



## Downstream Interface Configuration

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This document describes how to configure the downstream interfaces on the Cisco cBR Series Converged Broadband Router.

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## 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.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to <http://tools.cisco.com/ITDIT/CFN/>. An account on <http://www.cisco.com/> is not required.

## 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>

## Information About Downstream Interface Configuration

### Overview

- Each downstream port requires port level configuration and channel level configuration. Port level configuration is optimized with a frequency profile that defines ranges of frequencies available on the port. Channel level configuration is optimized with a QAM profile and channel range configuration block that auto-increments frequency and duplicates annex, modulation, and interleaver.
- Each channel requires a set of parameters: frequency, annex, modulation, interleaver, and DOCSIS channel id.

- Configuration is done in 4 major blocks of configuration:
  - QAM Profile—Example: “cable downstream qam-profile 1”
  - Frequency Profile—Example: “cable downstream freq-profile 2”
  - Port/Controller—Example: “controller Integrated-Cable 3/0/0”
  - RF Channel block—Example: “rf-chan 0 31”

### Downstream RF Port and Channel Management

The downstream RF port and channel management feature is responsible for the configuration and management of the downstream RF ports and channels. Each downstream RF channel can be provisioned either as a DOCSIS or traditional MPEG video QAM channel.

#### QAM Profile

A QAM profile describes the common downstream channel modulator settings, referred to as physical layer parameters. This includes QAM constellation, symbol rate, interleaver-depth, spectrum-inversion, and annex. The QAM profile is described by *CCAP DownPhyParams* object. Default QAM profiles are supported and customized for DOCSIS or MPEG Video, which are described as *DocsisPhyDefault* and *VideoPhyDefault* objects, respectively.

A maximum of 32 QAM profiles can be defined. There are six system-defined QAM profiles (0 to 5), which cannot be deleted or modified. You can define profiles 6 to 31.

The system defined profiles are:

- Profile 0 - default-annex-b-64-qam
  - interleaver-depth: I32-J4
  - symbol rate: 5057 kilo-symbol/second
  - spectrum-inversion: off
- Profile 1 - default-annex-b-256-qam
  - interleaver-depth: I32-J4
  - symbol rate: 5361 kilo-symbol/second
  - spectrum-inversion: off
- Profile 2 - default-annex-a-64-qam
  - interleaver-depth: I12-J17
  - symbol rate: 6952 kilo-symbol/second
  - spectrum-inversion: off
- Profile 3 - default-annex-a-256-qam
  - interleaver-depth: I12-J17
  - symbol rate: 6952 kilo-symbol/second

- spectrum-inversion: off
- Profile 4 - default-annex-b-64-qam
  - interleaver-depth: I128-J1
  - symbol rate: 5057 kilo-symbol/second
  - spectrum-inversion: off
- Profile 5 - default-annex-b-256-qam
  - interleaver-depth: I128-J1
  - symbol rate: 5361 kilo-symbol/second
  - spectrum-inversion: off

### Spectrum Inversion

Spectrum inversion happens as a result of mixing processes in RF or IF electronics. Spectrum inversion allows for the adaptation of older equipment with the new plant. The mixing of I and Q are used to create a quadrant profile. For some setups, the inversion of the quadrant profile is needed where the axis are flipped such that I represents the X and Q represents the Y-axis. Most modern equipment can detect and resolve the inversion split.

You can change this spectrum inversion configuration on a user-defined qam-profile. It cannot be changed on a system generated qam-profile from 0 to 5.

### Frequency Profile

A frequency profile defines the ranges of frequencies available on a port. A maximum of 16 frequency profiles can be defined. There are four system-defined frequency profiles (0 to 3), which cannot be deleted or modified. You can define profiles 4 to 15.

The system defined profiles are:

- Profile 0 - annex-b-low, Frequency range (Hz): 90000000 - 863999999
- Profile 1 - annex-b-high, Frequency range (Hz): 234000000 - 1002999999
- Profile 2 - annex-a-low, Frequency range (Hz): 94000000 - 867999999
- Profile 3 - annex-a-high, Frequency range (Hz): 267000000 - 1002999999

The frequency ranges are defined using lanes and blocks:

- Four lanes per port, each lane can support 216 MHz range.
- Four blocks per lane, each block can support 54 MHz range.
- Lanes and blocks may have overlapping frequency ranges.

# How to Configure Downstream Interfaces

This section contains the following:

## Configuring the Cisco CMTS Manually Using Configuration Mode

Connect a console terminal to the console port on the I/O controller. When asked if you want to enter the initial dialog, answer **no** to go into the normal operating mode of the router. After a few seconds the user EXEC prompt (**Router>**) appears.

## Configuring the QAM Profile on the Downstream Channels

### Procedure

	Command or Action	Purpose
Step 1	<b>enable</b> <b>Example:</b> Router> <b>enable</b>	Enables privileged EXEC mode. Enter your password if prompted.
Step 2	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
Step 3	<b>cable downstream qam-profile</b> <i>Qam_Profile_ID</i> <b>Example:</b> Router(config)# <b>cable downstream qam-profile 3</b>	Defines or modifies a QAM profile.
Step 4	<b>annex</b> {A   B   C} <b>Example:</b> Router(config-qam-prof)# <b>annex A</b>	Defines the profile MPEG framing format. The default is Annex B.
Step 5	<b>description</b> <i>LINE</i> <b>Example:</b> Router(config-qam-prof)# <b>description qam1</b>	Name or description for this profile.
Step 6	<b>interleaver-depth</b> {I12-J17   I128-J1   I128-J2   I128-J3   I128-J4   I128-J5   I128-J6   I128-J7   I128-J8   I16-J8   I32-J4   I64-J2   I8-J16} <b>Example:</b> Router(config-qam-prof)# <b>interleaver-depth I64-J2</b>	Defines the interleaver depth. The default is I32 J4 for DOCSIS.
Step 7	<b>modulation</b> {256   64} <b>Example:</b> Router(config-qam-prof)# <b>modulation 64</b>	Defines the modulation. The default is 256QAM.

	Command or Action	Purpose
<b>Step 8</b>	<b>spectrum-inversion</b> {off   on} <b>Example:</b> Router(config-qam-prof) # <b>spectrum-inversion on</b>	Enables or disables spectrum inversion. Default is off.
<b>Step 9</b>	<b>symbol-rate</b> <i>value</i> <b>Example:</b> Router(config-qam-prof) # <b>symbol-rate 5057</b>	Defines the symbol rate. Value is in kilo-symbol/sec.
<b>Step 10</b>	<b>exit</b> <b>Example:</b> Router(config-qam-prof) # <b>exit</b>	Exits from the QAM profile configuration mode.

## Configuring the Frequency Profile on the Downstream Channels

### 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 downstream freq-profile</b> <i>DS_frequency_profile_ID</i> <b>Example:</b> Router(config) # <b>cable downstream freq-profile 4</b>	Defines or modifies a frequency profile.
<b>Step 4</b>	<b>exit</b> <b>Example:</b> Router(config) # <b>exit</b>	Exits from the frequency lane configuration mode.

## Configuring the Controller on the Downstream Channels

### 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.

	Command or Action	Purpose
Step 2	<b>configure terminal</b> <b>Example:</b> Router# <b>configure terminal</b>	Enters global configuration mode.
Step 3	<b>controller integrated-cable slot/subslot/port</b> <b>Example:</b> Router(config)# <b>controller Integrated-Cable 3/0/0</b>	Enters the controller sub-mode.
Step 4	<b>base-channel-power value</b> <b>Example:</b> Router(config-controller)# <b>base-channel-power 26</b>	Sets the base channel power level. If not specified, the default value is calculated based on the number of carriers. Maximum limit is 34 dBmV DRFI. If you configure a value greater than the maximum specified by DRFI, the following message is displayed:  Caution: RF Power above DRFI specification. May result in minor fidelity degradation.
Step 5	<b>freq-profile number</b> <b>Example:</b> Router(config-controller)# <b>freq-profile 0</b>	Specifies the frequency profile for the port.
Step 6	<b>max-carrier value</b> <b>Example:</b> Router(config-controller)# <b>max-carrier 1</b>	Specifies the maximum number of carriers.
Step 7	<b>mute</b> <b>Example:</b> Router(config-controller)# <b>mute</b>	Mutes the port. Use the <b>no</b> prefix to unmute the port. Default is "no mute".
Step 8	<b>rf-chan starting_Qam_ID ending_Qam_ID</b> <b>Example:</b> Router(config-controller)# <b>rf-chan 0 1</b>	Enters RF channel configuration sub-mode to configure an individual channel or a block of channels.
Step 9	<b>shutdown</b> <b>Example:</b> Router(config-controller)# <b>shutdown</b>	Changes the port administration state to down. Use the <b>no</b> prefix to change the port administration state to up.

## Troubleshooting Tips

### Shutting and No Shutting Downstream Controller Immediately

**Problem** Shutting down a downstream controller on a cable line card and bringing the controller back up immediately can cause a Queue ID Pending Drain event on the system. This results in traffic disruption to the modems or modems going offline.

**Solution** It is recommended that you wait for a few seconds (>30 secs) before issuing the no shut command on a shut downstream controller. The system also restricts the user from issuing the no shut command immediately by printing this message.

```
Config change could not be applied as a cleanup is pending following shut on
controller x/x/x. Please wait for the cleanup to complete before attempting to
no shut controller.
```

## Configuring the RF Channel on a Controller

The RF channel submode is entered from the channel controller configuration submode using the **rf-chan** command as described in the previous section. If an individual channel was specified in the **rf-chan** command, only that channel configuration is changed. If a block of channels was specified in the **rf-chan** command, the configuration change is applied to all channels in the block.



**Note** If the user tries to add a video type RF channel to a cable interface, the following message appears to reject the configuration:

```
X/X/X rf-channel XX is video type channel, it can't be configured as primary DS
```

If a RF channel is configured under cable interface, when the user tries to change the channel type to video, the following message appears to reject the configuration:

```
X/X/X rf channel X can't be set to video type.
It is configured under Cable1/0/1.
Please remove the configuration before change the gam type
```

### Step 1 **docsis-channel-id** *dcid*

**Example:**

```
Router(config-rf-chan)#docsis-channel-id 1
```

Changes the channel DOCSIS channel identifier. In block mode, the value is assigned to the first channel and incremented for successive channels.

### Step 2 **frequency** *value*

**Example:**

```
Router(config-rf-chan)#frequency 93000000
```

Configures the channel's center frequency in Hz. The available frequency range is determined from the port's frequency profile, if configured. If not configured, the available range will be the full port spectrum. In block mode, the frequency will be assigned to the first channel. Successive channels will get the next center frequency for the annex specified in the QAM profile (+6 Hz for Annex B, +8 Hz for Annex A).

### Step 3 **mute**

**Example:**

```
Router(config-rf-chan)#mute
```

Mutes the RF channel. Enter the **no** prefix to unmute the channel. Default is "no mute".

### Step 4 **power-adjust** *pwr\_adj\_range*



**Example:**

```
Router(config-rf-chan)#power-adjust 8.0 - 0.0 dBmV
```

Adjusts the RF channel's power.

**Step 5** **qam-profile** *qam\_profile\_number***Example:**

```
Router(config-rf-chan)#qam-profile 0
```

Specifies the QAM profile for this channel.

**Step 6** **rf-output** *value***Example:**

```
Router(config-rf-chan)#rf-output normal
```

Changes the RF output mode to test the channel.

**Step 7** **shutdown****Example:**

```
Router(config-rf-chan)#shutdown
```

Changes the channel administration state to down. Use the **no** prefix to change the channel administration state to up. The default is "no shut".

**Step 8** **type** *value***Example:**

```
Router(config-rf-chan)#type video
```

Configures the channel QAM type. The default is DOCSIS.

## Configuration Examples

### Downstream Interface Configuration Example

The example below shows the configuration of:

- QAM Profile—The system defined QAM profile for Annex B and 256 QAM.
- Frequency Profile—The system defined frequency profile annex-b-low.
- Controller and RF channel—Port 0 on slot 3/0 with frequency profile 0; 96 channels with QAM profile 1 and center frequencies starting at 93 MHz.

```
cable downstream qam-profile 1
annex B
modulation 256
interleaver-depth I32-J4
symbol-rate 5361
spectrum-inversion off
description default-annex-b-256-qam
```

```

cable downstream freq-profile 0
  lane 1 start-freq 90000000
    block 1 start-freq 90000000
    block 2 start-freq 138000000
    block 3 start-freq 186000000
    block 4 start-freq 234000000
  lane 2 start-freq 282000000
    block 1 start-freq 282000000
    block 2 start-freq 330000000
    block 3 start-freq 378000000
    block 4 start-freq 426000000
  lane 3 start-freq 474000000
    block 1 start-freq 474000000
    block 2 start-freq 522000000
    block 3 start-freq 570000000
    block 4 start-freq 618000000
  lane 4 start-freq 666000000
    block 1 start-freq 666000000
    block 2 start-freq 714000000
    block 3 start-freq 762000000
    block 4 start-freq 810000000
controller Integrated-Cable 3/0/0
max-carrier 128
base-channel-power 34
freq-profile 0
rf-chan 0 95
type DOCSIS
frequency 93000000
rf-output NORMAL
power-adjust 0
docsis-channel-id 1
qam-profile 1

```

### Show Command Examples for Displaying the State

Use the following commands to display the state of any QAM profile, Frequency profile, downstream controller or channel.

#### QAM Profile Configuration Example

```

Router#show cable qam-profile 0
QAM Profile ID 0: default-annex-b-64-qam
  annex: B
  modulation: 64
  interleaver-depth: I32-J4
  symbol rate: 5057 kilo-symbol/second
  spectrum-inversion: off
Router#

```

#### Frequency Profile Configuration Example

```

Router#show cable freq-profile 0
Frequency Profile ID 0 annex-b-low:
  Lane 1 start-freq 900000000hz
    Block 1 start-freq 900000000hz
    Block 2 start-freq 1380000000hz
    Block 3 start-freq 1860000000hz
    Block 4 start-freq 2340000000hz
  Lane 2 start-freq 2820000000hz

```

```

        Block 1 start-freq 282000000hz
        Block 2 start-freq 330000000hz
        Block 3 start-freq 378000000hz
        Block 4 start-freq 426000000hz
Lane 3 start-freq 474000000hz
        Block 1 start-freq 474000000hz
        Block 2 start-freq 522000000hz
        Block 3 start-freq 570000000hz
        Block 4 start-freq 618000000hz
Lane 4 start-freq 666000000hz
        Block 1 start-freq 666000000hz
        Block 2 start-freq 714000000hz
        Block 3 start-freq 762000000hz
        Block 4 start-freq 810000000hz
Router#

```

### Controller Configuration Example

```

Router#show controller Integrated-Cable 3/0/0 rf-port
Admin: UP MaxCarrier: 128 BasePower: 34 dBmV Mode: normal
Rf Module 0: UP
Frequency profile: 0
Free freq block list has 1 blocks:
    666000000 - 863999999
Rf Port Status: UP
Router#

```

### RF Channel Configuration Example

```

Router#show controller integrated-Cable 3/0/0 rf-channel 0-3 95
Chan State Admin Frequency Type Annex Mod srates Interleaver dcid power output
0 UP UP 93000000 DOCSIS B 256 5361 I32-J4 1 34 NORMAL
1 UP UP 99000000 DOCSIS B 256 5361 I32-J4 2 34 NORMAL
2 UP UP 105000000 DOCSIS B 256 5361 I32-J4 3 34 NORMAL
3 UP UP 111000000 DOCSIS B 256 5361 I32-J4 4 34 NORMAL
95 UP UP 663000000 DOCSIS B 256 5361 I32-J4 96 34 NORMAL

```

```

Router# show controller integrated-Cable 3/0/0 rf-channel 0 verbose
Chan State Admin Frequency Type Annex Mod srates Interleaver dcid power output
0 UP UP 93000000 DOCSIS B 256 5361 I32-J4 1 34 NORMAL
Qam profile: 1
Spectrum Inversion: Off
Frequency Lane: 1 Block: 1 index: 1
Resource status: OK
License: granted <02:00:04 EDT Jan 2 2012>
JIB channel number: 0
Chan EnqQ Pipe RAF SyncTmr Vid Mac Video Primary DqQ TM Mpts Sniff
0 0 0 4 0 0 0000.0000.0000 0 0 0 0 0 NO
Grp Prio P Prate Phy0-ctl Phy1-ctl Enable Tun-Id L2TPv3_Ses_id
0 0 0 1 1 0 TRUE 0 0
Chan Qos-Hi Qos-Lo Med-Hi Med-Lo Low-Hi Low-Lo
0 32774 16384 32768 16384 65536 32768
Chan Med Low TB-neg Qos_Exc Med_Xof Low_Xof Qdrops Pos Qlen(Hi-Med-lo) Fl
0 0 0 0 0 0 0 0 Y 0 0 0 0
DSPHY Info:
DSPHY Register Local Copy: QPRHI = c0000163, QPRLO = e30d0
DSPHY Register Local Copy Vaddr = 80000290, qam2max_mapping = 80000000
DSPHY Register Local Copy: SPR ID = 0, SPR Mapping= c200000a
Last read from HW: Mon Jan 2 02:02:04 2012
QPRHI = c0000163, QPRLO = e30d0, SPR = c200000a SPRMAPING c0000000 Q2Max 80000000
Last time read spr rate info from HW: Mon Jan 2 13:21:41 2012
SPR ID 0, rate value in kbps 0, overflow count 0, underflow count 0

```

```

Router# sh controllers Integrated-Cable 7/0/0 counter rf-channel
Controller RF MPEG MPEG MPEG Sync MAF/UCD User QAM
           Chan Packets bps Mbps Packets Packets Mbps Util
           Tx Percentage
7/0/0      0 0 0 00.00 0 0 00.00 000.00
7/0/0      1 0 0 00.00 0 0 00.00 000.00
7/0/0      2 8239954 2475952 02.47 0 0 02.39 006.60
7/0/0      3 85927382 25769779 25.76 0 0 24.94 068.71
7/0/0      4 85927608 25769027 25.76 0 0 24.94 068.71
7/0/0      5 8239088 2474599 02.47 0 0 02.39 006.59
7/0/0      6 8210840 2463770 02.46 0 0 02.38 006.57
7/0/0      7 50103 15040 00.01 0 0 00.01 000.04
7/0/0      8 50103 15040 00.01 0 0 00.01 000.04

```

```
Router# show cable licenses ds
```

```

-----
Entitlement: Downstream License
Consumed count: 672
Consumed count reported to SmartAgent: 672
Forced-Shut count: 0
Enforced state: No Enforcement

```

```
Router#
```

## Additional References

### 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>	<a href="http://www.cisco.com/support">http://www.cisco.com/support</a>

## Feature Information for Downstream Interface Configuration on the Cisco cBR Router

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://cfng.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 2: Feature Information for Downstream Interface Configuration**

Feature Name	Releases	Feature Information
Downstream Interface Configuration	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.
Display QAM Utilization Percentage using the <b>sh controllers Integrated-Cable 7/0/0 counter rf-channel</b>	Cisco IOS XE Gibraltar 16.10.1f	This feature was integrated on the Cisco cBR Series Converged Broadband Routers.

