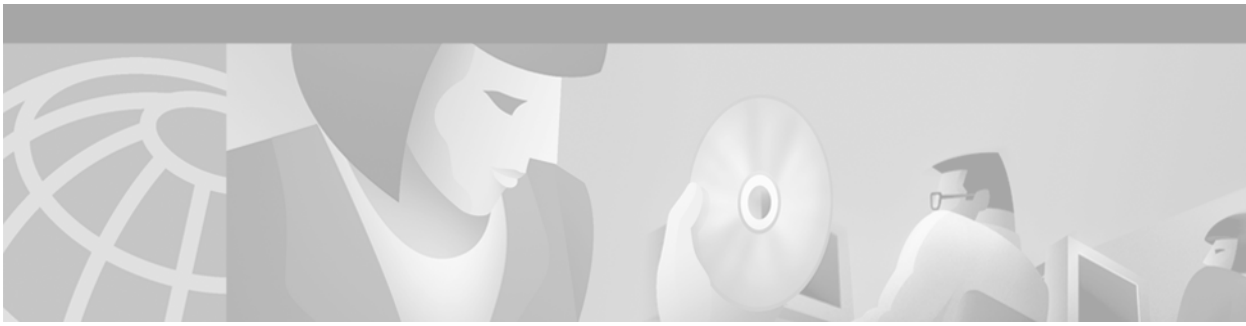

Cisco uBR7200 Series Dynamic Upstream Modulation

This feature module describes the spectrum management enhancement Dynamic Upstream Modulation feature in Cisco uBR7200 series universal broadband routers. Cisco IOS Release 12.1(3a)EC1 supports the Dynamic Upstream Modulation feature on the Cisco uBR-MC1xC and Cisco uBR-MC16S cable modem cards.

Dynamic Upstream Modulation improves service quality in Data Over Cable Service Interface Specification (DOCSIS) installations offering data, voice, or video services. Cisco uBR-MC16S and Cisco uBR-MC1xC modem cards monitor the signal-to-noise ratio (SNR) and forward error correction (FEC) counters in the active return path of each upstream port. The software with Dynamic Upstream Modulation tracks whether the upstream channel signal quality can support the modulation scheme configured, and adjusts to the most robust modulation scheme when necessary.

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Feature Overview

Noise in the upstream line from the consumer to the service provider degrades data transmission from the subscriber home. If the noise impairment is of substantial duration, it may cause the cable modem to temporarily lose communication with the headend facility altogether. As a contingency plan, Multiple Service Operators (MSOs) can reserve multiple upstream frequencies or channels for their subscribers so that if one channel suffers too much interference, the Cable Modem Termination System (CMTS) requests that the cable modems hop to another channel. This method of ingress avoidance is called frequency agility. The Dynamic Upstream Modulation feature in Cisco IOS Release 12.1(3a)EC1 checks that the upstream signal can support the configured modulation scheme, and adjusts to a more robust modulation scheme if necessary. When return path conditions improve, this feature returns the upstream channel to the higher modulation scheme.

The upstream channel is characterized by many cable modems transmitting to the CMTS. These signals operate in a burst mode of transmission. Time in the upstream channel is slotted. The CMTS provides time slots and controls the usage for each upstream interval.

The Cisco uBR7200 series equipment periodically broadcasts Upstream Channel Descriptor (UCD) messages to all cable modems. These messages define upstream channel characteristics including upstream frequencies, symbol rates and modulation schemes, FEC parameters, and other physical layer values.

Cisco supports all DOCSIS error correction encoding and modulation types and formats. Upstream signals are demodulated using Quadrature Phase Shift Keying (QPSK) or Quadrature Amplitude Modulation (16QAM). QPSK carries information in the phase of the signal carrier, but 16QAM uses both phase and amplitude to carry information.

Sending data reliably in the upstream direction is an issue because upstream spectrum varies greatly between cable plants. Select upstream parameters based on your cable plant's return paths.

Tips Customize upstream profiles for maximum trade-offs between bandwidth, efficiency, and upstream channel robustness. For example, 16QAM requires approximately 7dB higher carrier-to-noise ratio (CNR) to achieve the same bit error rate (BER) as QPSK, but transfers information at twice the rate of QPSK.

Caution You can assign upstream modulation profiles to specific upstream ports based on the Cisco cable modem card used. But, only those familiar with Data Over Cable Service Interface Specification (DOCSIS) who have received the proper training should create upstream modulation profiles.

Dynamic Upstream Modulation adjusts the modulation profiles of an upstream channel based on upstream signal quality. A modulation profile is a collection of six burst profiles that are sent out in a UCD message to configure modem transmit parameters for the upstream message types: request, request/data, initial maintenance, station maintenance, short grant, and long grant.

The return path of several fiber nodes can be combined together at a single point to form a single RF frequency domain called a combiner group. The frequency hop table associated with a combiner group is called a spectrum group. Dynamic Upstream Modulation can be configured on interfaces with fixed upstream frequencies or on interfaces with assigned spectrum groups.

Dynamic Upstream Modulation can be used along with spectrum groups. If you are using the Cisco uBR-MC16S card, when Dynamic Upstream Modulation and spectrum groups are configured on the same interface, the modulation switchover is chosen as the first corrective action, followed by a frequency hop, and finally a reduction in channel width. For information on spectrum groups and the Cisco uBR-MC16S card, see *Cisco uBR7200 Series MC16S Cable Modem Card Spectrum Management*.

Based on the SNR estimate of the receiver circuitry and FEC correctable/uncorrectable thresholds of a particular upstream channel on an Cisco uBR-MC16C or Cisco uBR-MC16S cable modem card, the 16QAM channel can change automatically to a QPSK channel. You can enable or disable the SNR thresholds. On a Cisco uBR-MC16S cable modem card, you can enable or disable the automatic switch feature when spectrum management is on.

Note The automatic switch of a 16QAM to QPSK feature is only available on Cisco uBR-MC16C and Cisco uBR-MC16S cable modem cards.

For example, if you configure Dynamic Upstream Modulation on the Cisco uBR7200 series using modulation profiles 1 and 2, where:

- Modulation profile 1 is the primary modulation profile using 16QAM

  Modulation profile 1 (16QAM) uses the more bandwidth-efficient modulation scheme and has a higher throughput than modulation profile 2 (QPSK).

- Modulation profile 2 is the secondary modulation profile using QPSK

  Modulation profile 2 (QPSK) uses the more robust modulation scheme, but it is not bandwidth-efficient.

Note Cisco recommends that the primary profile uses 16QAM modulation and the secondary uses QPSK, but this is optional. The two modulation profiles can both be QPSK or 16QAM. It is not mandatory that one is 16QAM and the other QPSK. But, modulation profile switchover is tied to 16QAM and QPSK thresholds.

The criteria for modulation profile 1 to switch to modulation profile 2 (more robust modulation scheme) includes one of the following:

- The upstream SNR goes below 25dB (SNR < 25dB), or
- The number of correctable FEC errors is more than 3% of the packets received in a 15 second time period, or
- The number of uncorrectable FEC errors is more than 1% of the packets received in a 15 second time period.

The criteria for modulation profile 2 to switch to modulation profile 1 includes all of the following:

- The upstream SNR is above 28dB (SNR > 28dB), and
- The number of correctable FEC errors is more than 3% of the packets received in a 15 second time period, and
- The number of uncorrectable FEC errors is less than 1% of the packets received in a 15 second time period.

In the previous example, modulation profile 1 switches to modulation profile 2 based on OR conditions. Modulation profile 2 switches to modulation profile 1 based on AND conditions.

Benefits

- Reduces the risk associated with transitioning to 16QAM modulation in the return path, and provides assurance that subscribers remain online and connected during return path impairments.
- Checks that the active upstream signal quality can support the configured modulation scheme, and proactively adjusts to the more robust modulation scheme when necessary.
- Eliminates the necessity to hop channels for cable modems to stay online by automatically switching from the primary modulation profile to the secondary modulation profile.

Restrictions

- Upstream modulation profiles can be assigned to specific cable modems based on the upstream ports associated with the cable modems.
- Only those who have received training and are familiar with DOCSIS should create upstream modulation profiles.
- When using the Dynamic Upstream Modulation feature with the Cisco uBR-MCxxC or Cisco uBR-MC16S cards, and/or when setting variable upstream channel widths for the Cisco uBR-MC16S card in HFC environments where Voice Over IP (VoIP) services are required, frequent changes to upstream modulation or channel width could briefly impact the quality of voice calls. Future software enhancements will provide commands to set the SNR and FEC thresholds broad enough to avoid frequent upstream modulation or channel width changes.

Related Documents

- *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*
- *Cisco uBR7200 Series Universal Broadband Router Hardware Installation Guide*
- *Cisco uBR7200 Series Software Release Notes and Features*
- *Cisco uBR7200 Series Configuration Notes*
- *Regulatory Compliance and Safety Information for the Cisco uBR7200 Series Universal Broadband Router*
- *Cisco IOS Release 12.1 Multiservice Applications Configuration Guide*
- *Cisco IOS Release 12.1 Multiservice Applications Command Reference*

Supported Platforms

- Cisco uBR7223 with Cisco uBR-MC1xC or Cisco uBR-MC16S cable modem cards
- Cisco uBR7246 with Cisco uBR-MC1xC or Cisco uBR-MC16S cable modem cards
- Cisco uBR7246 VXR with Cisco uBR-MC1xC or Cisco uBR-MC16S cable modem cards

Supported Standards, MIBs, and RFCs

Standard

DOCSIS 1.0.

MIBs

- This feature is supported by Cisco uBR7200 series MIBs and DOCSIS MIBs enhancing the manageability of customer infrastructures.

For descriptions of supported MIBs and how to use MIBs, see the Cisco MIB web site on CCO at http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml.

RFCs

No new or modified RFCs are supported by this feature.

Prerequisites

- Verify that you are using the Cisco IOS software release that supports the Cisco uBR-MC1xC or Cisco uBR-MC16S cable modem card.
- Ensure your network is designed to support reliable broadband data transmission.

  At minimum, your network must include:

  – Computer on the WAN side of your Cisco uBR7200 series configured as a Dynamic Host Configuration Protocol (DHCP) server to assign IP addresses to cable modems or set-top boxes on the hybrid fiber coaxial (HFC) network.

  – Cisco uBR7200 series-compatible IF-to-RF upconverter installed in the downstream data path at your headend site. The upconverter is installed between the Cisco uBR7200 series and the combiner.

    The combiner refers to all cables, amplifiers, and taps at the headend or cable distribution center that connect the Cisco uBR7200 series to the HFC network.

  – Diplex filters installed in the downstream RF path between the cable modems and the cable modem cards in the Cisco uBR7200 series. RG-59 headend coaxial cable with the maximum braid available (60 percent + 40 percent braid), double foil, and the correct connector for this cable.
- Complete a basic configuration of the Cisco uBR7200 series as described in the *Cisco uBR7200 Series Universal Broadband Router Software Configuration Guide*.
- Due to the nature of CATV technology, upstream noise management is a significant issue. Cisco recommends that you follow rigorous North American plant maintenance procedures documented in the *NCTA Supplement on Upstream Transport Issues* to adjust return amplifiers and lasers.

- Cisco uBR7200 series has one preconfigured (primary) modulation profile that defines a typical profile for QPSK modulation. To use the Dynamic Upstream Modulation feature, you must create a second modulation profile that has a higher modulation scheme than the preconfigured profile.

Configuration Tasks

Configuring Dynamic Upstream Modulation, page 6

Configuring Dynamic Upstream Modulation

	Command	Purpose
Step 1	`Router(config)# configure terminal`	Enters configuration mode.
Step 2	`Router(config)# cable modulation-profile` *iuc fec-tbytes fec-len burst-len guard-t mod scrambler seed diff pre-len last-cw uw-len*	Creates a modulation profile. A modulation profile is a collection of six burst profiles sent out in a UCD message to configure modem transmit parameters for the upstream message types: request, initial maintenance, station maintenance, short grant, and long grant. *profile* = Modulation profile number. *iuc* = Interval usage code or upstream burst type. Valid entries are: **initial**, **long**, **request**, **short**, or **station**. **Note** To use this command correctly, enter a line with all parameters for each upstream burst type. An incomplete burst profile causes unreliable operation, or loss of modem connectivity. *fec-tbytes* = The number of bytes that can be corrected per FEC code word. Valid values are from 0 to 10, where 0 means no FEC. *fec-len* = FEC code word length. Valid values are from 16 to 253. *burst-len* = Maximum burst length in minislots. Valid values are from 0 to 255, where 0 means no limit. *guard-t* = Guard time in symbols. The time between successive bursts. *mod* = Modulation. Valid entries are **16qam** and **qpsk**. *scrambler* = Enable or disable scrambler. Valid entries are **scrambler** and **no-scrambler**.

	Command	Purpose
		Turning the scrambler off can cause packet loss, and is only used in lab testing environments. Errors or incompatible configurations in the burst profile(s) cause modems to either drop connectivity, drop short or long data packets, or fail to connect to the network. It is possible to build a burst profile set for which no implementation of a DOCSIS receiver is capable of receiving the modem's transmission. 160 Ksymbol/sec and 2560 Ksymbol/sec data rates are highly sensitive to unique word length, preamble length, and FEC sizing. Incorrect choices for these values can cause poor or no connectivity at these symbol rates. *seed* = Scrambler seed in hexidecimal format. Valid values are from 0x0000 to 0x7FFF. *diff* = Enable or disable differential encoding. Valid entries are **diff** and **no-diff**. *pre-len* = Preamble length in bits. Valid values are from 2 to 128. *last-cw* = Handling of FEC for last code word. Valid entries are **fixed** for fixed code word length and **shortened** for shortened last code word. *uw-len* = Upstream unique word length. Enter **uw8** for 8-bit unique words or **uw16** for 16-bit unique code words.
Step 3	`Router(config)# interface type slot/port`	Configures the interface where: *type* = cable *slot* = slot number in chassis (slot numbers begin with a 0) *port* = port number on cable modem slot (port numbers begin with a 0)
Step 4	`Router(config-int)# cable upstream port-number modulation-profile primary-profile-number secondary-profile-number`	Adds the modulation profile to the interface. *port-number* = port number on cable modem slot (port numbers begin with a 0) *primary-profile-number* = The primary modulation profile added to the interface. *secondary-profile-number* = The additional modulation profile added to the interface.
Step 5	`Router(config-int)# exit`	Enter **exit** to go back to the configuration mode.

Verifying Your Settings

Step 1 Enter the **show running-config** command at the Router# prompt to check the value of the settings you have entered.

```
Router# show running-config
```

To review changes you make to the configuration, use the **show startup-config** command to display the information stored in NVRAM.

Step 2 Use the **show cable modulation-profile** privileged EXEC command to display modulation profile group information.

```
Router# show cable modulation-profile [profile] [iuc-code]
```

profile—(Optional) Profile number. Valid values are from 1 to 8.

iuc-code—(Optional) Internal usage code.

Valid options are:

- **initial**—initial ranging burst
- **long**— long grant burst
- **request**—request burst
- **short**—short grant burst
- **station**— station ranging burst

Configuration Examples

• Modulation Profiles Example, page 8

Modulation Profiles Example

The Cisco uBR7200 series Cisco IOS Release 12.1(3a)EC1 has one preconfigured modulation profile resident in memory, which defines a typical profile for QPSK modulation. In order to use the Dynamic Upstream Modulation feature, a second profile must be created that is unique from the first profile, and typically provides a higher modulation scheme.

The following example is a modulation profile for 16QAM, in which the initial, request, and station maintenance messages are sent as QPSK, and the short and long data packets are sent as 16QAM. 16QAM modulation is more bandwidth-efficient than QPSK, but QPSK is more robust than 16QAM.

Note The upstream request and station maintenance messages use less time on the cable network when configured in QPSK for symbol rates of 640, 1280 and 2560 Ksymbols/sec, Thus, these messages are actually more efficient when used in QPSK mode and they ensure a more reliable modem connection. The upstream initial maintenance message takes exactly the same amount of time on the cable network no matter how it is configured. Modems will connect more quickly and experience fewer cycles of power-adjustment during initial maintenance if the system is set for QPSK.

```
Router# configure terminal
Router(config)# cable modulation-profile 2 request 0 16 1 8 qpsk scrambler
152 no-diff 64 fixed uw8
Router(config)# cable modulation-profile 2 initial 5 34 0 48 qpsk scrambler
152 no-diff 128 fixed uw16
Router(config)# cable modulation-profile 2 station 5 34 0 48 qpsk scrambler
152 no-diff 128 fixed uw16
Router(config)# cable modulation-profile 2 short 6 75 6 8 16qam scrambler 152
no-diff 72 fixed uw8
Router(config)# cable modulation-profile 2 long 8 220 0 8 16qam scrambler 152
no-diff 160 fixed uw8
```

In the following example, all message types are carried with 16QAM modulation. Although 16QAM modulation offers a consistent modulation scheme for all five types of messages, the added length of the 16QAM preamble offsets the increased bandwidth efficiency of the MAC data message for the station maintenance messages and bandwidth request messages.

```
Router# configure terminal
Router(config)# cable modulation-profile 2 request 0 16 1 8 16qam scrambler
152 no-diff 128 fixed uw16
Router(config)# cable modulation-profile 2 initial 5 34 0 48 16qam
scrambler 152 no-diff 256 fixed uw16
Router(config)# cable modulation-profile 2 station 5 34 0 48 16qam
scrambler 152 no-diff 256 fixed uw16
Router(config)# cable modulation-profile 2 short 5 75 6 8 16qam scrambler
152 no-diff 144 fixed uw8
Router(config)# cable modulation-profile 2 long 8 220 0 8 16qam scrambler
152 no-diff 160 fixed uw8
```

Add the **cable upstream** *port-number* **modulation-profile** *primary profile-number secondary profile-number* command to the appropriate interface(s). In this example, modulation-profile 2 is for 16QAM modulation and profile 1 is for QPSK modulation.

```
Router# configure terminal
Router(config)# interface Cable6/0
Router(config-if)# cable upstream 0 modulation-profile 2 1
```

Command Reference

- **cable modulation-profile, page 10**
- **cable upstream modulation-profile, page 13**
- **show cable modulation-profile, page 14**

cable modulation-profile

To define the modulation profile, use the **cable modulation-profile** global configuration command. To remove the specified modulation profile, use the **no** form of this command.

cable modulation-profile *profile iuc fec-tbytes fec-len burst-len guard-t mod scrambler seed diff pre-len last-cw uw-len*

no cable modulation-profile *profile iuc fec-tbytes fec-len burst-len guard-t mod scrambler seed diff pre-len last-cw uw-len*

Syntax Description

profile	Modulation profile number.
iuc	Interval usage code. Valid entries are: initial, long, request, short, or station.
fec-tbytes	The number of bytes that can be corrected per FEC code word. Valid values are from 0 to 10, where 0 means no FEC.
fec-len	FEC code word length. Valid values are from 16 to 253.
burst-len	Maximum burst length in minislots. Valid values are from 0 to 255, where 0 means no limit.
guard-t	Guard time in symbols. The time between successive bursts.
mod	Modulation. Valid entries are 16qam and qpsk.
scrambler	Enable or disable scrambler. Valid entries are scrambler and no-scrambler.
seed	Scrambler seed in hexidecimal format. Valid values are from 0x0000 to 0x7FFF.
diff	Enable or disable differential encoding. Valid entries are diff and no-diff.
pre-len	Preamble length in bits. Valid values are from 2 to 128.
last-cw	Handling of FEC for last code word. Valid entries are fixed for fixed code word length and shortened for shortened last code word.
uw-len	Upstream unique word length. Enter uw8 for 8-bit unique words or uw16 for 16-bit unique code words.

Defaults

Modulation profile #1

Command Modes

Global configuration

Command History

Release	Modification
11.3 NA	This command was introduced.
12.0(7)XR2	This command was used
12.1(3a)EC1	This command was used.

Usage Guidelines

A modulation profile is a collection of six burst profiles that are sent out in an Upstream Channel Descriptor (UCD) message to configure modem transmit parameters for the upstream message types: request, initial maintenance, station maintenance, short grant, and long grant.

You can use the **no cable modulation-profile** command to remove all modulation profiles except modulation profile 1. In the case of modulation profile 1, the **no cable modulation-profile** command sets all the parameters in a burst to default values.

Caution Changes to modulation profiles causes changes to the physical layer. Because changing physical layer characteristics affects router performance and function, this task should be reserved for expert users.

To use the **cable modulation-profile** command correctly, enter a line with all parameters for each upstream burst type. An incomplete burst profile causes unreliable operation, or loss of modem connectivity.

Turning the scrambler off can cause packet loss, and is only used in lab testing environments.

Errors or incompatible configurations in the burst profile(s) cause modems to either drop connectivity, drop short or long data packets, or fail to connect to the network. It is possible to build a burst profile set for which no implementation of a DOCSIS receiver is capable of receiving the modem's transmission.

The data rates 160 Ksymbol/sec and 2560 Ksymbol/sec are highly sensitive to unique word length, preamble length, and FEC sizing. Incorrect choices for these values can cause poor or no connectivity at these symbol rates.

Examples

The following example defines the burst parameters for profile 2:

The request burst is defined to have:

- 0 fec-tbytes
- 16 kbytes fec-len
- burst-len of 1
- guard time of 8
- mod value of qpsk
- scrambler enabled with a seed value of 152
- differential encoding disabled
- preamble length of 64 bits
- fixed code word length
- 8-bit unique words for upstream unique word length

The remaining initial, station, short, and long bursts are defined in similar fashion for profile 2.

```
Router(config)# cable modulation-profile 2 request 0 16 1 8 qpsk scrambler 152 no-diff 64
fixed uw8
Router(config)# cable modulation-profile 2 initial 5 34 0 48 qpsk scrambler 152 no-diff
128 fixed uw16
Router(config)# cable modulation-profile 2 station 5 34 0 48 qpsk scrambler 152 no-diff
128 fixed uw16
Router(config)# cable modulation-profile 2 short 6 75 6 8 16qam scrambler 152 no-diff 144
fixed uw8
Router(config)# cable modulation-profile 2 long 8 220 0 8 16qam scrambler 152 no-diff 160
fixed uw8
```

Note You must create all of the bursts (request, initial, station, short and long) for this modulation profile using the **modulation profile** command.

See the **show cable modulation-profile** command for a description of the output display fields.

Related Commands

Command	Description
cable upstream modulation-profile	Assigns a modulation profile to an interface.
show cable modulation-profile	Displays modulation profile group information.

cable upstream modulation-profile

To assign a modulation profile to an interface, use the **cable upstream modulation-profile** interface configuration command. To assign the default primary modulation profile (profile #1) to the interface, use the **no** form of this command.

cable upstream *n* **modulation-profile** *primary-profile-number secondary-profile-number*

no cable upstream *n* **modulation-profile** *primary-profile-number secondary-profile-number*

Syntax Description

n	Port number on the cable modem slot (port numbers begin with a 0).
primary-profile number	Default modulation profile added to the interface.
secondary-profile number	Additional modulation profile added to the interface.

Defaults

Primary modulation profile (profile #1)

Command Modes

Interface configuration

Command History

Release	Modification
11.3 NA	This command was first introduced.
12.0(7)XR2	This command was used.
12.1(3a)EC1	This command was modified to add the *primary-profile-number* and *secondary-profile-number.*

Usage Guidelines

You can configure modulation profiles with fixed upstream frequencies or on interfaces with assigned spectrum groups. The Dynamic Upstream Modulation feature uses modulation profiles to track upstream signal quality. It checks that the upstream signal can support the configured modulation scheme, and adjusts to a more robust modulation scheme if necessary. When return path conditions improve, it returns the upstream channel to the higher modulation scheme.

In Cisco uBR-MC1xC and Cisco uBR-MC16S cable modem cards, when Dynamic Upstream Modulation and spectrum groups are configured on the same interface, the first corrective action is modulation switchover, then frequency hopping, and finally reduction in channel width.

Examples

The following example assigns the primary modulation profile 2 and the secondary modulation profile 1 to port (interface) 0:

```
Router(config-if)# cable upstream 0 modulation-profile 2 1
```

show cable modulation-profile

To display modulation profile group information, use the **show cable modulation-profile** privileged EXEC command.

show cable modulation-profile [*profile*] [*iuc-code*]

Syntax Description

profile	(Optional) Profile number. Valid values are from 1 to 8.
iuc-code	(Optional) Internal usage code. Valid options are: initial—Initial ranging burst long— Long grant burst request—Request burst short—Short grant burst station— Station ranging burst

Defaults

No default behavior or values.

Command Modes

Privileged EXEC

Command History

Release	Modification
11.3 XA	This command was first introduced.
12.(0)7XR2	This command was used.
12.1(3a)EC1	This command was used.

Usage Guidelines

The **show cable modulation-profile** command displays modulation profile group information. A modulation profile is a collection of six burst profiles that are sent out in a UCD message to configure modem transmit parameters for the following upstream message types: request, initial maintenance, station maintenance, short grant, and long grant.

The following is sample output from the **show cable modulation-profile** command:

```
router# show cable modulation-profile 1

Mo IUC     Type  Preamb Diff FEC     FEC   Scrambl Max  Guard Last Scrambl Preamb
                 length enco T       CW    seed    B    time  CW           offset
                                bytes    size            size  size  short
1  request qpsk  64     no   0x0     0x10  0x152   1    8     no    yes     56
1  initial qpsk  128    no   0x5     0x22  0x152   0    48    no    yes     0
1  station qpsk  128    no   0x5     0x22  0x152   0    48    no    yes     0
1  short   qpsk  72     no   0x5     0x4B  0x152   0    8     no    yes     48
```

The following table describes the fields shown in the **show cable modulation-profile** display.

Field	Description
Mo	Modulation profile group number. A modulation profile group is the set of burst profiles that define upstream transmit characteristics for the various types of upstream transmission classes.
IUC	Internal usage code. Each upstream transmit burst belongs to a class which is given a number called the IUC. Bandwidth maps messages by IUC codes used to allocate upstream time slots. The following types are currently defined: Request—bandwidth request slot Initial maintenance—initial link registration contention slot Station maintenance—link keep-alive slot Short data grant—short data burst slot Long data grant—long data burst slot
Type	Modulation type.
Preamb length	Preamble length.
Diff enco	Differential encoding enabled (yes) or not enabled (no).
FEC T bytes	Number of bytes that can be corrected for each FEC code word.
FEC CW size	Size, in bytes, of the FEC codeword.
Scrambl seed	Scrambler seed value in hex format.
Max B size	Maximum burst size.
Guard time size	Time between successive bursts measured in symbols.
Last CW short	Handling of FEC for shortened last code word.
Scrambl	Scrambler enabled (yes) or not enabled (no).
Preamb offset	The bits to be used for the preamble value.

Related Commands

Command	Description
cable upstream modulation-profile	Configures a spectrum group to use a specified frequency.

Debug Commands

- **debug cable freqhop, page 16**

debug cable freqhop

To display debug messages for frequency hopping, use the **debug cable freqhop** EXEC command. To disable debugging output, use the **no** form of this command.

debug cable freqhop

no debug cable freqhop

Syntax Description

This command has no arguments or keywords.

Defaults

Debugging for frequency hopping is not enabled.

Command Modes

EXEC mode.

Command History

Release	Modification
12.0(4)XI	This command was introduced.
12.(0)5T	This command was used.
12.1(3a)EC1	This command was used.

Examples

```
Router# debug cable freqhop
CMTS freqhop debugging is on
```

Related Commands

Command	Description
debug cable hw-spectrum	Displays messages for frequency hopping.