

Configuring Cisco uBR7246 Universal Broadband Router Features

Cisco uBR7246 universal broadband features enable the Cisco uBR7246 universal broadband router to communicate with a hybrid fiber coaxial (HFC) cable network via a Cisco MC11 cable modem card. Cisco MC11 cable modem cards allow you to connect cable modems on the HFC network to a Cisco uBR7246 in a Community Antenna Television (CATV) headend facility. The modem card provides the interface between the Cisco uBR7246 protocol control information (PCI) bus and the radio frequency (RF) signal on the HFC network. For a description of the commands used to configure universal broadband features, refer to the “Cisco uBR7246 Universal Broadband Features Commands” chapter in the *Voice, Video, and Home Applications Command Reference*.

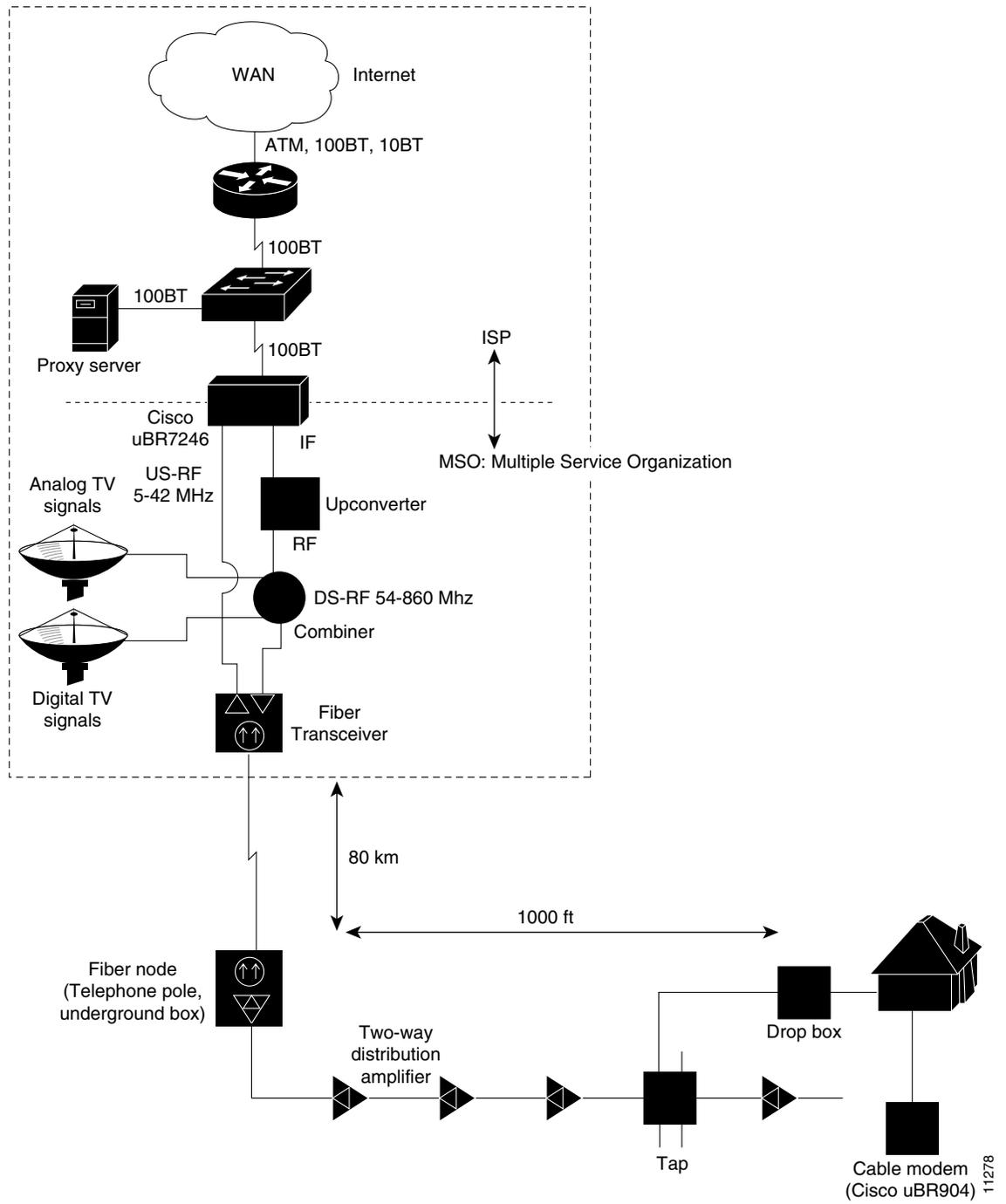
The MC11 cable modem cards consist of the following components:

- One downstream cable F-connector port—The downstream port supports quadrature amplitude modulation (QAM) speeds of 64-QAM, or 6 bits per symbol. A symbol is the basic unit of modulation in CATV systems.
- One upstream cable F-connector port—The upstream port supports quadrature phase shift keying (QPSK) modulation, or 2 bits per symbol.
- Cable Media Access Control (MAC) unit—The cable MAC frames and encrypts the downstream signal for RF transmission and passes the signal to the downstream physical layer (PHY). Reverses the signal framing and encryption on the upstream signal from the upstream PHY.
- Downstream PHY unit—The downstream PHY generates a modulated, intermediate frequency (IF) output signal at a frequency of 44 MHz and passes the IF signal to an external IF to RF upconverter installed in the downstream path.
- Upstream PHY unit—The upstream PHY receives the modulated, upstream signal at a frequency of 5 MHz to 40 MHz and passes the signal to the cable MAC to remove the framing and encryption formats.
- Spectrum manager—The spectrum manager continuously monitors the noise in unused upstream channels. If the signal-to-noise ratio reaches an unacceptable level on a particular channel, the spectrum manager will automatically assign a new upstream channel to the cable modem using that channel. This feature is referred to as frequency agility.

You must install at least one Cisco MC11 cable modem card in the Cisco uBR7246 chassis to establish communication between the Cisco uBR7246 and the HFC network.

Figure 38 shows the network topology for the modem card and illustrates network connections using the Cisco uBR7246.

Figure 38 Topology for uBR7246 Universal Broadband



Description of Cisco uBR7246 Cable Router

As shown in Figure 38, the Cisco uBR7246 serves as an interface between a WAN backbone and an HFC cable plant. Typically installed at a CATV headend, the Cisco uBR7246 is often located with the following internet service provider-related components:

- Ethernet switch
- Proxy server
- WAN Router

The Ethernet switch is used to reduce traffic on the WAN backbone.

The proxy server usually functions as a Web cache for host computers, and the DHCP/TFTP server for cable modems. DHCP for host computers in the HFC plant is often handled over the WAN. The WAN router provides a gateway to the data network.

On the RF side, the downstream port is assigned a 6-8 MHz channel slot at a standard broadcast CATV frequency. An upconverter device is used to convert the 44 MHz intermediate frequency (IF) output to the assigned slot. In North America, carrier frequencies in the forward plant are assigned between 54-860 MHz. After upconversion, the signal is combined with other analog TV or digital TV signals and sent to the transmit input of a fiber transceiver.

The receive input of the fiber transceiver is connected to an upstream port of the Cisco uBR7246. The upstream port is assigned a 0.2-3.2 MHz frequency band in the reverse plant. In North America, carrier frequencies in the reverse plant are between 5-42 MHz.

The fiber transceiver is connected to up to 80 kilometers of optical fiber. Signals are carried in analog form to a neighborhood where they terminate in a fiber node. The fiber node, located on a telephone pole or in an underground box, converts the optical signal back to an electrical signal, which is passed on to a two-way, distribution amplifier system. The distribution amplifier system passes through the neighborhood where it is tapped off to individual CATV subscribers. Typically, there are 500-1500 homes passed per fiber node.

A coaxial cable delivers the signal from the tap to a subscriber's drop box. From the drop box, the signal is split and cabled to consumer CATV appliances. In addition to analog or digital television, the subscriber obtains data services using a cable modem appliance, like the Cisco uBR904 cable modem.

Benefits of Cisco uBR7246

The Cisco uBR7246 features bring value to the digital broadband network by:

- Enabling the cost-effective deployment of advanced routing capabilities deep into the cable network.
- Combining the power and functionality of a Cisco 7200 series router with the high-speed network access of a Cable Modem Termination Shelf (CMTS). By combining these two essential functions, the Cisco uBR7246 router conserves valuable headend rack space, and it allows cable operators to deploy routing capability in every CMTS location, which improves network performance.

- Providing a universal platform for deployment of both current and future modem technologies via modular upgrades while protecting the operator's invested capital.
- Leveraging Cisco's industry-standard routing hardware and Cisco IOS software to deliver advanced network services and applications. The Cisco uBR7246 uses the same port adapters as the Cisco 7500 and Cisco 7200 series routers, and they are fully interchangeable. This adaptability and flexibility allows the operator to configure the network with any interface desired, including Ethernet, Fast Ethernet, FDDI, ATM, packet-over-SONET, and serial.

The Cisco uBR7246 cable modem cards are fully compatible with the Data Over Cable System Interface Specification (DOCSIS) established by major North American cable operators through the Multimedia Cable Network System (MCNS) consortium.

The Cisco uBR7246 supports both two-way and telephone return modems on a single downstream channel. The Cisco uBR7246 therefore allows both one-way and two-cable plants to provide cable modem service, and gives cable operators the flexibility to roll out service in systems that are only partially upgraded to two-way.

List of Terms

Community Antenna Television (CATV)—Broadband transmission facility.

Downstream—Frequency multiplexed band in a CATV channel that distributes signals from headend to users. In this instance, downstream refers to the data flow from the Cisco MC11 modem card in a Cisco uBR7246 to the user's cable modem.

Headend—Originating point of a signal in a Cable TV system.

IF—Intermediate frequency. Intermediate electromagnetic frequencies generated by a superheterodyne radio receiver.

HFC—Hybrid fiber coaxial cable. Distribution cabling concept using both fiber optic and coaxial cable. Fiber is used for the backbone distribution medium, terminating in a remote unit where optoelectrical conversion takes place. The signal is then passed as data to coaxial cables that carry it to its destination.

QAM—Quadrature amplitude modulation. Modulation technique that allows data-encoded symbols to be represented in 16 or 32 different states.

QPSK—Quaternary phase shift keying. Compression technique used in modems and wireless networks, allowing the transmission of 2 bits per symbol. QPSK provides a 2:1 compression ratio, resulting in double efficiency for the circuit being used.

RF—Radio frequency. Group of electromagnetic energy whose wavelengths are between the audio and light range, usually between 500 KHz and 300 GHz.

Symbol—Phase range of a sine wave.

Upstream—Frequency multiplexed band in a CATV channel that distributes signals from transmitting stations to headend. In this instance, upstream refers to the data flow from a cable modem to the Cisco MC11 modem card in a Cisco uBR7246.

Prerequisite Tasks

Before you can configure Cisco uBR7246 universal broadband router features, you must first:

- Make sure that your current network is designed to support broadband transmission. At the very least, your network must include the following:
 - Computer on the WAN side of your Cisco uBR7246 configured as a DHCP server to assign IP addresses to cable modems on the HFC network.
 - Cisco uBR7246-compatible IF-to-RF upconverter installed in the downstream data path at your headend site. The upconverter is installed between the Cisco uBR7246 and the combiner.

Note The combiner refers to all cables, amplifiers, and taps at the headend or cable distribution center that connect the Cisco uBR7246 to the hybrid fiber coaxial (HFC) network.

- Diplex filters installed in the downstream RF path between the cable modems and the cable modem cards in the Cisco uBR7246. Diplex filters are used to convert the single, bidirectional signals used by cable modems to the two, separate unidirectional signals used by the cable modem cards.
- RG-59 headend coaxial cable with the maximum braid available (60% + 40% braid), double foil, and the correct connector for this cable. The center conductor must be straight and extend 1/8 inch (3.2 mm) beyond the end of the connector and the connector should be securely crimped to the cable.
- Complete a basic configuration of the Cisco uBR7246. This includes, as a minimum, the following tasks:
 - Configure a host name and password for the Cisco uBR7246. For more information about how to configure a host name and password, refer to the *Cisco uBR7246 Universal Broadband Router Installation and Configuration Guide*.
 - Configure the Cisco uBR7246 to support IP. For more information about how to configure IP, refer to the refer to the “IP Overview,” “Configuring IP Addressing,” and “Configuring IP Services” chapters in the *Network Protocols Configuration Guide, Part 1*.
 - Install and configure at least one port adapter to provide WAN connectivity. The Cisco uBR7246 supports the following port adapters: 4-port 10BASE-T Ethernet, 8-port 10BASE-T Ethernet, 100BASE-T Fast Ethernet, ATM, and HSSI.

For information about installing and configuring the 4-port 10BASE-T port adapter, refer to the *4-E Ethernet 10BASE-T Port Adapter Installation and Configuration* document.

For information about installing and configuring the 8-port 10BASE-T port adapter, refer to the *8-E Ethernet 10BASE-T Port Adapter Installation and Configuration* document.

For information about installing and configuring the 100BASE-T Fast Ethernet port adapter, refer to the *100BASE-T Fast Ethernet Port Adapter Installation and Configuration* document.

For information about installing and configuring the ATM port adapter, refer to the *ATM Port Adapter Installation and Configuration* document.

For information about installing and configuring the HSSI port adapter, refer to the *HSSI Port Adapter Installation and Configuration* document.

- Install at least one Cisco MC11 cable modem card in the appropriate slot of Cisco uBR7246 chassis. For information about installing the Cisco MC11 cable modem card, refer to the *Cisco uBR7246 Universal Broadband Router Cable Modem Card Installation and Configuration* document.

Supported MIBs and RFCs

The Cisco uBR7246 universal broadband features support the RF Interface Management Information Base (MIB). No RFCs are supported by this feature.

Universal Broadband Features Configuration Task List

The Cisco IOS software command-line interface (CLI) is used to configure the Cisco MC11 cable modem card for correct operation on the HFC network. Perform the following tasks to configure the MC11 cable modem card. For some tasks, the default values are adequate to configure the device; these configuration tasks are optional.

- Configure the Downstream Cable Interface (Optional)
- Configure the Upstream Cable Interface
- Configure and Activate Baseline Privacy
- Configure and Activate Frequency Agility
- Activate IP Address Resolution Protocol (Optional)
- Activate Host-to-Host Communication (Proxy ARP) (Optional)
- Set Optional IP Parameters (Optional)
- Manage Cable Modems on the HFC Network (Optional)

Configure the Downstream Cable Interface

The first step in configuring the MC11 cable modem interface is to configure the downstream cable interface. In this case, downstream refers to the data flow from the Cisco MC11 modem card in a Cisco uBR7246 to the user's cable modem. Data passing through the MC11 cable modem card is converted to IF and then run through an upconverter to transform the signal to RF. This RF signal is then sent down the line to the user's cable modem. Downstream cable interface commands configure the frequency, symbol rate, compression, and modulation of the downstream signal.

Perform the following tasks to configure the downstream cable interface:

- Set the Downstream Center Frequency
- Set the Downstream Symbol Rate
- Set the Downstream MPEG Framing Format (Annex A or Annex B)
- Set the Downstream Modulation
- Set the Downstream Interleave Depth
- Activate the Downstream Carrier

Note The default values for the commands used in these configuration steps are, in most cases, adequate to configure the Cisco uBR7246.

Set the Downstream Center Frequency

You need to set the downstream frequency of your RF output to comply with the expected input frequency of your upconverter. To do this, enter the fixed center frequency of the downstream RF carrier for a downstream port.

Downstream frequency is an information-only command that should reflect the digital carrier frequency, which is the center frequency of the downstream RF carrier (the channel) for that downstream port. The configuration controlling the digital carrier frequency is done in the IF-to-RF upconverter that must be installed in the downstream path from the Cisco uBR7246. Refer to the upconverter's manufacturer's instructions for information about configuring the upconverter.

The digital carrier frequency is specified to be the center of a 6.0 MHz channel. For example, EIA channel 95 spans 90.000 to 96.000 MHz. The center frequency is 93.000 MHz, which is the digital carrier frequency that should be configured as the downstream frequency.

Note The digital carrier frequency is not the same as the video carrier frequency. For EIA channel 95, the video carrier frequency is 91.250 MHz, which is 1.75 MHz below the center frequency.

Note This command currently has no effect on external upconverters; it is informational only.

To set the downstream center frequency, use the following command in cable interface configuration mode:

Command	Purpose
cable downstream frequency <i>down-freq-hz</i>	Enter the fixed center frequency for your downstream RF carrier in Hz.

Validation Tips

To verify the current value of the center frequency, enter the **show controllers cable** command for the downstream port that you have just configured:

- If the center frequency is fixed, the actual frequency will be displayed:

```
router# show controllers cable 6/0 downstream
Cable6/0 Downstream is up
  Frequency=96000000, Channel Width 6 MHz, 64-QAM, Symbol Rate 5.056941 Msps
  FEC ITU-T J.83 Annex B, R/S Interleave I=32, J=4
```

- If the center frequency is not fixed, the frequency will show that it is not set:

```
router# show controllers cable 6/0 downstream
Cable6/0 Downstream is up
  Frequency is not set. Channel Width 6 MHz, 64-QAM, Symbol Rate 5.056941 Msps
  FEC ITU-T J.83 Annex B, R/S Interleave I=32, J=4
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure you have calculated and entered the center frequency for your headend accurately.

Set the Downstream Symbol Rate

You need to set the megasymbols per second (MSPS) rate for a downstream port on a cable modem card. A symbol is the basic unit of modulation. QPSK encodes 2 bits per symbol, 16-QAM encodes 4 bits per symbol, 64-QAM encodes 6 bits per symbol, and 256-QAM encodes 8 bits per symbol. The valid range for the downstream symbol rate is 0 to 6,000,000 MSPS.



Caution The default downstream symbol rate is set to comply with MCNS specifications for Annex B cable modem support at 5.056941 MSPS with 64-QAM modulation and 5.36037 MSPS with 256-QAM modulation. This command should only be used to change the symbol rate to support Annex A cable modems that are used outside North America.

To set the downstream symbol rate, use the following command in cable interface configuration mode:

Command	Purpose
<code>cable downstream symbol-rate <i>number</i></code>	Set the downstream symbol rate for Annex A (5.056944 MSPS). Do not enter the decimal point in the symbol rate.

Validation Tips

To verify the downstream symbol rate, enter the **show controllers cable** command for the downstream port that you have just configured:

```
router# show controllers cable 6/0 downstream
Cable6/0 Downstream is up
  Frequency=96000000, Channel Width 6 MHz, 64-QAM, Symbol Rate 5.056941 MSPS
  FEC ITU-T J.83 Annex B, R/S Interleave I=32, J=4
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure you have selected the default if you are using Annex B cable modems.
- Make sure that you have entered the correct symbol rate for Annex A specifications if you are using Annex A cable modems. Do not enter the decimal point when entering the symbol rate.
- Make sure the downstream carrier is active by entering the **cable downstream if-output** command.

Set the Downstream MPEG Framing Format (Annex A or Annex B)

The MPEG framing format must be compatible with the downstream symbol rate you set. Set the MPEG framing format for a downstream port on a cable modem card to either Annex A or Annex B.

Annex B is the North America standard and Annex A is the European standard. You should review your local standards and specifications for downstream MPEG framing to determine which format you should use.

Note The cable modem card downstream ports and the cable modems on the HFC network connected through these ports must be set to the same MPEG framing format.

To set the downstream MPEG framing format, use the following command in cable interface configuration mode:

Command	Purpose
<code>cable downstream annex {A B}</code>	Set the downstream MPEG framing format.

Validation Tips

To verify the downstream MPEG framing format (Annex A or Annex B) setting, enter the **show controllers cable** command for the downstream port that you have just configured:

```
router# show controllers cable 6/0 downstream
Cable6/0 Downstream is up
  Frequency=96000000, Channel Width 6 MHz, 64-QAM, Symbol Rate 5.056941 Msps
  FEC ITU-T J.83 Annex B, R/S Interleave I=32, J=4
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure you have selected the correct setting for your location.
- Make sure the downstream carrier is active by entering the **cable downstream if-output** command.

Set the Downstream Modulation

Downstream modulation is the number of symbols per second; by setting the downstream modulation, you define the speed at which data travels downstream to the user, which is 64 qam (6 bits per downstream symbol rate).

Note The Cisco cable modem cards currently do not offer a downstream modulation setting for 256-QAM (8 bits per downstream symbol rate).

Configure the Downstream Cable Interface

To set the downstream modulation, use the following command in cable interface configuration mode:

Command	Purpose
cable downstream modulation 64qam	Set the standard MCNS rate.

Validation Tips

To verify the downstream modulation setting, enter the **show controllers cable** command for the downstream port that you have just configured:

```
router# show controllers cable 6/0 downstream
Cable6/0 Downstream is up
Frequency=96000000, Channel Width 6 MHz, 64-QAM, Symbol Rate 5.056941 Msps
FEC ITU-T J.83 Annex B, R/S Interleave I=32, J=4
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure you have selected the default if you are not certain about the modulation rate needed.
- Make sure the downstream carrier is active by entering the **cable downstream if-output** command.

Set the Downstream Interleave Depth

The next step is to set the interleave depth for a downstream port on a cable modem card. A higher interleave depth provides more protection from bursts of noise on the HFC network; however, it will increase downstream latency. The valid values are 8, 16, 32 (default), 64, and 128.

To set the downstream interleave depth, use the following command in cable interface configuration mode:

Command	Purpose
cable downstream interleave-depth {8 16 32 64 128}	Set the downstream interleave depth.

Validation Tips

To verify the downstream interleave depth setting, enter the **show controllers cable** command for the downstream port that you have just configured:

```
router# show controllers cable 6/0 downstream
Cable6/0 Downstream is up
Frequency=96000000, Channel Width 6 MHz, 64-QAM, Symbol Rate 5.056941 Msps
FEC ITU-T J.83 Annex B, R/S Interleave I=32, J=
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure the downstream carrier is active by entering the **cable downstream if-output** command.

Activate the Downstream Carrier

To activate a downstream port on a cable modem card for digital data transmissions over the HFC network, use the following commands in global configuration mode:

Step	Command	Purpose
1	interface cable <i>port/slot</i>	Specify a cable interface and enter the cable interface configuration mode.
2	cable downstream if-output	Activate downstream digital data from the Cisco uBR7246. (This is the default setting.)

Validation Tips

To verify that the downstream carrier is active (up), enter the **show controllers cable** command for the downstream port that you have just configured:

```
router# show controllers cable 6/0 downstream
Cable6/0 Downstream is up
Frequency=96000000, Channel Width 6 MHz, 64-QAM, Symbol Rate 5.056941 Msps
FEC ITU-T J.83 Annex B, R/S Interleave I=32, J=4
```

Troubleshooting Tips

If you are having trouble with this configuration:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.

Configure the Upstream Cable Interface

The next step is to configure the upstream cable interface. In this case, upstream refers to the data flow from a cable modem to the Cisco MC11 modem card in a Cisco uBR7246. The user's cable modem sends an RF signal back to the MC11 cable modem card, which translates the RF signal back to data format. Upstream cable interface commands configure the frequency and input power level of the upstream signal, in addition to error detection and correction of the upstream signal.

The configuration of the upstream cable interface depends on each cable operator's physical plant.

Perform the following tasks to configure the upstream cable interface:

- Set the Upstream Frequency
- Set the Upstream Input Power Level
- Activate Upstream Forward Error Correction
- Activate the Upstream Scrambler
- Activate the Upstream Ports

Set the Upstream Frequency

You need to set the upstream frequency of your RF output to comply with the expected input frequency of your Cisco MC11 cable modem. You do this by entering a fixed frequency of the upstream RF carrier for an upstream port. The valid range for a fixed upstream frequency is 5,000,000 Hz to 42,000,000 Hz.

Note Make sure that the upstream frequency selected does not interfere with the frequencies used for any other upstream applications running in the cable plant.

Note The cable interface will not operate until you either set a fixed upstream frequency or create and configure a spectrum group. See the section "Create Spectrum Groups" later in this document.

To set the upstream frequency, use the following command in cable interface configuration mode:

Command	Purpose
<code>cable upstream port frequency up-freq-hz</code>	Enter the fixed center frequency for your upstream RF carrier in Hz.

Validation Tips

To verify the current value of the upstream frequency, enter the **show controllers cable** command for the upstream port that you have just configured:

```
router# show controllers cable 6/0 u0
Cable6/0 Upstream 0 is up
  Frequency 7.008 MHz, Channel Width 1.6 MHz, QPSK Symbol Rate 1.280 Msps
  Nominal Input Power Level 0 dBmV, Tx Timing Offset 0
  Ranging Backoff Start 0, Ranging Backoff End 4, Tx Backoff Start 0
  Tx Backoff End 4, Modulation Profile Group 1
  part_id=0x3136, rev_id=0x02, rev2_id=0x61
  nb_agc_thr=0x0100, nb_agc_nom=0x3000
  Range Load Reg Size=0x58
  Request Load Reg Size=0x0C
  Minislot Size in number of Timebase Ticks is = 8
  Minislot Size in Symbols =64
  Minislot Size in Bytes = 16
  UCD Count = 361894
  DES Reg #580 = E204301, #584 = 3E030303, #588 = 0.
  #590 = C0C0C0C.
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure that you have entered the correct upstream port number. Currently this is always u0.
- Make sure you have selected a valid frequency for your headend.

Set the Upstream Input Power Level

The Cisco uBR7246 controls the output power levels of the cable modems to meet the desired upstream input power level. The default setting of 0 dBmV is the optimal setting for the upstream power level.



Caution If you increase the input power level, the cable modems on your HFC network will increase their transmit power level. This might cause an increase in the carrier-to-noise ratio (CNR) on the network. Be careful if you adjust this parameter. You might violate the upstream return laser design parameters.

To set the upstream input power level, use the following command in cable interface configuration mode:

Command	Purpose
<code>cable upstream port power-level dbmv</code>	Enter the upstream power level in dBmV.

Validation Tips

To verify the current value of the upstream input power level, enter the **show controllers cable** command for the upstream port that you have just configured:

```
router# show controllers cable 6/0 u0
Cable6/0 Upstream 0 is up
  Frequency 7.008 MHz, Channel Width 1.6 MHz, QPSK Symbol Rate 1.280 Msps
  Nominal Input Power Level 0 dBmV, Tx Timing Offset 0
  Ranging Backoff Start 0, Ranging Backoff End 4, Tx Backoff Start 0
  Tx Backoff End 4, Modulation Profile Group 1
  part_id=0x3136, rev_id=0x02, rev2_id=0x61
  nb_agc_thr=0x0100, nb_agc_nom=0x3000
  Range Load Reg Size=0x58
  Request Load Reg Size=0x0C
  Minislot Size in number of Timebase Ticks is = 8
  Minislot Size in Symbols = 64
  Minislot Size in Bytes = 16
  UCD Count = 361894
  DES Reg #580 = E204301, #584 = 3E030303, #588 = 0.
  #590 = C0C0C0C.
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure that you have entered the correct upstream port number. Currently this is always u0.
- Make sure you have selected a valid input power level for your headend and the cable modems on your HFC network.

Activate Upstream Forward Error Correction

The Cisco uBR7246 uses forward error correction (FEC) to attempt to correct any upstream data that might have been corrupted. FEC is activated by default and should not be disabled. When FEC is activated, all cable modems on the network also activate FEC.

To activate the upstream forward error correction, use the following command in cable interface configuration mode:

Command	Purpose
cable upstream <i>port/slot</i> fec	Enable FEC.

Validation Tips

To verify if FEC is activated or deactivated, enter the command **more system:running-config** and look for the cable interface configuration information. The following is an excerpt from the **more system:running-config** command output.

```
router# more system:running-config
Building configuration...

!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 cable insertion-interval 150000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure that you have entered the correct upstream port number. Currently this is always u0.

Activate the Upstream Scrambler

The scrambler on the upstream RF carrier enables cable modems on the HFC network to use built-in scrambler circuitry for upstream data transmissions. The scrambler circuitry improves reliability of the upstream receiver on the cable modem card. The upstream scrambler is activated by default and should not be disabled.



Caution The Scrambler must be activated for normal operation. Deactivate only for prototype modems that do not support scrambler.

To activate the upstream scrambler, use the following command in cable interface configuration mode:

Command	Purpose
cable upstream <i>port</i> scrambler	Enable the scrambler.

Validation Tips

To verify if the upstream scrambler is activated, enter the command **more system:running-config** and look for the cable interface configuration information. The following is an excerpt from the **more system:running-config** command output.

```
router# more system:running-config
Building configuration...

Current configuration:
!
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 cable insertion-interval 150000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
end
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure that you have entered the correct upstream port number. Currently this is always u0.

Activate the Upstream Ports

Activate the RF carrier on the upstream ports. Each upstream port must be activated to enable upstream data from the cable modems on the HFC network to the Cisco uBR7246.

To activate the upstream ports, use the following commands in global configuration mode:

Step	Command	Purpose
1	interface cable <i>port/slot</i>	Specify a cable interface, and enter the cable interface configuration mode.
2	no cable upstream 0 shutdown	Enable upstream data traffic.

Validation Tips

To verify if the upstream ports are activated or deactivated, enter the **show interface cable** command for the upstream port that you have just configured:

```
router# show interface cable 6/0
Cable6/0 is up, line protocol is up
Hardware is BCM3210 FPGA, address is 00e0.1e5f.7a60 (bia 00e0.1e5f.7a60)
Internet address is 1.1.1.3/24
MTU 1500 bytes, BW 27000 Kbit, DLY 1000 usec, rely 255/255, load 1/255
Encapsulation, loopback not set, keepalive not set
ARP type: ARPA, ARP Timeout 04:00:00
Last input 00:00:25, output 00:00:00, output hang never
Last clearing of "show interface" counters never
Queueing strategy: fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  10878 packets input, 853740 bytes, 0 no buffer
  Received 3679 broadcasts, 0 runts, 0 giants, 0 throttles
  3 input errors, 3 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  5401 packets output, 645885 bytes, 0 underruns
  0 output errors, 0 collisions, 9 interface resets
  0 output buffer failures, 0 output buffers swapped out
```

Troubleshooting Tips

If you are having trouble:

- Make sure the cable connections are not loose or disconnected.
- Make sure the cable modem card is firmly seated in its Cisco uBR7246 chassis slot.
- Make sure that you have entered the correct slot and port numbers when you typed the command.
- Make sure that you have entered the correct upstream port number. Currently this is always u0.

Configure and Activate Baseline Privacy

To encrypt upstream and downstream data, you need to configure and activate baseline privacy. Baseline privacy on an HFC network is configured with key encryption keys (keks) and traffic encryption keys (teks). The encryption is based on 40-bit or 56-bit data encryption standard (DES) encryption algorithms.

A kek is assigned to a cable modem based on the cable modem's service identifier (SID) and permits the cable modem to connect to the Cisco uBR7246 when baseline privacy is activated. The tek is assigned to a cable modem when its kek has been established. The tek is used to encrypt data traffic between the cable modem and the Cisco uBR7246.

Keks and teks can be set to expire based on a grace-time or a life-time value. A grace-time key is used to assign a temporary key to a cable modem to access the network. A life-time key is used to assign a more permanent key to a cable modem. Each cable modem that has a life-time key assigned will request a new life-time key from the Cisco uBR7246 before the current one expires.

Note This feature is not available in all Cisco IOS software versions; in addition, this is an export-controlled feature. Check to make sure that the Cisco IOS software you are using supports baseline privacy.

The configuration and activation of baseline privacy depend on each cable operator's physical plant.

To configure and activate baseline privacy, perform the following tasks:

- Configure Kek Encryption Key Privacy
- Configure Traffic Encryption Key Privacy
- Activate Baseline Privacy

Configure Kek Encryption Key Privacy

To configure kek data privacy on the HFC network, use one of the following command in global configuration mode:

Command	Purpose
cable privacy kek grace-time <i>seconds</i>	Set the cable privacy kek grace time.
or	or
cable privacy kek life-time <i>seconds</i>	Set the cable privacy kek life time.

A grace-time kek can be set from 300 to 1,800 seconds. A life-time kek can be set from 86,400 to 6,048,000 seconds.

Validation Tips

To verify the kek life-time or grace-time values that have been set, enter the **show cable privacy kek** command:

```
router# show cable privacy kek
Configured KEK life-time value = 750000
```

Troubleshooting Tips

If you are having trouble, make sure you have entered a valid value for grace time or life time.

Configure Traffic Encryption Key Privacy

To configure tek data privacy on the HFC network, use the following command in global configuration mode:

Command	Purpose
cable privacy tek grace-time <i>seconds</i>	Set the cable privacy tek grace time.
or	or
cable privacy tek life-time <i>seconds</i>	Set the cable privacy tek life time.

A grace-time tek can be set from 300 to 1,800 seconds. A life-time tek can be set from 1,800 to 604,800 seconds.

Validation Tips

To verify the tek life-time or grace-time values that have been set, enter the **show cable privacy tek** command:

```
router# show cable privacy tek
Configured TEK life-time value = 56000
```

Troubleshooting Tips

If you are having trouble, make sure you have entered a valid value for grace time or life time.

Activate Baseline Privacy

After the kek and tek values have been set, you can activate encryption on the HFC network.

To activate baseline data privacy on the HFC network, use the following commands in global configuration mode:

Step	Command	Purpose
1	cable privacy enable	Activate cable privacy. This is the default.
2	cable privacy mandatory	Activate cable privacy and do not allow access for any unencrypted cable modem connections.

Validation Tips

To verify if baseline privacy is activated, enter the **cable privacy enable** or **cable privacy mandatory** command. By default, cable privacy is enabled and can only be disabled with the **no cable privacy** command.

Troubleshooting Tips

If you are having trouble, make sure you have entered a valid value for grace time or life time for kek and tek privacy.

Configure and Activate Frequency Agility

Frequency agility is a way to improve performance on upstream signal traffic and to compensate for noise and interference. The spectrum manager monitors the upstream frequencies; if too much noise or interference is detected in an upstream channel, the spectrum manager reassigns the upstream channel to a different upstream frequency.

Frequency agility is configured and activated using spectrum groups. A spectrum group is a table of frequencies that can be used by upstream ports to implement a frequency-hopping policy. There are two types of policies, blind and scheduled, with two corresponding types of spectrum groups.

- **Blind**—The spectrum manager automatically assigns a new upstream channel frequency when station maintenance (keep-alive) messages fail for approximately 2.5 minutes. This represents a complete impairment of the upstream due to noise, plant, or equipment failure.
- **Scheduled**—The spectrum manager automatically assigns a new upstream frequency at set times during the day.

Note The cable interface will not operate until you either create and configure a spectrum group or set a fixed upstream frequency. From the interface configuration prompt, an interface is assigned membership in a spectrum group. From the interface point of view, the spectrum group also represents the set of upstreams connected to the same group of fiber nodes. This allows the spectrum manager to know if upstream frequencies need to be managed together.

The configuration and activation of frequency agility depends on each cable operator's physical plant.

To configure and activate frequency agility, perform the following tasks:

- Create Spectrum Groups
- Configure and Activate Spectrum Groups

Create Spectrum Groups

To create spectrum groups, use the following commands in global configuration mode:

Step	Command	Purpose
1	cable spectrum-group <i>group-number</i> type blind	Create a blind spectrum group.
2	cable spectrum-group <i>group-number</i> type scheduled daily	Create a scheduled spectrum group that can change its frequency and power level at the same time every day.
3	cable spectrum-group <i>group-number</i> type scheduled periodic-sec <i>seconds</i>	Create a scheduled spectrum group that can change its frequency and power level at a specified interval in seconds.

Validation Tips

To verify that a spectrum group has been created, enter the **show cable spectrum-group** command:

```
router# show cable spectrum-group
spectrum-group 1
spectrum-group 2
spectrum-group 3
```

Troubleshooting Tips

If you are having trouble, make sure you have entered a valid spectrum group number and type.

Configure and Activate Spectrum Groups

After you create a spectrum group, you need to configure a list of upstream frequencies and nominal power levels that each spectrum group can use when an upstream frequency change is necessary. Each spectrum group should have its own list of upstream frequencies. Valid frequencies are 5,000,000 to 42,000,000 Hz, and valid power levels are –10 dBmV to 10 dBmV. The power level value should only be changed if you want to change only the power level as part of spectrum management. The standard power level is 0 dBmV.

Note You must repeat this command for each frequency or power level that you want to add to a spectrum group's list of valid values.

To configure and activate a spectrum group, use the following command in global configuration mode:

Command	Purpose
cable spectrum-group <i>group-number</i> [time <i>hh:mm:ss</i>] frequency <i>number</i> [<i>power-level-dbmV</i>]	Add the upstream frequency to the list of valid frequencies with a default power level for a spectrum group.

Validation Tips

To verify if spectrum groups have been configured and activated, enter the **show cable spectrum-group** command:

```
router# show cable spectrum-group
spectrum-group 1
 6 .500 MHz  0 dBmV input level
 7 .000 MHz  0 dBmV input level
spectrum-group 2
 7 .500 MHz -5 dBmV input level
spectrum-group 3
 9 .000 MHz -0 dBmV input level
 9 .500 MHz -5 dBmV input level
```

Troubleshooting Tips

If you are having trouble, make sure you entered a valid spectrum group number, time, frequency, and input power level.

Activate IP Address Resolution Protocol

Address Resolution Protocol (ARP) is an Internet protocol used to map IP addresses to MAC addresses on computers and other equipment installed in a network. You need to activate ARP requests so the Cisco uBR7246 can perform IP address resolution on the downstream path.

Note The default values for the commands used in this configuration step are, in most cases, adequate to configure the Cisco uBR7246.

Activate Address Resolution Protocol Requests

To activate ARP requests, use the following command in cable interface configuration mode:

Command	Purpose
<code>cable arp</code>	Enable ARP.

Validation Tips

To verify if ARP has been activated, enter the command `more system:running-config` and look for the cable interface configuration information. If ARP has been activated, it does not appear in this output. If ARP has been deactivated, it will appear in the output as `no cable arp` as shown in this command output excerpt:

```
router# more system:running-config
Building configuration...

Current configuration:
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 no cable arp
 cable insertion-interval 150000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble, make sure you entered the correct port and modem card slot number when you activated ARP and when you entered the `show interface cable` command.

Activate Host-to-Host Communication (Proxy ARP)

Proxy ARP allows the Cisco uBR7246 to issue ARP requests on behalf of cable modems on the same cable network subnet.

Note Because the downstream and upstreams are separate interfaces, modems cannot directly perform ARP with other modems on the cable plant.

Note The default values for the commands used in this configuration task are, in most cases, adequate to configure the Cisco uBR7246.

Activate Proxy ARP Requests

To activate proxy ARP for host-to-host communications, use the following command in cable interface configuration mode:

Command	Purpose
cable proxy-arp	Enable proxy ARP on the cable interface.

Validation Tips

To verify if proxy ARP has been activated or deactivated, enter the command **more system:running-config** and look for the cable interface configuration information. If proxy ARP has been activated, it does not appear in this output. If proxy ARP has been deactivated, it appears in the output as no cable proxy-arp as shown in this command output excerpt:

```
router# more system:running-config
Building configuration...

Current configuration:
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 no cable proxy-arp
 cable insertion-interval 150000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble, make sure you entered the correct port and modem card slot number when you activated proxy ARP.

Set Optional IP Parameters

There are additional IP parameters that you can optionally set to enable downstream echoing of upstream data.

To configure optional IP parameters, perform the following tasks:

- Activate IP Multicast Echo
- Activate IP Broadcast Echo

Note The default values for the commands used in these configuration steps are, in most cases, adequate to configure the Cisco uBR7246.

Activate IP Multicast Echo

You can activate upstream IP multicast echo so that the Cisco uBR7246 can echo multicast packets. The default is “on” (IP multicast echo is activated). To activate IP multicast echo, use the following command in cable interface configuration mode:

Command	Purpose
<code>cable ip-multicast-echo</code>	Enable IP multicast echo.

Validation Tips

To verify if IP multicast echo has been activated or deactivated, enter the command **more system:running-config** and look for the cable interface configuration information. If IP multicast echo has been activated, it does not appear in this output. If IP multicast echo has been deactivated, it appears in this output as no cable ip-multicast-echo as shown in the command output excerpt below:

```
router# more system:running-config
Building configuration...

Current configuration:
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 no cable ip-multicast-echo
 cable insertion-interval 150000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble, make sure that you have entered the correct slot and port numbers when you entered cable interface configuration mode.

Activate IP Broadcast Echo

You can activate upstream IP broadcast echo so that the Cisco uBR7246 can echo broadcast packets. The default value is “off” (IP broadcast echo is not activated). To activate IP broadcast echo, use the following command in cable interface configuration mode:

Command	Purpose
<code>cable ip-broadcast-echo</code>	Enable IP broadcast echo.

Validation Tips

To verify if IP broadcast echo has been activated or deactivated, enter the command **more system:running-config** and look for the cable interface configuration information as shown in this command output excerpt:

```
router# more system:running-config
Building configuration...

Current configuration:
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 cable ip-broadcast-echo
 cable insertion-interval 150000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble, make sure that you entered the correct slot and port numbers when you entered cable interface configuration mode.

Manage Cable Modems on the HFC Network

After you have completed upstream and downstream signal configuration, there are a number of different things you can do to manage how your cable modems operate in the HFC network. You can control access by forcing cable modems to authenticate with the Cisco uBR7246, allow only known cable modems to send upstream data, move cable modems to different channels, and define a length of time a cable modem can request a connection.

To manage cable modems, perform the following tasks:

- Activate Cable Modem Authentication
- Activate Cable Modem Upstream Address Verification
- Activate Cable Modem Upstream Address Verification
- Activate Cable Modem Insertion Interval

Note The default values for the commands used in these configuration steps are, in most cases, adequate to configure the Cisco uBR7246.

Activate Cable Modem Authentication

You can activate authentication so all cable modems must return a known text string to register with the Cisco uBR7246 for access to the network. The text string can be from 1 to 80 characters in length. The default is “on” (cable modem authentication is activated).

To activate cable modem authentication, use the following command from the cable interface configuration mode:

Command	Purpose
cable shared-secret <i>secret-key</i>	Enable cable modem authentication.

Validation Tips

To verify if cable modem authentication has been activated or deactivated, enter the command **more system:running-config** and look for the cable interface configuration information. If cable modem authentication has been activated, it does not appear in this output. If cable modem authentication has been deactivated, it appears in this output as no cable secret-shared as shown in this command output excerpt:

```
router# more system:running-config
Building configuration...

Current configuration:
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 no cable secret-shared
 cable insertion-interval 150000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble, make sure you entered the correct slot and port numbers when you entered cable interface configuration mode.

Activate Cable Modem Upstream Address Verification

You activate cable modem upstream address verification to ensure that only known cable modems on the HFC network can transmit upstream data to a Cisco uBR7246. The default is “off” (cable modem upstream address verification is deactivated).

To activate or deactivate cable modem upstream verification, use the following command:

Command	Purpose
cable source-verify	Activate cable modem upstream verification.

Validation Tips

To verify that cable modem upstream verification has been activated or deactivated, enter the command **more system:running-config** and look for the cable interface configuration information. If cable modem upstream verification has been deactivated, it does not appear in this output. If cable modem upstream verification has been activated, it appears in this output as cable source-verify as shown in this command output excerpt:

```
router# more system:running-config
Building configuration...

Current configuration:
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 cable source-verify
 cable insertion-interval 2000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble, make sure that you entered the correct slot and port numbers when you entered cable interface configuration mode.

Activate Cable Modem Insertion Interval

When a cable modem is ready to transmit data, it requests a channel from the Cisco uBR7246. You can limit the amount of time that a cable modem requests a channel for the first time from the Cisco uBR7246. A cable modem’s initial channel request is known as insertion. The valid range is 100 to 2000 milliseconds.

To activate cable modem insertion interval, use the following command in cable interface configuration mode:

Command	Task
cable insertion-interval <i>milliseconds</i>	Set the insertion interval in milliseconds.

Validation Tips

To verify that a cable modem insertion interval has been set, enter the command **more system:running-config** and look for the cable interface configuration information as shown in this command output excerpt:

```
router# more system:running-config
Building configuration...

Current configuration:
!
interface Cable6/0
 ip address 1.1.1.1 255.255.255.0
 no keepalive
 cable insertion-interval 2000
 cable downstream annex B
 cable downstream modulation 64qam
 cable downstream interleave-depth 32
 cable downstream symbol-rate 5056941
 cable upstream 0 frequency 15008000
 cable upstream 0 fec
 cable upstream 0 scrambler
 no cable upstream 0 shutdown
!
```

Troubleshooting Tips

If you are having trouble, make sure that you entered the correct slot and port numbers when you typed the command.

Universal Broadband Features Configuration Example

Most of the default values for the commands described in this document are adequate to configure the Cisco uBR7246. The following example shows the minimum configuration necessary to enable this feature:

```
! Enter the global configuration mode.
configure terminal
!
!Enter the cable interface configuration mode. This example shows that the
!Cisco MC11 card is in the 6th slot or bottom slot of the Cisco uBR7246 chassis.
 interface cable 6/0
!
!Configure the upstream data frequency. In this example, for channel 0, the frequency
is 15, 800 MhZ, or 15,800,000 Hz.
 cable u0 1580000

!Enable cable interface.
 no cable upstream 0 shutdown
!
Enable router interface.
 no shutdown
!Set interface's IP address
 ip address <ipaddr> <subnet mask>

end
```