCmtsUtscCfgCmMacAddr	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.6
I_docsPnmCmtsUtscCfgCenterFreq	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8
I_docsPnmCmtsUtscCfgSpan	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9
I_docsPnmCmtsUtscCfgNumBins	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10
I_docsPnmCmtsUtscCfgAveraging	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.11
I_docsPnmCmtsUtscCfgQualifyCenterFreq	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.13
I_docsPnmCmtsUtscCfgQualifyBw	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.14
I_docsPnmCmtsUtscCfgQualifyThrshld	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15
I_docsPnmCmtsUtscCfgWindow	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16
I_docsPnmCmtsUtscCfgOutputFormat	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17
I_docsPnmCmtsUtscCfgRepeatPeriod	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18
I_docsPnmCmtsUtscCfgFreeRunDuration	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19
I_docsPnmCmtsUtscCfgTriggerCount	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20

Capture configuration parameters	Corresponding MIB OID value
I_docsPnmCmtsUtscCfgStatus	1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21

Starting from Cisco IOS XE Gibraltar 16.12.1x release, PNM output format 'timeIQ' and UTSC trigger mode 'cmMac' are supported in upstream triggered spectrum capture configuration objects.

Below is an example of the SNMP command configuration with PNM output format 'timeIQ' and UTSC trigger mode 'cmMac'.

```
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 x "0B 01 01 0C"
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0 s "path"

snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.415084.1 i 6
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.415084.1 i 4
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.2.415084.1 i ifindex
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.415084.1 i 6
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.6.415084.1 x "CM
MAC"
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.415084.1 u 16400000
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.415084.1 u 6400000
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.415084.1 u 1024
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.11.415084.1 u 245
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.13.415084.1 u 10240000
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.14.415084.1 u 25600000
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15.415084.1 i -200
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.415084.1 i 3
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.415084.1 i 1
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18.415084.1 u 25000
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19.415084.1 u 5000
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20.415084.1 u 500
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.415084.1 i 1
snmpset -v2c -c private 10.74.54.13 1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.415084.1 i 1
```

Upstream Triggered Spectrum Capture Configuration MIB Objects

The following Upstream Triggered Spectrum Capture configuration MIB objects are supported for PNM:

- `CaptureCfg` – Contains the test trigger mode and its required configuration.
- `CaptureCtrl` – Controls when the test is started and stopped.
- `CaptureStatus` – Contains the current status of the test.
- `CaptureCapability` – Exposes CCAP Upstream Triggered Spectrum Capture capabilities.

The following Upstream Triggered Spectrum Capture configuration MIBs are supported. SNMP walk is supported for all the MIB objects.

- `docsPnmCmtsUtscCfgTriggerMode` - This attribute indicates which upstream triggered spectrum capture function trigger modes are supported. Only FreeRun is supported.

Starting with Cisco IOS XE Dublin 17.12.1, UTSC supports three trigger modes: FreeRun, Other, and CM-MAC.

The following are the enumerated values for trigger mode for PNM.

- `D_docsPnmCmtsUsSpecAnTrigMode_other 1`
- `D_docsPnmCmtsUsSpecAnTrigMode_freeRunning 2`

- D_docsPnmCmtsUsSpecAnTrigMode_sid 4
- D_docsPnmCmtsUsSpecAnTrigMode_idleSid 5
- D_docsPnmCmtsUsSpecAnTrigMode_minislotNumber 6
- D_docsPnmCmtsUsSpecAnTrigMode_cmMac 6

- For FreeRun mode, the CCAP initiates sampling and continues sampling until the time duration configured in the attribute FreeRunDuration has transpired. Sampling terminates when the time duration configured in FreeRunDuration has elapsed or when FFT is disabled. The interval between captures is the greater of RepeatPeriod and the minimum period that is supported by the CCAP.
- From Cisco IOS XE Gibraltar 16.12.1x release, PNM output format 'timeIQ' and UTSC trigger mode 'cmMac' are supported in upstream triggered spectrum capture configuration objects.
- Trigger mode set and get examples:

- **snmp** commands:

```

server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.<ifIndex>.1 -i 2
clabProjDocsis.27.1.3.10.2.1.3.<ifIndex>.1 = 2

server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.<ifIndex>.1
clabProjDocsis.<ifIndex> = 2

```

- **net-snmp** commands:

```

server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.<ifIndex>.1 i 2
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.3.<ifIndex>.1 = INTEGER: 2

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.3.<ifIndex>.1 = INTEGER: 2

```

- docsPnmCmtsUtscCfgCenterFreq - This attribute specifies the center frequency of the upstream spectrum to be sampled for analysis.

- **snmp** commands:

```

server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1 -g 102400000
clabProjDocsis.27.1.3.10.2.1.8.<ifIndex> = 102400000

server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.8.<ifIndex>.1 = 102400000

```

- **net-snmp** commands:

```

server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1 u 102400000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1 = Gauge32: 102400000

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1 = Gauge32: 102400000

```

- `docsPnmCmtsUtscCfgSpan` - This attribute determines the frequency span of the upstream spectrum sample capture. When this attribute is read, it provides the actual span, which may be different from the requested (configured) span due to implementation effects.

- **snmp** commands:

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.<ifIndex>.1 -g 204800000
clabProjDocsis.27.1.3.10.2.1.9.<ifIndex>.1 = 204800000

server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.9.<ifIndex>.1 = 204800000
```

- **net-snmp** commands:

```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.<ifIndex>.1 u 204800000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.9.<ifIndex>.1 = Gauge32: 204800000

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.9.<ifIndex>.1 = Gauge32: 204800000
```



Note The center frequency and span capture parameters are set to zero as per OSSI specifications on capture configuration entry creation. For freerun trigger mode, you must set these values in the valid range to run capture tests on the port.

- `docsPnmCmtsUtscCfgNumBins` - This attribute determines the number of frequency bins or samples per span when sampling the upstream spectrum. This attribute provides the actual number of bins, which may be different from the configured number due to implementation effects.

- **snmp** commands

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.<ifIndex>.1 -g 4096
clabProjDocsis.27.1.3.10.2.1.10.<ifIndex>.1 = 4096

server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.10.<ifIndex>.1 = 4096
```

- **net-snmp** commands

```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.<ifIndex>.1 u 4096
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.10.<ifIndex>.1 = Gauge32: 4096

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.10.<ifIndex>.1 = Gauge32: 4096
```

- `docsPnmCmtsUtscCfgAveraging` - This attribute specifies whether the CCAP should average spectral frequency domain sample power to remove spurious spectral peaks and troughs and the number of samples to use to calculate the average power. The CCAP must not calculate the average of the upstream spectrum

samples when the value of Averaging is zero. The CCAP MUST calculate the average power of upstream spectrum samples, over the number of samples that are specified, when the value of the Averaging attribute is nonzero.

- **snmpr commands**

```

• server > setany -v2c <cmts_ip> <community_name>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.11.<ifIndex>.1 -g 245
  clabProjDocsis.27.1.3.10.2.1.11.<ifIndex>.1 = 245

• server > getone -v2c <cmts_ip> <community_name>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.11.<ifIndex>.1 u 245
  clabProjDocsis.27.1.3.10.2.1.11.<ifIndex>.1 = 245

```

- **net-snmp commands**

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.11.<ifIndex>.1 u 245
  SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.11.<ifIndex>.1 = Gauge32: 245

• server > snmpget -v2c -c <community_name> <cmts_ip>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.11.<ifIndex>.1
  SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.11.<ifIndex>.1 = Gauge32: 245

```

- docsPnmCmtsUtsCcfgCmMacAddr - This attribute specifies the cable modem from which the CCAP captures upstream transmissions. This attribute is used only when the TriggerMode is CmMac and is ignored otherwise.

- **net-snmp commands**

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.6.<ifIndex>.1
  x "CM-MAC"

• server > snmpget -v2c -c <community_name> <cmts_ip>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.6.<ifIndex>.1

```

- docsPnmCmtsUtsCcfgQualifyCenterFreq - This attribute specifies the center frequency of a band that is used to qualify a spectrum for upload. The average of the FFT linear power values in this band is computed and compared to a threshold. If the average power in the band is below the threshold, the spectrum is discarded. If the power average is greater than or equal to the threshold, the spectrum is considered qualified.

- **snmpr commands**

```

• server > setany -v2c <cmts_ip> <community_name>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.13.<ifIndex>.1 -g 102400000
  clabProjDocsis.27.1.3.10.2.1.13.<ifIndex>.1 = 102400000

• server > getone -v2c <cmts_ip> <community_name>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.13.<ifIndex>.1
  clabProjDocsis.27.1.3.10.2.1.13.<ifIndex>.1 = 102400000

```

- **net-snmp commands**

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
  1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.13.<ifIndex>.1 u 102400000
  SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.13.<ifIndex>.1 = Gauge32:
  102400000

```

```

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.13.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.13.<ifIndex>.1 = Gauge32:
102400000

```

- docsPnmCmtsUtscCfgQualifyBw - This attribute specifies the bandwidth of a band that is used to qualify a spectrum for upload. The average of the FFT linear power values in this band is computed and compared to a threshold. If the average power in the band is below the threshold, the spectrum is discarded. If the power average is greater than or equal to the threshold, the spectrum is considered qualified.

- **snmpr** commands:

```

• server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.14.<ifIndex>.1 -g 25600000
clabProjDocsis.27.1.3.10.2.1.14.<ifIndex>.1 = 25600000

• server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.14.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.14.<ifIndex>.1 = 25600000

```

- **net-snmp** commands:

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.14.<ifIndex>.1 u 25600000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.14.<ifIndex>.1 = Gauge32: 25600000

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.14.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.14.<ifIndex>.1 = Gauge32: 25600000

```

- docsPnmCmtsUtscCfgQualifyThrshld - This attribute specifies the threshold that is applied to qualify a spectrum for upload. The average of the FFT linear power values in the specified band is computed and compared to this threshold. If the average power in the band is below the threshold, the spectrum is discarded. If the power average is greater than or equal to the threshold, the spectrum is considered qualified.

- **snmpr** commands

```

• server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15.<ifIndex>.1 -i 200
clabProjDocsis.27.1.3.10.2.1.15.<ifIndex> = -200

• server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.15.<ifIndex>.1 = -200

```

- **net-snmp** commands

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15.<ifIndex>.1 i -200
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.15.<ifIndex>.1 = INTEGER: -200

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.15.<ifIndex>.1 = INTEGER: -200

```

- docsPnmCmtsUtscCfgWindow - This attribute indicates which of the upstream triggered spectrum capture function window formats are supported by the CCAP. Currently Cisco cBR-8 supports rectangular

(default), Blackmann-Harris, and Hann and Hamming formats. The following are the enumerated values for window mode for PNM.

- D_docsPnmCmtsUtscCfgWindow_other 1
- D_docsPnmCmtsUtscCfgWindow_rectangular 2
- D_docsPnmCmtsUtscCfgWindow_hann 3
- D_docsPnmCmtsUtscCfgWindow_blackmanHarris 4
- D_docsPnmCmtsUtscCfgWindow_hamming 5
- D_docsPnmCmtsUtscCfgWindow_flatTop 6
- D_docsPnmCmtsUtscCfgWindow_gaussian 7
- D_docsPnmCmtsUtscCfgWindow_chebyshev 8

- Window mode set and get examples:

- **snmpr** commands:

```

server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1 -i 3
clabProjDocsis.27.1.3.10.2.1.16.<ifIndex>.1= 3

server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.16.<ifIndex>.1 = 3

server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1 -i 6
Error code set in packet - COMMIT_FAILED_ERROR: 1.

```

- **net-snmp** commands:

```

server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1 i 3
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1 = INTEGER: 3

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1 = INTEGER: 3

server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1 i 6
Error in packet.
Reason: commitFailed
Failed object: SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.16.<ifIndex>.1

```



Note

- Flat-top, Gaussian, and Chebyshev window-modes are not supported.
-

- docsPnmCmtsUtscCfgOutputFormat - This attribute indicates the upstream triggered spectrum capture function data output formats that are supported by the CCAP. The CCAP is capable of reporting upstream spectrum sample FFT output data in power format. The enumeration value for power format is fftPower.

CCAP supports time-IQ and fftPower output format. The time-IQ is supported from Cisco IOS XE Gibraltar 16.12.1x. The following are the enumerated values for output format mode for PNM.

- D_docsPnmCmtsUtscCfgOutputFormat_timeIQ 1
- D_docsPnmCmtsUtscCfgOutputFormat_fftPower 2
- D_docsPnmCmtsUtscCfgOutputFormat_rawAdc 3
- D_docsPnmCmtsUtscCfgOutputFormat_fftIQ 4
- D_docsPnmCmtsUtscCfgOutputFormat_fftAmplitude 5
- D_docsPnmCmtsUtscCfgOutputFormat_fftDb 6

• Output format mode set and get examples:

• **snmp** commands:

- ```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1 -i 2
clabProjDocsis.27.1.3.10.2.1.16.<ifIndex>.1 = 2
```
- ```
server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.17.<ifIndex>.1 = 2
```
- ```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1 -i 4
Error code set in packet - COMMIT_FAILED_ERROR: 1.
```

• **net-snmp** commands:

- ```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1 i 2
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1 = INTEGER: 2
```
- ```
server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1 = INTEGER: 2
```
- ```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1 i 4
```
- ```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.<ifIndex>.1 i 1
```




---

**Note** Only the `fft-pwr` and `time-IQ` output formats are currently supported.

---

- `docsPnmCmtsUtscCfgRepeatPeriod` - This attribute specifies the length of time in milliseconds for which the CCAP continues to capture and return FFT results when in free running mode. The CCAP is permitted to trigger at larger intervals if unable to support the requested interval. Configuring a zero value indicates that the test is to run once only.
- The Repeat Period is configured in microseconds and default is 50000 usec. The CCAP MUST reject an attempt to set RepeatPeriod to a value greater than the current value of FreeRunDuration.

- Repeat Period set and get examples:

- **snmpr** commands:

```

• server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 -g 25000
clabProjDocsis.27.1.3.10.2.1.18.<ifIndex>.1 = 25000

• server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.18.<ifIndex>.1 = 25000

```

- **net-snmp** commands:

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 u 25000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 25000

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 25000

```

- docsPnmCmtsUtsCCfgFreeRunDuration - This attribute specifies the length of time in milliseconds for which the CCAP continues to capture and return FFT results when in free running mode. Sample captures are expected to take a few microseconds. If FreeRunDuration is set for longer than a sample capture duration, the CCAP could potentially capture more sample data than it can store.
- The CCAP MUST reject an attempt to set FreeRunDuration to a value less than the current value of RepeatPeriod. Freerun duration is configured in millisecond and the default value is 1000ms (1 second). The CCAP CLC currently captures 10 samples per second stacked in a single file. With default freerun duration configuration, there will be 11 samples.
- FreeRun Duration set and get examples:

- **snmpr** commands

```

• server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19.<ifIndex>.1 -g 5000
clabProjDocsis.27.1.3.10.2.1.19.<ifIndex>.1 = 5000

• server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.19.<ifIndex>.1 = 5000

```

- **net-snmp** commands

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19.<ifIndex>.1 u 5000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.19.<ifIndex>.1 = Gauge32: 5000

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.19.<ifIndex>.1 = Gauge32: 5000

```

- docsPnmCmtsUtsCCfgTriggerCount - This attribute determines the number of times to trigger upstream spectrum sample capture when Enable and InitiateTest are set to true and configured trigger conditions are met. The trigger count configuration does NOT apply and is ignored by CCAP for captures in FreeRun trigger mode.

- Trigger count set and get examples:

- **snmpr** commands

```

• server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20.<ifIndex>.1 -g 200
clabProjDocsis.27.1.3.10.2.1.20.<ifIndex>.1 = 200

• server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.20.<ifIndex>.1 = 200

```

- **net-snmp** commands

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20.<ifIndex>.1 u 200
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.20.<ifIndex>.1 = Gauge32: 200

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.20.<ifIndex>.1 = Gauge32: 200

```

- docsPnmCmtsUtscCfgStatus - This attribute determines the creation, deletion, and change of status of an actual capture configuration entry on any port of the CCAP CLC. All capture entries must first be created by a client on a port before attempting to initiate any tests on the port. Thereby the client ‘owns’ that port and its configuration after creation. No other client can run any tests on the port till the currently active client ‘destroys’ the configuration entry and thereby releases ownership of that port.
- Any tests on a given port that is owned by a client can be run only when the capture configuration status is ‘Active’. When a configuration is created, it is created with certain default values and marked ‘Not Ready’. All capture parameters must be configured in valid range for the capture entry status to become ‘Active’. If the configuration values for various capture parameters are modified by the user/client and not according to the OSSI specification, the configuration status of the entry will be marked ‘NotReady’.
- A capture configuration entry cannot be modified to any state unless created first. An entry cannot be recreated without destroying the previous version first. An entry cannot be modified when capture tests are currently running on the port.
- The following are the enumerated values for configuration entry status for PNM:

- D\_docsPnmCmtsUtscCfgStatus\_active 1
- D\_docsPnmCmtsUtscCfgStatus\_notInService 2
- D\_docsPnmCmtsUtscCfgStatus\_notReady 3
- D\_docsPnmCmtsUtscCfgStatus\_createAndGo 4
- D\_docsPnmCmtsUtscCfgStatus\_createAndWait 5
- D\_docsPnmCmtsUtscCfgStatus\_destroy 6

- Utsc Configuration Entry set/get example:

- **snmpr** commands

```

• server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1 -i 4
clabProjDocsis.27.1.3.10.2.1.21.<ifIndex>.1 = 4

```

```

• server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1
clabProjDocsis.27.1.3.10.2.1.21.<ifIndex>.1 = 1

```

- **net-snmp** commands

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1 i 4
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1 = INTEGER: 4

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1 = INTEGER: 3

```




---

**Note** A configuration can be created with certain default values and is marked 'Not Ready'. It is only changed to 'Active' when valid capture configuration parameters are configured by the user. Capture tests can only be run on configurations that are 'Active'.

---

- Set multiple capture config parameters at the same time.

```

• Server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 -g 45000
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20.<ifIndex>.1 -g 10
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1 -g 100000000
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.<ifIndex>.1 -g 8092
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15.<ifIndex>.1 -i -100
clabProjDocsis.27.1.3.10.2.1.18.<ifIndex>.1 = 45000
clabProjDocsis.27.1.3.10.2.1.20.<ifIndex>.1 = 10
clabProjDocsis.27.1.3.10.2.1.8.<ifIndex>.1 = 100000000
clabProjDocsis.27.1.3.10.2.1.10.<ifIndex>.1 = 8092
clabProjDocsis.27.1.3.10.2.1.15.<ifIndex>.1 = -100 10.3.1.1.<ifIndex>.1 = 0

```

SNMP walk is supported for all the above MIB objects.

The following is an example of SNMP walk on upstream triggered spectrum capture configuration parameter repeat period:

```

server > snmpwalk -v2c <cmts_ip> -c <community_name> 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18

SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 45000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 45000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 45000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 45000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 45000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 45000
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.18.<ifIndex>.1 = Gauge32: 50000
<<!--snip-->

```

## Upstream Triggered Spectrum Capture Control Objects and MIBs

The following Upstream Triggered Spectrum Capture control objects and MIBs are supported:

- PNM UTSC OBJECTS OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10
- PNM UTSC CAPTURE CONTROL OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.Y.Z

Where Y is Ifindex, and Z is the PNM Upstream Triggered Spectrum Capture Configuration Index – Which is always 1. Currently only one capture configuration per upstream port is supported.

- The capture control entry can be used to start captures or stop any active captures. The `docsPnmCmtsUtscCtrlInitiateTest` is a boolean value which when set, initiates a capture.
- Starting a capture (You can only start a capture only if you have configured and owned the port, and if the capture configuration entry is active).

- **snmpr** commands:

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 -i 1
clabProjDocsis.27.1.3.10.3.1.1.<ifIndex>.1 = 1

server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1
clabProjDocsis.27.1.3.10.3.1.1.<ifIndex>.1 = 1
```

- **net-snmp** commands:

```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 i 1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 = INTEGER: 1

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 = INTEGER: 1
```

- Stop a capture (You can stop an active capture only if you own that port):

- **snmpr** commands:

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 -i 2
clabProjDocsis.27.1.3.10.3.1.1.<ifIndex>.1 = 2

server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1
clabProjDocsis.27.1.3.10.3.1.1.<ifIndex>.1 = 2
```




---

**Note** Ensure that you pass a value '2', for the **setany** command to stop the capture.

---

- **net-snmp** commands:

```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 i 2
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 = INTEGER: 2

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 = INTEGER: 2
```





**Note** Ensure that you pass a value '2', for the **snmpset** command to stop the capture.

## Upstream Triggered Spectrum Capture Status Objects and MIBs

The following Upstream Triggered Spectrum Capture status objects and MIBs are supported:

- PNM UTSC OBJECTS OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10
- PNM UTSC CAPTURE STATUS OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10.4.1.1.Y.Z  
Where Y is Ifindex, and Z is the PNM Upstream Triggered Spectrum Capture Configuration Index – Which is always 1. Currently only one capture configuration per upstream port is supported.
- The capture status MIB is a read-only MIB. It reports the status of the capture on a given port (if owned by that client).
- When the value is `sampleReady`, the CCAP has completed capturing and recording samples. Following are the enumerated values for capture status entry for PNM.

- `D_docsPnmCmtsUtscStatusMeasStatus_other 1`
- `D_docsPnmCmtsUtscStatusMeasStatus_inactive 2`
- `D_docsPnmCmtsUtscStatusMeasStatus_busy 3`
- `D_docsPnmCmtsUtscStatusMeasStatus_sampleReady 4`
- `D_docsPnmCmtsUtscStatusMeasStatus_error 5`
- `D_docsPnmCmtsUtscStatusMeasStatus_resourceUnavailable 6`
- `D_docsPnmCmtsUtscStatusMeasStatus_sampleTruncated 7`

- The status is `inactive` when the capture configuration entry is created and is marked `busy` when the tests are actively running on the port. Any platform resource limitation to run a test to make the status `'resource unavailable'` and the error encountered while running a test would mark the status as `'error'`.
- Get capture status on a port (You can get the status of capture on the port only if you own that port).

- **snmpr** commands:

```
server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.4.1.1.<ifIndex>.1
clabProjDocsis.27.1.3.10.4.1.1.<ifIndex>.1 = 4
```

- **net-snmp** commands:

```
server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.4.1.1.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.4.1.1.<ifIndex>.1 = INTEGER: 4
```

## Upstream Triggered Spectrum Capture Capability Objects and MIBs

The following Upstream Triggered Spectrum Capture capability objects and MIBs are supported for PNM:

- PNM UTSC OBJECTS OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10
- PNM UTSC CAPTURE CAPABILITY OID: 1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.X.Y

Where X is the capability parameter and Y is the Ifindex.

- The capture capability MIB is a read-only MIB. The Upstream Triggered Spectrum Capture Capabilities object exposes capabilities that are supported by the CCAP for Upstream Triggered Spectrum Capture trigger modes, data output formats, and windowing function used when performing the discrete Fourier transform.
- The following are the enumerated values for capture capability entry for PNM for CCAP.
  - docsPnmCmtsUtscCapabTriggerMode 1
  - docsPnmCmtsUtscCapabOutputFormat 2
  - docsPnmCmtsUtscCapabWindow 3
  - docsPnmCmtsUtscCapabDescription 4

- Get capture capability on a port:

- **snmp** commands:

- `server > getone -v2c <cmts_ip> <community_name>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.1.<ifIndex>  
docsPnmCmtsObjects.10.1.1.1.<ifIndex> = 00 02`
- `server > getone -v2c <cmts_ip> <community_name>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.2.<ifIndex>  
docsPnmCmtsObjects.10.1.1.2.<ifIndex> = 04`
- `server > getone -v2c <cmts_ip> <community_name>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.3.<ifIndex>  
docsPnmCmtsObjects.10.1.1.3.<ifIndex> = 1e`
- `server > getone -v2c <cmts_ip> <community_name>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.4.<ifIndex>  
docsPnmCmtsObjects.10.1.1.4.<ifIndex> = Center Frequency range and resolution`

- **net-snmp** commands:

- `server > snmpget -v2c -c <community_name> <cmts_ip>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.1.<ifIndex>  
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.1.1.1.<ifIndex> = Hex-STRING: 00 02`
- `server > snmpget -v2c -c <community_name> <cmts_ip>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.2.<ifIndex>  
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.1.1.2.<ifIndex> = Hex-STRING: 04`
- `server > snmpget -v2c -c <community_name> <cmts_ip>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.3.<ifIndex>  
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.1.1.3.<ifIndex> = Hex-STRING: 1`
- `server > snmpget -v2c -c <community_name> <cmts_ip>  
1.3.6.1.4.1.4491.2.1.27.1.3.10.1.1.4.<ifIndex>  
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.1.1.4.<ifIndex> = STRING: "Center  
Frequency range and resolution"`

## Upstream Triggered Spectrum Capture Bulk Data Control Objects and MIBs

Table 4: Feature History

| Feature Name                        | Release Information         | Feature Description                                                                                                                                                                                                                                                                                           |
|-------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Multiple Bulk Data Transfer support | Cisco IOS XE Dublin 17.12.1 | You can now configure multiple BDTs for the following: <ul style="list-style-type: none"> <li>• For TFTP in CM-MAC and Other trigger modes. PNM BDT (DocsPnmBulkDataTransferCfgTable) MIB extends support from one TFTP server address to three.</li> <li>• Guestshell in IPv4 for all UTSC modes.</li> </ul> |
| PNM BDT MIB Updates                 | Cisco IOS XE Dublin 17.12.1 | In this release, PNM BDT MIB (docsPnmBulkDataTransferCfg) can support both OFDMA RxMER and UTSC. (UTSC has three trigger modes: Freerun, other, and CM-MAC.) The <b>docPnmBulkDestIpaddr</b> object (UTSC CM-MAC) is also supported.                                                                          |

The following Upstream Triggered Spectrum Capture bulk data control objects and MIBs are supported for PNM:

- PNM Bulk Data Control Objects OID: 1.3.6.1.4.1.4491.2.1.27.1.1.1
- PNM BULK DATA CONTROL OID: 1.3.6.1.4.1.4491.2.1.27.1.1.1.X

Where X is the bulk data transfer control parameter.

- The Bulk Data Transfer (BDT) control objects that are supported are the IPaddress type, BDT server IP and BDT destination path. This indicates to the CCAP the location where the capture results files are sent through TFTP transfer. In CBR8, the TFTP transfer is done through IOX container and as such, other BDT objects aren't relevant to this design model. IP address type can be automatically set by CCAP based on the server IP value specified.
- The following are the enumerated values for BDT for PNM:
  - docsPnmBulkDestIpAddrType 1
  - docsPnmBulkDestIpAddr 2
  - docsPnmBulkDestPath 3
- Set the BDT IPv4 IP address type and TFTP IP address.
  - **snmpr** commands:
    - server > setany -v2c <cmts\_ip> <community\_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 -o 20:01:0d:b8 docsPnmBulkDestIpAddr.0 = 20 01 0d b8
    - server > getone -v2c <cmts\_ip> <community\_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.1.0 docsPnmBulkDestIpAddrType.0 = ipv4(1)

```

• server > getone -v2c <cmts_ip> <community_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0
docsPnmBulkDestIpAddr.0 = 20 01 0d b8

```

- **net-snmp** commands:

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 x 20010db8
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.2.0 = Hex-STRING: 20 01 0D B8

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.1.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.1.0 = INTEGER: 1

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.2.0 = Hex-STRING: 20 01 0D B8

```

- Set the BDT IPv6 IP address type and TFTP IP address.

- **snmpr** commands:

```

• server > setany -v2c <cmts_ip> <community_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0
-o 20:01:0d:b8:85:a3:00:00:00:00:8a:2e:03:70:73:11

docsPnmBulkDestIpAddr.0 = 2001 0db8 85a3 0000 0000 8a2e 0370 7311

• server > getone -v2c <cmts_ip> <community_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.1.0
docsPnmBulkDestIpAddrType.0 = ipv6(2)

• server > getone -v2c <cmts_ip> <community_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0
docsPnmBulkDestIpAddr.0 = 2001 0db8 85a3 0000 0000 8a2e 0370 7311

```

- **net-snmp** commands:

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 x 20010db885a3000000008a2e03707311
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.2.0 = Hex-STRING: 20 01 0D B8 85 A3
00 00 00 00 8A 2E 03 70 73 11

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.1.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.1.0 = INTEGER: 2

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.2.0 = Hex-STRING: 20 01 0D B8 85 A3
00 00 00 00 8A 2E 03 70 73 11

```

- Set the BDT destination TFTP path.

- **snmpr** commands:

```

• server > setany -v2c <cmts_ip> <community_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0
-o pnm
docsPnmBulkDestPath.0 = pnm

• server > getone -v2c <cmts_ip> <community_name> 1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0
docsPnmBulkDestPath.0 = pnm

```

- **net-snmp** commands:

```

• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0 s 'pnm/test'
SSNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.3.0 = STRING: "pnm/test"

• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.3.0 = STRING: "pnm/test"

```

### Multiple TFTP Servers Support for PNM BDT SNMP Infra

In releases before Cisco IOS XE Cupertino 17.9.1y, only one BDT TFTP destination server per CCAP is supported to store the captured UTSC or RxMER data, and maximum eight captures on upstream ports per line card and a maximum of 20 captures per CBR8 is supported for both I-CMTS and RPHY. All captured files are stored into the same TFTP server.

- Starting with Cisco IOS XE Cupertino 17.9.1y, the new PNM BDT MIB (docsPnmBulkDataTransferCfgTable) support has been added. It introduces support for multiple TFTP destination servers, and simultaneous capture of both UTSC freerun and RxMER data and store into different TFTP server locations. PNM captured files can be stored in three different TFTP servers simultaneously. Each TFTP server detail is stored into BDT table using unique index values (that is, 1, 2 and 3).
- Starting with Cisco IOS XE Dublin 17.12.1, PNM Bulk Data Transfer configuration (docsPnmBulkDataTransferCfgTable) MIB extends support from one TFTP server address to three.
- The existing PNM Bulk Data Control Table MIB remains supported with the following changes.
  - Capture doesn't start if the destination TFTP IP address and PATH aren't configured.
  - For UTSC other mode, the path isn't required and only IP is required.
- Starting with Cisco IOS XE Cupertino 17.9.1y, PNM BulkData Transfer Cfg MIB and the legacy PNM Bulk Data Control MIB, can be configured and used at the same time.
- Starting with Cisco IOS XE Cupertino 17.9.1y, we support legacy BDT table for UTSC other and CM MAC trigger modes. PNM BDT MIB (docsPnmBulkDataTransferCfgTable) can support OFDMA RxMER and UTSC.
- Starting with Cisco IOS XE Dublin 17.12.1, PNM BDT MIB (docsPnmBulkDataTransferCfg) can support both OFDMA RxMER and UTSC. UTSC has three trigger modes: Freerun, other, and CM-MAC). The **docPnmBulkDestIpaddr** object (UTSC CM-MAC) is also supported.

The captured UTSC or RxMER data are stored into the same TFTP server or different TFTP servers. This is done based on the destination index mappings between BDT table and RxMER or UTSC configuration settings. The destination index is configured as part of the docsPnmCmtsUtscCfgTable for UTSC and docsPnmCmtsUsOfdmaRxMerTable for Rxmer captures and should map to one of the indices created in the BDT table - docsPnmBulkDataTransferCfgTable. So based on this destination index mapping, captured data is stored into respective TFTP server locations.

LCs can run captures as long the max limit per LC and per cBR-8 aren't exceeded but only using one of the three allowed TFTP servers. That is, there's no restriction that a server can be mapped to only one utsc capture config at a time, the same server can be mapped to different type of captures

A BDT table entry may be modified at any given time. However, if there's a capture running using the BDT entry, the capture continues to run with the prior TFTP information with which it was started. The updated BDT details take effect only for new captures which started after that update.

### Proactive Network Management

- Provides measurement and reporting of network conditions.
- Detection of plant impairments and interference.

### docPnmBulkDestIpaddr



**Note** The **docPnmBulkDestIpaddr** object (UTSC CM-MAC) is also supported on legacy BDT table.

The **docPnmBulkDestIpaddr** object exports spectrum capture data by TFTP. The set of **docPnmBulkDestIpaddr** isn't a required configuration for initialing capture, but needed for the TFTP. In the R-PHY system, the upstream spectrum is captured by the RPD. The captured spectrum data is delivered from the RPD to the CCAP Core via SpecMan or PNM pseudowires, described in [R-UEPI]. Configure L2TPv3 pseudo wire destining to Viavi server, RPD sends the data to RCI server directly. The existing **docPnmBulkDestIpaddr** is used configure the L2TP pseudo wire destination. In a case where upstream spectrum data must be captured continuously and delivered timely to a PNM server, it's possible for the controlling CCAP Core to create a static pseudowire between the RPD and the PNM server, thus bypassing the CCAP itself in the data plane. In this case, the PNM server is considered a Traffic Engine that supports L2TPv3 data plane only but doesn't support the GCP or the L2TPv3 control plane protocols. There could be a separate communication path between the PNM server and the CCAP Core to exchange UTSC configuration, control, and status information.

### Basic Infrastructure to Support Multiple TFTP Servers

#### PNM CCAP Bulk File Transfer Objects

The following are the DataTransferCfg MIB objects that are specified in DOCS-PNM-MIB in CM-SP-CCAP-OSSIV3.1-I23-220216 spec and these MIB objects is used to support multiple TFTP destination servers to upload the captured UTSC and RxMER data from cBR-8.

Starting with Cisco IOS XE 17.12.1, docsPnmBulkDataTransferCfgEntry MIB supports PNM CM-MAC, Other, and FreeRun trigger-modes for multiple destination indices.

**Table 5: PNM CCAP Bulk File Transfer Objects**

| CCAP bulk data control Objects               | OID                                 | Supported |
|----------------------------------------------|-------------------------------------|-----------|
| docsPnmBulkFileTransfer                      | 1.3.6.1.4.1.4491.2.1.27.1.1.3       | Yes       |
| docsPnmBulkDataTransferCfgTable              | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1     | Yes       |
| docsPnmBulkDataTransferCfgEntry              | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1   | Yes       |
| docsPnmBulkDataTransferCfgDestIndex          | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.1 | Yes       |
| docsPnmBulkDataTransferCfgDestHostname       | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.2 | No        |
| docsPnmBulkDataTransferCfgDestHostIpAddrType | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3 | Yes       |

| CCAP bulk data control Objects              | OID                                 | Supported |
|---------------------------------------------|-------------------------------------|-----------|
| docsPnmBulkDataTransferCfgDestHostIpAddress | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4 | Yes       |
| docsPnmBulkDataTransferCfgDestPort          | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.5 | No        |
| docsPnmBulkDataTransferCfgDestBaseUri       | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6 | Yes       |
| docsPnmBulkDataTransferCfgProtocol          | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.7 | No        |
| docsPnmBulkDataTransferCfgLocalStore        | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.8 | No        |
| docsPnmBulkDataTransferCfgRowStatus         | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9 | Yes       |

The destination port and protocol are set to default values which are shown below, it only has read access.

- docsPnmBulkDataTransferCfgDestPort = 69 (UDP)
- docsPnmBulkDataTransferCfgProtocol = 1 (tftp)

### UTSC Config Table Object

The new objects below are added to the existing UTSC Capture config table as mentioned in the spec but the object which is relevant to `DataTransferCfg` is supported as shown in the following table.

**Table 6: UTSC Config Table Object**

| UTSC docsPnmCmtsUtscCfgTable Objects | OID                                   | Supported |
|--------------------------------------|---------------------------------------|-----------|
| docsPnmCmtsUtscCfg                   | 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.22 | No        |
| docsPnmCmtsUtscCfgMaxResultsPerFile  | 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.23 | No        |
| docsPnmCmtsUtscCfgDestinationIndex   | 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.24 | Yes       |

### Upstream OFDMA RxMER table object

The following new object is added to the existing Upstream OFDMA RxMER table:

**Table 7: Upstream OFDMA RxMER table object**

| docsPnmCmtsUsOfdmaRxMerTable object     | OID                               | Supported |
|-----------------------------------------|-----------------------------------|-----------|
| docsPnmCmtsUsOfdmaRxMerDestinationIndex | 1.3.6.1.4.1.4491.2.1.27.1.3.7.1.7 | Yes       |
| docsPnmBulkDataTransferCfgEntry         | 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1 | Yes       |

Starting with Cisco IOS XE Dublin 17.12.1, docsPnmBulkDataTransferCfgEntry MIB supports multiple destination indexes for OFDMA RxMER.

### Legacy PNM Bulk Data Control Objects

The legacy docsPnmBulkCtl objects continue to be supported for all capture types with a Guest shell design.

Table 8: Legacy PNM Bulk Data Control Objects

| docsPnmCmtsUsOfdmaRxMerTable object | OID                             |
|-------------------------------------|---------------------------------|
| docsPnmBulkDestIpAddrType           | 1.3.6.1.4.1.4491.2.1.27.1.1.1.1 |
| docsPnmBulkDestIpAddr               | 1.3.6.1.4.1.4491.2.1.27.1.1.1.2 |
| docsPnmBulkDestPath                 | 1.3.6.1.4.1.4491.2.1.27.1.1.1.3 |
| docsPnmBulkUploadControl            | 1.3.6.1.4.1.4491.2.1.27.1.1.1.4 |

The IP type and upload control are set to default values as shown below, it only has read access.

- docsPnmBulkDestIpAddrType is automatically set as the IPV4 (1)/IPV6(2), will be set automatically while configuring ipv4 or ipv6 address.
- docsPnmBulkUploadControl is set to default as autoupload (3).




---

**Note** This object only has read-access. You cannot modify the value via the `snmpset` command.

---

UTSC/RxMER capture is blocked to start capture if Destination IP address and PATH aren't configured.




---

**Note** The CM-MAC or OTHER mode capture types aren't supported with docsPnmBulkDataTransferCfg MIB.

---

### PNM UTSC/RxMER Config Destination Index

The BDT and UTSC/RxMER configs are linked using below destination the docsPnmCmtsUtscCfgDestinationIndex and docsPnmCmtsUsOfdmaRxMerDestinationIndex indices with the default index values as **0xFFFFFFFF**.

You must configure this index to one of the valid BDT config indexes. If capture is started with default index value, then it uses TFTP server details configured using Legacy MIBs. If valid BDT index is mapped, then it uses the TFTP server details that are configured in that BDT index. Capture can't be started if the row status of the mapped BDT index isn't in ACTIVE state.

### PNM BDT MIB Details

```
docsPnmBulkDataTransferCfgTable DocsPnmBulkDataTransferCfgEntry.[DestIndex]
```

BDT MIB table rows are created with unique dest index value to store three different TFTP server details. A maximum of 3 **DestIndex** are supported and the **DestIndex** values for can be 1,2, or 3. In cBR-8, the following BDT objects are supported.

Starting with Cisco IOS XE Dublin 17.12.1, docsPnmBulkDataTransferCfgEntry MIB supports multiple destination indexes.



Table 9: PNM BDT MIB Details

| OBJECTS                                      | Supported |
|----------------------------------------------|-----------|
| docsPnmBulkDataTransferCfgDestHostname       | NO        |
| docsPnmBulkDataTransferCfgDestHostIpAddrType | YES       |
| docsPnmBulkDataTransferCfgDestHostIpAddress  | YES       |
| docsPnmBulkDataTransferCfgDestPort           | NO        |
| docsPnmBulkDataTransferCfgDestBaseUri        | YES       |
| docsPnmBulkDataTransferCfgProtocol           | NO        |
| docsPnmBulkDataTransferCfgLocalStore         | NO        |
| docsPnmBulkDataTransferCfgRowStatus          | YES       |



**Note** BDT table active status is not required for OTHER mode, only a valid IP configuration is necessary. If the same BDT entry is to be used for both OTHER and freerun/rxmer mode, then the TFTP path must be specified in the correct format, in the BDT table and BDT entry must be active for freerrun/rxmer, to use this BDT entry.

- docsPnmBulkDataTransferCfgDestHostIpAddrType: To set IP types either IPV4 (1) and IPV6 (2)
- docsPnmBulkDataTransferCfgDestHostIpAddress: To set IPV4/IPV6 address in hex value. Configure BDT URI in this format - `tftp://{tftp_ip}/{tftp_path}`.
- docsPnmBulkDataTransferCfgDestBaseUri: To set IPV4/IPV6 address and PATH details in TFTP URL format.
- docsPnmBulkDataTransferCfgRowStatus: To create or update or delete a row in BDT table.
- docsPnmBulkDataTransferCfgProtocol: This object is hardcoded, same for port and supported for read.

Rows can be created with **createandgo** and **createandwait**.

If created with “**createandgo** then one time mandatory configs (ip address and Uri) are configured, and then row is moved to ACTIVE state automatically, else it remains in NOT READY state.

If created with **createandwait** then one time mandatory configs (ip address and Uri) are configured, and then row is moved to NotInUse state and user must configure the row to ACTIVE state manually.

### SUPHA, LCHA, and LCPR

**SUPHA** - All BDT MIB configs get erased on SUPSO, you must reconfigure the BDT rows with all required details.

**LCHA/LCPR** - BDT MIB runs in SUP IOSd process so BDT configs remain intact after LCHA/LCPR.

The following is an example of the steps that are required for PNM BDT configuration.

#### 1. Row: Create a BDT entry.

```
snmpset -v2c -c pnm 113.113.113.113 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 i 4
```

**2. IP Type:** Set an IP type.

```
snmpset -v2c -c pnm 113.113.113.113 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 i 1
```

**3. IP/IPv6 address:** Set IPV4/IPV6 address.

```
snmpset -v2c -c pnm 113.113.113.113 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 x COA8648C
```

**4. Uri:** Set TFTP URL format.

```
snmpset -v2c -c pnm 113.113.113.113 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 s
tftp://192.168.100.140/pnm1
```




---

**Note** You must configure both TFTP IP and BDT URI to initiate the UTSC capture.

---

```
RPHY#test cable pnm bdt config get-ip
```

```
BDT TABLE ip addresses:
The destination index : 1
The assigned IP is type : 1
IPv4: 192.168.100.140
IPv6: ---
```

```
BDT V0 TFTP details:
```

```
The assigned IP is type: 0
IPv4: ---
IPv6: ---
```

```
CHN3-RACK3-RPHY#test cable pnm bdt config get-path
```

```
BDT TABLE TFTP path:
```

```
Destination Index = 1 : TFTP path is = tftp://192.168.100.140/pnm1
```

```
BDT V0 TFTP Path:
```

```
oob-auto@oob-auto:/tftpboot/pnm1$ snmpwalk -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.2.1 = ""
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 = Hex-STRING: C0 A8 64 8C
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.5.1 = Gauge32: 69
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 = STRING: "tftp://192.168.100.140/pnm1"
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.7.1 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.8.1 = INTEGER: 0
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 = INTEGER: 1
oob-auto@oob-auto:/tftpboot/pnm1$
```

**To Delete a row:**

```
snmpset -v2c -c pnm 113.113.113.113 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 i 6
```

```
PHY#test cable pnm bdt config get-ip
```

```
BDT TABLE ip addresses:
```

```
BDT V0 TFTP details:
```

```
The assigned IP is type: 0
IPv4: ---
IPv6: ---
```

```
RPHY#test cable pnm bdt config get-path
```

```
BDT TABLE TFTP path:
```

```
BDT V0 TFTP Path:
```

RPHY#

The following example shows PNM BDT dest index mapping to UTSC configs.

1. UTSC destination index should be set to BDT index before starting the capture. If destination index is not set in UTSC (DocsPnmCmtsUtscCfgEntry), it uses the legacy PNM Bulk Data objects for getting the TFTP details.
2. RxMER destination index should be set to BDT index before starting the capture. If not set it uses the legacy TFTP infra. If destination index is not set in RxMER table (DocsPnmCmtsUsOfdmaRxMerEntry), it uses the legacy PNM Bulk Data objects for TFTP purpose.

Before setting BDT index:

```
RPHY#test cable pnm uts configure show 0 client-id 1 2/0/0
```

```
Acquire capcfg for capture entry success, ret: No error
```

```
Capture Config params for client 1 on clc 2/0/0
```

```
utsc config index 1
BDT TFTP dest index FFFFFFFF
physical channel 0
logical channel 0
snmp ifIndex 490350
trigger-mode freerun
frequency 70000000
span 30000000
bins 4096
window mode blackman-harris
output format fft-pwr
repeat-period 50000
duration 500000
trigger-count 0
capcfg entry status active
minislot count 0
sid 0
timestamp 0
cm-mac 0000.0000.0000
averaging 0
qualify frequency 0
qualify bandwidth 5120000
qualify threshold -100
```

RPHY#

```
snmpset -v2c -c pnm 113.113.113.113 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.24.490446.1 u 1
```

```
RPHY#test cable pnm uts configure show 0 client-id 1 2/0/0
```

```
Acquire capcfg for capture entry success, ret: No error
```

```
Capture Config params for client 1 on clc 2/0/0
```

```
utsc config index 1
BDT TFTP dest index 1
physical channel 0
logical channel 0
snmp ifIndex 490350
trigger-mode freerun
frequency 70000000
span 30000000
bins 4096
window mode blackman-harris
output format fft-pwr
repeat-period 50000
```

```

duration 500000
trigger-count 0
capcfg entry status active
minislot count 0
sid 0
timestamp 0
cm-mac 0000.0000.0000
averaging 0
qualify frequency 0
qualify bandwidth 5120000
qualify threshold -100

```

RPHY#

Before setting BDT index:

RPHY#test cable pnm rxmer show-job-list

| Job | Client | ifIndex | CM-Mac         | Status   | Enable | Pre-Eq | Num-Avgs | Retry |
|-----|--------|---------|----------------|----------|--------|--------|----------|-------|
| 0   | SNMP   | 490350  | 9058.515c.a3e8 | INACTIVE | N      | N      | 1        | 0     |

-----  
 BdtDestIndex  
 -----  
 0 SNMP 490350 9058.515c.a3e8 INACTIVE N N 1 0  
 FFFFFFFF

PNM RxMER job count 1

RPHY#

After setting BDT index:

```
snmpset -v2c -c pnm 113.113.113.113 1.3.6.1.4.1.4491.2.1.27.1.3.7.1.7.490350 u 1
```

RPHY#test cable pnm rxmer show-job-list

| Job | Client | ifIndex | CM-Mac         | Status   | Enable | Pre-Eq | Num-Avgs | Retry |
|-----|--------|---------|----------------|----------|--------|--------|----------|-------|
| 0   | SNMP   | 490350  | 9058.515c.a3e8 | INACTIVE | N      | N      | 1        | 0     |

-----  
 BdtDestIndex  
 -----  
 0 SNMP 490350 9058.515c.a3e8 INACTIVE N N 1 0 1

PNM RxMER job count 1

RPHY#

Successful creation for three rows:

```

oob-auto@oob-auto:/tftpboot/pnm1$
oob-auto@oob-auto:/tftpboot/pnm1$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 i 4
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 = INTEGER: 4
oob-auto@oob-auto:/tftpboot/pnm1$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 i 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 = INTEGER: 1
oob-auto@oob-auto:/tftpboot/pnm1$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 x C0A8648C
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 = Hex-STRING: C0 A8 64 8C
oob-auto@oob-auto:/tftpboot/pnm1$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 s tftp://192.168.100.140/pnm1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 = STRING: "tftp://192.168.100.140/pnm1"
oob-auto@oob-auto:/tftpboot/pnm1$
oob-auto@oob-auto:/tftpboot/pnm1$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.2 i 4
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.2 = INTEGER: 4
oob-auto@oob-auto:/tftpboot/pnm1$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.2 i 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.2 = INTEGER: 1
oob-auto@oob-auto:/tftpboot/pnm1$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.2 x C0A8648D
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.2 = Hex-STRING: C0 A8 64 8D

```

```

oob-auto@oob-auto:/tftpboot/pnml$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.2 s tftp://192.168.100.141/pnm2
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.2 = STRING: "tftp://192.168.100.141/pnm2"
oob-auto@oob-auto:/tftpboot/pnml$
oob-auto@oob-auto:/tftpboot/pnml$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.3 i 4
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.3 = INTEGER: 4
oob-auto@oob-auto:/tftpboot/pnml$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.3 i 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.3 = INTEGER: 1
oob-auto@oob-auto:/tftpboot/pnml$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.3 x COA8648E
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.3 = Hex-STRING: C0 A8 64 8E
oob-auto@oob-auto:/tftpboot/pnml$
oob-auto@oob-auto:/tftpboot/pnml$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.3 s tftp://192.168.100.142/pnm3
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.3 = STRING: "tftp://192.168.100.142/pnm3"
oob-auto@oob-auto:/tftpboot/pnml$

```

### Snmpwalk of three BDT rows

```

oob-auto@oob-auto:/tftpboot/pnml$ snmpwalk -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.2.1 = ""
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.2.2 = ""
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.2.3 = ""
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.2 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.3 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 = Hex-STRING: C0 A8 64 8C
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.2 = Hex-STRING: C0 A8 64 8D
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.3 = Hex-STRING: C0 A8 64 8E
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.5.1 = Gauge32: 69
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.5.2 = Gauge32: 69
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.5.3 = Gauge32: 69
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 = STRING: "tftp://192.168.100.140/pnm1"
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.2 = STRING: "tftp://192.168.100.141/pnm2"
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.3 = STRING: "tftp://192.168.100.142/pnm3"
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.7.1 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.7.2 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.7.3 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.8.1 = INTEGER: 0
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.8.2 = INTEGER: 0
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.8.3 = INTEGER: 0
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.2 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.3 = INTEGER: 1

```

### Legacy PNM MIB configuration and snmpwalk:

```

oob-auto@oob-auto:/tftpboot/pnml$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 x COA8648C
iso.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 = Hex-STRING: C0 A8 64 8C
oob-auto@oob-auto:/tftpboot/pnml$ snmpset -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0 s pnml
iso.3.6.1.4.1.4491.2.1.27.1.1.1.3.0 = STRING: "pnml"
oob-auto@oob-auto:/tftpboot/pnml$
oob-auto@oob-auto:/tftpboot/pnml$ snmpwalk -v2c -c pnm 113.113.113.113
1.3.6.1.4.1.4491.2.1.27.1.1.1
iso.3.6.1.4.1.4491.2.1.27.1.1.1.1.0 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 = Hex-STRING: C0 A8 64 8C
iso.3.6.1.4.1.4491.2.1.27.1.1.1.3.0 = STRING: "pnml"
iso.3.6.1.4.1.4491.2.1.27.1.1.1.4.0 = INTEGER: 3
oob-auto@oob-auto:/tftpboot/pnml$
oob-auto@oob-auto:/tftpboot/pnml$

```

## Bulk Data Transfer for CM-MAC Trigger Mode

The CM-MAC trigger mode now supports multiple bulkDataTransferCfg MIB, with index starting from 1 to 3. Each index denotes a target server.

The following is an example of the steps that are required for PNM BDT configuration docsPnmBulkFileTransfer MIB in CM-MAC trigger mode:

1. Set the TFTP server IP address with docsPnmBulkFileTransfer MIB with index 1.

- a. **Row:** Create a BDT entry.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 i 4
```

- b. **Destination IP Type:** Set a Destination IP type.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 i 1
```

- c. **Destination IP address:** Set the destination IP address.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 x "14 01 00 21"
```

- d. **Uri:** Set TFTP URL format.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 s
tftp://20.1.0.33/jiexiao/PNM
```

The following configuration is an example with index 2 for CM-MAC trigger mode:

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.2 i 4
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.2 i 1
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.2 x "0a 4f c4 8f"
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.2 s
tftp://10.79.196.143/PNM
```

The following configuration is an example with index 3 for CM-MAC trigger mode:

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.3 i 4
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.3 i 1
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.3 x "14 01 00 22"
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.3 s
tftp://20.1.0.34/jiexiao/WBFFT
```

2. Configure the SNMP RPD usport ifindex:

```
snmpwalk -c private -v2c 20.5.30.11 ifDescr | grep RPD| grep badb.ad13.4cf2 | grep
```

where, badb,ad13.4cf2 is the target RPD's MAC address.

You can verify the SNMP configuration using the following show command:

```
Router#show snmp mib ifmib ifindex | s 1004.9fb1.0500
RPD(1004.9fb1.0500)-usport0: Ifindex = 513396
RPD(1004.9fb1.0500)-usport1: Ifindex = 513397
RPD(1004.9fb1.0500)-dsport0: Ifindex = 515444
```

where, 513396 is the ifIndex for usport0.

3. Configure the upstream channel.

```
Router#scm rpd name shelf-node5
```

| D | MAC Address    | IP Address | I/F        | MAC           | Prim | RxPwr  | Timing | Num |
|---|----------------|------------|------------|---------------|------|--------|--------|-----|
| I | Dev            |            |            | State         | Sid  | (dBmV) | Offset | CPE |
| P | Class          |            |            |               |      |        |        |     |
|   | 4800.33ee.dc6e | 12.0.1.34  | C7/0/9/UB  | w-online (pt) | 1    | -0.50  | 1176   | 0   |
|   | N CM           |            |            |               |      |        |        |     |
|   | 5039.5577.0bbc | 12.0.1.42  | C7/0/10/U0 | online (pt)   | 1    | 0.00   | 866    | 0   |
|   | N CM           |            |            |               |      |        |        |     |
|   | 5039.5577.06e2 | 12.0.1.43  | C7/0/10/U0 | online (pt)   | 2    | 0.00   | 867    | 0   |
|   | N CM           |            |            |               |      |        |        |     |

To verify an upstream ranging class ID of a cable modem, use the **show cable modem** command with the **verbose** keyword.

Following is a sample output of the **show cable modem verbose** command:

```
Router#show cable modem 4458.2945.2da6 verbose
```

```
MAC Address : 4458.2945.2da6
IP Address : 91.7.0.6
IPv6 Address : ---
Dual IP : N
Prim Sid : 1
Host Interface : C9/0/11/UB
RPD ID : 1004.9fb1.0500
MD-DS-SG / MD-US-SG : 1 / 1
MD-CM-SG : 0x15B0101
Primary Wideband Channel ID : 58625 (Wi9/0/5:0)
Primary Downstream : Do9/0/5:3 (RfId : 58627, SC-QAM)
Wideband Capable : Y
DS Tuner Capability : 8
RCP Index : 3
RCP ID : 00 10 00 00 08
Downstream Channel DCID RF Channel : 4 9/0/5:3 (SC-QAM)
Downstream Channel DCID RF Channel : 1 9/0/5:0 (SC-QAM)
Downstream Channel DCID RF Channel : 2 9/0/5:1 (SC-QAM)
Downstream Channel DCID RF Channel : 3 9/0/5:2 (SC-QAM)
Downstream Channel DCID RF Channel : 5 9/0/5:4 (SC-QAM)
Downstream Channel DCID RF Channel : 6 9/0/5:5 (SC-QAM)
Downstream Channel DCID RF Channel : 7 9/0/5:6 (SC-QAM)
Downstream Channel DCID RF Channel : 8 9/0/5:7 (SC-QAM)
UDC Enabled : N
US Frequency Range Capability : Standard (5-42 MHz)
Extended Upstream Transmit Power : 0dB
Multi-Transmit Channel Mode : Y
Max US SC-QAMs Supported : 4
Number of US in UBG : 1
Minimum power load in DRW (dB) : 16.50
Upstream Channel : US0
Device ID : 0
Ranging Status : sta
Upstream SNR (dB) : 38.16
Upstream Data SNR (dB) : 41.55
Received Power (dBmV) : 0.00
```

```
Router#show cable modem 4458.2945.2da6
```

| D | MAC Address | IP Address | I/F | MAC   | Prim | RxPwr  | Timing | Num |
|---|-------------|------------|-----|-------|------|--------|--------|-----|
| I | Dev         |            |     | State | Sid  | (dBmV) | Offset | CPE |
| P | Class       |            |     |       |      |        |        |     |

```
4458.2945.2da6 91.7.0.6 C9/0/11/UB w-online (pt) 1 0.00 868 0
N
```

#### 4. Configure the upstream channel ifIndex.

To identify the SNMP ifIndex value, execute the following show command:

```
Router#show snmp mib ifmib ifindex | s 9/0/11
Cable9/0/11: Ifindex = 1348
Cable9/0/11-upstream0: Ifindex = 502392
Cable9/0/11-upstream1: Ifindex = 502393
Cable9/0/11-upstream2: Ifindex = 502394
Cable9/0/11-upstream3: Ifindex = 502395
Cable9/0/11-upstream4: Ifindex = 502396
Cable9/0/11-upstream5: Ifindex = 502397
Cable9/0/11-upstream6: Ifindex = 502398
Cable9/0/11-upstream7: Ifindex = 502399
Cable9/0/11-upstream8: Ifindex = 502400
Cable9/0/11-upstream9: Ifindex = 502401
Cable9/0/11-upstream10: Ifindex = 502402
Cable9/0/11-upstream11: Ifindex = 502403
Cable9/0/11-upstream12: Ifindex = 502404
Cable9/0/11-upstream13: Ifindex = 502405
Cable9/0/11-upstream14: Ifindex = 502406
Cable9/0/11-upstream15: Ifindex = 502407
```

#### 5. Configure the upstream channel center frequency.

#### 6. Start the CM-MAC capture.

The following is an example of the SNMP command configuration to start the CM-MAC trigger mode capture:

```
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.415082.1 i 6
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.415082.1 i 4
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.2.415082.1 i 404045
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.415082.1 i 6
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.6.415082.1 x "48
00 33 ee dd 9e"
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.415082.1 u 16400000
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.415082.1 u 6400000
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.415082.1 u 4096
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.11.415082.1 u 245
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.13.415082.1 u
10240000
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.14.415082.1 u
25600000
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.15.415082.1 i -200
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.16.415082.1 i 3
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.17.415082.1 i 1
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.18.415082.1 u 25000
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19.415082.1 u 5000
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.20.415082.1 u 1000
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.415082.1 i 1
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.24.415082.1 u 1
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.415082.1 i 1
```

where, 404045 is the upstream channel ifIndex, 16400000 is the center frequency, 4096 is the number of bins.

#### Verifying the CM-MAC Capture:



The following is an example of the SNMP command configuration to verify the CM-MAC trigger mode capture:

```
$ snmpwalk -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1
```

```
Router#test cable pnm bdt config get-ip
```

```
BDT TABLE ip addresses:
```

```
The destination index : 1
```

```
The assigned IP is type : 1
```

```
IPv4: 20.1.0.33
```

```
IPv6: ---
```

```
The destination index : 2
```

```
The assigned IP is type : 1
```

```
IPv4: 10.79.196.143
```

```
IPv6: ---
```

```
The destination index : 3
```

```
The assigned IP is type : 1
```

```
IPv4: 20.1.0.33
```

```
IPv6: ---
```

```
BDT V0 TFTP details:
```

```
The assigned IP is type: 1
```

```
IPv4: 20.1.0.33
```

```
IPv6: ---
```

```
Router#test cable pnm uts configure show 0 client-id 1 1004.9fb1.0500 0
```

```
Acquire capcfg for capture entry success, ret: No error
```

```
Capture Config params for client 1 on clc 9/0/8
```

```
utsc config index 1
BDT TFTP dest index 1
physical channel 0
logical channel 502392
snmp ifIndex 513396
trigger-mode cm-mac-add
frequency 16800000
span 6400000
bins 1100
window mode hann
output format fft-pwr
repeat-period 100000
duration 300000
trigger-count 3000
capcfg entry status active
minislot count 0
sid 1
timestamp 0
cm-mac 4458.2945.2da6
averaging 8
qualify frequency 10240000
qualify bandwidth 25600000
qualify threshold -200
```

```
Router#test cable pnm uts show
```

```
--- PNM UTSC Activity ---
```

```
CLC 9/0/8 dev 0 client 1 test 1 in progress
```

```
RphyNode-L09#
```

Verify the spectrum capabilities using the following show command:

```
Router#show cable card 9/0 us-triggered-spectrum uts-common
```

Last event

```

UTSCOM event STATUS
 client_id 1
 test_id 1
 port 8
 dev 0
 phys_chan 22740992
 logi_chan 1
 status 3

```

Port 8 Dev 0 configuration

```

UTSCOM event START
 client_id 1
 test_id 1
 port 8
 dev 0
 phys_chan 22740992
 logi_chan 1
 sac index 1
 trigger-mode 6
 frequency 16800000
 span 6400000
 bins 1100
 window 3
 output 2
 repeat-period 100000
 duration 300000
 trigger-count 3000
 qual-center-freq 10240000
 qual-bw 25600000
 qual-threshld -200
WBFFT Dev port, devId, trig-mode,data-ready, packets on WBFFT dev, countdown:
wbfft dev 0: 8 0 6 1 156 2938
wbfft dev 1: 64 8 0 0 0 0
wbfft dev 2: 64 8 0 0 0 0
wbfft dev 3: 64 8 0 0 0 0
wbfft dev 4: 64 8 0 0 0 0
wbfft dev 5: 64 8 0 0 0 0
wbfft dev 6: 64 8 0 0 0 0
wbfft dev 7: 64 8 0 0 0 0
total packets: 156

```

Verify the frequency from the running configuration:

```

Router#show run | s rpd140
cable rpd rpd140
 identifier 1004.9fb1.0500
 type shelf
 rpd-ds 0 base-power 25
 core-interface Te9/1/1
 principal
 rpd-ds 0 downstream-cable 9/0/5 profile 3
 rpd-us 0 upstream-cable 9/0/8 profile 1
 rpd-us 1 upstream-cable 9/0/9 profile 1
 rpd-ds 0 static-pseudowire ndfviavi0 profile 2
 rpd-us 0 static-pseudowire viavi0 profile 2
 r-dti 2

```

```
rpd-event profile 0
rpd-55d1-us-event profile 0
```

To verify the upstream controller profile configuration, use the following show command:

```
Router#show run | s upstream controller-profile 1
cable upstream controller-profile 1
 us-channel 0 channel-width 3200000 3200000
 us-channel 0 docsis-mode atdma
 us-channel 0 frequency 11400000
 us-channel 0 minislots-size 2
 us-channel 0 modulation-profile 221
no us-channel 0 shutdown
 us-channel 1 channel-width 3200000 3200000
 us-channel 1 docsis-mode atdma
 us-channel 1 frequency 14600000
 us-channel 1 minislots-size 2
 us-channel 1 modulation-profile 221
no us-channel 1 shutdown
 us-channel 2 channel-width 3200000 3200000
 us-channel 2 docsis-mode atdma
 us-channel 2 frequency 17800000
 us-channel 2 minislots-size 2
 us-channel 2 modulation-profile 221
```

## Bulk Data Transfer for Other Trigger Mode

Bulk Data Transfer can support three multiple bulkDataTransferCfg MIB, and the index value starts from 1 to 3.

The following is an example of the steps that are required for PNM BDT bulkDataTransferCfg MIB configuration with multiple destination indexes for the Other trigger mode:

**1. Row:** Create a BDT entry.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 i 4
```

**2. IP Type:** Set a Destination IP type.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 i 1
```

**3. Destination IP address:** Set the destination IP address.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 x "14 01 00 21"
```

**4. Uri:** Set TFTP URL format.

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 s
tftp://20.1.0.33/jiexiao/PNM
```

The following configuration is an example with index 2 for Other trigger mode:

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.2 i 4
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.2 i 1
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.2 x "0a 4f c4 8f"
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.2 s
tftp://10.79.196.143/PNM
```

The following configuration is an example with index 3 for Other trigger mode:

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.3 i 4
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.3 i 1
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.3 x "14 01 00 22"
```

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.3 s
tftp://20.1.0.34/jiexiao/WBFFT
```

The following configuration is an example of IPv6 for UTSC Other trigger mode:

```
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.9.1 i 4
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.3.1 i 2
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.4.1 x "20 01 00 03 00
00 00 00 00 00 00 00 00 01 99"
snmpset -v2c -c private x.x.x.x 1.3.6.1.4.1.4491.2.1.27.1.1.3.1.1.6.1 s
tftp://[2001:3::199]/utsc
```




---

**Note** You must configure both TFTP IP and BDT URI to initiate the UTSC capture.

---

```
RPHY#test cable pnm bdt config get-ip
BDT TABLE ip addresses:
The destination index : 1
The assigned IP is type : 1
IPv4: 20.1.0.33
IPv6: ---

The destination index : 2
The assigned IP is type : 1
IPv4: 10.79.196.143
IPv6: ---

The destination index : 3
The assigned IP is type : 1
IPv4: 20.1.0.33
IPv6: ---

BDT V0 TFTP details:
The assigned IP is type: 0
IPv4: ---
IPv6: ---

CHN3-RACK3-RPHY#test cable pnm bdt config get-path

BDT TABLE TFTP path:

Destination Index = 1 : TFTP path is = tftp://20.1.0.33/jiexiao/PNM
Destination Index = 2 : TFTP path is = tftp://10.79.196.143/PNM
Destination Index = 3 : TFTP path is = tftp://20.1.0.33/jiexiao/WBFFT

RPHY#test cable pnm bdt config row-status
BDT TABLE Row status:

Destination Index = 1 : Row status is = 1
Destination Index = 2 : Row status is = 1
Destination Index = 3 : Row status is = 1
```

## High-Split Upstream Spectrum Capture Support

This feature allows 409.6M span to be configured with Upstream Triggered Spectrum Capture “other” mode for cBR-8 routers. This allows the full spectrum capture range of 0 MHz to 204.8MHz to be supported. Pass through occurs on cBR-8. L2TP packets go directly to a Viavi RCI Agent.

**BCM Chip Limitation:**

- When sample rate is set as 204.8 MHz, useful span = 204.8 MHz \* 80% = 163.84 MHz
- When sample rate is set as 409.6 MHz, useful span = 409.6 MHz \* 80% = 327.68 MHz

**Limitations**

- Only accepts span greater than 204.8MHz when trigger mode is `other`.
- Any span greater than 204.8MHz is converted to 409.6MHz on the RPD side.
- Resolution is 100KHz for span greater than 204.8MHz and bin size is equal to 4096.

**Example**

- Center Frequency = 153.6MHz
- Span = 307.2MHz (adopt to 409.6MHz on RPD)
- Reported frequency range [-51.2 MHz to 358.4MHz]
- Expected frequency range [0 MHz to 204.8MHz] need to extract from bin data [512, 2560]

## Multiple Spectrum Acquisition Circuits on a Single Port

*Table 10: Feature History*

| Feature Name                                            | Release Information         | Feature Description                                                       |
|---------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------|
| Multiple Spectrum Acquisition Circuits on a single port | Cisco IOS XE Dublin 17.12.1 | You can now configure two Spectrum Acquisition Circuits on a single port. |

Starting with Cisco IOS XE Dublin 17.12.1, you can configure two spectrum acquisition circuits (MIG-I-4365) on a single port at the same time and two UTSC configuration entries are supported. Prior to Cisco IOS XE Dublin 17.12.1, only one UTSC configuration entry was supported. The receiver (Cox) collects TimeIQ and spectrum FFT data for a single port.

cBR-8 reads the spectrum acquisition circuits supported trigger mode from the RPD reported capabilities.

The following are the supported trigger modes that have to be mapped to the spectrum acquisition circuits type:

- Other or FreeRun trigger mode for wide band.
- CM-MAC trigger mode for narrow band.



- Note**
- When the required spectrum acquisition circuits are in the operation mode, the capture start operation fails.
  - You cannot configure two FreeRun or other trigger mode on the same RPD.
  - You cannot configure two CM-MAC trigger mode on the same port.

The receiver (BCM3161) supports multiple spectrum acquisition circuits and has:

- Two Narrow band spectrum acquisition circuits—Captures on one delegated upstream port.
- One Wide band spectrum acquisition circuits—Captures on one of the two upstream ports.

## Configuring Multiple Spectrum Acquisition Circuits on a Single Port

The following example shows how to create two rows for the UTSC configuration:

```
snmpset -v2c -c private 10.74.59.202 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.513439.1 i 4
snmpset -v2c -c private 10.74.59.202 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.513439.2 i 4
```

The SNMP walk is supported for the upstream triggered spectrum capture.

The following is an example of the SNMP walk on the upstream triggered spectrum capture configuration parameter:

For BCM3161, the configuration 1 is for the OTHER trigger mode and configuration 2 is for the CM-MAC trigger mode running on the same port.

```
$ snmpwalk -v2c -c private 10.74.59.202 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.513439
iso.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.513439.1 = INTEGER: 1
iso.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.513439.2 = INTEGER: 6

$ snmpset -v2c -c private 10.74.59.202 1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.513439.1 i 1
iso.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.513439.1 = INTEGER: 1
$ snmpset -v2c -c private 10.74.59.202 1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.513439.2 i 1
iso.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.513439.2 = INTEGER: 1

$ snmpwalk -v2c -c private 10.74.59.202 1.3.6.1.4.1.4491.2.1.27.1.3.10.4.1.1.513439
iso.3.6.1.4.1.4491.2.1.27.1.3.10.4.1.1.513439.1 = INTEGER: 3
iso.3.6.1.4.1.4491.2.1.27.1.3.10.4.1.1.513439.2 = INTEGER: 3
```

## Verifying the Spectrum Acquisition Circuits Configuration

To verify the spectrum acquisition circuits capabilities sent from cBR-8, execute the following show command:

```
Router#show cable rpd
Load for five secs: 6%/1%; one minute: 7%; five minutes: 8%
Time source is NTP, 18:04:00.099 CST Mon Jul 10 2023

MAC Address IP Address I/F State Role HA Auth Name
0018.48fe.e643 30.85.65.150 Te6/1/5 online Pri Act N/A vecima-rpd
1004.9fb1.1300 30.85.65.152 Te6/1/5 online Pri Act N/A ng13-shelf-node2

! = PTP clock out of phaselock occurred, ^ = Default password in use

Router#show cable rpd 0018.48fe.e643 spectrum-capture-capabilities
Load for five secs: 18%/1%; one minute: 8%; five minutes: 8%
Time source is NTP, 18:04:08.239 CST Mon Jul 10 2023
```

RPD ID : 0018.48fe.e643  
 NumSacs : 4  
 SacIndex : 0

SacDescription : Wideband spectrum analysis circuit, upstream RF ports 0 & 0  
 MaxCaptureSpan : 409600000 Hz  
**MinimumCaptureFrequency : 0 Hz**  
**MaximumCaptureFrequency : 409600000 Hz**  
**SupportedTriggerModes : |freeRunning|miniSlotCount|sid|burstIuc|timestamp|**  
 SupportedOutputFormats : |timeIQ|fftPower|fftIQ|fftAmplitude|  
 SupportedWindowFormats : |rectangular|hann|blackmanHarris|hamming|flatTop|gaussian|chebyshev|  
 SupportsAveraging : Support  
 SupportedAggregationMethods : None  
 SupportsSpectrumQualification : Not Support  
 MaxNumBins : 4096  
 MinNumBins : 256  
 MinRepeatPeriod : 100000 us  
 SupportedTrigChanTypes : |OFDMA|  
 PwType : |PNM PW|  
**LowestCapturePort : 0**  
**HighestCapturePort : 0**  
 SupportsScanningCapture : Not Support  
 MinScanningRepeatPeriod : 0 ms

RPD ID : 0018.48fe.e643  
 NumSacs : 4  
 SacIndex : 1

SacDescription : Narrowband spectrum analysis circuit, upstream RF port 0  
 MaxCaptureSpan : 204800000 Hz  
 MinimumCaptureFrequency : 0 Hz  
 MaximumCaptureFrequency : 85120000 Hz  
**SupportedTriggerModes : |freeRunning|miniSlotCount|sid|burstIuc|**  
 SupportedOutputFormats : |timeIQ|fftPower|fftIQ|fftAmplitude|  
 SupportedWindowFormats : |rectangular|hann|blackmanHarris|hamming|flatTop|gaussian|chebyshev|  
 SupportsAveraging : Support  
 SupportedAggregationMethods : None  
 SupportsSpectrumQualification : Not Support  
 MaxNumBins : 4096  
 MinNumBins : 256  
 MinRepeatPeriod : 100000 us  
 SupportedTrigChanTypes : |SC-QAM|  
 PwType : |SpecMan PW|  
**LowestCapturePort : 0**  
**HighestCapturePort : 0**  
 SupportsScanningCapture : Not Support  
 MinScanningRepeatPeriod : 0 ms

RPD ID : 0018.48fe.e643  
 NumSacs : 4  
 SacIndex : 3

SacDescription : Wideband spectrum analysis circuit, upstream RF ports 1 & 1  
 MaxCaptureSpan : 409600000 Hz  
**MinimumCaptureFrequency : 0 Hz**  
**MaximumCaptureFrequency : 409600000 Hz**  
**SupportedTriggerModes : |freeRunning|miniSlotCount|sid|burstIuc|timestamp|**  
 SupportedOutputFormats : |timeIQ|fftPower|fftIQ|fftAmplitude|  
 SupportedWindowFormats : |rectangular|hann|blackmanHarris|hamming|flatTop|gaussian|chebyshev|  
 SupportsAveraging : Support  
 SupportedAggregationMethods : None  
 SupportsSpectrumQualification : Not Support  
 MaxNumBins : 4096  
 MinNumBins : 256  
 MinRepeatPeriod : 100000 us

```

SupportedTrigChanTypes : |OFDMA|
PwType : |PNM PW|
LowestCapturePort : 1
HighestCapturePort : 1
SupportsScanningCapture : Not Support
MinScanningRepeatPeriod : 0 ms

RPD ID : 0018.48fe.e643
NumSacs : 4
SacIndex : 4

SacDescription : Narrowband spectrum analysis circuit, upstream RF port 1
MaxCaptureSpan : 204800000 Hz
MinimumCaptureFrequency : 0 Hz
MaximumCaptureFrequency : 85120000 Hz
SupportedTriggerModes : |freeRunning|miniSlotCount|sid|burstIuc|
SupportedOutputFormats : |timeIQ|fftPower|fftIQ|fftAmplitude|
SupportedWindowFormats : |rectangular|hann|blackmanHarris|hamming|flatTop|gaussian|chebyshev|
SupportsAveraging : Support
SupportedAggregationMethods : None
SupportsSpectrumQualification : Not Support
MaxNumBins : 4096
MinNumBins : 256
MinRepeatPeriod : 100000 us
SupportedTrigChanTypes : |SC-QAM|
PwType : |SpecMan PW|
LowestCapturePort : 1
HighestCapturePort : 1
SupportsScanningCapture : Not Support
MinScanningRepeatPeriod : 0 ms

```

## UTSC CM-MAC for Third-Party RPD

*Table 11: Feature History*

| Feature Name                    | Release Information         | Feature Description                                                                                                                                                                                              |
|---------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| UTSC CM-MAC for third-party RPD | Cisco IOS XE Dublin 17.12.1 | cBR-8 now supports the suitable spectrum acquisition circuit and sends the related spectrum acquisition circuit index for the CM-MAC trigger mode. The UTSC CM-MAC works with the Cisco RPD and third-party RPD. |

cBR-8 uses a spectrum acquisition circuit for a third-party capture in the CM-MAC mode. The CM-MAC is for NBFFT, and only uses the SPECMAN session. The capture supports narrow band spectrum for a modem on a used upstream channel.

cBR-8 supports the IQ-FFT data based on the CM-MAC trigger mode on the PNM upstream capture for NBFFT. This process initiates sampling data on a grant for any SID assigned to CM-MAC. Then the CCAP receives the burst corresponding to the grant to perform the spectrum analysis capture.

The spectrum acquisition circuit index is selected from the reported capture capabilities list. The capture is triggered between PNM and UTSC. The high and low bin sessions are removed from the port and the correct PNM or SPECMAN sessions are retained for each spectrum acquisition circuit entity.



In the CM-MAC trigger mode, a SPECMAN dynamic session per channel per port is established. This session helps to communicate between the Cisco RPD and the third-party RPD. A specified MAC address defining a SID is triggered. Each available upstream channel establishes a SPECMAN session by default. For the CM-MAC trigger mode to work, ensure that you add the dynamic PNM standby sessions setup when the RPD is online.



**Note** The CM-MAC trigger mode supports LCHA and SUPHA.

When there are configuration updates to the RPD, the RPD reconnects, and the CM-MAC trigger mode works under the following conditions:

- cBR-8 first checks if it is a CM-MAC trigger mode.
- cBR-8 sets up the dynamic PNM session, only after the RPD is online.

### Example: Sample Configuration for UTSC CM-MAC for Third-Party RPD

Configure upstream channel ifIndex

```
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.2.415082.1 i 404045
```

Configure trigger mode CM-MAC

```
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.415082.1 i 6
```

Configure CM-MAC

```
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.6.415082.1 x "48 00
33 ee dd 9e"
```

Configure center frequency

```
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.415082.1 u 16400000
```

```
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.415082.1 u 6400000
```

Configure bins

```
snmpset -v2c -c private 20.5.1.49 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.10.415082.1 u 4096
```

## Configuring the PNM MAX-HOLD UTSC Other Trigger Mode

When RPHY configuration is for PNM MAX-HOLD UTSC Other trigger mode, RPHY sends PNM data continuously, until the user issues stop command or the duration is complete.

To configure for MAX-HOLD trigger mode on the Supervisor, complete the following steps:

**Step 1** Configure the PNM `docsPnmCmtsUtseCfgTriggerMode` to 'other' mode. Both the SNMP and CLI can set the trigger mode. See the following examples:

- For SNMP:

```
snmpset -v2c -c private 80.4.2.11 1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.3.435572.1 i 1
```

- For CLI:

```
test cable pnm uts configure trigger-mode other
```

Adding a new TrigMode to MIB might take long and cause many specification changes.

**Step 2** Set the PNM bulk destination IP address.

- For SNMP:

```
snmpset -v2c -c private 80.4.2.11 1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 x "20 01 0d b8"
```

- For CLI:

```
test cable pnm bdt config set-ip 32.1.13.184
```

**Step 3** Start and stop the capture test.

- Starting the SNMP:

```
snmpset -v2c -c private 80.4.2.11 1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.435572.1 i 1
```

- Starting the CLI:

```
test cable pnm uts start client-id 1 test-id 1 0004.9f00.0591 0
```

- Stopping the SNMP:

```
snmpset -v2c -c private 80.4.2.11 1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.435572.1 i 0
```

- Stopping the CLI:

```
test cable pnm uts stop client-id 1 test-id 1 0004.9f00.0591 0
```

**Step 4** Enable GCP message support. Send the TFTP server IP address and Static L2TP session ID through TLV58 message, and the TrigMode 'other' is send to RPD through TLV41 message.

## Proactive Network Management MAX-HOLD trigger mode

Table 12: Feature History

| Feature Name                     | Release Information         | Feature Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Support for 262144 L2TP sessions | Cisco IOS XE Dublin 17.12.1 | <p>The maximum number of L2TP sessions is increased from 131072 to 262144. The benefit of having more L2TP sessions is that it enables better support for large-scale RPD deployments.</p> <p><b>Note:</b></p> <p>System logs are created when the number of sessions get close 262144. Configure the <b>memory chunk siblings threshold 20000</b> command, to eliminate system logs.</p> <p>The <b>rate-limit</b> warning is logged when L2TP session number is greater than 262144.</p> |

The cBR enables MAX-HOLD trigger mode support in PNM. The non-CCAP defined MAX-HOLD mode offers significant advantages over the existing FREE-RUN mode that was used earlier. With the MAX-HOLD trigger mode, the RPD sends samples much faster - one sample every 2ms, compared to the earlier rate of one sample per 100ms. The RPD also sends the sample to the server, instead of the Line Card.

The MAX-HOLD trigger mode support functionality includes:

- cBR support for the configuration of the MAX-HOLD trigger mode
- cBR support for notify UBUNTU server IP and Static L2tp session IDs to RPD
- RPD usage of the max hold mode to capture the upstream spectrum
- RPD sending the captured BIN to UBUNTU server

## Debugging the PNM feature on cBR8

cBR supports debugging on Upstream Triggered Spectrum Capture – Proactive Network Management by using the debug commands available for the UTSCOM client on supervisor.

Use the CLI to enable the debug commands:

- **debug cable pnm utscom-error**
- **debug cable pnm utscom-debug**

Use the following show command to check the state of capture on the Line Card. It lists the total number of samples per capture context in the CLC. When the capture tests are running, the packet counts on the corresponding Line Card would keep incrementing.

```
Router# show cable card 6/0 us-triggered-spectrum uts-commonLAST event
UTSCOM event STATUS
client_id 1
test_id 1
port 0
dev 8
phy_chan 0
logi_chan 0
status 4
WBFFT Dev trig-mode, data-ready, packets on WBFFT dev, countdown :
wbfft dev 0: 0 0 11 0
wbfft dev 1: 0 0 0 0
wbfft dev 2: 0 0 0 0
wbfft dev 3: 0 0 0 0
wbfft dev 4: 0 0 0 0
wbfft dev 5: 0 0 0 0
wbfft dev 6: 0 0 0 0
wbfft dev 7: 0 0 0 0
total packets: 11
```

The **dtrack** utility can also be used for debugging the packets punted through CPP from CLC to container. To use the **dtrack** utility, complete the following steps:

1. On the supervisor, use the following CLI:

```
test platform hardware qfp active feature docsis dtrack mac 0001.aaaa.cccc
test platform hardware qfp active feature docsis dtrack packe
```

2. Start the trigger and use the following CLI to dump the packets (this can be very verbose as there are 10 samples per file per second):

```
show platform hardware qfp active feature docsis dtrack statistics verbose
```

To obtain the dumping statistics on the IOX container, use the following CLI:

- **dir** `harddisk:/iox/repo-lxc/lxc-data/<CAF id>/logs/`
- **more** `harddisk:/iox/repo-lxc/lxc-data/<CAF id>/logs/.stats`
- **more** `harddisk:/iox/repo-lxc/lxc-data/<CAF id>/logs/pnm.log`

To change configuration on the container console, complete the following steps:

1. Log onto the CAF console as root.
2. Run the `echo "DEBUG" > /data/logs/.loglevel` command.

```
debug level are: ERROR, WARNING, INFO, DEBUG, DEBUG1, DEBUG2, DEBUG3, DEBUG4
```

3. Run the `echo "0" > /data/logs/.resend` command.

```
value "0" disable "tftp resend" due to tftp error.
value "12" enable clc log pnm file at local.
```

Ensure that the PNM TFTP process is active and running on the `guestshell` container as listed:

```
cbr8# guestshell run systemctl status pnm
â pnm.service - cbr pnm telemetry delivery system
Loaded: loaded (/etc/systemd/system/pnm.service; disabled; vendor preset: disabled)
Active: active (running) since Wed 2019-01-09 15:13:40 UTC; 1min 28s ago
```

- If the PNM service is not active, attempt recovery by going through the following steps:
  1. Destroy the `guestshell` instance. Run the `guestshell destroy` command.
  2. Recreate the `gusetshell` by running the `guestshell enable` command.
  3. Check if the `guestshell` instance is running by using the `show app-hosting list` command. Verify that the PNM service is active.
- Verify that the TFTP server IP is reachable from the `guestshell` container and ping is successful.

```
guestshell run ping -c5 <tftp_server_ip>
```

## Quick Install Guide

You can bring up the Proactive Network Management and get the captures running using a minimal configuration. Complete the following steps to enable PNM with a minimal configuration:

1. Find the correct PNM Interface Index for the RPD. Run the `show snmp mib ifmib ifindex | include <rpd_mac>` command.

```
Router# show snmp mib ifmib ifindex | i badb.ad13.2be0
RPD(badb.ad13.2be0)-usport0: Ifindex = 435564
```

Where `badb.ad13.2be0` is the RPD identifier.

2. Ensure that the `guestshell` container is up and running on both active and standby SUP. Run the `show app-hosting list` command.

```
Router# show app-hosting list
App id State

guestshell RUNNING
```

3. Ensure that the `pnm` process is running on the `guestshell`. Run the `guestshell run systemctl status pnm` command. For more information on the command usage, go through [Step 4, on page 10](#).
4. Configure the Bulk Data Transfer parameters. Go through the following steps to set the TFTP IP address and TFTP path. Alternatively, also go through [Upstream Triggered Spectrum Capture Bulk Data Control Objects and MIBs, on page 27](#) for detailed information.

- Set the BDT IPv4 IP address type and TFTP IP address

- **snmpr** commands:

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 -o 20:01:0d:b8

docsPnmBulkDestIpAddr.0 = 20 01 0d b8
```

- **net-snmp** commands:

```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0 x 20010db8
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.2.0 = Hex-STRING: 20 01 0D B8

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.1.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.1.0 = INTEGER: 1

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.2.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.2.0 = Hex-STRING: 20 01 0D B8
```

- Set the BDT destination TFTP path

- **snmpr** commands:

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0 -o pnm
docsPnmBulkDestPath.0 = pnm
```

- **net-snmp** commands:

```
server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0 s 'pnm/test'
SSNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.3.0 = STRING: "pnm/test"

server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.1.1.3.0
SNMPv2-SMI::enterprises.4491.2.1.27.1.1.1.3.0 = STRING: "pnm/test"
```

5. Create and configure a capture config entry. Go through the [Upstream Triggered Spectrum Capture Control Objects and MIBs, on page 23](#) for information on creating and configuring a capture config entry.

## 6. Set the minimum capture config paramters that are needed (center-frequency, span and duration).

- a. Set the `D_docsPnmCmtsUtscCfgStatus_createAndGo` 4.

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1 -i 4
clabProjDocsis.27.1.3.10.2.1.21.<ifIndex>.1 = 4
```

- b. Set the `docsPnmCmtsUtscCfgCenterFreq`.

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.8.<ifIndex>.1 -g 102400000
clabProjDocsis.27.1.3.10.2.1.8.<ifIndex>.1 = 102400000
```

- c. Set the `docsPnmCmtsUtscCfgSpan`.

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.9.<ifIndex>.1 -g 204800000
clabProjDocsis.27.1.3.10.2.1.9.<ifIndex>.1 = 204800000
```

- d. Set the `docsPnmCmtsUtscCfgFreeRunDuration`. Increase the duration to a large value to keep the freerun capture running.

```
server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.19.<ifIndex>.1 -g 5000
clabProjDocsis.27.1.3.10.2.1.19.<ifIndex>.1 = 5000
```

- e. Ensure that the config entry status is active.

```
server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.2.1.21.<ifIndex>.1 = INTEGER: 1
```




---

**Note** Ensure that the capture center frequency and span are in a valid range. IOS error messages are triggered if the user attempts to start capture tests with an invalid capture configuration. The recommended configuration values are provided in the messages.

---

## 7. Start the PNM capture.

- **snmpr** commands:

```
• server > setany -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 -i 1
clabProjDocsis.27.1.3.10.3.1.1.<ifIndex>.1 = 1
```

```
• server > getone -v2c <cmts_ip> <community_name>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 i 1
clabProjDocsis.27.1.3.10.3.1.1.<ifIndex>.1 = 1
```

- **net-snmp** commands:

```
• server > snmpset -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 i 1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 = INTEGER: 1
```

```
• server > snmpget -v2c -c <community_name> <cmts_ip>
1.3.6.1.4.1.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1
SNMPv2-SMI::enterprises.4491.2.1.27.1.3.10.3.1.1.<ifIndex>.1 = INTEGER: 1
```

## 8. The captures are running and files should appear on the TFTP server under the BDT TFTP path configured.

# Proactive Network Management using OFDMA RxMER Probes

Cisco cBR 16.12.1y supports Proactive Network Management using OFDMA RxMER Probes. This feature enables collection and reporting of the OFDMA channel Receive Modulation Error Ratio (RxMER) for every subcarrier.

The DOCSIS 3.1 CMTS and CM support OFDMA RxMER probes. The CM transmits signals over the OFDMA upstream channel to the CMTS. The signals are received at the upstream PHY, and each subcarrier in the OFDMA channel is evaluated. RxMER is defined as the ratio of the average power of the ideal QAM constellation to the average error-vector power. The error vector is the difference between the equalized received probe value and the known correct probe value. If some subcarriers (such as exclusion bands) cannot be measured by the CMTS, a value of 0xFF will be returned for that subcarrier.

PNM RxMER probes are initiated and controlled through SNMP MIB commands. The DOCS-PNM-MIB specification details the applicable commands under the **docsPnmCmtsUsOfdmaRxMerTable**. A single RxMER probe can be started for each OFDMA channel in the system by specifying the target cable modem mac-address. The RxMER probe results are sent to a remote TFTP server using the IOX Guestshell PNM service

The following command options are supported for **DocsPnmCmtsUsOfdmaRxMerTable**:

- **docsPnmCmtsUsOfdmaRxMerEntry.[ifIndex]**

Each row of the **DocsPnmCmtsUsOfdmaRxMerTable** is uniquely identified by the OFDMA channel ifIndex. You can identify the ifIndex of a particular OFDMA channel by running the following command:

```
Router# show snmp mib ifmib ifindex | i Cable1/0/2-upstream7 Cable1/0/2-upstream7:
Ifindex = 389839
```

- **docsPnmCmtsUsOfdmaRxMerEnable**

Set to TRUE to initiate collection of the RxMER data and send to TFTP server. Setting it to FALSE restores the MIB values to defaults.

- **docsPnmCmtsUsOfdmaRxMerCmMac**

Specifies the mac-address of the CM that performs the RxMER probe.

- **docsPnmCmtsUsOfdmaRxMerPreEq**

You can either set the value to TRUE to perform RxMER probe with Pre-Equalization, or choose to set the value to FALSE to perform RxMER probe without Pre-Equalization.




---

**Note** We recommend that probing is done with Pre-Equalization, as this will have the CM transmit on each sub-carrier using a gain that will normalize the signal arriving at the CMTS.

---

- **docsPnmCmtsUsOfdmaRxMerNumAvg**

This is in the range of 1-255. Any integer greater than one will generate multiple probes and average the result before sending it to the TFTP server.

- **docsPnmCmtsUsOfdmaRxMerMeasStatus**

Indicates the status of the probe request [Inactive, Busy, SampleReady, Error]. See the MIB definition for complete details. Ensure that no modifications are made to other MIB fields for the table entry while the probe is in `Busy` state.

- **docsPnmCmtsUsOfdmaRxMerFileName**

Displays the name of the file written to the TFTP server. You can choose to leave it blank, and an autogenerated filename will be used. The filename is read back after the probe is complete and the status is read as `SampleReady`.



**Note** Do note that new file names are not autogenerated for subsequent probes. Hence, ensure that your filename value is cleared or set to a new value before initiating a subsequent probe. This will avoid the problem of new probe data overwriting information on the previous probe with the same filename.

- **docsPnmCmtsUsOfdmaRxMerDestinationIndex**

Specifies the multiple destination index added to the existing Upstream OFDMA RxMER.

## PNM RxMER Probe High Availability

- **docsPnmCmtsUsOfdmaRxMerTable**

- SUPHA: In progress operation will need to be restarted by the operator after the switchover. Currently the IOX PNM service is not available after a SUP-HA event.
- LCHA: In progress operation will need to be restarted by the operator after switchover



**Note** When restarting the RxMER probe on the Standby Line Card, care should be taken to identify the new `ifIndex` of the OFMDA channel. This will be different from the Primary Line Card.

- LCPR: Operations that are in progress will be restarted by SUP after the LCPR completion. An internal operation timeout will restart the RxMER probe after one minute, for a maximum of three attempts. During this time, the RxMER status will remain as “Busy”.

## RxMer Probe Debugging

You can use the following command options to display the status and count of the PNM RxMER jobs.

- To display the status of PNM RxMER jobs by `ifIndex`, use the **test cable pnm rxmer show** command. See the following usage example:

```
Router# test cable pnm rxmer show
```

| Job | Client | ifIndex | CM-Mac         | Status   | Enable | Pre-Eq | Num-Avgs | Retry |
|-----|--------|---------|----------------|----------|--------|--------|----------|-------|
| 0   | SNMP   | 389838  | 0000.0000.0000 | INACTIVE | N      | N      | 1        | 0     |



```

0 SNMP 389839 0000.0000.0000 INACTIVE N N 1 0
0 SNMP 389933 0000.0000.0000 INACTIVE N N 1 0
0 SNMP 389981 0000.0000.0000 INACTIVE N N 1 0
.
.
.
0 SNMP 404239 0000.0000.0000 INACTIVE N N 1 0
0 SNMP 404246 0000.0000.0000 INACTIVE N N 1 0
0 SNMP 404247 0000.0000.0000 INACTIVE N N 1 0

```

```
PNM RxMER job count 33
```

- To display the count of all the PNM RxMER jobs by ifIndex, use the **test cable pnm rxmer <ifIndex> get all** command. See the following example:

```

Router# test cable pnm rxmer 389838 get all PNM RxMER MIB for ifIndex 389838
Status: INACTIVE
CM-mac: 0000.0000.0000

Enable: False
Pre-Eq: OFF
Num-Avgs: 1
TFTP filename: <default>

```

When upstream profile management is enabled, the **show cable modem <mac> prof-mgmt upstream verbose** command can also be used to view the OFDMA RxMER probe data. The values shown should be similar to, but not exactly the same as the values reported in the TFTP upload file. This is because data was collected using probes at different times.

The RxMER probe data can also be collected and displayed directly on the CBR8 console using the **ping docsis pnm <ip-address> upstream <us-chan> ignored** command. This command will initiate a RxMER probe to the targeted cable modem upstream OFDMA channel. The **ignore** option on the command will prevent the RxMER probe results from impacting OFDMA profile management. The RxMER probe data can then be viewed on the console using the **show cable modem <ip-address> prof-mgmt upstream ignored** command. For example:

```

Router# ping docsis pnm 9.23.4.91 upstream 6 ignore
Queueing 1 MAC-layer station maintenance intervals, timeout is 80 msec:
!
Success rate is 100 percent (1/1)

cbr8# show cable modem 9.23.4.91 prof-mgmt upstream ignored
Upstream Profile Management Data (Ignored):
MAC Address : 4800.33ea.6e3e
Number of US Chan : 1

Ucid : 7
RxMer Exempt Percent : 0
RxMer Margin qDB : 0
RxMer Threshold Percent : 2
Start Sc : 148
End Sc : 1067
Num RxMER Measurement : 1068
Tx Time : 0h:03m:49s ago
Rx Time : 0h:03m:49s ago
MER Poll Period (min) : 5
Auto Profile Upgrade : Yes
Upgrd Dly Cnt (cur/cfg) : 0/1
Upgrd Dly rcmd IUC : none
Recommended IUC : 13

```

```

Current IUC : 13
Downgrade IUC : 13
RxMER send/recv count : 196/196
DBC : 31/31/0/0/0
 (send/succeed/err/reject/timeout)
State : Ready
Profile Downgrade : Disabled
0x0000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0x0020 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0x0040 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0x0060 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0x0080 00000000 00000000 00000000 00000000 00000000 00000000 00000000
0x00A0 ABADB6A7 AAB1B2AE B1B9B5A8 B4A7ABB0 A4B3ACAE AEB1BAB4 B2ADB3B4 B0B7B9B5
0x00C0 BAB3B5AA A5A3A7AB ABB2ACB1 B1B1B3AC B4ADAFAB 9DACAA5AE AEB5ACB1 A6ADB4B2
0x00E0 A3B7ADBB B5ADAE7 A8A7ABB2 9EAEBDB1 AAB1B6B7 B2AFAAB0 9BB0B1AF B7ACB5AD
0x0100 AFB0B0AF A9B7A8AB B1AEB5B1 B59FAEB3 A4ADB1B3 AFB0AEB1 AEABADB7 ABB6B9B6
0x0120 ACB7B5AE ADABB5A7 A4AEB0AA ADB2B8AB B1ADAEB6 A4B2B3AF AEB7A9AE BA9FABAC
0x0140 9AA5B5BB B1BAB9B7 B0A0A8B3 A4A0B3B6 B1A7B1B5 B1ADA9B0 A6B2B1BB AFB9ACAF
0x0160 B4A4B4A7 A2A7B6B3 B1B9ADB7 B5A1B7AD A6ADBCA8 AEB3B4AD AEB0B0B3 ADAEB3B1
0x0180 A8AEACAF B0ADB4A4 A5ACB0AF B1B7B2B0 B2A5B8AC 9FABAFB7 B7A9AFB0 B6B3B1B3
0x01A0 B7AAB1B2 ACBBADC1 A8B3AAB2 B7B1B5B5 BEB1AEB6 ADB3B1AD ACB0B1B2 B7BBAFB8
0x01C0 AFAEACB5 ACB5B1B0 AEA8ACAE B4B5B0AC B4B9ADB5 B4ADB5B6 B2B3AAAB A8AEB4AC
0x01E0 AEAFAFB5 AAafb0B6 ADADAAB4 ABACABB6 B3A5ABB1 ADB4B7B9 AEB6BFAF B1B5B3B0
0x0200 ACAFBAB2 B4B5B3AF B2B4B1BB B5AFADB7 B5B1B3B2 B4B0B0B3 B7B0ACB5 B1B1B0B7
0x0220 AEAAACB9 B8AFACAF B7B1AFAD ADB1B3AE A9B9B0B0 B0AFB2AB ACADACB2 ACB4B2AE
0x0240 A8ABB1AF ADBBA8AC B4B1B3B4 B4AFADB8 B1AEA6AD B0AFAEAD BBB1B4B7 AEA7ADA7
0x0260 AEB2AEB5 B0AAB5B1 B3ACAFB6 B1ACB2A3 A8B7BCAA B5A9ABA9 B6B7AAA8 ACB1A9B3
0x0280 B0B1AFAA B4AEB1A9 ABACB4AF B3B4AFAC B1B0B2B1 B0B0B0B0 B5B7AEB0 B7B2B9A1
0x02A0 B1B0AFB1 AEAE4A7 ABB4B8B0 ADB0ABAE B1A9B9AD B2B1BBAF B1B4AAAF A8ADB3A9
0x02C0 BDA9B9B0 B2ADB0B2 AEAfB3B4 B0AEAAAF AEAfB4A9 B4A9ADB0 B6A9B1AB B0AFAEAB
0x02E0 B1ADA9B2 A8A9A9AC ACACB2AF A8AAB1B4 ABB0ADAD B8ADB1B6 ADB4AEAE AEB0ABB1
0x0300 B2ADACAF ABADABB7 ACA8ACAD A9AFAAB5 A9B0B1BA B1ADB4B3 ABB0AFB0 AEB0ADB2
0x0320 AFABADB7 B0AEABA8 ABFAFB1 A8A7ADAB B3AFAAB2 A9B1B6AE B1B0B1AE ACADB4B7
0x0340 ADB2B0AF B4B1ACA9 B7AFADB5 A9ACB1AD A6ADA6B1 AAA3A3A4 B7A5AFAA A7B2ABB4
0x0360 A8AFA7A7 A6A8ACAF ADA3B4AB A8AAB8AB A5A5ABA4 A7A8BBB1 ABA6A8A4 A79FA9A1
0x0380 AEA3AFAC B1AEABAD ACA8A7A6 B4A2A9A8 A8B2A2AB ABA2A6AE A99B9EA6 A9A59EA4
0x03A0 9FAD99A5 9FA39FA4 ABACA3A5 AA9FA9A1 9EA59AA2 9F9EAA9D A4A5A6A2 A59FA7A1
0x03C0 A09E98A0 9DA0A39F 9C9CA09F 9C999899 9695969A 9597939D 97979B9B 9C909291
0x03E0 938D9790 8B929492 998B8D95 8C85898A 8D878D87 7F7F7E83 817B847F 7E888071
0x0400 75787C76 7A707375 6C6A6D69 6C5B6565 615D5B68 55575458 554C5046 3641452B
0x0420 39402E32 16191D1A 1C223434

```

SC RxMER Distribution (Excluded SCs are ignored):

```

*: 2%
>44dB: ***** 46.95%
44dB: ***** 21.19%
43dB: ***** 11.30%
42dB: ** 5.10%
41dB: * 2.28%
40dB: * 2.50%
39dB: 1.08%
38dB: 1.63%
37dB: 0.65%
36dB: 0.76%
35dB: 0.54%
34dB: 0.21%
33dB:
<33dB: ** 5.76%
-----100
 Percent of Subcarriers

```

Active SC RxMER Statistics (in 1/4 dB):

Active Subcarrier RxMER Mean : 0xAA

```
Active Subcarrier RxMER Standard Deviation : 0x52
Active Subcarrier RxMER Threshold Value : 0x5F
Active Subcarrier RxMER Threshold Frequency (Hz): 46800000
```

# Proactive Network Management using OFDMA RxPwr Probes

## PNM OFDMA RxPwr MIB Overview

- Provides an estimate of the received power in a specified OFDMA channel at the F connector input of either a CMTS-integrated linecard or RPD.
- The measurement is based on upstream probes, which are typically the same probes used for pre-equalization adjustment.

### *Proactive Network Management:*

- Provides measurement and reporting of network conditions.
- Detection of plant impairments and interference.

### *Orthogonal Frequency-Division Multiple Access (OFDMA).*

- DOCSIS 3.1 Upstream Channel modulation scheme where multiple users are allocated to a channel in both the time and frequency domain.
- OFDMA channels have multiple subcarriers (frequency and modulation).

The following command options are supported for **docsPnmCmt UsOfdmaRxPwrTable**

```
DocsPnmCmtsUsOfdmaRxPwrEntry.
 [OFDMA channel ifIndex, CmMac]
 docsPnmCmtsUsOfdmaRxPwrEnable,
 docsPnmCmtsUsOfdmaRxPwrCmMac,
 docsPnmCmtsUsOfdmaRxPwrPreEq,
 docsPnmCmtsUsOfdmaRxPwrNumAvgs,
 docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd,
 docsPnmCmtsUsOfdmaRxPwrMeasStatus,
```

## PNM RxPwr MIB Details

```
DocsPnmCmtsUsOfdmaRxPwrTable
DocsPnmCmtsUsOfdmaRxPwrEntry[OFDMA channel ifIndex, CM Mac]
```

- A MIB table with rows corresponding to the OFDMA channels configured on the system.
- Each OFDMA channel is identified by a unique ifIndex.

```
router #show snmp mib ifmib ifindex | i Cable1/0/2-upstream7
Cable1/0/2-upstream7: Ifindex = 389839
```

- **docsPnmCmtsUsOfdmaRxPwrEnable**
  - Set to **TRUE** to **initiate measurement** of the received power.
  - Set to **FALSE** to restore MIB values to defaults.

### **Example:**

```
./setany -v2c 8.23.1.1 private docsPnmCmtsUsOfdmaRxPwrEnable.389838.000000000001 -i 1
docsPnmCmtsUsOfdmaRxPwrEnable.389838.000000000001 = true(1)
```

```
router#show cable modem 0000.0000.0001 pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp
0000.0000.001 9.23.0.14 Ca1/0/0:u6 w-online(pt) 1 Y -0.2
2023-03-02 14:55:23
```

```
router#test cable pnm us-rxpwr 488046 cm-mac 0000.0000.0001 get all
PNM US-RxPwr Get Entry for ifIndex 488046, CM 0000.0000.0001
 ifIndex: 488046
 chid: 6
 CM-Mac: 0000.0000.0001
 Status: SAMPLE READY (4)
 Enable: Disable (2)
 Pre-Eq: On (1)
 Num-Avgs: 1
 Rx Power: -2 (-0.2 dBmv)
 Probe Retry Cnt: 0
 Probe Configured: Y
 Partial-Mode: 0x00 (None)
 TimeStamp: 2023-03-02 14:55:52
```

- **docsPnmCmtsUsOfdmaRxPwrCmMac**: The mac-address of the modem that performs the RxPwr probe.

- **docsPnmCmtsUsOfdmaRxPwrPreEq**

- Set **TRUE** to request modem **enable equalizer** during probe burst.

The Upstream Controller OFDMA Channel's "equalization-coefficient" must also be enabled (default).

- Set **FALSE** to request modem **disable equalizer** during probe burst.
- Probing with equalizer enabled is preferred as the CM transmits on each sub-carrier using a gain that normalizes the signal arriving at the CMTS.

### Example:

```
./setany -v2c 8.23.1.1 private docsPnmCmtsUsOfdmaRxPwrPreEq.488046.000000000001 -i 1
docsPnmCmtsUsOfdmaRxPwrPreEq.3488046.000000000001 = true(1)
```

```
router#show cable modem 0000.0000.0001 pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp
0000.0000.001 9.23.0.14 Ca1/0/0:u6 w-online(pt) 1 Y ---
0
```

```
router#test cable pnm us-rxpwr 488046 cm-mac 0000.0000.0001 get all
PNM US-RxPwr Get Entry for ifIndex 488046, CM 0000.0000.0001
 ifIndex: 488046
 chid: 6
 CM-Mac: 0000.0000.0001
 Status: INACTIVE (2)
 Enable: Disable (2)
 Pre-Eq: On (1)
 Num-Avgs: 1
 Rx Power: -255 (-25.5 dBmv)
 Probe Retry Cnt: 0
```

```

Probe Configured: Y
Partial-Mode: 0x00 (None)
TimeStamp: 0

```

- **docsPnmCmtsUsOfdmaRxPwrNumAvgs**

- Range is 1-32. cBR-8 doesn't support values above 32.
- >1 generates multiple probes and average the result reported by docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd

**Example:**

```

./setany -v2c 8.23.1.1 private docsPnmCmtsUsOfdmaRxPwrNumAvgs.488046.000000000001 -I 1
docsPnmCmtsUsOfdmaRxPwrNumAvgs.488046.000000000001 = 1

```

```

router# show cable modem 0000.0000.0001 pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp
0000.0000.001 9.23.0.14 Ca1/0/0:u6 w-online(pt) 1 N ---
0

```

```

router #test cable pnm us-rxpwr 488046 cm-mac 0000.0000.0001 get all
PNM US-RxPwr Get Entry for ifIndex 488046, CM 0000.0000.0001
 ifIndex: 488046
 chid: 6
 CM-Mac: 0000.0000.0001
 Status: INACTIVE (2)
 Enable: Disable (2)
 Pre-Eq: Off (2)
 Num-Avgs: 1
 Rx Power: -255 (-25.5 dBmv)
 Probe Retry Cnt: 0
 Probe Configured: Y
 Partial-Mode: 0x00 (None)
 TimeStamp: 0

```

- **docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd**: After triggering the measurement via Enable, wait for MeasStatus to return SampleReady and then read this MIB variable to retrieve the resulting power measurement.
- **docsPnmCmtsUsOfdmaRxMerMeasStatus**: Indicates the status of the requested measurements and result [Inactive, Busy, SampleReady, Error]

## PNM RxMER Probe High Availability

- **SUPHA**

- MIBs may be temporarily unavailable while newly active SUP completes initialization of non-dataplane subsystems after becoming active.
- SNMP architecture of cBR-8 changes the ifIndex of channels to match the currently active slot.
- In Progress operation will need to be restarted by operator after switchover for entry with ifIndex of newly active slot.

**Before Switchover:**

```

docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd[488046] [STRING: 4800.33ef.3b0a] = INTEGER: -6.0
dB

```

**After Switchover to Secondary:**

```
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd[485742][STRING: 4800.33ef.3b0a] = INTEGER: -6.0
dB
```

- **LCPR**

*IOSd-CLC and CDMAN LCPR:* If measurement is in progress when LCPR is triggered, some measurement samples may be lost and MeasStatus may report “Error” instead of “SampleReady”. If this occurs, set Enable to TRUE to restart the measurement.

The following is a sample output for the `show cable modem pnm us-rxpwr` command:

```
router#show cable modem pnm us-rxpwr
MAC Address IP Address I/F MAC State Num Pre RxPwr TimeStamp
 Avg Eq (dBmv)
4800.33ef.053e 9.38.8.21 Ca1/0/0:u6 w-online (pt) 10 N -5.7 2023-03-02
09:23:55
4800.33ef.053e 9.38.8.21 Ca1/0/0:u7 w-online (pt) 3 N -6.0 2023-03-02
09:24:46
4800.33ef.093a 9.38.8.5 Ca1/0/0:u6 w-online (pt) 32 N -6.0 2023-03-02
09:28:57
4800.33ef.093a 9.38.8.5 Ca1/0/0:u7 w-online (pt) 5 N -6.0 2023-03-02
09:29:48
206a.9454.30ac 9.38.8.34 Ca1/0/2:u6 w-online (pt) 1 N -6.2 2023-03-02
09:32:17
4800.33ef.0d1a 9.38.8.11 Ca9/0/0:u6 w-online (pt) 32 N -6.0 2023-03-02
09:46:33
4800.33ef.0d1a 9.38.8.11 Ca9/0/0:u6 w-online (pt) 32 N -6.0 2023-03-02
09:46:33
4800.33ef.3f12 9.38.8.27 Ca9/0/0:u6/p w-online (pt) 1 N --- 2023-03-02
09:41:30
4800.33ef.3f12 9.38.8.27 Ca9/0/0:u7/p w-online (pt) 7 N -6.0 2023-03-02
09:42:21
4800.33ef.3e86 9.38.8.20 Ca9/0/1:u6 w-online (pt) 2 N -6.0 2023-03-02
09:48:11
4800.33ef.3e86 9.38.8.20 Ca9/0/1:u7 w-online (pt) 1 N -6.0 2023-03-02
09:49:02
4800.33ef.0666 9.38.8.2 Ca9/0/8:u6 w-online (pt) 1 N -6.0 2023-03-02
09:49:53
4800.33ef.0666 9.38.8.2 Ca9/0/8:u7 w-online (pt) 3 N -5.7 2023-03-02
09:50:44
4800.33ef.3f3e 9.38.8.16 Ca9/0/9:u6 w-online (pt) 2 N -6.0 2023-03-02
09:51:3
4800.33ef.3f3e 9.38.8.16 Ca9/0/9:u7 w-online (pt) 32 N -3.0 2023-03-02
09:52:22
```

The following is a sample output for the `test cable pnm us-rxpwr snmp-walk all` command:

```
router#test cable pnm us-rxpwr snmp-walk all
Chan Num Retry
Probe ID CM-Mac Partial Status Enable Pre-Eq Avg RxPwr Cnt Config
Timestamp Mode

488046 6 4800.33ef.053e SAMPLE READY N N 10 -57 0 Y
2023-03-02 09:23:55 0x00 (None)
488046 6 4800.33ef.093a SAMPLE READY N N 32 -60 0 Y
2023-03-02 09:28:57 0x00 (None)
```

|                                 |   |                |        |       |   |   |    |      |   |   |
|---------------------------------|---|----------------|--------|-------|---|---|----|------|---|---|
| 488047                          | 7 | 4800.33ef.053e | SAMPLE | READY | N | N | 3  | -60  | 0 | Y |
| 2023-03-02 09:24:46 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 488047                          | 7 | 4800.33ef.093a | SAMPLE | READY | N | N | 5  | -60  | 0 | Y |
| 2023-03-02 09:29:48 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 488142                          | 6 | 206a.9454.30ac | SAMPLE | READY | N | N | 1  | -62  | 0 | Y |
| 2023-03-02 09:32:17 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 501870                          | 6 | 4800.33ef.0d1a | SAMPLE | READY | N | N | 32 | -60  | 0 | Y |
| 2023-03-02 09:46:33 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 501870                          | 6 | 4800.33ef.3f12 | SAMPLE | READY | N | N | 7  | -255 | 0 | Y |
| 2023-03-02 09:42:21 0x01 (RNG)  |   |                |        |       |   |   |    |      |   |   |
| 501871                          | 7 | 4800.33ef.0d1a | SAMPLE | READY | N | N | 1  | -57  | 0 | Y |
| 2023-03-02 09:47:20 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 501871                          | 7 | 4800.33ef.3f12 | SAMPLE | READY | N | N | 7  | -60  | 0 | Y |
| 2023-03-02 09:42:21 0x01 (RNG)  |   |                |        |       |   |   |    |      |   |   |
| 501918                          | 6 | 4800.33ef.3e86 | SAMPLE | READY | N | N | 2  | -255 | 0 | Y |
| 2023-03-02 09:48:11 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 501919                          | 7 | 4800.33ef.3e86 | SAMPLE | READY | N | N | 1  | -60  | 0 | Y |
| 2023-03-02 09:49:02 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 502254                          | 6 | 4800.33ef.0666 | SAMPLE | READY | N | N | 1  | -60  | 0 | Y |
| 2023-03-02 09:49:53 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 502255                          | 7 | 4800.33ef.0666 | SAMPLE | READY | N | N | 3  | -57  | 0 | Y |
| 2023-03-02 09:50:44 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 502302                          | 6 | 4800.33ef.3f3e | SAMPLE | READY | N | N | 2  | -60  | 0 | Y |
| 2023-03-02 09:51:32 0x00 (None) |   |                |        |       |   |   |    |      |   |   |
| 502303                          | 7 | 4800.33ef.3f3e | SAMPLE | READY | N | N | 32 | -30  | 0 | Y |
| 2023-03-02 09:52:22 0x00 (None) |   |                |        |       |   |   |    |      |   |   |

### SNMP Agent docsPnmCmtsUsOfdmaRxPwrEntry Walk

```
docsPnmCmtsUsOfdmaRxPwrEnable[488046] [STRING: 4800.33ef.53e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[488046] [STRING: 4800.33ef.93a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[488047] [STRING: 4800.33ef.53e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[488047] [STRING: 4800.33ef.93a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[488142] [STRING: 206a.9454.30ac] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[501870] [STRING: 4800.33ef.d1a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[501871] [STRING: 4800.33ef.d1a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[501871] [STRING: 4800.33ef.3f12] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[501918] [STRING: 4800.33ef.3e86] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[501919] [STRING: 4800.33ef.3e86] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[502254] [STRING: 4800.33ef.666] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[502255] [STRING: 4800.33ef.666] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[502302] [STRING: 4800.33ef.3f3e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrEnable[502303] [STRING: 4800.33ef.3f3e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[488046] [STRING: 4800.33ef.53e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[488046] [STRING: 4800.33ef.93a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[488047] [STRING: 4800.33ef.53e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[488047] [STRING: 4800.33ef.93a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[488142] [STRING: 206a.9454.30ac] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[501870] [STRING: 4800.33ef.d1a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[501871] [STRING: 4800.33ef.d1a] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[501871] [STRING: 4800.33ef.3f12] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[501918] [STRING: 4800.33ef.3e86] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[501919] [STRING: 4800.33ef.3e86] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[502254] [STRING: 4800.33ef.666] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[502255] [STRING: 4800.33ef.666] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[502302] [STRING: 4800.33ef.3f3e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrPreEq[502303] [STRING: 4800.33ef.3f3e] = INTEGER: false(2)
docsPnmCmtsUsOfdmaRxPwrNumAvgs[488046] [STRING: 4800.33ef.53e] = Gauge32: 10
docsPnmCmtsUsOfdmaRxPwrNumAvgs[488046] [STRING: 4800.33ef.93a] = Gauge32: 32
docsPnmCmtsUsOfdmaRxPwrNumAvgs[488047] [STRING: 4800.33ef.53e] = Gauge32: 3
docsPnmCmtsUsOfdmaRxPwrNumAvgs[488047] [STRING: 4800.33ef.93a] = Gauge32: 5
docsPnmCmtsUsOfdmaRxPwrNumAvgs[488142] [STRING: 206a.9454.30ac] = Gauge32: 1
docsPnmCmtsUsOfdmaRxPwrNumAvgs[501870] [STRING: 4800.33ef.d1a] = Gauge32: 32
```

```

docsPnmCmtsUsOfdmaRxPwrNumAvgs [501871] [STRING: 4800.33ef.d1a] = Gauge32: 1
docsPnmCmtsUsOfdmaRxPwrNumAvgs [501871] [STRING: 4800.33ef.3f12] = Gauge32: 7
docsPnmCmtsUsOfdmaRxPwrNumAvgs [501918] [STRING: 4800.33ef.3e86] = Gauge32: 2
docsPnmCmtsUsOfdmaRxPwrNumAvgs [501919] [STRING: 4800.33ef.3e86] = Gauge32: 1
docsPnmCmtsUsOfdmaRxPwrNumAvgs [502254] [STRING: 4800.33ef.666] = Gauge32: 1
docsPnmCmtsUsOfdmaRxPwrNumAvgs [502255] [STRING: 4800.33ef.666] = Gauge32: 3
docsPnmCmtsUsOfdmaRxPwrNumAvgs [502302] [STRING: 4800.33ef.3f3e] = Gauge32: 2
docsPnmCmtsUsOfdmaRxPwrNumAvgs [502303] [STRING: 4800.33ef.3f3e] = Gauge32: 32
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [488046] [STRING: 4800.33ef.53e] = INTEGER: -5.7 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [488046] [STRING: 4800.33ef.93a] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [488046] [STRING: 4800.33ef.93a] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [488047] [STRING: 4800.33ef.93a] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [488142] [STRING: 206a.9454.30ac] = INTEGER: -6.2 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [501870] [STRING: 4800.33ef.d1a] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [501871] [STRING: 4800.33ef.d1a] = INTEGER: -5.7 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [501871] [STRING: 4800.33ef.3f12] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [501918] [STRING: 4800.33ef.3e86] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [501919] [STRING: 4800.33ef.3e86] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [502254] [STRING: 4800.33ef.666] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [502255] [STRING: 4800.33ef.666] = INTEGER: -5.7 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [502302] [STRING: 4800.33ef.3f3e] = INTEGER: -6.0 dB
docsPnmCmtsUsOfdmaRxPwrOnePtSixPsd [502303] [STRING: 4800.33ef.3f3e] = INTEGER: -3.0 dB
docsPnmCmtsUsOfdmaRxPwrMeasStatus [488046] [STRING: 4800.33ef.53e] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [488046] [STRING: 4800.33ef.93a] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [488047] [STRING: 4800.33ef.53e] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [488047] [STRING: 4800.33ef.93a] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [488142] [STRING: 206a.9454.30ac] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [501870] [STRING: 4800.33ef.d1a] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [501871] [STRING: 4800.33ef.d1a] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [501871] [STRING: 4800.33ef.3f12] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [501918] [STRING: 4800.33ef.3e86] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [501919] [STRING: 4800.33ef.3e86] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [502254] [STRING: 4800.33ef.666] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [502255] [STRING: 4800.33ef.666] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [502302] [STRING: 4800.33ef.3f3e] = INTEGER: sampleReady (4)
docsPnmCmtsUsOfdmaRxPwrMeasStatus [502303] [STRING: 4800.33ef.3f3e] = INTEGER: sampleReady (4)

```

## Clearing Modem on Proactive Network Management Upstream Channel RxPwr

Table 13: Feature History

| Feature Name                        | Release Information         | Feature Description                                                                     |
|-------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------|
| New CLI support for PNM OFDMA RxPwr | Cisco IOS XE Dublin 17.12.1 | You now have new CLI support for Proactive Network Management using OFDMA RxPwr Probes. |

The following are the new CLIs supported for PNM OFDMA RxPwr:

- `router#clear cable modem pnm us-rxpwr`
- `router#clear cable modem pnm us-rxpwr upstream <0-15>`
- `router#clear cable modem pnm us-rxpwr upstream Cable <slot/0/interface> pnm us-rxpwr upstream <0-15>`
- `router#clear cable modem pnm us-rxpwr upstream Cable <mac address> pnm us-rxpwr`



```
router#clear cable modem pnm us-rxpwr upstream Cable <ip address> pnm
us-rxpwr
```

- router#clear cable modem pnm us-rxpwr upstream Cable <mac address> pnm
us-rxpwr upstream <0-15>

```
router#clear cable modem pnm us-rxpwr upstream Cable <ip address> pnm
us-rxpwr upstream <0-15>
```

The following scenarios indicate the Proactive Network Management upstream channel RxPwr clear and show commands:

- **Clearing Modem on PNM Upstream Channel RxPwr**

To clear all the PNM upstream channel RxPwr information for cable modems, use the following **clear cable modem pnm us-rxpwr** command in the privileged EXEC mode.

```
router#clear cable modem pnm us-rxpwr
```

The following is a sample output for the **show cable modem pnm us-rxpwr** command:

```
router#show cable modem pnm ?
 us-rxpwr PNM US RxPwr (1.6 MHz normalized) from docsPnmCmtsUsOfdmaRxPwrTable

router#show cable modem pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp
State Avgs Eq (dBmv)

4800.33ef.3c52 9.14.0.11 Ca1/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:38:14
4800.33ef.3c52 9.14.0.11 Ca1/0/0:u7 w-online (pt) 2 Y 0.7
2023-09-02 10:38:14
4800.33ef.3a72 9.14.0.45 Ca1/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:40:26
4800.33ef.3a72 9.14.0.45 Ca1/0/0:u7 w-online (pt) 2 Y 0.0
2023-09-02 10:40:26
4800.33ef.3a12 9.14.0.56 Ca1/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:39:31
4800.33ef.3a12 9.14.0.56 Ca1/0/0:u7 w-online (pt) 2 Y 0.0
2023-09-02 10:39:31
4800.33ef.39ce 9.14.0.51 Ca1/0/0:u6 w-online (pt) 1 Y 0.2
2023-09-02 10:40:27
4800.33ef.39ce 9.14.0.51 Ca1/0/0:u7 w-online (pt) 2 Y 0.2
2023-09-02 10:40:27
4800.33ef.3a92 9.14.0.60 Ca1/0/0:u6 w-online (pt) 1 Y 0.2
2023-09-02 10:40:28
4800.33ef.3a92 9.14.0.60 Ca1/0/0:u7 w-online (pt) 2 Y 0.2
2023-09-02 10:40:28
4800.33ef.0baa 9.14.0.72 Ca1/0/0:u6 w-online (pt) 1 Y 0.5
2023-09-02 10:38:14
4800.33ef.0baa 9.14.0.72 Ca1/0/0:u7 w-online (pt) 2 Y -0.2
2023-09-02 10:38:14
4800.33ef.3aa2 9.14.0.55 Ca1/0/0:u6 w-online (pt) 1 Y 0.2
2023-09-02 10:38:20
4800.33ef.3aa2 9.14.0.55 Ca1/0/0:u7 w-online (pt) 2 Y 0.2
2023-09-02 10:38:20
4800.33ee.f732 9.14.0.73 Ca1/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:38:13
4800.33ee.f732 9.14.0.73 Ca1/0/0:u7 w-online (pt) 2 Y 0.0
2023-09-02 10:38:13
4800.33ef.060a 9.14.0.70 Ca1/0/0:u6 w-online (pt) 1 Y 1.0
2023-09-03 08:57:41
4800.33ef.060a 9.14.0.70 Ca1/0/0:u7 w-online (pt) 8 Y 0.2
```

```

2023-09-02 10:38:13
0cb9.37d8.00c4 9.14.0.36 Ca1/0/0:u6 w-online(pt) 1 Y -t-
2023-09-02 10:40:29
0cb9.37d8.00c4 9.14.0.36 Ca1/0/0:u7 w-online(pt) 3 Y -t-
2023-09-02 10:40:29
4800.33ef.38ae 9.14.0.66 Ca1/0/0:u6 w-online(pt) 1 Y 0.2
2023-09-02 10:39:30
4800.33ef.38ae 9.14.0.66 Ca1/0/0:u7 w-online(pt) 2 Y 0.2
2023-09-02 10:39:30
4800.33ef.394e 9.14.0.44 Ca1/0/0:u6 w-online(pt) 1 Y 0.0
2023-09-02 10:40:25
4800.33ef.394e 9.14.0.44 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:40:25
4800.33ef.3a9a 9.14.0.35 Ca1/0/0:u6 w-online(pt) 1 Y 0.0
2023-09-02 10:39:37
4800.33ef.3a9a 9.14.0.35 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:39:37
4800.33ef.38c2 9.14.0.38 Ca1/0/0:u6 w-online(pt) 1 Y 0.2
2023-09-02 10:39:41
4800.33ef.38c2 9.14.0.38 Ca1/0/0:u7 w-online(pt) 2 Y 0.2
2023-09-02 10:39:41
4800.33ef.3a82 9.14.0.54 Ca1/0/0:u6 w-online(pt) 1 Y 0.2
2023-09-02 10:39:41
4800.33ef.3a82 9.14.0.54 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:39:41
4800.33ef.3972 9.14.0.53 Ca1/0/0:u6 w-online(pt) 1 Y 0.2
2023-09-02 10:38:24
4800.33ef.3972 9.14.0.53 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:38:24
d4b9.2f6e.f4b8 9.14.0.75 Ca1/0/1:u6 w-online(pt) 2 Y 0.2
2023-09-02 10:40:30
d4b9.2f6e.f4b8 9.14.0.75 Ca1/0/1:u7 w-online(pt) 3 Y 0.2
2023-09-02 10:40:30
4800.33ef.06ca 9.14.0.71 Ca1/0/1:u6 w-online(pt) 2 Y 0.0
2023-09-02 10:40:31
4800.33ef.06ca 9.14.0.71 Ca1/0/1:u7 w-online(pt) 3 Y 0.2
2023-09-02 10:40:31
4800.33ea.716a 9.14.0.74 Ca1/0/1:u6 w-online(pt) 2 Y 0.0
2023-09-02 10:40:30
4800.33ea.716a 9.14.0.74 Ca1/0/1:u7 w-online(pt) 3 Y 0.0
2023-09-02 10:40:30
4800.33ef.0ac2 9.14.0.34 Ca1/0/1:u6 w-online(pt) 2 Y -0.2
2023-09-02 10:40:31
4800.33ef.0ac2 9.14.0.34 Ca1/0/1:u7 w-online(pt) 3 Y 0.0
2023-09-02 10:40:31

```

```

i = probe inactive
n = very low power or no energy
q = equalization coefficient config mismatch with probe pre-equalization setting
t = probe response timeout condition, no probe response received
x = probe not sent

```

- **Clearing Modem on PNM Upstream Channel RxPwr on a Specific OFDMA channel**

To clear all the PNM upstream channel RxPwr information for cable modems on a specific OFDMA channel, use the following **clear cable modem pnm us-rxpwr** command in the privileged EXEC mode.

```
router#clear cable modem pnm us-rxpwr upstream <0-15>
```

- **Clearing Modem on PNM Upstream Channel RxPwr on a Specific Cable Interface**

To clear all the PNM upstream channel RxPwr information for cable modems on a specific cable interface on a specific OFDMA channel, use the following **clear cable modem pnm us-rxpwr Cable** command in the privileged EXEC mode.

```
router#clear cable modem pnm us-rxpwr upstream Cable <slot/0/interface> pnm us-rxpwr
upstream <0-15>
```

The following is a sample output for the **show clear cable modem pnm us-rxpwr Cable** command:

```
router#show clear cable modem C1/0/0 pnm us-rxpwr ?
| Output modifiers
| <cr> <cr>

router#show clear cable modem C1/0/0 pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp

4800.33ef.3c52 9.14.0.11 Cal/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:38:14
4800.33ef.3c52 9.14.0.11 Cal/0/0:u7 w-online (pt) 2 Y 0.7
2023-09-02 10:38:14
4800.33ef.3a72 9.14.0.45 Cal/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:40:26
4800.33ef.3a72 9.14.0.45 Cal/0/0:u7 w-online (pt) 2 Y 0.0
2023-09-02 10:40:26
4800.33ef.3a12 9.14.0.56 Cal/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:39:31
4800.33ef.3a12 9.14.0.56 Cal/0/0:u7 w-online (pt) 2 Y 0.0
2023-09-02 10:39:31
4800.33ef.39ce 9.14.0.51 Cal/0/0:u6 w-online (pt) 1 Y 0.2
2023-09-02 10:40:27
4800.33ef.39ce 9.14.0.51 Cal/0/0:u7 w-online (pt) 2 Y 0.2
2023-09-02 10:40:27
4800.33ef.3a92 9.14.0.60 Cal/0/0:u6 w-online (pt) 1 Y 0.2
2023-09-02 10:40:28
4800.33ef.3a92 9.14.0.60 Cal/0/0:u7 w-online (pt) 2 Y 0.2
2023-09-02 10:40:28
4800.33ef.0baa 9.14.0.72 Cal/0/0:u6 w-online (pt) 1 Y 0.5
2023-09-02 10:38:14
4800.33ef.0baa 9.14.0.72 Cal/0/0:u7 w-online (pt) 2 Y -0.2
2023-09-02 10:38:14
4800.33ef.3aa2 9.14.0.55 Cal/0/0:u6 w-online (pt) 1 Y 0.2
2023-09-02 10:38:20
4800.33ef.3aa2 9.14.0.55 Cal/0/0:u7 w-online (pt) 2 Y 0.2
2023-09-02 10:38:20
4800.33ee.f732 9.14.0.73 Cal/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:38:13
4800.33ee.f732 9.14.0.73 Cal/0/0:u7 w-online (pt) 2 Y 0.0
2023-09-02 10:38:13
4800.33ef.060a 9.14.0.70 Cal/0/0:u6 w-online (pt) 1 Y 1.0
2023-09-03 08:57:41
4800.33ef.060a 9.14.0.70 Cal/0/0:u7 w-online (pt) 8 Y 0.2
2023-09-02 10:38:13
0cb9.37d8.00c4 9.14.0.36 Cal/0/0:u6 w-online (pt) 1 Y -t-
2023-09-02 10:40:29
0cb9.37d8.00c4 9.14.0.36 Cal/0/0:u7 w-online (pt) 3 Y -t-
2023-09-02 10:40:29
4800.33ef.38ae 9.14.0.66 Cal/0/0:u6 w-online (pt) 1 Y 0.2
2023-09-02 10:39:30
4800.33ef.38ae 9.14.0.66 Cal/0/0:u7 w-online (pt) 2 Y 0.2
2023-09-02 10:39:30
4800.33ef.394e 9.14.0.44 Cal/0/0:u6 w-online (pt) 1 Y 0.0
2023-09-02 10:40:25
```

```

4800.33ef.394e 9.14.0.44 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:40:25
4800.33ef.3a9a 9.14.0.35 Ca1/0/0:u6 w-online(pt) 1 Y 0.0
2023-09-02 10:39:37
4800.33ef.3a9a 9.14.0.35 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:39:37
4800.33ef.38c2 9.14.0.38 Ca1/0/0:u6 w-online(pt) 1 Y 0.2
2023-09-02 10:39:41
4800.33ef.38c2 9.14.0.38 Ca1/0/0:u7 w-online(pt) 2 Y 0.2
2023-09-02 10:39:41
4800.33ef.3a82 9.14.0.54 Ca1/0/0:u6 w-online(pt) 1 Y 0.2
2023-09-02 10:39:41
4800.33ef.3a82 9.14.0.54 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:39:41
4800.33ef.3972 9.14.0.53 Ca1/0/0:u6 w-online(pt) 1 Y 0.2
2023-09-02 10:38:24
4800.33ef.3972 9.14.0.53 Ca1/0/0:u7 w-online(pt) 2 Y 0.0
2023-09-02 10:38:24

```

```

i = probe inactive
n = very low power or no energy
q = equalization coefficient config mismatch with probe pre-equalization setting
t = probe response timeout condition, no probe response received
x = probe not sent

```

```

Avgs Eq (dBmv) State

```

#### • Clearing Modem on PNM Upstream Channel RxPwr on a Specific Cable Modem

To clear the PNM upstream channel RxPwr information for a specific cable modem, use the following **clear cable modem pnm us-rxpwr [H.H.H or A.B.C.D] upstream** command in the privileged EXEC mode.

Where [H.H.H] is a specific modem's unique MAC address and [A.B.C.D] is a specific modem's assigned IP address.

```

router#clear cable modem pnm us-rxpwr upstream Cable H.H.H pnm us-rxpwr
router#clear cable modem pnm us-rxpwr upstream Cable A.B.C.D pnm us-rxpwr

```

The following is a sample output for the **show cable modem mac address pnm us-rxpwr** command:

```

router#show cable modem 4800.33ef.060a pnm us-rxpwr ?
| Output modifiers
<cr> <cr>

```

```

router#show cable modem 4800.33ef.060a pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp
4800.33ef.060a 9.14.0.70 Ca1/0/0:u6 w-online(pt) 1 Y 1.0
2023-09-03 08:57:41
4800.33ef.060a 9.14.0.70 Ca1/0/0:u7 w-online(pt) 8 Y 0.2
2023-09-02 10:38:13

```

```

i = probe inactive
n = very low power or no energy
q = equalization coefficient config mismatch with probe pre-equalization setting
t = probe response timeout condition, no probe response received
x = probe not sent

```

#### • Clearing Modem on PNM Upstream Channel RxPwr on a Specific Cable Modem on a Specific Upstream Channel OFDMA Channel

To clear the PNM upstream channel RxPwr information for a specific cable modem on a specific upstream channel OFDMA channel, use the following `clear cable modem pnm us-rxpwr [H.H.H or A.B.C.D]` command in privileged EXEC mode.

Where [H.H.H] is a specific modem's unique MAC address and [A.B.C.D] is a specific modem's assigned IP address.

```
router#clear cable modem pnm us-rxpwr upstream Cable H.H.H pnm us-rxpwr upstream <0-15>
router#clear cable modem pnm us-rxpwr upstream Cable A.B.C.D pnm us-rxpwr upstream <0-15>
```

## Verifying the Proactive Network Management Using OFDMA RxPwr Probes

You can verify the Proactive Network Management using OFDMA RxPwr Probes under the following scenarios:

- **Verifying the PNM using Specific Status Reason Codes**

The following example shows the PNM RxPwr Probe to the modem 0cb9.37d8.00c4 failure due to a *-t-* timeout because the modem did not respond to the PNM RxPwr Probe.

```
router#scm 0cb9.37d8.00c4 pnm us
router#show cable modem 0cb9.37d8.00c4 pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp
State Avgs Eq (dBmv)
0cb9.37d8.00c4 9.14.0.36 Ca1/0/0:u6 w-online (pt) 1 Y -t-
2023-09-02 10:40:29
0cb9.37d8.00c4 9.14.0.36 Ca1/0/0:u7 w-online (pt) 3 Y -t-
2023-09-02 10:40:29
```

where,

- *i*—indicates that the probe is inactive
- *n*—very low power or no energy
- *q*—equalization coefficient configuration mismatch with probe pre-equalization setting
- *t*—probe response timeout condition, no probe response received
- *x*—probe not sent

- **Verifying the PNM using Upstream Channel Partial-Service Mode (RNG)**

If the OFDMA upstream channel of a modem is in a partial-service condition due to RNG mode, then the PNM RxPwr Probes are not sent to the modem and will be dropped on the iCMTS.

The **I/F** column indicates the upstream channel partial-service condition with a */p* following the interface name string. And, the RxPwr column has the specific status reason code *-x-* indicating the PNM RxPwr probe request was dropped. There is a possibility that the OFDMA upstream channel entered the partial-service condition after the PNM RxPwr Probe was received from the modem. In this case, the **I/F** column indicates the upstream channel partial-service condition with a */p* following the interface name string. And, the RxPwr column has the specific status reason code *-i-* to indicate the PNM RxPwr Probe is in the inactive state.

The following example shows the PNM RxPwr Probe to the OFDMA upstream channel in a partial-service condition state due to RNG mode and denotes **-t-** indicating the PNM RxPwr Probe in inactive state and **/p** the interface name string and **-x** indicating the probe request dropped.

```
router#show cable modem 4800.33ef.060a pnm us-rxpwr
```

| MAC Address<br>TimeStamp              | IP Address | I/F        | MAC | State         | Num | Pre | RxPwr<br>(dBmv) |
|---------------------------------------|------------|------------|-----|---------------|-----|-----|-----------------|
| 4800.33ef.060a<br>2023-09-02 10:41:12 | 9.14.0.70  | Ca1/0/0:u6 | /p  | w-online (pt) | 1   | Y   | <b>-x-</b>      |
| 4800.33ef.060a<br>2023-09-02 10:38:13 | 9.14.0.70  | Ca1/0/0:u7 |     | w-online (pt) | 8   | Y   | 0.2             |

```
router#show cable modem 4800.33ef.060a pnm us-rxpwr
```

| MAC Address<br>TimeStamp              | IP Address | I/F        | MAC | State         | Num | Pre | RxPwr<br>(dBmv) |
|---------------------------------------|------------|------------|-----|---------------|-----|-----|-----------------|
| 4800.33ef.060a<br>2023-09-02 10:44:02 | 9.14.0.70  | Ca1/0/0:u6 | /p  | w-online (pt) | 1   | Y   | <b>-i-</b>      |
| 4800.33ef.060a<br>2023-09-02 10:38:13 | 9.14.0.70  | Ca1/0/0:u7 |     | w-online (pt) | 8   | Y   | 0.2             |

#### • Verifying the PNM using Equalization Coefficient Configuration Mismatch

If there is a mismatch between the PNM RxPwr Probe *DocsPnmCmtsOfdmaRxPwrEntry's docsPnmCmtsOfdmaRxPwrPreEq* (Pre-Equalization) setting and the iCMTS's Upstream Controller configuration or the RPHY's Upstream Controller Profile configuration of the OFDMA channel's equalization-coefficient, then the RxPwr column has the specific status reason code **-q-** to indicate the PNM RxPwr Probe equalization coefficient configuration mismatch case.

The following example shows the OFDMA channel's equalization-coefficient denoting **-q-** indicating the PNM RxPwr Probe equalization coefficient configuration mismatch case.

```
router#show cable modem 4800.33ef.060a pnm us-rxpwr
```

| MAC Address<br>TimeStamp              | IP Address | I/F        | MAC | State         | Num | Pre | RxPwr<br>(dBmv) |
|---------------------------------------|------------|------------|-----|---------------|-----|-----|-----------------|
| 4800.33ef.060a<br>2023-09-03 08:46:20 | 9.14.0.70  | Ca1/0/0:u6 |     | w-online (pt) | 1   | Y   | <b>-q-</b>      |
| 4800.33ef.060a<br>2023-09-02 10:38:13 | 9.14.0.70  | Ca1/0/0:u7 |     | w-online (pt) | 8   | Y   | 0.2             |

#### • Verifying the Probe Timeout

If a PNM RxPwr Probe request to a specific modem on a specific OFDMA upstream channel is not answered by the modem within 60 seconds, then the RxPwr column has the specific status reason code **-t-** to indicate that the PNM RxPwr Probe response timeout condition, no probe response received case. During the time period that the iCMTS waits for the modem's PNM RxPwr response, the RxPwr column has the specific status reason code **---** to indicate that the PNM RxPwr Probe is in a *Busy* condition case.

The following example shows the OFDMA channel's equalization-coefficient denoting the PNM RxPwr Probe Busy condition case:

```
router#show cable modem 4800.33ef.060a pnm us-rxpwr
```

| MAC Address<br>TimeStamp              | IP Address | I/F        | MAC | State         | Num | Pre | RxPwr<br>(dBmv) |
|---------------------------------------|------------|------------|-----|---------------|-----|-----|-----------------|
| 4800.33ef.060a<br>2023-09-02 21:56:05 | 9.14.0.70  | Ca1/0/0:u6 |     | w-online (pt) | 1   | Y   | <b>---</b>      |

```
4800.33ef.060a 9.14.0.70 Ca1/0/0:u7 w-online (pt) 8 Y 0.2
2023-09-02 10:38:13
```

Eventually, the sample output displays the timeout condition:

```
router#show cable modem 4800.33ef.060a pnm us-rxpwr
MAC Address IP Address I/F MAC Num Pre RxPwr
TimeStamp
4800.33ef.060a 9.14.0.70 Ca1/0/0:u6 w-online (pt) 1 Y -t-
2023-09-02 21:56:05
4800.33ef.060a 9.14.0.70 Ca1/0/0:u7 w-online (pt) 8 Y 0.2
2023-09-02 10:38:13
```

## Troubleshooting Proactive Network Management Issues

The Upstream Triggered Spectrum Capture issues, their possible causes, and resolution are listed.

- Capture configuration failure:
  - Ensure that the ifindex that is used is correct and the port is configured correctly under RPD for RPHY.
  - Ensure that the capture configuration entry was created properly and the client/snmp owns the capture port using MIB commands.
  - Ensure that the parameters being configured are supported and within the valid range.
  - Enable **debug cable pnm utscom-error** to check for any errors.
- Capture control or initiate test failure:
  - Ensure that the capture configuration is created and configured correctly by the client using MIB commands.
  - Verify that the capture configuration entry status is active using MIB commands.
  - The total number of captures is below the enforced limit.
  - Ensure that no other tests are already running on the port using MIB commands.
  - Ensure that only one port per RPD is running the test.
- TFTP file transfer failure:
  - Ensure that the BDT TFTP information is configured correctly on the CMTS.
  - Ensure that the TFTP server is reachable and the destination location is writable.
  - Ensure that the container is in running state using show commands.
  - Ensure that the PNM TFTP process is active and running on the `guestshell` container and the TFTP server IP is reachable from the `guestshell` container.
  - Ensure that the capture tests are running correctly and with the CLC show, CLI show, files are being generated.
  - Check dtrack to ensure that the punt path is working and packets are being sent to the container.

- Use the PNM debug and the container statistics/log file to check for any errors.
- PNM packets are not reaching guestshell:
  - Check dtrack. All PNM packets should be punted with punt-cause Service-Engine.
  - Run bash in guestshell, and check **RX packets** in ifconfig.
  - Run bash in guestshell, and use tcpdump to check if the PNM packets are arriving.
  - PNM packets from CLC use the Global Routing Table, and there is no mechanism to allow these packets to use anything other than GRT. If the guestshell and VirtualPortGroup are in the VRF, you can add a static route which directs the PNM packets into VRF. For example:

The current configuration is:

```
!
ip vrf vrf_pnm
 rd yyy:zzz
 route-target export yyy:w
 route-target import yyy:w
!
interface VirtualPortGroup0
 ip vrf forwarding vrf_pnm
 ip address P.Q.R.253 255.255.255.252
 no mop enabled
 no mop sysid
!
app-hosting appid guestshell
 app-vnic gateway0 virtualportgroup 0 guest-interface 0
 guest-ipaddress P.Q.R.254 netmask 255.255.255.252
 app-default-gateway P.Q.R.253 guest-interface 0
!
```

Add a static route:

```
(config)# ip route P.Q.R.254 255.255.255.255 VirtualPortGroup0
```

## Upstream External PMA

Table 14: Feature History

| Feature Name                     | Release Information          | Feature Description                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Upstream External PMA with Kafka | Cisco IOS XE Dublin 17.12.1y | <p>In this release, Upstream External PMA is supported with Kafka. cBR8-routers publish US RxMER data automatically based on OFDMA <b>prof-mgmt</b> configured interval. The Publish rate can be down-sampled using the <b>cable telemetry topic us-rxmer publish-rate</b> command.</p> <p>In this release, RxMer probe averaging is supported.</p> |



| Feature Name                         | Release Information          | Feature Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Upstream External PMA with SNMP/TFTP | Cisco IOS XE Dublin 17.12.1x | <p>In previous releases, the operator would need to provision static OFDMA modulation profile definitions that addressed all known and anticipated plant conditions, both static and dynamic.</p> <p>In this release, the operator has the ability to allow an external Artificial Intelligence (AI) to both tune the profiles for specific plants and dynamically change modulation definitions to address dynamic plant conditions. The AI resides within an external Profile Management Application (PMA).</p> |

In previous releases, the operator would need to provision static OFDMA modulation profile definitions that addressed all known and anticipated plant conditions, both static and dynamic. This required the operator to perform manual tuning and it did not fully optimize profile definitions for specific dynamic plant conditions.

Starting with Cisco IOS XE Dublin 17.12.1x, the operator has the ability to allow an external AI to both tune the profiles for specific plants and dynamically change modulation definitions to address dynamic plant conditions. The AI resides within an external Profile Management Application (PMA).

### Upstream External PMA with SNMP/TFTP

Starting with Cisco IOS XE Dublin 17.12.1x, US-PMA is supported with SNMP/TFTP. PMA uses the SNMP PNM MIB to probe the OFDMA channel and generate OSSI RxMER formatted files to a TFTP server.

Use the **cable upstream ofdma-prof-mgmt snmp pnm-rxmer-intercept** command to generate a TFTP file from the current profile-mgmt RxMER data. When enabled, SNMP PNM probe requests returns the existing channel RxMER data, avoiding additional probe overhead on the channel.

The PMA retrieves RxMER data from the TFTP server to generate OFDMA mini-slot bit-loading (MSBL) overrides. The PMA sets MSBL overrides using Exec CLI commands and commits.

### Operation Method

The following steps describe the Operation Method for configuring PMA.

1. Configure the cBR-8 router with baseline OFDMA channel profiles.
2. The cBR-8 router US prof-mgmt performs RxMER probing and IUC selection.
3. PMA triggers RxMER probe via SNMP MIB - docsPnmCmtsUsOfdmaRxMerTable.
4. The cBR-8 router initiates RxMER probe request (or optionally retrieves the latest RxMER data from profile selection).
5. The cBR-8 router's TFTP RxMER data is sent to the destination server.
6. PMA back end reads RxMER data from files on the TFTP server.

7. PMA computes the optimal OFDMA channel profile MSBL overrides.
8. PMA sets MSBL overrides in cBR-8 using Exec CLI commands.
9. The cBR-8 router updates DOCSIS UCD MMMs to communicate new profile content to RPDs and modems.
10. The cBR-8 router profile-mgmt performs RxMER probing and IUC selection (ongoing) to move modems to new optimal IUC profiles.

### Upstream External PMA with Kafka

Starting with Cisco IOS XE Dublin 17.12.1y, US-PMA is supported with Apache Kafka. Apache Kafka is an open-source distributed event streaming platform. Kafka supports a producer/broker/consumer model where the cBR-8 acts as the producer and the external PMA is the consumer. A Kafka broker (or broker cluster) runs on an external server in the network and provides reception of events that are published from the cBR-8, persistent storage for events and delivery of event data to consumers.

The cBR-8 publishes US RxMER events on Kafka automatically based on the OFDMA profile-mgmt configured interval. The event publish rate can be down-sampled using the **publish-rate** configuration option. The PMA Kafka consumer receives US RxMER events to generate OFDMA MSBL overrides. PMA sets MSBL overrides with Exec CLIs and commits.

The following example shows how to configure upstream external PMA with Kafka.

1. Configure US-PMA feature.

```
cable upstream pma external
```

2. Configure the Cable Telemetry Services.

```
cable telemetry enable
```

3. Configure the US-RxMER Topic with event publish rate.

```
cable telemetry topic us-rxmer publish-rate 1
```

4. Configure the Kafka Broker

```
cable telemetry broker kafka-broker
 bootstrap-servers 1.2.0.150
 topic us-rxmer
```

### Kafka Broker Connection

The Kafka broker must be specified by IPv4 address using the **bootstrap-servers** command:

```
cable telemetry broker kafka-broker
 bootstrap-servers 1.2.0.150
```

The following Kafka Broker configuration is required in **server.properties** when starting the server.

```
[root@kafka-server config]#bin/kafka-server-start.sh config/server.properties
Listener name, hostname and port the broker will advertise to clients.
If not set, it uses the value for "listeners".
advertised.listeners=PLAINTEXT://1.2.0.150:9092
```

## Kafka US-RxMER Telemetry Event

cBR-8 Telemetry events are published on Kafka using Google Protocol Buffer (GPB) message format. GPB is a language-neutral, platform-neutral, extensible mechanism for serializing structured data.

Here are the details of the Cisco Telemetry GPB file:

- Package: **cisco\_cable\_telemetry**
- Message: **PmaUsRxMer**
- Sub-messages
  - **OssiPnmUsRxMer**
  - **PmaUsRxMerHdr**

Here is a sample GPB **.proto** file for the US-RxMER event:

```

/*
 *
 * file: cisco_cable_telemetry.proto
 *
 * Upstream MER Telemetry and channel stats, Google Proto Buff format
 *
 * Copyright (c) 2022-2024 by Cisco Systems, Inc.
 * All rights reserved.
 */

syntax = "proto3";

package cisco_cable_telemetry;

message OssiPnmUsRxMer {
 uint32 file_type = 1;
 uint32 major_ver = 2;
 uint32 minor_ver = 3;
 uint32 capture_time = 4;
 uint32 if_index = 5;
 string ccap_id = 6;
 bytes rpd_id = 7;
 uint32 rpd_port_num = 8;
 bytes cm_mac_addr = 9;
 uint32 number_of_averages = 10;
 uint32 preeq_on_off = 11;
 uint32 subcarrier_zero_center_freq = 12;
 uint32 first_active_subcarrier_index = 13;
 uint32 subcarrier_spacing_in_khz = 14;
 uint32 rx_mer_byte_len = 15;
 bytes rx_mer_data = 16;
}

message PmaUsRxMerHdr {
 uint32 version = 1;
 uint32 slot = 2;
 uint32 ctrlr = 3;
 uint32 us_channel = 4;
 uint32 mac_domain = 5;
 uint32 ucid = 6;
 uint32 ucd_cc = 7;
 uint64 total_cws = 8;
 uint64 good_cws = 9;
 uint64 corr_cws = 10;
 uint64 uncorr_cws = 11;
}

```

```

}

message PmaUsRxMer {
 PmaUsRxMerHdr header = 1;
 OssiPnmUsRxMer ossi = 2;
}

```

### US-PMA with Kafka Telemetry Summary

- cBR-8 publishes US RxMER data automatically based on OFDMA prof-mgmt configured interval. Publish rate can be down-sampled using the configured **publish-rate** option.
- PMAconsumer receives US RxMER data to generate OFDMA MSBL overrides.
- PMAsets MSBL overrides with Exec CLIs and commits.

### US-PMA Configuration Commands

Upstream PMA configuration commands can be grouped into three areas:

- PMA configuration control for MSBL overrides
- PMA configuration when using SNMP/TFTP
- PMA configuration when using Kafka

**Table 15: US-PMA Configuration Commands for MSBL Overrides**

| Command                                 | Description                                                                                                                                                                                                                                       |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[no] cable pma upstream external</b> | <p>Global level config to enable PMA control.</p> <p>The default is <b>no cable pma upstream external</b></p> <p>Enables MSBL override Exec CLI support.</p> <p>On <b>no cable pma upstream external all</b>, PMA band overrides are removed.</p> |

| Command                                                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>[no] cable pma upstream commit-action</b><br/> <b>[recalculate   wait]</b></p> | <p>Configures an action for the cBR-8 to take when the PMA commits the MSBL overrides for an OFDMA channel.</p> <p><b>Recalculate</b> – Causes the cBR-8 to recalculate the recommended IUC for each modem using the OFDMA channel with the newly committed MSBL override data IUCs. Modems that have a new recommended IUC are automatically activated on the new IUC immediately using a DBC-REQ message. The OFDMA prof-mgmt interval is unaffected by this DBC-REQ.</p> <p><b>Wait</b> - Causes the cBR-8 to wait until the next OFDMA prog-mgmt interval, and therefore new RxMER data, before recalculating the recommended IUC for each modem using the OFDMA channel with the recently committed MSBL override data IUCs.</p> <p>Default is <b>cable pma upstream commit-action recalculate</b>. This may result in an immediate change to the modem's active data IUC. Upstream profile management will again reevaluate the recommended IUC at the next regular profile management interval.</p> |
| <p><b>[no] cable pma upstream clear-action [recalculate   wait]</b></p>              | <p>Configures an action for the cBR-8 to take when the PMA clears the MSBL overrides for an OFDMA channel.</p> <p><b>Recalculate</b> – causes the cBR-8 to recalculate the recommended IUC for each modem using the OFDMA channel with the baseline data IUCs. Modems that have a new recommended IUC are activated on the new IUC immediately using a DBC-REQ message. The OFDMA prof-mgmt interval is unaffected by this DBC-REQ.</p> <p><b>Wait</b> – causes the cBR-8 to wait until the next OFDMA prog-mgmt interval, and therefore new RxMER data, before recalculating the recommended IUC for each modem using the OFDMA channel with the baseline data IUCs.</p> <p>Default is <b>cable pma upstream clear-action recalculate</b>. This may result in an immediate change to the modems active data IUC. Upstream profile management again reevaluates the recommended IUC at the next regular profile management interval.</p>                                                                   |

Table 16: US-PMA Configuration Commands for SNMP/TFTP

| Command                                                             | Description                                                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>[no] cable upstream ofdma-prof-mgmt snmp pnm-rxmer-intercept</b> | Enable docsPnmCmtsUsOfdmaRxMerTable to retrieve RxMER from the profile selection cache instead of triggering new probe measurement on OFDMA channel. Enabling this option saves measurement overhead on the OFDMA channel by using measurements that are already collected.<br><br>Disabled by default. |
| <b>[no] snmp-server enable traps cable ofdma-cfg-change</b>         | Enable SNMP trap to be sent when OFDMA channel configuration parameter is changed, such as frequency, subcarrier spacing, modulation profile or data-iuc override change, or channel shutdown.<br><br>Disabled by default.                                                                              |
| <b>[no] cable kman tftp quarantine [timeout &lt;5-1440&gt;]</b>     | Provides the option to globally enable/disable the TFTP quarantine feature. It also allows to optionally configure the timeout in minutes for the entries in the quarantine database.<br><br>The feature is enabled by default and the default timeout is 15 minutes.                                   |

Table 17: US-PMA Configuration Commands for Kafka

| Command                           | Description                                                                                                                  |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>[no]cable telemetry enable</b> | Enables the cBR-8 Telemetry event publication services using Kafka.<br><br>The default is <b>no cable telemetry enable</b> . |

| Command                                                                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>[no] cable telemetry topic us-rxmer publish-rate &lt;count&gt;</b></p> | <p>Enables the us-rxmer topic publishing and defines the rate at which per-modem RxMER data is published to the Kafka Broker. The default config is <b>no cable telemetry topic us-rxmer</b></p> <p><b>publish-rate &lt;count&gt;</b>: down samples before publishing. "publish every Nth RxMER probe"</p> <p>Example 1:</p> <pre>Profile management RxMER interval 5 minutes. Desired us-rxmer publish rate 4 hours.  cable telemetry topic us-rxmer publish-rate 48</pre> <p>Example 2:</p> <pre>Profile management RxMER interval 30 minutes. Desired us-rxmer publish rate 1 hour. cable telemetry topic us-rxmer publish-rate 2</pre> |
| <p><b>[no] cable telemetry broker &lt;broker-name&gt;</b></p>                | <p>Enters the <b>config-cable-telemetry-broker</b> CLI sub-mode to configure the Kafka broker information. The broker-name can be any descriptive ascii string uniquely identifying the broker. A maximum of 2 brokers/broker-clusters can be configured.</p> <p>The default configuration is <b>no cable telemetry broker</b></p>                                                                                                                                                                                                                                                                                                         |
| <p><b>bootstrap-servers &lt;string&gt;</b></p>                               | <p>A <b>config-cable-telemetry-broker</b> sub-mode command used to configure the Kafka broker host-port information for this broker/broker-cluster.</p> <p>&lt;string&gt; format is a comma-separated list of host1:port1,host2:port2,...</p> <p>The host must be an IPv4 address.</p> <p>For Kafka broker cluster support, multiple hosts should be configured.</p> <p>Example:</p> <pre>bootstrap-servers 1.2.2.250:9092,1.2.2.252:29092</pre> <p>The default configuration is <b>no bootstrap-servers</b>.</p>                                                                                                                          |
| <p><b>topic us-rxmer</b></p>                                                 | <p>A <b>config-cable-telemetry-broker</b> sub-mode command that is used to enable the US RxMER topic publishing to this broker.</p> <p>The default configuration is <b>no topic us-rxmer</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                          |

## US-PMA Telemetry Using Kafka - Sample Configuration

```
cable telemetry enable
cable telemetry topic us-rxmer publish-rate 1
cable telemetry broker kafka-broker
bootstrap-servers 1.2.2.251 topic us-rxmer
cable telemetry broker bxb-cluster bootstrap-servers 1.2.2.253, 1.2.2.254 topic us-rxmer
 topic us-rxmer
```

## US-PMA MSBL Override Exec Commands

The external PMA processes RxMER data to calculate MSBL overrides to improve the OFDMA channel performance. Data-IUCs mini-slot modulation values will be adjusted by the PMA to deliver increased throughput, reduced codeword errors, better stability, and quicker response to dynamic changes in channel conditions. To accomplish this, the PMA uses the Exec CLIs below.

### PMA MSBL Operation Method

The following steps describe the Operation Method for a PMA to override the MSBL values.

1. Stage MSBL overrides for each OFDMA channel, for each Data-IUC.

Using the **cable pma upstream mod-override ... data-iuc ... mslot ... modulation** command, MSBL overrides should be applied across mini-slot ranges to minimize CLI execution. It is not a requirement to set all mini-slot bit-loading values. Any unset values will remain at their configured baseline modulation value. Note: If the PMA overrides an Data-IUC that is unconfigured in the baseline config, the starting mini-slot modulation is NONE (zero bit-loaded).

2. Commit the MSBL Overrides.

Using the **cable pma upstream mod-override ... commit all** command.

3. Depending upon the configured commit-action, modems will begin to utilize the new MSBL override data-IUCs either immediately (recalculate commit-action), or at their next profile-mgmt interval (wait commit-action).



Table 18: US-PMA MSBL Override Exec Commands

| Command                                                                                                                                                       | Description |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| cable pma upstream mod-override <controller ...<br>  ifIndex ...> data-iuc <iuc> mslot <ms_start><br><ms_end> modulation <msbl-qam> [pilot-pattern<br><1-14>] |             |

| Command | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | <p>Add OFDMA IUC MSBL overrides to the staged area.</p> <p>This command is only available when <b>cable upstream pma external</b> is configured. An error is returned if not configured - <b>%PMA-US-FAIL: 'cable pma upstream external' is not configured!</b></p> <p>Upon success, the cBR-8 echoes the command and respond with - <b>%PMA-US-SUCCESS</b></p> <p>The PMA should wait for the response from each command before proceeding to issue subsequent MSBL override commands. A subsequent MSBL override command can overwrite the previous one if there is overlap.</p> <p>The OFDMA channel may be referenced using either the controller or ifIndex:</p> <ul style="list-style-type: none"> <li>• ... controller upstream-cable<br/>         &lt;slot&gt;/&lt;subslot&gt;/&lt;ctrl&gt; us-channel<br/>         &lt;ofdma-chan&gt;</li> <li>• ... ifIndex &lt;ofdma-snmpp-ifIndex&gt;</li> </ul> <p>Data-IUC may be specified as one of:</p> <p>10 Data IUC type 10<br/>         11 Data IUC type 11<br/>         12 Data IUC type 12<br/>         13 Data IUC type 13<br/>         5 Data IUC type 5<br/>         6 Data IUC type 6<br/>         9 Data IUC type 9</p> <p>The PMA is allowed to specify an IUC that is not configured in the cBR-8 base configuration. In this case, any mini-slots not set remain at ZERO bit-loading.</p> <p>Mini-slot range must be valid for the current OFDMA channel configuration.</p> <p>Modulation override values:</p> <p>NONE ZERO bit-loading<br/>         QPSK QPSK<br/>         8-QAM 8-QAM<br/>         16-QAM 16-QAM<br/>         32-QAM 32-QAM</p> |

| Command                                                                                                                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                            | 64-QAM 64-QAM<br>128-QAM 128-QAM<br>256-QAM 256-QAM<br>512-QAM 512-QAM<br>1024-QAM 1024-QAM<br>2048-QAM 2048-QAM<br><br>Pilot-Pattern may be optionally specified. If not specified, the pilot pattern remains at the current setting. If no pilot pattern is specified in the base config, the lowest pilot pattern is chosen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>cable pma upstream mod-override &lt;controller ...   ifIndex ...&gt; commit all</b>                                                                                     | Commits the staged MSBL overrides on the channel for all IUCs, causing them to take effect on the OFDMA channel with a single UCD change.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>cable pma upstream mod-override &lt;controller ...   ifIndex ...&gt; clear &lt;committed   staged   all&gt;</b><br><br><b>cable pma upstream mod-override clear all</b> | Removes the MSBL overrides that have been applied by the PMA. The<br><br><b>Staged</b> – removes any PMA MSBL overrides that have been applied, but not yet committed. This returns the channel to a state where there are no pending overrides. This does not affect the committed overrides currently in effect on the channel.<br><br><b>Committed</b> – removes any PMA overrides that have been committed. The OFDMA channel is restored to use the configured baseline OFDMA profile. Clearing the committed overrides does not affect any staged overrides.<br><br><b>All</b> – removes the staged and committed MSBL overrides that have been applied by the PMA from all line cards in the system<br><br>This command returns the system to its clean state when no PMA has applied to any channel.<br><br>This is the only exec CLI allowed when the secondary line card is active. |
| <b>cable pma upstream mod-override &lt;controller ...   ifIndex ...&gt; clear counters</b>                                                                                 | Reset the US PMA exec command counters and last action timestamp from the specified OFDMA channel.<br><br>This does not affect any staged or committed MSBL overrides.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

Baseline OFDMA channel configuration.

```
cable mod-profile-ofdma 489
subcarrier-spacing 25KHz
initial-rng-subcarrier 32
fine-rng-subcarrier 192
```

```

data-iuc 5 modulation 2048-QAM pilot-pattern 8
data-iuc 6 modulation 1024-QAM pilot-pattern 8
data-iuc 9 modulation 512-QAM pilot-pattern 8
data-iuc 10 modulation 256-QAM pilot-pattern 8
data-iuc 11 modulation 128-QAM pilot-pattern 8
data-iuc 12 modulation 64-QAM pilot-pattern 8
data-iuc 13 modulation 16-QAM pilot-pattern 8

```

#### PMA Control Exec CLIs' Example – MSBL override.

```

Router# cable pma upstream mod-override controller upstream-cable 9/0/0 us-channel
 12 data-iuc 5 mslot 30 59 modulation 1024 pilot-pattern 11

Router# cable pma u mod con up 9/0/0 u 12 d 5 m 90 109 m 1024
Router# cable pma u mod con up 9/0/0 u 12 d 9 m 90 133 m 256 p 10
Router# cable pma u mod con up 9/0/0 u 12 d 10 m 70 79 m 128
Router# cable pma u mod con up 9/0/0 u 12 d 11 m 60 89 m 32 p 10
Router# cable pma u mod con up 9/0/0 u 12 d 12 m 60 89 m NONE
Router# cable pma u mod con up 9/0/0 u 12 commit all

```

#### PMA set default modulation with two bands overrides.

```

Router# cable pma upstream mod-override controller upstream-cable 9/0/0
 us-channel 12 data-iuc 5 mslot 0 236 modulation 1024 pilot-pattern 11
Router# cable pma u mod con up 9/0/0 u 12 d 5 m 24 78 m 2048
Router# cable pma u mod con up 9/0/0 u 12 d 5 m 144 202 m 2048
Router# cable pma u mod con up 9/0/0 u 12 commit all

```

#### PMA updates band override.

```

Router# cable pma u mod con up 9/0/0 u 12 d 5 m 135 143 m 2048 p 10
Router# cable pma u mod con up 9/0/0 u 12 commit all

```




---

**Note** New overrides are relative to the current committed bit-loading.

---

#### PMA reset to baseline then override

```

Router# cable pma u mod con up 9/0/0 u 12 clear committed all
Router# cable pma u mod con up 9/0/0 u 12 d 5 m 122 206 m 2048 p 11
Router# cable pma u mod con up 9/0/0 u 12 commit all

```




---

**Note** New overrides are relative to the baseline configured bit-loading.

---

### PMA Control Exec CLI Response

The cBR-8 router responds to MSBL override and commit Exec CLIs with success or failure.

```

router# cable pma upstream mod-override controller upstream-cable 9/0/0
 us-channel 12 data-iuc 5 mslot 144 202 modulation 2048-QAM pilot-pattern
11

%PMA-US-SUCCESS (LC9): <cable pma upstream mod-override controller upstream-cable 9/0/0 us-channel
12 data-iuc 5 mslot 144 202 modulation 2048-QAM pilot-pattern 11> successful.

router# cable pma u mod con up 9/0/0 u 12 commit all

%PMA-US-SUCCESS (LC9): <cable pma u mod con up 9/0/0 u 12 commit all> successful.

```

PMA must wait for a response or prompt before issuing the next command (synchronous).

Failure contains a reason string.

```
Router# cable pma u mod con up 9/0/0 us 12 d 5 m 25 30 m 512
```

```
%PMA-US-FAIL (LC9): reason <Invalid mslot range> for <cable pma u mod con up 9/0/0 us 12 d 5 m 25 30 m 512>
```

**Table 19: PMA Control Exec CLI Failure Response**

| <b>%PMA-US-FAIL reason &lt;&gt;</b>                | <b>Command failed to run</b>                                                                                                                                              |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>%PMA-US-FAIL reason &lt;&gt;</b>                | <b>Command failed to run</b>                                                                                                                                              |
| line card not ready                                | line card is not up yet, none of USPMA CLI can be run                                                                                                                     |
| Channel invalid                                    | Can't find the channel                                                                                                                                                    |
| Channel not OFDMA                                  | Channel is not OFDMA                                                                                                                                                      |
| Channel admin state not UP                         | Channel admin state is DOWN, no staging or commit commands can be run on admin DOWN channel                                                                               |
| Channel state not UP                               | Channel operational state is DOWN, staging command can be run but commit command can't be run.                                                                            |
| Invalid IUC                                        | Data IUC is not valid, should not happen as only valid IUC is allowed with syntax check                                                                                   |
| Invalid mslot range                                | Minislot range is out of OFDMA channel minislot range                                                                                                                     |
| Invalid pilot pattern                              | The pilot pattern doesn't match with channel supported pilot pattern, either mismatch with subcarrier spacing or mismatch with existing boosted/non-boosted pilot pattern |
| Too many modulation group                          | The override makes the burst profile too segmented that exceed 126 modulation groups limit on certain IUC per MULPI spec                                                  |
| Memory alloc failure                               | Internal memory allocation failure                                                                                                                                        |
| USPMA not allowed when LCHA secondary LC is active | Command not allowed when LCHA in progress and secondary LC is active                                                                                                      |

### PMA Control Exec CLI Notice

Upon OFDMA channel frequency, subcarrier spacing, modulation profile or data-iuc override change, or any configuration change in the modulation profile, all the PMA override is cleared on the channel.

```
Router# cable upstream controller-profile 10
 us-channel 12 subcarrier-spacing 25KHz
 us-channel 12 modulation-profile 489
 us-channel 12 frequency-range 75000000 85000000
 us-channel 12 data-iuc 5 band 80000000 82000000 modulation 1024-QAM pilot-pattern
11
 cable mod-profile-ofdma 48
```

After PMA override is cleared due to channel configuration change, notification a string is shown on the console when **next** Exec CLI is entered.

```
Router# cable pma upstream mod-override controller upstream-cable 9/0/0
 us-channel 12 data-iuc 5 mslot 144 202 modulation 2048-QAM pilot-pattern
1
```

**%PMA-US-NOTICE (SUP):** Previously configured override config has been cleared on this channel due to modulation profile/freq/subcarrier change by the user. This command run on top of this channel baseline config.

**%PMA-US-SUCCESS (LC9):** <cable pma upstream mod-override controller upstream-cable 9/0/0 us-channel 12 data-iuc 5 mslot 144 202 modulation 2048-QAM pilot-pattern 11> successful.

### Operations That Clear the PMA Override

MSBL overrides clear Exec CLIs.

**cable pma upstream mod-override <controller ... | iffIndex ...> clear <committed | staged> all**

**cable pma upstream mod-override clear all**

OFDMA channel frequency, subcarrier spacing, modulation profile or data-iuc override change, or any configuration change in the modulation profile.

Disable/Enable the PMA feature [**no**] **cable pma upstream external**.

Line Card reloading/rebooting without LCHA. PMA Override is preserved after LCHA switchover and revert.

### US-PMA Integration Notes

- All OFDMA data-iuc's (5, 6, 9, 10, 11, 12, 13) may be overridden, regardless of their state in the baseline config.
  - Minislots that are not overridden or defined in the baseline config default to zero bit-loading.
  - If you must remove an IUC present in the baseline config, the PMA may override the data-iuc with all zero bit-loading. This is an option for IUCs not present in the baseline config as well if a simple common mode of operation for IUC removal is needed.
- The **clear committed all** command removes all data-iuc overrides and update the UCD to baseline.

### UCD Message Size Restriction

- DOCSIS MULPI Spec allows every data IUC to have up to 126 modulation groups after PMA override – that is only 1 or 2 consecutive minislots sharing the same modulation/pilot pattern on average.
- When all 7 data IUCs are overridden to the maximum number of modulation groups, the UCD message is close to 2000 bytes.  $7 * 126 = 882$  modulation groups + around 8 total exclusion bands and unused bands.
- Currently the system supports the OFDMA channel UCD message up to 1515 bytes.
  - A total of 600 modulation groups are supported across all 7 data IUCs.
  - Example override: leave IUC13 not overridden and less than 100 modulation groups each on other 6 data IUCs.
  - The restriction is enforced at the US PMA stage command time.

**US-PMA MSBL Override Show Commands**

*Table 20: US-PMA MSBL Override Show Commands*

| Command                                                                                                                                                              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>show cable pma upstream &lt;controller ...   ifIndex ...   interface ... &gt; [base   staged   committed   stats   all   mslot-sc-mapping   sc-mslot-mapping]</b> | <p>Provides visibility to the current state of the MSBL overrides as applied by the PMA on the per channel level.</p> <p>The channel can be specified by US controller channel, MD interface US channel or ifIndex channel.</p> <p>Baseline configuration, Staged and Committed overrides can be viewed, as well as the baseline and staged preview and committed data IUC burst profile.</p> <p>Performance data from PMA override can be shown from stats.</p> <p>Minislot to subcarrier and subcarrier to minislot mappings are available to be shown as well.</p> |
| <b>show cable pma upstream &lt;slot&gt;/&lt;subslot&gt; [base   staged   committed   stats   all   summary [total] ]</b>                                             | <p>Provides visibility to the current state of the MSBL overrides as applied by the PMA on the per line card level. Display all the channels on this line card slot that PMA has been applied.</p> <p>Summary output provides the commands counters and last timestamp of the commands on this line card.</p>                                                                                                                                                                                                                                                         |
| <b>show cable pma upstream [base   staged   committed   stats   all   summary [total]]</b>                                                                           | <p>Provides visibility to the current state of the MSBL overrides as applied by the PMA on the system. Displays all the channels on the system that PMA has been applied.</p> <p>Summary output provides the commands counters and last timestamp of the commands on the system.</p>                                                                                                                                                                                                                                                                                  |

**show cable pma ups stats**

```

router#show cable pma ups interf ca2/0/0 up 6 stats
===== Ca2/0/0/U6, UC2/0/0:U12, ifIndex:490350 =====
IUC : 5 6 9 10 11 12 13

Total FEC CWS :5369 33 0 0 0 0 253
Corr FEC CWS :3631 21 0 0 0 0 0
Uncorr FEC CWS :0 0 0 0 0 0 0
Uncorr CWS% :0.0 0.0 0.0 0.0 0.0 0.0 0.0
TrafficRxMer (DB):30.50 15.75 0.0 0.0 0.0 0.0 24.0
Total Modems :0 4 0 0 0 0 4
Base Rate (Mbps) :104.51 94.98 85.45 75.93 66.40 56.87 37.89
Committed Mods :512-QAM~1024-QAM 1024-QAM 512-QAM 256-QAM 256-QAM~1024-QAM 64-QAM 16-QAM
PMA Commit (Mbps) :96.77 94.98 85.45 75.93 97.13 56.87 37.89
PMA Staged (Mbps) :0.0 0.0 0.0 93.57 0.0 0.0 0.0

PMA Status flags: Config Type - EXT Commit-Action - RECALC Clear-Action - RECALC Staged
 - 0x8 Committed - 0x11 Cleared-by-config - FALSE
PMA Last Staged Timestamp : Nov 1 12:03:07

```

```

PMA Last Committed Timestamp : Nov 1 12:03:03
PMA Last Clear by CLI Timestamp : -
PMA Last Clear by Config Timestamp : -
PMA Exec commands counters:
 Staged | Committed | Clear
good fail clear |good fail clear |by-config fail
 5 0 0 | 1 0 0 | 0 0

```

### show cable pma ups summary

```

router#show cable pma upstream summary
PMA Exec commands summary:
 OFDMA | Staged | Committed | Clear |....
Channel	good fail clear	good fail clear	by-ch-cfg fail
UC2/0/0:U12 5 0 0 1 0 0 0 0 |....
Total (LC2): 5 0 0 1 0 0 0 0 |....
.....
UC9/0/0:U13 8 1 0 0 0 0 1 0 |....
Total (LC9): 8 1 0 0 0 0 1 0 |....

```

```

router#show cable pma upstream summary total
PMA Exec commands summary:
 OFDMA | Staged | Committed | Clear |....
Channel	good fail clear	good fail clear	by-ch-cfg fail
Total (LC2): 5 0 0 1 0 0 0 0 |....
Total (LC9): 8 1 0 0 0 0 1 0 |....

```

### Continuation of the output:

```

router#show cable pma upstream summary
PMA Exec commands summary:
....|
....| Last-timestamp
....| staged committed clear-by-cli clear-by-ch-cfg
-----|-----|-----|-----|-----|
....| Nov 1 12:03:07 Nov 1 12:03:03 - -
....| Nov 1 12:03:07 Nov 1 12:03:03 - -
....
....| Nov 1 12:08:27 - Nov 1 11:50:31
....| Nov 1 12:08:27 - Nov 1 11:50:31

```

```

router#show cable pma upstream summary total
PMA Exec commands summary:
....|
....| Last-timestamp
....| staged committed clear-by-cli clear-by-ch-cfg
-----|-----|-----|-----|-----|
....| Nov 1 12:03:07 Nov 1 12:03:03 - -
....| Nov 1 12:08:27 - Nov 1 11:50:31

```

### US-PMA RxMer TFTP

The new version 2 RxMer TFTP file header formats with the following new fields are supported:

- RPD ID (MAC Address)
- RPD Port Number



**Table 21: Show Commands**

| Command                                                                          | Description                                                                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>show platform software kman R0 stats [listener   pnm   tftp   telemetry ]</b> | Provides visibility into the statistics that are maintained in kman for different components that are listed in the options.                                                                                                                                                |
| <b>show platform software kman R0 tftp quarantine</b>                            | Provides visibility into the Kman Pnm TFTP quarantine database.<br><br>It lists the TFTP servers and the associated paths that have been quarantined by the Kman TFTP due to unfavorable conditions and lists the time remaining for each entry in the quarantine database. |

**US-PMA Show Commands**

```

Router# show platform software kman RP active stats tftp
TFTP Client Stats

TFTP Total Sessions : 0
TFTP Xfer Success : 0
TFTP Xfer Failure : 0

TFTP Server Err : 0
TFTP WRQ Send Err : 0
TFTP WRQ Rsp Timeout : 0
TFTP DAT Send Err : 0
TFTP DAT Rsp Timeout : 0

Router# show platform software kman R0 stats telemetry
PMA RxMER Telemetry

PMA RxMER Tx Success : 2218
PMA RxMER Tx Failure : 0

OFDMA Status Telemetry

OFDMA Status Tx Success : 10
OFDMA Status Tx Failure : 0

router#show platform software kman R0 tftp quarantine
KMAN TFTP Feature Info:
Tftp Qdb Enable : enabled
Tftp Qdb Timeout(mins) : 15

KMAN TFTP Quarantine List:
 Tftp Server Time Remaining(min) Tftp Path

```

**Table 22: PMA Control Exec CLI Failure Response**

| Command                                      | Description                                                      |
|----------------------------------------------|------------------------------------------------------------------|
| <b>show cable kman config</b>                | Displays local config settings relevant to IOSd-SUP and IOSd-CLC |
| <b>show platform software kman R0 config</b> | Displays config settings relevant to KMAN binos process          |

| Command                                             | Description                                           |
|-----------------------------------------------------|-------------------------------------------------------|
| <b>show cable telemetry brokers</b>                 | Displays broker information in IOSd-SUP               |
| <b>show platform software kman R0 kafka brokers</b> | Displays broker information from KMAN process         |
| <b>show platform software kman R0 kafka topics</b>  | Displays kafka topics that are supported by KMAN      |
| <b>show platform software kman R0 kafka stats</b>   | Displays statistics for kafka publishing              |
| <b>show platform software kman R0 ipcecl</b>        | Displays ipcecl information that is supported by KMAN |

```

router# show cable kman config
KMAN global settings:
 IP Address : 10.2.0.1
 Telemetry Enable : enabled
 PNM Enable : enabled
 CCAP-ID : snowleopard
 Tftp Qdb Enable : enabled
 Qdb timeout(mins) : 15

KMAN Topics:
 US-RxMER : enabled
 publish-rate : 1

snowleopard#show platform software kman R0 kafka broker
Broker: bxb-kafka-01
 Bootstrap.Servers : 1.2.2.251

 Broker State: UP

router# show platform software kman R0 kafka stats

Broker: bxb-kafka-01
Node Names: 1.2.2.251:9092
State: UP

Tx Packets : 2409
Tx Bytes : 2758075
Tx Retry : 0
Rx Packets : 2409
Rx Bytes : 214497
Cur Outq Len : 0
Max Outq Len : 8

Topic Prod Msg Prod bytes Tx Msgs Tx Msg bytes Err Msgs

us-rxmer 2227 2240687 2226 2239236 0

Router# show platform hardware qfp active feature docsis clc-pkt-punt [clear]
Stats for CLC Packets Punted to KMAN

PNM

RxMER : 0
UTSC : 0
AQProbe: 0

Telemetry
RxMER : 70

Unknown: 0

```

## US-PMA SNMP

### docsPnmCmts UsOfdmaRxMerTable

PMA uses this MIB table to trigger RxMer measurements which is sent to the TFTP server.

```
DocsPnmCmtsUsOfdmaRxMerEntry.[OFDMA channel ifIndex]
 docsPnmCmtsUsOfdmaRxMerEnable,
 docsPnmCmtsUsOfdmaRxMerCmMac,
 docsPnmCmtsUsOfdmaRxMerPreEq,
 docsPnmCmtsUsOfdmaRxMerNumAvgs,
 docsPnmCmtsUsOfdmaRxMerMeasStatus,
 docsPnmCmtsUsOfdmaRxMerFileName,
```

Option is available to avoid probe measurement and send most recent measurement that is collected by profile selection instead. The following command can be optionally configured.

```
cable upstream ofdma-prof-mgmt snmp pnm-rxmer-intercept
```

The above command generates a TFTP file with current profile-mgmt RxMER data. If enabled, avoids additional probe on channel, reducing probe overhead on channel.

### OFDMA Configuration Change Trap

A SNMP trap is added to notify the user that OFDMA channel frequency, subcarrier spacing, modulation profile or data-iuc override change, channel shutdown, or any configuration change has occurred. Configuration to enable/disable the SNMP trap for OFDMA configuration change is as follows:

```
config terminal
[no] snmp-server enable traps cable ofdma-cfg-change
end
```

Default setting is OFDMA Config Change trap disabled. The traps are generated immediately after the OFDMA configuration changes.

The OFDMA Configuration Change Trap is the **linkDown** and **linkUp** SNMP traps (snmpTraps.4, snmpTraps.3) with locIfReason string **OFDMA Configuration Change**, and the OFDMA channel interface descriptor, Example:

```
Community: public
From: 8.5.1.1
sysUpTimeInstance = 22:29:05.18
snmpTrapOID.0 = linkUp
ifIndex.501918 = 501918
ifDescr.501918 = Cable9/0/1-upstream6
ifType.501918 = 278
locIfReason.501918 = OFDMA Configuration Change
ifAdminStatus.501918 = up(1)
ifOperStatus.501918 = up(1)
```

Trap **linkDown** or **linkUp** is based on the OFDMA channel operational status.

### SNMP MIBs of interest for PMA

```
docsIf31CmtsUsOfdmaDataIucStatsEntry OBJECT-TYPE
 SYNTAX DocsIf31CmtsUsOfdmaDataIucStatsEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION
 "The conceptual row of docsIf31CmtsUsOfdmaDataIucStatsTable.
 An instance exists for each Data IUC profile on a given US OFDMA channel."
 INDEX {
 ifIndex,
 docsIf31CmtsUsOfdmaDataIucStatsDataIuc
 } ::= { docsIf31CmtsUsOfdmaDataIucStatsTable 1 }
```

```

DocsIf31CmtsUsOfdmaDataIucStatsEntry ::= SEQUENCE
{
 docsIf31CmtsUsOfdmaDataIucStatsDataIuc Unsigned32,
 docsIf31CmtsUsOfdmaDataIucStatsMinislotPilotPattern Unsigned32,
 docsIf31CmtsUsOfdmaDataIucStatsMinislotModulation UsOfdmaModulationType,
 docsIf31CmtsUsOfdmaDataIucStatsTotalCodewords Counter64,
 docsIf31CmtsUsOfdmaDataIucStatsCorrectedCodewords Counter64,
 docsIf31CmtsUsOfdmaDataIucStatsUnreliableCodewords Counter64,
 docsIf31CmtsUsOfdmaDataIucStatsInOctets Counter64,
 docsIf31CmtsUsOfdmaDataIucStatsCtrDiscontinuityTime TimeStamp,
 docsIf31CmtsUsOfdmaDataIucStatsAssignedCmCt Unsigned32,
 docsIf31CmtsUsOfdmaDataIucStatsIucAverageMer TenthdB

DocsIf31CmUsOfdmaChanEntry ::=
SEQUENCE {
 docsIf31CmUsOfdmaChanConfigChangeCt Unsigned32,
 docsIf31CmUsOfdmaChanSubcarrierZeroFreq Unsigned32,
 docsIf31CmUsOfdmaChanFirstActiveSubcarrierNum Unsigned32,
 docsIf31CmUsOfdmaChanLastActiveSubcarrierNum Unsigned32,
 docsIf31CmUsOfdmaChanNumActiveSubcarriers Unsigned32,
 docsIf31CmUsOfdmaChanSubcarrierSpacing SubcarrierSpacingType,
 docsIf31CmUsOfdmaChanCyclicPrefix UsOfdmaCyclicPrefix,
 docsIf31CmUsOfdmaChanRollOffPeriod UsOfdmaRollOffPeriod,
 docsIf31CmUsOfdmaChanNumSymbolsPerFrame Unsigned32,
 docsIf31CmUsOfdmaChanTxPower Unsigned32,
 docsIf31CmUsOfdmaChanPreEqEnabled TruthValue,
 docsIf31CmUsOfdmaChanChannelId Unsigned32

DocsIf31CmtsUsOfdmaChanEntry ::= SEQUENCE {
 docsIf31CmtsUsOfdmaChanTemplateIndex Unsigned32,
 docsIf31CmtsUsOfdmaChanConfigChangeCt Unsigned32,
 docsIf31CmtsUsOfdmaChanTargetRxPower TenthdBmV,
 docsIf31CmtsUsOfdmaChanLowerBdryFreq Unsigned32,
 docsIf31CmtsUsOfdmaChanUpperBdryFreq Unsigned32,
 docsIf31CmtsUsOfdmaChanSubcarrierSpacing SubcarrierSpacingType,
 docsIf31CmtsUsOfdmaChanCyclicPrefix UsOfdmaCyclicPrefix,
 docsIf31CmtsUsOfdmaChanNumSymbolsPerFrame Unsigned32,
 docsIf31CmtsUsOfdmaChanRollOffPeriod UsOfdmaRollOffPeriod,
 docsIf31CmtsUsOfdmaChanPreEqEnable TruthValue,
 docsIf31CmtsUsOfdmaChanFineRngGuardband Unsigned32,
 docsIf31CmtsUsOfdmaChanFineRngNumSubcarriers Unsigned32,
 docsIf31CmtsUsOfdmaChanFineRngPreambleLen Unsigned32,
 docsIf31CmtsUsOfdmaChanInitRngGuardband Unsigned32,
 docsIf31CmtsUsOfdmaChanInitRngNumSubcarriers Unsigned32,
 docsIf31CmtsUsOfdmaChanInitRngPreambleLen Unsigned32,
 docsIf31CmtsUsOfdmaChanProvAttribMask AttributeMask,
 docsIf31CmtsUsOfdmaChanTxBackoffStart Integer32,
 docsIf31CmtsUsOfdmaChanTxBackoffEnd Integer32,
 docsIf31CmtsUsOfdmaChanRangingBackoffStart Integer32,
 docsIf31CmtsUsOfdmaChanRangingBackoffEnd Integer32,
 docsIf31CmtsUsOfdmaChanUtilization Unsigned32,
 docsIf31CmtsUsOfdmaChanId Integer32,
 docsIf31CmtsUsOfdmaChanSubcarrierZeroFreq Unsigned32,
 docsIf31CmtsUsOfdmaChanTargetMapInterval Unsigned32
}

docsIf31CmtsUsOfdmaSubcarrierTypeEntry OBJECT-TYPE
SYNTAX DocsIf31CmtsUsOfdmaSubcarrierTypeEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
 "The conceptual row of docsIf31CmtsUsOfdmaSubcarrierStatusTable.
 An instance exists for each Profile on a given OFDMA upstream."
INDEX {
 ifIndex,

```

```

 docsIf31CmtsUsOfdmaSubcarrierTypeStartSubcarrierId
 }
 ::= { docsIf31CmtsUsOfdmaSubcarrierTypeTable 1 }

DocsIf31CmtsUsOfdmaSubcarrierTypeEntry ::=
 SEQUENCE {
 docsIf31CmtsUsOfdmaSubcarrierTypeStartSubcarrierId Unsigned32,
 docsIf31CmtsUsOfdmaSubcarrierTypeEndSubcarrierId Unsigned32,
 docsIf31CmtsUsOfdmaSubcarrierTypeSubcarrierType UsOfdmaSubcarrierType
 }

```



**Note** All OFDMA data-iuc's (5, 6, 9, 10, 11, 12, 13) may be overridden, regardless of their state in the baseline config.

Minislots that are not overridden and not defined in the baseline config default to zero bit-loading.

If you must remove an IUC present in the baseline config, the PMA may override the data-iuc with all zero bit-loading. This is an option for IUCs not present in the baseline config as well if a simple common mode of operation for IUC removal is needed.

The `clear committed all` command removes all data-iuc overrides and updates the UCD to baseline.

### Kafka Manager (KMAN)

Starting with Cisco IOS XE Dublin 17.12.1x release, a new Binos process was introduced to support Kafka. This process also services the SNMP PNM TFTP requests replacing the legacy Guestshell PNM TFTP application. In addition to the show commands mentioned above that refer to “kman”, several system commands are available under the general platform CLIs that provide additional details about the KMAN process status. Refer to **show platform software kman** for these commands.

### SUPHA and SUPPR

#### SUPHA

Exec MSBL overrides are maintained across SUPSOs.

KMAN process on the SUP supports SUPSO.

#### SUPPR

Exec MSBL override is maintained across KMAN PRs.

KMAN process on the SUP supports process restart (PR).

Trigger with **test plat soft process exit kman R0 stateless**.

TFTP of PNM data continues functioning after KMAN PR completes.

Some in flight RxMer data will be dropped during the process restart.

### LCHA and LCPR

#### LCHA

Exec MSBL overrides is maintained across LCSOs.

TFTP of RxMER continues functioning after the LCSO completes.

Some in flight RxMer data may be dropped during the LCSO.

**LCPR**

Exec MSBL overrides are maintained across IOSd-CLC and CDMAN PRs.

TFTP of RxMER continues functioning after IOSd-CLC or CDMAN PR completes.

Some in flight RxMer data may be dropped during the process restart.

## Feature Information for Proactive Network Management

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <https://cfmg.cisco.com/>. An account on Cisco.com is not required.

**Table 23: Feature Information for Upstream Triggered Spectrum Capture - Proactive Network Management**

| Feature Name                                                     | Releases                        | Feature Information                                                                                                   |
|------------------------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| DOCSIS 3.1 Upstream Triggered Spectrum Capture                   | Cisco IOS XE Gibraltar 16.10.1  | This feature was integrated into Cisco IOS XE Gibraltar 16.10.1 on the Cisco cBR Series Converged Broadband Routers.  |
| MAX-HOLD trigger mode                                            | Cisco IOS XE Gibraltar 16.10.1d | This feature was integrated into Cisco IOS XE Gibraltar 16.10.1d on the Cisco cBR Series Converged Broadband Routers. |
| Support PNM output format 'timeIQ' and UTSC trigger mode 'cmMac' | Cisco IOS XE Gibraltar 16.12.1x | This feature was integrated into Cisco IOS XE Gibraltar 16.12.1x on the Cisco cBR Series Converged Broadband Routers. |
| Proactive Network Management using OFDMA RxMER Probes            | Cisco IOS XE Gibraltar 16.12.1y | This feature was integrated into Cisco IOS XE Gibraltar 16.12.1y on the Cisco cBR Series Converged Broadband Routers. |