IGMP-Triggered Dynamic Channel Change Load Balancing for DOCSIS 2.0 Cable Modems

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The Internet Group Management Protocol (IGMP) Triggered Dynamic Channel Change (DCC) Load Balancing (LB) feature is introduced to avoid rejection of new video streams either due to bandwidth constraints or repeated admission control failures on an interface.

If there are admission control failures during a session request, the load balancing infrastructure provides a list of downstream channels to which the cable modem (CM) can be moved. Downstream channels that already carry the existing session replication are given preference.

Note This feature is supported only on DOCSIS 2.0 CMs and DOCSIS 3.0 CMs operating in narrowband (NB) mode.

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 IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs

The IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs feature is supported on the Cisco CMTS routers in Cisco IOS Release 12.2(33)SCF and later releases. The table below shows the hardware compatibility prerequisites for this feature.

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

Table 1: IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs – Compatibility Matrix

Cisco CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	Cisco IOS Release 12.2(33)SCF and later releases • PRE2[1] • PRE4 Cisco IOS Release 12.2(33)SCH and later releases • PRE5	Cisco IOS Release 12.2(33)SCF and later releases • Cisco uBR10-MC5X20U/H • Cisco UBR-MC20X20V • Cisco uBR-MC3GX60V[2]
Cisco uBR7246VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCF and later releases • NPE-G2	Cisco IOS Release 12.2(33)SCF and later releases • Cisco uBR-MC88V [3]
Cisco uBR7225VXR Universal Broadband Router	Cisco IOS Release 12.2(33)SCF and later releases • NPE-G2	Cisco IOS Release 12.2(33)SCF and later releases • Cisco uBR-MC88V

1 PRE = Performance Routing Engine
2 The Cisco uBR-MC3GX60V cable interface line card is compatible only with PRE4.
3 The Cisco uBR-MC88V cable interface line card is compatible only with NPE-G2.

Software Prerequisites

- The IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs feature is enabled on every CM based on the load balancing policy.
- Load balancing infrastructure ensures that the CM is assigned to the intended load balancing group (LBG).
- CM is moved during session setup depending on the existing multicast replications and bandwidth requirements.
- CM cannot move the downstream channels that are forwarding any voice or video traffic if any active sessions are being forwarded on that CM.
- Route processor and line card high availability is supported.

Restrictions for IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs

- IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs feature is only supported on NB CMs.
- When an IGMP-triggered DCC load balancing request is sent to the Cisco CMTS, the route processor (RP) queues the request and performs admission control checks and processes the request only if the result is a success.
- CMs with an active stream are not moved.
- DOCSIS 3.0 that are wideband (WB) CMs will not be moved for any optimization.
- Downstream selection and attribute checking is performed on the host line card for multicast sessions.
- For NB DOCSIS 2.0 and DOCSIS 3.0 modems that are either Multicast DSID Forwarding (MDF) enabled or MDF-disabled, combined optimization technique is applied at the time of session request. For more information, see Combined Optimization Technique, on page 4.
- Encrypted multicast streams are not supported in IGMP-triggered DCC load balancing.

Information About IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs

IGMP-triggered DCC load balancing for DOCSIS 2.0 CM ensures that new video streams are not rejected due to multiple admission control failures. This solution leverages the DOCSIS 3.0 load balancing infrastructure to identify a subset of downstream channels where the CMs can be moved. The downstream channel that is already carrying the existing session replication is preferred over other channels and the CM is moved to this channel to avoid further replication.

If no other downstream channel carries this video stream or does not support the required bandwidth, the CM is moved to a new downstream channel based on the downstream channel in the DCC request for DOCSIS 2.0 CMs—for CMs to be moved across MAC domains.

The following sections describe the technique used to load balance CMs, and the interaction of the IGMP-Triggered DCC Load Balancing feature with DOCSIS LB and Fairness Across DOCSIS Interfaces:

Combined Optimization Technique

The IGMP-Triggered DCC Load Balancing feature combines replication-based and bandwidth-based optimization techniques to decide when and how load balancing take place.

Replication-based optimization—This technique minimizes the number of active replications by load balancing a CM to a downstream where the replications exits.

Bandwidth-based optimization—If a new replication needs to be created and the current downstream channel cannot handle the replication request due to insufficient committed information rate (CIR) bandwidth, the CM will be load balanced to a downstream that has the lowest CIR usage.

The combined optimization technique follows these rules:

- When a session request comes in, the replication-based optimization technique is given preference.
- When there are second streams and best effort (BE) traffic on the same bonding group (BG), the weighted RF utilization is measured before making a decision about whether a new replication should be created.
- If there are no existing replications or a new replication needs to be created, the bandwidth-based technique is used to move the CM to a new BG.
- For unicast sessions, the CIR bandwidth-based approach is used.

Note The IGMP-Triggered DCC Load Balancing feature is not supported for unicast sessions for Cisco IOS Release 12.2(33)SCF.

- When there are multiple overlapping BGs carrying the replication, no preference is given based on size.

Session Creation Request

When a new session request is received, the IGMP-Triggered DCC Load Balancing feature moves CMs when:

- IGMP-triggered DCC load balancing is configured.
- There are no PacketCable Multimedia (PCMM) based multicast flows.
- There are no non-zero CIR unicast or IGMP-based multicast flows on the downstream channel.

The following rules apply during admission control decisions for the session replication request:

- For multicast session requests, the downstream channels carrying the existing replications are the primary candidates if:
  - The forwarding interface is a subset of the current downstream channels or receive channel configuration (RCC) of the CM. In this case, the CM is automatically assigned to the existing multicast session.
  - The replication is forwarding on an interface that is a subset of the LBG of the CM. In this case, the CM is moved to the candidate downstream channel.
- If the utility-based threshold is reached, such that non-video traffic is significantly affected, a new replication is created irrespective of an existing replication.

Note Static multicast sessions are handled in the same way as dynamic sessions with an existing session replication.

The following rules apply when a new session replication is required to be created:

- A new session replication is created if its admission to the current downstream channel interfaces passes.
- If the new session replication admission fails, the downstream channels in the LBG of the CM are searched for target downstream channels. This search is to find the forwarding interface with the least-utilized CIR.

If no new candidates are found, the session replication creation fails and the request is rejected.

Deployment of the IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 and DOCSIS 3.0 CMs

In an HFC plant with DOCSIS 2.0 and DOCSIS 3.0 CMs, the following points should be noted:

- Downstream forwarding to all DOCSIS 2.0 and NB CMs is done using cable, modular-cable (MC), and integrated-cable (IC) interfaces.

Note Cable interfaces on the Cisco uBR10-MC5X20 cable interface line card that use MDF are not supported.

- While using MC and IC interfaces for downstream forwarding, it is crucial to ensure that the configured **rf-bandwidth-percentage** is sufficient to serve the need for that interface.
- DOCSIS 3.0 CMs in wideband mode can receive traffic that is forwarded on all interfaces whose downstream channels are a subset of the RCC of the CM. However, by default forwarding always occur on the corresponding wideband interface. To forward downstream data on the MC and IC interface, configure specific attributes-based forwarding.

The following rules apply to multicast forwarding selection with IGMP-Triggered DCC load balancing feature in the following hybrid environments:

- For DOCSIS 3.0 CMs:
  - The existing replication is used if the session replication exists on a downstream channel that is subset of the RCC of the CM and the flow attribute matches the existing replication flow.
  - A new replication is created when the session replication exists on a downstream channel that is subset of the RCC of the CM, but the flow attributes do not match the existing replication flow.
  - A new replication is created if the session replication does not exists on a downstream channel that is subset of the RCC of the CM, but exists on a downstream channel that is a subset of the LBG of the CM.
  - If the session replication does not exist, but the flow attributes specifically point to a particular downstream channel, then the first downstream to match the attribute requirements along with the

admission criteria of the flow is used for the forwarding. If the attributes match the BG and downstream channel, then than the BG is used for forwarding.

- For DOCSIS 2.0 CMs:
  - Existing replication is used if the session replication already exists on a downstream channel that is a subset of the LBG of the CM. For more information, see Session Creation Request, on page 4.
  - New replication is created if the session replication already exists on a BG that is a subset of the LBG of the CM.

Interaction of IGMP-Triggered DCC Load Balancing With DOCSIS Load Balancing

DOCSIS load balancing is based on the following methods that the Cisco CMTS uses to determine when interfaces are balanced:

- Modems method
- Service-flow method
- Utilization method

For more information on these DOCSIS LB methods, see Load Balancing and Dynamic Channel Change on the Cisco CMTS Routers .

A single load balance group is used for both the DOCSIS and IGMP-triggered DCC load balancing. DOCSIS load balancing decisions are made during CM registration (static load balancing) as well as after registration (dynamic load balancing; depending on traffic conditions) to achieve a balanced system. IGMP-triggered DCC load balancing is triggered at the time of a video request.

CMs with active video-over-DOCSIS (VDOC) sessions are excluded from moving during the periodic dynamic balancing by DOCSIS load balancing. This can lead to situations where due to the number of CMs with active video session and the pattern of the usage, the interface is unbalanced. However, it is possible to have an unbalanced, but stable state based on the DOCSIS load balancing criteria.

- CMs with active video sessions are counted in the DOCSIS load balancing statistics, but are not allowed to move.
- IGMP-triggered DCC load balancing decisions are independent of the DOCSIS load balancing criteria.

show cable load-balance vdoc and **show cable load-balance docsis-group vdoc** commands provide detailed information on the state of the IGMP-triggered DCC load balancing for a particular LBG. These commands also include information to display why a non-balanced stable state is achieved.

Interaction of IGMP-Triggered DCC Load Balancing With Fairness Across DOCSIS Interfaces

CIR is the average available bandwidth under normal conditions. There may be an allowance of burstable bandwidth, known as the excess information rate (EIR). The connection always supports the CIR rate, and

sometimes the EIR rate, provided there is adequate bandwidth. The CIR plus EIR is either equal to or less than the speed of the access port into the network.

The bandwidth allocation for BE traffic among BGs depends on:

- Statically configured bandwidth percentage
- Actual amount of admitted CIR
- Statically configured remaining ratio

Although the "remaining ratio" is meant for the bandwidth provisioning for the BE traffic, the actual amount of bandwidth used by the BE traffic depends on all three of the above factors.

So, the purpose is to adjust the guaranteed BG bandwidth adaptively to accommodate the CIR flow request by moving guaranteed bandwidth between the adjacent BGs (those that share RF channels). This is referred to as Adaptive CIR. After satisfying the CIR requests, the BG bandwidth is further adjusted based on the estimated traffic and active BE service flow count weighted by DOCSIS priority, so that flows with the same traffic priority get the same amount of bandwidth across BGs. This is referred to as EIR Fairness. The solution as a whole is called Fairness Across DOCSIS Interfaces.

For the IGMP-triggered DCC load balancing to work seamlessly with Fairness Across DOCSIS Interfaces, it relies on the non-guaranteed bonus bandwidth for each BG to determine the threshold and BG capacity.

Note For NB and DOCSIS 3.0 load balancing operations, admission control does not utilize non-guaranteed bonus bandwidth for load balancing checks.

Therefore, if the admission control check passes, the probability that the service flow creation fails due to insufficient bandwidth is fairly low considering the requests will be serially processed.

Restrictions

- Because the host MAC domain does not have the complete information when the BG is shared across multiple MAC domains, due to bandwidth fragmentation in the service flow admission control (SFAC), admission control may fail even though the CIR bandwidth is available on the BG.
- Because the CIR bandwidth information is sent from the active route processor to the host MAC domain with the keepalives, the information is out of synchronization by 2 seconds. This may cause a race condition of possible incomplete or inaccurate knowledge at the time of the session creation.
- When Fairness Across DOCSIS Interfaces is configured, the MAC domain hosts must have the non-guaranteed bonus bandwidth information per bucket, per BG.
- For multicast sessions, there is a possibility that although a CM was moved to a different downstream to satisfy bandwidth requirements, the flow is rejected even though admission control had passed. The race condition here being that the bandwidth has been allocated to other flows in the meantime.

DOCSIS 2.0 Multicast Enhancement for VDOC

This feature enables you to tune a DOCSIS 2.0 CM to a specific downstream and supports static and dynamic multicast video forwarding on it. The vdoc-enabled keyword enables the VDOC load balancing for static multicast groups.

The set-top boxes (STB) are configured with static video streams. The Cisco CMTS will check if the CMs that are connected to these STBs are already on the specific downstream interface with these multicast replications when the Cisco CMTS receives joins for these static streams. If the CMs are not on the correct downstreams, then a DCC message is sent to the line card to initiate the CM to move to the correct downstream interface.

Static multicast sessions are not a MUST to enable this rule. The CM(s) can be moved to use an existing replication, static or dynamic with preference being given to static flows.

This feature has the following restrictions:

- This feature is not supported on LBGs, which are derived from fiber node configuration and with multicast encryption.
- This feature does not support logical upstream channels.
- This feature works with DOCSIS 2.0 and NB DOCSIS 3.0 CMs, which are MDF-enabled.
- For MDF-enabled CMs, the CM may support DCC but do not receive traffic till the next join arrives.
- Multicast quality of service (QoS) must be configured either globally or on the bundle interface.
- The CMs that support DCC due to load-balancing will use initialization technique 0 irrespective of the initialization technique configured on the LBG.
- This feature does not support multicast encryption. However, if the static group is configured for multicast encryption, then this feature will process the join and move the CM if required.

How to Configure IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs

The following sections describe how to create and configure LBGs to enable load balancing on the Cisco CMTS. Each task is marked as required or optional, as appropriate.

Creating a Load Balancing Group

This section describes how to create an LBG. You must create at least one LBG before the Cisco CMTS can begin load balancing CMs.

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.

	Command or Action	Purpose
Step 3	**cable load-balance group** *n* **method** [**modems** | **service-flows** | **utilization**] **Example:** `Router(config)# cable load-balance group 10 method service-flows`	Creates an LBG with the following parameters: • *n*—Number of the LBG. In Cisco IOS Release 12.2(33)SCE3 and earlier, the valid range is from 1 to 80. In Cisco IOS Release 12.2(33)SCE4 and later releases, the valid range is from 1 to 256. **Note** If downstream channels are not included in an LBG, then each downstream channel can be considered a separate domain. • **modems—**(Optional) Specifies that the LBG should use the number of active CMs on an interface to determine the current load (default). • **service-flows—**(Optional) Specifies that the LBG should use the number of active service flow IDs (SFIDs) on an interface to determine the current load. • **utilization—**(Optional) Specifies that the LBG should use the current percentage of utilization on an interface to determine the current load. (To avoid unnecessary movement of CMs, the utilization method does not perform load balancing until the amount of utilization on an interface is at 25 percent or more.)
Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Creating a Load Balancing Rule

This configuration is optional. This section describes how to create a load balancing rule. You must create at least one load balancing rule before the Cisco CMTS can use load balancing policies.

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.

	Command or Action	Purpose
Step 3	**cable load-balance docsis-enable** **Example:** `Router(config)# cable load-balance docsis-enable`	Enables DOCSIS load balancing on the Cisco CMTS.
Step 4	**cable load-balance rule** *rule-id* **vdoc-enabled** **Example:** `Router(config)# cable load-balance rule 1 vdoc-enabled`	Creates a rule that prevents a CM from disabling or enabling load balancing. • **vdoc-enabled—**Enables the VDOC LB for static and dynamic multicast groups. • *rule-id***—**Rule ID of the rule to load balance CM
Step 5	**cable load-balance docsis-policy** *policy-id* **rule** *rule-id* **Example:** `Router(config)# cable load-balance docsis-policy 1 rule 1`	Creates a DOCSIS policy and associates an existing rule with the policy. • *policy-id***—**DOCSIS policy to be created. • **rule** *rule-id***—**Specifies the rule to be used with the DOCSIS policy.
Step 6	**cable load-balance docsis-group** *docsis-group-id* **index** **Example:** `Router(config)# cable load-balance docsis-group 1 index 81`	Configures a DOCSIS LBG on the Cisco CMTS. • *docsis-group-id***—**DOCSIS LBG ID. A valid DOCSIS LBG ID ranges from 1 to 2147483647 and does not overlap with the legacy LBG ID.
Step 7	**downstream Modular-Cable** *slot/subslot/controller* **rf-channel** *rf-channel* **Example:** `Router(config-lb-group)# downstream Modular-Cable 5/0/0 rf-channel 0-11`	Associates a set of upstreams with individual modular cable downstream channels into a given cable MAC domain. • *slot***—**Cable interface slot. The valid values range from 5 to 8. • *subslot***—**Cable interface subslot. The valid values are 0 or 1. • *controller***—**Modular-cable controller number. The valid values range from 0 to 2. • **rf-channel—**Specifies the association of a continuous range of RF channels within the downstream. • *rf channels***—**Range of RF channel physical ports.
Step 8	**downstream cable** *slot/subslot/controller* **Example:** `Router(config-lb-group)# downstream Cable 7/0/0`	Assigns a primary downstream channel for a fiber node. • *slot***—**Cable interface slot. The valid values range from 5 to 8. • *subslot***—**Cable interface subslot. The valid values are 0 or 1. • *controller***—**Modular-cable controller number. The valid values range from 0 to 2.
Step 9	**upstream cable** *slot/subslot/port upstream-list*	Sets upstream channels in a DOCSIS LBG.

	Command or Action	Purpose
	Example: `Router(config-lb-group)# upstream cable 7/0/0 0`	• **cable***slot/subslot/port*—Specifies the Cisco CMTS interface slot, subslot, and port number parameters. ◦ *slot*—Cable interface slot. The valid values range from 5 to 8. ◦ *subslot*—Cable interface subslot. The valid values are 0 and 1. ◦ *port*—Modular-Cable controller number. The valid values are 0 to 2. • *upstream-list*—Upstream channel list ranging from 0 to 7.
Step 10	**init-tech-list** *grouplist* [**ucc**] **Example:** `Router(config-lb-group)# init-tech-list 1`	Sets the DCC initialization techniques that the Cisco CMTS can use for load balancing CMs. • *grouplist*—DCC initialization technique list. **Note** It is not recommended to use init-tech-list 0. • **ucc**—(Optional) Determines whether Upstream Channel Change (UCC) can be used for modems during dynamic upstream load balancing.
Step 11	**docsis-policy** *policy-id* **Example:** `Router(config-lb-group)# docsis-policy 1`	Assigns a policy to a DOCSIS LBG. • *policy-id*—LBG policy number. The policy number can range from 0 to 4294967295.
Step 12	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Creating a Load Balancing Policy

This configuration is optional. This section describes how to create a load balancing policy. You must create at least one load balancing rule before the Cisco CMTS can use a load balancing policy.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	• Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Router> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable load-balance docsis-policy** *policy-id* **rule** *rule-id* **Example:** `Router(config)# cable load-balance docsis-policy 2 rule 1`	Creates a load balancing rule with the following parameters: • *policy-id* —DOCSIS policy to be created. • **rule** *rule-id*—Specifies the rule to be used with the DOCSIS policy.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Configuring a Load Balancing Group

This section describes how to configure an LBG. All steps are optional, unless you want to change the default load balancing configuration.

Restriction When assigning cable interfaces to LBGs, be aware of the following restrictions:

- An upstream can belong to only one LBG.
- All downstreams and upstreams in an LBG must share physical connectivity to the same group of CMs. Downstreams can be in a separate LBG than upstreams, but all downstreams or all upstreams that have the same RF physical connectivity must be members of the same LBG. You cannot distribute downstreams or upstreams that share physical connectivity across multiple LBGs.

DETAILED STEPS

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

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable load-balance docsis-group** *docsis-group-id* **Example:** `Router(config)# cable load-balance group 1 index 81`	Configures a DOCSIS LBG on the Cisco CMTS. • *n* —DOCSIS LBG ID. A valid DOCSIS LBG ID ranges from 1 to 2147483647 and does not overlap with the legacy LBG ID.
Step 4	**downstream cable** *slot/subslot/controller* **Example:** `Router(config-lb-group)# downstream cable 7/0/0`	Assigns a primary downstream channel for a fiber node. • *slot*—Cable interface slot. The valid values range from 5 to 8. • *subslot*—Cable interface subslot. The valid value is 0 or 1. • *controller*—Modular-Cable controller number. The valid values range from 0 to 2.
Step 5	**upstream cable** *slot/subslot/port upstream-list* **Example:** `Router(config-lb-group)# upstream cable 7/0/0 0`	Sets upstream channels in a DOCSIS LBG. • **cable** *slot/subslot/port*—Cisco CMTS interface slot, subslot, and port number parameters. ◦ *slot*—Cable interface slot. The valid values range from 5 to 8. ◦ *subslot*—Cable interface subslot. The valid value is 0 or 1. ◦ *port*—Modular-cable controller number. The valid values range from 0 to 2. • *upstream-list*—Upstream channel list ranging from 0 to 7.
Step 6	**init-tech-list** *grouplist* [**ucc**] **Example:** `Router(config-lb-group)# init-tech-list 1`	Sets the DCC initialization techniques that the Cisco CMTS can use to load balancing CMs. • *grouplist*—DCC initialization technique list. • **ucc**—(Optional) Determines whether UCC can be used for modems during dynamic upstream load balancing.
Step 7	**docsis-policy** *n* **Example:** `Router(config-lb-group)# docsis-policy 1`	Assigns a policy to a DOCSIS LBG. • *n*—LBG policy number. The policy number can range from 0 to 4294967295.

	Command or Action	Purpose
Step 8	**exit** **Example:** `Router(config-lb-group)# exit`	Exits the DOCSIS LBG on the Cisco CMTS.

Step 9	**cable load-balance group** *n* **policy** {**pcmm** | **ugs** | **us-groups-across-ds**}
	
	Example:
	`Router(config)# cable load-balance group 10 policy ugs`
	`Router(config)# cable load-balance group 10 policy pcmm`
	`Router(config)# cable load-balance group 10 policy us-groups-across-ds`
		Sets the load balancing policy.
		• *n*—Number of the LBG.
		In Cisco IOS Release 12.2(33)SCE3 and earlier, the valid range is from 1 to 80. In Cisco IOS Release 12.2(33)SCE4 and later releases, the valid range is from 1 to 256.
		• **pcmm**—Enables balancing of modems with active PCMM service flows.
		• **ugs**—Enables balancing of modems with active unsolicited grants service (UGS) service flows.
		• **us-groups-across-ds**—Enables load balancing on upstream groups across the downstream. The downstream group method will be ignored.

Step 10	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.

Verifying IGMP-Triggered DCC Load Balancing Operations

This section describes how to use certain show commands to verify the configuration and operation of the IGMP-Triggered DCC Load Balancing feature on the Cisco CMTS.

- **show cable load-balance docsis-group** *vdoc*
- **show cable multicast db detail**
- **show cable multicast db** [*cm-mac-address*]

Examples

The following is a sample output of the **show cable load-balance docsis-group vdoc** command:

```
Router# show cable load-balance docsis-group 2 vdoc
Interface            State Group  Util Total      IGMP    CIR    High Low
                           Index       Targeted   Repl    Init   Util CIR
In7/0/0:0 (453 MHz)  up    81     0%   37(m)      12(m)   25(m)  10   10
In7/0/0:1 (459 MHz)  up    81     0%   37(15)     12(10)  25(5)  30   1
In7/0/0:2 (465 MHz)  up    81     0%   37(m)      12(m)   25(m)  20   10
Util: Current Utilization
Total Targeted: # of times the DS was targeted to be used by VDOC LB
```

```
                w or w/o move
             m: # of times the DS was targeted with a move required

IGMP Repl: subset of Total Targeted, # of times it was due to existing
repl
          m: Targeted via IGMP repl w/ a move required
CIR Init: subset of Total Targetd, # of times it was due to new CIR flow
         m: Targeted via CIR w/ a move required
High Util: #of times the DS was rejected w/ a existing replication due
to high
           util. (regardless of CMs exiting DS)
High CIR: #of times the DS was rejected due to low CIR

Router# show cable multicast db bundle 1 230.1.1.1 detail
Interface            Fwd Intfc   group           source          Cause
Bundle1              Mo3/0/0:0   230.1.1.1       N/A             No LB
ETDB received IGMP   ETDB processed IGMP
Jan 30 03:57:24.759   Jan 30 03:57:24.763
Sid      gc_id    Stat Index   DSID       Stat Index Allocated
DEFAULT  N/A      61322        0x4F259    Jan 30 03:57:24.759
8206     1        61323        0x4F259    Jan 30 03:57:24.759
```

The table below displays the conditions when a new replication is created.

Table 2: Conditions When a New Replication is Created

Cause	Description
NEW_REPLN_NO_LB	Load balancing is not configured.
NEW_REPLN	New replication.
NEW_REPLN_DS_HI_UTIL	Downstream has high utilization of bandwidth.
NEW_REPLN_NO_MOVE	CM move is not allowed.
NEW_REPLN_DS_NOT_LBG	Downstream is not part of the LBG.
NEW_W_EXIST_REPLN_FOR_WB	Replication exists for the wideband CM.
REPLN_FAIL	Replication failure; use existing replication.
REPLN_DCC	CM requested a DCC.
REPLN_DCC_FAIL	DCC of the CM failure.
REPLN_MDF_DIS	CM was MDF disabled.
REPLN_STATIC_CLI	Static CLI configured.
REPLN_STATIC_TLV	Static TLV configured.
REPLN_INTFC_GC	Interface GC configured.
REPLN_PCMM	PCMM replication.
REPLN_HA	Replication created after HA.

```
Router# show cable multicast db 001e.6bfb.248a
Session (S,G) : (*,230.1.1.1)
Fwd Intfc  Sub Intfc            Host Intfc      Hosts      Proxy    Static   DCC
Mo3/0/0:5  Bundle1              Cable7/0/0          1          N         N     N
```

Additional References

Related Documents

Document Title	URL
Cisco IOS Commands for the Cisco CMTS Routers	http://www.cisco.com/en/US/docs/ios/cable/command/reference/ cbl_book.html
Cisco IOS CMTS Cable Software Configuration Guide, Release 12.2SC	http://www.cisco.com/en/US/docs/ios/cable/configuration/guide/ 12_2sc/cbl_12_2sc_book.html
Cisco uBR10000 Series Universal Broadband Router Release Notes	http://www.cisco.com/en/US/products/hw/cable/ps2209/ prod_release_notes_list.html

Standards and RFCs

Standard/RFC	Title
CableLabs™ DOCSIS specifications	http://www.cablelabs.com/cablemodem/
CableLabs™ PacketCable MultiMedia specifications	http://www.cablelabs.com/packetcable/specifications/multimedia.html

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs

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 3: Feature Information for IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 CMs

Feature Name	Releases	Feature Information
IGMP-Triggered DCC Load Balancing for DOCSIS 2.0 Cable Modems	12.2(33)SCF	This feature was introduced. The **vdoc** keyword was added to the following commands: • **show cable load-balance vdoc** • **show cable load-balance docsis-group vdoc**