Cable Modem Steering on the Cisco CMTS Routers

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The cable modem steering feature helps to redirect or steer cable modems to multiple CMTS routers using downstream frequency overrides. A configurable string is used to bond the cable modem to the proper CMTS. Once the bonding is done, the CMTS can move the cable modem within itself for load balancing.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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.

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Prerequisites for Cable Modem Steering

DOCSIS 3.0-defined type, length, values (TLVs) are required to aid channel selection. All TLVs encoded as general extension information in cable modem configuration files are backward compatible with DOCSIS 1.1 and DOCSIS 2.0 cable modems.

The table below shows the hardware compatibility prerequisites for this feature.

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

Table 1: Cable Modem Steering Hardware Compatibility Matrix

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later releases • PRE2 Cisco IOS Release 12.2(33)SCB and later releases • PRE4 Cisco IOS Release 12.2(33)SCH and later releases • PRE5	Cisco IOS Release 12.2(33)SCB and later releases • Cisco uBR10-MC5X20U/H Cisco IOS Release 12.2(33)SCC and later releases • Cisco UBR-MC20X20V Cisco IOS Release 12.2(33)SCE and later releases • Cisco uBR-MC3GX60V [1]
Cisco uBR7246VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later releases • NPE-G1 • NPE-G2	Cisco IOS Release 12.2(33)SCA and later releases • Cisco uBR-MC28U/X Cisco IOS Release 12.2(33)SCD and later releases • Cisco uBR-MC88V [2]

CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR7225VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCA and later releases • NPE-G1 Cisco IOS Release 12.2(33)SCB and later releases • NPE-G2	Cisco IOS Release 12.2(33)SCA and later releases • Cisco uBR-E-28U • Cisco uBR-E-16U • Cisco uBR-MC28U/X Cisco IOS Release 12.2(33)SCD and later releases • Cisco uBR-MC88V

[1] Cisco uBR3GX60V cable interface line card is not compatible with PRE2. You must use PRE4 with the Cisco uBR3GX60V cable interface line card.

[2] Cisco uBR-MC88V cable interface line card is not compatible with NPE-G1. You must use NPE-G2 with the Cisco uBR-MC88V cable interface line card.

Restrictions for Cable Modem Steering

The Cable Modem Steering feature has the following general restrictions:

- To restrict the cable modem on the exact downstream on the target CMTS, the redirection must be configured on the target CMTS.

- You must manually execute the **clear cable modem service-type** command to clear the cable modem service type identifier stored at the CMTS during registration.

- You must manually execute the **clear cable modem attribute-masks** command to clear the cable modem attribute masks stored at the CMTS during registration. These attribute masks are used to restrict usage of upstream channels during ranging time.

- cable modem steering supports only upstream masks.

- Channel steering does not take place when the cable modem fails in initial ranging.

- The cable modem will take more time to come online when channel steering is deployed. The time taken is proportional to the number of modems, and the downstreams and upstreams that the cable modem can reach.

- A modem cannot be load balanced to any upstream channel with attributes that conflict with attribute masks of the modem.

- The keep alive detection feature may trigger an line card (LC) switchover. For more details on the Keep Alive feature, see N+1 Redundancy for the Cisco Cable Modem Termination System.

- Each interface should have an active modem or use **no keepalive** on this interface.

- The required attribute mask and the forbidden attribute mask of an upstream should be configured in such a way that the bitwise AND of the two masks are zero. For example, if you configure required attribute mask with the value 0x30 and forbidden attribute mask with the value 0x20, the cable modem may not work properly, because the binary representation of both the configured masks will be 1 at the 5th bit.

Information About Cable Modem Steering

Cable modem steering allows you to redirect or steer the cable modems to one or more CMTS routers using downstream frequency overrides. Once a cable modem registers on a downstream on the proper CMTS router, the CMTS router can move the cable modem to any location for load balancing.

The DOCSIS 3.0-compliant Service Type Identifier used as the configurable string in the cable modem configuration file is backward-compatible with DOCSIS 1.1 and DOCSIS 2.0 cable modems.

The CMTS router can also impose restrictions on the number of channels a cable modem can use. DOCSIS 3.0 defines several TLVs to aid the channel selection.

The following TLVs are used in cable modem steering:

- TLV 43.9 (Cable Modem Attribute Masks) limits the set of channels the CMTS router can assign to the cable modem by allowing or forbidding certain binary attributes. The cable modem attribute masks have four sub-TLVs and cable modem steering makes use of two sub-TLVs, which are listed below:

  ◦ TLV 43.9.3—Cable Modem Upstream Required Attribute Mask (C.1.1.18.1.8.3 of CM-SP-MULPIv3.0-I07-080215). It is a 32-bit mask representing the set of binary upstream channel attributes required for the cable modem.

  ◦ TLV 43.9.4—Cable Modem Upstream Forbidden Attribute Mask (C.1.1.18.1.8.4 of CM-SP-MULPIv3.0-I07-080215). It is a 32-bit mask representing the set of binary upstream channel attributes forbidden for the cable modem.

- TLV 43.11 is used for a redirection action based on the service type identifier field. The cable modem sends the TLV 43.11 in the REG-REQ MAC message. The DOCSIS 1.1 and DOCSIS 2.0 modems will also send this file ID when doing the registration.

- TLV43.1, defined as Policy ID in DOCSIS 2.0 and DOCSIS 3.0, is parsed and stored in the cable modem during registration. Before moving the cable modem during load balancing (LB), the CMTS router checks whether the cable modem has a preconfigured policy with the same Policy ID. If the policy does exist, the CMTS router disables LB for this cable modem and moves to the next cable modem. If the policy does not exist on the CMTS router, or the Policy ID is missing from the cable modem configuration file, LB prohibition is not performed.

The following TLVs are supported in cable modem steering:

- TLV 43.11 (Service type identifier) from section C.1.1.18.1.10 in CM-SP-MULPIv3.0-I07-080215.

- Cable modem attribute masks (TLV 43.9) from C.1.1.18.1.8.3 and C.1.1.18.1.8.4 of CM-SP-MULPIv3.0-I07-080215.

- TLV portion (43.1, Policy ID) of REQ-REQ

- TLV 19---Channel Class ID

- TLV 18--- Ranging Hold-off Priority Field

Cable modem steering contains three small featurettes: Channel Redirection, Channel Restriction, and Load Balancing. The Load Balancing feature is covered in the Load Balancing, Dynamic Channel Change, and Dynamic Bonding Change on the Cisco CMTS Routers document .

Channel Redirection

The service type identifier-based channel redirection allows you to redirect or steer the cable modems to one or more CMTS routers using downstream frequency overrides. A configurable string in the cable modem configuration file is used to bond the cable modem to the correct CMTS router. A global CLI ties the string to the downstream frequency, which is configured on the CMTS router.

Once a cable modem registers on a downstream of a CMTS router, the CMTS router can move the cable modem to any location within the CMTS for load balancing.

A DOCSIS 3.0-compliant TLV (TLV 43.11) service identifier is used as the configurable string in the cable modem configuration file. It is backward-compatible with DOCSIS 1.1 and DOCSIS 2.0 cable modems. This TLV is used as the tag of the cable modem to decide whether to redirect or not. The method used to redirect is downstream frequency override in the ranging phase.

Channel Restriction

The Cisco CMTS router can impose restrictions on the channels a cable modem uses based on the cable modem configuration file or its capabilities. For example, Advanced Time Division Multiple Access (ATDMA) capable cable modems should not use Time Division Multiple Access (TDMA) upstream channels.

DOCSIS 3.0 provides guidelines on how a CMTS router can choose a pair of channels for a cable modem at both registration time and during autonomous load balancing. DOCSIS 3.0 defines several TLVs to aid channel selection, including the service type identifier, load balancing group ID, and cable modem attribute masks and service flow attribute masks.

Except for the service flow attribute masks, the TLVs are encoded as general extension information in the cable modem configuration file, which are backward compatible with DOCSIS 1.1 and DOCSIS 2.0 cable modems.

Channel restriction looks only for upstream cable modem attribute masks, and is therefore compatible with DOCSIS 1.1, DOCSIS 2.0 and DOCSIS 3.0 cable modems in non-Multiple Transmit Channel (MTC) mode.

Note In Cisco IOS Release 12.2(33)SCC and later releases, it is recommended to assign a cable modem to different Restricted Load Balancing Groups (RLBGs) to restrict the usage of channels, instead of using attribute masks.

Note In Cisco IOS Release 12.2(33)SCH1, the cable modems can come wideband online (w-online) with up to 16 downstream channels and 4 upstream channels. Effective with Cisco IOS Release 12.2(33)SCH2, the cable modems can come w-online with up to 24 downstream channels and 8 upstream channels. These features are not supported on the Cisco uBR10012 routers using PRE2, and the Cisco uBR7200 series routers using NPE-G1.

Upstream Channel Descriptor TLV for Ranging Hold-off

The Upstream Channel Descriptor (UCD) TLV for Ranging Hold-off feature, introduced in Cisco IOS Release 12.2(33)SCH, enables the CMTS router to hold off a cable modem from initial ranging based on TLV 18 and 19 specified in the upstream channel descriptor (UCD) messages. The router can hold off a cable modem from initial ranging only for 5 minutes. This default value cannot be changed. This feature is supported with DOCSIS 2.0 and later releases cable modems using upstream logical channels.

> **Note** The UCD TLV for Ranging Hold-off feature is supported only with DOCSIS load balance.

Ranging Class ID

The CMTS enables UCD TLV for ranging hold-off after detecting the TLVs from the cable modem registration request (REG-REQ) or multipart registration request (REG-REQ-MP), and saves these TLVs as a cable modem ranging class ID.

By default, DOCSIS load balance is supported for all cable modems with all types of ranging class IDs. In the event of DOCSIS load balance, a cable modem moves to the target upstream channel only if the ranging class ID matches with the upstream channel class ID.

Cable Modem Exclusion for DOCSIS Load Balance

You can exclude a cable modem or a group of cable modems from DOCSIS load balance based on their device type, MAC address, and Organizational Unique Identifier (OUI) using the **cable load-balance exclude** command in global configuration mode.

How to Configure Cable Modem Steering on the CMTS Router

This section describes the following required and optional procedures:

Configuring a Channel Redirection

To configure a channel redirection that allows you to redirect or steer the cable modems to one or more CMTS using the downstream frequency override in the ranging phase, use the **cable service type ds-frequency** command.

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Restriction	You can redirect cable modems matching the service type identifier to a downstream frequency. However, one service type identifier cannot be redirected to multiple downstream frequencies.	

During registration, the cable modem service type identifier is stored in the CMTS to redirect target downstream frequency during ranging time. If you want to clear the stored service type identifier, you must manually execute the **clear cable modem service-type** command.

To restrict the cable modem on the exact downstream on the target CMTS, the redirection must be configured on the target CMTS. If the cable modems are redirected to the source CMTS, the dynamic load balance may not work properly and the cable modem may drop offline during load balancing. For the cable modems to be redirected it must reach the target frequency.

DETAILED STEPS

	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 service type** *service-type-id* **ds-frequency** *frequency* **Example:** Router(config)# **cable service type commercial ds-frequency 519000000**	Redirects matching service types to downstream frequency. • *service-type-id*—Specifies the service type identifier to be redirected. Maximum length is 16. • *frequency*—Specifies the downstream frequency to which the cable modems are redirected.

Configuring a Channel Restriction

To impose restrictions on the channels a cable modem can use based on its configuration file or capabilities, use the **cable upstream attribute-mask** command.

Before You Begin

Advanced Time Division Multiple Access (ATDMA) capable cable modems should be restricted from using Time Division Multiple Access (TDMA) upstream channels.

Restriction
- The cable modem attribute masks (TLV 43.9) are a function of the CMTS support and are compatible only with legacy DOCSIS 1.1 and DOCSIS 2.0 cable modems.

- When the CMTS cannot find an appropriate US channel in the same legacy LB group, the cable modem steering checking is skipped and cable modems come online. The US channel must meet the requirement of cable modem upstream attribute masks if a load balancing group (LBG) is not configured.

- During registration, the cable modem attribute masks are stored at the CMTS. These are then used to restrict usage of upstream channels during ranging time. You must manually execute the **clear cable modem attribute-masks** command to clear the stored attribute masks.

DETAILED STEPS

	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	**interface cable** *slot/subslot/port* **Example:** Router(config)# **interface cable 5/0/4**	Enables the cable interface.
Step 4	**cable upstream** *upstream-interface* **attribute-mask** *attribute-mask* **Example:** Router(config-if)# **cable upstream 0 attribute-mask ffff**	Configures the attribute mask on a particular upstream interface. • *upstream-interface*—Specifies the upstream port. • *attribute-mask*—Specifies the attribute mask bitmap in hexadecimal format. Example: 0-FFFFFFFF **Note** From Cisco IOS Release 12.2(33)SCC, the bit 0 in *attribute-mask* is bypassed when cable modem steering checks it.

Configuring an Upstream Channel Class ID

This configuration is optional. A channel class ID must be configured for an upstream logical channel if you want to configure UCD TLV ranging hold-off on the CMTS router.

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Restriction	Legacy load balance cannot be configured on a MAC domain if an upstream channel belonging to the MAC domain has a channel class ID configured. Similarly, a channel class ID cannot be configured on an upstream channel if legacy load balance is already configured on the MAC domain of the upstream channel.

DETAILED STEPS

	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	**interface cable** *slot/subslot/cable-interface-index* **Example:** Router(config)# **interface cable 5/0/4**	Specifies the cable interface and enters cable interface configuration mode. Arguments for this command may vary depending on the CMTS router, line card, and Cisco IOS software release. For details, see the Cisco IOS CMTS Cable Command Reference . • *Slot*—Slot where a line card resides. • *Subslot* (Cisco uBR10012 only)—Secondary slot number of a line card. • *cable-interface-index*—Downstream port or MAC domain index of a line card.
Step 4	**cable upstream** *port-number* **chan-class-id** *id* **Example:** Router(config-if)# **cable upstream 0 chan-class-id ff**	Configures the channel class ID for an upstream logical channel. • *port-number*—Cable upstream port number. The valid range depends on the number of upstream channels configured in a MAC domain. For example, if the total number of upstream channels configured is 4, then the valid range for the upstream port number is from 0 to 3. • *id*—Channel class ID for the logical upstream channel in the hexadecimal format. The valid range is from 0 to ffffffff. The default value is 0.
Step 5	**end** **Example:** Router(config-if)# **end**	Returns to privileged EXEC mode.

Configuring an Upstream Ranging Hold-off Priority Value

This configuration is optional.

Maximum time that a cable modem can inhibit transmissions on an upstream channel in response to its ranging class ID matching a bit value in the Ranging Hold-off Priority field in the cable modem configuration file is 300 seconds (five minutes) per *DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification* . This default timer value cannot be changed.

DETAILED STEPS

	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	**interface cable** *slot/subslot/cable-interface-index* **Example:** `Router(config)# interface cable 5/0/4`	Specifies the cable interface and enters cable interface configuration mode. Arguments for this command may vary depending on the CMTS router, line card, and Cisco IOS software release. For details, see the Cisco IOS CMTS Cable Command Reference . • *Slot*—Slot where a line card resides. • *Subslot* (Cisco uBR10012 only)—Secondary slot number of a line card. • *cable-interface-index*—Downstream port or MAC domain index of a line card.
Step 4	**cable upstream** *port-number* **rng-holdoff** *priority* **Example:** `Router(config-if)# cable upstream 0 rng-holdoff 1`	Configures the ranging hold-off priority value for an upstream logical channel. • *port-number*—Upstream port number. The valid range depends on the number of upstream channels configured in a MAC domain. For example, if the total number of upstream channels configured is 4, then the valid range for the upstream port number is from 0 to 3. • **rng-holdoff** *priority*—Specifies the ranging hold-off priority value in the hexadecimal format. The valid range is from 0 to ffffffff. The default value is 0.
Step 5	**end** **Example:** `Router(config-if)# end`	Returns to privileged EXEC mode.

Configuration Examples for Cable Modem Steering

This section provides the following configuration examples:

Example: Configuring a Channel Class ID and Ranging Hold-off Priority Value

The following example shows configuration of a channel class ID and its ranging hold-off priority value on a cable interface line card on the Cisco uBR10012 router:

```
interface Cable8/1/0
downstream Integrated-Cable 8/1/0 rf-channel 0-3
cable mtc-mode
no cable packet-cache
cable bundle 1
cable upstream max-ports 4
cable upstream bonding-group 1
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
cable upstream bonding-group 2
  upstream 0
  upstream 2
  upstream 3
  attributes 80000000
cable upstream bonding-group 3
  upstream 0
  upstream 1
  upstream 2
  upstream 3
  attributes 80000000
cable upstream 0 connector 0
cable upstream 0 frequency 24400000
cable upstream 0 channel-width 1600000 1600000
cable upstream 0 max-logical-chans 1
cable upstream 0 docsis-mode atdma
cable upstream 0 minislot-size 4
cable upstream 0 range-backoff 3 6
cable upstream 0 modulation-profile 221
cable upstream 0 chan-class-id FF
cable upstream 0 rng-holdoff F
no cable upstream 0 shutdown
cable upstream 1 connector 1
cable upstream 1 frequency 22800000
cable upstream 1 channel-width 1600000 1600000
cable upstream 1 max-logical-chans 1
cable upstream 1 docsis-mode atdma
cable upstream 1 minislot-size 4
cable upstream 1 range-backoff 3 6
cable upstream 1 modulation-profile 221
cable upstream 1 chan-class-id F
```

Example: Clearing a Channel Redirection

To clear the cable modem attributes, use the **clear cable modem** command as shown in the following examples:

```
Router# clear cable modem all
Router# clear cable modem oui string
Router# clear cable modem cable slot/subslot/port offline
```

To clear the cable modem service type identifiers, use the **clear cable modem service-type** command as shown in the following examples:

```
Router# clear cable modem all service-type-id
Router# clear cable modem oui string service-type-id
Router# clear cable modem slot/subslot/port offline service-type-id
```

Verifying and Troubleshooting Cable Modem Steering

This section provides the verification and troubleshooting information:

Verifying a Channel Redirection

To verify configuration of channel redirection, use the **show cable modem verbose** command as shown in the following example:

```
Router# show cable modem verbose

MAC Address                          : 0019.474d.e291
IP Address                           : 41.42.0.0
IPv6 Address                         : ---
Dual IP                              : N
Prim Sid                             : 15
Host Interface                       : C5/0/4/U0
MD-DS-SG                             : N/A
Wideband Capable                     : Y
RCP Index                            : 0
sysDescr                             :
Upstream Power                       : 0.00 dBmV (SNR = 36.12 dB)
Downstream Power                     : 0.00 dBmV (SNR = ----- dB)
Timing Offset                        : 1874
Initial Timing Offset                : 1874
Curr US Timing Adjust                : 0
Prev US Timing Adjust                : 0
Received Power                       :  0.00 dBmV
MAC Version                          : DOC2.0
QoS Provisioned Mode                 : DOC1.1
Enable DOCSIS2.0 Mode                : Y
Phy Operating Mode                   : tdma
Modem Status                         : {Modem=online(pt), Security=assign(tek)}
Capabilities                         : {Frag=Y, Concat=Y, PHS=Y}
Security Capabilities                : {Priv=BPI+, EAE=N}
L2VPN Capabilities                   : {L2VPN=N, eSAFE=N}
Sid/Said Limit                       : {Max US Sids=16, Max DS Saids=15}
Optional Filtering Support           : {802.1P=N, 802.1Q=N, DUT=N}
Transmit Equalizer Support           : {Taps/Symbol= 1, Num of Taps= 24}
Number of CPE IPs                    : 0(Max CPE IPs = 16)
CFG Max-CPE                          : 10
Flaps                                : 0()
Errors                               : 0 CRCs, 0 HCSes
Stn Mtn Failures                     : 0 aborts, 0 exhausted
Total US Flows                       : 1(1 active)
Total DS Flows                       : 1(1 active)
Total US Data                        : 1 packets, 401 bytes
Total US Throughput                  : 0 bits/sec, 0 packets/sec
Total DS Data                        : 0 packets, 0 bytes
Total DS Throughput                  : 0 bits/sec, 0 packets/sec
LB group index                       : 0x0
LB reg_group_id                      : 0x0
LB policy id                         : 0
LB reg_policy_id                     : 0
LB priority                          : 0
Required DS Attribute Mask           : 0x0
Forbidden DS Attribute Mask          : 0x0
Required US Attribute Mask           : 0x0
```

```
Forbidden US Attribute Mask       : 0x0
Service Type ID                   : commercial
Active Classifiers                : 0 (Max = NO LIMIT)
DSA/DSX messages                  : permit all
Number of Multicast DSIDs Support : 15
MDF Capability Mode               : 0
FCType10 Forwarding Support       : N
Features Bitmask                  : 0x0
Total Time Online                 : 00:59
```

To view the modems having the service type identifier, use the **show cable modem service-type** *service-type-id* command as shown in the following example:

```
Router# show cable modem service-type commercial
                                                                    B D
MAC Address     IP Address     I/F       MAC       Prim Service-type-id   P I
                                         State     Sid                    I P
0018.6812.29ae 41.42.2.212    C5/0/4/U2 offline    3838 commercial        N N
0018.6811.f9f8 41.42.0.140    C5/0/4/U2 offline    3225 commercial        N N
0018.6811.fba6 41.42.5.169    C5/0/4/U2 offline    3439 commercial        N N
0018.6812.225a 41.42.3.210    C5/0/4/U2 offline    3355 commercial        N N
0018.6811.fa8c 41.42.1.133    C5/0/4/U2 offline    3091 commercial        N N
0018.6812.37e8 41.42.0.136    C5/0/4/U2 offline    7439 commercial        N N
0018.6811.fbca 41.42.2.255    C5/0/4/U2 offline    6263 commercial        N N
0018.6811.fb44 41.42.2.17     C5/0/4/U2 offline    2996 commercial        N N
0018.6812.2f20 41.42.0.100    C5/0/4/U2 offline    3544 commercial        N N
```

Verifying a Channel Restriction

To verify the service type identifier and cable modem attribute masks configured for a cable modem, use the **show cable modem verbose** command as shown in the following example:

```
Router# show cable modem 0019.474d.e291 verbose

MAC Address                       : 0019.474d.e291
IP Address                        : 40.3.100.16
IPv6 Address                      : ---
Dual IP                           : N
Prim Sid                          : 35
Host Interface                    : C5/0/4/U0
MD-DS-SG                          : 1
MD-CM-SG                          : 0x40100
Primary Downstream                : Mo1/0/0:0 (RfId : 0)
Wideband Capable                  : N
RCP Index                         : 0
sysDescr                          :
Upstream Power                    : 0.00 dBmV (SNR = 36.12 dB)
Downstream Power                  : 0.00 dBmV (SNR = ----- dB)
Timing Offset                     : 1573
Initial Timing Offset             : 1573
Curr US Timing Adjust             : 0
Prev US Timing Adjust             : 0
Received Power                    :  -0.50 dBmV
MAC Version                       : DOC2.0
QoS Provisioned Mode              : DOC1.1
Enable DOCSIS2.0 Mode             : Y
Phy Operating Mode                : tdma
Modem Status                      : {Modem=online, Security=disabled}
Capabilities                      : {Frag=Y, Concat=Y, PHS=Y}
Security Capabilities             : {Priv=, EAE=N}
L2VPN Capabilities                : {L2VPN=N, eSAFE=N}
Sid/Said Limit                    : {Max US Sids=16, Max DS Saids=15}
Optional Filtering Support        : {802.1P=N, 802.1Q=N, DUT=N}
Transmit Equalizer Support        : {Taps/Symbol= 1, Num of Taps= 24}
Number of CPE IPs                 : 0(Max CPE IPs = 16)
CFG Max-CPE                       : 16
Flaps                             : 0()
Errors                            : 0 CRCs, 0 HCSes
Stn Mtn Failures                  : 0 aborts, 0 exhausted
```

```
Total US Flows                    : 1(1 active)
Total DS Flows                    : 1(1 active)
Total US Data                     : 7 packets, 619 bytes
Total US Throughput               : 0 bits/sec, 0 packets/sec
Total DS Data                     : 2 packets, 148 bytes
Total DS Throughput               : 4 bits/sec, 0 packets/sec
LB group index                    : 0x0
LB reg_group_id                   : 0x0
LB policy id                      : 2
LB reg_policy_id                  : 2
LB priority                       : 0
Required DS Attribute Mask        : 0x0
Forbidden DS Attribute Mask       : 0x0
Required US Attribute Mask        : 0x1111
Forbidden US Attribute Mask       : 0x0
Service Type ID                   : commercial
Active Classifiers                : 0 (Max = NO LIMIT)
DSA/DSX messages                  : permit all
Voice Enabled                     : NO
DS Change Times                   : 0
Boolean Services                  : 0
Number of Multicast DSIDs Support : 0
MDF Capability Mode               : 0
FCType10 Forwarding Support       : N
Features Bitmask                  : 0x0
Total Time Online                 : 00:19
```

Verifying an Upstream Ranging Class ID Configuration

To verify an upstream ranging class ID of a cable modem, use the **show cable modem** command with the **verbose** keyword.

Following is a sample output of the **show cable modem verbose** command in Cisco IOS Release 12.2(33)SCH1:

```
Router# show cable modem 68b6.fcfe.2285 verbose

MAC Address : 68b6.fcfe.2285
IP Address : 192.168.0.8
IPv6 Address : 2001:DB8:10:1:9951:1972:33F9:9867
Dual IP : Y
Prim Sid : 235
Host Interface : C7/0/1/UB
MD-DS-SG / MD-US-SG : 1 / 1
MD-CM-SG : 0x3D0101
Primary Wideband Channel ID : 2305 (Wi7/0/0:0)
Primary Downstream : In7/0/0:3 (RfId : 1731)
Wideband Capable : Y
RCP Index : 3
RCP ID : 00 10 00 00 18
Downstream Channel DCID RF Channel : 117 7/0/0:0
Downstream Channel DCID RF Channel : 118 7/0/0:1
Downstream Channel DCID RF Channel : 119 7/0/0:2
Downstream Channel DCID RF Channel : 120 7/0/0:3
Downstream Channel DCID RF Channel : 121 7/0/1:0
Downstream Channel DCID RF Channel : 122 7/0/1:1
Downstream Channel DCID RF Channel : 123 7/0/1:2
Downstream Channel DCID RF Channel : 124 7/0/1:3
Downstream Channel DCID RF Channel : 125 7/0/2:0
Downstream Channel DCID RF Channel : 126 7/0/2:1
Downstream Channel DCID RF Channel : 127 7/0/2:2
Downstream Channel DCID RF Channel : 128 7/0/2:3
Downstream Channel DCID RF Channel : 129 7/0/3:0
Downstream Channel DCID RF Channel : 130 7/0/3:1
Downstream Channel DCID RF Channel : 131 7/0/3:2
Downstream Channel DCID RF Channel : 132 7/0/3:3
Extended Upstream Transmit Power : 61dB
Multi-Transmit Channel Mode : Y
Number of US in UBG : 4
Upstream Channel : US0 US1 US2 US3
```

```
Ranging Status : sta sta sta sta
Upstream SNR (dB) : 36.12 36.12 36.12 36.12
Upstream Data SNR (dB) : -- -- -- --
Received Power (dBmV) : -0.50 -0.50 0.00 -0.50
Reported Transmit Power (dBmV) : 38.25 38.25 38.25 38.25
Peak Transmit Power (dBmV) : 61.00 61.00 61.00 61.00
Phy Max Power (dBmV) : 51.00 51.00 51.00 51.00
Minimum Transmit Power (dBmV) : 24.00 24.00 24.00 24.00
Timing Offset (97.6 ns): 1348 1348 1348 1348
Initial Timing Offset : 1092 1092 1092 1348
Rng Timing Adj Moving Avg(0.381 ns): 0 0 -1 0
Rng Timing Adj Lt Moving Avg : 644 737 644 0
Rng Timing Adj Minimum : 0 0 -256 0
Rng Timing Adj Maximum : 65536 65536 65536 256
Pre-EQ Good : 0 0 0 0
Pre-EQ Scaled : 0 0 0 0
Pre-EQ Impulse : 0 0 0 0
Pre-EQ Direct Loads : 0 0 0 0
Good Codewords rx : 25 30 36 67
Corrected Codewords rx : 0 0 0 0
Uncorrectable Codewords rx : 0 0 0 0
Phy Operating Mode : atdma* atdma* atdma* atdma*
sysDescr :
Downstream Power : 0.00 dBmV (SNR = ----- dB)
MAC Version : DOC3.0
QoS Provisioned Mode : DOC1.1
Enable DOCSIS2.0 Mode : Y
Modem Status : {Modem= w-online, Security=disabled}
Capabilities : {Frag=N, Concat=N, PHS=Y}
Security Capabilities : {Priv=, EAE=Y, Key_len=}
L2VPN Capabilities : {L2VPN=Y, eSAFE=Y}
Sid/Said Limit : {Max US Sids=8, Max DS Saids=64}
Optional Filtering Support : {802.1P=N, 802.1Q=N, DUT=Y}
Transmit Equalizer Support : {Taps/Symbol= 1, Num of Taps= 24}
Number of CPE : 1(Max CPE = 16)
Number of CPE IPs : 0(Max CPE IPs = 16)
CFG Max-CPE : 16
Flaps : 0()
Errors : 0 CRCs, 0 HCSes
Stn Mtn Failures : 0 aborts, 0 exhausted
Total US Flows : 1(1 active)
Total DS Flows : 1(1 active)
Total US Data : 29 packets, 8048 bytes
Total US Throughput : 0 bits/sec, 0 packets/sec
Total DS Data : 1 packets, 275 bytes
Total DS Throughput : 0 bits/sec, 0 packets/sec
LB group ID assigned (index) : 2151481601 (48385)
LB group ID in config file (index) : N/A (N/A)
LB policy ID : 0
LB policy ID in config file : 0
LB priority : 0
Tag :
Required DS Attribute Mask : 0x0
Forbidden DS Attribute Mask : 0x0
Required US Attribute Mask : 0x0
Forbidden US Attribute Mask : 0x0
Service Type ID :
Service Type ID in config file :
Ranging Class ID : 0x2
Active Classifiers : 0 (Max = NO LIMIT)
CM Upstream Filter Group : 0
CM Downstream Filter Group : 0
CPE Upstream Filter Group : 0
CPE Downstream Filter Group : 0
DSA/DSX messages : permit all
Voice Enabled : NO
DS Change Times : 0
Boolean Services : 2
Number of Multicast DSIDs Support : 63
MDF Capability Mode : 2
IGMP/MLD Version : MLDv2
FCType10 Forwarding Support : Y
Features Bitmask : 0x0
```

```
Total Time Online : 08:06 (08:06 since last counter reset)
CM Initialization Reason : T4_EXPIRED
CFG Max IPv6 CPE Prefix : 16 (-1 used)
```

Following is a sample output of the **show cable modem verbose** command in Cisco IOS Release 12.2(33)SCH2:

```
Router# show cable modem 68b6.fcfe.22e5 verbose

MAC Address                        : 68b6.fcfe.22e5
IP Address                         : 192.168.0.8
IPv6 Address                       : 2001:DB8:10:1:9951:1972:33F9:9867
Dual IP                            : Y
Prim Sid                           : 8
Host Interface                     : C8/0/0/UB
MD-DS-SG / MD-US-SG                 : 1 / 2
MD-CM-SG                           : 0x5A0102
Primary Wideband Channel ID        : 3073 (Wi8/0/0:0)
Primary Downstream                 : Mo8/0/0:0 (RfId : 2304)
Wideband Capable                   : Y
RCP Index                          : 3
RCP ID                             : 00 10 00 00 18
Downstream Channel DCID RF Channel : 45    8/0/0:0
Downstream Channel DCID RF Channel : 46    8/0/0:1
Downstream Channel DCID RF Channel : 47    8/0/0:2
Downstream Channel DCID RF Channel : 48    8/0/0:3
Downstream Channel DCID RF Channel : 49    8/0/0:4
Downstream Channel DCID RF Channel : 50    8/0/0:5
Downstream Channel DCID RF Channel : 51    8/0/0:6
Downstream Channel DCID RF Channel : 52    8/0/0:7
Downstream Channel DCID RF Channel : 53    8/0/0:8
Downstream Channel DCID RF Channel : 54    8/0/0:9
Downstream Channel DCID RF Channel : 55    8/0/0:10
Downstream Channel DCID RF Channel : 56    8/0/0:11
Downstream Channel DCID RF Channel : 57    8/0/0:12
Downstream Channel DCID RF Channel : 58    8/0/0:13
Downstream Channel DCID RF Channel : 59    8/0/0:14
Downstream Channel DCID RF Channel : 60    8/0/0:15
Downstream Channel DCID RF Channel : 61    8/0/0:16
Downstream Channel DCID RF Channel : 62    8/0/0:17
Downstream Channel DCID RF Channel : 63    8/0/0:18
Downstream Channel DCID RF Channel : 64    8/0/0:19
Downstream Channel DCID RF Channel : 65    8/0/0:20
Downstream Channel DCID RF Channel : 66    8/0/0:21
Downstream Channel DCID RF Channel : 67    8/0/0:22
Downstream Channel DCID RF Channel : 68    8/0/0:23
UDC Enabled                        : N
Extended Upstream Transmit Power   : 61dB
Multi-Transmit Channel Mode        : Y
Number of US in UBG                : 8
Upstream Channel                   : US0       US1       US2       US3
Ranging Status                     : sta       sta       sta       sta
Upstream SNR (dB)                  : 30.62     32.32     18.25     24.26
Upstream Data SNR (dB)             : --        --        --        --
Received Power (dBmV)              : 0.50      0.00      -0.50     -0.50
Reported Transmit Power (dBmV)     : 30.75     30.75     29.25     29.25
Peak Transmit Power (dBmV)         : 61.00     61.00     61.00     61.00
Phy Max Power (dBmV)               : 48.00     48.00     48.00     48.00
Minimum Transmit Power (dBmV)      : 21.00     21.00     21.00     21.00
Timing Offset        (97.6 ns)     : 1800      1800      1800      1800
Initial Timing Offset              : 1544      1544      1544      1544
Rng Timing Adj Moving Avg(0.381 ns): -1        0         -1        -1
Rng Timing Adj Lt Moving Avg       : -7        0         -7        -7
Rng Timing Adj Minimum             : -256      0         -256      -256
Rng Timing Adj Maximum             : 65536     65536     65536     65536
Pre-EQ Good                        : 0         0         0         0
Pre-EQ Scaled                      : 0         0         0         0
Pre-EQ Impulse                     : 0         0         0         0
Pre-EQ Direct Loads                : 0         0         0         0
Good Codewords rx                  : 1201      1262      833       656
Corrected Codewords rx             : 0         0         169       117
Uncorrectable Codewords rx         : 0         0         205       335
Phy Operating Mode                 : atdma*    atdma*    atdma*    atdma*
Upstream Channel                   : US4       US5       US6       US7
```

```
Ranging Status                          : sta       sta       sta       sta
Upstream SNR (dB)                       : 15.53     31.62     31.1      31.87
Upstream Data SNR (dB)                  : --        --        --        --
Received Power (dBmV)                   : 0.00      0.00      -0.50     0.50
Reported Transmit Power (dBmV)          : 29.25     30.75     30.75     30.75
Peak Transmit Power (dBmV)              : 61.00     61.00     61.00     61.00
Phy Max Power (dBmV)                    : 48.00     48.00     48.00     48.00
Minimum Transmit Power (dBmV)           : 21.00     21.00     21.00     21.00
Timing Offset           (97.6 ns): 1800           1800      1800      1800
Initial Timing Offset                   : 1544      1800      1544      1544
Rng Timing Adj Moving Avg(0.381 ns): -1           -1        46        0
Rng Timing Adj Lt Moving Avg            : -7        -7        104       0
Rng Timing Adj Minimum                  : -256      -256      0         0
Rng Timing Adj Maximum                  : 65536     256       65536     65536
Pre-EQ Good                             : 0         0         0         0
Pre-EQ Scaled                           : 0         0         0         0
Pre-EQ Impulse                          : 0         0         0         0
Pre-EQ Direct Loads                     : 0         0         0         0
Good Codewords rx                       : 718       1328      1173      1252
Corrected Codewords rx                  : 110       0         0         0
Uncorrectable Codewords rx              : 298       0         0         0
Phy Operating Mode                      : atdma*    atdma*    atdma*    atdma*
sysDescr                                : DOCSIS 3.0 Cable Modem Router
Downstream Power                        : 7.40 dBmV (SNR = 43.30 dB)
MAC Version                             : DOC3.0
QoS Provisioned Mode                    : DOC1.1
Enable DOCSIS2.0 Mode                   : Y
Modem Status                            : {Modem= w-online, Security=disabled}
Capabilities                            : {Frag=N, Concat=N, PHS=Y}
Security Capabilities                   : {Priv=, EAE=Y, Key_len=}
L2VPN Capabilities                      : {L2VPN=Y, eSAFE=Y}
Sid/Said Limit                          : {Max US Sids=8, Max DS Saids=64}
Optional Filtering Support              : {802.1P=N, 802.1Q=N, DUT=Y}
Transmit Equalizer Support              : {Taps/Symbol= 1, Num of Taps= 24}
Number of CPE                           : 0(Max CPE = 16)
Number of CPE IPs                       : 0(Max CPE IPs = 16)
Number of CPE IPv6                      : 0(Max CPE IPv6 = 16)
CFG Max-CPE                             : 16
Flaps                                   : 19(Oct 11 04:00:25)
Errors                                  : 0 CRCs, 0 HCSes
Stn Mtn Failures                        : 0 aborts, 12 exhausted
Total US Flows                          : 1(1 active)
Total DS Flows                          : 1(1 active)
Total US Data                           : 3294 packets, 577031 bytes
Total US Throughput                     : 0 bits/sec, 0 packets/sec
Total DS Data                           : 2263 packets, 200777 bytes
Total DS Throughput                     : 0 bits/sec, 0 packets/sec
LB group ID assigned (index)            : 2153382146 (55810)
LB group ID in config file (index) : N/A (N/A)
LB policy ID                            : 0
LB policy ID in config file             : 0
LB priority                             : 0
Tag                                     :
Required DS Attribute Mask              : 0x0
Forbidden DS Attribute Mask             : 0x0
Required US Attribute Mask              : 0x0
Forbidden US Attribute Mask             : 0x0
Service Type ID                         :
Service Type ID in config file          :
Ranging Class ID                        : 0x2
Active Classifiers                      : 0 (Max = NO LIMIT)
CM Upstream Filter Group                : 0
CM Downstream Filter Group              : 0
CPE Upstream Filter Group               : 0
CPE Downstream Filter Group             : 0
DSA/DSX messages                        : permit all
Voice Enabled                           : NO
DS Change Times                         : 0
Boolean Services                        : 2
Number of Multicast DSIDs Support       : 63
MDF Capability Mode                     : 2
IGMP/MLD Version                        : MLDv2
FCType10 Forwarding Support             : Y
```

```
Features Bitmask                     : 0x0
Total Time Online                    : 9h27m    (9h27m    since last counter reset)
CM Initialization Reason             : BAD_DHCP_ACK
CFG Max IPv6 CPE Prefix              : 16 (-1 used)
```

Clearing Attribute Masks

If the cable modem fails to come online after configuring attribute masks in the cable modem configuration file, you can use the following procedure to verify the contents of the cable modem configuration file and clear its contents if the attribute masks are configured differently.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show cable modem verbose** **Example:** Router# **show cable modem verbose**	Verifies whether the cable modem attribute masks have been configured in the cable modem configuration file. **Note** If the cable modem configuration file shows any change, use the **clear cable modem attribute-masks** command.
Step 3	**clear cable modem attribute-masks** **Example:** Router# **clear cable modem all attribute-masks**	Clears the cable modem attribute masks stored in CMTS.
Step 4	**show running-config** **Example:** Router# **show running-config**	Displays the running configuration. Use it to verify whether upstream masks of the cable modem are configured on the corresponding upstream channel.

Debugging Channel Redirection

Use the following steps to debug channel redirection:

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router> **enable**	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show running config**	Displays the running configuration.

	Command or Action	Purpose
	Example: Router# **show running config**	**Note** You can use this information to verify the CMTS configuration to make sure that the cable modems can reach the configured downstream-frequency.
Step 3	**debug cable range** **Example:** Router# **debug cable range**	Displays ranging messages from cable modems on the Hybrid Fiber-Coaxial (HFC) network.
Step 4	**debug cable registration** **Example:** Router# **debug cable registration**	Displays debug messages for the cable modem registration process.
Step 5	**debug cable mac-address** *mac* **verbose** **Example:** Router# **debug cable mac-address 00E0.1E00.0000 ffff.ff00.0000 verbose**	Displays debug information for a specific cable modem.
Step 6	**clear cable modem** *mac* **delete** **Example:** Router# **clear cable modem 00E0.1E00.0000 ffff.ff00.0000 delete**	Removes the specified modem from the CMTS. **Note** This allows the CMTS to re-register the cable modem's page.

Troubleshooting Tips

This section provides tips and commands you can use to troubleshoot your cable modem steering configuration.

- Because empty rules are not allowed, if you remove the last rule of a policy, using **no cable load-balance docsis-policy** *policy-id* **rule** *rule-id* or **no cable load-balance rule** *rule-id,* the policy itself will be removed.

- Use the **show running | include docsis-policy** command or the **show running-config | include rule** command to see the policy and rule configured in the system.

Additional References

The following sections provide references related to the Cable Modem Steering feature.

Related Documents

Related Topic	Document Title
CMTS cable commands	Cisco IOS CMTS Cable Command Reference
DOCSIS 1.1 as it relates to Cisco CMTS	Cisco IOS CMTS Cable Software Configuration Guide
Load Balancing and Dynamic Channel Change (DCC)	Load Balancing and Dynamic Channel Change on the Cisco CMTS Routers
N+1 Redundancy	N+1 Redundancy for the Cisco Cable Modem Termination System

Standards and RFCs

Standard	Title
CM-SP-MULPIv3.0-I07-080215	DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification
CM-SP-MULPIv3.0-I18-120329	DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification
CM-SP-RFI2.0-I13-080215	DOCSIS 2.0 Radio Frequency Interface Specification

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/cisco/web/support/index.html

Feature Information for Cable Modem Steering

Use Cisco Feature Navigator to find information about 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 http://tools.cisco.com/ITDIT/CFN/. An account on http://www.cisco.com/ is not required.

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

Table 2: Feature Information for Cable Modem Steering on the Cisco CMTS Routers

Feature Name	Releases	Feature Information
Channel Redirection	12.2(33)SCB	Channel redirection allows you to redirect or steer the cable modems to one or more CMTS using downstream overrides.
		The following sections provide information about this feature:
		• Channel Redirection, on page 5
		• Configuring a Channel Redirection, on page 6
		• Verifying a Channel Redirection, on page 12
		The following commands were introduced or modified:
		• **cable service type**
		• **cable service type ds-frequency**
		• **clear cable modem attribute-masks**
		• **clear cable modem service-type**
		• **show cable modem service-type-id**

Feature Name	Releases	Feature Information
Channel Restriction	12.2(33)SCB	The CMTS can impose restrictions on the channels a cable modem can use based on the cable modem configuration file or its capabilities. The following sections provide information about this feature: • Channel Restriction, on page 5 • Configuring a Channel Restriction, on page 7 • Verifying a Channel Restriction, on page 13 The following command is introduced: **cable upstream attribute-mask**.
Channel Restriction	12.2(33)SCB4	When the CMTS cannot find an appropriate US channel in the same legacy LB group, the cable modem steering checking is skipped and cable modems come online. The following sections provide information about this feature: • Configuring a Channel Restriction, on page 7
RLBG/GLBG Support and NB DBS Interact with DLB Support	12.2(33)SCC	The following sections have been updated with information about this feature: • Channel Restriction, on page 5 • Configuring a Channel Restriction, on page 7

Feature Name	Releases	Feature Information
UCD TLV for Ranging Hold-off	12.2(33)SCH	The UCD TLV for Ranging Hold-off feature enables the CMTS router to hold off a cable modem from initial ranging. The following sections provide information about this feature: • Upstream Channel Descriptor TLV for Ranging Hold-off, on page 6 • Configuring an Upstream Channel Class ID, on page 8 • Configuring an Upstream Ranging Hold-off Priority Value , on page 10 The following commands were introduced or modified: • **cable load-balance exclude** • **cable upstream chan-class-id** • **cable upstream rng-holdoff** • **show cable modem verbose**
16x4 Cable Modem Support	12.2(33)SCH1	The cable modems can come w-online with up to 16 downstream channels and 4 upstream channels. The following section provides information about this feature: • Channel Restriction, on page 5
24x8 Cable Modem Support	12.2(33)SCH2	The cable modems can come w-online with up to 24 downstream channels and 8 upstream channels. The following section provides information about this feature: • Channel Restriction, on page 5