



Cisco DOCSIS 3.0 Downstream Solution Overview for the Cisco M-CMTS

This chapter provides an overview of the Cisco DOCSIS 3.0 Downstream (DS) Solution for the Cisco Modular Cable Termination System (M-CMTS), and contains the following major topics:

- [Description and Scope, page 2-3](#)
- [Cisco DOCSIS 3.0 DS Solution Key Features, page 2-7](#)
- [Cisco DOCSIS 3.0 DS Solution Components, page 2-10](#)



Note

In this chapter, the terms wideband channel, bonded channel, and bonding group refer to a logical grouping of one or more physical RF channels where the MPEG-TS packets are carried.



Note

The SPA-24XDS-SFP SPA in this chapter is referred to as the Cisco Wideband SPA, unless specified otherwise.

Description and Scope

The Cisco Wideband SPA and Cisco uBR-MC3GX60V line card support Cisco M-CMTS DS channels. In the Cisco M-CMTS implementation, the DS channels are aggregated and encapsulated for the Gigabit Ethernet using the Downstream External PHY Interface (DEPI) protocol as defined by DOCSIS M-CMTS.

In case of the Cisco Wideband SPA, the DS channels can be referred to as SPA DS channels to differentiate them from the Cisco cable interface line card downstream channels. The Cisco M-CMTS DS channels can be used either as primary-capable channels (narrowband channels), or as part of bonded channels (wideband channels), or both. The Cisco DOCSIS 3.0 Downstream Solution provides narrowband data services to support DOCSIS 1.x and DOCSIS 2.0 modems and wideband data services to support DOCSIS 3.0 modems over existing hybrid fiber-coaxial (HFC) networks, and it also enables the DOCSIS 1.x, DOCSIS 2.0 and DOCSIS 3.0 modems to share the same Cisco M-CMTS DS channel.

With the wideband data services, multiple M-CMTS DS channels are aggregated into a single logical wideband channel (bonding group) that delivers higher bandwidth to the wideband cable modem than was not previously possible with DOCSIS 2.0 Solution. This aggregation of the M-CMTS DS channels is referred to as channel bonding.

The maximum bandwidth supported depends on the number of M-CMTS DS channels that can be aggregated into a wideband channel. The Cisco IOS Release 12.2(33)SCE has been tested with modems with up to eight DS channels. Some examples of modems tested with the solution are:

- The Scientific Atlanta DPC3010 wideband cable modem supports downstream throughput of 300 Mbps (with a wideband channel consisting of eight RF channels at 6 MHz and 256 QAM). In the upstream path, the DPC3010 has four channels all bondable and supporting approximately 100 Mbps of upstream traffic.)
- The Scientific Atlanta DPC2505 wideband cable modem supports downstream throughput of over 100 Mbps (with a wideband channel consisting of 3 RF channels at 6 MHz and 256 QAM on an Annex B cable plant).

Compatibility with Prior Versions of DOCSIS

The Cisco DOCSIS 3.0 Downstream Solution can be deployed in parallel with DOCSIS 1.x and DOCSIS 2.0 modem technology. The Cisco uBR-MC5X20 cable interface line card along with CISco Wideband SPA, supports DOCSIS 1.x, DOCSIS 2.0, and DOCSIS 3.0 cable modems on SPA primary-capable downstream channels and SPA bonded channels. The Cisco uBR-MC3GX60V cable interface line card also supports DOCSIS 1.x/2.0 and DOCSIS 3.0 cable modems on primary-cable downstream channel and bonded channels.

Cisco DOCSIS 3.0 Solution Capabilities

The Cisco DOCSIS 3.0 DS Solution provides the following capabilities:

- Primary-capable DS channels that are provided by Cisco Wideband SPA and Cisco uBR-MC3GX60V cable interface line card. Primary-capable channels carry the proper signalling to register and maintain DOCSIS modems. Non-primary-capable channels are used only to bear data traffic. A modem must be able to tune to at least one frequency that carries a primary-capable channel.

Primary-capable channels on the Wideband SPA DS channels (also known as SPA RF channels) are associated with the upstream channels from the cable interface line cards (for example, Cisco uBR10-MC5X20 line card). To be primary-capable, these downstream channels carry SYNC messages, Upstream Channel Descriptors (UCD), and Mini-slot Allocation Packet (MAP) messages for at least one upstream channel. They may also carry primary MAC Domain Descriptor (MDD) messages for DOCSIS 3.0 modems.

This capability provides following advantages:

- Increases legacy downstream port density.
- Allows legacy and bonded modems to share the same SPA DS channels.
- Supports 3-channel bonding for 3-channel modems and 8-channel bonding for Linksys modems on the SPA DS channels.
- Extensible MAC domain for the Cisco uBR10-MC5X20 and Cisco uBR-MC3GX60V cable interface line cards. This capability has following advantages:
 - Provides support for multiple primary-capable channels per MAC domain.
 - Allows flexible upstream and downstream associations within a MAC domain.
 - Allows association of bonded channel to MAC domains.
- Primary-capable DS channel selection—Provides primary-capable DS channel selection to facilitate channel bonding and reliability of voice-enabled modems.

- High availability—Provides high availability support for modems on SPA DS channels and Cisco uBR-MC3GX60V cable interface line card.
- DOCSIS 1.x, DOCSIS 2.0, and legacy feature support on Cisco Wideband SPA DS channels.
- DOCSIS 3.0 is supported on Cisco Wideband SPA DS channels and Cisco uBR-MC3GX60V cable interface line card.

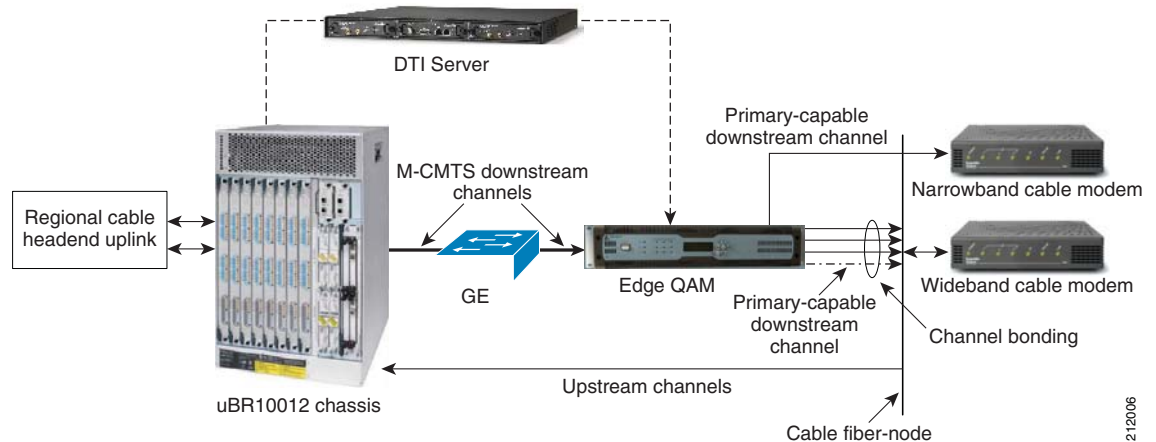
Architecture and Scope

The Cisco DOCSIS 3.0 DS Solution includes these major components:

- Wideband cable modem termination system (WCMTS)—Cisco uBR10012 router
The WCMTS is the component located at the cable television system headend or distribution hub and exchanges digital signals with cable modems in a cable network to enable data connectivity to a WAN.
- Cisco Wideband SPA and Cisco Wideband SIP
The Cisco Wideband SIP for the 1-Gbps Wideband SPA is a carrier card that is installed in the Cisco uBR10012 router chassis in slots 1/0, slot 3/0, or both. The SIP provides no network connectivity on its own. The Cisco Wideband SPA that inserts into the bay of the SIP provides ports for network connectivity. It enables cable operators to offer high-speed broadband connectivity.
- Cable interface line cards—Cisco uBR-MC5X20S/U/H and Cisco uBR-MC3GX60V
For more information about the Cisco uBR-MC5X20 line card, see *Configuring the Cisco uBR-MC5X20 Cable Interface Line Card* at the following URL:
http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr10_mc5x20s_u_h/feature/guide/mc5x20u.html
For more information about the Cisco uBR-MC3GX60V line card, see *Configuring the Cisco uBR-MC3GX60V Cable Interface Line Card* at the following URL:
http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr_mc3gx60v/configuration/guide/mc3g60_cfg.html
- DOCSIS Timing and Control Card (DTCC)
The DTCC provides centralized DOCSIS clock and time-stamp distribution to the cable interface line cards within the WCMTS. This card allows synchronization of the DOCSIS clock and time stamp to an external DTI server.
- DOCSIS Timing Interface (DTI) server
The DTI server provides DOCSIS clock generation in an M-CMTS architecture. It ensures that the DOCSIS time stamp and frequency between the M-CMTS core, edge QAM device, and upstream are synchronized to nanosecond levels.
- Edge QAM device
The edge quadrature amplitude modulation (EQAM) device is a network element that is separate from the Cisco CMTS. It allows operators to leverage the same network resources to support multiple types of services, such as data, voice, and video.
- Wideband cable modem (WCM)
WCMs are modems that are DOCSIS 3.0-compliant and support DS channel bonding.
- Narrowband cable modem (NCM)
NCMs are modems that are DOCSIS 1.x/2.0-compliant and support data from a single RF channel.

Figure 2-1 presents a simplified view of the Cisco DOCSIS 3.0 DS Solution. In Figure 2-1, four RF channels are bonded into a wideband channel (bonding group).

Figure 2-1 Cisco DOCSIS 3.0 Downstream Solution



In Cisco IOS Release 12.2(33)SCB, the following components have been added to the scope of the Cisco DOCSIS 3.0 DS Solution:

- Cisco 10000 SIP-600 SPA Interface Processor

The Cisco SIP-600 is a high-performance, feature-rich SIP that functions as a carrier card for Wideband SPAs on the Cisco uBR10012 router. The SIP is compatible with one or more platform-independent SPAs.

- Gigabit Ethernet SPA

In addition to the Cisco Wideband SPA, the Cisco SIP-600 also supports the following Gigabit Ethernet SPAs:

- 5-Port Gigabit Ethernet SPA
- 1-Port 10-Gigabit Ethernet SPA (supported on PRE4 only)

In Cisco IOS Release 12.2(33)SCE, the Cisco uBR-MC3GX60V cable interface line card has been added to the scope of the Cisco DOCSIS 3.0 DS solution.

Starting with Cisco IOS Release 12.2(33)SCG, MAC domains hosted on the Cisco uBR-MC3GX60V cable interface line card can include DS channels from the Cisco Wideband SPAs. The Cisco uBR-MC3GX60V cable interface line cards and the Cisco Wideband SPA can now coexist on a single chassis and share DS channels. For more information on how to configure the Cisco Wideband SPA with the Cisco uBR-MC3GX60V cable interface line card, see *Configuring the Cisco uBR-MC3GX60V Cable Interface Line Card* at the following URL:

http://www.cisco.com/en/US/docs/interfaces_modules/cable/broadband_processing_engines/ubr_mc3gx60v/configuration/guide/mc3g60_cfg.html

Cisco DOCSIS 3.0 DS Solution Scope

The scope of the Cisco DOCSIS 3.0 DS Solution comprises fully tested and supported Cisco and Scientific Atlanta components, as well as selected third-party components that Cisco has tested for interoperability.

The following aspects of the Cisco DOCSIS 3.0 DS Solution are in scope:

- DOCSIS 3.0 DS software
- Wideband CMTS (Cisco uBR10012 router)
- Cable interface and network uplink line cards
- Cisco Wideband SIP and Cisco Wideband SPA
- DTCC
- DTI server
- Edge QAM device
- Narrowband cable modem
- Wideband cable modem
- DOCSIS 1.x, DOCSIS 2.0 and DOCSIS 3.0 cable modem configuration file parameters
- Cisco IOS command set for wideband channel configuration, provisioning, and maintenance
- Cisco IOS command set for wideband hardware monitoring, troubleshooting, and debugging
- MIBs for the wideband CMTS, wideband cable modem, and wideband channel and service statistics

Device configuration that is in scope for this document is limited to the Cisco uBR-MC3GX60V cable interface line card, Cisco Wideband SIP, and Cisco Wideband SPA.

Comprehensive documentation for other Cisco CMTS components is provided in the existing Cisco uBR10012 documentation set, which is accessible at www.cisco.com.

For information on Edge QAM device installation and software configuration, refer to the Edge QAM device documentation provided by the vendor.

Out of Scope

The Cisco DOCSIS 3.0 DS Solution related information in this document pertains to the components listed in the “[Cisco DOCSIS 3.0 DS Solution Scope](#)” section. The hardware and software components that make up the remainder of the cable data network, are not included in the scope of the Cisco DOCSIS 3.0 DS Solution.

For the Cisco DOCSIS 3.0 DS Solution, the cable network management tools and operations support system (OSS) facilities for wideband cable, are outside the scope of the solution.

Cisco DOCSIS 3.0 DS Solution Key Features

For each major release, key features are listed in the following sections.

Starting with Cisco IOS Release 12.3(23)BC, the Cisco DOCSIS 3.0 DS Solution provides the following key features:

- Primary-capable Wideband SPA DS channels
 - Modular-cable interfaces
Represents the narrowband capability of a SPA DS channel.
 - DOCSIS 1.x and DOCSIS 2.0 cable modem support on primary-capable SPA DS channels
Primary-capable channels provide narrowband data services to support DOCSIS 1.x and DOCSIS 2.0 modems.

- Increased port density

Provides up to 48 SPA DS channels plus 40 built-in DS channels in addition to the DS channels on the Cisco uBR10-MC5X20 cable interface line cards for DOCSIS 1.x and DOCSIS 2.0 traffic.
- SPA DS channel sharing

Provides narrowband data services to support DOCSIS 1.x and DOCSIS 2.0 modems and wideband data services to support DOCSIS 3.0 cable modems over HFC networks; it also enables DOCSIS 1.x, DOCSIS 2.0 and DOCSIS 3.0 cable modems to share the same SPA RF channel.
- Enhancements to SPA DS channels
 - Annex and modulation configurable for individual SPA RF channels
 - Layer 2 Transport Protocol (L2TP) encapsulation support on Downstream External PHY Interface (DEPI)
 - Each Cisco Wideband SPA can support up to 24 downstream RF channels and 32 logical wideband channels (bonding groups).
 - Extensible MAC domain construction using Channel Grouping Domain (CGD)
 - Flexible association of primary-capable SPA DS channels with upstream channels within the same MAC domain
- DOCSIS 1.x, DOCSIS 2.0 and legacy feature support on primary-capable SPA DS channels
 - Load balancing
 - Virtual interface bundling
 - Full DOCSIS Quality of Service (QoS)
 - Committed Information Rate (CIR) Admission Control
 - Bonded multicast
 - Non-bonded multicast
 - DOCSIS Set-top Gateway (DSG)
 - Subscriber Accounting and Management Interface Specification (SAMIS)
 - Multiprotocol Label Switching (MPLS) and Virtual Private Network (VPN)
 - Baseline Privacy Interface (BPI) and Baseline Privacy Interface Plus (BPI+)
 - Payload Header Suppression (PHS)
 - Packet Cable and PacketCable™ Multimedia (PCMM)
 - Cable modem flaplist
 - Source verify (with Dynamic Host Configuration Protocol [DHCP] option)
 - Computer Assisted Law Enforcement Act (CALEA), Service Independent Intercept (SII), and Packet Intercept
 - Cable modem remote query
 - DOCSIS packet filters
 - Cable Address Resolution Protocol (ARP)
- Channel bonding of downstream channels from the SPA for DOCSIS 3.0 cable modem support.
- Downstream channel selection

- Provides support for voice-enabled cable modems
- Existing Cisco uBR10012 router can be upgraded to wideband CMTS with add-on components.
- Cisco DOCSIS 3.0 DS Solution supports timing synchronization to the DTI server using DTCC.
- The Cisco Wideband SPA supports external Gigabit Ethernet interface to connect to the EQAM device directly or through the network.
- Cisco uBR10012 router (CMTS) supports up to two Cisco Wideband SPAs in a Wideband SIP.
- Cisco Wideband CMTS and line cards have built-in redundancy and resiliency features.
- Harmonic NSG 9000 edge QAM device is tested for interoperability.
- The Symmetricom TimeCreator 1000 DTI server is tested for interoperability.
- Linksys WCM300-NA, WCM300-EURO (for EuroDOCSIS), and WCM300-JP (for J-DOCSIS) wideband cable modems support the receiving of up to eight RF channels, which can be bonded into wideband channels. One traditional DOCSIS DS channel is used for MAC management and signaling messages.
- Linksys WCM300-NA, WCM300-EURO, and WCM300-J wideband cable modems support one primary bonded (wideband) channel for unicast and multicast traffic and up to two secondary bonded channels for multicast traffic.
- Scientific Atlanta DPC2505 and EPC2505 wideband cable modems support one bonded DS channel consisting of three RF channels, of which one RF channel is a primary DS channel that is used for cable modem registration.

Starting with Cisco IOS Release 12.2(33)SCB, the following additional features are supported on the Cisco DOCSIS 3.0 DS Solution:

- DOCSIS WFQ Scheduler

The DOCSIS WFQ Scheduler is an output packet scheduler that provides output scheduling services on both WAN uplink interfaces and DOCSIS DS interfaces.
- CMTS Dynamic Bandwidth Sharing

This new Cisco CMTS feature enables dynamic bandwidth sharing (DBS) on modular cable and wideband cable interfaces.
- Voice support on wideband modems

CMTS supports voice services on voice-enabled wideband cable modems.
- Wideband Modem Resiliency

The Wideband Modem Resiliency feature provides the best possible service in the event of non-primary RF channel disruptions to ensure that a cable modem remains operational. With the implementation of this feature, the Cisco CMTS does not force a cable modem to perform a MAC reset if the CM loses connectivity to the Cisco CMTS on one or all of its non-primary RF channels.
- DOCSIS 3.0 DS Bonding for Bronze Certification

The DOCSIS 3.0 DS Bonding for Bronze Certification feature helps cable operators offer new, more bandwidth-intensive services by adding one or more additional DS QAM channels to the standard broadband DOCSIS system.

In Cisco IOS Release 12.2(33)SCE, apart from the features supported in Cisco IOS Release 12.2(23)BC and Cisco IOS Release 12.2(33)SCB, the following additional features are supported on the DOCSIS 3.0 DS Solution:

- Cisco uBR-MC3GX60V cable interface line card support
- N+1 Redundancy for the Cisco uBR-MC3GX60V cable interface line card

**Note**

Starting with Cisco IOS Release 12.2(33)SCE1, the N+1 redundancy feature including DEPI redundancy is supported on the Cisco uBR-MC3GX60V cable interface line card.

- M-CMTS simplification statistics
- Automatic DOCSIS Channel ID Assignment

In Cisco IOS Release 12.2(33)SCG, apart from the features supported in the previous Cisco IOS releases, the following additional feature is supported on the Cisco DOCSIS 3.0 DS solution:

- Cisco Wideband SPA and Cisco uBR-MC3GX60V line card can share downstream channels. The MAC domains hosted on the Cisco uBR-MC3GX60V cable line card can include downstream channels from the Cisco Wideband SPAs.

**Note**

Unless otherwise specified, the information given in this document for the Cisco M-CMTS DS solution using the Cisco Wideband SPA with the Cisco uBR10-MC5X20 line card is applicable to the Cisco M-CMTS DS solution using the Cisco Wideband SPA and the Cisco uBR-MC3GX60V line card.

Cisco DOCSIS 3.0 DS Solution Components

Cisco DOCSIS 3.0 Downstream consists of Cisco and Scientific Atlanta components that are tested, documented, and fully supported by Cisco or Scientific Atlanta. Also, third-party equipment, although not fully supported by Cisco, has been selected and tested for interoperability with the solution components.

Cisco and Scientific Atlanta Equipment

For the Cisco DOCSIS 3.0 DS solution, the following Cisco and Scientific Atlanta equipment have been tested in the context of the solution:

- Cisco uBR10012 universal broadband router with route processor (PRE) modules and the following components:
 - Cisco SIP for the 1-Gbps Wideband SPA—Referred to in this document as the Cisco Wideband SIP or Wideband SIP
 - Cisco 1-Gbps Wideband SPA—Referred to in this document as the Cisco Wideband SPA or Wideband SPA
 - Cisco uBR10-MC5X20S/U/H, Cisco uBR10-MC5X20U-D or Cisco uBR-MC3GX60V cable interface line cards.

**Note**

The Cisco uBR-MC3GX60V cable interface line card cannot be used with PRE2.

- Wideband cable modem
 - Linksys WCM300-NA, WCM300-EURO, and WCM300-JP wideband cable modems Scientific Atlanta DPC2505 and EPC2505 wideband cable modems
 - Scientific Atlanta DPC3000 and DPC3010 modems
- Cisco RF Gateway 1 and Cisco RF Gateway 10

Third-Party Equipment

For the Cisco DOCSIS 3.0 DS Solution, [Table 2-1](#) lists the third-party component, vendor, and the basic functionality provided by each component.

Table 2-1 *Component Partners and Basic Functionality*

Component and Vendor	Basic Functionality
Symmetricon TimeCreator 1000 www.symmetricon.com	DTI Server
Harmonic NSG 9000 www.harmonicinc.com	Edge QAM device

