Cisco Remote PHY Device Provisioning Guide for Cisco 1x2 RPD Software 1.1

First Published: 2017-06-04

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

© 2018 Cisco Systems, Inc. All rights reserved.

CONTENTS

CHAPTER 1 **Network Authentication** 1

Hardware Compatibility Matrix for Cisco Remote PHY Device 1

Information about Network Authentication 2

How to Enable Network Authentication 2

Installing Certificates in Radius Server 3

Configuring Radius Server 3

Configuring Switch 3

Verifing Authentication Status 4

CHAPTER 2 **Synchronizing Time on Cisco Remote PHY Devices** 5

Hardware Compatibility Matrix for Cisco Remote PHY Device 5

Information about Time Synchronization 6

Remote DTI 6

Restrictions for Configuring Time Synchronization 6

How to Configure Time Synchronization 7

Configuring Time Interface and PTP domain 7

Verifying Time Interface and PTP Domain Configuration 8

Configure RPD PTP Connection 9

Verifying RPD PTP Connection Configuration 9

Associate R-DTI with RPD 9

Verifying Associating R-DTI with RPD 10

Verifying PTP Clock Functioning 12

Verifying PTP Clock Running Domain 12

Verifying Time Sync State 12

Verifying Time Sync Statistics 13

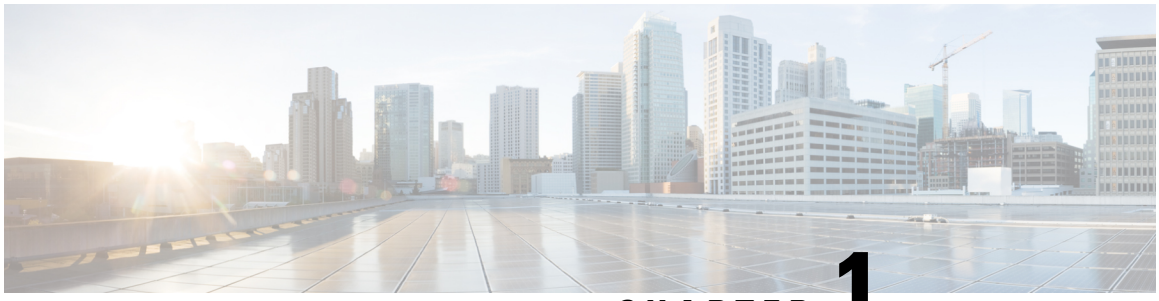
Configuration Examples 14

Example: Configuring Time Interface and PTP Domain 14
Example: Configure RPD PTP Connection 14
Example: Associate R-DTI with RPD 15
Feature Information for Synchronizing Time on R-PHY Devices 15

CHAPTER 3 **DEPI/UEPI/L2TP integration with Cisco Remote PHY Device 17**
Hardware Compatibility Matrix for Cisco Remote PHY Device 17
Information about DEPI/UEPI/L2TP integration with RPD 18
DEPI 18
UEPI 18
How to Configure DEPI/UEPI/L2TP integration with RPD 18
Configuring depi-class/l2tp-class Pair 19
Verifying the RPD Status 19
Displaying DEPI Ralated Information 19
Feature Information for DEPI/UEPI/L2TP integration with RPD 20

CHAPTER 4 **DEPI Latency Measurement 21**
Hardware Compatibility Matrix for Cisco Remote PHY Device 21
Information about DEPI Latency Measurement 22
How to Configure DLM 22
Configuring DLM 22
Verifying DLM Configuration 23
Example: DLM Configuration 23
Feature Information for DLM 23

CHAPTER 5 **Multiple Cores 25**
Hardware Compatibility Matrix for Cisco Remote PHY Device 25
Information about Multiple Cores 26
Restrictions for Multiple Cores Configuration 26
How to Configure Multiple Cores 26
Configuring Multiple Cores 27
Verifying Multiple Cores Configuration 27



CHAPTER 1

Network Authentication

This document describes the Remote PHY device network authentication 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.

Use Cisco Feature Navigator to find information about the platform support and Cisco software image support. To access Cisco Feature Navigator, go to the link http://tools.cisco.com/ITDIT/CFN/. You do not require a cisco.com login account.

- Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 1
- Information about Network Authentication, on page 2
- How to Enable Network Authentication, on page 2

Hardware Compatibility Matrix for Cisco Remote PHY Device

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

Table 1: Hardware Compatibility Matrix for the Cisco Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Node	**and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2= **and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2-PKEY=
Cisco GS7000 Super High Output Intelligent Node (iNode)	**and Later Releases** Cisco Intelligent Remote PHY Device 1x2 • PID—iRPD-1X2= • PID—iRPD-1X2-PKEY=

Note The -PKEY suffix in the PID indicates units that enable the SCTE-55-2 Out-of-Band protocol support.

Information about Network Authentication

RPD must be able to operate in both authenticated and unauthenticated networks. Whether authentication is required for an RPD is determined by the network that it is connected to. In some cases, RPD is located in an untrusted network, and it must connect to devices inside the trusted network, which presents a potential security vulnerability. 802.1x is introduced to provide authentication services to eliminate the potential security issues.

802.1x is a Layer 2 protocol that uses EAP (Extensible Authentication Protocol) to provide authentication services. Following certificates are needed to use the network authentication:

- Cablelabs Root CA certificate: caRoot.pem
- CableLabs Device CA Certificate: deviceCA.pem
- RPD Certificate: rpdCert.pem, private key: rpd.key
- Cablelabs Service Provider CA Certificate: spCA.pem
- AAA Server Certificate: aaaCert.pem, private key: aaa.key

How to Enable Network Authentication

This section describes how to enable network authentication for RPD.

Installing Certificates in Radius Server

To install the certificate in Radius server, follow the steps below:

Step 1 Combine CA certificate for AAA server.

Example:

```
cat spCA.pem caRoot.pem > ca_root_srv.pem
```

Step 2 In freeRadius Server, copy "ca_root_srv.pem", "spCA.pem", "aaaCert.pem" and "aaa.key" to "/etc/freeradius/certs".

Configuring Radius Server

To install the certificate in RPD, follow the steps below:

Step 1 Define a new client in /etc/freeradius/clients.conf.

Example:

```
client rphytest_ng13 {
        ipaddr = 20.5.0.36
        secret = rphytest
        shortname = ng13_switch
        require_message_authenticator = yes
}
```

The "ipaddr" is the switch's management ip address.

Step 2 In "/etc/freeradius/eap.conf", change the following lines in "tls" to specify the server's private key file and certificate files.

Example:

```
tls {
      …
        private_key_file = ${certdir}/aaa.key
        certificate_file = ${certdir}/aaaCert.pem
        CA_file = ${cadir}/ca_root_srv.pem
}
```

Step 3 Start radius in radius sever.

Example:

```
sudo freeradius
```

Make sure only one freeradius instance is running.

Configuring Switch

To configure the switch, follow the steps below:

Note This procedure is for Catalyst 3750 switch, other switch may use different commands.

Step 1 Add the following configuration in global configuration mode.

Example:

```
dot1x system-auth-control   /* enable 802.1x */
aaa new-model
aaa authentication dot1x default group radius
radius-server host 10.79.41.103 auth-port 1812 key rphytest
```

Step 2 Add the following configuration under interface which connects to RPD.

Example:

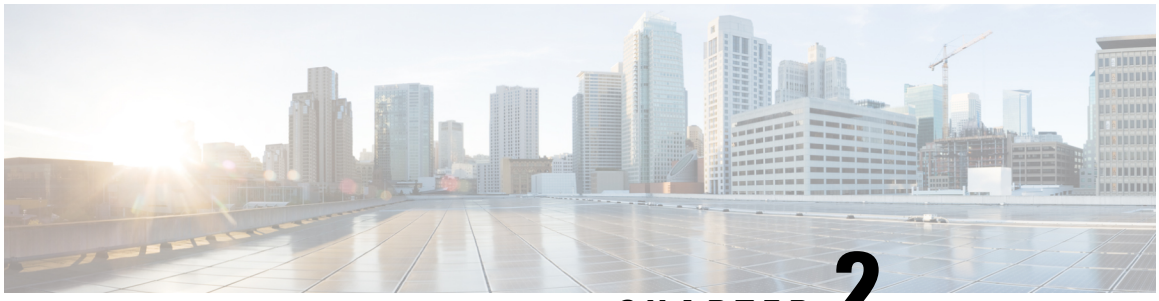
```
authentication port-control auto
dot1x pae authenticator
```

Verifying Authentication Status

To displays dot1x authentication information for RPD, use the **show dot1x** command as shown in the following example:

```
Router# show dot1x summary
 Interface        Core-id                  EAP_Received     Status
 vbh0             CORE-3415960568          True             UP

Router# show dot1x detail
Interface        Core-id                  EAP_Received        Status
vbh0             CORE-3415960568          True                UP
bssid=01:80:c2:00:00:03
freq=0
ssid=
id=0
mode=station
pairwise_cipher=NONE
group_cipher=NONE
key_mgmt=IEEE 802.1X (no WPA)
wpa_state=COMPLETED
ip_address=30.85.40.47
address=00:04:9f:00:03:73
Supplicant PAE state=AUTHENTICATED
suppPortStatus=Authorized
EAP state=SUCCESSselected
Method=13 (EAP-TLS)EAP TLS
cipher=ECDHE-RSA-AES256-SHA
tls_session_reused=0
eap_session_id=0d53798f5b46014cc92a4ac1151521bae6a14c98f919eb5e8c81a701b7272be7f812e7e5a75881768d74d311795a3b1f0e37bfa7fff7dcc4685d36f216bec59850
uuid=ab722cfb-84dc-5835-a905-edfec20f78c3
```



CHAPTER 2

Synchronizing Time on Cisco Remote PHY Devices

This section explains how to synchronize time on the Remote PHY (R-PHY) devices and CCAP core of the Cisco cBR Router.

- Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 5
- Information about Time Synchronization, on page 6
- How to Configure Time Synchronization, on page 7
- Configuration Examples, on page 14
- Feature Information for Synchronizing Time on R-PHY Devices, on page 15

Hardware Compatibility Matrix for Cisco Remote PHY Device

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

Table 2: Hardware Compatibility Matrix for the Cisco Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Node	**and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2= **and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2-PKEY=

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Intelligent Node (iNode)	**and Later Releases** Cisco Intelligent Remote PHY Device 1x2 • PID—iRPD-1X2= • PID—iRPD-1X2-PKEY=

Note The -PKEY suffix in the PID indicates units that enable the SCTE-55-2 Out-of-Band protocol support.

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.

The GS7000 R-PHY supports map re-stamp option.

Restrictions for Configuring Time Synchronization

The following restrictions are applicable to configuring time synchronization on Cisco cBR.

- Cisco cBR and RPD does not support PTP over IPv6
- Cisco cBR supports only the PTP slave on SUP-PIC

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 0 (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 3: 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	

Parameter	Description	Value Range	Default Value
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)		
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 0
Load for five secs: 5%/2%; one minute: 6%; five minutes: 6%
No time source, 15:16:20.421 CST Wed Mar 15 2017

                    PTP Ordinary Clock [Domain 0]
State          Ports Pkts sent Pkts rcvd Redundancy Mode
PHASE_ALIGNED  1     3687693   11177073  Hot standby
                            PORT SUMMARY
```

```
                                        PTP Master
Name           Tx Mode Role  Transport State Sessions Port Addr
slave-from-903 unicast slave Lo1588    Slave 2        10.10.10.11

                              SESSION INFORMATION
slave-from-903 [Lo1588] [Sessions 2]
Peer addr       Pkts in Pkts out In Errs Out Errs
10.10.10.11      5588900 1843789  0       0
10.10.10.12      5588173 1843904  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 1 (RPD PTP connection)
 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_SLAVE
Priority 1/2/local  : 128/255/128
Profile             : 001b19000100-000000 E2E
Total Ports/Streams : 1  /2
--PTP Port   1, Enet Port   1 ----
  Port local Address :10.10.10.11
  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 1  Master IP: 10.10.10.11
  ==Stream 1 : Port 1  Master IP: 10.10.10.11
```

Associate R-DTI with RPD

To associate R-DTthe local prefix SID associated to the segment ID, use the following commands.

```
enable
configure terminal
interface type [slot_#/]port_#
cable rpd node1
identifier 0044.4f04.0044 (node vbh0 mac)
 core-interface Te3/1/0
 rpd-ds 0 downstream-cable 3/0/0 profile 3
 rpd-us 0 upstream-cable 3/0/0 profile 3
r-dti 1
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
Load for five secs: 8%/2%; one minute: 9%; five minutes: 9%
Time source is user configuration, 11:00:17.381 CST Wed Mar 22 2017
Building configuration...
Current configuration : 107879 bytes
!
! Last configuration change at 10:59:23 CST Wed Mar 22 2017
!
version 16.6
service timestamps debug datetime msec localtime show-timezone
service timestamps log datetime msec localtime show-timezone
service internal
no platform punt-keepalive disable-kernel-core
platform ipccl log-history 0
platform punt-policer 10 10
platform punt-policer 10 10 high
platform punt-policer 80 10
platform punt-sbrl subscriber rate no-drop
platform shell
!
hostname RphyNode-L09
!
boot-start-marker
boot system harddisk:cbrsup-universalk9.16.05.01prd9.SPA.bin
boot-end-marker
!
!
----
!
cable tag 10
 name docsis1.0
 docsis-version docsis10
!
cable tag 11
 name docsis1.1
 docsis-version docsis11
!
-----
cable load-balance docsis-group 1
 restricted
 upstream Upstream-Cable 3/0/3 us-channel 0-3
 method utilization
 threshold load 15
 threshold load minimum 2
 policy pure-ds-load
 init-tech-list 4
 interval 60
 tag docsis1.0
 tag docsis1.1
 tag docsis2.0
 tag docsis3.0
!
---
cable metering ipdr-d3 session 1 type 1
cable metering source-interface TenGigabitEthernet4/1/1
cable modem remote-query 30 public
cable modem vendor 00.02.00 "Apache-ACB"
cable modem vendor E8.6D.52 "Motorola"
cable modem vendor 00.1F.E1 "Ambit"
cable modem vendor 00.1F.E2 "Ambit"
```

```
cable modem vendor 00.D0.DD "Sunrise"
!
!
----
!
no network-clock synchronization automatic
!
ptp clock boundary 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 10.10.10.11
  clock source 192.168.0.0
 clock-port master-local master
  transport ipv4 unicast interface Lo1588 negotiation
!
-----
r-dti 2
 rpd-event profile 0
!
ptp r-dti 2
 ptp-domain 0
 clock-port 1
   clock source ip 10.10.10.11
   clock source ip 192.168.0.0 alternate
!
ptp r-dti 3
 ptp-domain 0
 clock-port 1
   clock source ip 10.10.10.11
   clock source ip 192.168.0.0 alternate
!
ptp r-dti 10
 ptp-domain 0
 clock-port 1
   clock source ip 10.10.10.11
   clock source ip 192.168.0.0 alternate
   announce interval -3
   announce timeout 3
!
ptp r-dti 11
 ptp-domain 0
 priority1 101
 priority2 102
 local-priority 100
 clock-port 2
   ethernet 1
   clock alternate-first
   clock source ip 10.10.10.11
   clock source ip 192.168.0.0 alternate
   transport cos 0
   transport dscp 63
   sync interval -1
   announce timeout 255
   delay-req interval -7
   unicast grant-duration 60
   local-priority 255
!
ptp r-dti 12
 ptp-domain 0
 clock-port 1
```

```
   ethernet 0
   clock source ip 10.10.10.11
!
ptp r-dti 60
 ptp-domain 0
!
cable video
!
end
```

Verifying PTP Clock Functioning

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

```
Router#show ptp clock running
Load for five secs: one minute: 5%; five minutes:
Time source is NTP, 14 CST Fri Feb 17 2017
PTP Ordinary clock [Domain 0]
State         Ports pkts sent pkts rcvd Redundancy Mode
PHASE-ALIGNED 1     7339500   22245593  Hot standby
   Port Summary
Name           Tx Mode Role  Transport State Sessions PTP Master Port Addr
slave-from-903 unicast slave  L01588    Slave 2        10.10.10.11
```

Verifying PTP Clock Running Domain

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

```
Router#show ptp clock running domain 0
Load for five secs: 5%/2%; one minute: 6%; five minutes: 6%
No time source, 15:16:20.421 CST Wed Mar 15 2017
                      PTP Ordinary Clock [Domain 0]
State          Ports Pkts sent Pkts rcvd Redundancy Mode
PHASE_ALIGNED  1     3687693   11177073  Hot standby
                               PORT SUMMARY
                                          PTP Master
Name           Tx Mode Role  Transport State Sessions Port Addr
slave-from-903 unicast slave Lo1588    Slave 2        10.10.10.11

                              SESSION INFORMATION
slave-from-903 [Lo1588] [Sessions 2]
Peer addr       Pkts in Pkts out In Errs Out Errs
10.10.10.11      5588900 1843789  0       0
192.168.0.10     5588173 1843904  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     : SUB_SYNC
current tod     : 1485414295   Thu Jan 26 07:04:55 2017
active stream   : 0
==stream    0   :
  port id       :                0
  master ip     :       10.10.10.11
  stream state  :       PHASE_LOCK
  Master offset :             -405
```

```
  Path    delay :           -17071
  Forward delay :           -17476
  Reverse delay :           -16623
  Freq offset   :          -291143
  1Hz  offset   :             -676
==stream    1   :
  port id       :                0
  master ip     :      192.168.0.11
  stream state  :       PHASE_LOCK
  Master offset :             -369
  Path    delay :            -1619
  Forward delay :            -1988
  Reverse delay :            -1260
  Freq offset   :          -297905
  1Hz  offset   :             -664
```

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    4  :
  2@0-00:06:51.568 1@0-00:06:41.930 0@0-00:04:17.925
  4@0-00:03:58.724
 ClockState  5  :
  5@0-00:07:12.640 4@0-00:07:10.182 3@0-00:07:06.825
  2@0-00:06:51.825 1@0-00:06:51.530
 BstPktStrm  1  :
  0@0-00:06:42.029
 SetTime     1  :
  1000000000@0-00:04:00.045
 StepTime    1  :
  125126755@0-00:06:14.670
 AdjustTime  64 :
  -676@0-07:34:32.546 -733@0-07:33:31.545  -838@0-07:32:30.546
  -892@0-07:31:29.545 -935@0-07:30:28.545 -1033@0-07:29:27.545
  -914@0-07:28:26.546  916@0-07:26:24.545  2507@0-07:25:18.170
streamId  msgType           rx     rxProcessed lost        tx
 0        SYNC              433439 433439      4294574083  0
 0        DELAY REQUEST     0      0           0           433439
 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    433437 433437      4294548766  0
 0        P-DELAY FOLLOWUP  0      0           0           0
 0        ANNOUNCE          27098  27098       0           0
 0        SIGNALING         285    285         0           285
 0        MANAGEMENT        0      0           0           0
   TOTAL                    894259 894259      8589122849  433724
 1        SYNC              433435 433435      4294574085  0
 1        DELAY REQUEST     0      0           0           433439
 1        P-DELAY REQUEST   0      0           0           0
 1        P-DELAY RESPONSE  0      0           0           0
 1        FOLLOW UP         0      0           0           0
 1        DELAY RESPONSE    10351  10351       4104        0
 1        P-DELAY FOLLOWUP  0      0           0           0
 1        ANNOUNCE          27098  27098       4294901760  0
 1        SIGNALING         285    285         0           285
 1        MANAGEMENT        0      0           0           0
   TOTAL                    471169 471169      8589479949  433724
```

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 10.10.10.11 255.255.255.224

interface TenGigabitEthernet5/1/3 (connect to PTP master)
ip address 192.168.0.13 255.255.255.224

ip route 10.10.10.11 255.255.255.224 192.168.0.12   (route to PTP master loopback ip)

ptp clock ordinary domain 0 (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 1
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 0004.9f03.0061 (node vbh0 mac)
 core-interface Te3/1/0
 rpd-ds 0 downstream-cable 3/0/0 profile 3
 rpd-us 0 upstream-cable 3/0/0 profile 3
r-dti 1
 rpd-event profile 0
```

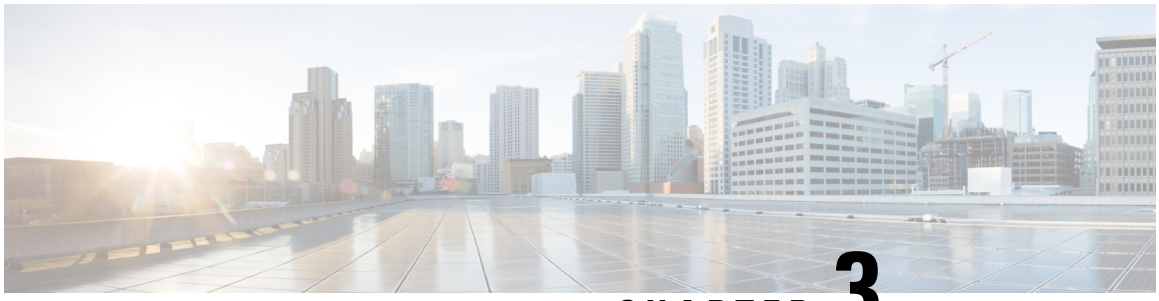
Feature Information for Synchronizing Time on R-PHY Devices

Use Cisco Feature Navigator to find information about the platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to the http://www.cisco.com/go/cfn link. An account on the Cisco.com page is not required.

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

Table 4: Feature Information for Synchronizing Time on R-PHY Devices

Feature Name	Releases	Feature Information
Synchronizing Time on R-PHY Devices	Cisco 1x2 RPD Software 1.1	This feature was introduced on the Cisco Remote PHY Device.



CHAPTER 3

DEPI/UEPI/L2TP integration with Cisco Remote PHY Device

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.

Use Cisco Feature Navigator to find information about the platform support and Cisco software image support. To access Cisco Feature Navigator, go to the link http://tools.cisco.com/ITDIT/CFN/. You do not require a cisco.com login account.

- Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 17
- Information about DEPI/UEPI/L2TP integration with RPD, on page 18
- How to Configure DEPI/UEPI/L2TP integration with RPD, on page 18
- Feature Information for DEPI/UEPI/L2TP integration with RPD, on page 20

Hardware Compatibility Matrix for Cisco Remote PHY Device

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

Table 5: Hardware Compatibility Matrix for the Cisco Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Node	**and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2= **and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2-PKEY=
Cisco GS7000 Super High Output Intelligent Node (iNode)	**and Later Releases** Cisco Intelligent Remote PHY Device 1x2 • PID—iRPD-1X2= • PID—iRPD-1X2-PKEY=

Note The -PKEY suffix in the PID indicates units that enable the SCTE-55-2 Out-of-Band protocol support.

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 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
```

Displaying 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 6: 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.

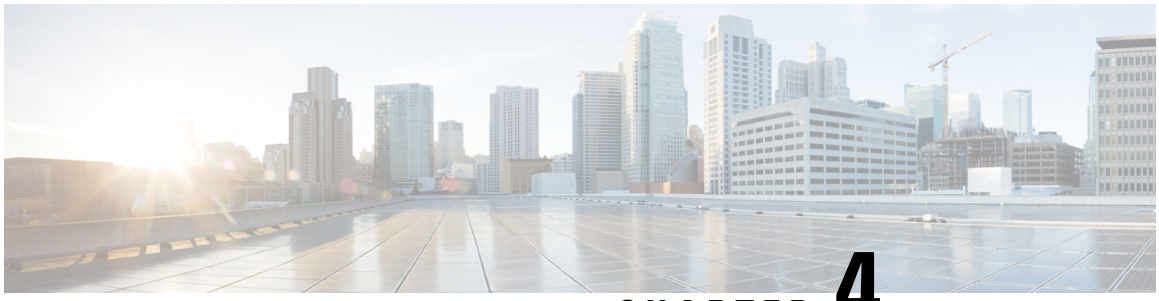
Feature Information for DEPI/UEPI/L2TP integration with RPD

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 7: Feature Information for DEPI/UEPI/L2TP integration with RPD

Feature Name	Releases	Feature Information
DEPI/UEPI/L2TP integration with RPD	Cisco 1x2 RPD Software 1.1	This feature was introduced on the Cisco cBR Series Converged Broadband Routers.



CHAPTER 4

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.

Use Cisco Feature Navigator to find information about the platform support and Cisco software image support. To access Cisco Feature Navigator, go to the link http://tools.cisco.com/ITDIT/CFN/. You do not require a cisco.com login account.

- Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 21
- Information about DEPI Latency Measurement, on page 22
- How to Configure DLM, on page 22
- Example: DLM Configuration, on page 23
- Feature Information for DLM, on page 23

Hardware Compatibility Matrix for Cisco Remote PHY Device

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

Table 8: Hardware Compatibility Matrix for the Cisco Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Node	**and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2= **and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2-PKEY=
Cisco GS7000 Super High Output Intelligent Node (iNode)	**and Later Releases** Cisco Intelligent Remote PHY Device 1x2 • PID—iRPD-1X2= • PID—iRPD-1X2-PKEY=

Note The -PKEY suffix in the PID indicates units that enable the SCTE-55-2 Out-of-Band protocol support.

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 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 9: 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
```

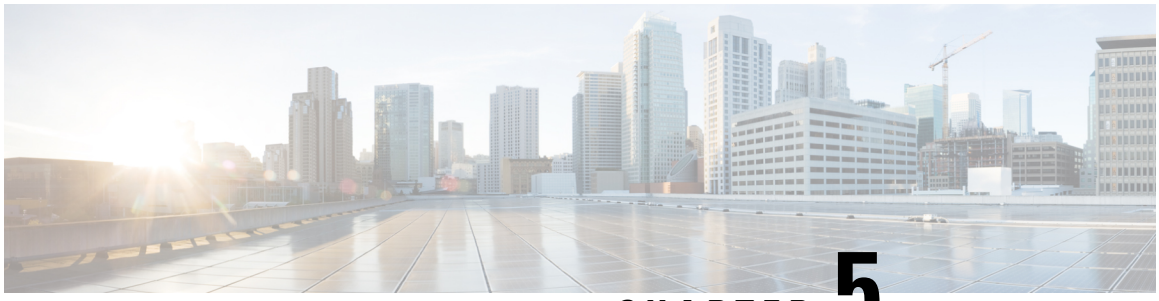
Feature Information for DLM

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 10: Feature Information for DLM

Feature Name	Releases	Feature Information
DEPI Latency Measurement	Cisco 1x2 RPD Software 1.1	This feature was introduced on the Cisco cBR Series Converged Broadband Routers.



CHAPTER 5

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.

Use Cisco Feature Navigator to find information about the platform support and Cisco software image support. To access Cisco Feature Navigator, go to the link http://tools.cisco.com/ITDIT/CFN/. You do not require a cisco.com login account.

- Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 25
- Information about Multiple Cores, on page 26
- How to Configure Multiple Cores, on page 26

Hardware Compatibility Matrix for Cisco Remote PHY Device

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

Table 11: Hardware Compatibility Matrix for the Cisco Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Node	**and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2= **and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2-PKEY=

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Intelligent Node (iNode)	**and Later Releases** Cisco Intelligent Remote PHY Device 1x2 • PID—iRPD-1X2= • PID—iRPD-1X2-PKEY=

Note The -PKEY suffix in the PID indicates units that enable the SCTE-55-2 Out-of-Band protocol support.

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
```

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.