Cisco Remote PHY System Overview

Finding Feature Information

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

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.

- Introduction, on page 1
- Hardware Compatibility Matrix for Cisco Remote PHY Device, on page 2
- Benefits, on page 3
- Cisco CCAP RF Line Card for R-PHY, on page 3
- Cisco Digital Physical Interface Card, on page 3
- Cisco Remote PHY Device, on page 5
- Network Architecture, on page 6
- Network Topologies, on page 6

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 Remote PHY Device

Cisco HFC Platform	Remote PHY Device
Cisco GS7000 Super High Output Node	**Cisco 1x2 / Compact Shelf RPD Software 2.1 and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2= **Cisco 1x2 / Compact Shelf RPD Software 2.1a and Later Releases** Cisco Remote PHY Device 1x2 • PID—RPD-1X2-PKEY=
Cisco GS7000 Super High Output Intelligent Node (iNode)	**Cisco 1x2 / Compact Shelf RPD Software 4.1 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.

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.

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 and conforms to the Integrated CMTS (I-CMTS) architecture. 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.

Table 2: Physical Specifications of the DPIC

Unit	Dimensions
Width	10.96 in (27.8cm)
Height	1.43 in (3.6cm)
Depth	7.32 in (18.6cm) with handle
Weight	2.943lb (1.335kg)

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

The faceplate of the Cisco DPIC has the following:

- Optic Cable Clip—Helps route and manage the optic cables.
- 8 x SFP+ ports—Used as 8 x 10GE lanes for DOCSIS traffic to the Cisco RPDs.
- 10GE Link Status LED—Indicates the status of the 10GE link.
- Status LED—Indicates the status of the Cisco DPIC.
- Replace LED—Indicates the Cisco DPIC must be replaced.

Onboard Failure Logging

The Onboard Failure Logging (OBFL) feature enables the storage and collection of critical failure information in the nonvolatile memory of a Field Replaceable Unit (FRU), like a route processor (RP) or line card. The data stored through OBFL assists in understanding and debugging the field failures upon Return Material Authorization (RMA) of a RP or line card at repair and failure analysis sites. OBFL records operating temperatures, voltages, hardware uptime, and any other important events that assist board diagnosis in case of hardware failures.

For more information about the feature, see Onboard Failure Logging.

Note The sample output provided in the Onboard Failure Logging guide may vary slightly for the Cisco CMTS routers.

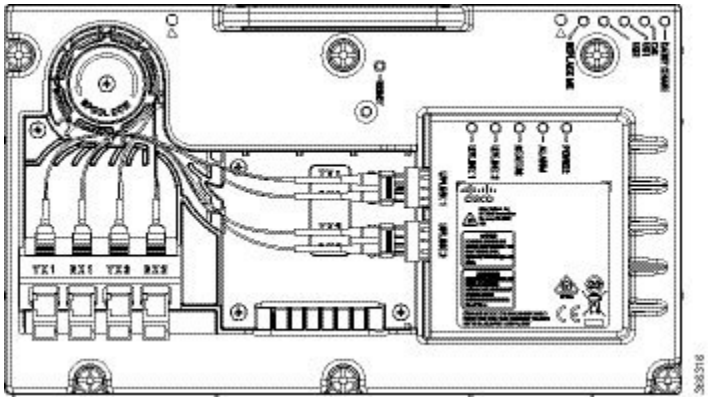
Cisco Remote PHY Device

The Cisco Remote PHY Device (RPD) has two variants – The standard RPD and the newer Intelligent RPD (iRPD). The standard RPD resides inside the Cisco GS7000 node while the Intelligent RPD (iRPD) resides inside the Intelligent 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.

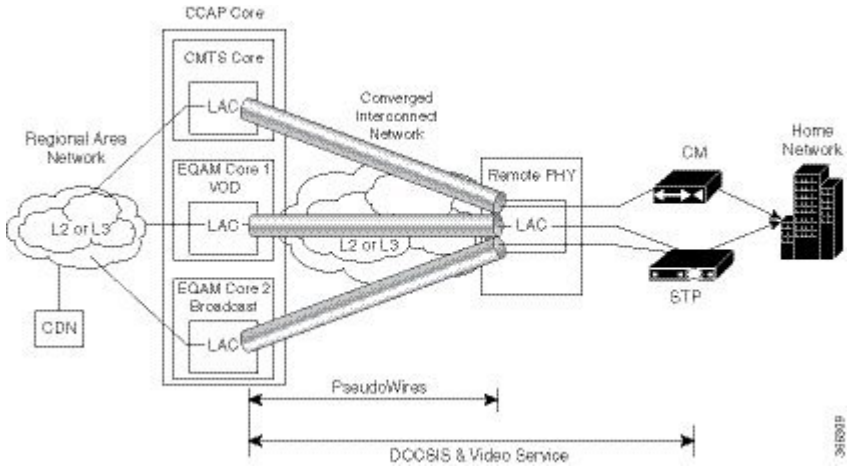
Figure 1: Cisco RPD



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.

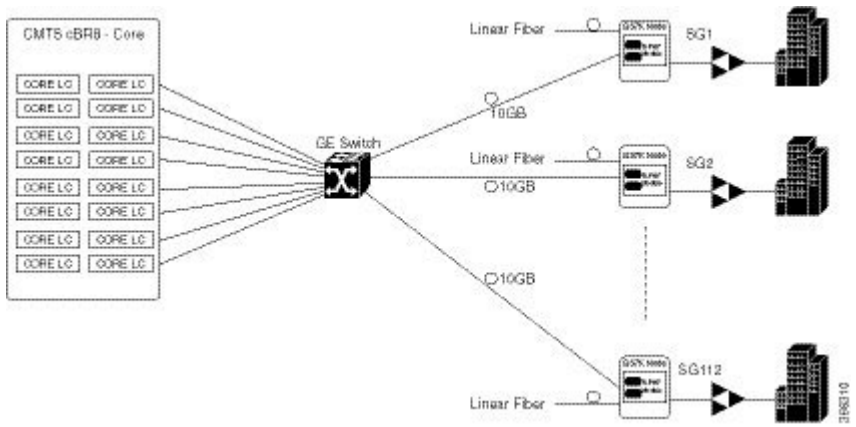
Figure 2: Single Controller Sharing Architecture



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.

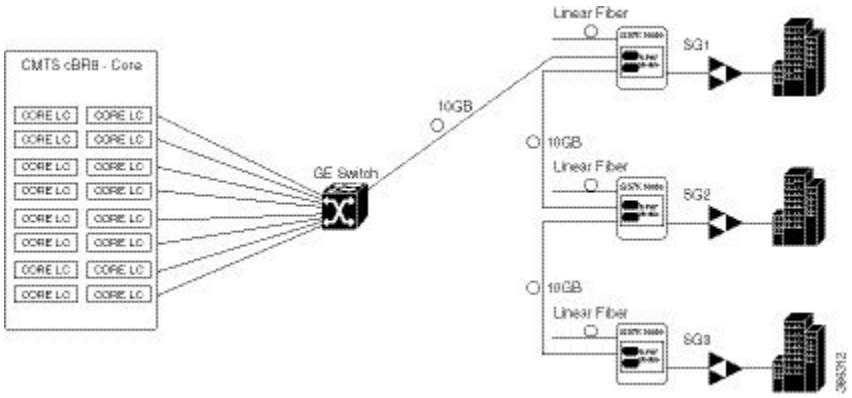
Other Supported Topologies

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 reprograming 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.