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.


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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

<table>
<thead>
<tr>
<th>CMTS Platform</th>
<th>Processor Engine</th>
<th>Cable Interface Cards</th>
</tr>
</thead>
</table>
| 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 |  
| 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 |  

## Restrictions for Cable Modem Steering

The Cable Modem Steering feature has the following general restrictions:

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

2. 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.

3. 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.

4. Cable modem steering supports only upstream masks.

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

6. 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.

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

8. 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.

9. Each interface should have an active modem or use `no keepalive` on this interface.

10. 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.

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### Table: Cable Modem Steering on the Cisco CMTS Routers

<table>
<thead>
<tr>
<th>CMTS Platform</th>
<th>Processor Engine</th>
<th>Cable Interface Cards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco uBR7225VXR Universal Broadband Router</td>
<td>Cisco IOS Release 12.2(33)SCA and later releases</td>
<td>Cisco IOS Release 12.2(33)SCA and later releases</td>
</tr>
<tr>
<td></td>
<td>• NPE-G1</td>
<td>• Cisco uBR-E-28U</td>
</tr>
<tr>
<td></td>
<td>Cisco IOS Release 12.2(33)SCB and later releases</td>
<td>• Cisco uBR-E-16U</td>
</tr>
<tr>
<td></td>
<td>• NPE-G2</td>
<td>• Cisco uBR-MC28U/X</td>
</tr>
</tbody>
</table>

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.
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-MULPv3.0-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-MULPv3.0-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.

- TLV 43.1, 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-MULPv3.0-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-MULPv3.0-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.
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

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| Step 1 | enable | Enables privileged EXEC mode.  
  - Enter your password if prompted. |
| Example: | Router> enable |
| Step 2 | configure terminal | Enters global configuration mode. |
| Example: | Router# configure terminal |
| Step 3 | cable service type service-type-id ds-frequency frequency | 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. |
| Example: | Router(config)# cable service type commercial ds-frequency 519000000 |

### 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**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example: Router&gt; enable</td>
<td>Enables privileged EXEC mode. Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example: Router# configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>interface cable slot/subslot/port</td>
</tr>
<tr>
<td>Example: Router(config)# interface cable 5/0/4</td>
<td>Enables the cable interface.</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>cable upstream upstream-interface attribute-mask attribute-mask</td>
</tr>
<tr>
<td>Example: Router(config-if)# cable upstream 0 attribute-mask ffff</td>
<td>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-FFFFFFFE</td>
</tr>
<tr>
<td>Note</td>
<td>From Cisco IOS Release 12.2(33)SCC, the bit 0 in attribute-mask is bypassed when cable modem steering checks it.</td>
</tr>
</tbody>
</table>

**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.
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.

**Restriction**

### DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Router&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface cable</td>
<td>Specifies the cable interface and enters cable interface configuration</td>
</tr>
<tr>
<td>slot/subslot/cable-interface-index</td>
<td>mode. Arguments for this command may vary depending on the CMTS router,</td>
</tr>
<tr>
<td>Example:</td>
<td>line card, and Cisco IOS software release. For details, see the Cisco</td>
</tr>
<tr>
<td></td>
<td>IOS CMTS Cable Command Reference .</td>
</tr>
<tr>
<td>Router(config)# interface</td>
<td>• Slot—Slot where a line card resides.</td>
</tr>
<tr>
<td>cable 5/0/4</td>
<td>• Subslot (Cisco uBR10012 only)—Secondary slot number of a line card.</td>
</tr>
<tr>
<td><strong>Step 4</strong> cable upstream</td>
<td>Configures the channel class ID for an upstream logical channel.</td>
</tr>
<tr>
<td>port-number chan-class-id id</td>
<td>• port-number—Cable upstream port number. The valid range depends on</td>
</tr>
<tr>
<td>Example:</td>
<td>the number of upstream channels configured in a MAC domain. For</td>
</tr>
<tr>
<td>Router(config-if)# cable</td>
<td>example, if the total number of upstream channels configured is 4, then</td>
</tr>
<tr>
<td>upstream 0 chan-class-id ff</td>
<td>the valid range for the upstream port number is from 0 to 3.</td>
</tr>
<tr>
<td><strong>Step 5</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Router(config-if)# end</td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>enable</td>
</tr>
<tr>
<td>Example:</td>
<td>Router&gt; enable</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>configure terminal</td>
</tr>
<tr>
<td>Example:</td>
<td>Router# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>interface cable slot/subslot/cable-interface-index</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config)# interface cable 5/0/4</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>cable upstream port-number rng-holdoff priority</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-if)# cable upstream 0 rng-holdoff 1</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>end</td>
</tr>
<tr>
<td>Example:</td>
<td>Router(config-if)# end</td>
</tr>
</tbody>
</table>
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:

```bash
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
```

Example: Clearing a Channel Redirection

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

```bash
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 : DOC2.2
QoS Provisioned Mode : DOC1.1
Enable DOCSIS2.0 Mode : Y
Phy Operating Mode : tdma
Modem Status :
Capabilities : {Modem=online(pt), Security=assign(tek)}
Security Capabilities : {Priv=BPI+, EAE=N}
L2VPN Capabilities : {L2VPN=N, eSAFE=N}
S1d/Said Limit : {Max US Sids=16, Max DS Saids=15}
Optional Filtering Support : {802.1P=N, 802.1Q=N, DU-T=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
```
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:

```bash
Router# show cable modem service-type commercial
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
0018.6811.fba6  41.42.2.255 C5/0/4/U2 offline 7439 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:

```bash
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 : C5/0/4/00
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 Sids=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
CPG Max-CPE : 16
Flaps : 0
Errors : 0 CRCs, 0 HCSes
Stn Mtn Failures : 0 aborts, 0 exhausted
```
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
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 (W17/0/0:0)
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 0 0 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=}
LZVFN Capabilities : {LZVFN=Y, eSAFE=Y}
Sid/Id Limit : {Max US Sids=8, Max DS Sids=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
Dual IF : 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 (W18/0/0:0)
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 -1 -1 -1
Rng Timing Adj LT Moving Avg : -7 -7 -7 -7
Rng Timing Adj Minimum : -256 -256 -256 -256
Rng Timing Adj Maximum : 65536 65536 65536 65536
Pr-EQ Good : 0 0 0 0
Pr-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*
```

Cisco CMTS Router Downstream and Upstream Features Configuration Guide

OL-27606-08
Cisco CMTS Router Downstream and Upstream Features Configuration Guide

Verifying an Upstream Ranging Class ID Configuration

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
Phys 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=, EAR=Y, Key_len=}
L2VPN Capabilities : {L2VPN-Y, eSAFE=Y}
Sid/Said Limit : (Max US Sids=8, Max DS Sids=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 US 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/DOX 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

Cable Modem Steering on the Cisco CMTS Routers
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**

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

Debugging Channel Redirection

Use the following steps to debug channel redirection:

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Router&gt; enable</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td><strong>Step 2</strong> show running-config</td>
<td>Displays the running configuration.</td>
</tr>
</tbody>
</table>
### Troubleshooting Tips

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

- **Clearing Attribute Masks**, on page 18
- **Debugging Channel Redirection**, on page 18
- 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

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

### Standards and RFCs

<table>
<thead>
<tr>
<th>Standard</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM-SP-MULPlv3.0-I07-080215</td>
<td>DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification</td>
</tr>
<tr>
<td>CM-SP-MULPlv3.0-I18-120329</td>
<td>DOCSIS 3.0 MAC and Upper Layer Protocols Interface Specification</td>
</tr>
<tr>
<td>CM-SP-RFI2.0-I13-080215</td>
<td>DOCSIS 2.0 Radio Frequency Interface Specification</td>
</tr>
</tbody>
</table>

### Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support website provides extensive online resources, including documentation and tools for</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
<tr>
<td>troubleshooting and resolving technical issues with Cisco products and technologies.</td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
</tbody>
</table>
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://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Note
The table below 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>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| 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** |
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| 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 |
<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
</table>
| 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 |