



## DOCSIS 2.0 A-TDMA Modulation Profiles

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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.

### Finding Feature Information

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.

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## Hardware Compatibility Matrix for the Cisco cBR Series Routers



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

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

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	<p><b>Cisco IOS-XE Release 16.5.1 and Later Releases</b></p> <p>Cisco cBR-8 Supervisor:</p> <ul style="list-style-type: none"> <li>• PID—CBR-SUP-250G</li> <li>• PID—CBR-CCAP-SUP-160G</li> </ul>	<p><b>Cisco IOS-XE Release 16.5.1 and Later Releases</b></p> <p>Cisco cBR-8 CCAP Line Cards:</p> <ul style="list-style-type: none"> <li>• PID—CBR-LC-8D30-16U30</li> <li>• PID—CBR-LC-8D31-16U30</li> <li>• PID—CBR-RF-PIC</li> <li>• PID—CBR-RF-PROT-PIC</li> <li>• PID—CBR-CCAP-LC-40G</li> <li>• PID—CBR-CCAP-LC-40G-R</li> <li>• PID—CBR-CCAP-LC-G2-R</li> <li>• PID—CBR-SUP-8X10G-PIC</li> <li>• PID—CBR-2X100G-PIC</li> </ul> <p>Digital PICs:</p> <ul style="list-style-type: none"> <li>• PID—CBR-DPIC-8X10G</li> <li>• PID—CBR-DPIC-2X100G</li> </ul> <p>Cisco cBR-8 Downstream PHY Module:</p> <ul style="list-style-type: none"> <li>• PID—CBR-D31-DS-MOD</li> </ul> <p>Cisco cBR-8 Upstream PHY Modules:</p> <ul style="list-style-type: none"> <li>• PID—CBR-D31-US-MOD</li> </ul>

## 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 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
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
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Router> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 3</b>	<b>cable modulation-profile</b> <i>profile</i> <b>tdma</b> { <b>mix</b>   <b>qam-16</b>   <b>qpsk</b>   <b>robust-mix</b> } <b>Example:</b> Router(config)# <b>cable modulation-profile 3 tdma mix</b> Router(config)# <b>cable modulation-profile 4 tdma qpsk</b>	Creates a preconfigured modulation profile, where the burst parameters are set to their default values for each burst type:  <b>Note</b> You can also create custom modulation profiles with the <b>cable modulation-profile</b> 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.
<b>Step 4</b>	<b>exit</b> <b>Example:</b> Router(config)# <b>exit</b>	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
<b>Step 1</b>	<b>enable</b> <b>Example:</b> Router> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 3</b>	<b>cable modulation-profile</b> <i>profile</i> <b>mixed</b> { <b>mix-high</b>   <b>mix-low</b>   <b>mix-mid</b>   <b>mix-qam</b>   <b>qam-16</b>   <b>qpsk</b>   <b>robust-mix-high</b>   <b>robust-mix-mid</b>   <b>robust-mix-qam</b> }	Creates a preconfigured modulation profile, where the burst parameters are set to their default values for each burst type:

	Command or Action	Purpose
	<p><b>Example:</b></p> <pre>Router(config)# cable modulation-profile 143 mixed mix-medium Router(config)# cable modulation-profile 144 mixed mix-high</pre>	<p><b>Note</b> The <b>robust-mix</b> profiles are similar to but more robust than the <b>mix</b> profiles, so that they are more able to deal with noise on the upstream.</p> <p><b>Note</b> You can also create custom modulation profiles with the <b>cable modulation-profile</b> 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.</p>
<b>Step 4</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config)# exit</pre>	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
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>cable modulation-profile</b> <i>profile</i> <b>atdma</b> {<b>mix-high</b>   <b>mix-low</b>   <b>mix-mid</b>   <b>mix-qam</b>   <b>qam-8</b>   <b>qam-16</b>   <b>qam-32</b>   <b>qam-64</b>   <b>qpsk</b>   <b>robust-mix-high</b>   <b>robust-mix-low</b>   <b>robust-mix-mid</b>}</p> <p><b>Example:</b></p> <pre>Router(config)# cable modulation-profile 242 atdma qam-32 Router(config)# cable modulation-profile 243 atdma qam-64</pre> <p><b>Example:</b></p>	<p><b>Note</b> For Cisco Remote PHY 220, preamble with QPSK modulation must have values—<math>32 \times 2^n</math> (0, 1, 2, 3) bits.</p> <p>Preamble with 16-QAM modulation must have values—<math>64 \times 2^n</math> (0, 1, 2,) bits.</p> <p><b>Note</b> The <b>robust-mix</b> profiles are similar to but more robust than the <b>mix</b> profiles, so that they are more able to deal with noise on the upstream.</p>



	Command or Action	Purpose
	<pre> 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 </pre>	<p><b>Note</b> You can also create custom modulation profiles with the <b>cable modulation-profile</b> 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.</p> <p><b>Note</b> For Cisco Remote PHY 220, preamble with QPSK modulation must have values—<math>32 \times 2^n</math> (0, 1, 2, 3) bits.</p> <p>Preamble with 16-QAM modulation must have values—<math>64 \times 2^n</math> (0, 1, 2,) bits.</p>
<b>Step 4</b>	<p><b>exit</b></p> <p><b>Example:</b></p> <pre>Router(config)# exit</pre>	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
<b>Step 1</b>	<p><b>enable</b></p> <p><b>Example:</b></p> <pre>Router&gt; enable</pre>	Enables privileged EXEC mode. Enter your password if prompted.
<b>Step 2</b>	<p><b>configure terminal</b></p> <p><b>Example:</b></p> <pre>Router# configure terminal</pre>	Enters global configuration mode.
<b>Step 3</b>	<p><b>controller upstream-Cable slot/subslot/port</b></p> <p><b>Example:</b></p> <pre>Router(config)# controller upstream-Cable 2/0/1</pre>	Enters controller configuration mode for the interface.

	Command or Action	Purpose
Step 4	<b>us-channel</b> <i>n</i> <b>docsis-mode</b> { <i>atdma</i>   <i>tdma</i>   <i>tdma-atdma</i> } <b>Example:</b> <pre>Router(config-controller)# us-channel 0 docsis-mode atdma</pre>	Configures the upstream for the desired DOCSIS mode of operation.
Step 5	<b>us-channel</b> <i>n</i> <b>modulation-profile</b> <i>primary-profile-number</i> [ <i>secondary-profile-number</i> ] [ <i>tertiary-profile-number</i> ] <b>Example:</b> <pre>Router(config-controller)# us-channel 0 modulation-profile 241</pre>	Assigns up to three modulation profiles to the upstream port. <b>Note</b> The type of modulation profiles must match the DOCSIS mode configured for the upstream, using the <b>us-channel docsis-mode</b> command.
Step 6	<b>us-channel</b> <i>n</i> <b>equalization-coefficient</b> <b>Example:</b> <pre>Router(config-controller)# us-channel 0 equalization-coefficient</pre>	(Optional) Enables the use of a DOCSIS pre-equalization coefficient on the upstream port.
Step 7	<b>us-channel</b> <i>n</i> <b>ingress-noise-cancellation</b> <i>interval</i> <b>Example:</b> <pre>Router(config-controller)# us-channel 0 ingress-noise-cancellation 400</pre>	(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	<b>us-channel</b> <i>n</i> <b>maintain-psd</b> <b>Example:</b> <pre>Router(config-controller)# us-channel 0 maintain-psd</pre>	(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. <b>Note</b> Repeat <a href="#">Step 3, on page 9</a> through <a href="#">Step 8, on page 10</a> for each upstream to be configured.
Step 9	<b>end</b> <b>Example:</b> <pre>Router(config-controller)# end</pre>	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 State	Prim Sid	Ver	QoS Prov	Frag	Concat	PHS	Priv	DS	US
									Saids	Sids
1859.334d.7b4c	init(i)	145	DOC1.0	DOC1.0	no	no	no	0	0	0
1859.334d.fa8c	offline	146	DOC1.0	DOC1.0	no	no	no	0	0	0
1859.334d.fa02	offline	147	DOC1.0	DOC1.0	no	no	no	0	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
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 minislots-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 minislots-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 minislots-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 minislots-size 4
us-channel 5 modulation-profile 221
us-channel 5 shutdown
!

```

## Additional References

### Related Documents

Related Topic	Document Title
Cisco CMTS Commands	<i>Cisco IOS CMTS Cable Command Reference</i> <a href="http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.html">http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.html</a>

### 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
<ul style="list-style-type: none"> <li>• DOCS-BPI-PLUS-MIB</li> <li>• DOCS-CABLE-DEVICE-MIB (RFC 2669)</li> <li>• DOCS-CABLE-DEVICE-TRAP-MIB</li> <li>• DOCS-IF-EXT-MIB</li> <li>• DOCS-IF-MIB (RFC 2670)</li> <li>• DOCS-QOS-MIB</li> <li>• DOCS-SUBMGT-MIB</li> <li>• IGMP-STD-MIB (RFC 2933)</li> </ul>	<p>To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:</p> <p><a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></p>

**Technical Assistance**

Description	Link
<p>The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.</p> <p>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.</p> <p>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.</p>	<p><a href="http://www.cisco.com/support">http://www.cisco.com/support</a></p>

## Feature Information for DOCSIS 2.0 A-TDMA Modulation Profile

Use Cisco Feature Navigator to find information about the platform support and software image support. Cisco Feature Navigator enables you to determine which software images support a specific software release, feature set, or platform. To access Cisco Feature Navigator, go to the <https://cfmg.cisco.com/> link. An account on the Cisco.com page is not required.



**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.

