Cisco Remote PHY Shelf 7200 Software Configuration Guide for Cisco Remote PHY Shelf 7200 Software 1.1

First Published: 2019-01-31

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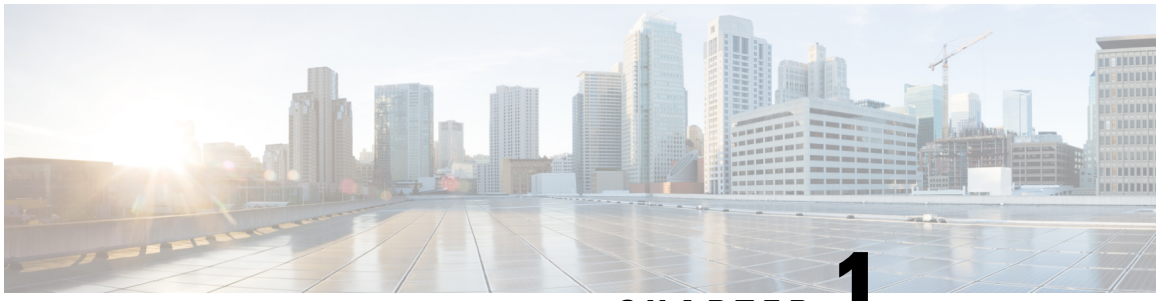

CHAPTER 1

Cisco Remote PHY System Overview

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

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Introduction

Driven by market evolution towards triple-play services, cable operators in emerging markets are seeking standardized and digital fiber-based solutions for economical and future proof access technologies. Much of the demand is driven by the need to provide higher bandwidth packet transport for Internet connectivity, video and voice services.

Data Over Cable Systems Interface Standard (DOCSIS®) is a standardized technology for services over cable and thus has strong interoperability between system providers. It also provides robust Quality of Service (QoS) methods, ensuring packet delivery during periods of network congestion. Traditionally, DOCSIS runs on linear fiber (or HFC) to provide service and is not naturally applicable for digital fiber. Cisco has bridged the gap by introducing a new access technology called the Remote PHY.

Existing Architecture

In the emerging markets, most triple-play consumers live in multi-tenant buildings (referred to as Multi Dwelling Units or MDU) with the number of residents usually being less than 500 residents per building or cluster. These buildings are typically served by fiber with one of several “final 100 meter” technologies installed in the buildings. These technologies include fiber, twisted pair, Ethernet, and coaxial. Cable operators have access to the cable in the building and use this cable for their services. Several technologies exist for enabling two-way services over cable. These include a number of proprietary and vendor-specific methods. However, a standards-based approach to using cable is typically preferred by operators, since this ensures vendor interoperability.

Need for the Cisco Remote PHY Solution

DOCSIS and EuroDOCSIS are standards that define two-way operation over a cable network. DOCSIS provides the necessary Quality of Service (QoS) tools for ensuring voice call connectivity during periods of network congestion that are anticipated in triple-play networks. DOCSIS is a robust and mature technology for voice, video, and IP video services.

The Cisco Remote PHY solution leverages existing IP technologies like Ethernet PON (EPON), Gigabit-capable Passive Optical Networks (GPON), and Metro Ethernet (MetroE) equipment; it deploys DOCSIS in MDUs over digital fiber to enable two-way services over cable.

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 1: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

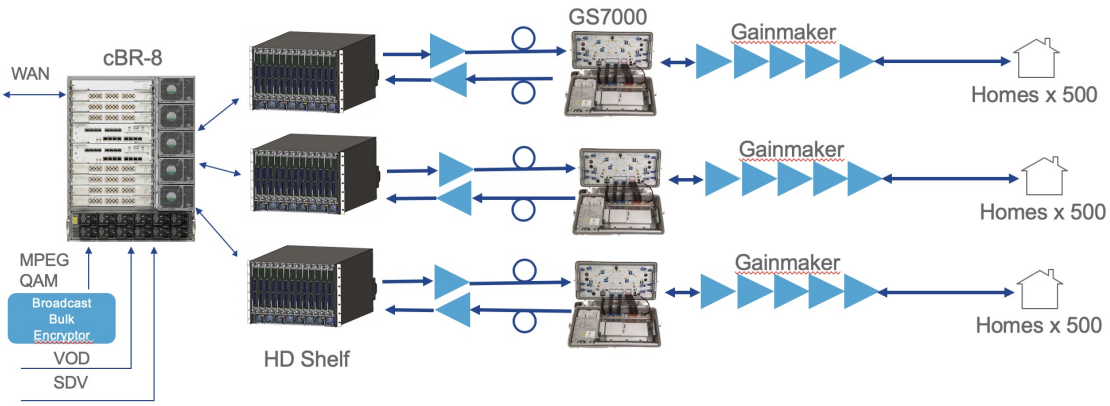
Benefits

- Cost effectively addresses bandwidth requirements for today's Service Groups with low to medium bandwidth requirement
- Dramatically reduces cost of addressing high bandwidth requirements in conjunction with future cloud CMTS solution
- Lower hub space and power requirements
- Enables independent scaling of CMTS Core and PHY
- Migration path to Cloud CMTS

Cisco Remote PHY Shelf 7200 Network

Cisco Remote PHY Shelf 7200 solution supports the following network architecture, its benefits include:

- Share cBR-8 capacity across multiple hubs
- Fewer RPHY cores required
- Increased cBR-8 scale (ports/SG)
- Higher core license utilization



Cisco cBR-8 Line Card for Remote PHY

Cisco cBR-8 router supports following line card for the Remote PHY system.

Cisco CCAP RF Line Card for Remote PHY

The Cisco CCAP RF line card for remote PHY architecture is available in two flavours:

- CBR-LC-8D31-16U30—This RF line card with the downstream and upstream PHY modules can be connected with the Cisco GS7000 node by configuring it using the **card cBR-CCAP-LC-40G r-phy** command.
- CBR-CCAP-LC-40G-R—This RF line card with no downstream and upstream PHY modules can be connected with the Cisco GS7000 node and Remote PHY Shelf 7200. For more information, see Cisco cBR Series Converged Cable Access Platform 40G Remote PHY Line Card Data Sheet

  .

Cisco Digital Physical Interface Card

The Cisco Digital Physical Interface Card (DPIC) transmits and receives RF signals between the subscriber and headend over the hybrid fiber-coaxial (HFC) system and is DOCSIS-compliant. This interface card is designed specifically for the Cisco cBR router. The PID is cBR-DPIC-8X10G. For more information, see Cisco cBR Series 8x10G Remote PHY Digital Physical Interface Card Data Sheet.

The DPIC is installed in the CMTS and connected to the Cisco GS7000 node via the EPON, GPON, or Metro Ethernet. It supports both downstream and upstream traffic. Both the downstream and upstream traffic share the same ports.

The DPIC supports:

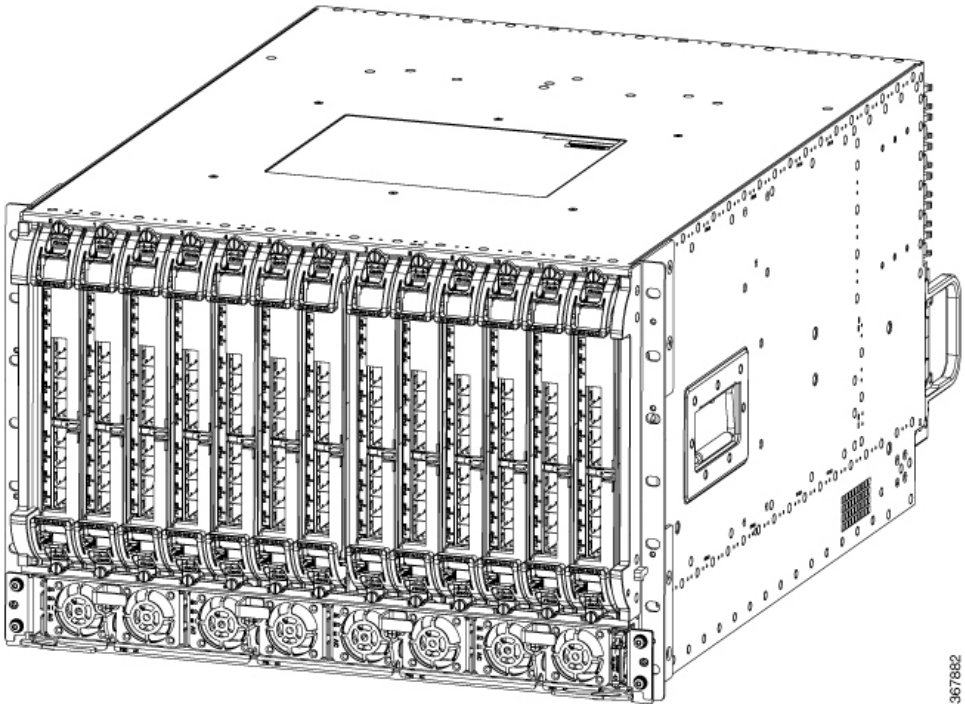
- Eight ten gigabit ethernet SFP+ interfaces
- 80 gigabit non-blocking switching architecture with 40+40 protection scheme
- 40 gigabit DOCSIS traffic bandwidth when connected with the Cisco CBR-CCAP-LC-40G-R line card
- Cisco SFP-10G-SR-S/Cisco SFP-10G-LR-S/Cisco SFP-10G-ZR-S/Cisco SFP-10G-ER-S optic modules
- MACSec and 1588 TC

Cisco Remote PHY Shelf 7200

The Cisco Remote PHY Shelf 7200 is a 7 rack unit (RU) chassis. It supports 13 RPD modules and 6 RF PICs. Below are some of its features:

- 13 slots high availability chassis
- Full spectrum DOCSIS 3.0 support
- CCAP support
- Support of optical overlay architectures
- US/DS RF switching function between dedicated-protect and active RPD modules
- Hitless Line Card high availability (12+1)
- N+N Power Supply Redundancy
- Support for up to 72 SG with high availability

Figure 1: Cisco Remote PHY Shelf 7200



RPD Line Card

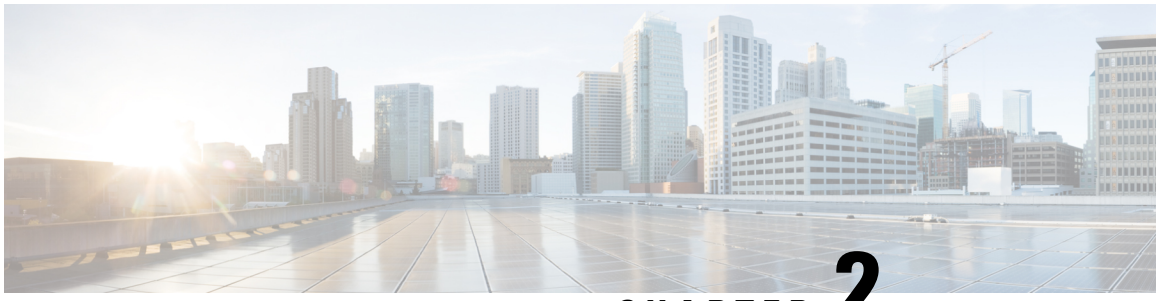
The Cisco Remote PHY Shelf 7200 RPD Line Card has the following features:

- Compliance to DOCSIS 3.1 specification
- 12 US RF ports
  - US Frequency Range 5 MHz – 204 MHz
  - Support up to 12 ATDMA /8 ATDMA+4 SCDMA per port
  - Support up to 2 OFDMA (96 MHz) Receivers per port
  - Spectrum management (FFT)
- 6 DS RF ports
  - DS Frequency Range: 54 MHz - 1.218 GHz
  - 160 QAM per port
  - 6 OFDM min 24 MHz and max 192 MHz channel width per port
  - RF Monitoring: D3.0 Tuner/demod with RF power, MER, BER report
  - DOCSIS/Video de-jitter buffer (20 ms (+/-10 ms) at 60 Gbps)

PIC

The PIC card uses solid-state switch to create a switching path between the dedicated protect RPD in slot 6 and the 12 other RPDs in the Cisco Remote PHY Shelf 7200 chassis. The features of the Cisco Remote PHY Shelf 7200 PIC are:

- Surge protector
- Demodulator
- Power meter
- US test signal
- Solid-state switches 2:1, 6:1
- DS RF amp for better return loss matching
- MES in control of all PIC functions through I2C control
- Simplified power design and power sequencer
- DS at MCX connector meets the DOCSIS 3.1 RF specification
- ACT2 PID
- FLASH holding calibration data
- No firmware upgradeable images
- US and DS ports accept 75 Ohm accepts compression type MCX connectors



CHAPTER 2

Cisco Remote PHY Shelf 7200 Bring Up

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 7
- Information about Bring Up, on page 7
- How to Bring Up Cisco Remote PHY Shelf 7200 , on page 8

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 2: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information about Bring Up

Bring up process is prerequisite to the operation of the remote PHY system, just like the cable modem bring up in a DOCSIS system.

How to Bring Up Cisco Remote PHY Shelf 7200

This section describes how to bring up Cisco Remote PHY Shelf 7200 .

Configuring Cisco Remote PHY Shelf 7200

After powering up, user needs to configure host name, login password and management IP of the Cisco Remote PHY Shelf 7200 . See the following examples:

```
HA-Shelf-FCC# configure terminal
HA-Shelf-FCC(config)# hostname prefix Shelf

Shlef(config)#login password Dp*14raR

Shlef(config)#mgmt ip 1.200.1.4 netmask 255.255.255.0 gateway 1.200.1.0
```

User also need to configure SFP+ port mode and eRPD trunk mode based on actual network topology. Refer to Cisco Remote PHY Shelf 7200 Backhaul Port Mapping and Link Redundancy Configuration and Cisco Remote PHY Shelf 7200 Trunk VLAN Configuration for more details.

Configuring DHCP Server

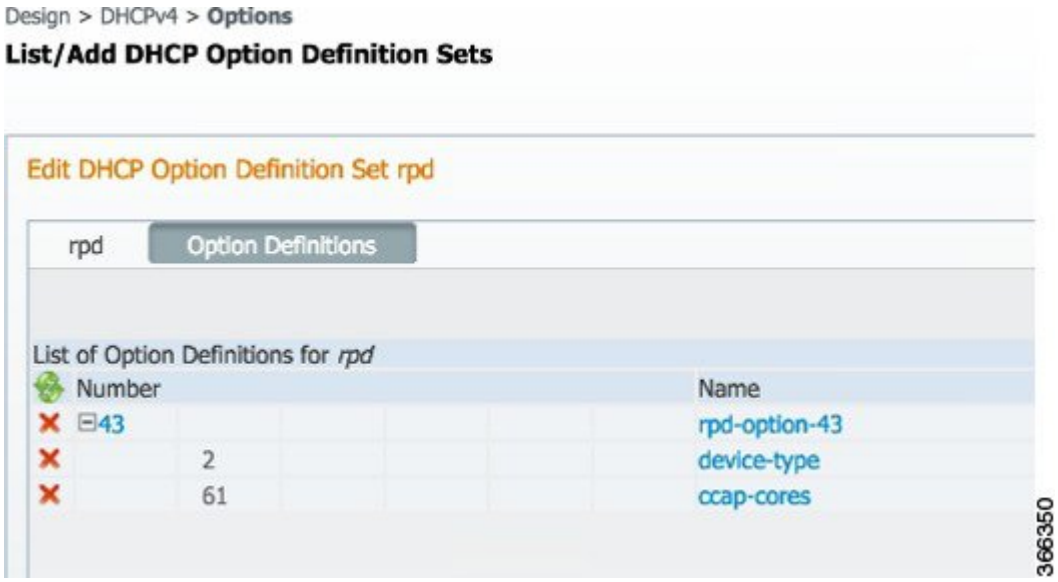
You can choose to configure the DHCP server using any of the following methods.

Configuring DHCP Server using IPv4

To configure DHCP server using IPv4, follow the steps below:

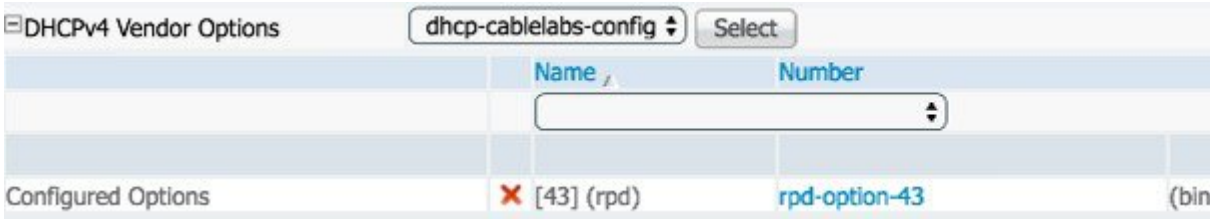
1. Add option for CCAP-Core. Fill in the name, DHCP type, and vendor option string as shown in the figure below.

2. Define option. Fill in the option number and name as shown in the figure below.



3. Define suboption. Fill in the name, type and repeat of suboption 61 as shown in the following figure.

4. Add the option into policy as shown in the following figure. Replace the IP address 120.102.15.1 in the figure to the DPIC port IP address.

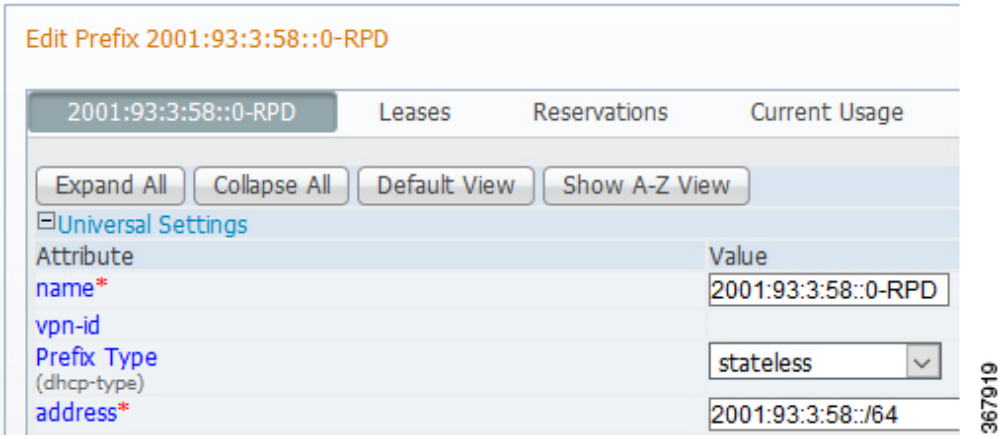


Configuring DHCP Server using IPv6 Stateless

The Cisco Remote PHY System supports the Stateless Address Auto Configuration (SLAAC). IPv6 address assignment of the RPD is governed by the configuration bits set in the ICMPv6 Router Advertisement (RA) message and the presence of a valid prefix in the Prefix Information Option (PIO). For more information about RPD IPv6 address assignment, refer to section 6.7 of Remote PHY Specification.

To configure DHCP server using IPv6 Stateless and enable SLAAC, follow the steps below:

1. Configure Prefix Type to “stateless” in CNR prefix.
2. Configure ICMPv6 Router RA message M Bit=0 and O Bit =1.



Note It is recommended that you follow the DHCP options listed in *Table 2 - Router Advertisement M Bit and O Bit Settings For SLAAC* of section 6.7.1 (CM-SP-R-PHY-I10) or 6.6.1 (CM-SP-R-PHY-I11) in the Remote PHY Specification.

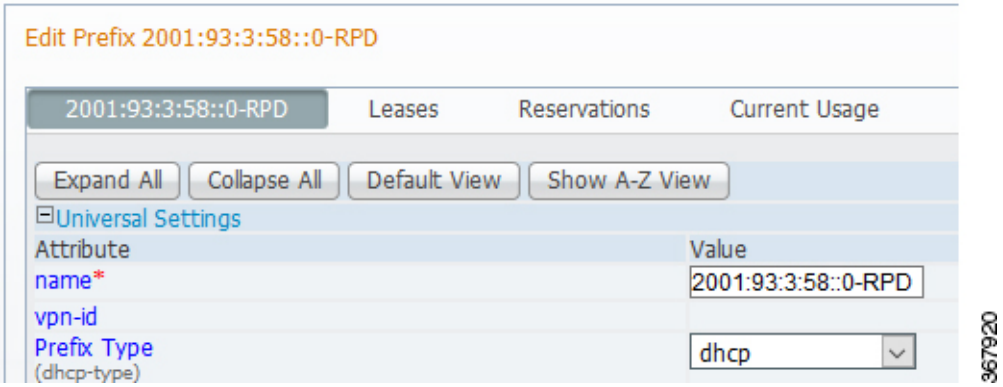
To display the RPD get IPv6 address by SLAAC, use the **show dhcp** command.

```
R-PHY#show dhcp
Interface  IP-Address                          Subnet-Mask
vbh0       2001:93:3:58:1204:9fff:fec1:100  ffff:ffff:ffff:ffff::

Details:
-------------------------------------------------------------------------------
Interface:                  vbh0
AddrType:                   IPv6<Stateless>
TimeServers:                2001:20:1:1::33
TimeOffset:                 28800
LogServers:                 2001:20:1:1::33
CCAPCores:                  2001:93:3:58::1
```

Configuring DHCP Server using IPv6 Stateful

To configure DHCP server using IPv6 Stateful, follow the steps below:

1. Configure Prefix Type to “dhcp” in CNR prefix. See the following image.
2. Configure ICMPv6 Router RA message M Bit=1.



To display the RPD get IPv6 address by Stateful method, use the **show dhcp** command.

```
R-PHY#show dhcp
Interface  IP-Address                        Subnet-Mask
vbh0       2001:93:3:58::d8  ffff:ffff:ffff:ffff::

Details:
--------------------------------------------------------------------------------
Interface:                    vbh0
AddrType:                     IPv6<Stateful>
TimeServers:                  2001:20:1:1::33
TimeOffset:                   28800
LogServers:                   2001:20:1:1::33
CCAPCores:                    2001:93:3:58::1
```

Configuring PTP

To configure PTP, use the following example as reference:

On cBR-8 router:

```
interface Loopback1588
  ip address 159.159.159.4 255.255.255.255
interface TenGigabitEthernet5/1/3   /* connect to ASR903 */
  ip address 192.104.10.4 255.255.255.0

ip route 10.90.3.93 255.255.255.255 192.104.10.93   /* route to ASR903 loopback ip */

ptp clock ordinary domain 0
  servo tracking-type R-DTI
  clock-port slave-from-903 slave
    delay-req interval -4
    sync interval -5
    sync one-step
    transport ipv4 unicast interface Lo1588 negotiation
    clock source 10.90.3.93   /* ASR903 loopback ip */

ptp r-dti 1
  ptp-domain 0   /* same domain number with ptp server */
  clock-port 1
    ethernet 1   /* default value is same index with clock-port index, for RPD, ethernet
1=vbh0, ethernet 2=vbh1 */
    clock-source 10.90.3.93 gateway 93.3.10.2   /* clock-source is ASR093 loopback ip,
gateway is ASR903 BDI ID for node */
```

On ASR903 router as PTP primary:

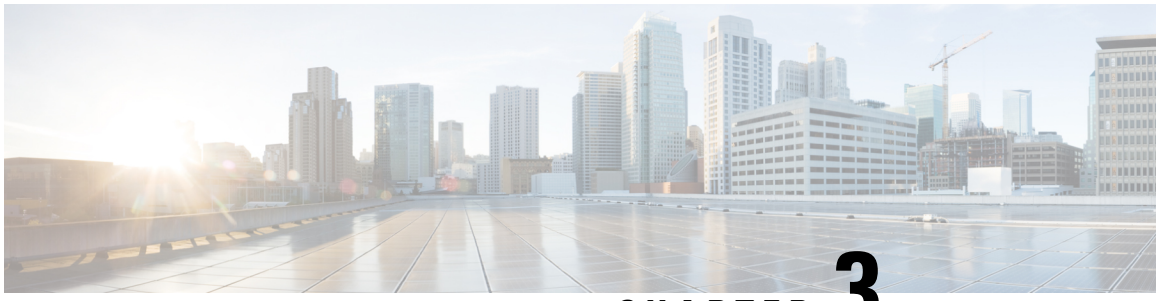
```
ptp clock ordinary domain 0
 clock-port Master-to-all-cBR8 master
  sync interval -5
  sync one-step
  transport ipv4 unicast interface Lo1588 negotiation

interface Loopback1588
 ip address 10.90.3.93 255.255.255.255

interface GigabitEthernet0/3/5
 no ip address
 negotiation auto
 cdp enable
 service instance 31 ethernet   /* 31 is vlan id */
  encapsulation dot1q 31
  rewrite ingress tag pop 1 symmetric
  bridge-domain 31
 service instance 32 ethernet
  encapsulation dot1q 32
  rewrite ingress tag pop 1 symmetric
  bridge-domain 32
interface BDI31   /* for cBR, SUP PIC */
 ip address 192.104.10.93 255.255.255.0
 no shut
interface BDI32   /* For RPD */
 ip address 93.3.10.2 255.255.255.0
 no shut

ip route 159.159.159.4 255.255.255.255 192.104.10.48   /* route to cbr-8 loopback ip */
```

Configuring cBR-8

To configure the cBR-8 to bring up the RPD, use the following example as reference:

```
/* D-PIC TenGiga interface config */
interface TenGigabitEthernet0/1/0
  ip address 93.3.10.1 255.255.255.0
  ip helper-address 20.1.0.33

/* Downstream/Upstream controller profile */
cable downstream controller-profile 1
rf-chan 0 95
  type DOCSIS
  frequency 381000000
  rf-output NORMAL
  qam-profile 1
  docsis-channel-id 1

cable upstream controller-profile 2
  us-channel 0 channel-width 6400000 6400000
  us-channel 0 docsis-mode atdma
  us-channel 0 minislot-size 4
  us-channel 0 modulation-profile 221
  no us-channel 1 shutdown

/* RPD configuration */
cable rpd node1
  identifier 0004.9f03.0061
  type shelf
  core-interface Te0/1/0
   rpd-ds 0 downstream-cable 7/0/0 profile 1
```

```
 rpd-us 0 upstream-cable 7/0/0 profile 2
 rpd-us 1 upstream-cable 7/0/8 profile 2
r-dti 1
rpd-event profile 0
```



CHAPTER 3

Synchronizing Time on Cisco Remote PHY Shelf 7200

This section explains how to synchronize time on the RPD and CCAP core of the Cisco cBR Router.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 15
- Information about Time Synchronization, on page 15
- How to Configure Time Synchronization, on page 16
- Configuration Examples, on page 25
- Feature Information for Synchronizing Time on Cisco Remote PHY Shelf 7200 , on page 26

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 3: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information about Time Synchronization

In a Remote PHY system, synchronizing its local timestamp and reference frequency to the cable converged access platform core function (CCAP Core) is important. The protocol used for this feature, the Precision

Time Protocol (PTP), helps in synchronizing time between a CCAP core function and a series of remote PHY devices (RPD) that enable R-PHY and provides support for converged DOCSIS, video, and out-of-band (OOB) services.

Cisco CBR-8 supports PTP Ordinary Clock (OC) slave mode, in which the PTP slave ports are from the backhaul 10GE Ethernet ports or the management Ethernet ports of SUP PIC.

Remote DTI

Remote DOCSIS Timing Interface (R-DTI) is the network synchronization protocol used between CCAP-core and R-PHY. When traffic from the CCAP-Core is received on the downstream receiver, the following processes occur:

- Terminates DEPI framing
- Extracts the payload, frames it, modulates, and transmits it out

During the upstream process, the signal is received from the coax and the system demodulates it. From the FEC payload, the DOCSIS frames are extracted and placed in the UEPI encapsulation. The frames are then transmitted through the upstream transmitter to the CCAP core. A local CPU manages DEPI and GCP control planes, and interfaces with network management. A clocking circuit interfaces with the R-DTI and manages clocking for the R-DTI entity.

How to Configure Time Synchronization

Note To know more about the commands referenced in this module, see the Cisco IOS Master Command List.

Configuring Time Interface and PTP domain

To configure time interface and PTP domain, use the following procedure.

```
enable
configure terminal
interface type [slot_#/port_#
interface Loopback1588
  ip address <IP Address/subnet>

interface TenGigabitEthernet<slot/port>
  ip address <IP Address/subnet>

ip route < PTP master IP Address/subnet> < loopback IP Address>

ptp clock ordinary domain 55 (This is for CBR PTP connection)
 servo tracking-type R-DTI
 clock-port slave-from-903 slave
  delay-req interval -4
  sync interval -5
  sync one-step
  transport ipv4 unicast interface Lo1588 negotiation
  clock source < PTP master loopback IP Address>
```

The following table explains the parameters used in this example:

Table 4: Parameters for time interface and PTP domain configuration

Parameter	Description	Value Range	Default Value
ptp r-dti [id]		1-64	
description	R-DTI name or description		
ptp-domain [id]	Domain number of IEEE 1588	0-127	
local-priority [value]	Set local priority	128	128
priority1 [value]	Set priority1	0-255	128
priority2 [value]	Set priority2	0-255	255
mode [value]	R-DTI mode	other, slave master	slave
profile [value]	Set PTP ITU-T profile	default/G.8275.2	default
clock-port [id]	Configure clock port	1-32	
state [value]	Set Ethernet port admin status	other, up, down, testing	up
ethenet [value]	Set Ethernet port for clock port	0-32	The default value is clock port index
clock source [ip] gateway [ip]	Set clock address	ipv4 address, ipv6 address	
clock alternate-first	Select alternate source first		
transport [value]	Set transport encapsulation	other, ipv4, ipv6	ipv4
transport cos [value]	COS of 802.1Q	0-7	6
transport dscp [value]	DSCP of IP differentiated services	0-63	47
local-priority [value]	Set local priority	1-255	128
sync interval [value]	Set an interval for sync packets	0-7(-7 -0)	
announce interval [value]	Set an interval for announcement packets	0-3(-3 -0)	
delay-req interval [value]	Set an interval for PTP delay-req packets0-7(-7 -0)		

Parameter	Description	Value Range	Default Value
announce timeout [value]	Set timeout interval for announcement packets	3-255	
unicast grant-duration [value]	Set the grant duration time in seconds for unicast	60-1000	300
description	Clock port name or description		

Verifying Time Interface and PTP Domain Configuration

The following example shows how to verify the time interface and PTP domain configuration:

```
Router# show ptp clock running domain 55
                     PTP Ordinary Clock [Domain 55]
         State          Ports          Pkts sent      Pkts rcvd      Redundancy Mode
         PHASE_ALIGNED  1              16012          45126          Hot standby
                                PORT SUMMARY
                                                                                PTP Master
Name           Tx Mode      Role         Transport    State        Sessions     Port Addr
slave-from-903 unicast      slave        Lo1588       Uncalibrated 1            10.10.1.11
                             SESSION INFORMATION
slave-from-903 [Lo1588] [Sessions 1]
 Peer addr          Pkts in     Pkts out   In Errs    Out Errs
 10.10.1.11         45126       16012      0          0
```

Configure RPD PTP Connection

To configure RPD PTP connection, use the following commands.

```
enable
configure terminal
interface type [slot_#/]port_#
ptp r-dti 55(RPD PTP connection)
 profile G.8275.2
 ptp-domain 0
 clock-port <same domain number with PTP server>
  clock source ip <IP Address> gateway ip <IP Address>
  clock source ip <IP Address> gateway ip <IP Address> alternate
  !--<clock-source is PTP master loopback ip, gw is the next hop to reach the ptp master>--!
```

Verifying RPD PTP Connection Configuration

The following example shows how to verify the RPD PTP Connection configuration:

```
Router# show ptp clock 0 config
Domain/Mode         :   0/OC_MASTER
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /0
--PTP Port 188, Enet Port   0 ----
```

```
  Port local Address :192.168.100.100
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  1 Timeout       :  3
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  3   DSCP: 47

Router# show ptp clock 1 config
Domain/Mode         :  55/OC_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /1
--PTP Port  22, Enet Port   1 ----
  Port local Address :40.3.6.185
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  0 Timeout       : 11
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  6   DSCP: 47
  ==Stream 4 : Port 22 Master IP: 10.10.1.11

Router# show ptp clock 2 config
Domain/Mode         :  55/OC_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /1
--PTP Port  22, Enet Port   1 ----
  Port local Address :40.3.6.187
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  0 Timeout       : 11
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  6   DSCP: 47
  ==Stream 0 : Port 22 Master IP: 10.10.1.11

Router# show ptp clock 3 config
Domain/Mode         :  55/OC_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /1
--PTP Port  22, Enet Port   1 ----
  Port local Address :40.3.6.189
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  0 Timeout       : 11
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  6   DSCP: 47
  ==Stream 2 : Port 22 Master IP: 10.10.1.11

Router# show ptp clock 4 config
Domain/Mode         :  55/OC_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /1
--PTP Port  22, Enet Port   1 ----
  Port local Address :40.3.6.191
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  0 Timeout       : 11
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  6   DSCP: 47
  ==Stream 6 : Port 22 Master IP: 10.10.1.11

Router# show ptp clock 5 config
Domain/Mode         :  55/OC_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /1
--PTP Port  22, Enet Port   1 ----
```

```
  Port local Address :40.3.6.193
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  0 Timeout       : 11
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  6   DSCP: 47
  ==Stream 8 : Port 22 Master IP: 10.10.1.11

Router# show ptp clock 6 config
Domain/Mode         :  55/OC_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /1
--PTP Port  22, Enet Port   1 ----
  Port local Address :40.3.6.194
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  0 Timeout       : 11
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  6   DSCP: 47
  ==Stream 10: Port 22 Master IP: 10.10.1.11
```

Associate R-DTI with RPD

To associate the RPD with R-DTI, use the following commands..

```
enable
configure terminal
interface type [slot_#/]port_#
cable rpd node1
identifier badb.ad17.4820 (node vbh0 mac)
 core-interface Te7/1/4
 rpd-ds 0 downstream-cable 7/0/16 profile 0
 rpd-us 0 upstream-cable 7/0/16 profile 0
r-dti 20
rpd-event profile 0
```

Verifying Associating R-DTI with RPD

The following example shows how to verify whether the RPD is associated to R-DTI:

```
Router# show running-config | sec r-dti
r-dti 20
 r-dti 20
 r-dti 20
 r-dti 20
 r-dti 20
 r-dti 20
ptp r-dti 20
profile G.8275.2
 ptp-domain 55
 clock-port 22
   ethernet 1
   clock source ip 10.10.1.11

Router# show running-config | sec cable rpd
cable rpd nh13-00
 identifier badb.ad17.4820
 core-interface Te7/1/4
  principal
  rpd-ds 0 downstream-cable 7/0/16 profile 0
```

```
  rpd-us 0 upstream-cable 7/0/16 profile 0
 r-dti 20
 rpd-event profile 0
cable rpd nh13-01
 identifier badb.ad17.4821
 core-interface Te7/1/4
  principal
  rpd-ds 0 downstream-cable 7/0/17 profile 0
  rpd-us 0 upstream-cable 7/0/17 profile 0
 r-dti 20
 rpd-event profile 0
cable rpd nh13-02
 identifier badb.ad17.4822
 core-interface Te7/1/4
  principal
  rpd-ds 0 downstream-cable 7/0/18 profile 0
  rpd-us 0 upstream-cable 7/0/18 profile 0
 r-dti 20
 rpd-event profile 0
cable rpd nh13-03
 identifier badb.ad17.4823
 core-interface Te7/1/4
  principal
  rpd-ds 0 downstream-cable 7/0/19 profile 0
  rpd-us 0 upstream-cable 7/0/19 profile 0
 r-dti 20
rpd-event profile 0
cable rpd nh13-04
 identifier badb.ad17.4824
 core-interface Te7/1/4
  principal
  rpd-ds 0 downstream-cable 7/0/20 profile 0
  rpd-us 0 upstream-cable 7/0/20 profile 0
 r-dti 20
 rpd-event profile 0
cable rpd nh13-05
 identifier badb.ad17.4825
 core-interface Te7/1/4
  principal
  rpd-ds 0 downstream-cable 7/0/21 profile 0
  rpd-us 0 upstream-cable 7/0/21 profile 0
 r-dti 20
 rpd-event profile 0
```

Verifying PTP Clock Functioning

To verify whether the PTP Clock is running, use the following commands:

```
Router#show ptp clock running
                      PTP Ordinary Clock [Domain 55]
         State          Ports          Pkts sent      Pkts rcvd      Redundancy Mode
         PHASE_ALIGNED  1              40979          120805         Hot standby

                                PORT SUMMARY
                                                                                PTP Master
Name           Tx Mode      Role         Transport    State        Sessions     Port Addr
slave-from-903 unicast      slave        Lo1588       Slave        1            10.10.1.11
```

Verifying PTP Clock Running Domain

The following example shows how to verify the PTP clock running domain:

```
Router# show ptp clock running domain 55
                    PTP Ordinary Clock [Domain 55]
         State          Ports          Pkts sent      Pkts rcvd      Redundancy Mode
         PHASE_ALIGNED  1              16012          45126          Hot standby
                              PORT SUMMARY
                                                                                PTP Master
Name           Tx Mode      Role         Transport    State        Sessions     Port Addr
slave-from-903 unicast      slave        Lo1588       Uncalibrated 1            10.10.1.11
                             SESSION INFORMATION
slave-from-903 [Lo1588] [Sessions 1]
 Peer addr          Pkts in    Pkts out   In Errs    Out Errs
10.10.1.11         45126      16012      0          0
```

Verifying Time Sync State

To verify the status of time synchronization, use the show ptp clock <n> state command as given in the following example:

```
Router# show ptp clock 0 state
apr state       : PHASE_LOCK
clock state     : CLOCK_VERIFY
current tod     : 1541653898   Thu Nov  8 05:11:38 2018
active stream   : 0
==stream    0   :
  port id       :                0
  master ip     :       10.10.1.11
  local ip      :       40.3.6.187
  stream state  :       PHASE_LOCK
  Master offset :             -698
  Path    delay :            63314
  Forward delay :            62616
  Reverse delay :            62973
  Freq offset   :           -88276
  1Hz  offset   :              -34
==stream    2   :
  port id       :                1
  master ip     :       10.10.1.11
  local ip      :       40.3.6.189
  stream state  :       PHASE_LOCK
  Master offset :              490
  Path    delay :            72755
  Forward delay :            73471
  Reverse delay :            72039
  Freq offset   :           -85798
  1Hz  offset   :            -5123
==stream    4   :
  port id       :                2
  master ip     :       10.10.1.11
  local ip      :       40.3.6.185
  stream state  :       PHASE_LOCK
  Master offset :             -604
  Path    delay :            63017
  Forward delay :            62413
  Reverse delay :            62997
  Freq offset   :           -87014
  1Hz  offset   :               70
==stream    8   :
  port id       :                4
  master ip     :       10.10.1.11
  local ip      :       40.3.6.193
  stream state  :       PHASE_LOCK
  Master offset :              664
  Path    delay :            63231
```

```
  Forward delay :            63691
  Reverse delay :            62771
  Freq offset   :           -86365
  1Hz  offset   :               -6

Router# show ptp clock 1 state
apr state       : PHASE_LOCK
clock state     : CLOCK_VERIFY
current tod     : 1541653902   Thu Nov  8 05:11:42 2018
active stream   : 0

Router# show ptp clock 2 state
apr state       : PHASE_LOCK
clock state     : CLOCK_VERIFY
current tod     : 1541653906   Thu Nov  8 05:11:46 2018
active stream   : 0

Router# show ptp clock 3 state
apr state       : PHASE_LOCK
clock state     : CLOCK_VERIFY
current tod     : 1541653909   Thu Nov  8 05:11:49 2018
active stream   : 0

Router# show ptp clock 4 state
apr state       : PHASE_LOCK
clock state     : CLOCK_VERIFY
current tod     : 1541653912   Thu Nov  8 05:11:52 2018
active stream   : 0

Router# show ptp clock 5 state
apr state       : PHASE_LOCK
clock state     : CLOCK_VERIFY
current tod     : 1541653918   Thu Nov  8 05:11:58 2018
active stream   : 0

Router# show ptp clock 6 state
apr state       : PHASE_LOCK
clock state     : CLOCK_VERIFY
current tod     : 1541653920   Thu Nov  8 05:12:00 2018
active stream   : 0
```

Verifying Time Sync Statistics

To verify the statistics of the time synchronization, use the show ptp clock <n> state command as given in the following example:

```
Router# show ptp clock 0 statistics
 AprState    7  :
           2@0-01:12:30.128          1@0-01:11:03.722          3@0-00:31:02.762
           2@0-00:06:42.742          1@0-00:06:23.496          0@0-00:05:25.894
           4@0-00:05:07.269
 ClockState  3  :
           3@0-00:06:50.180          2@0-00:06:43.180          1@0-00:06:42.697
 BstPktStrm  1  :
           0@0-00:05:01.875
 SetTime     1  :
  10000000000@0-00:05:05.337
 StepTime    1  :
    722733l3@0-00:05:57.337
 AdjustTime  124        :
        -312@0-03:06:25.962          3@0-03:05:24.961        -50@0-03:04:23.961
         238@0-03:03:22.961         19@0-03:02:21.961       -106@0-03:01:20.961
         -48@0-03:00:19.961        211@0-02:59:18.961         54@0-02:58:17.962
```

streamId	msgType	rx	rxProcessed	lost	tx
0	SYNC	41030	41030	0	0
0	DELAY REQUEST	0	0	0	41031
0	P-DELAY REQUEST	0	0	0	0
0	P-DELAY RESPONSE	0	0	0	0
0	FOLLOW UP	0	0	0	0
0	DELAY RESPONSE	41028	41028	4294891017	0
0	P-DELAY FOLLOWUP	0	0	0	0
0	ANNOUNCE	2565	2565	0	0
0	SIGNALING	27	27	0	27
0	MANAGEMENT	0	0	0	0
TOTAL		84650	84650	4294891017	41058
2	SYNC	40980	40980	0	0
2	DELAY REQUEST	0	0	0	40981
2	P-DELAY REQUEST	0	0	0	0
2	P-DELAY RESPONSE	0	0	0	0
2	FOLLOW UP	0	0	0	0
2	DELAY RESPONSE	40608	40608	4294891243	0
2	P-DELAY FOLLOWUP	0	0	0	0
2	ANNOUNCE	2561	2561	0	0
2	SIGNALING	27	27	0	27
2	MANAGEMENT	0	0	0	0
TOTAL		84176	84176	4294891243	41008
4	SYNC	41074	41074	0	0
4	DELAY REQUEST	0	0	0	41074
4	P-DELAY REQUEST	0	0	0	0
4	P-DELAY RESPONSE	0	0	0	0
4	FOLLOW UP	0	0	0	0
4	DELAY RESPONSE	41072	41072	4294891140	0
4	P-DELAY FOLLOWUP	0	0	0	0
4	ANNOUNCE	2567	2567	0	0
4	SIGNALING	27	27	0	27
4	MANAGEMENT	0	0	0	0
TOTAL		84740	84740	4294891140	41101
6	SYNC	0	0	0	0
6	DELAY REQUEST	0	0	0	0
6	P-DELAY REQUEST	0	0	0	0
6	P-DELAY RESPONSE	0	0	0	0
6	FOLLOW UP	0	0	0	0
6	DELAY RESPONSE	0	0	0	0
6	P-DELAY FOLLOWUP	0	0	0	0
6	ANNOUNCE	2609	2609	0	0
6	SIGNALING	9	9	0	9
6	MANAGEMENT	0	0	0	0
TOTAL		2618	2618	0	9
8	SYNC	40902	40902	0	0
8	DELAY REQUEST	0	0	0	40903
8	P-DELAY REQUEST	0	0	0	0
8	P-DELAY RESPONSE	0	0	0	0
8	FOLLOW UP	0	0	0	0
8	DELAY RESPONSE	38773	38773	4294892784	0
8	P-DELAY FOLLOWUP	0	0	0	0
8	ANNOUNCE	2556	2556	0	0
8	SIGNALING	27	27	0	27
8	MANAGEMENT	0	0	0	0
TOTAL		82258	82258	4294892784	40930
10	SYNC	0	0	0	0
10	DELAY REQUEST	0	0	0	0
10	P-DELAY REQUEST	0	0	0	0
10	P-DELAY RESPONSE	0	0	0	0
10	FOLLOW UP	0	0	0	0
10	DELAY RESPONSE	0	0	0	0
10	P-DELAY FOLLOWUP	0	0	0	0
10	ANNOUNCE	2598	2598	0	0

```
10       SIGNALING          9           9              0           9
10       MANAGEMENT         0           0              0           0
  TOTAL                     2607        2607           0           9
```

Configuration Examples

This section provides examples for configuring Cisco cBR for time synchronization.

Example: Configuring Time Interface and PTP Domain

The following example shows how to configure time interface and PTP domain:

```
enable
configure terminal
interface Loopback1588
ip address 100.100.100.40 255.255.255.255

interface TenGigabitEthernet4/1/7.1 (connect to PTP master)
ip address 100.100.10.92 255.255.255.0
route 10.10.10.11 255.255.255.224 192.168.0.12 (route to PTP master loopback ip)
ptp clock ordinary domain 55 (This is for cbr ptp connection)
 servo tracking-type R-DTI
 clock-port slave-from-903 slave
 delay-req interval -4
 sync interval -5
 sync one-step
 transport ipv4 unicast interface Lo1588 negotiation
 clock source 10.10.1.11 (PTP master loopback ip)
```

Example: Configure RPD PTP Connection

The following example shows how to configure RPD PTP connection:

```
enable
configure terminal
ptp r-dti 20
profile G.8275.2
ptp-domain 0
 mode slave
 priority1 128
 priority2 255
 local-priority 128
 clock-port 1
   ethernet 1
   …
 clock-port 2
   ethernet 2
   …
clock-port 1
   ethernet 1
   state up
   transport ipv4
   clock source ip 10.10.1.12 gw 10.10.1.1
    clock source ip 192.168.0.0 gateway ip 10.10.1.2 alternate
   transport cos 6
   transport dscp 47
   sync interval -4
   announce interval 0
   announce timeout 11
   delay-req interval -4
```

```
  unicast grant-duration 300
  local-priority 128
```

Example: Associate R-DTI with RPD

The following example shows how to associate R-DTI with RPD:

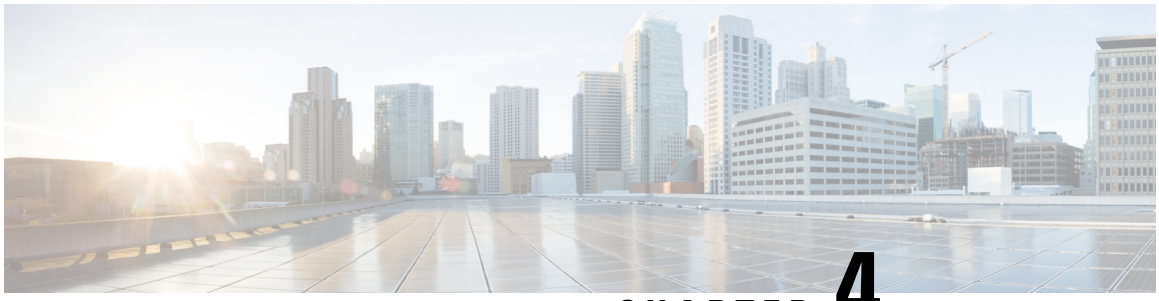
```
enable
configure terminal
cable rpd node1
 identifier badb.ad17.4820 (node vbh0 mac)
 core-interface Te7/1/4
  rpd-ds 0 downstream-cable 7/0/16 profile 0
  rpd-us 0 upstream-cable 7/0/16 profile 0
 r-dti 20
 rpd-event profile 0
```

Feature Information for Synchronizing Time on Cisco Remote PHY Shelf 7200

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 5: Feature Information for Synchronizing Time on Cisco Remote PHY Shelf 7200

Feature Name	Releases	Feature Information
Synchronizing Time	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .



CHAPTER 4

DEPI/UEPI/L2TP integration with RPD

This document describes how to configure the DEPI/UEPI/L2TP integration with RPD on the Cisco cBR Series Converged Broadband Router.

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 27
- Information about DEPI/UEPI/L2TP integration with RPD, on page 28
- How to Configure DEPI/UEPI/L2TP integration with RPD, on page 28
- Feature Information for DEPI/UEPI/L2TP integration with RPD, on page 30

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 6: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information about DEPI/UEPI/L2TP integration with RPD

DEPI

Downstream External PHY Interface (DEPI) is the downstream interface between the CCAP Core and the RPD. R-DEPI is based on DEPI. More specifically, it is an IP pseudowire between the MAC and PHY in an MHAv2 system that contains both a data path for DOCSIS frames, video packets, and OOB packets, as well as a control path for setting up, maintaining, and tearing down sessions.

UEPI

Upstream External PHY Interface (UEPI) is the upstream interface between the RPD and the CCAP Core. Like DEPI, it is an IP pseudowire between the PHY and MAC in an MHAv2 system that contains both a data path for DOCSIS frames, and a control path for setting up, maintaining, and tearing down sessions.

How to Configure DEPI/UEPI/L2TP integration with RPD

This section describes how to configure DEPI/UEPI/L2TP integration with RPD.

Configuring depi-class/l2tp-class Pair

It's not permitted to change the default l2tp-class configuration (rphy-l2tp-global-class) for R-DEPI by user, because the parameter values are fine tuned to accommodate most common cases.

If user wants to use parameter values other than the default ones, they can use manually defined depi-class/l2tp-class pair. To do so, follow the example below:

```
Router# configure terminal
Router(config)# l2tp-class l2tp_demo
Router(config-l2tp-class)#exit
Router(config)# depi-class depi_demo
Router(config-depi-class)#l2tp-class l2tp_demo
Router(config-depi-class)#exit
Router(config)#cable rpd node
Router(config-rpd)#core-interface Te1/1/7
Router(config-rpd-core)#depi depi_demo /* Be sure to configure when the RPD core is offline*/
Router(config-rpd-core)#end
```

Verifying depi-class/l2tp-class Pair Configuration

To verifying depi-class/l2tp-class pair configuration, use the **show running-config** command as shown in the example below:

```
Router# show running-config | section rpd
alias exec scr show cable rpd
cable rpd node
identifier 0004.9f00.0901
core-interface Te1/1/7
  principal
  rpd-ds 0 downstream-cable 1/0/31 profile 155
```

```
  rpd-us 0 upstream-cable 1/0/63 profile 100
  depi depi_demo
r-dti 1
rpd-event profile 0
```

When the RPD core is online, use the **show l2tp tunnel** command as shown in the example below:

```
Router# show l2tp tunnel
LocTunID   RemTunID   Remote Name   State  Remote Address  Sessn L2TP Class/
                                             Count VPDN Group
2375973187 4191827509 OpenRPD       est    120.100.1.20    86    l2tp_demo
2982856686 2223617345 OpenRPD       est    120.100.1.20    86    l2tp_demo
```

Verifying the RPD Status

To verify the RPD status, use the **show cable rpd** command as shown in the example below:

```
Router# show cable rpd
Load for five secs: 6%/1%; one minute: 5%; five minutes: 5%
No time source, *04:52:03.936 UTC Tue Jan 17 2017

MAC Address     IP Address    I/F      State       Role   HA    Name
0004.9f00.0901  91.0.10.10    Te1/1/0  init(l2tp)  Pri    Act   node
```

Display DEPI Ralated Information

To display the Downstream External PHY Interface (DEPI) related information, use the command as shown in the following example:

```
Router#show cable rpd depi

DEPI Tunnel and Session Information Total tunnels 1 sessions 26
LocTunID   RemTunID   Remote Device  State  Remote Address  Sessn L2TP Class
                                             Count
338514820  671581873  0004.9f00.0901 est    10.10.10.11     26    rphy-l2tp-gl...

LocID      RemID      Pseudowire      State  Last Chg Uniq ID    Type Mode RemSt
0x41040008 0x00000B02 US1/0/0:2(R)    est    00:34:57 21          P    PSP  UP
0x41010000 0x00000600 US1/0/0:0(D)    est    00:34:57 11          P    PSP  UP
0x00002006 0x00000405 DS1/0/0:5       est    00:34:57 6           P    PSP  UP
0x00002004 0x00000403 DS1/0/0:3       est    00:34:57 4           P    PSP  UP
0x4100000C 0x00000D03 US1/0/0:3(M)    est    00:34:57 23          P    PSP  UP
0x00002002 0x00000401 DS1/0/0:1       est    00:34:57 2           P    PSP  UP
0x00002007 0x00000406 DS1/0/0:6       est    00:34:57 7           P    PSP  UP
0x00002008 0x00000407 DS1/0/0:7       est    00:34:57 8           P    PSP  UP
0x4101000C 0x00000603 US1/0/0:3(D)    est    00:34:57 24          P    PSP  UP
0x41000004 0x00000D01 US1/0/0:1(M)    est    00:34:57 15          P    PSP  UP
0x00002001 0x00000400 DS1/0/0:0       est    00:34:57 1           P    PSP  UP
0x41080008 0x00000F02 US1/0/0:2(S)    est    00:34:57 22          P    PSP  UP
0x41010004 0x00000601 US1/0/0:1(D)    est    00:34:57 16          P    PSP  UP
0x41020000 0x00000800 US1/0/0:0(B)    est    00:34:57 12          P    PSP  UP
0x00002009 0x00000408 DS1/0/0:8       est    00:34:57 9           P    PSP  UP
0x41010008 0x00000602 US1/0/0:2(D)    est    00:34:57 20          P    PSP  UP
0x41000008 0x00000D02 US1/0/0:2(M)    est    00:34:57 19          P    PSP  UP
0x4108000C 0x00000F03 US1/0/0:3(S)    est    00:34:57 26          P    PSP  UP
0x00002003 0x00000402 DS1/0/0:2       est    00:34:57 3           P    PSP  UP
0x41080000 0x00000F00 US1/0/0:0(S)    est    00:34:57 14          P    PSP  UP
0x41040004 0x00000B01 US1/0/0:1(R)    est    00:34:57 17          P    PSP  UP
0x41080004 0x00000F01 US1/0/0:1(S)    est    00:34:57 18          P    PSP  UP
0x41000000 0x00000D00 US1/0/0:0(M)    est    00:34:56 10          P    PSP  UP
0x00002005 0x00000404 DS1/0/0:4       est    00:34:56 5           P    PSP  UP
```

```
0x4104000C 0x00000B03 US1/0/0:3(R)    est    00:34:56 25         P    PSP  UP
0x41040000 0x00000B00 US1/0/0:0(R)    est    00:34:56 13         P    PSP  UP

outer#show cable rpd 0004.9f03.0214 te7/1/0 depi tunnel

Load for five secs: 7%/2%; one minute: 6%; five minutes: 6%
No time source, *12:41:44.228 CST Mon Mar 20 2017

LocTunID   RemTunID   Remote Device  State  Remote Address  Sessn L2TP Class
                                                           Count
3388764998 1054297851 0004.9f03.0214 est    10.10.10.11     29    rphy-l2tp-gl...
```

Table 7: show cable rpd depi Field Descriptions

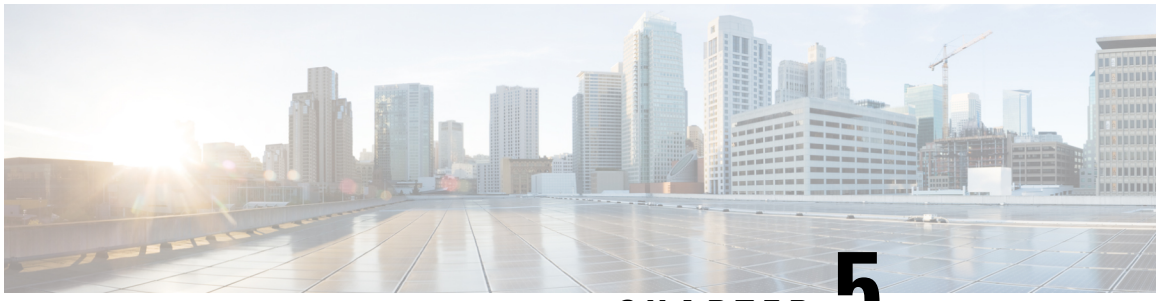
Field	Description
LocID	Local session ID.
RemID	Remote session ID.
US1/0/0:2(R)	US means UEPI session, DS means DEPI session. This string means UEPI session on line card slot 1, controller 0, rf-channel 2.
est in State	Established state.
P in Type	On primary line card.

Feature Information for DEPI/UEPI/L2TP integration with RPD

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 8: Feature Information for DEPI/UEPI/L2TP integration with RPD

Feature Name	Releases	Feature Information
DEPI/UEPI/L2TP integration with RPD	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .



CHAPTER 5

DEPI Latency Measurement

This document describes how to configure the DEPI latency measurement on the Cisco cBR Series Converged Broadband Router.

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 31
- Information about DEPI Latency Measurement, on page 32
- How to Configure DLM, on page 32
- Example: DLM Configuration, on page 33
- Feature Information for DLM, on page 33

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 9: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information about DEPI Latency Measurement

The DEPI Latency Measurement (DLM) packet is a specific type of data packet used for measuring the network latency between the CCAP core and the RPD. There are two types of DLM packets, ingress DLM packet and egress DLM packet. The ingress DLM measures the latency between the CCAP core and the ingress point in the RPD, and the egress DLM measures the latency between the CCAP core and the egress point of the RPD. For now, only the ingress DLM is supported. Egress DLM will be supported in the future if required.

How to Configure DLM

This section describes how to configure DLM on Cisco cBR-8.

Configuring DLM

To configure DLM, complete the following procedure. DLM is disabled by default, only enabled when configured.

```
configure terminal
cable rpd name
core-interface interface_name
network-delay dlm interval_in_seconds
```

Verifying DLM Configuration

To verify the DLM configuration, use the **show cable rpd** *ip_address* **dlm** command as shown in the example below:

```
Router# show cable rpd 0000.bbaa.0002 dlm
Load for five secs: 4%/1%; one minute: 4%; five minutes: 4%
Time source is NTP, 13:12:36.253 CST Sun Jan 1 2017
DEPI Latency Measurement (ticks) for 0000.bbaa.0002
 Last Average DLM:              4993
 Average DLM (last 10 samples): 4990
 Max DLM since system on:       5199
 Min DLM since system on:       4800
 Sample #     Latency (usecs)
 x------------x------------
 0            491
 1            496
 2            485
 3            492
 4            499
 5            505
 6            477
 7            474
 8            478
 9            471
```

The table below shows descriptions for the fields displayed by this command:

Table 10: show cable rpd dlm Field Descriptions

Field	Description
Last Average DLM	It means the last time average DLM (AD). At first, the Last Average DLM (LAD) is always 0, when the absolute value of (LAD - AD) exceeds or equal to 75us, LAD will be updated to be the value of AD, MAP advance triggered to update, AD will keep updating with the last (latest) 10 samples.

Example: DLM Configuration

The following example shows how to configure DLM:

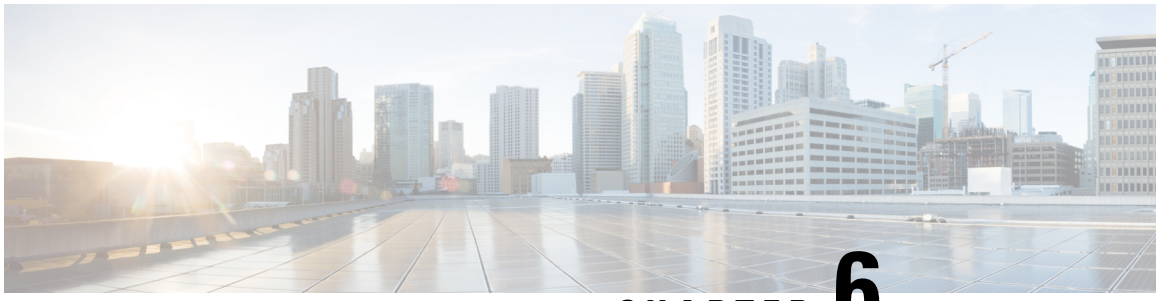
```
Router# configure terminal
Router(config)#cable rpd 1
Router(config-rpd)#core-interface tenGigabitEthernet 3/1/0
Router(config-rpd-core)#network-delay dlm 10
```

Feature Information for DLM

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 11: Feature Information for DLM

Feature Name	Releases	Feature Information
DEPI Latency Measurement	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .



CHAPTER 6

Multiple Cores

This document describes the multiple cores in the Remote PHY system.

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 35
- Information about Multiple Cores, on page 36
- How to Configure Multiple Cores, on page 36

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 12: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information about Multiple Cores

The RPD can be managed by more than one CCAP core. An RPD is controlled by exactly one principal CCAP core and zero or more auxiliary CCAP core(s). Each CCAP core manages a subset of RPD resources, e.g., particular channels or RF ports.

Principal core is responsible for the configuration of common parameters for the RPD and for certain device management functions. Principal core can provide DOCSIS, video or OOB service. Auxiliary cores are responsible for providing video or OOB services. They are restricted to the resource set assigned to them by the principal core.

Restrictions for Multiple Cores Configuration

The following restrictions are applicable to mutiple cores configuration:

- Maximum four cores are supported.
- DOCSIS controllers can only be configured to principal core, while video controllers can be configured to all cores.
- Only one core can be principal, the rest will be auxiliary.
- Principal core needs to be configured explicitly.
- At least one DOCSIS downstream controller and one upstream controller are needed for principal core.
- No upstream controller for auxiliary core and at least one downstream controller is needed for auxiliary core.
- Only single CMTS is supported.
- No downstram frequency and channel id overlap is allowed for all the cores.

How to Configure Multiple Cores

This section describes how to configure multiple cores on Cisco cBR-8.

Configuring Multiple Cores

To configure the multiple cores, follow the example below:

```
Router(config)# cable rpd sjc_block22   /* unique name for each rpd */
Router(config-rpd)# description rpd for sjc block 22
Router(config-rpd)# identifier 1122.3344.5566   /* unique id for each rpd.*/
Router(config-rpd)# rpd-ds 0 power-level 5   /* DS max-carrier and power-level info */
Router(config-rpd)# rpd-ds 0 dedicated-cw-tone cw1   /* DS pilot tone info */
Router(config-rpd)# core-interface Te3/1/0   /* Core side interface (D-PIC interface) for
services below */
Router(config-rpd-core)# principal   /* Specify the principal core */
Router(config-rpd-core)# rpd-ds 0 controller downstream-cable 3/0/0 profile 100 /* DS docsis
 channel config*/
Router(config-rpd-core)# rpd-ds 0 controller downstream-cable 3/0/1 profile 200 /* DS docsis
 channel config*/
```

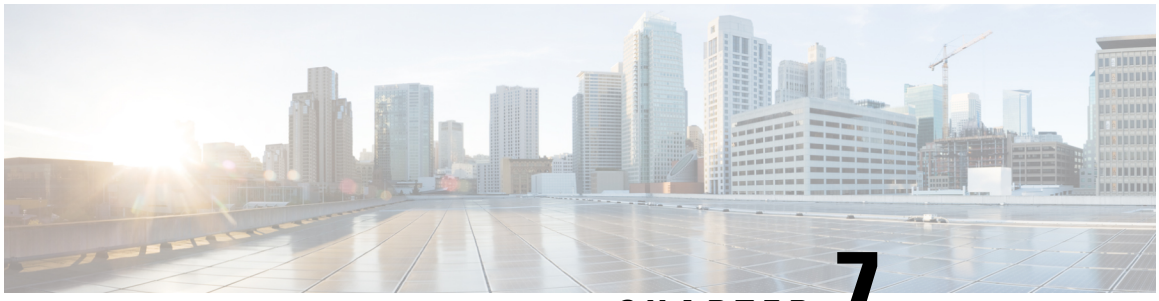
```
Router(config-rpd-core)# rpd-ds 0 downstream-cable 3/0/2 profile 300 /* DS video channel
config*/
Router(config-rpd-core)# rpd-ds 0 downstream-cable 3/0/3 profile 400 /* DS video channel
config*/
Router(config-rpd-core)# rpd-us 0 upstream-cable 3/0/0 profile 101 /* US 0 docsis channel
config*/
Router(config-rpd-core)# rpd-us 1 upstream-cable 3/0/1 profile 101   /* US 1 docsis channel
 config*/
Router(config-rpd-core)# depi depi_rpd_block22    /* RPD DEPI configuration.*/
Router(config-rpd-core)# exit
Router(config-rpd)# core-interface Te9/1/1 /* Support multiple core-interface for cases
such as video is using separate LC*/
Router(config-rpd-core)# rpd-ds 0 downstream-cable 9/0/1 profile 200  /* DS video channel
config*/
Router(config-rpd-core)# depi depi_rpd_block22    /* RPD DEPI configuration.*/
Router(config-rpd-core)# exit
Router(config-rpd)# r-dti 1
Router(config-rpd)# rpd-event profile 0
Router(config-rpd)# rpd-55d1-us-event profile 0
```

Verifying Multiple Cores Configuration

To display the information of the principal and auxiliary cores, use the **show cable rpd** command as shown in the example below:

```
Router# show cable rpd
MAC Address     IP Address         I/F          State        Role HA  Name
0004.9f00.0907  120.100.2.20     Te1/1/6   online       Pri   Act  node
0004.9f00.0907  120.100.2.20     Te1/1/0   online       Aux  Act  node
0004.9f00.0907  120.100.2.20     Te1/1/1   online       Aux  Act  node
0004.9f00.0907  120.100.2.20     Te1/1/2   online       Aux  Act  node
```

Note Only the active cores are displayed, stand-by cores are hidden.



CHAPTER 7

GCPP Support for Remote PHY

This document provides information on the Generic Control Protocol Principal (GCPP) support on Cisco cBR-8 series routers.

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 39
- Information About GCPP Support, on page 40
- How to Configure GCPP Core, on page 41
- Configuration Example, on page 41
- Feature Information for GCPP Support, on page 42

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 13: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

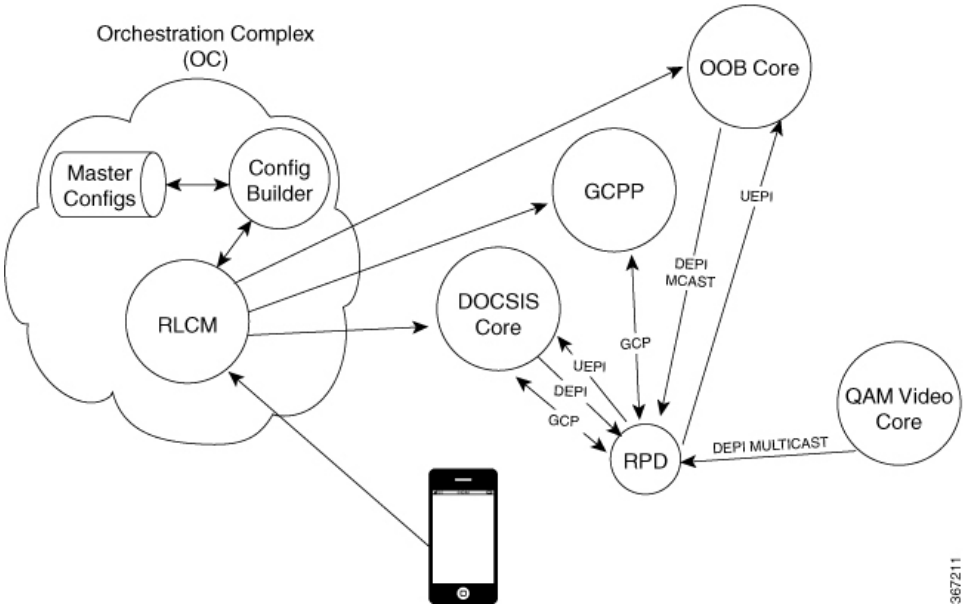
Information About GCPP Support

The Generic Control Protocol (GCP) sets up a control plane tunnel over a generic transport protocol such as TCP or UDP. GCP is used to program the remote PHY system upstream and downstream parameters from the CMTS. It is also used to control the remote PHY system.

The Remote PHY architecture with GCPP (Generic Control Protocol Principal) server, includes separate DOCSIS, QAM video and OOB cores. To enable the use of multiple RPHY cores, the architecture utilizes a GCP Principal Core (GCPP). Initially, the RPDs contact and authenticate with the GCPP core, which also configures the RPDs in its domain in coordination with the Cores (DOCSIS, QAM video, and OOB).

Without the GCPP core, cBR8 is the principal core for RPD. However, in this GCPP architecture, the GCPP server is the principal core and the Cisco cBR8 is an auxiliary core.

Figure 2: Remote PHY Architecture with GCPP



GCPP Core

GCPP core provides containerized services for automating deployments, managing applications, the initial authentication of the RPDs, and configuring RPD features and video services. The Principal Core does not provide any services (video or data).

The GCPP configures RPDs using GCP with the details of the other Cores that will configure it and the resources that will be configured by those Cores. The GCPP then performs the RPD operational configuration and the video and OOB service configuration. By the end of this process, the RPD will have its operational configuration and video and OOB services set up.

The GCPP core performs the following three primary functions:

- Initial authentication of the RPD
- Initial configuration of the RPD, including the list of cores to which it connects and the resources that those other cores will configure

- Configuration of the multicast sources that the RPD uses to populate QAM video (broadcast and narrowcast) channels

GCPP allows integrating videos on a standardized, single video platform. It also provides the configuration of the RPD's video channels, removing the requirements from the Video Core to support RPD authentication and GCP configuration.

How to Configure GCPP Core

This section contains the following:

Adding GCPP Core IP Address

Add the GCPP core IP address in the original CNR RPD policy if your RPD helper address is cnr8/auto-cnr. Or add the DHCP pool with the GCPP core/CCAP core in the USD.

Configuring Cisco cBR for Enabling GCPP

To set the GCPP server as the core server, configure Cisco cBR to remove the principal keyword under RPD configuration.

```
cable rpd <RPD name>
 identifier <RPD ID>
 core-interface <slot/subslot/port>
  principal             <<<<<<<<<<< remove it, gcpp is the principal core
  rpd-ds <port-ID> downstream-cable <slot/sub-slot/controller> profile <ID>
  rpd-us <port-ID> upstream-cable <slot/sub-slot/controller> profile <ID>
 core-interface <slot/subslot/port>
  rpd-ds <port-ID> downstream-cable <slot/sub-slot/controller> profile <ID>
r-dti <ID>
 rpd-event profile <ID>
```

Configuration Example

This section provides example of Cisco cBR-8 Converged Broadband Router configuration when GCPP is the core.

Example: GCPP Configuration

```
cable rpd p1_0719
 identifier 0004.9f00.0719
 core-interface Te6/1/2
  rpd-ds 0 downstream-cable 6/0/17 profile 7
  rpd-us 0 upstream-cable 6/0/17 profile 7
 core-interface Te6/1/1
  rpd-ds 0 downstream-cable 6/0/3 profile 17
r-dti 6
 rpd-event profile 0
rpd-55d1-us-event profile 0
```

Feature Information for GCPP Support

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

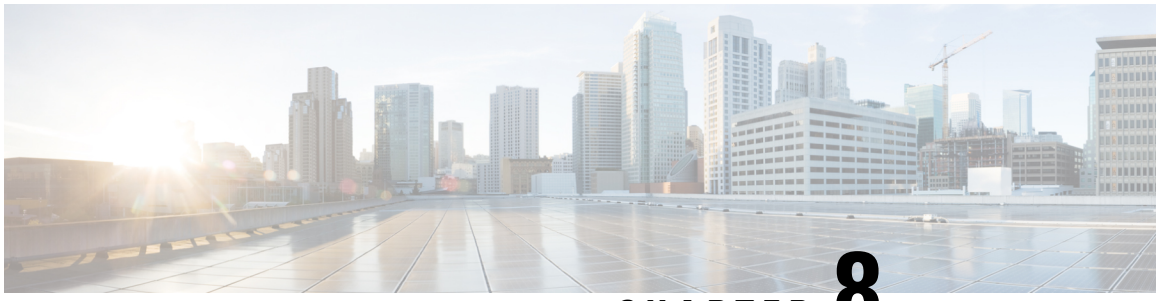
Table 14: Feature Information for GCPP Support

Feature Name	Releases	Feature Information
GCPP Support	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .

PART II

Cisco Remote PHY Shelf 7200 High Availability Guide for Cisco Remote PHY Shelf 7200 Software 1.1

- Cisco Remote PHY Shelf 7200 Backhaul Port Mapping and Link Redundancy, on page 45



CHAPTER 8

Cisco Remote PHY Shelf 7200 Backhaul Port Mapping and Link Redundancy

This document describes how to configure the backhaul port mapping and link redundancy on the Cisco Remote PHY Shelf 7200 Software 1.1.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 45
- Port Mapping and Redundancy, on page 45
- Configure Port Mapping and Link Redundancy, on page 49
- Feature Information for Port Mapping and Link Redundancy, on page 51

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 15: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

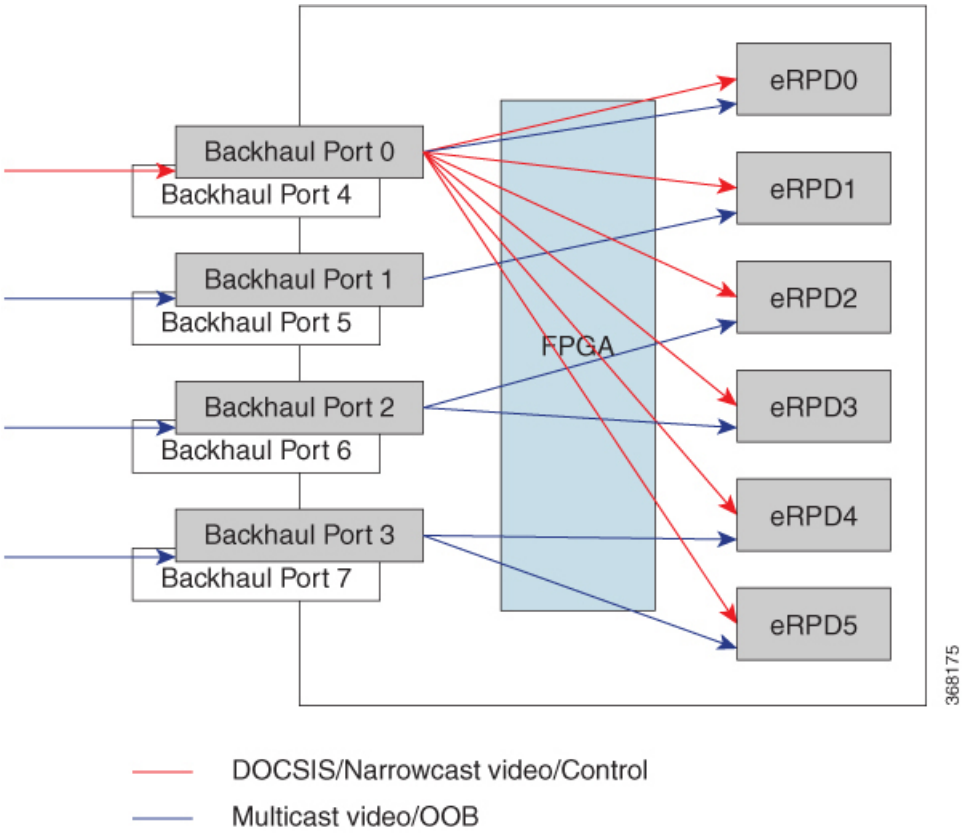
Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Port Mapping and Redundancy

The HA RPHY Shelf has eight SFP+ ports. These ports can be configured in 4+4 or 6+2 modes. By default, redundancy is not configured.

In the 4+4 mode, four 10GE ports are available in a redundant configuration, where four 10GE ports are active and the corresponding four 10GE ports are redundant. For example, backhaul port 4 protects backhaul port 0 while backhaul port 5 protects backhaul port 1. This is the default port mapping in the 4+4 mode.

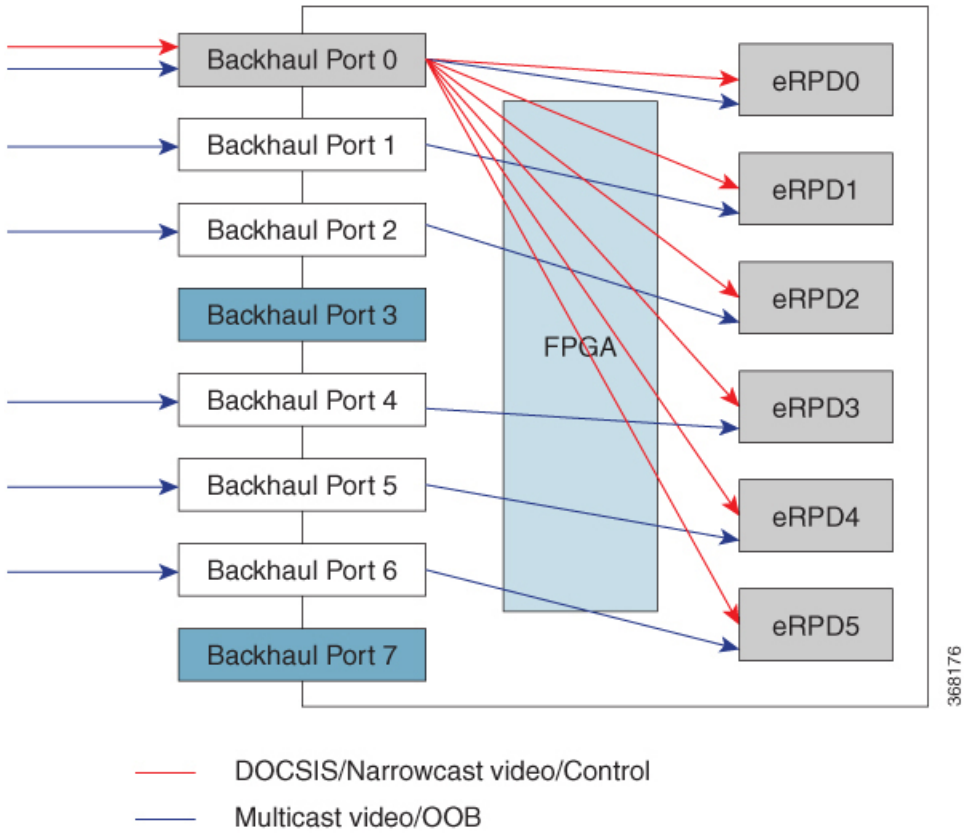
Figure 3: Default 4+4 Port Mapping



In the 4+4 mode, if all SFP+ ports are active and the default port mapping is configured, then each PHY device can receive up to 5Gbps unicast traffic and 4Gbps multicast traffic from the backhaul network.

In the 6+2 mode, for six active 10GE ports, two ports are redundant. In this mode, backhaul port 3 protects backhaul ports 4,5, and 6 while backhaul port 7 protects backhaul ports 0,1, and 2. This is the default port mapping in the 6+2 mode.

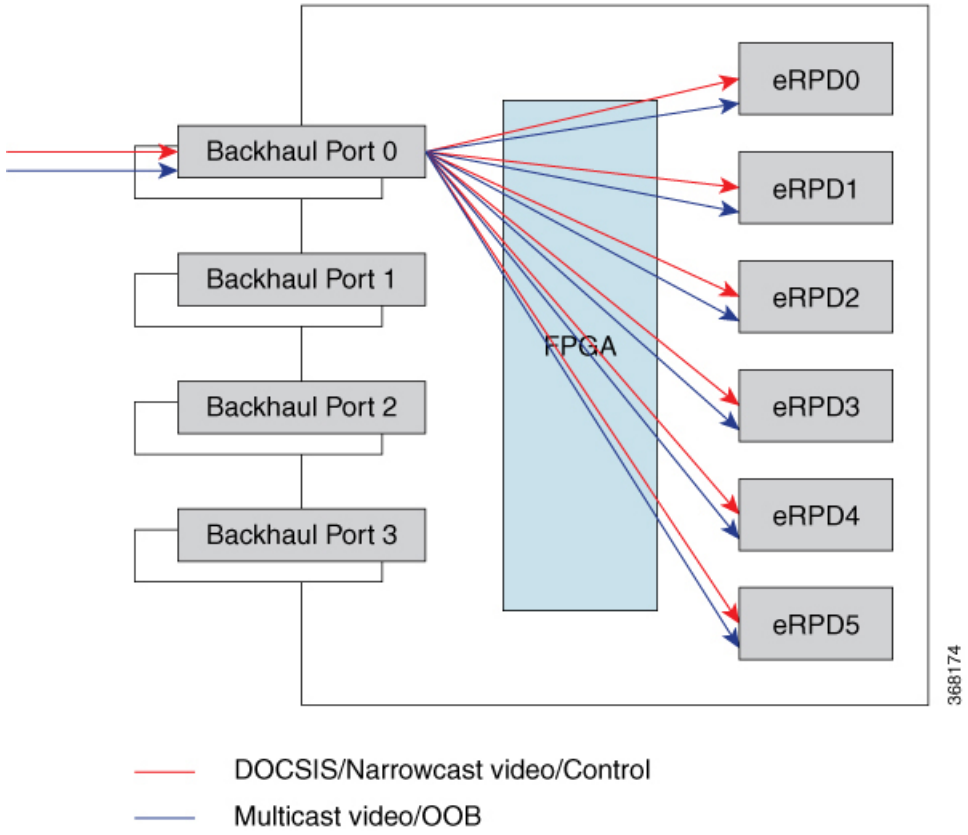
Figure 4: Default 6+2 Port Mapping



In this mode, if all SFP+ ports are active and the default port mapping is configured, then each PHY device can receive up to 10Gbps unicast traffic or 6Gbps unicast and 4Gbps multicast traffic from the backhaul network.

Based on bandwidth requirements, you can use any number of SFP+ ports. The mapping of ports can be configured using CLI commands. For example, when you want to use only one SFP+ port and all PHY devices, then you can map the ports like this.

Figure 5: Example of Port Mapping with One SFP+ Port



To switch between 4+4 mode and 6+2 mode, you can use backhaul mode switch or change using the command line interface.

Restrictions for Port Mapping

You can map any SFP+ ports to any PHY devices, but these restrictions apply.

- You cannot map redundant backhaul ports to eRPDs.
- For narrowcast, multicast DOCSIS, and control traffic, each PHY device receives DOCSIS and control data from only one 10GE SFP+ port.
- For video traffic, these restrictions apply.
  - Supports up to 96 QAM channels across eight SFP+ ports.
  - Supports a minimum of 64 narrowcast QAM channels per port.
  - Supports a maximum of 480 unique MPEG streams.
  - Each PHY device receives narrowcast video from only one 10GE SFP+ port.

Configure Port Mapping and Link Redundancy

This section describes how to configure port mapping and link redundancy on the Cisco Remote PHY Shelf 7200.

Map Ports to PHY Devices

Map the eight SFP+ ports with the six PHY devices, by following these steps.

```
enable
configure terminal
bh-erpd-mapping backhaul <0-7> erpd <0-5>
exit
show running-config bh-erpd-mapping
```

This is a sample configuration for mapping ports to PHY devices.

```
Router# enable
Router# configure terminal
Router(config)# bh-erpd-mapping backhaul 0 erpd 0
Router(config)# bh-erpd-mapping backhaul 0 erpd 1
Router(config)# bh-erpd-mapping backhaul 0 erpd 2
Router(config)# bh-erpd-mapping backhaul 0 erpd 3
Router(config)# bh-erpd-mapping backhaul 0 erpd 4
Router(config)# bh-erpd-mapping backhaul 0 erpd 5
Router(config)# exit
Router# show running-config bh-erpd-mapping
Building configuration...
bh-erpd-mapping backhaul 0 erpd 0
bh-erpd-mapping backhaul 0 erpd 1
bh-erpd-mapping backhaul 0 erpd 2
bh-erpd-mapping backhaul 0 erpd 3
bh-erpd-mapping backhaul 0 erpd 4
bh-erpd-mapping backhaul 0 erpd 5
```

Configure Link Redundancy

To configure link redundancy, follow these steps.

```
enable
configure terminal
link-redundancy mode [N/A | 6+2 | 4+4]
```

Modify Port Mapping

Modify port mapping configuration by following these steps.

```
enable
configure terminal
bh-erpd-mapping backhaul <0-7> erpd <0-5>
```

Verify Port Mapping

To view the port mapping configuration, follow these steps.

```
show bh-erpd-mapping slot number
```

This is an example of verifying port mapping.

```
Router# show bh-erpd-mapping slot 0
LC 0 :
backhaul0 <---> erpd0
backhaul0 <---> erpd1
backhaul0 <---> erpd2
backhaul0 <---> erpd3
backhaul0 <---> erpd4
backhaul0 <---> erpd5
```

Verify Link Redundancy

To view the link redundancy configuration, use this command.

```
show link-redundancy [slot number | all]
```

This is an example of verifying link redundancy. This configuration does not support link redundancy.

```
Router# show link-redundancy slot 0
LC 0 :

Backhaul |State   Role
---------|-----------------
0        |Active  Primary
1        |Active  Primary
2        |Active  Primary
3        |Active  Primary
4        |Active  Primary
5        |Active  Primary
6        |Active  Primary
7        |Active  Primary
---------------------------
```

This configuration is 6+2 redundant configuration.

```
Router# show link-redundancy slot 0
LC 0 :

---------------------------
Backhaul |State   Role
---------|-----------------
0        |Active  Primary
1        |Active  Primary
2        |Active  Primary
7        |Standby Secondary
---------|-----------------
3        |Standby Secondary
4        |Active  Primary
5        |Active  Primary
6        |Active  Primary
---------------------------
```

This configuration is 4+4 redundant configuration.

```
Router# show link-redundancy slot 0
LC 0 :
```

```
--------------------------
Backhaul |State   Role
---------|----------------
0        |Active  Primary
4        |Standby Secondary
---------|----------------
1        |Active  Primary
5        |Standby Secondary
---------|----------------
2        |Active  Primary
6        |Standby Secondary
---------|----------------
3        |Active  Primary
7        |Standby Secondary
--------------------------
```

Feature Information for Port Mapping and Link Redundancy

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

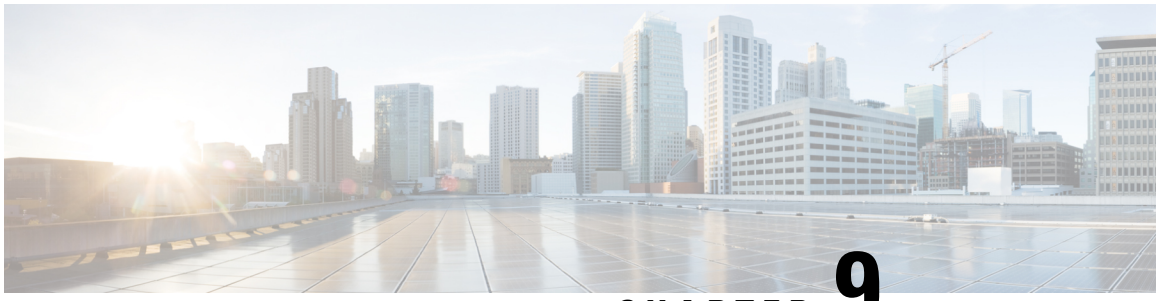
Table 16: Feature Information for Port Mapping and Link Redundancy

Feature Name	Releases	Feature Information
Port Mapping and Link Redundancy	Cisco Remote PHY Shelf 7200 Software 1.x	This feature was introduced on the Cisco Remote PHY Shelf 7200 device.

PART III

Cisco Remote PHY Shelf 7200 Configuration Guide for Cisco Remote PHY Shelf 7200 Software 1.1

- Cisco Remote PHY Controller Profile and RPD Configuration, on page 55
- Dynamic Bonding Group for RPHY, on page 69
- RPD IPv6, on page 79



CHAPTER 9

Cisco Remote PHY Controller Profile and RPD Configuration

This document describes how to configure the Cisco Remote PHY Controller Profile and RPD on the Cisco cBR Series Converged Broadband Router.

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 55
- Controller Profile and RPD, on page 56
- Configure Controller Profile and RPD, on page 58
- Troubleshooting Tips, on page 65
- Configuration Examples, on page 65
- Feature Information for Controller Profile and RPD Configuration, on page 66

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 17: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Controller Profile and RPD

The Controller Profile functions in a similar way to the controller integrated-cable Slot/Bay/Port (for downstream controller) or upstream-cable Slot/Bay/Port (for upstream controller) in I-CMTS. However if a Controller Profile is not associated to an RPD, physical resources cannot be allocated.

You can either unicast or multicast this profile. Multicast profile is used for DS sharing. You can multicast the same traffic to all RPDs in the multicast group, or to applications such as switched digital video (SDV) or BC video.

An R-PHY configuration consists of one principal core interface and one auxiliary core interface. The principal core specifies the DPIC interface to which the RPD connects. Auxiliary core interfaces specify the external DPIC interfaces that can be used for downstream sharing. Auxiliary core is used in this release only for video multicast and video OOB.

Configuring Controller Profile and cable RPD are the prerequisites for configuring R-PHY video.

The following table lists the DSCP value for different kinds of items.

Item	Per-Hop-Behavior (PHB)	DSCP Value
DOCSIS data (L2TP)	Best Effort	0
PTP	EF	46
PTP from RPD	EF	47
GCP	Best Effort	0
MAP/UCD (L2TP, DOCSIS control)	EF	46
BWR and RNG-REG	EF	46
Video	CS4	32
MDD (L2TP, DOCSIS control), voice	CS5	40

RPD Configurations

Compared to the iCMTS configuration, R-PHY configuration supports the following features:

- Up to 512 RPDs per CBR-8 chassis and 64 RPDs per CBR-CCAP-LC-40G-R line card
- 128 separate service groups per CBR-8 chassis
- 32 downstream controllers and up to 768 downstream channels per CBR-CCAP-LC-40G-R line card
- Up to 158 downstream channels (0-157) per downstream controller
- 64 upstream controllers, 128 SC-QAM upstream channels and 32 OFDMA upstream channels per CBR-CCAP-LC-40G-R line card
- Upstream sharing on CBR-CCAP-LC-G2-R is up to 8 RPDs per service group.
- Up to 8 RPDs per service group on each CBR-CCAP-LC-G2-R line card.

Note In Cisco IOS XE Fuji 16.8.1 and earlier releases, although 128 maximum upstream SCQAM channels per CBR-CCAP-LC-40G-R line card could be configured, the upstream maximum throughput per CBR-CCAP-LC-40G-R line card is 3Gbps which is due to USJIB limitation. So the upstream service could not be guaranteed when upper than 3Gbps upstream throughput per CBR-CCAP-LC-40G-R line card.

Cisco IOS XE Fuji 16.9.1 and later releases support 10 Gbps of upstream throughput on the CBR-CCAP-LC-40G and CBR-CCAP-LC-40G-R line cards on the Cisco cBR Series Converged Broadband Router.

In the R-PHY configuration, the following mapping relationships are supported between the controller and the port on RPD:

- Downstream 1:N (N>= 2) mapping: one DS controller is shared by several RPDs and one DS controller is mapped to one DS port of all these RPDs, that is “DS virtual split”, all these DS ports share the same signals from the same DS controller.
- Downstream N:1 mapping: several DS controllers are mapped into the same DS port of one RPD. Notice: the DS channels in these DS controller should use different rf-channel numbers
- Downstream N:N mapping: mixed 1:N and N:1 mapping. For example: several DS controllers are mapped into one DS port of one RPD. But at the same time they are “virtual split” DS controllers and are shared by several RPDs.
- Upstream 1:N(N<=8) mapping: one US controller can be shared by N (N<=8) US ports of multiple RPDs. Currently max two US ports are supported on one RPD, and for each US port, one US controller can be configured.

  For the two US ports of one RPD, the same US controller number can be configured.

Note Downstream 1:1 mapping is not supported under 512 RPD configuration, but still supported under smaller scale configuration.

Prerequisites for Configuring Controller Profile and RPD

The following restrictions are applicable to configuring controller profiles:

- All channels within the profiles of an RPD must be unique. Frequencies must not overlap each other.
- The principal core must contain at least one DOCSIS downstream profile
- Auxiliary core should contain only video and out-of-band profiles
- A DS controller can be associated to only one profile

Restrictions for Configuring Controller Profile and RPD

The following restrictions are applicable to configuring upstream controller profiles:

- Legacy controller configuration commands are not supported
- Legacy controller configuration cannot be shown in running-configuration

Configure Controller Profile and RPD

Configure Upstream Controller Profile

To configure the upstream controller-profile, use the cable upstream controller-profile command, as given in the following example:

```
cable upstream controller-profile 0
  cable def-phy-burst 0
  us-channel 0 chan-class-id 0
  us-channel 0 channel-width 1600000 1600000
  us-channel 0 docsis-mode atdma
  us-channel 0 equalization-coefficient
  us-channel 0 frequency 50000000
  us-channel 0 hop-priority frequency modulation channel-width
  us-channel 0 ingress-noise-cancellation 100
  us-channel 0 maintain-psd
  us-channel 0 max-logical-chans 1
  us-channel 0 minislot-size 4
  us-channel 0 modulation-profile 221
  us-channel 0 power-level 0
  us-channel 0 rng-holdoff 0
  no us-channel 0 shutdown
  us-channel 0 specsvl error-adaptive-profile 1
  us-channel 0 threshold cnr-profiles 25 13
  us-channel 0 threshold corr-fec 3
  us-channel 0 threshold hysteresis 3
  us-channel 0 threshold snr-profiles 25 13
  us-channel 0 threshold uncorr-fec 1
  ...
  end
```

Verify Upstream Controller Profile Configuration

To verify the Upstream controller profile configuration, use the **show cable upstream controller-profile** command or **show running-config | section upstream controller-profile** <*ID*> command, as shown in the following example:

```
Router#show cable upstream controller-profile 0
Load for five secs: 2%/0%; one minute: 3%; five minutes: 3%
Time source is NTP, 15:14:27.916 CST Fri Feb 24 2017

Upstream controller-profile 0
Description:
Upstream controller-profile 0 is being used by controller Upstream-Cable:
8/0/1,  8/0/0
  Controller Upstream-Cable
    ...
  Upstream-channel 0
    chan-class-id                  : 0x0
    channel-width                  : 1600000 1600000
    docsis-mode                    : atdma
    ...
```

Example for the **show running-config | section upstream controller-profile <ID>** command

```
Router#show running-config | s cable upstream controller-profile 0
cable upstream controller-profile 0
 us-channel 0 channel-width 1600000 1600000
 us-channel 0 docsis-mode atdma
 us-channel 0 equalization-coefficient
 us-channel 0 frequency 6000000
 us-channel 0 minislot-size 4
 us-channel 0 modulation-profile 221
 no us-channel 0 shutdown
 us-channel 1 channel-width 1600000 1600000
 us-channel 1 docsis-mode atdma
 us-channel 1 equalization-coefficient
 us-channel 1 frequency 7600000
 us-channel 1 minislot-size 4
 us-channel 1 modulation-profile 221
 no us-channel 1 shutdown
 us-channel 2 channel-width 1600000 1600000
 us-channel 2 docsis-mode atdma
 us-channel 2 equalization-coefficient
 us-channel 2 frequency 9200000
 us-channel 2 minislot-size 4
 us-channel 2 modulation-profile 221
 no us-channel 2 shutdown
 us-channel 3 channel-width 1600000 1600000
 us-channel 3 docsis-mode atdma
 us-channel 3 equalization-coefficient
 us-channel 3 frequency 10800000
 us-channel 3 minislot-size 4
 us-channel 3 modulation-profile 221
 no us-channel 3 shutdown
 us-channel 4 channel-width 1600000 1600000
 us-channel 4 docsis-mode atdma
 us-channel 4 frequency 12400000
 us-channel 4 minislot-size 4
 us-channel 4 modulation-profile 221
 no us-channel 4 shutdown
 us-channel 5 channel-width 1600000 1600000
 us-channel 5 docsis-mode atdma
 us-channel 5 frequency 14000000
 us-channel 5 minislot-size 4
 us-channel 5 modulation-profile 221
```

Configure RPD for US Controller Profile

To configure RPD for associating an upstream controller-profile, using the **rpd-ds** <*port-id*> **Upstream-Cable** <*slot/sub-slot/controller*> *[profile <id>]* command, as given in the following example:

```
Router(config)#cable rpd 1
 type shelf
 rpd-ds 0 max-carrier 150
 rpd-ds 0 base-power 28
 identifier 0004.9f00.0743
 core-interface Te8/1/0
  principal
  rpd-us 0 upstream-cable 8/0/0 profile 0
  rpd-us 1 upstream-cable 8/0/1 profile 4
 r-dti 11
 rpd-event profile 0
---
end
```

The Remote PHY Controller Profile now provides a new summary that displays the Per RPD us port description. The summary helps distinguish between the different controllers that share the same description of us-channels.

For example, the **show cable modem rpd all summary** command displays the following information:

```
Router#show cable modem rpd all summary

Load for five secs: 5%/0%; one minute: 5%; five minutes: 5%
No time source, *15:36:49.777 UTC Thu Mar 8 2018

RPD ID: badb.ad13.417c
Interface                    Cable Modem                                  Description
          Total Reg Oper  Unreg Offline Wideband initRC initD initIO initO
C9/0/4/U0  1     0   0     1     0       0        1      0     0      0  badb.ad13.417c us
 0
C9/0/4/U1  2     0   0     2     0       0        2      0     0      0  badb.ad13.417c us
 0
C9/0/4/U3  1     0   0     1     0       0        1      0     0      0  badb.ad13.417c us
 0
C9/0/5/U0  2     0   0     2     0       0        2      0     0      0  badb.ad13.417c us
 1
C9/0/5/U1  1     0   0     1     0       0        1      0     0      0  badb.ad13.417c us
 1

RPD ID: badb.ad13.41fa
Interface                    Cable Modem                                   Description
          Total Reg   Oper  Unreg Offline Wideband initRC initD initIO initO
C9/0/2/U0  2     0     0     2     0       1        1      0     0      1  badb.ad13.41fa
us 0
C9/0/2/U1  1     0     0     1     0       0        1      0     0      0  badb.ad13.41fa
us 0
C9/0/2/U3  1     0     0     1     0       0        1      0     0      0  badb.ad13.41fa
us 0
C9/0/3/U1  1     0     0     1     0       0        1      0     0      0  badb.ad13.41fa
us 1
C9/0/3/U2  2     0     0     2     0       0        2      0     0      0  badb.ad13.41fa
us 1
C9/0/3/U3  1     0     0     1     0       0        1      0     0      0  badb.ad13.41fa
us 1
```

Note The length of configurable limitation is 20 characters while there are 80 characters reserved.

Configure Downstream Controller Profile

To configure downstream controller profile, use the following commands:

```
configure terminal
cable downstream controller-profile <profile ID>
multicast-pool <id>
rf-chan 20 47
type video <SYNC | ASYNC>
frequency 231000000
max-carrier 150
rf-output NORMAL
qam-profile <profile ID>
```

The *multicast-pool <id>* defines the DEPI multicast group. The type video *<SYNC | ASYNC>* defines synchronous or asynchronous mode.

Verify Downstream Controller Profile Configuration

To verify the Downstream controller profile configuration, use the show cable downstream controller-profile command as shown in the following example:

```
Router#show running-config | section downstream controller-profile
cable downstream controller-profile 0
 rf-chan 0 3
  type DOCSIS
  frequency 111000000
  max-carrier 150
  rf-output NORMAL
  qam-profile 1
  docsis-channel-id 1
```

Configure RPD for DS Controller Profile

To configure RPD for associating a downstream controller-profile, use the following commands:

```
configure terminal
cable rpd RPD01
type shelf
rpd-ds 0 max-carrier 150
rpd-ds 0 base-power 28
identifier 0004.9f31.0435
core-interface Te3/1/0
principal
rpd-ds 0 downstream-cable 3/0/0 profile 1
rpd-ds 0 downstream-cable 3/0/1 profile 2
rpd-us 0 upstream-cable 3/0/0 profile 1
core-interface te6/1/0
rpd-ds 0 downstream-cable 6/0/0 profile 2
r-dti 1
rpd-event profile 0
```

The **rpd-ds** *0* **downstream-cable** *3/0/0 profile 1* associates *controller 3/0/0* with *profile 1*, which is a DOCSIS profile.

The **rpd-ds** *0* **downstream-cable** *3/0/1 profile 2* associates *controller 3/0/1* with *profile 2*, which is a video profile.

The *core-interface te6/1/0* defines an auxiliary interface for this RPD. This auxiliary interface is used to configure downstream sharing across line cards.

Verify RPD Association with Controller Profile

To verify the downstream controller profile association with RPD, use the **show running-config | section cable rpd <ID>** command as shown in the following example:

```
Router#show running-config | section cable rpd RPD01
cable rpd toi-test1
 type shelf
 rpd-ds 0 max-carrier 150
 rpd-ds 0 base-power 28
 identifier 0000.1cbf.0000
 core-interface Te2/1/0
  principal
  rpd-ds 0 downstream-cable 2/0/9 profile 0
 rpd-event profile 0
```

Configure Downstream Sharing

This configuration is optional. DS sharing is used for multicast (MC) traffic. To configure downstream sharing, use the following commands:

```
configure terminal
cable rpd RPD01
core-interface Te3/1/0
principal
rpd-ds 0 downstream-cable 3/0/1 profile 2
cable rpd RPD02
core-interface te3/1/0
principal
rpd-ds 0 downstream-cable 3/0/1 profile 2
```

Note All RDPs in the same multicast group should have the same controller and profile association.

Configure Controller in Fiber Node

To configure the controllers in fiber-node, use the **cable fiber-node** command, as given in the following example:

```
cable fiber-node 113
 downstream Downstream-Cable 8/0/0
 upstream Upstream-Cable 8/0/1
```

Verify CM RPD Association

To verify the RPD associated with the cable modem, use the **show cable modem rpd** command as shown in the following example:

```
Router# show cable modem rpd 0004.9f03.0249
Load for five secs: 4%/2%; one minute: 3%; five minutes: 4%
Time source is NTP, 10:48:11.763 CST Tue Feb 28 2017

                                                                          D
MAC Address    IP Address      I/F           MAC              Prim  RxPwr  Timing Num I
                                             State            Sid   (dBmv) Offset CPE  P
0023.be5a.bb6c 10.10.10.12     C6/0/0/UB     w-online         5     0.00   862    0    N
```

```
1859.3356.8876 10.10.10.13     C6/0/0/UB     w-online          6     0.50   907    0   N
```

Display GCP Ralated Information

To display Generic Control Plane (GCP) related information of the RPD, use the command as shown in the following example:

```
Router#show cable rpd 0004.9f03.0280 Te3/1/0 gcp-state

MAC Address     IP Address       I/F       State        Role HA  Auth Name
0004.9f03.0280  10.10.10.11      Te3/1/0   ready        Pri  Act N/A  2

A06#show cable rpd 0004.9f03.0280 Te3/1/0 gcp-state
MAC Address     IP Address       I/F       State        Role HA  Auth Name
0004.9f03.0280  10.10.10.11      Te3/1/0   ready        Pri  Act N/A  2

Router#show cable rpd name node te1/1/0 gcp-session

GCP Session ID : 10
Core Address   : 10.100.10.11:8190
RPD Address    : 10.10.10.11:60656
Next Hop MAC   : 0004.9F00.0901
Session State  : Active

Packet Statistics:
========================
Rx         : 5038
Tx         : 5034
Rx Dropped : 0
Tx Dropped : 0

Message Statistics:
========================
Rx         : 5948
Tx         : 5954
Rx Dropped : 7
Tx Dropped : 0
Rx Illegal : 0
Tx Illegal : 0

Router#show cable rpd 120.102.6.7 te9/1/1 gcp-transaction
 Load for five secs: 3%/1%; one minute: 4%; five minutes: 4%
No time source, *10:22:57.158 CST Thu Mar 16 2017

RPD ID           I/F        TRANS ID   GCP MSG TYPE             RCP MSG TYPE   TIMESTAMP
---------------- ---------- ---------- ------------------------ --------------
-------------------------
0004.9f31.1007   Te9/1/1    7452       GCP_MSG_ID_EDS_RSP       TYPE_REX       2017-03-16
10:22:54.440
0004.9f31.1007   Te9/1/1    7452       GCP_MSG_ID_EDS           TYPE_REX       2017-03-16
10:22:54.415
0004.9f31.1007   Te9/1/1    7451       GCP_MSG_ID_EDS_RSP       TYPE_REX       2017-03-16
10:22:54.240
0004.9f31.1007   Te9/1/1    7451       GCP_MSG_ID_EDS           TYPE_REX       2017-03-16
10:22:54.215
0004.9f31.1007   Te9/1/1    7450       GCP_MSG_ID_EDS_RSP       TYPE_REX       2017-03-16
10:22:54.040
0004.9f31.1007   Te9/1/1    7450       GCP_MSG_ID_EDS           TYPE_REX       2017-03-16
10:22:54.015
0004.9f31.1007   Te9/1/1    7449       GCP_MSG_ID_EDS_RSP       TYPE_REX       2017-03-16
10:22:53.836
0004.9f31.1007   Te9/1/1    7449       GCP_MSG_ID_EDS           TYPE_REX       2017-03-16
```

```
10:22:53.815
0004.9f31.1007   Te9/1/1    7448       GCP_MSG_ID_EDS_RSP       TYPE_REX       2017-03-16
10:22:50.236
0004.9f31.1007   Te9/1/1    7448       GCP_MSG_ID_EDS           TYPE_REX       2017-03-16
10:22:50.215
0004.9f31.1007   Te9/1/1    7447       GCP_MSG_ID_EDS_RSP       TYPE_REX       2017-03-16
10:22:50.038
0004.9f31.1007   Te9/1/1    7447       GCP_MSG_ID_EDS           TYPE_REX       2017-03-16
10:22:50.015
0004.9f31.1007   Te9/1/1    7446       GCP_MSG_ID_EDS_RSP       TYPE_REX       2017-03-16
10:22:49.839
0004.9f31.1007   Te9/1/1    7446       GCP_MSG_ID_EDS           TYPE_REX       2017-03-16
10:22:49.815
```

Display DEPI Ralated Information

To display the Downstream External PHY Interface (DEPI) related information, use the command as shown in the following example:

```
Router#show cable rpd depi

DEPI Tunnel and Session Information Total tunnels 1 sessions 26
LocTunID   RemTunID   Remote Device  State  Remote Address  Sessn L2TP Class
                                                           Count
338514820  671581873  0004.9f00.0901 est    10.10.10.11     26    rphy-l2tp-gl...

LocID      RemID      Pseudowire      State  Last Chg Uniq ID    Type Mode RemSt
0x41040008 0x00000B02 US1/0/0:2(R)    est    00:34:57 21          P    PSP  UP
0x41010000 0x00000600 US1/0/0:0(D)    est    00:34:57 11          P    PSP  UP
0x00002006 0x00000405 DS1/0/0:5       est    00:34:57 6           P    PSP  UP
0x00002004 0x00000403 DS1/0/0:3       est    00:34:57 4           P    PSP  UP
0x4100000C 0x00000D03 US1/0/0:3(M)    est    00:34:57 23          P    PSP  UP
0x00002002 0x00000401 DS1/0/0:1       est    00:34:57 2           P    PSP  UP
0x00002007 0x00000406 DS1/0/0:6       est    00:34:57 7           P    PSP  UP
0x00002008 0x00000407 DS1/0/0:7       est    00:34:57 8           P    PSP  UP
0x4101000C 0x00000603 US1/0/0:3(D)    est    00:34:57 24          P    PSP  UP
0x41000004 0x00000D01 US1/0/0:1(M)    est    00:34:57 15          P    PSP  UP
0x00002001 0x00000400 DS1/0/0:0       est    00:34:57 1           P    PSP  UP
0x41080008 0x00000F02 US1/0/0:2(S)    est    00:34:57 22          P    PSP  UP
0x41010004 0x00000601 US1/0/0:1(D)    est    00:34:57 16          P    PSP  UP
0x41020000 0x00000800 US1/0/0:0(B)    est    00:34:57 12          P    PSP  UP
0x00002009 0x00000408 DS1/0/0:8       est    00:34:57 9           P    PSP  UP
0x41010008 0x00000602 US1/0/0:2(D)    est    00:34:57 20          P    PSP  UP
0x41000008 0x00000D02 US1/0/0:2(M)    est    00:34:57 19          P    PSP  UP
0x4108000C 0x00000F03 US1/0/0:3(S)    est    00:34:57 26          P    PSP  UP
0x00002003 0x00000402 DS1/0/0:2       est    00:34:57 3           P    PSP  UP
0x41080000 0x00000F00 US1/0/0:0(S)    est    00:34:57 14          P    PSP  UP
0x41040004 0x00000B01 US1/0/0:1(R)    est    00:34:57 17          P    PSP  UP
0x41080004 0x00000F01 US1/0/0:1(S)    est    00:34:57 18          P    PSP  UP
0x41000000 0x00000D00 US1/0/0:0(M)    est    00:34:56 10          P    PSP  UP
0x00002005 0x00000404 DS1/0/0:4       est    00:34:56 5           P    PSP  UP
0x4104000C 0x00000B03 US1/0/0:3(R)    est    00:34:56 25          P    PSP  UP
0x41040000 0x00000B00 US1/0/0:0(R)    est    00:34:56 13          P    PSP  UP

outer#show cable rpd 0004.9f03.0214 te7/1/0 depi tunnel

Load for five secs: 7%/2%; one minute: 6%; five minutes: 6%
No time source, *12:41:44.228 CST Mon Mar 20 2017

LocTunID   RemTunID   Remote Device  State  Remote Address  Sessn L2TP Class
                                                           Count
```

```
3388764998 1054297851 0004.9f03.0214 est    10.10.10.11     29    rphy-l2tp-gl...
```

Table 18: show cable rpd depi Field Descriptions

Field	Description
LocID	Local session ID.
RemID	Remote session ID.
US1/0/0:2(R)	US means UEPI session, DS means DEPI session. This string means UEPI session on line card slot 1, controller 0, rf-channel 2.
est in State	Established state.
P in Type	On primary line card.

Troubleshooting Tips

Refer to the following troubleshooting tips if configuration errors occur.

If you configure DS controller profile and cable RPD, you can check the controller status, regardless of the status of the RPD. If the channel's state is DOWN, use verbose option to view the reason.

```
Router#show controllers downstream-Cable 6/0/1 rf-channel 20 <verbose>
Chan State Admin Frequency Type       Annex Mod  srate Interleaver dcid output
20    UP    UP   231000000 VIDEO-SYNC B     256   5361  I128-J1     -   NORMAL
```

Configuration Examples

This section provides example configurations for the R-PHY Controller Profile.

Example: Controller Profile Configuration

Upstream Controller Profile Configuration

```
configure terminal
cable upstream controller-profile 2
  cable def-phy-burst 0
  us-channel 0 chan-class-id 0
  us-channel 0 channel-width 1600000 1600000
  us-channel 0 docsis-mode atdma
  us-channel 0 equalization-coefficient
  us-channel 0 frequency 50000000
  us-channel 0 hop-priority frequency modulation channel-width
  us-channel 0 ingress-noise-cancellation 100
  us-channel 0 maintain-psd
  us-channel 0 max-logical-chans 1
  us-channel 0 minislot-size 4
  us-channel 0 modulation-profile 221
  us-channel 0 power-level 0
  us-channel 0 rng-holdoff 0
  no us-channel 0 shutdown
  us-channel 0 specsvl error-adaptive-profile 1
```

```
us-channel 0 threshold cnr-profiles 25 13
us-channel 0 threshold corr-fec 3
us-channel 0 threshold hysteresis 3
us-channel 0 threshold snr-profiles 25 13
us-channel 0 threshold uncorr-fec 1
...
end
```

Downstream Controller Profile Configuration

```
configure terminal
cable downstream controller-profile 1
multicast-pool 20
Rf-channel 0 15
Type docsis
Frequency 111000000
Rf-output NORMAL
Qam-profile 1
Docsis-channel-id 1
cable downstream controller-profile 2
multicast-pool 20
Rf-channel 20 47
Type video sync
Frequency 231000000
Rf-output NORMAL
Qam-profile 14
```

Example: Downstream Sharing Configuration

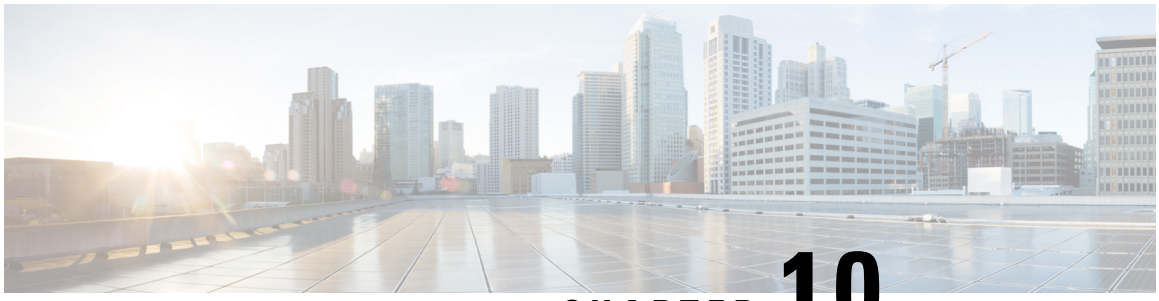
```
cable rpd RPD01
identifier 0004.9f31.0979
core-interface te6/1/0
principal
rpd-ds 0 downstream-cable 6/0/0 profile 1
rpd-ds 0 downstream-cable 6/0/1 profile 2
rpd-us 0 upstream-cable 6/0/0 profile 1
r-dti 6
rpd-event profile 0
cable rpd RPD2
identifier 0004.9f31.1437
core-interface Te3/1/0
principal
rpd-ds 0 downstream-cable 3/0/0 profile 1
rpd-us 0 upstream-cable 3/0/0 profile 1
core-interface Te6/1/0
rpd-ds 0 downstream-cable 6/0/1 profile 2
r-dti 3
rpd-event profile 0
```

Feature Information for Controller Profile and RPD Configuration

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 19: Feature Information for Controller Profile and RPD Configuration

Feature Name	Releases	Feature Information
Large Scale Controller Support (32DS/64US) with node	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .
512 RPD Support per Chassis	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .
Controller profile configuration	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .
US 128 channels	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .



CHAPTER 10

Dynamic Bonding Group for RPHY

The Dynamic Bonding Group (DBG) feature enables the system to automatically create bonding groups of different sizes based on the cable modems' capacity. It helps to manage the resources of all downstream bonding groups. When the number of available bonding groups reaches the lower limit, it reclaims the bonding groups that match the reclaim threshold set by the user. The modems used on these bonding groups are then moved to other bonding groups without primary channel change. This move makes space for new bonding group allocations. This automated way of creating and reclaiming bonding groups greatly reduces the management effort of RCC configuration. DBG also automatically accommodates primary channel and CM capacity distributions.

The load balancing feature leverages DBG to balance traffic among all channels. With DBG, the modem is assigned to the downstream bonding group without any static RCC configuration.

DBG supports the following:

- DOCSIS 3.0 channel types.
- DOCSIS 3.0 load balance.
- Interoperation with modem registration, load balancing, and high availability.
- Enhanced dynamic load balance to allow movement of modem without a change in the primary channel.
- Enhanced FPGA to allow channel utilization fairness.

This chapter describes how to configure the DBG feature on the Cisco Remote PHY Device.

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 70
- Configure Dynamic Bonding Group, on page 70
- Configure Load Balancing with Dynamic Bonding Group Enabled, on page 73
- Feature Information for Dynamic Bonding Group, on page 77

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 20: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Configure Dynamic Bonding Group

Before configuring DBG, it is assumed that interface Mac domain and fiber node are already configured on the Cisco cbr-8 router. The recommended primary channel distribution is one primary channel for contiguous four channels, such as 0, 4, 8, 12, 16, 20, 24, 28 and so on. For more information, see DOCSIS Interface and Fiber Node Configuration in the Cisco cBR Converged Broadband Routers DOCSIS Software Configuration Guide.

Note To know more about the commands referenced in this module, see the Cisco IOS Master Command List.

Enable Dynamic Bonding Group

DBG is disabled by default. Use **cable dynamic-bonding-group** command to enable DBG as shown in the following example:

```
ROUTER# configure terminal
ROUTER(config)# cable dynamic-bonding-group
ROUTER(config)# end
```

To configure the bonding group reclaim threshold, use **cable dynamic-bonding-group reclaim-threshold** command as shown in the following example:

```
ROUTER# configure terminal
ROUTER(config)# cable dynamic-bonding-group reclaim-threshold percent 5% modems 6
ROUTER(config)# end
```

5% is the default bonding group throughput percentage threshold, and 6 is the default cable modem count threshold. If the throughput of a bonding group is lower than 5% of all bonding groups' throughput, and this bonding group has less than 6 cable modems assigned to it, then this bonding group is reclaimed when the available bonding groups reach the lower limit (20%).

By default, cable modem registration and load balance trigger DBG creation when needed. If you want to disable the interoperation with cable modem registration and load balance, use the commands in the following example:

```
ROUTER# configure terminal
ROUTER(config)# no cable dynamic-bonding-group registration

ROUTER# configure terminal
ROUTER(config)# no cable dynamic-bonding-group load-balance
```

When DBG is enabled, we recommend you to complete the following configurations.

Enable DS-Resiliency and Configure Resiliency Bonding Group

To make sure that the modem is still in w-online state with maximum downstream capability when several RF channels are impaired, enable the ds-resiliency feature by running the following commands:

```
Router# configure terminal
Router(config)# cable resiliency ds-bonding
Router(config)# end


Router# configure terminal
Router(config)# interface wideband-Cable 3/0/1:30
Router(config-if)# cable ds-resiliency
Wideband-Cable3/0/1:30 is set to WB resiliency bonding group.
Remove any existing bundle and rf-channel configuration.
Router(config-if)# end
```

Enable ACFE

Enable ACFE feature to make sure that modem registration is not blocked because of QoS failures:

```
Router# configure terminal
Router(config)# cable acfe enable
Router(config)# end
```

Verify Dynamic Bonding Group Configuration

This section describes how to use certain **show** commands to verify if the dynamic bonding groups are created.

Check the modem's primary wideband interface using the **show cable modem wideband channel** command as shown in this example:

```
Router# show cable modem 4800.33ee.ebee wideband channel
MAC Address          IP Address          I/F          MAC         DSxUS      Primary
                                                      State                  WB
4800.33ee.ebee       30.132.15.246       C3/0/1/UB    w-online    32x2       Wi3/0/1:3
```

Check the modem's downstream tuner capability using the **show cable modem verbose | in DS Tuner** command as shown in the following example:

```
Router# show cable modem 4800.33ee.ebee verbose | in DS Tuner
DS Tuner Capability : 32
```

Check the related RCC using the **show cable mac-domain rcc** command as shown in the following example:

```
Router# show cable mac-domain c3/0/1 rcc
RCC-ID   RCP             RCs  MD-DS-SG  CMs  WB/RCC-TMPL       D3.0    D3.1
32       00 00 00 00 00  8    0         11   WB (Wi3/0/1:1)    Y       Y
33       00 00 00 00 00  32   0         6    WB (Wi3/0/1:3)    Y       Y
34       00 00 00 00 00  8    0         7    WB (Wi3/0/1:2)    Y       Y
35       00 00 00 00 00  8    0         7    WB (Wi3/0/1:4)    Y       Y
36       00 00 00 00 00  8    0         7    WB (Wi3/0/1:5)    Y       Y
```

Check the dynamically created bonding groups using the **show cable dynamic-bonding-group summary** command as shown in the following example:

```
Router# show cable dynamic-bonding-group summary
Dynamic bonding group: Enable
BG ID BG Name   BG Size CMs ServFlows Create Time         Create Client       BG State
RFid list
24834 Wi3/0/1:1 8       11  11        Sep 14 14:36:35.194 MODEM_ONLINE        OPERATIONAL
24832-24839
24836 Wi3/0/1:3 32      6    6        Sep 14 14:43:24.144 MODEM_ONLINE        OPERATIONAL
24832-24863
24835 Wi3/0/1:2 8       7    7        Sep 14 17:20:37.115 MODEM_ONLINE        OPERATIONAL
24840-24847
24837 Wi3/0/1:4 8       7    7        Sep 14 17:21:37.723 STATIC_LOAD_BALANCE OPERATIONAL
24856-24863
24838 Wi3/0/1:5 8       7    7        Sep 14 17:21:39.761 STATIC_LOAD_BALANCE OPERATIONAL
24848-24855
```

Table 21: Dynamic Bonding Group States

DBG State	Description
CREATE_WAITING_SUP	Line card sends a request to create DBG and waits for SUP to create the bonding group.
HOLD	DBG is created from SUP, or bonding group reverts from reclaim to ready-for-use state.
OPERATIONAL	If a modem is used on the bonding group after the HOLD state times out, the DBG state changes to OPERATIONAL.
RECLAIM_HOLD	Ready for reclaim. If no modem is used on the bonding group or match the reclaim in two minutes, the bonding group is reclaimed. The DBG state changes to RECLAIM_HOLD.
RECLAIM_MODEM_MOVING	Ready for reclaim. The modem is moved out of the bonding group.
RECLAIM_WAITING_SUP	Line card sends a DBG reclaim request and waits for SUP to reclaim the BG.

To display the detailed channel list information of dynamic bonding group, use the **show derived-config interface wideband** command as shown in the following example:

```
Router# show derived-config interface wideband-Cable 3/0/1:1
Building configuration...
Derived configuration: 113 bytes
!
interface Wideband-Cable3/0/1:1
  cable bundle 255
  cable rf-channels channel-list 0-7 bandwidth-percent 1
end
```

Check the usage of bonding group resource using the **show cable dynamic-bonding-group quota** command.

```
Router# show cable dynamic-bonding-group quota controller 3/0/1
slot/subslot/ctrlr: 3/0/1
Total BG number: 128
Used BG number (static/dynamic): 6(1/5) Available BG number: 122
Available BG list port: 0, 6-29, 31-127
```

Check the reclaimed bonding group using the **show cable dynamic-bonding-group reclaim-history summary** command:

```
Router# show cable dynamic-bonding-group reclaim-history summary
BG ID BG Name   BG Size Create Time     Create Client Reclaim Time    Reclaim Client RFid
list
24835 Wi3/0/1:2 16      Sep 14 14:40:27 MODEM_ONLINE  Sep 14 14:44:27 DBG_INTERNAL
24832-2484
```

Configure Load Balancing with Dynamic Bonding Group Enabled

If you want to use load balancing with the DBG enabled, we recommend that you configure the load balancing as shown here.

Enable Load Balancing for DOCSIS 3.0

To enable DOCSIS load balancing, run the following commands:

```
Router# config terminal
Router(config)# cable load-balance docsis-enable
Router(config)# end
```

When DOCSIS load balancing is enabled, run the following commands to enable load balancing for DOCSIS 3.0.

```
Router# config terminal
Router(config)# cable load-balance docsis30-enable
Router(config)# end
```

Enable DOCSIS 3.0 Static Load Balance

To balance the load of primary channels, enable static load balance using the following commands:

```
Router# configure terminal
```

```
Router(config)# cable load-balance docsis30-enable static
Router(config)# end
```

Enable DOCSIS 3.0 General Load Balance Group

To enable general load balance group, use cable load-balance docsis-group command as shown here:

```
Router# configure terminal
Router(config)# cable load-balance docsis-group fn 1 md c3/0/1
Router(config-lb-group)# no disable
Router(config-lb-group)# end
```

Enable Dynamic Load Balance and Fixed-Primary Channel Movement

To balance the load of all downstream channels based on utilization, enable dynamic load balance by running the following commands:

```
Router# configure terminal
Router(config)# cable load-balance docsis30-enable dynamic downstream
Router(config)# end
```

Fixed primary channel movement is disabled by default. With dynamic load balancing enabled, we recommend that you enable fixed primary channel movement to reduce service outage by running the following commands:

```
Router# configure terminal
Router(config)# cable load-balance fixed-primary-channel
Router(config)# end
```

Verify Static Load Balancing Configuration

This section describes how to use **show** commands to verify the configuration of the static load balancing.

Check the load of all primary channels using the **show cable load-balance docsis-group load** command as shown here:

```
Router# show cable load-balance docsis-group fn 1 md c3/0/1 load | in In
Interface           State   Group      Utilization Rsvd NBCM WB/UB Weight
In3/0/1:0(573 MHz)  initial 2147557888 0%(0%/0%)   0%   0    17    37
In3/0/1:4(597 MHz)  initial 2147557888 0%(0%/0%)   0%   0    17    37
In3/0/1:8(621 MHz)  initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:12(645 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:16(669 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:20(693 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:24(717 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
In3/0/1:28(741 MHz) initial 2147557888 0%(0%/0%)   0%   0    13    37
```

This command output lists all primary channels and shows the number of cable modems used with these channels. NBCM is the number of narrowband modems used with a channel while WBCM (WB/UB) is the number of wideband modems used with a channel. The total number of WBCMs must be balanced among all channels.

The difference between the total number of WBCMs used with any two channels is smaller or equal to the minimum threshold load. The default value of the minimum threshold load is 5.

Check the load of all RF channels using the **show cable load-balance docsis-group rfch-util** command as shown in this example:

```
Router# show cable load-balance docsis-group fn 1 md c3/0/1 rfch-util
Interface  Pstate Pending-In Pending-Out Throughput(Kbps) Util NBCM WBCM
In3/0/1:0  up     No         No          0                0%   0    17
In3/0/1:1  NA     No         No          0                0%   0    17
In3/0/1:2  NA     No         No          0                0%   0    17
In3/0/1:3  NA     No         No          0                0%   0    17
In3/0/1:4  up     No         No          0                0%   0    17
In3/0/1:5  NA     No         No          0                0%   0    17
In3/0/1:6  NA     No         No          0                0%   0    17
In3/0/1:7  NA     No         No          0                0%   0    17
In3/0/1:8  up     No         No          0                0%   0    13
In3/0/1:9  NA     No         No          0                0%   0    13
In3/0/1:10 NA     No         No          0                0%   0    13
In3/0/1:11 NA     No         No          0                0%   0    13
In3/0/1:12 up     No         No          0                0%   0    13
In3/0/1:13 NA     No         No          0                0%   0    13
In3/0/1:14 NA     No         No          0                0%   0    13
In3/0/1:15 NA     No         No          0                0%   0    13
……
Average: 0.0
Variance: 0.0
```

This command lists the load information of the primary and secondary channels. WBCM is the number of wideband modems used with a channel.

Check the cable modem's internal state in load balancing using the **show cable load-balance docsis-group modem-list wideband** command as shown in this example:

```
Router# show cable load-balance docsis-group fn 1 md c3/0/1 modem-list wideband
Codes: M - Multicast, U - UGS, P - PCMM, F - Max-Failures, X - eXcluded
       L - L2vpn, R - RSVP, S - DS-Resiliency
Primary WB    MAC Address     Primary DS  RCC-ID Priority MUPFXLRS State
Wi3/0/1:0     (3)
              c8fb.2631.0e56  In3/0/1:20  41     0        ------   LB_CM_HOLD_EXPIRE_IN 36
              c8fb.26a6.c3dc  In3/0/1:16  41     0        ------   LB_CM_HOLD_EXPIRE_IN 37
              c8fb.2631.0d7e  In3/0/1:16  41     0        ------   LB_CM_HOLD_EXPIRE_IN 43
Wi3/0/1:1     (9)
              c8fb.2631.0c80  In3/0/1:0   32     0        ------   LB_CM_STATIC_MOVING
              c8fb.2631.0cae  In3/0/1:0   32     0        ------   LB_CM_STATIC_READY
              c8fb.2631.0db0  In3/0/1:24  42     0        ------   LB_CM_STATIC_MOVING
              c8fb.2631.0c10  In3/0/1:28  42     0        ------   LB_CM_STATIC_MOVING
              c8fb.2631.0d80  In3/0/1:16  41     0        ------   LB_CM_STATIC_MOVING
              c8fb.2631.0d26  In3/0/1:24  41     0        ------   LB_CM_STATIC_MOVING
              a4a2.4a2d.b4aa  In3/0/1:20  41     0        ------   LB_CM_STATIC_MOVING
              c8fb.2631.0e5c  In3/0/1:0   32     0        ------   LB_CM_STATIC_MOVING
              c8fb.2631.0cb0  In3/0/1:0   32     0        ------   LB_CM_STATIC_MOVING
Wi3/0/1:2     (3)
              c8fb.2631.0d2a  In3/0/1:12  34     0        ------   LB_CM_HOLD_EXPIRE_IN 27
              c8fb.2631.0e5a  In3/0/1:12  34     0        ------   LB_CM_STATIC_MOVING
              c8fb.2631.0bfe  In3/0/1:8   34     0        ------   LB_CM_STATIC_MOVING
Wi3/0/1:3     (2)
              4800.33ea.54be  In3/0/1:28  33     0        ------   LB_CM_DYNAMIC_READY
              4800.33ee.ebe6  In3/0/1:20  33     0        ------   LB_CM_HOLD_EXPIRE_IN 1
Wi3/0/1:4     (2)
              c8fb.2631.0e44  In3/0/1:24  42     0        ------   LB_CM_HOLD_EXPIRE_IN 40
              c8fb.2631.0a44  In3/0/1:28  42     0        ------   LB_CM_HOLD_EXPIRE_IN 42
```

Table 22: Cable Modem States

CM State	Description
LB_CM_STATIC_READY	Modem is ready for static load balance movement.
LB_CM_STATIC_MOVING	Modem is in movement triggered by static load balance.
LB_CM_HOLD_EXPIRE_IN	Modem is in hold for the next movement. The default hold time, in seconds, is 600.
LB_CM_DYANMIC_READY	Modem is ready for dynamic load balance movement.
LB_CM_DYANMIC_MOVING	Modem is in movement triggered by dynamic load balance.
LB_CM_DISABLED	Modem is not ready for movement. If the modem failure movement count reaches maximum failure threshold, then set the modem in LB_CM_DISABLED to avoid further movement.

Verify Dynamic Load Balancing Configuration

This section describes how to use the **show** commands to verify the configuration of the dynamic load balancing.

Check the utilization of all RF channels using **show cable load-balance docsis-group rfch-util** command as shown in this example:

```
Router# show cable load-balance docsis-group fn 320 md c3/0/0 rfch-util
Interface  Pstate Pending-In Pending-Out Throughput(Kbps) Util NBCM WBCM
Do3/0/0:0  up     No         No          11754            31%  0    308
Do3/0/0:1  up     No         No          11754            31%  0    296
Do3/0/0:2  up     No         No          11754            31%  0    333
Do3/0/0:3  up     No         No          11754            31%  0    296
Do3/0/0:4  up     No         No          11754            31%  0    297
Do3/0/0:5  up     No         No          11754            31%  0    331
Do3/0/0:6  up     No         No          11754            31%  0    299
Do3/0/0:7  up     No         No          11753            31%  0    268
Do3/0/0:8  up     No         No          11754            31%  0    302
Do3/0/0:9  up     No         No          11754            31%  0    331
Do3/0/0:10 up     No         No          11753            31%  0    308
Do3/0/0:11 up     No         No          11754            31%  0    305
Do3/0/0:12 NA     No         No          12862            34%  0    258
Do3/0/0:13 NA     No         No          12862            34%  0    258
Do3/0/0:14 NA     No         No          12862            34%  0    258
……
Average: 30.416
Variance: 1.701
```

The traffic among all RF channels is considered balanced when the difference between any two RF channel utilization is under the threshold load. The default percentage of threshold load is 10%.

To check the potential target bonding group for each of the source bonding group, use the **show cable load-balance docsis-group target dbg** and the **show cable load-balance docsis-group target wide** commands as shown in this example:

```
Router# show cable load-balance docsis-group fn 320 md c3/0/0 target dbg
Interface      Bg-Id       Size     Group           Target
Wi3/0/0:0      24577       4        2147557695
Wi3/0/0:3      24580       4        2147557695
Wi3/0/0:4      24581       8        2147557695
Wi3/0/0:5      24582       8        2147557695
Wi3/0/0:6      24583       24       2147557695      33% [24576, 24584-24587, 24589-24607]
Wi3/0/0:7      24584       16       2147557695      30% [24576, 24586-24587, 24595-24607]
Wi3/0/0:8      24585       16       2147557695
Wi3/0/0:9      24586       32       2147557695
Wi3/0/0:10     24587       24       2147557695      33% [24576, 24584-24587, 24589-24607]
Wi3/0/0:11     24588       8        2147557695
Wi3/0/0:12     24589       8        2147557695      27% [24596-24603]
Wi3/0/0:13     24590       8        2147557695
Wi3/0/0:14     24591       4        2147557695

Router# show cable load-balance docsis-group fn 5 md c1/0/4 target wide
Interface      Bg-Id       State    Group           Target
Wi1/0/4:2      9219        up       2147510276      Wi1/0/4:4
Wi1/0/4:3      9220        up       2147510276
Wi1/0/4:4      9221        up       2147510276
```

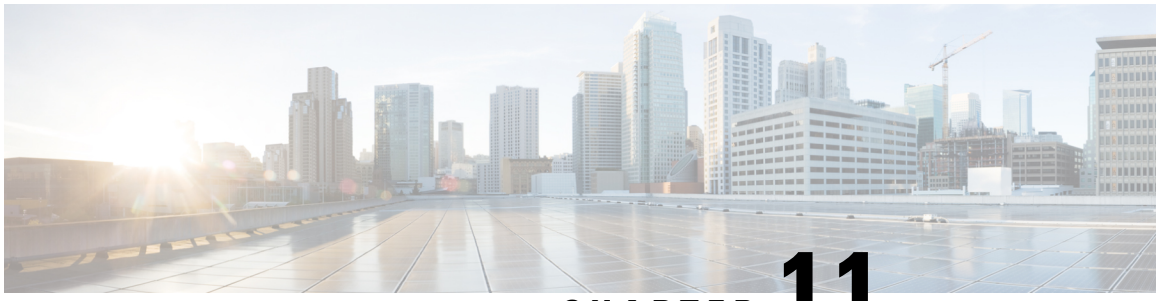
If there is no target bonding group in the output, it means that no bonding groups are created to balance traffic among RF channels.

Feature Information for Dynamic Bonding Group

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 23: Feature Information for Dynamic Bonding Group

Feature Name	Releases	Feature Information
Dynamic Bonding Group	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .



CHAPTER 11

RPD IPv6

Finding Feature Information

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 79
- Information about RPD IPv6, on page 80
- Configure RPD IPv6 Unicast Online, on page 80
- Feature Information for RPD IPv6, on page 83

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 24: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information about RPD IPv6

The CableLabs' MHAv2 standards requires CCAP Core and RPD must support both IPv4 and IPv6, which means the Remote PHY Signaling between the CCAP Core and RPD is able to run on both IPv4 and IPv6 networks.

Note

- CCAP Core can support IPv4/IPv6 dual stack.
- RPD can support either IPv4 or IPv6 network.
- RPD does not support IPv4/IPv6 Dual Stack at the same time.
- RPD will try IPv6 connection first. When DHCPv6 failed, RPD will try DHCPv4.
- For single RPD, all the server addresses, protocols to communicate with it must be in the same IP version.

Configure RPD IPv6 Unicast Online

This section describes how to configure RPD IPv6 Unicast Online on Cisco cBR-8.

Configure Unicast IPv6

To configure Unicast IPv6, complete the following procedure:

1. Enable IPv6 unicast routing.

```
configure terminal
ipv6 unicast-routing
```

2. Configure IPv6 Address on DPIC interface.

```
configure terminal
interface TenGigabitEthernet slot/1/port
ipv6 enable
ipv6 address ipv6_address
```

Configure RPD core interface

To configure RPD core interface, complete the following procedure:

```
configure terminal
cable rpd name
identifier rpd_mac
core-interface tenG_interface
principal
rpd-ds id downstream-cable controller profile id
rpd-us id upstream-cable controller profile id
```

Configure IPv6 PTP Clock Option

To configure the IPv6 PTP Clock Option, complete the following procedure:

1. Configure CBR as PTP secondary, see the configuration example below:

```
configure terminal
    interface Loopback1588
        ip address 158.158.158.5 255.255.255.255
    ptp clock ordinary domain 0
        servo tracking-type R-DTI
        clock-port slave-from-903 slave
        delay-req interval -4
        sync interval -5
        sync one-step
        transport ipv4 unicast interface Lo15888 negotiation
        clock source 10.90.3.93
```

Note CCAP-Core as PTP secondary can only support IPv4.

2. Configure R-DTI for PTP IPv6.

```
configure terminal
ptp r-dti number
ptp-domain domain
clock-port number
ethernet number
transport ipv6
clock source ipv6 address gateway ipv6 geteway
```

Note

- PTP domain and 1588 primary have same domain number.
- Clock source IPv6 address is 1588 primary IPv6 address.
- Gateway is next hop to 1588 primary, and it is optional.
- For RPHY Shelf 7200, user can use ethernet 1 for all 6 eRPDs in a RPD linecard, or use ethernet 1 to 6 for these eRPDs.

3. Associate R-DTI with RPD configuration.

```
configure terminal
cable rpd id
r-dti number
```

Verify IPv6 PTP Clock Option Configuration

To display the CBR PTP Status, use the **show ptp clock running** command as shown in the example below:

```
Router# show ptp clock running
Load for five secs: 6%/2%; one minute: 7%; five minutes: 8%
No time source, *05:11:13.610 UTC Sun Oct 22 2017
```

```
PTP Ordinary Clock [Domain 0]
         State          Ports          Pkts sent      Pkts rcvd      Redundancy Mode
         PHASE_ALIGNED  1              2478203        7512533        Hot standby
                                PORT SUMMARY
                                                                                PTP Master
Name           Tx Mode      Role         Transport    State        Sessions     Port Addr

slave-from-903 unicast      slave        Lo15888      Slave        1            10.90.3.93
```

To display the RPD PTP Status, use the **show ptp clock** command as shown in the example below:

```
Router# show ptp clock 0 config
Domain/Mode         :   0/OC_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /1
--PTP Port  23, Enet Port   1 ----
  Port local Address :2001:120:102:70:7:1b71:476c:70ba
  Unicast   Duration :300 Sync Interval : -4
  Announce  Interval :  0 Timeout       : 11
  Delay-Req Intreval : -4 Pdelay-req    : -4
  Priority  local    :128 COS:  6   DSCP: 47
  ==Stream 0 : Port 23 Master IP: 2001:10:90:3::93

Router# show ptp clock 0 state
apr state       : PHASE_LOCK
clock state     : SUB_SYNC
current tod     : 1508640223   Sun Oct 22 02:43:43 2017
active stream   : 0
==stream    0   :
  port id       :                0
  master ip     : 2001:10:90:3::93
  stream state  :       PHASE_LOCK
  Master offset :             3490
  Path    delay :           -27209
  Forward delay :           -27333
  Reverse delay :           -27085
  Freq offset   :          6544364
  1Hz  offset   :               49

Router# show ptp clock 0 statistics
 AprState    4  :
           2@0-00:06:25.027          1@0-00:06:15.382          0@0-00:03:51.377
           4@0-00:03:32.176
 ClockState  5  :
           5@0-00:06:36.141          4@0-00:06:33.684          3@0-00:06:30.510
           2@0-00:06:25.512          1@0-00:06:24.982
 BstPktStrm  1  :
           0@0-00:06:15.987
 StepTime    1  :
   908222863@0-00:05:42.199
 AdjustTime  2589       :
        -339@1-20:18:42.949       -321@1-20:17:41.949         49@1-20:16:40.949
         145@1-20:15:39.949          6@1-20:14:38.949        261@1-20:13:37.949
         327@1-20:12:36.949         76@1-20:11:35.949        157@1-20:10:34.949
streamId  msgType           rx          rxProcessed     lost        tx
 0         SYNC             2549177     2549177         4292476931  0
 0         DELAY REQUEST    0           0               0           2549150
 0         P-DELAY REQUEST  0           0               0           0
 0         P-DELAY RESPONSE 0           0               0           0
 0         FOLLOW UP        0           0               0           0
 0         DELAY RESPONSE   2549144     2549144         4292476934  0
 0         P-DELAY FOLLOWUP 0           0               0           0
 0         ANNOUNCE         159330      159330          4294836225  0
```

```
0         SIGNALING          1662         1662             0            1663
0         MANAGEMENT         0            0                0            0
  TOTAL                      5259313      5259313          12879790090  2550813
```

Verify RPD IPv6 Configuration

To display the RPD IPv6 Status, use the **show cable rpd ipv6** command as shown in the example below:

```
Router# show cable rpd ipv6
Load for five secs: 7%/2%; one minute: 9%; five minutes: 8%
No time source, *14:03:13.622 UTC Sun Oct 22 2017
MAC Address     I/F       State        Role HA  Auth IP Address
0004.9f03.0226  Te0/1/6   online       Pri  Act N/A  2001:120:102:70:7:1B71:476C:70BA
0004.9f03.0232  Te0/1/7   online       Pri  Act N/A  ---
0004.9f03.0256  Te0/1/2   online       Pri  Act N/A  2001:120:102:70:3:830A:FAEA:CF7E
0004.9f03.0268  Te0/1/6   online       Pri  Act N/A  2001:120:102:70:7:41F1:7CCD:4475
0004.9f03.0268  Te6/1/6   online       Aux  Act N/A  2001:120:102:70:7:41F1:7CCD:4475
badb.ad13.5d7e  Te0/1/2   online       Pri  Act N/A  2001:120:102:70:3:FF46:1FF9:29FE
```

Feature Information for RPD IPv6

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

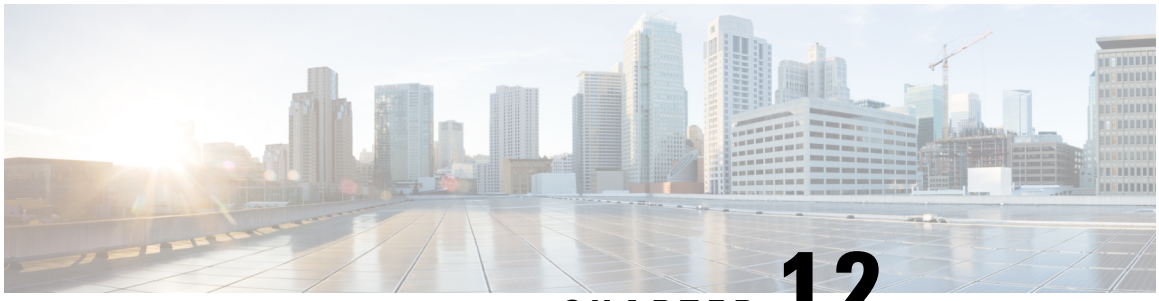
Table 25: Feature Information for RPD IPv6

Feature Name	Releases	Feature Information
RPD IPv6	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .

PART IV

Cisco Remote PHY Shelf 7200 Management Guide for Cisco Remote PHY Shelf 7200 Software 1.x

- Cisco Remote PHY Shelf 7200 Trunk VLAN Configuration, on page 87
- Cisco Remote PHY Shelf 7200 Software Image Upgrade, on page 91
- Cisco Remote PHY Shelf 7200 Fault Management, on page 95
- Cisco Remote PHY Shelf 7200 Device Operations and Debugging, on page 101



CHAPTER 12

Cisco Remote PHY Shelf 7200 Trunk VLAN Configuration

This document describes how to configure trunk VLAN for the Cisco Remote PHY Shelf 7200 Software 1.1.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 87
- Trunk VLAN , on page 87
- Configure Trunk VLAN, on page 88
- Verify Trunk VLAN Configuration, on page 88
- Feature Information for Trunk VLAN, on page 89

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 26: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Trunk VLAN

The Trunk VLAN feature enables you to configure virtual LAN on your Remote PHY Shelf 7200 device.

Each Remote PHY Shelf 7200 device has six uplink ports. Each upink port has two VLAN modes—access mode and trunk mode. Access mode is the default mode.

Each port can be configured in a different VLAN mode. However, if you want to configure link redundancy, all ports must be configured in the same mode.

In the trunk mode, ingress and egress packets have VLAN tags. In the access mode, packets do not have VLAN tags.

Configure Trunk VLAN

To configure trunk vlan, follow these steps.

```
HA-FCC# configure terminal
HA-FCC(config)# trunk vlan vlan_id slot slot_id erpd erpd_index
```

Table 27: Syntax Description

vlan_id	ID for the IEEE 802.1Q Virtual Local Area Network (VLAN) that should be used to tag the frames for this cable modem. The range is 2–4094.
slot_id	Slot number of the line card. The slot ID can be 0–5 and 7–12.
erpd_index	Specify the erpd. The erpd index is typically 0–5.

This example shows how to configure trunk VLAN.

```
HA-FCC(config)# trunk vlan 423 slot 12 erpd 0

eRPD trunk vlan configured successfully.
```

Verify Trunk VLAN Configuration

To view the trunk VLAN configuration, follow these steps.

```
show trunk vlan
```

This is an example of verifying trunk VLAN configuration.

```
HA-FCC# show trunk vlan
Slot  eRPD  VLAN
12    0          423
12    1          423
12    2          423
12    3          423
12    4          423
```

To view the trunk VLAN ID, slot number, and the erpd number, run the **show run | se trunk** or the **show startup-config | se trunk** command.

```
FCC# show run | se trunk
```

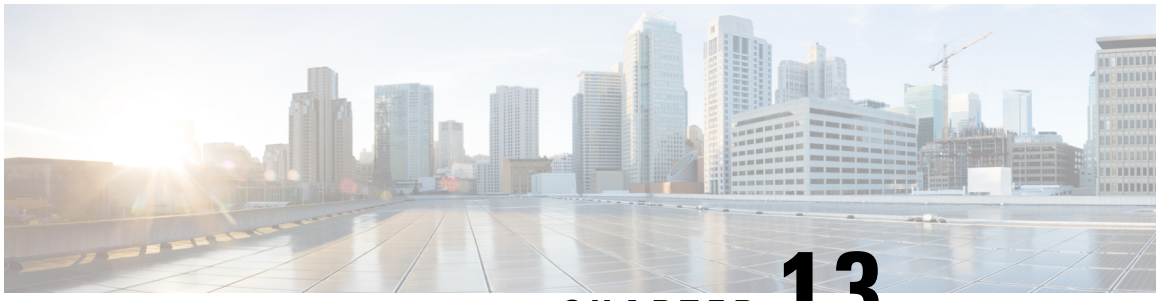
```
trunk vlan 423 slot 12 erpd 0
trunk vlan 423 slot 12 erpd 1
trunk vlan 423 slot 12 erpd 2
trunk vlan 423 slot 12 erpd 3
trunk vlan 423 slot 12 erpd 4

FCC# show startup-config | sec trunk
trunk vlan 423 slot 1 erpd 0
trunk vlan 423 slot 1 erpd 1
trunk vlan 423 slot 1 erpd 2
```

Feature Information for Trunk VLAN

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 28: Feature Information for Trunk VLAN

Feature Name	Releases	Feature Information
Trunk VLAN	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 device.



CHAPTER 13

Cisco Remote PHY Shelf 7200 Software Image Upgrade

This document describes how to upgrade the software image for the Cisco Remote PHY Shelf 7200 Software 1.1.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 91
- Information About Software Image Upgrade, on page 91
- How to Upgrade Software Cisco cBR and HA RPHY, on page 92
- Examples for Upgrading HA RPHY Software, on page 93
- Feature Information for Software Image Upgrade, on page 94

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 29: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information About Software Image Upgrade

You can upgrade the HA Shelf image in these two ways.

- Upgrade from cBR-8
- Upgrade from HA Shelf

You can upgrade one shelf group one at a time or upgrade all shelfs at once. You can upgrade software image through HTTP or TFTP. IPv4 and IPv6 are supported.

How to Upgrade Software Cisco cBR and HA RPHY

Note To know more about the commands referenced in this module, see the Cisco IOS Master Command List.

Upgrade HA Shelf Software From Cisco cBR

The RPD software upgrade can be initiated from Cisco cBR-8 router. Use the following commands for initiating the upgrade:

```
cable rpd group {all| group MAC} upgrade ip address {tftp|http} file_name
```

Upgrade Software from FCC or Master eRPD

To upgrade software from FCC or master eRPD, use these commands.

```
upgrade set server ip_address filename file_name transport {tftp|http}
upgrade control show config
upgrade control start
```

Verifying Software Upgrade

Verifying Software Upgrade From the Cisco cBR-8 Router

To view the status of the software upgrade from the Cisco cBR-8 router, use the **show cable rpd-upgrade group [all| group id] status** command.

```
Router# show cable rpd-upgrade group all status
GROUP-ID: 7abd.44a1.0000
ServerAddress: 10.74.59.226
Protocol: HTTP
Status: Idle
Filename: bundle/test.itb.sign
```

Verifying Software Upgrade From FCC or eRPD

To view the status of the software upgrade from FCC or eRPD, use the **upgrade control show status** command.

```
Router# upgrade control show status
Image download aborted.
```

```
Router# upgrade control show status
Downloading image on FCC.
```

Abort Software Upgrade

Abort Software Upgrade From the Cisco cBR-8 Router

To abort software upgrage from the Cisco cBR-8 router, use the **cable rpd group all upgrade abort** command.

```
Router# cable rpd group all upgrade abort
Abort software upgrade process successfully.
```

Abort Software Upgrade From FCC or eRPD

To abort software upgrage from FCC or eRPD, use the **upgrade control abort** command.

```
Router# upgrade control abort
Abort software upgrade process successfully.
```

Examples for Upgrading HA RPHY Software

See examples for the software upgrade from cBR-8 and FCC or master eRPD.

Example: HA RPHY Software Upgrade from Cisco cBR

```
Router# upgrade set server 203.0.113.1 filename bundle/test.itb.sign transport http
Router# upgrade control show config

file path: bundle/test.itb.sign
server: 203.0.113.1
transport: HTTP
Router# upgrade control start
Router# upgrade control show status.
Downloading image on FCC.


Router# cable rpd group all upgrade 203.0.113.2 http bundle/test.itb.sign
Router# cable rpd group all upgrade status
This group 0027.900a.4c1a is not HA-Shelf group.
GROUP-ID: 7abd.44a1.0000
ServerAddress: 203.0.113.2
Protocol: HTTP
Status: Image downloading on RPDLC
Filename: bundle/test.itb.sign
```

Example: HA RPHY Software Upgrade from FCC or Master eRPD

```
Router# upgrade set server 203.0.113.2 filename bundle/test.itb.sign transport http
Router# upgrade control start
Router# upgrade control show status
Downloading image on FCC.
Router# upgrade control abort
Abort software upgrade process successfully.
```

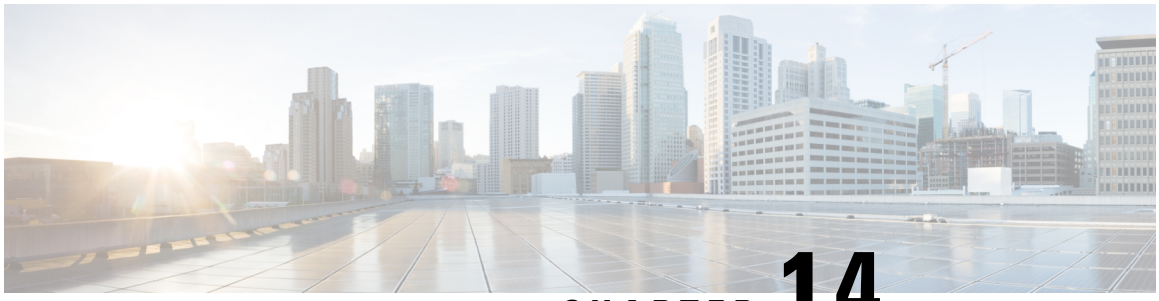
```
Router# upgrade control show status
Image download aborted.


Router# show cable rpd-upgrade group all status
GROUP-ID: 7abd.44a1.0000
ServerAddress: 203.0.113.2
Protocol: HTTP
Status: Idle
Filename: bundle/test.itb.sign
```

Feature Information for Software Image Upgrade

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 30: Feature Information for Software Image Upgrade

Feature Name	Releases	Feature Information
Software Image Upgrade	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 device.



CHAPTER 14

Cisco Remote PHY Shelf 7200 Fault Management

This document describes how to configure the events for fault management on the Cisco Remote PHY Shelf 7200 Software 1.1.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 95
- Information About Fault Management, on page 95
- How to Configure RPD Events, on page 96
- Configuration Examples , on page 99
- Feature Information for RPHY Fault Management, on page 99

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 31: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information About Fault Management

Fault management on RPD is required for remote monitoring, detection, diagnosis, reporting, and correcting the issues.

The Fault management module provides the following support:

- RPD can send events to the CCAP core
- CCAP core can get events from RPD
- Send RPD events using SNMP traps
- On the CCAP core, view log in to the CLI
- SNMP poll events are supported

RPD Event Reporting

An RPD logs events, generates asynchronous notifications that indicate malfunction situations, and notifies the operator about important events. The RPD event reporting includes two methods of reporting.

- During the initialization of RPD, CCAP core synchronizes events from the RPD.
- During run-time operations, RPD notifies the CCAP Core of the events

Restrictions for Configuring RPD Events

Following restrictions are applicable:

A maximum of 1000 events are retained on Cisco cBR. The RPD retains 1000 events locally and 1000 events in pending state.

How to Configure RPD Events

Configuring RPD Events

You can configure an event profile and apply it to RPD. Use the following commands to configure RPD events:

```
enable
configure terminal
cable profile rpd-event profile_id
  priority {emergency|alert|critical|error|warning|notice|informational|debug}
{0x0|0x1|0x2|0x3}
  enable-notify
```

- 0x0—No log
- 0x1— Save log in RPD local storage
- 0x2—Report to Cisco cBR
- 0x3— Save log in RPD local storage and report to Cisco cBR

You must enable-notifications for the RPD to report any event to the Core.

Applying the Event Profile to RPD

Use the following commands to apply the Event Profile to an RPD:

```
enable
configure terminal
cable rpd rpd_name
  rpd-event profile profile_id
```

Note If RPD is online when changing the profile, reset the RPD, after you change the profile.

Enable RPD Event Trap

You can enable RPD event traps to send RPD events using SNMP traps. Use the following commands to configure RPD event traps:

```
enable
configure terminal
snmp-server enable traps rpd-event priority
```

Priority can be 1-8, where:

- 1—Enable RPD event trap for emergency priority
- 2— Enable RPD event trap for alert priority
- 3—Enable RPD event trap for critical priority
- 4— Enable RPD event trap for error priority
- 5— Enable RPD event trap for warning priority
- 6— Enable RPD event trap for notice priority
- 7— Enable RPD event trap for informational priority
- 8— Enable RPD event trap for debug priority

The priority higher than the selected priority is also displayed.

Configure SNMP Trap Server

You can configure SNMP trap server on the cable modem using the following commands:

```
enable
cnfigure terminal
Router# snmp-server host ip_address traps version 2c public udp-port port_number
```

where,

- *ip_address*—IP address of the server
- *port_number*—UDP port number assigned to receive the SNMP traps. The same port number must also be configured on the SNMP server.

Getting RPD Events

To retrieve events from RPD, use the **cable rpd [RPD IP|RPD MAC|all] event {locallog|pending}** command, as given in the following example:

```
Router#cable rpd 30.84.2.111 event pending
```

Clearing All Events on Cisco cBR Database

To remove all Events on Cisco cBR, use the clear cable rpd all event command, as given in the following example:

```
Router# clear cable rpd event group RPD_MAC
```

Viewing the RPD Events

To view all RPD Events, use the **show cable rpd [RPD_MAC] event** command as given in the following example.

```
Router# show cable rpd 93.3.50.7 event
RPD            EventId    Level Count  LastTime       Message
0004.9f00.0861 66070204   Error  1     Feb21 12:11:06 GCP Connection Failure
CCAP-IP=30.85.33.2;RPD-ID=0004.9f00.0861;
0004.9f00.0861 2148074241 Error  1     Feb21 12:11:25 Session failed:connecting timeout,
@SLAVE: 93.3.50.7:None --> 30.85.33.2:8190;RPD-ID=0004.9f00.0861;
```

To view specific RPD event groups, use the **show cable rpd event group [RPD_MAC] [fcc|slot]** command as shown in this example.

```
Router# show cab rpd event group 7abd.44a1.0000 fcc
RPD            EventId         Level Count  LastTime       Message
7abd.44a1.0040 66070303 Criti  2            Oct16 20:50:35 FCC event
example;GROUP-ID=7abd.44a1.0000;
                                                    SLOT-ID=FCC;RPD-ID=7abd.44a1.0040;
```

```
Router# show cab rpd event group 7abd.44a1.0000 slot 9
RPD            EventId         Level Count  LastTime         Message
7abd.44a1.0140 66070700 Notic  1           Oct16 17:20:34   RPD=7a:bd:44:a1:01:40 PTP clock
 synchronized to Master=10.90.3.93;GROUP-ID=7abd.44a1.0000;

SLOT-ID=LC9;RPD-ID=7abd.44a1.0140;
```

Viewing RPD Events Using Log

To view all RPD Events, use the show logging command, as given in the following example.

```
Router# show logging | include RPD-ID=0004.9f00.0861
004181: Feb 21 12:18:59.649 CST: %RPHYMAN-3-RPD_EVENT_ERROR:  CLC5: rphyman:
GCP Connection Failure CCAP-IP=30.85.33.2;RPD-ID=0004.9f00.0861;EVENT-ID=66070204;
FirstTime=2017-2-21,12:11:6.0;
LastTime=2017-2-21,12:11:6.0;
Count=1;PendingQueue;
004185: Feb 21 12:19:18.875 CST: %RPHYMAN-3-RPD_EVENT_ERROR:  CLC5: rphyman:
```

```
Session failed:connecting timeout, @SLAVE: 93.3.50.7:None --> 10.10.10.12:1190;
RPD-ID=0004.9f00.0861;
EVENT-ID=2148074241;
FirstTime=2017-2-21,12:11:25.0;
LastTime=2017-2-21,12:11:25.0;
Count=1;PendingQueue;
```

Configuration Examples

This section provides example for the fault management configuration on Cisco cBR-8.

Example: RPD Event Configuration

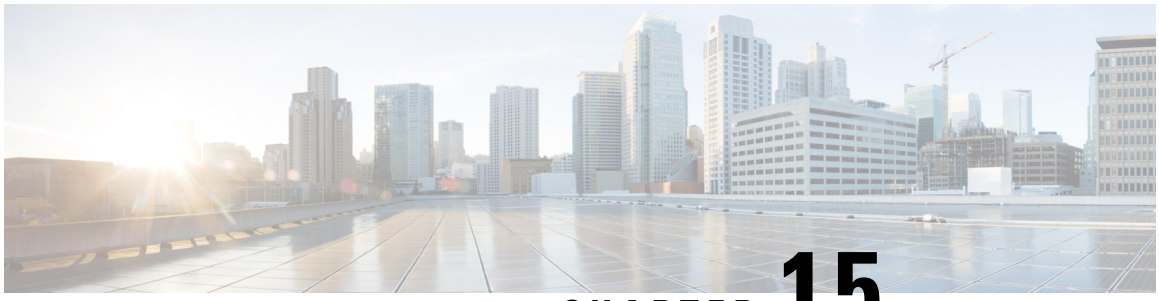
```
enable
configure terminal
cable profile rpd-event 6
    priority emergency 0x3
    priority alert 0x3
    priority critical 0x3
    priority error 0x3
    priority warning 0x3
    priority notice 0x3
    priority informational 0x3
    enable-notify
cable rpd node6
    identifier badb.ad13.5e08
    core-interface Te3/1/5
        principal
        rpd-ds 0 downstream-cable 3/0/17 profile 10
        rpd-us 0 upstream-cable 3/0/34 profile 13
    r-dti 16
    rpd-event profile 6
```

Feature Information for RPHY Fault Management

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 32: Feature Information for RPHY Fault Management

Feature Name	Releases	Feature Information
RPHY Fault Management	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200.



CHAPTER 15

Cisco Remote PHY Shelf 7200 Device Operations and Debugging

This document describes the operations and debugging of the Cisco Remote PHY Shelf 7200 Software 1.1.

- Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200 , on page 101
- Information about RPD Operations and Debugging, on page 101
- How to Access and Debug RPD, on page 102
- Feature Information for RPD Operations and Debugging, on page 104

Hardware Compatibility Matrix for Cisco Remote PHY Shelf 7200

Note Unless otherwise specified, the hardware components introduced in a given Cisco Remote PHY Shelf 7200 Software Release are supported in all subsequent releases.

Table 33: Hardware Compatibility Matrix for the Cisco Remote PHY Shelf 7200

Cisco CMTS Platform	Cisco Remote PHY Shelf 7200
Cisco cBR-8 Converged Broadband Router with Cisco IOS XE Gibraltar 16.10.1 and Later Releases	**Cisco Remote PHY Shelf 7200 Software 1.1 and Later Releases** Cisco Remote PHY Shelf 7200 • PID—HA-RPHY

Information about RPD Operations and Debugging

The operators might need secure remote access to the RPD for activities such as setting up the RPD before the installation, maintenance, or troubleshooting. The RPD supports Secure Shell (SSH) server that allows secure access to the RPD.

Prerequisites for RPD Operations

The following prerequisites are applicable for debugging or checking RPD operations:

- RPD has established GCP connection with the CCAP-core, and RPD IP address is retrievable from CCAP-core.
- RPD is assigned an IP address through the DHCP process, and the IP address is retrievable from the DHCP server.

How to Access and Debug RPD

Note To know more about the commands referenced in this module, see the Cisco IOS Master Command List.

To access RPD, log into RPD using your username and password.

Debugging RPD

Use the following procedure to debug RPD:

1. Disable RPD auto reboot by setting the reboot hold.

   ```
   R-PHY# set reboot hold
   ```

2. Collect the show CLI output.

   For RPD online issues, check which status is failed. You can check the following outputs:

   - show provision all
   - show provision history
   - show dhcp
   - show tod
   - show ptp clock 0 config
   - show ptp clock 0 state

   For modem online issue, check ds/us config and l2tp session.

   You can collect the following outputs:

   - show downstream channel configuration
   - show downstream channel counter dps (show multiple times)
   - show downstream depi configuration
   - show upstream channel configuration <port number> <channel number>
   - show upstream iuc counter <port number> <channel number> (show multiple times)

- show upstream map counter <port number> <channel number> (show multiple times)
- show upstream uepi configuration
- show l2tp tunnel
- show l2tp session

3. Enable RPD auto reboot, after collecting all logs and CLI output.

```
R-PHY#clear reboot hold
```

Debugging Cisco Smart PHY 7200

Collect the show CLI outpus to debug Cisco Smart PHY 7200:

- To display eeprom information of the FCC, use the **show diag eeprom** command in privileged EXEC mode.
- To display alarm, sensor, fan, FCC, and power related information, use the **show group environment** command in privileged EXEC mode.
- To display information about the PTP clock of the line card, use the **show ptp clock** command in privileged EXEC mode.
- To view the sync state of the PTP clock, use the **show tgc-clock** command in privileged EXEC mode.
- To view your RPHY diagnostics, use the **show platform diag** command in privileged EXEC mode.
- To display Cisco Remote-PHY devices (RPD) of all groups, use the **show cable rpd group** command in privileged EXEC mode.
- To display eRPD related information, use the **show erpd** command in privileged EXEC mode.
- To view virtual LAN configuration on your Remote PHY Shelf 7200 device, use the **show trunk vlan** command in privileged EXEC mode.
- To display event logging information and messages of the Cisco Remote PHY Devices (RPD), use the **show cable rpd event** command in privileged EXEC mode.
- To display information on the software upgrade, use the **upgrade control** command.
- To view port mapping and link redundancy details, use the **show running-config** command in privileged EXEC mode.
- To display the operation status of link redundancy, use the **show link-redundancy** command in privileged EXEC mode.

For detailed information about the commands and sample outputs, see the Cisco Remote PHY Shelf 7200 Command Reference Guide.

Feature Information for RPD Operations and Debugging

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 34: Feature Information for RPD Operations and Debugging

Feature Name	Releases	Feature Information
RPD Operations and Debugging	Cisco Remote PHY Shelf 7200 Software 1.1	This feature was introduced on the Cisco Remote PHY Shelf 7200 .