



## **Cisco Remote PHY System Startup Configuration for Cisco 2x2 RPD Software 2.x**

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# CHAPTER 1

## Cisco Remote PHY System Overview

### Finding Feature Information

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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 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 2x2 Remote PHY Device*

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

## Benefits

The Cisco Remote PHY solution provides a cost-effective digital fiber-based DOCSIS solution that uses Ethernet PON (EPON), Gigabit-capable Passive Optical Networks (GPON), or Metro Ethernet (MetroE) as the transmission network between the Cisco CMTS and CM. Both the PON technology and DOCSIS is used in the same network.

- Simple and low cost PON transmission as opposed to costly HFC transformation.
- Reduced investment cost including capital and operational expenditure.
- Low-cost yet highly stable Cisco GS7000 node (includes only the PHY layer).
- Reduced CMTS hardware complexity.
- No restriction on Converged Interconnect Network (CIN) network.
- Futureproof architecture. Easy to migrate as the hardware and control functions are on separate layers.



- End-to-end QoS assurance provided by DOCSIS.
- Support for all DOCSIS services.
- Support for existing DOCSIS network provisioning system.
- High access bandwidth.
- With deep fiber, the optical noise contribution to SNR is eliminated. As a result, the remote QAM modulator runs at higher orders of modulation as compared to a centralized QAM modulator.

## Cisco CCAP RF Line Card for R-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.
- CBR-CCAP-LC-G2-R—This line card supports a maximum of 8 RPDs in one service group.

## 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.

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 Device

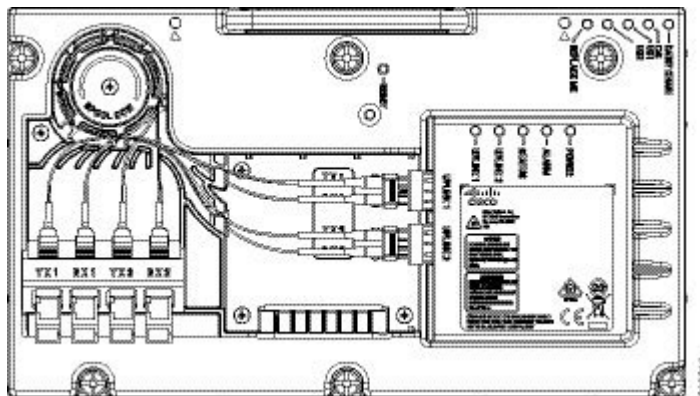
The Cisco 2x2 Remote PHY Device (RPD) resides inside the Cisco GS7000 node. Below are some of its features:

- Full spectrum DOCSIS 3.0 support

- Full spectrum DOCSIS 3.1 support
- Converged broadcast, narrowcast, and VOD video support
- Out of Band (OOB) signaling support
- Dual 10GBE SFP/SFP+ backhaul connectivity
- Support of Daisy Chain architecture topology
- CCAP support
- Support of optical overlay architectures

Additionally, the Cisco Intelligent Remote PHY Device (iRPD) provides an interface to the Intelligent Node RF section. This interface supports control plane communication that allows more extensive diagnostic and configuration control. The Intelligent Node supports touch-less configuration, per port spectrum capture, power-savings mode, and other enhanced features.

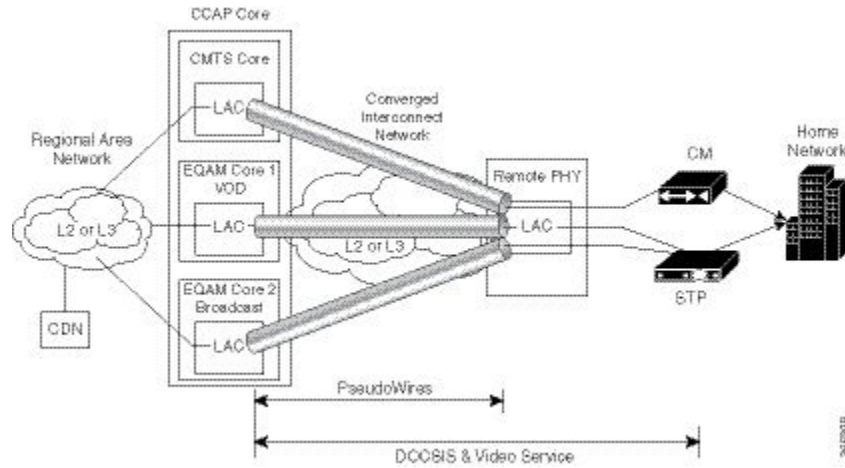
**Figure 1: Cisco 2x2 RPD**



## Network Architecture

The Cisco Remote PHY solution supports the *Single Controller Sharing* architecture. In this architecture, multiple Cisco GS7000 equipments share the downstream and upstream channels of a Cisco RF line card in a cisco cBR chassis.

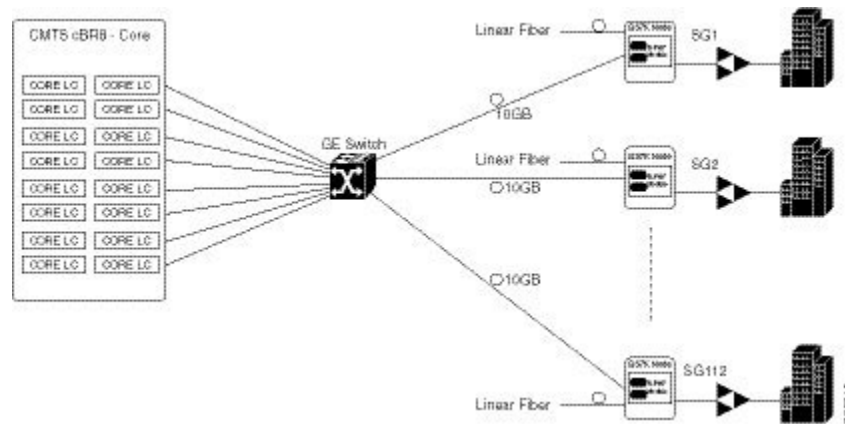
Figure 2: Single Controller Sharing Architecture



## Network Topologies

The Cisco Remote PHY solution supports the following Ethernet-based networking topologies.

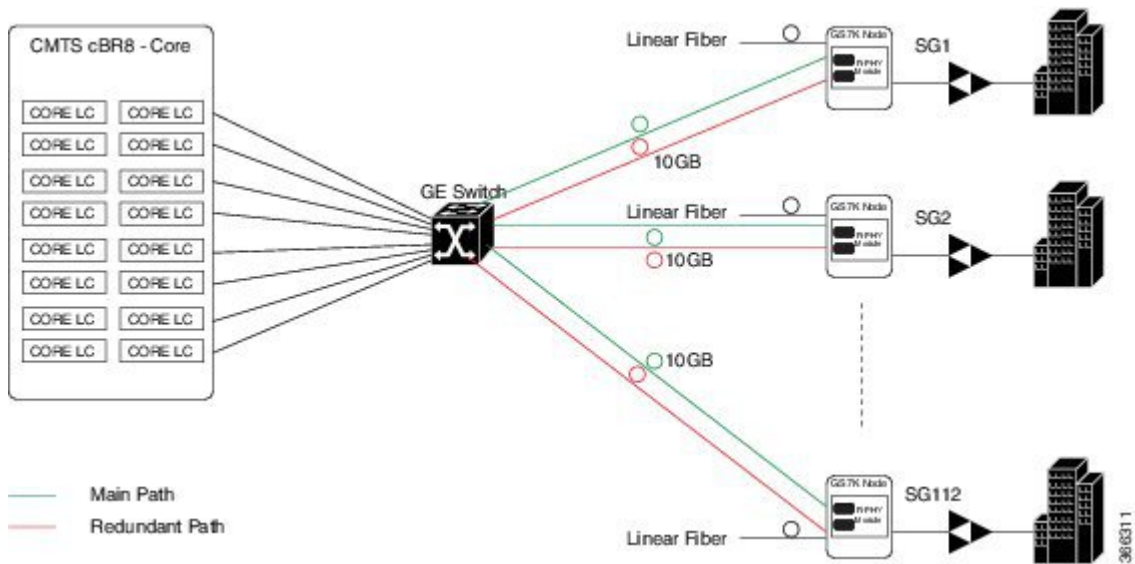
Figure 3: Standard Deployment



**Note** If you want to establish Equal-Cost Multi-Path (ECMP) connection between cBR-8 and RPD, pay attention to the ECMP configuration on both cBR-8 and the Converged Interconnect Network (CIN) routers. The number of maximum paths configured must be equal as or larger than the number of ECMP paths you want to set under the routing protocol for cBR-8 and the first adjacent CIN router.

## Other Supported Topologies

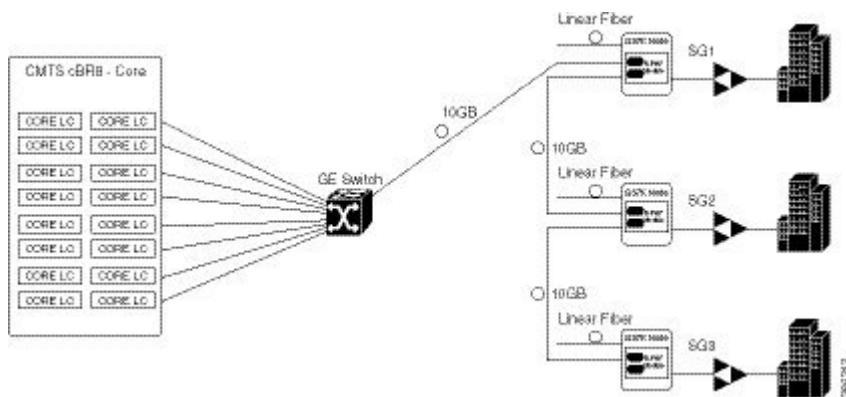
Figure 4: Path Redundancy Deployment



## Daisy Chain Architecture

Cisco Remote PHY devices support the daisy chain architecture. The daisy chain architecture includes multiple RPDs connected in series. This daisy chaining topology is transparent to CCAP core. The CCAP core is not notified about the chain topology because before the RPD sets up a GCP connection, notification flow is not configured.

Figure 5: Daisy Chain Deployment



### Limitations

- In the daisy-chaining topology, if one RPD in the chain is down or any link in the middle breaks, the RPD in the downstream is disconnected, until the chain is restored again.
- You must be careful when resetting or clearing an RPD, as the CCAP core is not notified about the chain topology. If you clear or reset an upstream RPD in a daisy-chain, all RPDs after that specific RPD will be disconnected until the upstream RPD boots up.

- Each RPD reset needs a reprogramming of the FPGA. The connection is interrupted during this reset.
- The daisy-chaining topology uses both 10G ports of an RPD. Hence, features like link redundancy and port redundancy which need a second port are not supported.
- You should ensure that the total upstream traffic from all RPDs in the chain is not oversubscribing the 10G ports.
- The last RPD in the chain is not allowed to connect back to the switch to avoid a ring.
- The maximum number of RPDs in the chain is limited to six.





## CHAPTER 2

# Cisco Remote PHY System Bring Up

### Finding Feature Information

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- [Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 9](#)
- [Information about Bring Up, on page 9](#)
- [How to Bring Up, on page 10](#)

## 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 2x2 Remote PHY Device*

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

## 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

This section describes how to bring up RPD on Cisco cBR-8.

## 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.

Design > DHCPv4 > Options

#### List/Add DHCP Option Definition Sets

Edit DHCP Option Definition Set rpd

Attribute	Value
Name*	rpd
DHCP Type*	V4
Description	
Vendor Option String	RPD
Vendor Option Regex String	
Vendor Option Enterprise Id	

366349

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



Design &gt; DHCPv4 &gt; Options

**List/Add DHCP Option Definition Sets**

Edit DHCP Option Definition Set *rpd*

*rpd* Option Definitions

List of Option Definitions for *rpd*

Number	Name
43	rpd-option-43
2	device-type
61	ccap-cores

366350

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

Design &gt; DHCPv4 &gt; Options

**List/Add DHCP Option Definition Sets**

Edit DHCP Option Definition Set *rpd*

*rpd* Option Definitions

Attribute	Value
Number*	61
Name*	ccap-cores
Description	
type*	IP address
repeat	1+

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.

DHCPv4 Vendor Options dhcp-cablelabs-config Select

Name	Number
Configured Options	[43] (rpd) rpd-option-43 (bin)

## 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:fecl: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 clock:

```
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 101
rf-chan 0 95
  type DOCSIS
  frequency 381000000
  rf-output NORMAL
  qam-profile 1
  docsis-channel-id 1

cable upstream controller 201
  us-channel 0 channel-width 1600000 1600000
  us-channel 0 docsis-mode atdma
  us-channel 0 minislots-size 4
  us-channel 0 modulation-profile 221
  no us-channel 1 shutdown

/* RPD configuration */
cable rpd node1
  identifier 0004.9f03.0061
  core-interface Te0/1/0
  rpd-ds 0 downstream-cable 0/0/0 profile 101
  rpd-us 0 upstream-cable 0/0/0 profile 201
  r-dti 1
  rpd-event profile 0

```

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

interface Cable0/0/0
  load-interval 30
  downstream Downstream-Cable 0/0/0 rf-channel 0-23
  upstream 0 Upstream-Cable 0/0/0 us-channel 0
  upstream 1 Upstream-Cable 0/0/0 us-channel 1
  upstream 2 Upstream-Cable 0/0/0 us-channel 2
  upstream 3 Upstream-Cable 0/0/0 us-channel 3
  cable upstream bonding-group 1
    upstream 0
    upstream 1
    upstream 2
    upstream 3
    attributes 80000001
    cable bundle 1
  cable ip-init ipv6
interface Wideband-Cable0/0/0:0
  cable bundle 1
  cable rf-channels channel-list 0-7 bandwidth-percent 10
interface Wideband-Cable0/0/0:1
  cable bundle 1
  cable rf-channels channel-list 8-15 bandwidth-percent 10
cable fiber-node 200
  downstream Downstream-Cable 0/0/0
  upstream Upstream-Cable 0/0/0
```





## CHAPTER 3

# Network Authentication

This document describes the Remote PHY device network authentication on the Cisco cBR Series Converged Broadband Router.

### Finding Feature Information

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- [Information about Network Authentication, on page 18](#)
- [How to Enable Network Authentication, on page 18](#)

## 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.

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# 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=0c53798f3b46014cc92a4c1151521ba6a14c98f91985e8c81a701b7272be7f812e7e5a75881768d74d311795a3b1f0e37bfa7fff7dc4685c86f216ec59850
```

```
uuid=ab722cfb-84dc-5835-a905-edfec20f78c3
```



## CHAPTER 4

# 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 21](#)
- [Information about Time Synchronization, on page 21](#)
- [How to Configure Time Synchronization, on page 22](#)
- [Configuration Examples, on page 29](#)
- [Feature Information for Synchronizing Time on R-PHY Devices, on page 30](#)

## 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 4: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device*

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

## 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) subordinate mode, in which the PTP subordinate 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-8.

- Cisco cBR-8 supports PTP subordinate on both SUP-PIC and DPIC.
- Cisco RPD PTP does not support pass-through mode. Pass-through mode means RPDs are communicating with PTP server through cBR-8, and cBR-8 is PTP unaware of the communication between RPDs with PTP server.

# How to Configure Time Synchronization

## 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 5: 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)	

Parameter	Description	Value Range	Default Value
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
rpd-55dl-us-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 ipcc1 log-history 0
platform punt-policer 10 10
platform punt-policer 10 10 high
platform punt-policer 80 10
platform punt-sbri1 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
  rpd-55d1-us-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    0
192.168.0.10   5588173 1843904 0    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
  rpd-55d1-us-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 [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn) link. An account on the [Cisco.com](http://Cisco.com) page is not required.



**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 6: Feature Information for Synchronizing Time on R-PHY Devices**

Feature Name	Releases	Feature Information
Synchronizing Time on R-PHY Devices	Cisco 2x2 RPD Software 2.x	This feature was introduced in the Cisco 2x2 Remote PHY Device.





## CHAPTER 5

# 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/>. An account at the <http://www.cisco.com/> site is not required.

- [Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 33](#)
- [Information about DEPI/UEPI/L2TP integration with RPD, on page 34](#)
- [How to Configure DEPI/UEPI/L2TP integration with RPD, on page 34](#)
- [Feature Information for DEPI/UEPI/L2TP integration with RPD, on page 36](#)

## 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 7: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device**

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

# 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 MHA v2 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 MHA v2 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
```



## Display DEPI Related 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 8: 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.

Field	Description
est in State	Established state.
P in Type	On primary line card.

## Feature Information for DEPI/UEPI/L2TP integration with RPD

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 [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn) link. An account on the [Cisco.com](http://Cisco.com) page is not required.



**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 9: Feature Information for DEPI/UEPI/L2TP integration with RPD*

Feature Name	Releases	Feature Information
DEPI/UEPI/L2TP integration with RPD	Cisco 2x2 RPD Software 2.x	This feature was introduced in the Cisco 2x2 Remote PHY Device.



## CHAPTER 6

# 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/>. An account at the <http://www.cisco.com/> site is not required.

- [Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 37](#)
- [Information about DEPI Latency Measurement, on page 38](#)
- [How to Configure DLM, on page 38](#)
- [Example: DLM Configuration, on page 39](#)
- [Feature Information for DLM, on page 39](#)

## 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 10: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device*

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

# 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 11: 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

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 [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn) link. An account on the [Cisco.com](http://Cisco.com) page is not required.



**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 12: Feature Information for DLM**

Feature Name	Releases	Feature Information
DLM	Cisco 2x2 RPD Software 2.x	This feature was introduced in the Cisco 2x2 Remote PHY Device.





## CHAPTER 7

# 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/>. An account at the <http://www.cisco.com/> site is not required.

- [Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 41](#)
- [Information about Multiple Cores, on page 42](#)
- [How to Configure Multiple Cores, on page 42](#)

## 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 13: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device*

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

## 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 multiple 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 downstream 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-55dl-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   Tel1/1/6     online     Pri  Act  node
0004.9f00.0907  120.100.2.20   Tel1/1/0     online     Aux  Act  node
0004.9f00.0907  120.100.2.20   Tel1/1/1     online     Aux  Act  node
0004.9f00.0907  120.100.2.20   Tel1/1/2     online     Aux  Act  node

```




---

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

---





## CHAPTER 8

# 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.

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/>. An account at the <http://www.cisco.com/> site is not required.

- [Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 45](#)
- [Information About GCPP Support, on page 46](#)
- [How to Configure GCPP Core, on page 47](#)
- [Configuration Example, on page 47](#)
- [Feature Information for GCPP Support, on page 48](#)

## 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 14: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device*

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

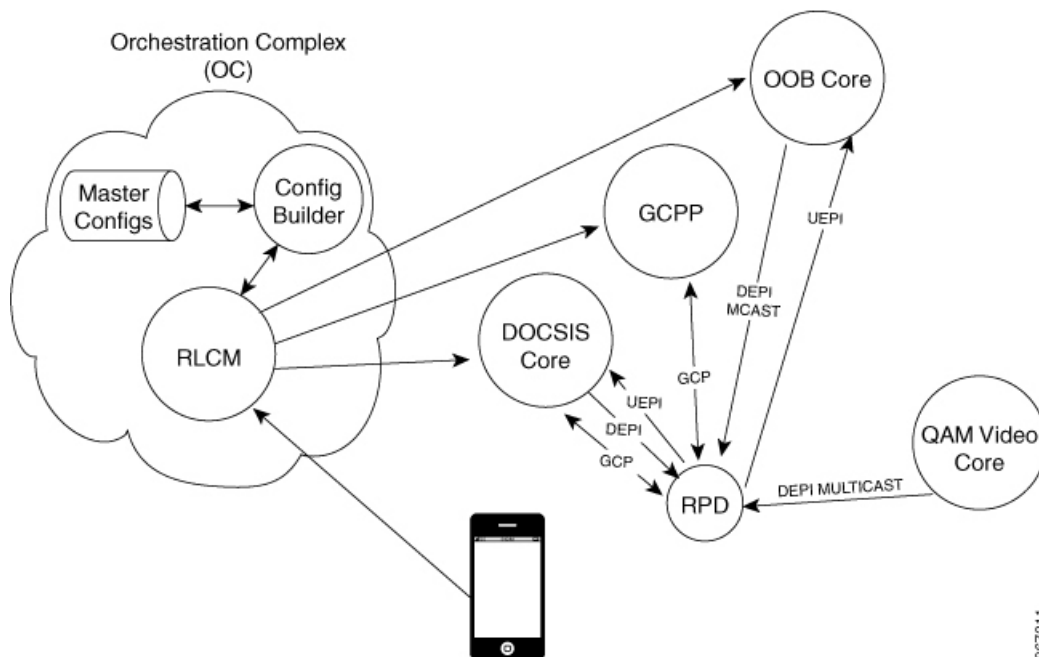
## Information About GCPP Support

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 6: Remote PHY Architecture with GCPP**



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## 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



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

## Feature Information for GCPP Support

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 [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn) link. An account on the [Cisco.com](http://Cisco.com) page is not required.



**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 15: Feature Information for GCPP Support**

Feature Name	Releases	Feature Information
GCPP Support	Cisco 2x2 RPD Software 2.x	This feature was introduced on the Cisco 2x2 Remote PHY Device.



## CHAPTER 9

# IKEv2 Mutual Authentication

This document describes the Remote PHY device IKEV2 mutual 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/>. An account at the <http://www.cisco.com/> site is not required.

- [Hardware Compatibility Matrix for Cisco Remote PHY Device](#), on page 49
- [Information about IKEv2 Mutual Authentication](#), on page 50
- [Configure IKEv2 Mutual Authentication](#), on page 50
- [Feature Information for IKEv2 Mutual Authentication](#), on page 51

## 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 16: Hardware Compatibility Matrix for the Cisco 2x2 Remote PHY Device*

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 BAU	Cisco 2x2 RPD Software 2.x and Later Releases Cisco Remote PHY Device 2x2 PID—RPD-2X2=

## Information about IKEv2 Mutual Authentication

When the RPD connects to the CCAP Core, a mutual authentication using IKEv2 with public key signatures is optionally required and a secure control session may be established which can be secured using IPsec.

Mutual authentication is optionally required between the RPD and CCAP Core, and a secure connection may not be required in all cases. 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.

Authentication is initiated by RPD. Whether the RPD is required to authenticate is under control of the CCAP Core.

## Configure IKEv2 Mutual Authentication

This section describes how to configure IKEv2 mutual authentication for RPD.



**Note** To know more about the commands referenced in this module, see the [Cisco IOS Master Command List](#).

## CMTS Side Configuration

### Global Configuration

To enable IKEv2 mutual authentication, use **cable rphy auth enable** command in the global configuration mode.

### Per PRD Configuration

To configure the IKEv2 mutual authentication per PRD, use **ikev2-core authentication {enable | disable | bypass}** command in the RPD configuration mode.

To display the authentication state, use **show cable rpd** command as shown in the following example:

```
Router#show cable rpd
Load for five secs: 5%/1%; one minute: 4%; five minutes: 5%
Time source is NTP, 10:08:45.016 CST Mon Sep 4 2017
MAC Address      IP Address      I/F      State      Role  HA    Auth  Name
0004.9f00.0719   6.6.6.100      Te6/1/2  online     Pri   Act   Y     p1_0719
0004.9f00.0719   6.6.6.100      Te6/1/1  online     Aux   Act   Y     p1_0719
badb.ad13.411c   6.6.6.101      Te6/1/2  onlissne   Pri   Act   Y     p2_411c
badb.ad13.411c   6.6.6.101      Te6/1/1  online     Aux   Act   Y     p2_411c
```



**Note** If RPD IKEv2 authentication is enabled, and RPD Core is authenticated, then the column of “auth” will show “Y”. If RPD IKEv2 authentication is enabled, and RPD Core is not authenticated, then the column of “auth” will show “N”. If RPD IKEv2 authentication is disabled, the column of “auth” will show “N/A”.



## RPD Node Side Configuration

To configure the IKEv2 mutual authentication on RPD node, use **ikev2 authentication {enable | disable}** command on RPD node.

To display the authentication configuration state, use **show ikev2** command as shown in the following examples:

```
R-PHY#show ikev2 configuration
IKEv2 authentication is currently enabled, next boot is enabled!

R-PHY#show ikev2 session
Local      Remote    Status
6.6.6.100  6.6.6.1   UP
```

## Feature Information for IKEv2 Mutual Authentication

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 [www.cisco.com/go/cfn](http://www.cisco.com/go/cfn) link. An account on the [Cisco.com](http://Cisco.com) page is not required.



**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 17: Feature Information for IKEv2 Mutual Authentication*

Feature Name	Releases	Feature Information
IKEv2 Mutual Authentication	Cisco 2x2 RPD Software 2.x	This feature was introduced in the Cisco 2x2 Remote PHY Device.

