Cisco Cable Wideband Components

This chapter describes the components of the Cisco Cable Wideband Solution, Release 1.0, and contains the following topics:

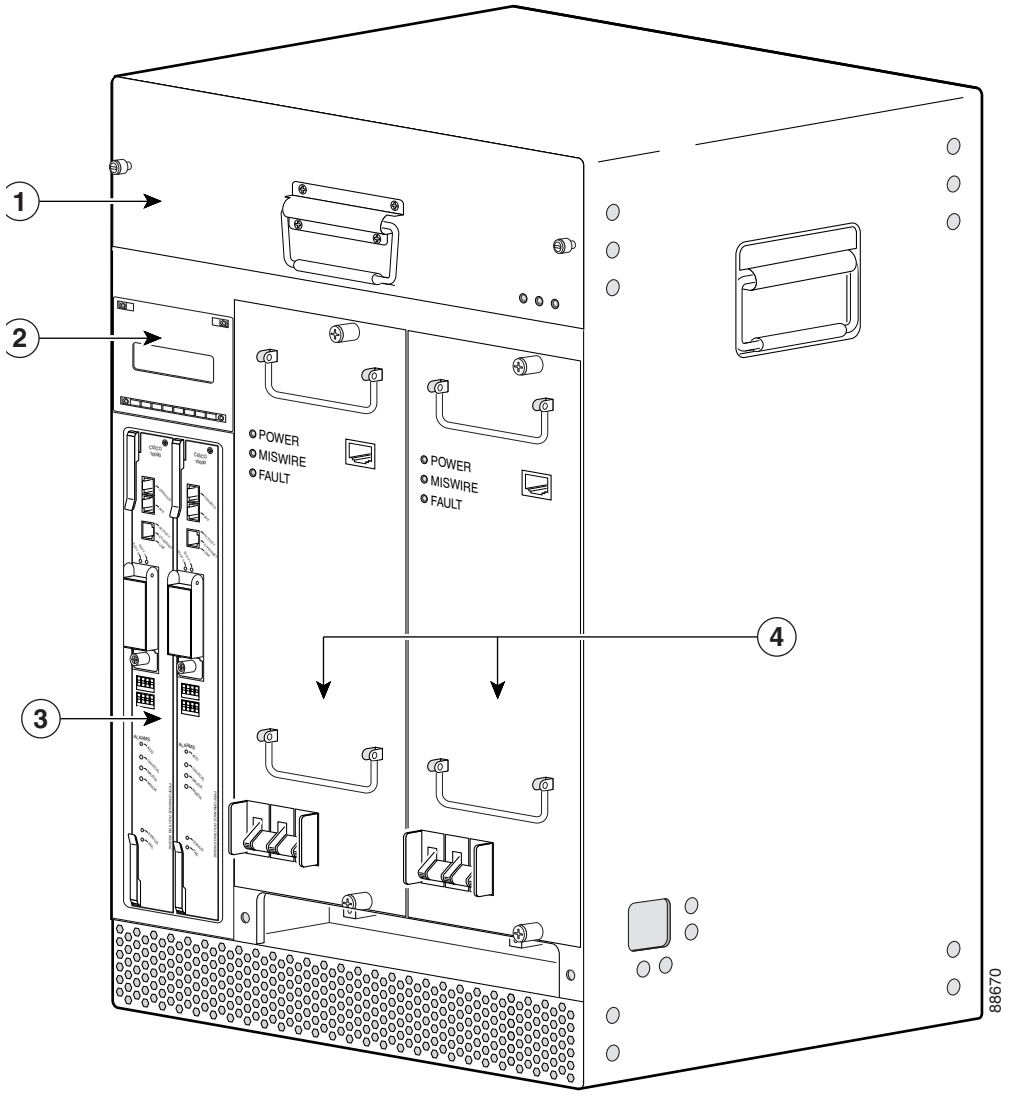
Cisco Cable Wideband Add-on Components

The Cisco uBR10012 router can be used as a DOCSIS 1.x/2.0 CMTS and, in this mode, does not need any wideband components. Wideband cable components can be added to the Cisco uBR10012 base system so that it can be used as a wideband CMTS. As demand for wideband cable grows, this ability to increase capacity by adding wideband components to an existing uBR10012 base system is less expensive than adding additional chassis. This Cisco Cable Wideband Solution add-on strategy reduces both capital expenditure and operational expenses.

Base CMTS Components

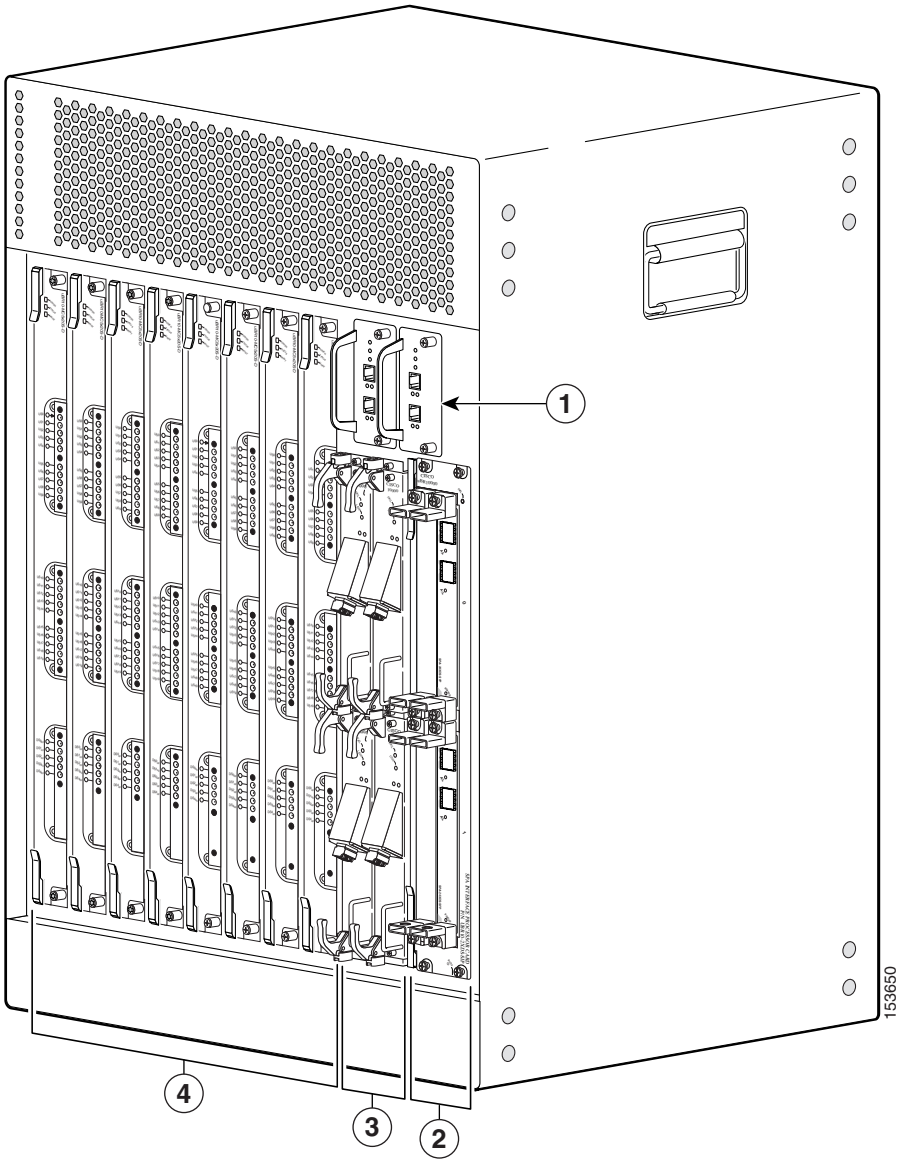
For the Cisco Cable Wideband Solution, Release 1.0, the Cisco uBR10012 router (Figure 2-1 and Figure 2-2) is the wideband cable modem termination system (WCMTS). The CMTS may be located at the cable headend or at a distribution hub. The Cisco Cable Wideband Solution uses the modular CMTS (M-CMTS) architecture with one or more external edge QAM (EQAM) devices.

Figure 2-1 Wideband CMTS: Cisco uBR10012 Router—Front View without Front Cover



1	Fan assembly module	**3**	Two Performance Routing Engine 2 (PRE2) processor modules
2	LCD module	**4**	Two DC Power Entry Modules (DC PEMs)

Figure 2-2 Wideband CMTS: Cisco uBR10012 Router —Rear View



1	Two Timing, Communication, and Control Plus (TCC+) cards	**3**	Four Half-Height Gigabit Ethernet line cards
2	One Wideband SIP with two Wideband SPAs	**4**	Eight uBR10-MC5X20S/U/H or uBR10-MC5X20U-D cable interface line cards

Figure 2-2 shows a fully loaded uBR10012 chassis. The minimum number of components needed for base CMTS or wideband CMTS operation is less than shown in Figure 2-2. For information on minimum and recommended hardware requirements, see the "Base CMTS Component Requirements" section on page 2-4 and the "Wideband CMTS Components" section on page 2-8.

Base CMTS Component Requirements

For the Cisco uBR10012 base system, Table 2-1 lists the minimum and recommended hardware configurations for major components. The base system can be used as a DOCSIS 1.x/2.0 CMTS and can be upgraded to a wideband CMTS. In the Recommended column, the number of components ensures that the Cisco uBR10012 router has component redundancy where it is available.

Cisco IOS Release 12.3(21)BC or later is required for wideband cable functionality.

Table 2-1 Cisco uBR10012 Base System: Minimum and Recommended Hardware

Component	Minimum	Recommended
Performance Routing Engine 2 (PRE2) Part number: ESR-PRE2/R	1	2
Timing, Communication, and Control Plus card (TCC+) Part number: UBR10-TCC+-T1	1	2
DC Power Entry Modules (DC PEMs) Part number: UBR10-PWR-DC (Primary) UBR10-PWR-DC\R (Redundant) OR AC Power Entry Modules (AC PEMs) Part number: UBR10-PWR-AC (Primary) UBR10-PWR-AC\R (Redundant)	1	2
Fan assembly module Part number: UBR-10-FAN-ASSY	1	1
LCD module Part number: UBR10-DSPL	1	1
Cable Interface Line Cards and Network Uplink Line Cards		
uBR10-MC5X20S/U/H or uBR10-MC5X20U-D cable interface line card Part number: uBR10-MC5X20S uBR10-MC5X20U uBR10-MC5X20H uBR10-MC5X20U-D	1	At least 2*
Half-Height Gigabit Ethernet (HHGE) network uplink line card Part number: ESR-HH-1GE	1	At least 2*
Slot splitter card (One is required for each two HHGE line cards.)	1	Varies*

* The number of line cards and slot splitter cards required will vary depending on the set of services and number of subscribers being supported.

The Cisco Gigabit Ethernet network uplink line card (part number UBR10-1GE) is also supported as a base CMTS component. It is a full-height line card that, for use with a Wideband SIP and SPA, should be installed in slot 3/0 or 4/0 of the uBR10012 router. However, the (full-height) Cisco Gigabit Ethernet line card is not recommended as a uBR10012 base system component for Wideband Cable because only two full-height Gigabit Ethernet line cards can be installed in the chassis. The uBR10012 chassis will support four Half-Height Gigabit Ethernet (HHGE) line cards in slots 3/0 and 4/0.

Cable Interface Line Cards and Network Uplink Line Cards

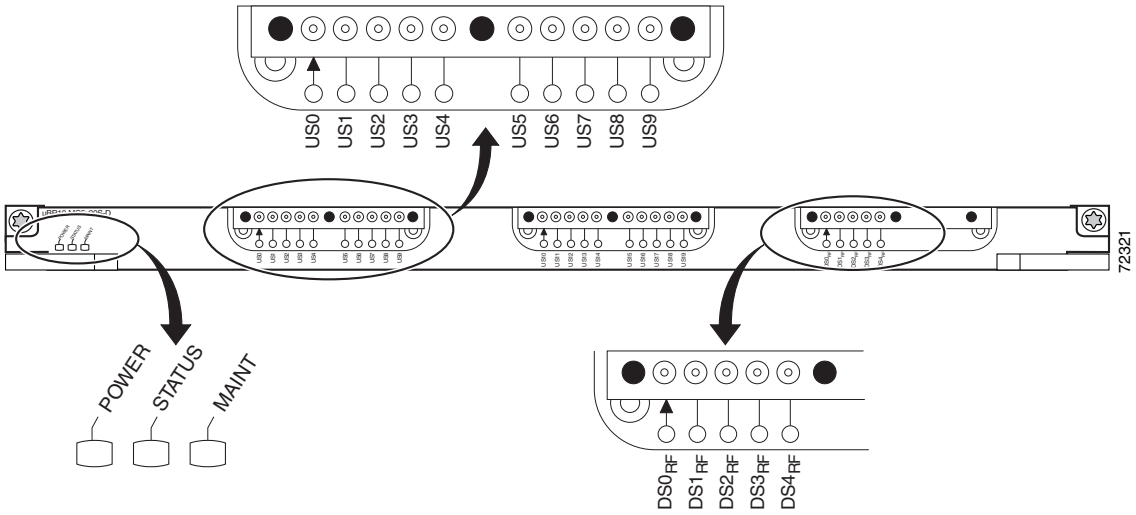
The cable interface line cards and network uplink line cards used on the Cisco uBR10012 base system are described in the following sections:

- Cisco uBR-MC5X20S/U/H and uBR10-MC5X20U-D Cable Interface Line Cards, page 2-5
- Cisco Half-Height Gigabit Ethernet Line Card, page 2-7

Cisco uBR-MC5X20S/U/H and uBR10-MC5X20U-D Cable Interface Line Cards

The Cisco uBR10-MC5X20S/U/H and uBR10-MC5X20U-D cable interface line cards transmit and receive RF signals between the subscriber and the headend over hybrid fiber/coax (HFC) network. Figure 2-3 shows the faceplate for these line cards.

Figure 2-3 Cisco uBR10-MC5X20S/U/H or uBR10-MC5X20U-D Cable Interface Line Card Faceplate



The Cisco uBR-MC5X20S/U/H and uBR10-MC5X20U-D cable interface line cards can be used for a standard DOCSIS 1.X/2.0 service or for a Cisco Cable Wideband service or for a combination of the two. These cable interface line cards support upstream and downstream traffic over DOCSIS-based cable modem networks.

For a DOCSIS 1.X/2.0 and for Cisco Cable Wideband Solution, Release 1.0, operation, upstream data from the subscriber comes through the upstream ports (US0-US19) on the line cards. The line card processes and configures the data and sends it across the backplane to the WAN/backhaul card and out to the Internet.

For a DOCSIS 1.X/2.0 system, downstream data to the subscriber, comes from the Internet through the WAN/backhaul card, and across the backplane to the cable interface line card. The cable interface card processes and configures the data and sends it out through the appropriate downstream port (DS0 - DS4) to be combined with the rest of the downstream signals in the headend.

For Cisco Cable Wideband Solution, Release 1.0 bonded channel operation, the cable interface line cards are used for upstream return traffic and signalling, for downstream MAC management and signaling traffic, and for DOCSIS 3.0 Downstream Channel Bonding operations. With wideband, the use of the cable interface line card's downstream channel is different than for a DOCSIS 1.X/2.0 system. The wideband channel's downstream data traffic uses the Cisco Wideband SPA and an external edge QAM device. See Chapter 3, "Cisco Cable Wideband Architecture" for more information on Cisco Cable Wideband systems.

Cisco uBR10-MC5X20S

The Cisco uBR10-MC5X20S cable interface line card supports downstream and upstream traffic over Data-over-Cable Service Interface Specification (DOCSIS)-based cable modem networks. The card supports downstream channels in the 70 to 860 MHz range, and upstream channels in the 5 to 42 MHz range. Each downstream port includes an onboard integrated upconverter. The Cisco uBR10-MC5X20S cable interface line card supports Annex B radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities. DOCSIS 2.0, Asynchronous Time Division Multiple Access (A-TDMA) rates are also supported.

Cisco uBR10-MC5X20U and H

The Cisco uBR10-MC5X20U/H cable interface line card supports both DOCSIS and EuroDOCSIS cable modem networks. The card supports downstream channels in the 70 to 860 MHz range, and upstream channels in the 5 to 65 MHz range. Each downstream port includes an onboard integrated upconverter. The Cisco uBR10-MC5X20U/H cable interface line card supports Annex B and Annex A radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities. DOCSIS 2.0, A-TDMA rates are also supported.

Compared to the Cisco uBR10-MC5X20U, the uBR10-MC5X20H increases the line card CPU speed, memory, and flash, allowing support of Voice over IP (VoIP) at much higher call loads and a higher percentage of modems running advanced DOCSIS features that typically consume line card CPU resources.

Cisco uBR10-MC5X20U-D

The Cisco uBR10-MC5X20U-D cable interface line card supports both DOCSIS and EuroDOCSIS cable modem networks. The Cisco uBR10-MC5X20U-D cable interface line card supports Annex A and Annex B radio frequency (RF) data rates, channel widths, and modulation schemes and has DOCSIS MAC management and spectrum management capabilities.

Table 2-2 shows the supported DOCSIS modulation schemes.

Table 2-2 Supported DOCSIS and EuroDOCSIS Modulation Schemes

Cable Interface Line Card	Downstream Modulation	Upstream Modulation
Cisco uBR10-MC5X20S	64-QAM[1], 256-QAM	QPSK[2], 8-, 16-, 32-, 64-QAM
Cisco uBR10-MC5X20U	64-QAM, 256-QAM	QPSK, 8-, 16-, 32-, 64-QAM
Cisco uBR10-MC5X20H	64-QAM, 256-QAM	QPSK, 8-, 16-, 32-, 64-QAM
Cisco uBR10-MC5X20U-D	64-QAM, 256-QAM	QPSK, 8-, 16-, 32-, 64-QAM

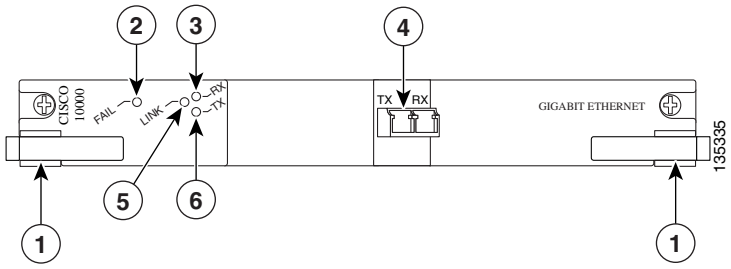
1. QAM = Quadrature Amplitude Modulation
2. QPSK = Quadrature Phase Shift Keying

The Cisco uBR-MC5X20S/U/H and uBR10-MC5X20U-D line cards use space-saving dense connectors. Each line card supports online insertion and removal (OIR) and can be added or removed without powering off the chassis. For more information on these cable interface line cards, refer to the document *Cisco uBR10-MC5X20S/U/H Cable Interface Line Card* (hardware installation).

Cisco Half-Height Gigabit Ethernet Line Card

The Cisco half-height Gigabit Ethernet (HHGE) line card is a single-port Gigabit Ethernet (GE) line card that provides a trunk uplink to devices such as backbone routers, as well as connections to content servers and IP telephony gateways. The GE line card provides the Cisco uBR10012 router with an IEEE 802.3z compliant Ethernet interface that can run up to 1 Gbps in full duplex mode. Figure 2-4 shows the faceplate for the HHGE line card.

Figure 2-4 Half-Height Gigabit Ethernet Line Card Faceplate

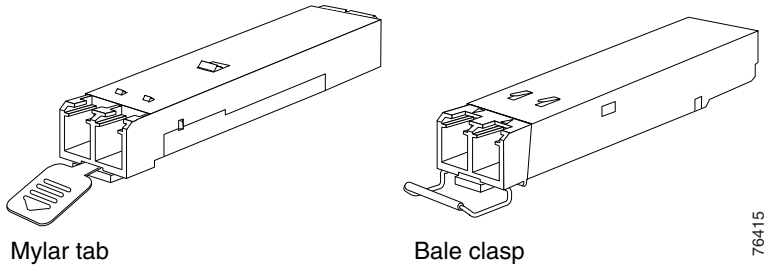


1	Ejector Levers	**4**	SFP Gigabit Ethernet Interface Converter
2	FAIL LED (yellow)	**5**	Link Status (green)
3	Receive Packet (green)	**6**	Transmit Packet (green)

The Cisco uBR10012 router supports up to four HHGE line cards to allow connectivity to multiple destinations, and to provide network layer redundancy. The HHGE line card requires a slot splitter card that should be installed in either slot 4/0 or slot 3/0 on the uBR10012 router. Each slot splitter can hold two HHGE line cards. Therefore, the uBR10012 base system with two slot splitters supports up to four HHGE lines cards.

The HHGE line card uses a small form-factor pluggable (SFP) gigabit interface converter (GBIC) module that supports a variety of Gigabit Ethernet interface types (SX LX/LH, and ZX), which you can change or upgrade at any time.

Figure 2-5 SFP Module for HHGE Line Cards



The following SFP modules are supported by the HHGE line card:

- 1000BASE-SX SFP—The SFP-GE-S, 1000BASE-SX SFP operates on ordinary multimode fiber optic link spans of up to 550 meters in length.
- 1000BASE-LX/LH SFP—The SFP-GE-L, 1000BASE-LX/LH SFP operates on ordinary single-mode fiber optic link spans of up to 10,000 meters in length.
- 1000BASE-ZX SFP—The GLC-ZX-SM, 1000BASE-ZX SFP operates on ordinary single-mode fiber optic link spans of up to 70 kilometers (km) in length. Link spans of up to 100 km are possible using premium single-mode fiber or dispersion-shifted single-mode fiber. The precise link span length depends on multiple factors such as fiber quality, number of splices, and connectors.

The HHGE line card supports online insertion and removal (OIR) and can be added or removed without powering off the chassis. For more information on the HHGE line card, refer to the *Cisco uBR10012 Universal Broadband Router Hardware Installation Guide.*

Wideband CMTS Components

A Cisco uBR10012 base system can be upgraded to a wideband CMTS by adding these components:

- Wideband SIP and Wideband SPA, page 2-8
- External Edge QAM Device, page 2-11

For information on the wideband CMTS functionality, see the "Modular CMTS" section on page 3-4.

Wideband SIP and Wideband SPA

The Wideband SIP and Wideband SPA needed for wideband cable can be added to the base Cisco uBR10012 system when they are required. For the Wideband SIP and Wideband SPA, Table 2-3 lists the minimum and recommended hardware configurations.

Table 2-3 Cisco uBR10012 Wideband Components: Minimum and Recommended Hardware

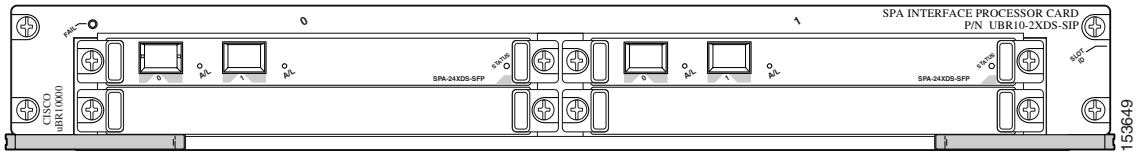
Component	Minimum	Recommended
Wideband SIP (SPA Interface Processor) Part Number: UBR10-2XDS-SIP	1	1
Wideband SPA (Shared Port Adapter) Part Number: SPA-24XDS-SFP	1	Varies*

* The number of Wideband SPAs required will vary depending on the set of services and number of subscribers being supported.

Cisco Wideband SIP

A SPA interface processor (SIP) is a carrier card that inserts into a router slot like a line card. The Wideband SIP provides no network connectivity on its own. The Wideband SIP occupies two full height slots on the uBR10012 router. Each Wideband SIP supports two Wideband SPAs. Figure 2-6 shows the Wideband SIP with two Wideband SPAs installed.

Figure 2-6 Wideband SIP Faceplate



When the uBR1012 router is used as a wideband CMTS, slots 1/0 and 2/0 are used for the Wideband SIPs. Slots 3/0 and 4/0 are reserved for half-height Gigabit Ethernet line cards.

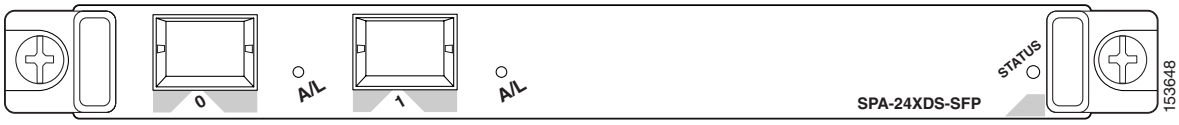
Online insertion and removal (OIR) is supported for both the Wideband SIP and the individual Wideband SPAs.

For more information on the Wideband SIP, see the *Cisco uBR10012 Universal Broadband Router SIP and SPA Hardware Installation Guide* and the *Cisco uBR10012 Universal Broadband Router SIP and SPA Software Configuration Guide*.

Cisco Wideband SPA

The Wideband SPA (Figure 2-7) is a single-wide, half-height shared port adapter (SPA) that provides Wideband Protocol for a DOCSIS Network formatting to the downstream data packets. The Wideband SPA is used for downstream data traffic only. It has one active and one redundant Gigabit Ethernet port that are used to send traffic to the external edge QAM device.

Figure 2-7 Wideband SPA Faceplate



The Cisco uBR10012 router can support up to two Wideband SPAs. Each Wideband SPA can support up to 12 logical wideband channels (bonding groups). Depending on how it is configured, each Wideband SPA allows up to 24 RF channels. Each logical wideband channel consists of multiple RF channels. The Cisco IOS CLI includes a set of commands to configure the Wideband SPA on the Cisco uBR10012 router.

The two Gigabit Ethernet ports on the Wideband SPA use small form-factor (SFP) modules (see Figure 2-8).

An SFP module is an input/output (I/O) device that plugs into the Gigabit Ethernet SFP ports on the Wideband SPA, linking the port with an edge QAM device through a fiber-optic network.

Figure 2-8 SFP Module (Fiber-Optic LC Connector)

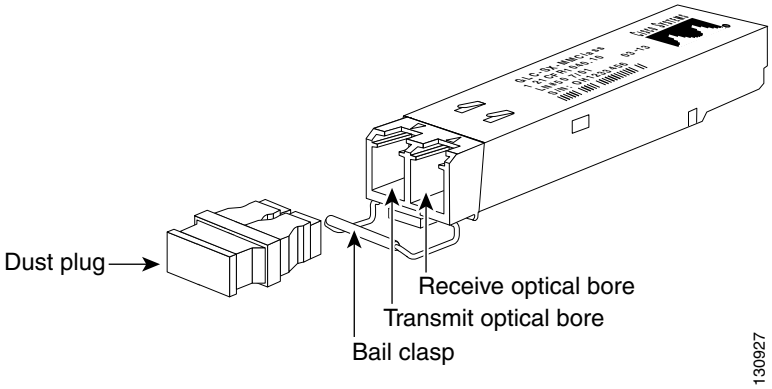


Table 2-4 lists the SFP modules that the Wideband SPA supports.

Table 2-4 SFP Modules for the Cisco Wideband SPA

SFP Module Product Number	SFP Module	Description
GLC-SX-MM	Short wavelength (1000BASE-SX)	Cisco 1000BASE-SX SFP transceiver module for multimode fiber (MMF), 850-nm wavelength
GLC-LH-SM	Long wavelength/long haul (1000BASE-LX/LH)	Cisco 1000BASE-LX/LH SFP transceiver module for single-mode fiber (SMF), 1300-nm wavelength
GLC-ZX-SM	Extended distance (1000BASE-ZX)	Cisco 1000BASE-ZX SFP transceiver module for SMF, 1550-nm wavelength

For more information on the Wideband SPA, see the *Cisco uBR10012 Universal Broadband Router SIP and SPA Hardware Installation Guide* and the *Cisco uBR10012 Universal Broadband Router SIP and SPA Software Configuration Guide*.

External Edge QAM Device

The Cisco wideband CMTS uses one or more external edge QAM (EQAM) devices. The EQAM device is a network element in a separate chassis from the CMTS. The EQAM device has two or more Gigabit Ethernet input interfaces that connect to a Wideband SPA. For output, the EQAM device has multiple QAM modulators and RF upconverters that connect to a hybrid fiber coaxial (HFC) network. The edge QAM device accepts MPEG over IP on its Gigabit Ethernet interfaces and routes the services to its QAM RF outputs.

The following edge QAM devices have been tested for interoperability with other Cisco Cable Wideband Solution, Release 1.0, components:

- Cisco RF Gateway 1, page 2-12
- Cisco RF Gateway 10, page 2-12
- Scientific Atlanta Continuum DVP XDQA24, page 2-13
- Harmonic NSG 9116, page 2-14
- Harmonic NSG 9000, page 2-14
- Vecima Networks VistaLynx VL1000, page 2-15

Table 2-5 lists the number of output QAM channels supported by each edge QAM device.

Table 2-5 EQAM Devices: Number of Output QAM Channels Supported

EQAM Device	Number of Output QAM Channels Supported
Scientific Atlanta Continuum DVP XDQA24	scalable up to 24 QAM channels
Cisco RF Gateway 1 and Cisco RF Gateway 10	scalable up to 48 QAM channels
Harmonic NSG 9116	16 QAM channels
Harmonic NSG 9000	scalable up to 72 QAM channels
Vecima Networks VistaLynx VL1000	scalable up to 24 QAM channels

Number of EQAM Devices Required

Each logical RF channel defined on the Wideband SPA must have one corresponding output QAM channel on an EQAM device. The number of EQAM devices required is determined by two factors:

- The number of logical RF channels in use on the Wideband SPAs in the CMTS. Each Wideband SPA supports up to 24 logical RF channels depending on how it is configured.
  - For annex A and 256 QAM, each Wideband SPA supports 18 RF channels.
  - For all other cases, each Wideband SPA supports 24 RF channels.
- The number of output QAM channels on the EQAM device. See Table 2-5.

As an example, if a Cisco uBR10012 router (CMTS) contains two Wideband SPAs and each Wideband SPA is configured for 18 RF channels, the total number of RF channels that are in use is 36. Therefore, 36 output QAM channels are required on the EQAM devices. This requirement for output QAM channels could be met by deploying, for example, two DVP XDQA24 EQAMs (with 48 total QAMs) or three NSG 9116 EQAMs (with 48 total QAMs).

If more than two EQAM devices are required for two Wideband SPAs, a Gigabit Ethernet switch is needed to connect the SPAs to the EQAM devices.

Cisco RF Gateway 1

As the first release in the Cisco RF Gateway Series of universal edge quadrature amplitude modulation (U-EQAM) products, the Cisco RF Gateway 1 introduces a fourth-generation, standards-based U-EQAM device for expansion of VoD, SDV, and high-speed data services.

The Cisco RF Gateway 1 is a highly dense, highly available and low-cost U-EQAM device, designed from the start to provide sufficient capacity to create a converged highly available Access/Edge.

Key features of the Cisco RF Gateway 1 include:

- Industry-leading scalability for a total stream processing capacity of 2048 streams per chassis
- Fully-redundant Gigabit Ethernet (GE) input ports (4 total for 2:2 redundancy) and redundant powering in just 1 RU
- Front-to-back airflow meets cable operator requirements and allows multiple RF Gateway 1 devices to be stacked.
- True U-EQAM for support of a multitude of applications: video (broadcast, SDV, SD/HD, MPEG-2, AVC) and IP (M-CMTS/DTI, DOCSIS 3.0).
- Fully frequency agile from 45–1000 MHz.
- Designed as a green EQAM with low power consumption.
- Increased solution resiliency and reliability due to full integration with both the Cisco video and data converged architectures.
- High QAM capacity enables highly efficient QAM sharing in a converged MPEG and IP environment.
- High availability and control plane redundancy with the Cisco USRM.
- Compliancy with ITU-T J.83 standard, Annex A (DVB), Annex B(ATSC), or Annex C (Japan).
- Internet Group Management Protocol Version 3 (IGMPv3) support.
- Designed for pre-encryption or integrated encryption support.
- Hot-swappable and auto-configurable QAM cards.

Figure 2-9 shows the Cisco RF Gateway 1 device.

Figure 2-9 Cisco RF Gateway 1 Device

Cisco RF Gateway 10

The Cisco RF Gateway 10 U-EQAM device provides the scalability and high-availability features required to support escalating QAM channel capacity needs. It allows your network to meet new levels of performance, capacity, power consumption, ease of management, and scalability.

The Cisco RF Gateway 10 features up to 480 QAM channels per chassis with the DS48 QAM line card, and the ability to scale with future QAM cards.

The Cisco RF Gateway 10 builds on the RF Gateway 1 and has the following advantages:

- Reduces operational cost of installing, configuring, and managing U-EQAM devices while increasing chassis capacity with field-upgradable components for simplified network build-out and increased service velocity
- Integrates with a wide variety of network architectures requiring advanced switching and routing features
- Reduces cost and complexity of WAN connections through 10-Gigabit Ethernet interfaces
- Enables expansion in system capacity without RF network re-cabling
- Reduces time for upgrading and replacing system components
- Improves rack cabling efficiencies and access

Figure 2-10 shows the Cisco RF Gateway 10 device.

Figure 2-10 Cisco RF Gateway 10 Device

Scientific Atlanta Continuum DVP XDQA24

The Scientific Atlanta Continuum DVP eXtra Dense QAM Array 24 (XDQA24) is one of the edge QAM devices that has been tested for interoperability with other solution components. The Continuum DVP XDQA24 has two redundant Gigabit Ethernet input interfaces that use small form-factor pluggable (SFP) modules for fiber-optic and copper links. It has 24 output QAM channels (12 outputs, each with two adjacent QAM channels). The Continuum DVP XDQA24 software is customized to accommodate the requirements of the Cisco Cable Wideband Solution.

Figure 2-11 Scientific Atlanta Continuum DVP XDQA24 Edge QAM Device

The Continuum DVP XDQA24 chassis is a single rack unit high. The Continuum DVP XDQA24 uses uses hot-swappable, auto-configurable QAM cards containing two QAM channels on a single RF converter. The Continuum DVP XDQA24 has fully redundant AC or DC power supplies. More detailed information and part numbers for the Continuum DVP XDQA24 are available at:

http://www.cisco.com/en/US/prod/collateral/video/ps9159/ps9195/ps9248/product_data_sheet0900aecd806d193d.pdf

Harmonic NSG 9116

The Harmonic Narrowcast Services Gateway (NSG) 9116 is one of the edge QAM devices that has been tested for interoperability with other solution components. The NSG 9116 has two redundant Gigabit Ethernet input interfaces that use small form factor (SFP) modules for fiber-optic and copper links. It has 16 output QAM channels (eight dual QAM output channels). The NSG 9116 software is customized to accommodate the requirements of the Cisco Cable Wideband Solution.

Figure 2-12 Harmonic NSG 9116 Edge QAM Device

The NSG 9116 chassis is a single rack unit high. The NSG 9116 comes with either an AC power supply or –48 VDC power supply. More detailed information on the NSG 9116 is available at:

http://www.harmonicinc.com

Harmonic NSG 9000

The Harmonic Narrowcast Services Gateway (NSG) 9000 is one of the edge QAM devices that has been tested for interoperability with other solution components. The NSG 9000 has three independent Gigabit Ethernet input interfaces that use small form factor (SFP) modules for fiber-optic and copper links. The NSG 9000 is DOCSIS 3.0-compliant.

The NSG 9000 provides scalable support up to 72 QAM RF outputs. The chassis is fitted with a passive backplane, while all the processing and modulation functions are performed on retrievable modules. The chassis has nine QAM RF module slots. Each hot-swappable QAM module has two RF ports, and each port is capable of supporting up to 4 adjacent QAM channels (3 channels in Annex A).

Figure 2-13 Harmonic NSG 9000 Edge QAM Device

The NSG 9000 is housed in a 2-RU chassis. The system can host two load-sharing AC or DC power supplies, which can be redundant to each other. More detailed information on the NSG 9000 is available at:

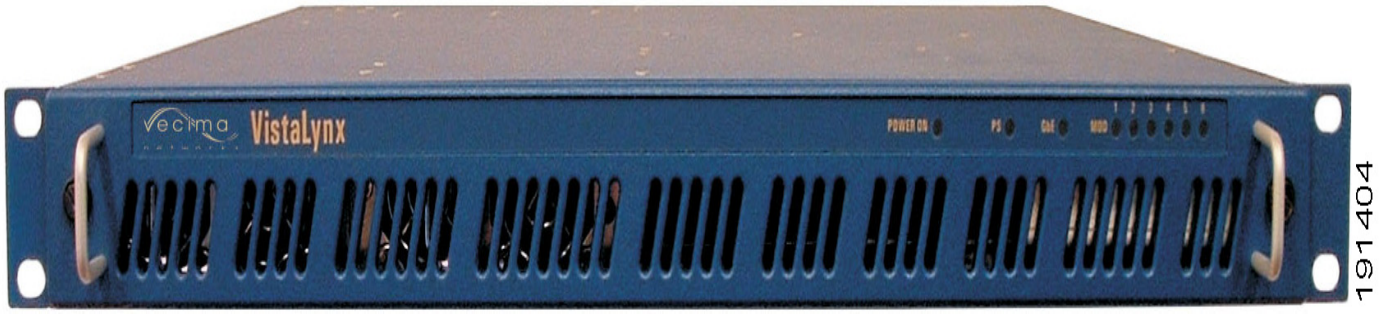
http://www.harmonicinc.com/

Vecima Networks VistaLynx VL1000

Vecima Networks VistaLynx VL1000 is one of the edge QAM devices that has been tested for interoperability with other solution components. The VistaLynx VL1000 has two redundant Gigabit Ethernet input interfaces that use small form factor (SFP) modules for fiber-optic and copper links.

The VistaLynx VL1000 QAM channels can be increased in increments of four to a maximum of 24 QAM channels. The chassis accepts a minimum of two QAM cards and a maximum of six, for a total of 24 QAM channels. Each hot-swappable QAM card contains two RF ports capable of generating two QAM channels per port.

Figure 2-14 Vecima Networks VistaLynx VL1000 Edge QAM Device



The VistaLynx VL1000 chassis is a single rack unit high. The system has two redundant AC power supplies. More detailed information on the VistaLynx VL1000 is available at:

http://www.vecima.com

Gigabit Ethernet Switch (Optional)

A Gigabit Ethernet (GE) switch can optionally be used to link the Wideband SPAs to edge QAM devices. The Gigabit Ethernet switch concentrates traffic from multiple GE links from the SPAs to a smaller number of GE links prior to fiber transport to the edge QAM devices.

A Gigabit Ethernet switch is required to connect Wideband SPAs to the EQAM devices in the following situations:

- If more than two EQAM devices are required for two Wideband SPAs
- If video-on-demand (VOD) traffic and the RF channels for wideband channels are mixed on the same EQAM device

Wideband Cable Modems

The Cisco Cable Wideband Solution, Release 1.0, supports the following wideband cable modem:

Linksys WCM300 Wideband Cable Modem

When used with the Cisco uBR10012 CMTS, the Linksys WCM300-NA (for DOCSIS), WCM300-EURO (for EuroDOCSIS), and WCM300-JP (for J-DOCSIS) wideband cable modems (Figure 2-15) support the acquisition of up to three wideband (bonded) channels: one primary bonded channel and two secondary bonded channels.

Note Cisco IOS 12.3(21a)BC3 or a later 12.3BC3 release is required for support of the Linksys WCM300-NA, WCM300-EURO, and WCM300-JP modems in wideband mode. In wideband mode, the MAC state of the modem is w-online, and the Cisco uBR10012 uses the Cisco DOCSIS 3.0 Downstream Channel Bonding feature.

For each wideband channel, the Linksys WCM300 wideband cable modem supports the reception of one or more bonded RF channels. The Linksys WCM300 software supports the receiving of a 50 MHz capture window of up to eight downstream channels at 6 MHz per channel or six downstream channels at 8 MHz per channel. The total of the RF channels in the primary and secondary bonded channels must comply with the 50 MHz capture-window limitation.

For wideband, the Linksys WCM300 also supports reception of one *primary downstream channel* (traditional DOCSIS channel from the uBR10-MC5X20 line card) for MAC management and signaling messages, and uses the associated traditional DOCSIS upstream channel for return data traffic and signaling. The upstream channel works as it does in DOCSIS 2.0 cable modems.

Figure 2-15 Linksys WCM300 Wideband Cable Modem

The Linksys WCM300 is DOCSIS 2.0 compatible and can be used in this mode (for example, if the modem is connected to a non-wideband Cisco CMTS or to a non-Cisco CMTS). The modem is also backward compatible with existing DOCSIS 1.X networks.

The Linksys WCM300-JP supports J-DOCSIS channel operation: 6 MHz Annex B extension support with a downstream frequency range of 88 to 860 MHz and an upstream frequency range of 5 to 65 MHz.

Separate Linksys WCM300 software images are used for DOCSIS and EuroDOCSIS channel widths. Downstreams in the wideband channel and associated traditional DOCSIS downstreams support 64-QAM and 256-QAM modulation.

The Linksys WCM300 wideband cable modem has two ports: an F-type 75 ohm connector provides a cable network attachment, and an RJ-45 port provides a 10/100/1000 Mbps Ethernet connection to the home or business. More information on the Linksys WCM300 wideband cable modem is available at:

http://www.cisco.com/en/US/products/ps8426/tsd_products_support_series_home.html

Scientific Atlanta DPC2505 and EPC2505 Wideband Cable Modems

When used with the Cisco uBR10012 CMTS, the Scientific Atlanta DPC2505 (for DOCSIS) and EPC2505 (for EuroDOCSIS) wideband cable modems support the receiving of one wideband channel. For the Cisco Cable Wideband Solution, Release 1.0, the wideband channel consists of two bonded downstream RF channels at 6 MHz per channel or at 8 MHz per channel.

In addition to the two bonded downstream RF channels, the Scientific Atlanta DPC2505/EPC2505 modem supports reception of one *primary downstream channel* (traditional DOCSIS channel from the uBR10-MC5X20 line card) for MAC management and signaling messages, and uses the associated traditional DOCSIS upstream channel for return data traffic and signaling. The upstream channel works as it does in DOCSIS 2.0 cable modems.

- Unicast data can be received on any downstream channel.
- DOCSIS 2.0 multicast data can be received only on the primary downstream channel.

The Scientific Atlanta DPC2505 is DOCSIS 2.0 compatible and can be used in this mode (for example, if the modem is connected to a non-wideband Cisco CMTS or to a non-Cisco CMTS). The modem is also backward compatible with existing DOCSIS 1.X networks.

Figure 2-16 Scientific Atlanta DPC2505 Cable Modem

The DPC2505/EPC2505 wideband cable modem has an F-type 75 ohm connector for a cable network attachment and has two data ports: a Gigabit Ethernet port with Auto negotiate and Auto-MDIX, and a USB 2.0 port.

The DPC2505/EPC2505 also features front-panel LEDs to provide visual feedback of real-time data transmission and operational status. The DPC2505 features WebWizard, a browser-based user interface. WebWizard is a powerful tool that facilitates installation and troubleshooting. WebWizard eliminates the need to load set-up software on the customer premises equipment (CPE).

The Scientific Atlanta DPC2505 is DOCSIS 2.0 certified, and the EPC2505 is Euro-DOCSIS 2.0 certified. More detailed information and part numbers for the DPC2505 and EPC2505 wideband cable modems are available at:

http://www.cisco.com/en/US/docs/video/at_home/Cable_Modems/2500_Series/4015259_B.pdf

Wideband CMTS Redundancy and Resiliency

The uBR10012 wideband CMTS and related hardware and software provide redundancy and resiliency to the Cisco Cable Wideband Solution. Reliable, fault-tolerant components and resilient network technologies automatically identify and overcome failures. The following sections describe the wideband CMTS redundancy and resiliency features:

- PRE2 Redundancy and Resiliency, page 2-19
- uBR10-MC5X20 Line Card Redundancy, page 2-19
- Wideband SPA Redundancy and Resiliency, page 2-20
- Edge QAM Redundancy, page 2-21

Table 2-6 summarizes redundancy and resiliency support for the Cisco uBR10012 base system's recommended hardware configuration (see Table 2-1). If component failure occurs, the components listed in Table 2-6 can be replaced without interrupting system operations when redundant components are correctly installed and configured.

Table 2-6 Cisco uBR 10012 Base System Redundancy and Resiliency

Modular CMTS Component	Redundancy and Resiliency Summary
PRE2 route processors	Two PRE2 modules. The Route Processor Redundancy Plus feature and DOCSIS Stateful Switchover provide the PRE2 modules with fast route processor failover without DOCSIS line card reboot.
Redundant power supplies	Two DC or AC power entry modules (PEMs). If one PEM fails, the other PEM immediately begins providing the required power to the system.
Redundant Timing, Communication, and Control Plus (TCC+) cards	The two TCC+ cards monitor each other's priority information so that if the active card fails, the active card role is transferred to the redundant backup card without loss of data.
Fan assembly module	The fan assembly has four internal fans. If a single fan fails and the fan assembly is still able to cool the chassis, the router will continue to function until the fan assembly module can be replaced.
Redundant Half-Height Gigabit Ethernet (HHGE) line cards	Multiple HHGE line cards to support connectivity to multiple destinations and to provide network layer redundancy.
uBR10-MC5X20S/U/H and uBR10-MC5X20U-D cable interface line cards	N+1 Redundancy provides automatic switchover and recovery for cable modems connected as DOCSIS 1.X/2.0 modems in the event that there is a cable interface line card failure.

Refer to the *Cisco uBR10012 Universal Broadband Router Hardware Installation Guide* for complete information on the uBR10012 router's hardware redundancy.

PRE2 Redundancy and Resiliency

The Route Processor Redundancy Plus (RPR+) feature and DOCSIS Stateful Switchover (DSSO) in the Cisco IOS software provide the Cisco uBR10012 router's PRE2 route processors with fast route processor failover without DOCSIS line card reboot.

Route Processor Redundancy Plus

The RPR+ feature enables the Cisco uBR10012 router to use two PRE2 route processors in a redundant configuration: an active and standby PRE2 module. If the active PRE2 module fails, or is removed from the system, the standby PRE2 detects the failure and initiates a switchover. During a switchover, the standby PRE2 assumes control of the router, connects with the network interfaces, and activates the local network management interface and system console.

Using the RPR+ feature, the standby PRE2 module is fully initialized and configured. This allows RPR+ to dramatically shorten the switchover time if the active PRE2 fails, or if a manual switchover is performed. Because both the startup configuration and running configuration are continually synchronized from the active to the standby PRE2 route processor, line cards are not reset during a switchover. The interfaces remain up during this transfer, so neighboring routers do not detect a link flap (that is, the link does not go down and back up).

The RPR+ feature does not require a full reboot of the system to perform a failover. When the system is originally initialized, the secondary PRE2 module performs an abbreviated initialization routine—the module performs all self-checks and loads the Cisco IOS software, but instead of performing normal systems operations it begins monitoring the primary PRE2 module. If the secondary PRE2 module detects a failure in the primary module, it can quickly assume the primary responsibility for systems operations.

During RPR+ switchover, wideband cable modems on the CMTS will stay online. The MAC state for the wideband cable modem will remain online for a modem registered as a DOCSIS 2.0 modem, or w-online for a modem registered as a wideband cable modem.

DOCSIS Stateful Switchover

DOCSIS Stateful Switchover increases service uptime by instantaneously switching over between dual route processors should one processor fail. Switchover takes place without resetting or reloading line cards or affecting related subsystems or processes. The advantage of DOCSIS Stateful Switchover (with RPR+) is that a switchover between the primary and standby RP will not require the cable interfaces to be reset, nor do the modems reregister or go offline. Furthermore, the cable modems retain their service IDs (SIDs) through the switchover.

For more information on PRE2 and RPR+ and DOCSIS Stateful Switchover, see the document *Route Processor Redundancy Plus on the Cisco uBR10012 Universal Broadband Router.*

uBR10-MC5X20 Line Card Redundancy

The Cisco uBR10012 router supports N+1 Redundancy on the cable interface line cards including the uBR10-MC5X20S/U/H and uBR10-MC5X20U-D line cards, which are used in the Cisco Cable Wideband Solution.

N+1 Redundancy can help limit Customer Premises Equipment (CPE) downtime by enabling robust automatic switchover and recovery in the event that there is a localized system failure. N+1 Redundancy adds synchronization between Hot Standby Connection-to-Connection Protocol (HCCP) Working interface configurations and those inherited upon switchover to HCCP Protect interfaces. This makes the configuration of both easier and switchover times faster.

A single Cisco uBR10012 CMTS can support up to eight uBR10-MC5X20S/U/H and uBR10-MC5X20U-D cable interface line cards, each featuring five downstream and 20 upstream cable interfaces for a total of up to 40 downstream and 160 upstream interfaces in the chassis. The eight-card 7+1 Redundancy scheme for the Cisco uBR10012 router supports redundancy for the cable interface line cards installed in a fully populated Cisco uBR10012 chassis. Other redundancy schemes are designed to support partial cable interface line card populations in a Cisco uBR10012 chassis.

N+1 Redundancy is made possible with the addition of a Cisco RF Switch to your cable headend network. A single Cisco RF Switch can be connected to the Cisco uBR10012 CMTS, allowing deployment of an N+1 Redundancy scheme where one protecting cable interface line card supports from one to seven Working cable interface line cards in the same chassis.

Note Both 7+1 and N+1 Redundancy switchover are supported *only for cable modems connected as DOCSIS 1.X/2.0 modems*. During 7+1 and N+1 Redundancy switchover, cable modems that are connected in wideband mode using the failed cable interface line card will lose connectivity. Manual intervention (for example, use of the **clear cable modem wideband reset** command) may be required to bring wideband cable modems w-online again.

For more information on N+1 redundancy for uBR1012 line cards, see the *Cisco Cable Modem Termination System Feature Guide*.

Wideband SPA Redundancy and Resiliency

The Wideband SPA provides redundancy and resiliency through a number of mechanisms. The Wideband SIP and Wideband SPAs support online insertion and removal (OIR) and are hot swappable.

Wideband SPA Redundant Gigabit Ethernet Ports

The Wideband SPA has one active and one redundant Gigabit Ethernet port that is used to send traffic to the external edge QAM device. If the link state of both Gigabit Ethernet ports (port 0 and 1) is up, the port that is discovered first as up becomes the active port (forwarding traffic). The other port, when its link state changes to up, becomes the redundant port. The Port Status LEDs for port 0 and 1 on the Wideband SPA will be green.

Each Gigabit Ethernet port can discover a link failure between itself and the device to which it is directly connected. If both Gigabit Ethernet links from the Wideband SPA to the edge QAM device are up, automatic failover to a redundant link behaves as follows:

- If both Gigabit Ethernet ports are directly connected to edge QAM device, automatic failover to the redundant link occurs.
- If both Gigabit Ethernet ports are connected to, for example, a switch between the Wideband SPA and the edge QAM device, automatic failover to the redundant link to the switch occurs.
- In the case where there is a switch between the Wideband SPA and the edge QAM device, the SPA cannot detect a link failure between the switch and the edge QAM device. No automatic failover to a redundant Gigabit Ethernet port and link occurs.

The **show controllers modular-cable** command shows the current state of the Wideband SPA's Gigabit Ethernet ports. With the Cisco IOS CLI, the Wideband SPA's Gigabit Ethernet ports are not specified on the command line as individual Gigabit Ethernet interfaces because the ports work in tandem as a redundant pair.

Wideband Channel Resiliency

If a wideband channel fails, the wideband cable modem goes offline and re-registers:

- If another wideband channel is available for the service, the wideband cable modem tries that channel and comes online.
- If no other wideband channel is available, the wideband cable modem comes online in traditional DOCSIS 2.0 mode.

Edge QAM Redundancy

Depending on the edge QAM device that is used, the edge QAM device can have varying degrees of redundancy. For information on a specific edge QAM device, see the vendor's documentation for that device.

Cisco RF Gateway 10 supports in-chassis redundancy. Cisco RF Gateway 1 supports Edge QAM redundancy through external RF signal manager switches. For more information, see the Cisco RF Gateway documentation at the following URL:

http://www.cisco.com/en/US/products/ps8360/tsd_products_support_series_home.html

Where to Find Information on Solution Hardware Components

Table 2-7 provides a list of the hardware installation documents that are most relevant to the Cisco Cable Wideband Solution's components. The complete list of uBR10012 hardware installation and upgrade guides are available at:

http://www.cisco.com/en/US/products/hw/cable/ps2209/prod_installation_guides_list.html

The *Release Notes for Cisco uBR10012 Universal Broadband Router for Cisco IOS Release 12.3(21) BC* are available at:

http://www.cisco.com/univercd/cc/td/doc/product/cable/ubr10k/ub10krns/index.htm

Table 2-7 Cisco Hardware Components: Where to Find More Information

Solution Component	Where to Find More Information
uBR10012 chassis Performance Routing Engine 2 (PRE2) Timing, Communication, and Control Plus card (TCC+) DC Power Entry Modules (DC PEMs) AC Power Entry Modules (AC PEMs) Fan assembly module LCD module	*Regulatory Compliance and Safety Information for the Cisco uBR10012 Universal Broadband Router* *Cisco uBR10012 Universal Broadband Router Hardware Installation Guide* (full installation guide) *Cisco uBR10012 Universal Broadband Router Hardware Installation Guide* (quick start guide)
uBR10-MC5X20S/U/H and uBR10-MC5X20U-D cable interface line cards	*Cisco uBR10012 Universal Broadband Router Hardware Installation Guide* (full installation guide) *Cisco uBR10-MC5X20S/U/H Cable Interface Line Cards - Hardware Installation Guide* *Cabling the Cisco uBR10-MC5X20S/U/H Cable Interface Line Card with Universal Cable Holder—UCH1* *Cabling the Cisco uBR10-MC5X20S/U/H Cable Interface Line Card with Universal Cable Holder—UCH2*
Half-Height Gigabit Ethernet (HHGE) network uplink line card	*Cisco uBR10012 Universal Broadband Router Hardware Installation Guide* (full installation guide) *Cisco uBR10012 Universal Broadband Router Gigabit Ethernet Half-Height Line Card Installation*
Wideband SPA Interface Processor (SIP) Wideband Shared Port Adapter (SPA)	*Cisco uBR10012 Universal Broadband Router SIP and SPA Hardware Installation Guide* *Cisco uBR10012 Universal Broadband Router SIP and SPA Software Configuration Guide*
Cisco RF Gateway documentation	http://www.cisco.com/en/US/products/ps8360/tsd_products_support_series_home.html
Harmonic NSG 9116 and NSG 9000 edge QAM devices	Refer to the vendor documentation.
Scientific Atlanta Continuum DVP XDQA24 edge QAM device	Refer to the vendor documentation.
Vecima Networks VistaLynx VL1000 edge QAM device	Refer to the vendor documentation.
Linksys WCM300-NA, WCM300-EURO, and WCM300-JP wideband cable modems	*Release Notes for Linksys WCM300 Cable Modem Software* Cisco Cable Wideband Solution Design and Implementation Guide, Release 1.0 (this document) *Cisco uBR10012 Universal Broadband Router SIP and SPA Software Configuration Guide*
Scientific Atlanta DPC2505 and EPC2505 wideband cable modems	Refer to the vendor documentation.