DOCSIS 2.0 A-TDMA Modulation Profiles

This document describes the DOCSIS 2.0 A-TDMA services feature, which provides support for DOCSIS 2.1 Advanced Time Division Multiple Access (A-TDMA) upstream modulation profiles on the router. This feature supplements the existing support for DOCSIS 1.0 and DOCSIS 1.1 Time Division Multiple Access (TDMA) modulation profiles.

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

Contents

- Hardware Compatibility Matrix for the Cisco cBR Series Routers, on page 1
- Prerequisites for DOCSIS 2.0 A-TDMA Modulation Profiles, on page 3
- Restrictions for DOCSIS 2.0 A-TDMA Services, on page 3
- Information About DOCSIS 2.0 A-TDMA Services, on page 3
- How to Configure DOCSIS 2.0 A-TDMA Services, on page 6
- Monitoring the DOCSIS 2.0 A-TDMA Services, on page 11
- Configuration Examples for DOCSIS 2.0 A-TDMA services, on page 13
- Additional References, on page 16
- Feature Information for DOCSIS 2.0 A-TDMA Modulation Profile, on page 18

Hardware Compatibility Matrix for the Cisco cBR Series Routers

Note The hardware components that are introduced in a given Cisco IOS-XE Release are supported in all subsequent releases unless otherwise specified.

Table 1: Hardware Compatibility Matrix for the Cisco cBR Series Routers

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	**Cisco IOS-XE Release 16.5.1 and Later Releases** Cisco cBR-8 Supervisor: • PID—CBR-SUP-250G • PID—CBR-CCAP-SUP-160G	**Cisco IOS-XE Release 16.5.1 and Later Releases** Cisco cBR-8 CCAP Line Cards: • PID—CBR-LC-8D30-16U30 • PID—CBR-LC-8D31-16U30 • PID—CBR-RF-PIC • PID—CBR-RF-PROT-PIC • PID—CBR-CCAP-LC-40G • PID—CBR-CCAP-LC-40G-R • PID—CBR-CCAP-LC-G2-R • PID—CBR-SUP-8X10G-PIC • PID—CBR-2X100G-PIC Digital PICs: • PID—CBR-DPIC-8X10G • PID—CBR-DPIC-2X100G Cisco cBR-8 Downstream PHY Module: • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D31-US-MOD

Note Do not use DPICs (8X10G and 2x100G) to forward IP traffic, as it may cause buffer exhaustion, leading to line card reload.

The only allowed traffic on a DPIC interface is DEPI, UEPI, and GCP traffic from the Cisco cBR-8 router to Remote PHY devices. Other traffic such as DHCP, SSH, and UTSC should flow via another router, since DPICs cannot be used for normal routing.

Prerequisites for DOCSIS 2.0 A-TDMA Modulation Profiles

- The cable physical plant must be capable of supporting the higher-bandwidth DOCSIS 2.0 A-TDMA modulation profiles.
- Cable modems must be DOCSIS-compliant. If cable modems go offline, or appear to be online but do not pass traffic when in the mixed TDMA/A-TDMA mode, upgrade the modem software to a DOCSIS-compliant version.
- The following are required to support the DOCSIS 2.0 A-TDMA features:
  - Cable modems must be DOCSIS 2.0 capable.
  - The DOCSIS configuration file for a DOCSIS 2.0 cable modem must either omit the DOCSIS 2.0 Enable field (TLV 39), or it must set TLV 39 to 1 (enable). If you set TLV 39 to 0 (disable), a DOCSIS 2.0 CM uses the TDMA mode.
  - The upstream must be configured for either A-TDMA-only or mixed TDMA/A-TDMA mode. To use the 6.4 MHz channel width, the upstream must be configured for A-TDMA-only mode.
- Complete a basic configuration of the router; this includes, at a minimum, the following tasks:
  - Configure a host name and password for the router.
  - Configure the router to support Internet Protocol (IP) operations.
  - Install and configure at least one WAN adapter to provide backbone connectivity.
- Determine a channel plan for the router and all of its cable interfaces.
- Verify that your headend site includes all necessary servers to support DOCSIS and Internet connectivity, including DHCP, ToD, and TFTP servers.
- The system clock on the router should be set to a current date and time to ensure that system logs have the proper timestamp and to ensure that the BPI+ subsystem uses the correct timestamp for verifying cable modem digital certificates.

Restrictions for DOCSIS 2.0 A-TDMA Services

- Does not support virtual channels, as described in DOCSIS 2.0 specification.
- Does not support Synchronous Code Division Multiple Access (S-CDMA) channels.
- Changing the DOCSIS mode of an upstream takes all cable modems on that upstream offline, which forces the cable modems to reregister, so that the CMTS can determine the capabilities of the cable modems on the new channels.

Information About DOCSIS 2.0 A-TDMA Services

DOCSIS 2.0 A-TDMA services improve the maximum upstream bandwidth on existing DOCSIS 1.0 and DOCSIS 1.1 cable networks by providing a number of advanced PHY capabilities that have been specified by the new DOCSIS 2.0 specifications.

DOCSIS 2.0 A-TDMA services incorporate the following advantages and improvements of DOCSIS 2.0 networks:

- Builds on existing DOCSIS cable networks by providing full compatibility with existing DOCSIS 1.0 and DOCSIS 1.1 cable modems. (The registration response (REG-RSP) message contains the DOCSIS version number to identify each cable modem's capabilities.)
- Upstreams can be configured for three different modes to support different mixes of cable modems:
  - An upstream can be configured for TDMA mode to support only DOCSIS 1.0 and DOCSIS 1.1 cable modems.
  - An upstream can be configured for A-TDMA mode to support only DOCSIS 2.0 cable modems.
  - An upstream can be configured for a mixed, TDMA/A-TDMA mode, to support both DOCSIS 1.0/DOCSIS 1.1 and DOCSIS 2.0 cable modems on the same upstream.

Note DOCSIS 2.0 A-TDMA cable modems will not register on a TDMA upstream if an A-TDMA or mixed upstream exists in the same MAC domain, unless the CMTS explicitly switches the cable modem to another upstream using an Upstream Channel Change (UCC) message. DOCSIS 1.0 and DOCSIS 1.1 cable modems cannot register on an A-TDMA-only upstream.

- A-TDMA mode defines new interval usage codes (IUC) of A-TDMA short data grants, long data grants, and Unsolicited Grant Service (UGS) grants (IUC 9, 10, and 11) to supplement the existing DOCSIS 1.1 IUC types.
- Increases the maximum channel capacity for A-TDMA upstreams to 30 Mbps per 6 MHz channel.
- A-TDMA and mixed modes of operation provide higher bandwidth on the upstream using new 32-QAM and 64-QAM modulation profiles, while retaining support for existing 16-QAM and QPSK modulation profiles. In addition, an 8-QAM modulation profile is supported for special applications.
- Supports a minislot size of 1 tick for A-TDMA operations.
- Increases channel widths to 6.4 MHz (5.12 Msymbol rate) for A-TDMA operations.
- A-TDMA and mixed modes of operation provide a more robust operating environment with increased protection against ingress noise and other signal impairments, using a number of new features:
  - Uses to a symbol (T)-spaced adaptive equalizer structure to increase the equalizer tap size to 24 taps, compared to 8 taps in DOCSIS 1.x mode. This allows operation in the presence of more severe multipath and microreflections, and can accommodate operation near band edges where group delay could be a problem.
  - Supports new QPSK0 and QPSK1 preambles, which provide improved burst acquisition by performing simultaneous acquisition of carrier and timing lock, power estimates, equalizer training, and constellation phase lock. This allows shorter preambles, reducing implementation loss.
  - Increases the forward error correction (FEC) T-byte size to 16 bytes per Reed Solomon block (T=16) with programmable interleaving.

Modes of Operation

Depending on the configuration, the DOCSIS 2.0 A-TDMA Service feature supports either DOCSIS or Euro-DOCSIS operation:

- DOCSIS cable networks are based on the ITU J.83 Annex B physical layer standard and Data-over-Cable Service Interface Specifications (DOCSIS, Annex B) specification, which use 6 MHz National Television Systems Committee (NTSC) channel plans. In this mode, the downstream uses a 6 MHz channel width

in the 85 to 860 MHz frequency range, and the upstream supports multiple channel widths in the 5 to 42 MHz frequency range.

- EuroDOCSIS cable networks are based on the ITU J.112 Annex A physical layer standard and European DOCSIS (EuroDOCSIS, Annex A) specification, which use 8 MHz Phase Alternating Line (PAL) and Systeme Electronique Couleur Avec Memoire (SECAM) channel plans. In this mode, the downstream uses an 8 MHz channel width in the 85 to 860 MHz frequency range, and the upstream supports multiple channel widths in the 5 to 65 MHz frequency range.

Note The difference between DOCSIS and EuroDOCSIS is at the physical layer. To support a DOCSIS or EuroDOCSIS network requires the correct configuration of the DOCSIS 2.0 A-TDMA Service card, as well as upconverters, diplex filters, and other equipment that supports the network type.

The table below shows the maximum supported DOCSIS 1.1 data rates.

Table 2: Maximum DOCSIS 1.1 Data Rates

Upstream Channel Width	Modulation Scheme	Baud Rate Sym/sec	Maximum Raw Bit Rate Mbit/sec
3.2 MHz	16-QAM QPSK	2.56 M	10.24 5.12
1.6 MHz	16-QAM QPSK	1.28 M	5.12 2.56

The table below shows the maximum supported DOCSIS 2.0 (A-TDMA-mode) data rates.

Table 3: Maximum DOCSIS 2.0 (A-TDMA-mode) Data Rates

Upstream Channel Width	Modulation Scheme	Baud Rate Sym/sec	Maximum Raw Bit Rate Mbit/sec
6.4 MHz	64-QAM	5.12 M	30.72
	32-QAM		25.60
	16-QAM		20.48
	8-QAM		15.36
	QPSK		10.24
3.2 MHz	64-QAM	2.56 M	15.36
	32-QAM		12.80
	16-QAM		10.24
	8-QAM		7.68
	QPSK		5.12

Upstream Channel Width	Modulation Scheme	Baud Rate Sym/sec	Maximum Raw Bit Rate Mbit/sec
1.6 MHz	64-QAM	1.28 M	7.68
	32-QAM		6.40
	16-QAM		5.12
	8-QAM		3.84
	QPSK		2.56

Modulation Profiles

To simplify the administration of A-TDMA and mixed TDMA/A-TDMA modulation profiles, the DOCSIS 2.0 A-TDMA Service feature provides a number of preconfigured modulation profiles that are optimized for different modulation schemes. We recommend using these preconfigured profiles.

Each mode of operation also defines a default modulation profile that is automatically used when a profile is not specifically assigned to an upstream. The default modulation profiles cannot be deleted. The table below lists the valid ranges according to cable interface and modulation type:

Table 4: Allowable Ranges for Modulation Profiles

Cable Interface	DOCSIS 1.X (TDMA)	Mixed DOCSIS 1.X/2.0	DOCSIS 2.0 (A-TDMA)
Cisco cBR-8 CCAP Line Cards	1 to 400 (default is 21)	1 to 400 (default 121)	1 to 400 (default 221)

Benefits

The DOCSIS 2.0 A-TDMA Service feature provides the following benefits to cable service providers and their partners and customers:

- Full compatibility with DOCSIS 1.0 and DOCSIS 1.1 cable modems (CMs) and cable modem termination systems (CMTS).
- Additional channel capacity in the form of more digital bits of throughput capacity in the upstream path.
- Increased protection against electronic impairments that occur in cable systems, allowing for a more robust operating environment.

How to Configure DOCSIS 2.0 A-TDMA Services

This section contains the following:

Creating Modulation Profiles

Cisco cable modem termination systems (CMTSs) can handle modulation profiles for the RF configuration of a voice and data cable modem plant. Cisco IOS® Software is designed with a default modulation profile that is optimal in most conditions. Therefore, do not change the default configuration. However, if the modulation needs are different for the customer plant, Cisco IOS Software has the ability to customize and to configure the modulation profiles to suit the customer needs.

Caution Only an expert, who understands modulation changes and Data-over-Cable Service Interface Specifications (DOCSIS), should modify these parameters. Otherwise, changes can cause disruption or the degradation of services because the commands affect the physical layer.

This section describes how to create modulation profiles for the different modes of DOCSIS operations, using the preconfigured modulation profile options.

Creating a TDMA Modulation Profile

This section describes how to create a modulation profile for the DOCSIS 1.0/DOCSIS 1.1 TDMA mode of operation, using one of the preconfigured modulation profiles.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 3	**cable modulation-profile** *profile* **tdma** {**mix** | **qam-16** | **qpsk** | **robust-mix**}
	Example:
	`Router(config)# cable modulation-profile 3 tdma mix`
	`Router(config)# cable modulation-profile 4 tdma qpsk`
		Creates a preconfigured modulation profile, where the burst parameters are set to their default values for each burst type:
		Note
		You can also create custom modulation profiles with the **cable modulation-profile** command by configuring the values for the individual burst parameters. These parameters, however, should not be modified unless you are thoroughly familiar with how changing each parameter affects the DOCSIS MAC layer. We recommend using the preconfigured default modulation profiles for most cable plants.

Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Creating a Mixed Mode Modulation Profile

This section describes how to create a modulation profile for the mixed TDMA/A-TDMA mode of operation, using one of the preconfigured modulation profiles.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 3	**cable modulation-profile** *profile* **mixed** {**mix-high** | **mix-low** | **mix-mid** | **mix-qam** | **qam-16** | **qpsk** | **robust-mix-high** | **robust-mix-mid** | **robust-mix-qam**}
	Example:
	`Router(config)# cable modulation-profile 143 mixed mix-medium`
	`Router(config)# cable modulation-profile 144 mixed mix-high`
		Creates a preconfigured modulation profile, where the burst parameters are set to their default values for each burst type:
		Note The **robust-mix** profiles are similar to but more robust than the **mix** profiles, so that they are more able to deal with noise on the upstream.
		Note You can also create custom modulation profiles with the **cable modulation-profile** command by configuring the values for the individual burst parameters. These parameters, however, should not be modified unless you are thoroughly familiar with how changing each parameter affects the DOCSIS MAC layer. We recommend using the preconfigured default modulation profiles for most cable plants.

Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Creating an A-TDMA Modulation Profile

This section describes how to create a modulation profile for the DOCSIS 2.0 A-TDMA mode of operation, using one of the preconfigured modulation profiles.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 3	**cable modulation-profile** *profile* **atdma** {**mix-high** | **mix-low** | **mix-mid** | **mix-qam** | **qam-8** | **qam-16** | **qam-32** | **qam-64** | **qpsk** | **robust-mix-high** | **robust-mix-low** | **robust-mix-mid**}
	Example:
	`Router(config)# cable modulation-profile 242 atdma qam-32`
	`Router(config)# cable modulation-profile 243 atdma qam-64`
	Example:
	`cable modulation-profile 45 tdma request 0 16 0 22 qpsk scrambler 152 no-diff 64 fixed`
	`cable modulation-profile 45 tdma initial 5 34 0 48 16qam scrambler 152 no-diff 256 fixed`
	`cable modulation-profile 45 tdma station 5 34 0 48 16qam scrambler 152 no-diff 256 fixed`
	`cable modulation-profile 45 tdma short 3 76 12 22 16qam scrambler 152 no-diff 128 shortened`
	`cable modulation-profile 45 tdma long 9 232 0 22 16qam scrambler 152 no-diff 128 shortened`
	`cable modulation-profile 45 tdma initial 5 34 0 48 16qam scrambler 152 no-diff 256 fixed`
		Note
		For Cisco Remote PHY 220, preamble with QPSK modulation must have values—32x2^n (0, 1, 2, 3) bits.
		Preamble with 16-QAM modulation must have values—64x2^n (0, 1, 2,) bits.
		Note
		The **robust-mix** profiles are similar to but more robust than the **mix** profiles, so that they are more able to deal with noise on the upstream.
		Note
		You can also create custom modulation profiles with the **cable modulation-profile** command by configuring the values for the individual burst parameters. These parameters, however, should not be modified unless you are thoroughly familiar with how changing each parameter affects the DOCSIS MAC layer. We recommend using the preconfigured default modulation profiles for most cable plants.
		Note
		For Cisco Remote PHY 220, preamble with QPSK modulation must have values—32x2^n (0, 1, 2, 3) bits.
		Preamble with 16-QAM modulation must have values—64x2^n (0, 1, 2,) bits.

Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Configuring the DOCSIS Mode and Profile on an Upstream

This section describes how to configure an upstream for a DOCSIS mode of operation, and then to assign a particular modulation profile to that upstream.

Note By default, all upstreams are configured for ATDMA-only mode, using the default modulation profile.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller upstream-Cable** *slot/subslot/port* **Example:** `Router(config)# controller upstream-Cable 2/0/1`	Enters controller configuration mode for the interface.
Step 4	**us-channel** *n* **docsis-mode** {**atdma** | **tdma** | **tdma-atdma**} **Example:** `Router(config-controller)# us-channel 0 docsis-mode atdma`	Configures the upstream for the desired DOCSIS mode of operation.
Step 5	**us-channel** *n* **modulation-profile** *primary-profile-number* [*secondary-profile-number*] [*tertiary-profile-number*] **Example:** `Router(config-controller)# us-channel 0 modulation-profile 241`	Assigns up to three modulation profiles to the upstream port. **Note** The type of modulation profiles must match the DOCSIS mode configured for the upstream, using the **us-channel docsis-mode** command.
Step 6	**us-channel** *n* **equalization-coefficient** **Example:** `Router(config-controller)# us-channel 0 equalization-coefficient`	(Optional) Enables the use of a DOCSIS pre-equalization coefficient on the upstream port.
Step 7	**us-channel** *n* **ingress-noise-cancellation** *interval* **Example:** `Router(config-controller)# us-channel 0 ingress-noise-cancellation 400`	(Optional) Configures the interval, in milliseconds, for which the interface card should sample the signal on an upstream to correct any ingress noise that has appeared on that upstream.
Step 8	**us-channel** *n* **maintain-psd** **Example:** `Router(config-controller)# us-channel 0 maintain-psd`	(Optional) Requires DOCSIS 2.0 cable modems that are operating on an ATDMA-only upstream to maintain a constant power spectral density (PSD) after a modulation rate change. **Note** Repeat Step 3, on page 10 through Step 8, on page 10 for each upstream to be configured.

	Command or Action	Purpose
Step 9	**end** **Example:** `Router(config-controller)# end`	Exits controller configuration mode and returns to privileged EXEC mode.

Monitoring the DOCSIS 2.0 A-TDMA Services

This section contains the following:

Displaying Modulation Profiles

To display the modulation profiles that are currently defined on the CMTS, use the **show cable modulation-profile** command without any options:

```
Router# show cable modulation-profile

Mod Docsis  IUC     Type   Pre Diff FEC  FEC  Scrmb  Max Guard Last Scrmb Pre   Pre   RS
    -Mode                  len enco T    k    seed   B   time  CW         offst Type
                                   BYTE BYTE        siz size  short
1   atdma   request 16qam  32  no   0x0  0x10 0x152  0   22    no   yes   0     qpsk1 no
1   atdma   initial 16qam  64  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk1 no
1   atdma   station 16qam  64  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk1 no
1   atdma   a-short 16qam  64  no   0x4  0x4C 0x152  7   22    yes  yes   0     qpsk1 no
1   atdma   a-long  16qam  64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
1   atdma   a-ugs   16qam  64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
2   atdma   request 16qam  32  no   0x0  0x10 0x152  0   22    no   yes   0     qpsk1 no
2   atdma   initial 16qam  64  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk1 no
2   atdma   station 16qam  64  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk1 no
2   atdma   a-short 16qam  64  no   0x4  0x4C 0x152  7   22    yes  yes   0     qpsk1 no
2   atdma   a-long  16qam  64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
2   atdma   a-ugs   16qam  64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
21  tdma    request qpsk   36  no   0x0  0x10 0x152  0   22    no   yes   0     qpsk  na
21  tdma    initial qpsk   98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk  na
21  tdma    station qpsk   98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk  na
21  tdma    short   qpsk   64  no   0x3  0x4C 0x152  12  22    yes  yes   0     qpsk  na
21  tdma    long    qpsk   64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk  na
121 mixed   request qpsk   36  no   0x0  0x10 0x152  0   22    no   yes   0     qpsk  na
121 mixed   initial qpsk   98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk  na
121 mixed   station qpsk   98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk  na
121 mixed   short   qpsk   64  no   0x3  0x4C 0x152  12  22    yes  yes   0     qpsk  na
121 mixed   long    qpsk   64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk  na
121 mixed   a-short 64qam  64  no   0x6  0x4C 0x152  6   22    yes  yes   0     qpsk1 no
121 mixed   a-long  64qam  64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
121 mixed   a-ugs   64qam  64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
221 atdma   request qpsk   36  no   0x0  0x10 0x152  0   22    no   yes   0     qpsk0 no
221 atdma   initial qpsk   98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk0 no
221 atdma   station qpsk   98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk0 no
221 atdma   a-short 64qam  64  no   0x6  0x4C 0x152  6   22    yes  yes   0     qpsk1 no
221 atdma   a-long  64qam  64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
```

To display a specific modulation profile in detail, specify the profile number with the **show cable modulation-profile** command:

```
Router# show cable modulation-profile 221
```

```
Mod Docsis  IUC     Type  Pre Diff FEC  FEC  Scrmb  Max Guard Last Scrmb Pre   Pre   RS
    -Mode                 len enco T    k    seed   B   time  CW         offst Type
                                   BYTE BYTE        siz size  short
221 atdma   request qpsk  36  no   0x0  0x10 0x152  0   22    no   yes   0     qpsk0 no
221 atdma   initial qpsk  98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk0 no
221 atdma   station qpsk  98  no   0x5  0x22 0x152  0   48    no   yes   0     qpsk0 no
221 atdma   a-short 64qam 64  no   0x6  0x4C 0x152  6   22    yes  yes   0     qpsk1 no
221 atdma   a-long  64qam 64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
221 atdma   a-ugs   64qam 64  no   0x9  0xE8 0x152  0   22    yes  yes   0     qpsk1 no
```

Displaying Cable Modem Capabilities and Provisioning

To display the capabilities of the online cable modems and how the modems were provisioned, use the **show cable modem mac** command:

```
Router# show cable modem mac

MAC Address     MAC          Prim  Ver    QoS    Frag Concat PHS Priv DS    US
                State        Sid          Prov                        Saids Sids
1859.334d.7b4c  init(i)      145   DOC1.0 DOC1.0 no   no     no       0     0
1859.334d.fa8c  offline      146   DOC1.0 DOC1.0 no   no     no       0     0
1859.334d.fa02  offline      147   DOC1.0 DOC1.0 no   no     no       0     0
1859.334d.65b0  online(pt)   148   DOC3.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.6622  offline      149   DOC1.0 DOC1.0 no   no     no       0     0
1859.334d.7a50  init(i)      150   DOC1.0 DOC1.0 no   no     no       0     0
1859.334d.7a2e  offline      151   DOC1.0 DOC1.0 no   no     no       0     0
1859.334d.7d14  online(pt)   152   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.6636  online(pt)   153   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.7cf0  online(pt)   154   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.6742  online(pt)   155   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.7b2a  online(pt)   156   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.7e64  online(pt)   157   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.ede0  online(pt)   158   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.7b8a  online(pt)   159   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.6604  online(pt)   160   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.f93a  online(pt)   161   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.7bf0  online(pt)   162   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.596a  online(pt)   163   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.7d38  online(pt)   164   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.fc64  online(pt)   165   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.6434  online(pt)   166   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
1859.334d.f62a  online(pt)   167   DOC2.0 DOC1.1 yes  yes    yes BPI+ 15    16
!
```

To display how many cable modems of each DOCSIS type are online each upstream, use the **show cable modem mac summary** command:

```
Router# show cable modem mac summary

                             Cable Modem Summary
                             -------------------
                           Mac Version                        QoS Provision Mode
Interface        Total   DOC3.0  DOC2.0  DOC1.1  DOC1.0   Reg/Online   DOC1.1  DOC1.0
Cable3/0/1/U0    20      0       5       0       15       5            5       0
Cable3/0/1/U1    23      0       9       0       14       9            9       0
Cable3/0/1/U2    21      0       8       0       13       8            8       0
Cable3/0/1/U4    42      0       9       0       33       9            9       0
Cable3/0/1/U5    20      0       15      0       5        15           15      0
Cable3/0/1/U6    18      1       14      0       3        15           15      0
Cable3/0/2/U0    26      0       26      0       0        26           26      0
Cable3/0/2/U1    28      0       28      0       0        28           28      0
Cable3/0/2/U2    24      0       24      0       0        24           24      0
```

```
Cable3/0/2/U4    72      0       72      0       0       72          72      0
Cable3/0/3/U0    67      0       63      0       4       63          63      0
Cable3/0/3/U1    85      1       84      0       0       85          85      0
Cable3/0/3/U2    1       0       1       0       0       1           1       0
Cable3/0/4/U0    12      0       1       0       11      1           1       0
Cable3/0/4/U1    39      0       0       0       39      0           0       0
Cable3/0/4/U2    12      0       1       0       11      1           1       0
Cable3/0/4/U4    65      0       11      0       54      11          11      0
Cable3/0/4/U5    10      0       10      0       0       10          10      0
Cable3/0/4/U6    5       0       5       0       0       5           5       0
Cable3/0/5/U0    27      0       27      0       0       27          27      0
Cable3/0/5/U1    27      0       27      0       0       27          27      0
Cable3/0/5/U2    26      0       26      0       0       26          26      0
Cable3/0/5/U4    77      0       77      0       0       77          77      0
Cable3/0/6/U4    14      14      0       0       0       14          14      0
Cable3/0/6/U5    12      12      0       0       0       12          12      0
Cable3/0/6/U6    5       5       0       0       0       5           5       0
```

Configuration Examples for DOCSIS 2.0 A-TDMA services

This section contains the following:

Creating Modulation Profiles Examples

This section contains the following:

Example: DOCSIS 1.0/DOCSIS 1.1 TDMA Modulation Profiles

The following sample configurations show typical modulation profiles for the DOCSIS 1.0/DOCSIS 1.1 TDMA mode of operation:

- Profile 21 is the default profile for TDMA operations.
- Profiles 24 and 25 use the preconfigured 16-QAM and QPSK modulation profiles.
- Profile 26 is a typical QPSK modulation profile using some customized burst parameters.

```
cable modulation-profile 24 tdma qam-16
cable modulation-profile 25 tdma qpsk
cable modulation-profile 26 tdma request 0 16 0 8 qpsk scrambler 152 no-diff 68 fixed
cable modulation-profile 26 tdma initial 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed
cable modulation-profile 26 tdma station 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed
cable modulation-profile 26 tdma short 4 76 12 8 qpsk scrambler 152 no-diff 80 shortened
cable modulation-profile 26 tdma long 8 236 0 8 qpsk scrambler 152 no-diff 80 shortened
```

Example: Mixed TDMA/A-TDMA Modulation Profiles

The following sample configurations show typical modulation profiles for the DOCSIS 1.X/DOCSIS 2.0 mixed TDMA/A-TDMA mode of operation:

- Profile 121 is the default profile for mixed mode operations.
- Profiles 122 through 126 use the preconfigured mixed mode modulation profiles.
- Profile 127 is a typical mixed mode modulation profile some customized burst parameters.

```
cable modulation-profile 121 mixed request 0 16 0 8 qpsk scrambler 152 no-diff 64 fixed
cable modulation-profile 121 mixed initial 5 34 0 48 qpsk scrambler 152 no-diff 32 fixed
cable modulation-profile 121 mixed station 5 34 0 48 qpsk scrambler 152 no-diff 32 fixed
cable modulation-profile 121 mixed short 5 75 6 8 qpsk scrambler 152 no-diff 72 shortened
```

```
cable modulation-profile 121 mixed long 8 220 0 8 qpsk scrambler 152 no-diff 80 shortened
cable modulation-profile 121 mixed a-short 0 16 15 99 64qam scrambler 152 no-diff 128
shortened qpsk0 0 18
cable modulation-profile 121 mixed a-long 0 16 15 200 64qam scrambler 152 no-diff 128
shortened qpsk0 0 18

cable modulation-profile 122 mixed mix-high
cable modulation-profile 123 mixed mix-low
cable modulation-profile 124 mixed mix-medium
cable modulation-profile 125 mixed qam-16
cable modulation-profile 126 mixed qpsk

cable modulation-profile 127 mixed request 0 16 0 8 qpsk scrambler 152 no-diff 68 fixed
cable modulation-profile 127 mixed initial 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed
cable modulation-profile 127 mixed station 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed
cable modulation-profile 127 mixed short 6 76 7 8 16qam scrambler 152 no-diff 160 shortened

cable modulation-profile 127 mixed long 8 231 0 8 16qam scrambler 152 no-diff 160 shortened

cable modulation-profile 127 mixed a-short 9 76 6 8 32qam scrambler 152 no-diff 160 shortened
 qpsk1 1 2048
cable modulation-profile 127 mixed a-long 12 231 0 8 64qam scrambler 152 no-diff 132 shortened
 qpsk1 1 2048
```

Example: DOCSIS 2.0 A-TDMA Modulation Profiles

The following sample configurations show typical modulation profiles for the DOCSIS 2.0 A-TDMA mode of operation:

- Profile 221 is the default profile for A-TDMA mode operations.
- Profiles 222 through 226 use the preconfigured A-TDMA mode modulation profiles.
- Profile 227 is a typical A-TDMA mode modulation profile customized burst parameters.

```
cable modulation-profile 221 atdma request 0 16 0 8 qpsk scrambler 152 no-diff 64 fixed
qpsk0 0 18
cable modulation-profile 221 atdma initial 5 34 0 48 qpsk scrambler 152 no-diff 32 fixed
qpsk0 0 18
cable modulation-profile 221 atdma station 5 34 0 48 qpsk scrambler 152 no-diff 32 fixed
qpsk0 0 18
cable modulation-profile 221 atdma short 5 75 6 8 qpsk scrambler 152 no-diff 72 shortened
qpsk0 0 18
cable modulation-profile 221 atdma long 8 220 0 8 qpsk scrambler 152 no-diff 80 shortened
qpsk0 0 18
cable modulation-profile 221 atdma a-short 5 99 10 8 64qam scrambler 152 no-diff 128 shortened
 qpsk0 0 18
cable modulation-profile 221 atdma a-long 15 200 0 8 64qam scrambler 152 no-diff 128 shortened
 qpsk0 0 18

cable modulation-profile 222 atdma qam-8
cable modulation-profile 223 atdma qam-16
cable modulation-profile 224 atdma qam-32
cable modulation-profile 225 atdma qam-64
cable modulation-profile 226 atdma qpsk

cable modulation-profile 227 atdma request 0 16 0 8 qpsk scrambler 152 no-diff 68 fixed
qpsk0 1 2048
cable modulation-profile 227 atdma initial 0 16 0 0 qpsk no-scrambler no-diff 2 fixed qpsk1
 0 18
cable modulation-profile 227 atdma station 5 34 0 48 qpsk scrambler 152 no-diff 128 fixed
qpsk0 1 2048
cable modulation-profile 227 atdma a-short 9 76 6 8 32qam scrambler 152 no-diff 160 shortened
 qpsk1 1 2048
```

```
cable modulation-profile 227 atdma a-long 12 231 0 8 64qam scrambler 152 no-diff 132 shortened
 qpsk1 1 2048
cable modulation-profile 227 atdma a-ugs 3 231 0 8 16qam scrambler 152 no-diff 80 shortened
 qpsk1 1 2048
```

Assigning Modulation Profiles to Upstreams Examples

This section contains the following:

Example: Assigning DOCSIS 1.0/DOCSIS 1.1 TDMA Modulation Profiles

The following sample configuration shows DOCSIS 1.0/DOCSIS 1.1 TDMA modulation profiles being assigned to the upstreams. The TDMA modulation profile (profile 21) is assigned to the upstream controller 2/0/0.

```
controller Upstream-Cable 2/0/0
 us-channel 0 channel-width 1600000 1600000
 us-channel 0 docsis-mode tdma
 us-channel 0 minislot-size 4
 us-channel 0 modulation-profile 21
 no us-channel 0 shutdown
 us-channel 1 channel-width 1600000 1600000
 us-channel 1 docsis-mode tdma
 us-channel 1 minislot-size 4
 us-channel 1 modulation-profile 21
 no us-channel 1 shutdown
 us-channel 2 channel-width 1600000 1600000
 us-channel 2 docsis-mode tdma
 us-channel 2 minislot-size 4
 us-channel 2 modulation-profile 21
 no us-channel 2 shutdown
 us-channel 3 channel-width 1600000 1600000
 us-channel 3 docsis-mode tdma
 us-channel 3 minislot-size 4
 us-channel 3 modulation-profile 21
 no us-channel 3 shutdown
 !
```

Example: Assigning Mixed TDMA/A-TDMA Modulation Profiles

The following sample configuration shows mixed mode TDMA/A-TDMA modulation profiles being assigned to the upstreams. The mixed modulation profile (profile 121) is assigned to the upstream controller 2/0/15.

```
controller Upstream-Cable 2/0/15
 us-channel 0 channel-width 1600000 1600000
 us-channel 0 docsis-mode tdma-atdma
 us-channel 0 minislot-size 4
 us-channel 0 modulation-profile 121
 no us-channel 0 shutdown
 us-channel 1 channel-width 1600000 1600000
 us-channel 1 docsis-mode tdma-atdma
 us-channel 1 minislot-size 4
 us-channel 1 modulation-profile 121
 no us-channel 1 shutdown
 us-channel 2 channel-width 1600000 1600000
 us-channel 2 docsis-mode tdma-atdma
 us-channel 2 minislot-size 4
 us-channel 2 modulation-profile 121
 no us-channel 2 shutdown
 us-channel 3 channel-width 1600000 1600000
```

```
 us-channel 3 docsis-mode tdma-atdma
 us-channel 3 minislot-size 4
 us-channel 3 modulation-profile 121
 no us-channel 3 shutdown
!
```

Example: Assigning DOCSIS 2.0 A-TDMA Modulation Profiles

The following sample configuration shows DOCSIS 2.0 A-TDMA modulation profiles being assigned to the upstreams. The A-TDMA modulation profile (profile 221) is assigned to the upstream controller 2/0/10.

```
controller Upstream-Cable 2/0/10
 us-channel 0 channel-width 1600000 1600000
 us-channel 0 docsis-mode atdma
 us-channel 0 minislot-size 4
 us-channel 0 modulation-profile 221
 no us-channel 0 shutdown
 us-channel 1 channel-width 1600000 1600000
 us-channel 1 docsis-mode atdma
 us-channel 1 minislot-size 4
 us-channel 1 modulation-profile 221
 no us-channel 1 shutdown
 us-channel 2 channel-width 1600000 1600000
 us-channel 2 docsis-mode atdma
 us-channel 2 minislot-size 4
 us-channel 2 modulation-profile 221
 no us-channel 2 shutdown
 us-channel 3 channel-width 1600000 1600000
 us-channel 3 docsis-mode atdma
 us-channel 3 minislot-size 4
 us-channel 3 modulation-profile 221
 no us-channel 3 shutdown
 us-channel 4 channel-width 1600000 1600000
 us-channel 4 docsis-mode atdma
 us-channel 4 minislot-size 4
 us-channel 4 modulation-profile 221
 us-channel 4 shutdown
 us-channel 5 channel-width 1600000 1600000
 us-channel 5 docsis-mode atdma
 us-channel 5 minislot-size 4
 us-channel 5 modulation-profile 221
 us-channel 5 shutdown
!
```

Additional References

Related Documents

Related Topic	Document Title
Cisco CMTS Commands	*Cisco IOS CMTS Cable Command Reference* http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.html

Standards

Standards	Title
SP-RFIv1.1-I09-020830	Data-over-Cable Service Interface Specifications Radio Frequency Interface Specification, version 1.1
SP-RFIv2.0-I03-021218	Data-over-Cable Service Interface Specifications Radio Frequency Interface Specification, version 2.0
SP-OSSIv2.0-I03-021218	Data-over-Cable Service Interface Specifications Operations Support System Interface Specification, version 2.0
SP-BPI+-I09-020830	Data-over-Cable Service Interface Specifications Baseline Privacy Plus Interface Specification, version 2.0
RFC 2233	DOCSIS OSSI Objects Support
RFC 2665	DOCSIS Ethernet MIB Objects Support
RFC 2669	Cable Device MIB

MIBs

MIBs	MIBs Link
• DOCS-BPI-PLUS-MIB • DOCS-CABLE-DEVICE-MIB (RFC 2669) • DOCS-CABLE-DEVICE-TRAP-MIB • DOCS-IF-EXT-MIB • DOCS-IF-MIB (RFC 2670) • DOCS-QOS-MIB • DOCS-SUBMGT-MIB • IGMP-STD-MIB (RFC 2933)	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: https://cfnng.cisco.com/mibs

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature Information for DOCSIS 2.0 A-TDMA Modulation Profile

Note The following table lists the software release in which a given feature is introduced. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Table 5: Feature Information for DOCSIS 2.0 A-TDMA Modulation Profile

Feature Name	Releases	Feature Information
DOCSIS 2.0 A-TDMA Modulation Profile	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the cisco cBR Series Converged Broadband Routers.