DOCSIS Load Balancing Groups

First Published: April 11, 2015

Support for the restricted load balancing group (RLBG)/general load balancing group (GLBG) is based on DOCSIS 3.0 specifications.

Your software release may not support all the features that are documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. The Feature Information Table at the end of this document provides information about the documented features and lists the releases in which each feature is supported.

Contents

- Hardware Compatibility Matrix for the Cisco cBR Series Routers, on page 1
- Prerequisites for DOCSIS Load Balancing Groups, on page 3
- Restrictions for DOCSIS Load Balancing Groups, on page 3
- Information About DOCSIS Load Balancing Groups, on page 4
- How to Configure DOCSIS Load Balancing Groups, on page 10
- Configuration Examples for DOCSIS Load Balancing Groups, on page 21
- How to Configure Load Balancing with Operational Simplification, on page 22
- Verifying DOCSIS Load Balancing Groups, on page 25
- Additional References, on page 31
- Feature Information for DOCSIS Load Balancing Groups, on page 31

Hardware Compatibility Matrix for the Cisco cBR Series Routers

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

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

Cisco CMTS Platform	Processor Engine	Interface Cards
Cisco cBR-8 Converged Broadband Router	**Cisco IOS-XE Release 16.5.1 and Later Releases** Cisco cBR-8 Supervisor: • PID—CBR-SUP-250G • PID—CBR-CCAP-SUP-160G	**Cisco IOS-XE Release 16.5.1 and Later Releases** Cisco cBR-8 CCAP Line Cards: • PID—CBR-LC-8D30-16U30 • PID—CBR-LC-8D31-16U30 • PID—CBR-RF-PIC • PID—CBR-RF-PROT-PIC • PID—CBR-CCAP-LC-40G • PID—CBR-CCAP-LC-40G-R • PID—CBR-CCAP-LC-G2-R • PID—CBR-SUP-8X10G-PIC • PID—CBR-2X100G-PIC Digital PICs: • PID—CBR-DPIC-8X10G • PID—CBR-DPIC-2X100G Cisco cBR-8 Downstream PHY Module: • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D31-US-MOD

Note Do not use DPICs (8X10G and 2x100G) to forward IP traffic, as it may cause buffer exhaustion, leading to line card reload.

The only allowed traffic on a DPIC interface is DEPI, UEPI, and GCP traffic from the Cisco cBR-8 router to Remote PHY devices. Other traffic such as DHCP, SSH, and UTSC should flow via another router, since DPICs cannot be used for normal routing.

Prerequisites for DOCSIS Load Balancing Groups

DOCSIS Load Balancing Groups including Restricted/General Load Balancing groups with Downstream Dynamic Load Balancing feature has the following prerequisites:

- A RLBG and a DOCSIS 2.0 GLBG should have a load balancing group (LBG) ID.
- A LBG should have a default policy ID.
- During registration, a cable modem (CM) that has been assigned to a LBG must also be assigned a policy ID and priority, through Simple Network Management Protocol (SNMP), the cable modem configuration file, or Cisco Cable Modem Termination System (CMTS) configuration.
- The cable modem must send service type identifier (STID), service class name, and DOCSIS version and capability type/length/value (TLV) settings to the Cisco CMTS for registration if the fields are used by general tagging.

Restrictions for DOCSIS Load Balancing Groups

The DOCSIS Load Balancing Groups (LBG) including RLBG/GLBG Support with DLB Support feature has the following restrictions:

- A maximum of 256 DOCSIS policies and 256 rules per chassis are supported.
- Cross-line card (LC) configuration or moving of cable modems is not supported.
- When deployed with channel restriction features, if the target upstream channel attribute masks are against that of the cable modem, then the cable modem on the higher load upstream will not be load balanced, as the current load balancing moves cable modems only to the target upstream. However, cable modems that do not have an attribute mask can still be load balanced. You should consider the following while deploying the load balancing groups: the target upstream will always be the upstream that has the lowest load. If some other upstreams have the same load, the upstream with the lowest index will be chosen as the target upstream.
- We recommend all LBGs that share channels must use the same LB method.

The DOCSIS LBG with RLBG/GLBG Support and DLB Support feature have the following cross functional restrictions:

- Cable modems operating in the multiple transmit channel (MTC) mode do not register for a RLBG assignment, even if their configuration file contains relevant TLVs, such as STID and LBG ID. However, cable modems operating in the multiple receive channel (MRC) can register for a RLBG assignment.
- The Cisco CMTS can parse a specific TLV encoded in cable modem configuration file, and prohibit any DCC operation on the cable modems.
- DOCSIS MAC domain downstream service group (MD-DS-SG) channels in MDD messages are incorrect when a combination of channels from multiple line card types are placed in the same fiber node.

In a complex fiber node setup, with channels from more than one line card, or downstream channels of one MAC domain in more than one fiber node, some modems may not come w-online (wideband online). If a MAC domain has more than one MD-DS-SG, the MDD will contain more than one MD-DS-SG and cause the modem to perform downstream ambiguity resolution. When the modem analyzes the downstream channels from the other line card, it will not see MDD packets and disqualify the channel and the MD-DS-SG. The modem then sends a requested MD-DS-SG of 0 to the CMTS implying it will not participate in a bonding group.

Use the **show cable mac-domain downstream-service-group** command to see the channels in the same MD-DS-SG.

The DOCSIS LBG with RLBG/GLBG Support and DLB Support feature have the following scaling limitations:

- The total number of RLBGs and DOCSIS 2.0 GLBGs cannot exceed 256.
- The total number of tags in a Cisco CMTS cannot exceed 256.
- The total number of DOCSIS 3.0 GLBGs is bounded by free memory.
- A cable modem reset occurs if a CM moves from one cable interface to another because DCC init-tech 0 resets a cable modem during a LB move. A cable modem also resets if the two cable interfaces have been configured with a mismatched **cable ip-init** command.

Information About DOCSIS Load Balancing Groups

The DOCSIS 2.0 "Autonomous Load Balancing" specification is CM-centric, allowing a channel (US or DS) to be part of multiple RLBGs. Therefore, with the DOCSIS 2.0 specifications, you can decide on which channel the CM can be load balanced.

To configure the Restricted/General Load Balancing and Narrowband Dynamic Bandwidth Sharing with Downstream Dynamic Load Balancing feature, you should understand the following concepts:

Service-Based Load Balancing

Using the DOCSIS 3.0 modem-based load balancing specifications, you can manage the LB activity on a per-modem basis as follows:

1. Modem to RLBG association through STID
2. Modem to RLBG association through LBG ID
3. Per-modem LB policy assignment
4. Per-modem LB priority assignment
5. Per-modem channel restriction

Implementing the DOCSIS 3.0 modem-based LB specifications enables the Cisco CMTS to provide an advanced service-based LB. The service-based LB can be used to alleviate the burden for the modem-based provisioning and provide the operator an ability to selectively control LB activity based on modem service type. For example, for LB purposes modems can be classified based on:

- Device type
- DOCSIS version
- Service class

The results of the classification can then be used to selectively control the modem LB activity by mapping the modem to the following settings:

- LBG
- Policy

With the service-based LB enabled, existing service-based cable modem segregation features and channel restriction become special cases and can be handled within the same LB framework.

Functionality

The Cisco CMTS functions in the following ways for general tagging and service-based LB:

- The Cisco CMTS can classify some modems with user-defined modem classifiers using the STID, service class name, DOCSIS version and capability TLVs and MAC Organization Unique Identifier (OUI).
- Each modem classifier has a unique tag. The Cisco CMTS allows each modem to carry one tag. When multiple tags match one cable modem, the tag that has the least index gets applied on the cable modems.
- The Cisco CMTS classifies a CM and assigns a tag, and if a RLBG with that tag is configured, the CM gets assigned to that RLBG.
- The Cisco CMTS can match multiple tags to a RLBG and a DOCSIS policy.
- On the Cisco CMTS, a user can configure whether the general tagging overrides the RLBG or DOCSIS policy assignment using TLVs in the CM configuration file and SNMP when a conflict occurs.
- When doing autonomous LB, the Cisco CMTS ensures that the target channels are available to a specific CM with regard to admission control, the SF attribute masks, and CM attribute masks.
- The user can configure the number of times that a DCC fails a CM before the CM is removed from dynamic LB on the Cisco CMTS.
- The user can configure DCC initialization techniques or whether to use Upstream Channel Change (UCC) for a LBG or for a particular source and target pair on the Cisco CMTS. However, DCC is not issued to cable modems provisioned in DOCSIS 1.0 mode. By default, the UCC for a LBG is not configured and therefore, all channel changes are done through DCC.
- The Cisco CMTS supports LB on at least one logical channel on a physical US channel that has multiple logical US channels.
- As per the DOCSIS 3.0 specifications, a lower load balancing priority indicates a higher likelihood that a CM will be moved due to load balancing operations.
- You can create a policy to set the lower bandwidth for CMs. the LBG can only move cable modems with throughput that is above the threshold.

Compatibility

Both downstream and upstream autonomous load balancing is supported for single channel cable modems.

RLBG/GLBG Assignment

The user can configure one or more service type IDs for each RLBG. The user can also configure the Cisco CMTS, using CLI or SNMP, to restrict a particular cable modem to a certain STID and RLBG ID. However, if such a configuration is made, both the STID and RLBG ID in the configuration file are ignored by the Cisco CMTS.

When the STID is configured by CLI or SNMP or the STID is present in the cable modem configuration file, the Cisco CMTS selects an upstream and downstream channel, which offers the signaled service type, from a RLBG, if such channels exist. However, if an upstream and downstream channel do not exist that provide the signaled service type the Cisco CMTS assigns an upstream and downstream channel that does not offer the signaled service type.

When the LBG ID is configured by CLI or SNMP or the LBG ID is present in the cable modem configuration file, the Cisco CMTS examines the available choices for upstream and downstream channels and, if they include a channel pair associated with the signaled LBG, the Cisco CMTS assigns the cable modem to the signaled LBG. If these conditions are not met, the Cisco CMTS disregards the LBG ID.

If there are multiple upstream and downstream channels available that meet the requirements of the STID, if present, and the LBG ID, if present, the Cisco CMTS selects an upstream and/or downstream channel that meet the cable modem required and forbidden attribute masks requested in the configuration file. If upstream and downstream channels are not available that meet these criteria, the Cisco CMTS can disregard the cable modem attribute masks and select an alternative upstream and/or downstream channel.

In determining a target channel pair for a cable modem during registration time, the Cisco CMTS tries to find the target channel pair that can actually reach the cable modem by checking the current channel pair, the MD-DS-SG-ID (Media Access Control Domain Downstream Service Group Identifier) of cable modem (CM-DS-SG-ID) and the MD-US-SG-ID (Media Access Control Domain Upstream Service Group Identifier) of cable modem (CM-US-SG-ID), if present, and fiber node (FN) configurations. If the target channel pair is available to the cable modem and is different from the current channel pair, the Cisco CMTS is required to move the CM by means of DCC technique 0 or downstream frequency override (DFO).

When the Cisco CMTS identifies multiple candidate RLBGs for a CM, but cannot determine which fiber node configuration the cable modem is actually wired to, or cannot determine if the wired RLBG is unusable (when interfaces in the load balance group are disabled or in an administratively down state), the Cisco CMTS assigns the cable modem to the RLBG with the lowest group index. This assignment causes the Cisco CMTS to attempt to move the cable modem to interfaces it is not physically connected to, resulting in service outages for the CM.

The Cisco CMTS enforces fiber node checking during RLBG assignment.

The Cisco CMTS follows the following RLBG assignment rules:

- If there is no fiber node configuration, there is no change in the candidate RLBG list. However, if the fiber node is configured, the fiber node must be configured correctly to reflect the real fiber node connection.
- If the cable modem is inside a fiber node, only those RLBGs that are inside that fiber node are selected.
- If the cable modem is not inside any fiber node, that is, the fiber node configuration does not cover all the channels, only those RLBGs that are not inside any fiber node are selected.
- If an RLBG spans across multiple fiber nodes, it is not considered to be inside any fiber node.
- If no candidate RLBG is found, cable modems are assigned to the GLBG, if the GLBG exists.

Channel Assignment

For cable modems operating in MRC mode, the registration request message can have multiple TLVs to influence the selection of upstream and downstream channels that the Cisco CMTS assigns. To avoid conflicts between the multiple TLVs, the Cisco CMTS follows the precedence order defined below:

1. TLV 56—Channel Assignment
2. TLV 43.11—Service Type Identifier
3. TLV 43.3—Load Balancing Group ID
4. TLVs 24/25.31-33—Service Flow Attribute Masks
5. TLV 43.9—CM Attribute Masks

The Cisco CMTS must follow this TLV precedence order for cable modems not operating in MRC mode:

1. TLV 43.11—Service Type Identifier
2. TLV 43.3—Load Balancing Group ID
3. TLV 43.9—CM Attribute Masks
4. TLVs 24/25.31-33—Service Flow Attribute Masks

Note When a target for the new receive channel configuration (RCC) and Transmit channel configuration (TCC) is selected, ensure that the service level for cable modems is not decreased. Target total RCCs and TCCs must not be less than the source total RCCs and TCCs so that cable modems can keep their service level unchanged. This may cause some unbalanced results when high capacity cable modems come online, later releases..

The Cisco CMTS also considers the DOCSIS 3.0 cable modem capabilities defined in the registration request message and assigns the maximum number of channels that the CM requests.

The tables below define the load balancing matrix for RLBG and GLBG assignment:

Table 2: RLBG Assignment for DOCSIS Cable Modems

Operational Mode	**MAC Version**				
	DOCSIS 3.0 CM	**DOCSIS 2.x CM**	**DOCSIS 2.0 CM**	**DOCSIS 1.1 CM**	**DOCSIS 1.0 CM**
Non-MRC mode (online)	Assigned	Assigned	Assigned	Assigned	Assigned
MRC mode only (w-online)	Assigned	Assigned	Assigned	NA	NA
MRC/MTC mode (UB-online)	Assigned	NA	NA	NA	NA
	DOCSIS 3.0 cable modems are assigned to the DOCSIS 3.0 RLBG	NA	NA	NA	NA

Table 3: GLBG Assignment for DOCSIS Cable Modems

Operational Mode	**MAC Version**				
	DOCSIS 3.0 CM	**DOCSIS 2.x CM**	**DOCSIS 2.0 CM**	**DOCSIS 1.1 CM**	**DOCSIS 1.0 CM**
Non-MRC mode (online)	Assigned to the DOCSIS 2.0 GLBG without MD-DS-SG-ID/MD-US-SG-ID				
	Assigned to the DOCSIS 3.0 GLBG with MD-DS-SG-ID/MD-US-SG-ID		NA	NA	NA
MRC mode only (w-online)	Assigned to the DOCSIS 2.0 GLBG without MD-DS-SG-ID/MD-US-SG-ID				
	Assigned to the DOCSIS 3.0 GLBG with MD-DS-SG-ID/MD-US-SG-ID		NA	NA	NA
MRC/MTC mode (UB-online)	Assigned	NA	NA	NA	NA
	DOCSIS 3.0 cable modems are assigned to the DOCSIS 3.0 GLBG	NA	NA	NA	NA

The tables below give a snapshot view of the load balancing methods and the operations used to "move" bonded and non-bonded CMs.

Table 4: Load Balancing Method to Move Bonded and Non-bonded cable modems

Modem Mode	Dynamic Service Charge (Initialization Technique)	
	Within MAC Domain	**Across MAC Domains**
DOCSIS 3.0 cable modems in MTC mode	NA	DCC initialization technique 0
DOCSIS 3.0/DOCSIS 2.x cable modems in MRC-only mode	DCC initialization technique 0 **Note** CM with primary DS outside RLBG moves inside RLBG with DOCSIS 2.0 LB.	DCC initialization technique 0
DOCSIS 3.0 cable modems in MRC-only mode	DCC **Note** CM outside RLBG moves inside RLBG with DOCSIS 2.0 LB.	DCC initialization technique 0
DOCSIS 2.x cable modems in MRC-only mode	DCC/UCC **Note** CM outside RLBG moves inside RLBG with DOCSIS 2.0 LB.	DCC initialization technique 0
DOCSIS 2.0 /DOCSIS 1.1 cable modems in NB mode	DCC **Note** CM outside RLBG moves inside RLBG with DOCSIS 2.0 LB.	DCC initialization technique 0
	UCC **Note** CM outside RLBG moves inside RLBG with DOCSIS 2.0 LB.	UCC
DOCSIS 1.0 in NB mode	Force reinitialize CM **Note** CM outside RLBG moves inside RLBG with DOCSIS 2.0 LB.	Force reinitialize CM
	UCC **Note** CM outside RLBG moves inside RLBG with DOCSIS 2.0 LB.	UCC

Table 5: Using DCC/DBC to Load Balance Bonded and Non-bonded Cable Modems

Channel	CM in MRC, non-MTC Mode	DOCSIS 1.1/DOCSIS 2.0 cable modems with Single US/DS	DOCSIS 1.0 cable modems with Single US/DS
Upstream (US)	DCC	DCC	UCC

Channel	CM in MRC, non-MTC Mode	DOCSIS 1.1/DOCSIS 2.0 cable modems with Single US/DS	DOCSIS 1.0 cable modems with Single US/DS
Downstream (DS)	NA (within the same MAC domain)	DCC (within the same MAC domain).	Force reinitialize CM
	DCC with initialization technique 0 when moving cable modems across MAC domains.	DCC with initialization technique 0 when moving cable modems across MAC domains.	Force reinitialize CM

Error Handling of Channel Assignment

This restriction is modified. As long as the interface state of the channels is not "administratively down", all channels are available for LBG assignment. For other load balancing operations, such as moving modems using DCC, UCC, or DBC, the interface state of the channels should be in "initial", "up", "suspicious", or "testing" states.

The following conditions apply when an LBG is disabled:

- cable modems that match all load balancing criteria can be assigned to an LBG.
- cable modem moves for load balancing are disabled, but cable modem moves from outside of the LBG to inside of the LBG are allowed.

Upstream Load Balancing for DOCSIS 3.0 Cable Modems in Single Upstream Mode

The upstream load balancing functionality enables the Cisco CMTS router to effectively handle upstream traffic for wideband and narrowband cable modems that are in single upstream mode. Single upstream mode (Mx1) means that the modems cannot send upstream traffic on multiple upstream channels. In the event of traffic overload on a single upstream channel of a wideband or narrowband cable modem, the Cisco CMTS router automatically moves the cable modem to another upstream channel in the same load balancing group.

Note A cable modem operating in single upstream mode is assigned to a load balancing group based on the primary channel of the modem. A cable modem in single upstream mode can support multiple receive channel (MRC) mode or narrowband mode. However, a cable modem in single upstream mode cannot support multiple transmit channel mode (MTC).

Auto-generate DOCSIS 2.0 GLBG

Cisco CMTS does not automatically implement DOCSIS 2.0 GLBG. DOCSIS 2.0 GLBG is configured manually after a new fiber node - MAC domain (FN-MD) pair is added.

This enhancement to automatically generate DOCSIS 2.0 GLBG after adding a new FN-MD pair and resolving a new combination of MAC domain, cable modem, and service group (MD-CM-SG). This enhancement is implemented through a new command **cable load-balance d20 GLBG auto-generate**. The command has options to renew and update DOCSIS 2.0 GLBGs for a fiber node configuration.

Independent Upstream/Downstream Throughput Rules

Currently, during upstream or downstream load balancing, to move modems in load balancing operations, Cisco CMTS applies the DOCSIS policy throughput rules to both upstream and downstream throughput to upstream or downstream load balancing operations. In other words, for downstream load balancing, both upstream and downstream sets of rules are applied and similarly for upstream load balancing both set of rules are applied. This prevents movement of modems with low upstream or high downstream throughput and high upstream or low downstream throughput.

Upstream or downstream throughput rules are checked independently to corresponding upstream or downstream load balancing operations. During upstream load balancing, only upstream throughput rules are checked, and during downstream load balancing, only downstream throughput rules are checked.

The following important points are implemented for independent upstream/downstream throughput rules:

- If DOCSIS 2.0 load balancing policy configured is **us-across-ds**, it is recommended to configure a maximum of 16 downstream channels and 8 upstream channels.
- If a load balancing operation involves a change only in the downstream channel of a cable modem without any change to the upstream channel, then only the downstream lower boundary rules are checked.
- If a load balancing operation involves a change only in the upstream channel of a cable modem without any change to the downstream channel, then only the upstream lower boundary rules are checked.
- If a load balancing operation involves a change in both the upstream and downstream channels of a cable modem, then the modem rule check must pass all the rules for that (upstream or downstream) load balancing.
- If the load balancing policy configured is **pure-ds-load**, then only the downstream rules are checked.
- If the load balancing policy configured is **us-across-ds** or both **us-across-ds** and **pure-ds-load**, then two types of target interfaces occur as follows:
  - Local interface—where the cable modem shares the upstream with the source. Only downstream load balancing operation occurs.
  - Remote interface—where the the cable modem does not share the upstream with the source. The upstream/downstream load balancing is triggered by upstream load.

  If the load balancing policy configured is neither us-across-ds nor pure-ds-load, then the load balancing is done based on Mac domain load.

How to Configure DOCSIS Load Balancing Groups

The Restricted/General Load Balancing and Narrowband Dynamic Bandwidth Sharing with Downstream Dynamic Load Balancing feature can be configured as follows:

- A user can configure a DOCSIS 2.0 general load balancing group (GLBG) on the Cisco CMTS according to DOCSIS specification. The Cisco CMTS creates a DOCSIS 3.0 GLBG for each Media Access Control Domain Cable Modem Service Group (MD-CM-SG) automatically and checks whether the GLBG contains both upstream and downstream channels.
- A cable modem that is not provisioned to any RLBG and cannot resolve its MD-CM-SG gets assigned to a DOCSIS 2.0 GLBG. However, if the cable modem resolves its MD-CM-SG, it gets assigned to a DOCSIS 3.0 GLBG.

- A user can configure RLBGs and any upstream or downstream channel into multiple RLBGs on the Cisco CMTS. The Cisco CMTS checks whether a RLBG contains both upstream and downstream channels. A RLBG can cross multiple MDs.
- A backward compatibility with existing Cisco LB schemes is maintained. The users can switch between the old and new DOCSIS 3.0 compliant LB schemes.

Note When the Cisco IOS system is upgraded, if the docsis-policy configuration of the DOCSIS load balancing groups, is missing in the output of the **show running-config** command, apply the docsis-policy to the DOCSIS load balancing groups using the **docsis-policy** *policy-id* command again.

The following sections describe how to create and configure DOCSIS load balancing groups to enable DOCSIS load balancing on the Cisco CMTS:

Configuring DOCSIS 3.0 and 2.0 RLBG and DOCSIS 2.0 GLBG

This section describes how to create and configure a DOCSIS load balancing group. There is a separate configuration mode for a DOCSIS load balancing group that is different from the legacy load balancing group.

Note UGS/PCMM policy and threshold do not apply on DOCSIS 3.0 LB.

Procedure

	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 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 docsis-group** *docsis-group-id* **Example:**	Creates a DOCSIS load balance group on the Cisco CMTS, with the following parameter:

	Command or Action	Purpose
	`Router(config)# cable load-balance docsis-group 1`	The router enters DOCSIS load balancing group configuration mode.
Step 5	**init-tech-list** *tech-list* [**ucc**] **Example:** `Router(config-lb-group)# init-tech-list 1 ucc`	Sets the DCC initialization techniques that the Cisco CMTS can use to load balance cable modems.
Step 6	**downstream** {**Cable** {*slot/subslot/port* | *slot/port*} | **Integrated-Cable** {*slot/subslot/bay* | *slot/port*} {**rf-channel** *group list*}|{| *slot/port*} {**rf-channel** *group list*}} **Example:** `Router(config-lb-group)# downstream integrated-Cable 5/0/0 rf-channel 2`	Sets the downstream RF channels.
Step 7	**upstream Cable** {*slot/subslot/port* | *slot/port*} *upstream-list* **Example:** `Router(config-lb-group)# upstream Cable 1/0 2`	Sets upstream channels with the following parameters:
Step 8	**docsis-policy** *policy-id* **Example:** `Router(config-lb-group)# docsis-policy 0`	Assigns a policy to a group with the parameter that becomes the default policy assigned to the CM, if the CM does not choose a different policy.
Step 9	**restricted** **Example:** `Router(config-lb-group)# restricted`	Selects the restricted group type. By default, the general group type is selected.
Step 10	**init-tech-ovr Cable** {*slot/subslot/port* | *slot/port*} *upstream* **Cable** {*slot/subslot/port* } | *slot/port upstream* **init-tech-list** *0-4* [**ucc**] **Example:** `Router(config-lb-group)# init-tech-ovr Cable 8/1/0 0 Cable 8/1/1 1 init-tech-list 1 ucc`	Sets DCC initialization techniques that overrides the physical upstream channel pair. The **init-tech-ovr** command can also be used to determine whether the UCC can be used for modems during dynamic upstream load balancing. The following parameters override the physical upstream channel pair: **Note** The **init-tech-list** keyword accepts an upstream that is not added into the load balancing group. The upstream

	Command or Action	Purpose
		channel pair is invalid until the upstream is added. When the load balancing group is removed, all upstream channel pairs are also removed.
Step 11	**service-type-id** *string* **Example:** `Router(config-lb-group)# service-type-id commercial`	Adds a service type ID, with the following parameter, that is compared against the cable modem provisioned service type ID, to determine an appropriate restricted load balancing group (RLBG):
Step 12	**tag** *tag name* **Example:** `Router(config-lb-group)# tag t1`	Adds a tag to the RLBG.
Step 13	**interval** *<1-1000>* **Example:** `Router(config-lb-group)# interval 60`	Sets the time interval, the Cisco CMTS waits before checking the load on an interface.
Step 14	**method** {**modems** | **service-flows** | **utilization**} {**us-method** {**modems** | **service-flows** | **utilization**}} **Example:** `Router(config-lb-group)# method modems us-method modems`	Selects the method the Cisco CMTS use to determine the load.

Step 15	**policy** {**pcmm** | **ugs** | **us-across-ds** | **pure-ds-load**}
	Example:
	`Router(config-lb-group)# policy us-across-ds`
	`Router(config-lb-group)# policy ugs`
	`Router(config-lb-group)# policy pure-ds-load`
		Selects the modems based on the type of service flow that are balanced.

Step 16	**threshold** {**load** {**minimum** *<1-100>* | *<1-100>*}| **pcmm** *<1-100>* | **stability** *<0-100>* | **ugs** *<1-100>*}
	Example:
	`Router(config-lb-group)# threshold load minimum 10`
	`Router(config-lb-group)# threshold pcmm 70`
	`Router(config-lb-group)# threshold load 10`
	`Router(config-lb-group)# threshold stability 50`
	`Router(config-lb-group)# threshold ugs 70`
		Selects the percentage of use beyond which load balancing occurs.

	Command or Action	Purpose
Step 17	**exit** **Example:** `Router# exit`	Exits DOCSIS LBG configuration.

Configuring DOCSIS 3.0 GLBG

The following sections describe how to configure a DOCSIS 3.0 GLBG and also how to configure default values of DOCSIS 3.0 certification for the DOCSIS 3.0 general group:

Note If a Cable interface on the line card is in "no shut down" state, the associated DOCSIS 3.0 GLBGs are restored in the running-configuration.

Configuring a DOCSIS 3.0 General Load Balancing Group

This section describes how to configure a DOCSIS 3.0 general load balancing group.

Procedure

	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 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 docsis-group FN** *fn-id* **MD** *cable* {*slot/subslot/port* | *slot/port*} **Example:** `Router(config)# cable load-balance docsis-group FN 1 MD c5/0/0`	Enters the DOCSIS load balancing group configuration mode.
Step 5	**init-tech-list** *tech-list* [**ucc**] **Example:** `Router(config-lb-group)# init-tech-list 1 ucc`	Sets the DCC initialization technique list, with the following parameters.

	Command or Action	Purpose
Step 6	**disable** **Example:** `Router(config-lb-group)# disable`	Disables the load balance group.
Step 7	**docsis-policy** *policy-id* **Example:** `Router(config-lb-group)# docsis-policy 0`	Sets the load balance group policy.
Step 8	**interval** *1-1000* **Example:** `Router(config-lb-group)# interval 10`	Sets the interface polling interval.
Step 9	**method** {**modems** | **service-flows** | **utilization**} {**us-method** {**modems** | **service-flows** | **utilization**}} **Example:** `Router(config-lb-group)# method modems us-method modems`	Sets the load balancing type or method.
Step 10	**policy** {**pcmm** | **ugs** | **us-across-ds** | **pure-ds-load**} **Example:** `Router(config-lb-group)# policy us-across-ds`	Sets load balancing policy.
Step 11	**threshold** {**load** {**minimum** *1-100* | *1-100*} | **pcmm** *1-100* | **stability** *0-100* | **ugs** *1-100*} **Example:** `Router(config-lb-group)# threshold pcmm 70`	Sets the load balancing threshold in percentage.
Step 12	**exit** **Example:** `Router# exit`	Exits the DOCSIS load balancing group configuration mode.

Configuring Default Values of DOCSIS 3.0 Load Balancing Group

This section describes how to configure default values of DOCSIS 3.0 certification for a DOCSIS 3.0 general group on the Cisco CMTS. A DOCSIS 3.0 general group is automatically created for each MD-CM-SG derived from the fiber node (FN) configuration, and the group parameters are set as default values.

Note The configured default values of DOCSIS 3.0 certification are applicable to the new automatically created DOCSIS 3.0 GLBGs and do not affect the existing DOCSIS 3.0 GLBGs. When a DOCSIS 3.0 GLBG is removed and recreated, its group parameters do not change.

Note The default settings for interface polling interval, load balancing method, policy for modems selection, and threshold usage in percent, can be configured for DOCSIS 3.0 general group. For more information, see the Cisco IOS Cable Command Reference.

Procedure

	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 load-balance d30-ggrp-default disable** **Example:** `Router(config)# cable load-balance d30-ggrp-default disable`	Disables the default values of the DOCSIS 3.0 general load balance group (GLBG).
Step 4	**cable load-balance d30-ggrp-default init-tech-list** *tech-list* **Example:** `Router(config)# cable load-balance d30-ggrp-default init-tech-list 1`	Sets the default DOCSIS 3.0 GLBGs DCC and dynamic bonding change (DBC) initialization techniques.
Step 5	**cable load-balance d30-ggrp-default docsis-policy** *0-0xffffffff* **Example:** `Router(config)# cable load-balance d30-ggrp-default docsis-policy 2`	Sets the default DOCSIS 3.0 GLBGs policy ID.
Step 6	**exit** **Example:** `Router# exit`	Exits the global configuration mode.

Configuring Cable Modems to RLBG or a Service Type ID

This section shows how to configure a list of cable modems that are statically provisioned at the Cisco CMTS to a RLBG or a service type ID.

Procedure

	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 load-balance restrict modem** *index mac-addr* [*mac-mask*] {**docsis-group** *docsis-group-id* | **service-type-id** *string*} **Example:** `Router(config)# cable load-balance restrict modem 1 001a.c30c.7eee FFFF.FFFF.0000 docsis-group 100`	Assigns a modem or a group of modems with a common MAC mask to a load balancing group or a service type ID.
Step 4	**exit** **Example:** `Router# exit`	Exits the global configuration mode.

Configuring Rules and Policies

This section shows how to create and configure rules and DOCSIS policies to restrict the movement of modems during load balancing. Rules determine whether a modem can be moved and during which time periods. The time periods are measured in seconds with the start time being an offset from midnight measured in seconds. Rules are created individually and can be combined into policies. The user is able to create DOCSIS policies that consist of one or more rules. When more than one rule is part of a DOCSIS policy, all rules apply. Each group has a default DOCSIS policy.

Procedure

	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 load-balance rule** *rule-id* **Example:**	Creates a rule to prevent the modem from being moved.

	Command or Action	Purpose
	`Router(config)# cable load-balance rule 1`	
Step 4	**cable load-balance rule** rule-id {**enabled** | **disabled** | {**disable-period dis-start** *0-86400* **dis-period** <*0-86400*>**} | disable-throughput-lowerbound ds** | **us** *thrupt in kbps* | **vdoc-enabled}** **Example:** `Router(config)# cable load-balance rule 1 disable-period dis-start 40 dis-period 50`	Configures the rule. **Note** Static multicast groups should be configured on the appropriate bundle interface as well as on the correct forwarding interfaces to enable this rule. This feature will not be supported on load balancing groups which are derived from fiber node configuration and with multicast encryption.
Step 5	**cable load-balance docsis-policy** *policy-id* **rule** *rule-id* **Example:** `Router(config)# cable load-balance docsis-policy 2 rule 1`	Associates a particular rule with the DOCSIS policy with the following parameters:
Step 6	**exit** **Example:** `Router# exit`	Exits the global configuration mode.

Troubleshooting Tips

Problem When you disable load balancing and enable it for the next day using the **cable load-balance rule** *rule-id* **disable-period dis-start** *start-time* **dis-period** *disable-period* command, the load balancing is enabled at 12.00 am instead of the configured *disable-period*.

Possible Cause Load balancing rule cannot be disabled and enabled on the next day (that is, after 24 hours) using a single load balancing rule.

Solution Configure separate load balancing rules for disabling load balancing and enabling it on the next day. Configure the rule to disable load balancing using the **cable load-balance rule** *rule-id* **disable-period dis-start** *start-time* **dis-period 0** command. Configure the rule to enable load balancing using the **cable load-balance rule** *rule-id* **disable-period dis-start 0 dis-period** *disable-period* command to enable it for the next day.

Configuring Load Balancing Parameter for a Cable Modem Movement Failure

This section describes how to configure the number of times a CM can fail before the CM is removed from the dynamic load balancing group.

Procedure

	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 modem max-failures** *0-100* **Example:** `Router(config)# cable load-balance modem max-failures 10`	Configures the number of times a CM can fail before the CM is removed from the dynamic load balancing group.
Step 4	**exit** **Example:** `Router# exit`	Exits the global configuration mode.

Creating and Configuring TLV type Tag

The tags for TLV type matching rule are created and configured in this section.

Procedure

	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 tag** *1-1000* **Example:** `Router(config)# cable tag 1`	Creates a tag. Enters the cmts-tag configuration mode.
Step 4	**name** *tag name* **Example:** `Router(cmts-tag)# name CSCO`	Specifies the name of the tag.
Step 5	[**exclude**] **service-type-id** *service-type-id* **Example:** `Router(cmts-tag)# service-type-id HSD`	Configures the specified service type ID for the tag.
Step 6	[**exclude**]**service-class** *service-class-name* **Example:** `Router(cmts-tag)# service-class work`	Configures the specified service class name for the tag.

	Command or Action	Purpose
Step 7	[**exclude**] **docsis-version** *docsis version* **Example:** `Router(cmts-tag)# docsis-version docsis20`	Configures the specified DOCSIS version of the cable modem for the tag.
Step 8	**[exclude] oui** *oui of CM* **Example:** `Router(cmts-tag)# oui 00.1a.c3`	Configures the specified OUI of the cable modem for the tag.
Step 9	[**exclude**] **tlv** *type value* **Example:** `Router(cmts-tag)# tlv mrcs 4`	Configures the specified TLV type for the tag.
Step 10	**override** **Example:** `Router(cmts-tag)# override`	Overrides the TLV or SNMP during load balancing an RLBG.
Step 11	**exit** **Example:** `Router(cmts-tag)# exit`	Exits the cmts-tag configuration mode.
Step 12	**cable load-balance docsis-group** *docsis-group-id* **Example:** `Router(config)# cable load-balance docsis-group 1`	Creates a DOCSIS load balancing group on the Cisco CMTS. If the DOCSIS load balancing group is already present, the router enters the specified DOCSIS load balancing group configuration mode.
Step 13	**tag** *tag name* **Example:** `Router(config-lb-group)# tag CSCO`	Adds a tag to the load balancing group.
Step 14	**exit** **Example:** `Router(config-lb-group)# exit`	Exits the DOCSIS load balancing group configuration mode.
Step 15	**cable load-balance docsis-policy** *policy-id* **tag** *tag name* [**override**] **Example:** `Router(config)# cable load-balance docsis-policy 2 tag CSCO`	Creates a DOCSIS policy and associates a new rule or an existing rule with the policy.
Step 16	**exit** **Example:** `Router# exit`	Exits the global configuration mode.

Configuration Examples for DOCSIS Load Balancing Groups

This section describes a sample configuration example for configuring DOCSIS Load Balancing Groups including Restricted/General Load Balancing and downstream dynamic load balancing:

Example: Configuring a Tag

The following example shows how you can configure the tag to exclude a DOCSIS version, a MAC address, a service class name or a service type ID:

```
Router# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)# cable tag 1
Router(cmts-tag)# exclude ?
  docsis-version   set the match rule for docsis version
  oui              set the match rule for oui
  service-class    set the match rule for service class name
  service-type-id  set the match rule for service type id
Router(cmts-tag)# exclude docsis-version ?
  docsis10  Match docsis 1.0 modems
  docsis11  Match docsis 1.1 modems
  docsis20  Match docsis 2.0 modems
  docsis30  Match docsis 3.0 modems
Router(cmts-tag)# exclude docsis-version docsis10
Router(cmts-tag)# exclude oui ?
  WORD  OUI of the vendor in the format xx.xx.xx or xx:xx:xx
Router(cmts-tag)# exclude oui 00.1a.c3
Router(cmts-tag)# exclude service-class ?
  WORD  Service class name
Router(cmts-tag)# exclude service-class work
Router(cmts-tag)# exclude service-type-id ?
  WORD  Service Type ID
Router(cmts-tag)# exclude service-type-id commercial
```

Example: Disabling Load Balancing

Use the following commands to disable DOCSIS 3.0 GLBG:

```
Router(config)# cable load-balance docsis-group FN 1 MD cable 6/0/0
Router(config-lb-group)# disable
Router(config-lb-group)#
```

Use the following commands to disable DOCSIS 3.0 RLBG:

```
Router(config)# cable load-balance docsis-group 1
Router(config-lb-group)# disable
Router(config-lb-group)#
```

How to Configure Load Balancing with Operational Simplification

To configure Load Balancing Groups with Operational Simplification, complete the following steps:

SUMMARY STEPS

1. Define the global common Load Balancing profile. Specify the Load Balancing Group configure: method, interval, threshold, policy, and so on.
2. Define the Load Balancing Group under service-group profile. Associate the Load Balancing profile with Load Balancing group. Configure the DS and US channels.
3. Define the physical mapping info for US or DS channels under fiber-mode.
4. Define the service-group profile under Fiber-node.

DETAILED STEPS

Procedure

	Command or Action	Purpose

Step 1	Define the global common Load Balancing profile. Specify the Load Balancing Group configure: method, interval, threshold, policy, and so on.
	Example:
	`cable profile load-balance lb_1`
	`disable`
	`method utilization primary-distributed us-method utilization`
	`threshold load 2`
	`policy pcmm`
	`interval 1`	

Step 2	Define the Load Balancing Group under service-group profile. Associate the Load Balancing profile with Load Balancing group. Configure the DS and US channels.
	Example:
	`cable profile service-group sg`
	`load-balance docsis-group 0 profile lb_1`
	`downstream sg-channel 0-7`
	`upstream 0 sg-channel 0`
	`upstream 1 sg-channel 1`	

Step 3	Define the physical mapping info for US or DS channels under fiber-mode. **Example:** `cable fiber-node 1`	

	Command or Action	Purpose
	downstream sg-channel 0 15 downstream-Cable 6/0/0 rf-channel 0 15 upstream sg-channel 0 3 Upstream-Cable 6/0/0 us-channel 0 3	
Step 4	Define the service-group profile under Fiber-node. **Example:** cable fiber-node 1 service-group profile sg	

The Load Balancing Groups are auto-generated when the SG profile is applied.

Example

An example of the Load Balancing Groups Operational Simplification configuration, **show run** as is as follows:

```
cable profile load-balance lb
 method utilization primary-distributed us-method utilization
 threshold load 22
 threshold load lcmm 33
 policy lcmm
 policy pure-ds-load
 init-tech-list 1-3

cable profile service-group sg
    load-balance docs is-group 0 profile lb
    downstream sg-channel  0  15
    upstream 0  sg-channel  0
    upstream 1  sg-channel  1
    upstream 2  sg-channel  2
    upstream 3  sg-channel  3
load-balance docsis-group 2 profile RLBG_STB
     downstream sg-channel 0-3 8-11
     upstream 0 sg-channel  0

cable fiber-node 1
 downstream Downstream-Cable 6/0/0
 upstream Upstream-Cable 6/0/0
 downstream sg-channel 0 15 downstream-Cable downstream-Cable 6/0/0 rf-channel 0 15
        upstream sg-channel 0 3 Upstream-Cable 6/0/0 us-channel 0 3
 service-group profile sg
```

An example of the Load Balancing Groups Operational Simplification configuration, **show derived** as is as follows:

```
cable profile load-balance lb
 method utilization primary-distributed us-method utilization
 threshold load 22
 threshold load lcmm 33
 policy lcmm
 policy pure-ds-load
 init-tech-list 1-3

Cable profile service-group sg
```

```
   Load-balance docsis-group 0 profile lb
  downstream sg-channel  0  15
    upstream 0  sg-channel  0
    upstream 1  sg-channel  1
    upstream 2  sg-channel  2
    upstream 3  sg-channel  3
load-balance docsis-group 2 profile RLBG_STB
     downstream sg-channel 0-3 8-11
     upstream 0 sg-channel  0

Cable fiber-node 1
 downstream Downstream-Cable 6/0/0
 upstream Upstrea-CAble 6/0/0
 downstream sg-channel 0 15 downstream-Cable 6/0/0 rf-channel 0 15
 upstream sg-channel 0 3 Upstream-Cable 6/0/0 us-channel 0 3
 service-group profile sg

Cable load-balance docsis-group 2
 restricted
 downstream Downstream-Cable 6/0/0/ rf-channel 0 15
 upstream Upstream-Cable 6/0/0 us-channel 0-3
 method utilization primary-distributed
 threshold load 22
 threshold pcmm 33
 policy lcmm
 policy pure-ds-load
 init-tech-list 1-3
 cable managed fiber-node 1
 cable load-balance-profile lb
 cable load-balance docsis-group 3
 restricted
 downstream Downstream-Cable 6/0/0 rf-channel 0-3 8-11
Upstream Upstream-Cable 6/0/0 us-channel 0
Threshold load 55
Interval 5
Cable managed fiber-node 1
Cable load-balance-profile RLBG_STB
```

Load Balancing Groups with Operational Simplification

The Cisco IOS XE Gibraltar 16.10.1d supports simplified Load Balancing configuration in the Operational Simplification service group profile. Currently, CMTS supports auto creation of D30 GLBGs based on the existing configuration. Load Balancing would now support creation of RLBGs and D20 GLBGs.

Following are the salient features of the feature:

- For D20 GLBG created by Operational Simplification, the Group ID is in range [65024, 65535]. This follows legacy design.
- For RLBG created by Operational Simplification, the Group ID is related to the information of fiber-node id/us channel controller/docsis-group index in service group file. This also follows legacy range [1, 2147483647]. For example: RLBG ID: 12330208. Where '123' is the Fiber node ID, '302' is the Upstream-Cable 6/0/0, and '08' is the docsis-group index in service group profile.

```
cable profile service-group sg
  load-balance docsis-group 8 profile lb_1
  downstream sg-channel 0-7
```

```
upstream 0 sg-channel 0
upstream 1 sg-channel 1
```

- The default value of Load Balance profile are equal to the value of "cable load-balance d20-ggrp-default xxx".
- For Load Balancing Groups that are created by Operational Simplification, the user cannot configure them with CLI.
- For one service group profile, a user is only allowed to configure one GLBG load balance.
- A user can configure a maximum of 20 tags into one load balance profile.
- A user can configure a maximum of 15 service-type-ids into one load balance profile.
- Load Balancing Groups by Operational Simplification supports fly modification.
- For Load Balancing Groups created by Operational Simplification, if a user changes the option of Load Balance profile, the OPS would update all the related LBGs automatically. However, the user cannot change the type of LBGs.

For the Load Balaning Groups created by Operational Simplification, the configuration of the groups would not be dispalyed for the **show run** or the **show run all** commands. The Load Balancing Groups would only be displayed using the **derived** command. This change can simplify the running configuration.

```
clab-cbr-S11K01#show derived-config | sec cable load
cable load-balance docsis-group 1
restricted
downstream Downstream-Cable 6/0/0 rf-channel 0-7
upstream Upstream-Cable 6/0/0 us-channel 0-1
method utilization primary-distributed
threshold load 2
cable managed fiber-node 1
cable load-balance-profile lb_1
```

Verifying DOCSIS Load Balancing Groups

This section describes how to use certain show commands to verify the configuration of the Restricted/General Load Balancing and Narrowband Dynamic Bandwidth Sharing with Downstream Dynamic Load Balancing feature.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show cable load-balance docsis-group** {*docsis-group-id* | **FN** *fn-id* **MD cable** {*slot/subslot/port* | *slot/port*}} [**all** | **load** | **pending** | **statistics** | **target** | **modem-list** | **primary-load**]	Displays real-time configurational, statistical, and operational information of the load balancing operations on the router.

	Command or Action	Purpose

	Example:
	`Router# show cable load-balance docsis-group 1`
	`Router# show cable load-balance docsis-group fn 1 MD c8/1/4`	

Step 3	**show cable fiber-node** *fiber-node-id* [**spectrum**] **Example:** `Router# show cable fiber-node 3`	Displays information about a fiber node.
Step 4	**show cable load-balance** [**group** *n*] | [**all** | **load** | **pending** | **statistics** | **target** | **fiber-node-validation**] **Example:** `Router# show cable load-balance group 1`	Displays real-time statistical and operational information for load balancing operations. If given without any options, this command displays information for the load balancing groups and each cable interface's current load and load balancing status.
Step 5	**show cable modem** [*ip-address* | *mac-address* | **cable** *slot/port* [**upstream** *port*] | **name** *fqdn*] [*verbose*] **Example:** `Router# show cable modem 40.3.160.15 verbose`	Displays information for the registered and unregistered CMs.

Examples

Use the **show cable load-balance docsis-group** command to see the DOCSIS group status and to see the list of modems in the group, use the **show cable fiber-node** command to see the information on fiber nodes, use the **show cable load-balance** command to see information on LBG and DOCSIS channels, and use the **show cable modem** command to see the information on all the CMs.

The following examples show the output of the **show cable load-balance docsis-group** command:

```
Router# show cable load-balance docsis-group 2
DOCSIS LB Enabled: Yes
DOCSIS     Group Status Interval DCC mask  Policy     Method Threshold
Group      Index                /UCC                DS/US  M/E/U/P/S
2          82    RE 10       0xF8(0)/N 0          s/s    1/1/70/70/50
Router# show cable load-balance docsis-group 1 modem-list
US                    Group Index Mac Address      Priority
Mo1/0/0:0/U0          81          (1)
                                  0000.ca45.9898   0
Mo1/0/0:0/U1          81          (0)
Mo1/0/0:0/U2          81          (2)
                                  0013.711c.0820   0
                                  0016.924f.8300   0
```

The output of the **show cable load-balance docsis-group** command is modified to include an additional field MUPFXLR to display more status information on the modems in the DOCSIS groups. For more information, see the Cisco IOS Cable Command Reference.

The following example shows the modified output of the **show cable load-balance docsis-group** command:

```
Router#show cable load docsis-group fn 1 md c6/0/0 modem-list
Load for five secs: 1%/0%; one minute: 2%; five minutes: 1%
Time source is NTP, 13:39:31.300 PDT Thu Mar 28 2013
Codes: M - Multicast, U - UGS, P - PCMM, F - Max-Failures, X - eXcluded
       L - L2vpn, R - RSVP
Primary DS     Grp Idx MAC Address    RCC-ID Bad Rfid Priority MUPFXLR
In6/0/0:0/UB   40448   (6)
                       e448.c70c.98af 1              2        -------
                       e448.c70c.9b76 1              2        -------
                       e448.c70c.9c15 1              2        -------
                       e448.c70c.9a92 1              2        -------
                       e448.c70c.99e4 1              2        -------
                       e448.c70c.9a35 1              2        -------
In6/0/0:0/U0   40448   (0)
In6/0/0:0/U1   40448   (1)
                       e448.c70c.9915                2        -------
In6/0/0:0/U2   40448   (0)
In6/0/0:0/U3   40448   (0)
In6/0/0:1/UB   40448   (5)
                       e448.c70c.9abc 1              2        -------
                       e448.c70c.993f 1              2        -------
                       e448.c70c.9927 1              2        -------
                       e448.c70c.9b82 1              2        -------
                       4458.2945.2cb8 1              2        -------
In6/0/0:1/U0   40448   (0)
In6/0/0:1/U1   40448   (0)
In6/0/0:1/U2   40448   (0)
In6/0/0:1/U3   40448   (0)
In6/0/0:2/UB   40448   (5)
                       e448.c70c.9759 1              2        -------
                       e448.c70c.9a0e 1              2        -------
                       e448.c70c.992d 1              2        -------
                       e448.c70c.9a38 1              2        -------
                       0025.2ed9.9984 1              2        -----L-
In6/0/0:2/U0   40448   (0)
In6/0/0:2/U1   40448   (0)
In6/0/0:2/U2   40448   (0)
In6/0/0:2/U3   40448   (0)
In6/0/0:3/UB   40448   (5)
                       e448.c70c.9c00 1              2        -------
                       e448.c70c.99a5 1              2        -------
                       e448.c70c.9a5f 1              2        -------
                       e448.c70c.9a3b 1              2        -------
                       e448.c70c.96b1 1              2        -------
In6/0/0:3/U0   40448   (0)
In6/0/0:3/U1   40448   (0)
In6/0/0:3/U2   40448   (0)
In6/0/0:3/U3   40448   (0)
```

The following example shows the output of the **show cable fiber-node** command:

```
Router# show cable fiber-node
Fiber-Node         Config Status
Fiber-Node 1
       Modular-Cable 1/0/0:  0-1
    FN Config Status: Configured (status flags = 0x01)
    MDD Status: Valid
```

The following examples show the output of the **show cable load-balance** command:

```
Router#show cable load-balance
Group  Interval  Method        DCC Init   Threshold
                               Technique  Minimum  Static  Enforce  Ugs   PCMM
1      10        service-flows 1          1        2%      2%       ---   ---
2      10        modems        0          5        10%     ---      ---   ---

DOCSIS LB Enabled: No
Router# show cable load-balance load
Interface            State      Group  Utilization  Reserved Modems Flows Weight
                                Index
Cable5/0/3 (459 MHz) up         1      0%(0%/0%)       0%    7      7     37
Cable5/0/3/U0        up         1      0%              0%    2      2     1.2
Cable5/0/3/U1        up         1      0%              0%    2      2     1.2
Cable5/0/3/U2        up         1      0%              0%    2      2     1.2
Cable5/0/3/U3        up         1      0%              0%    1      1     1.2
Cable5/0/4 (465 MHz) up         1      0%(0%/0%)       0%    7      7     37
Cable5/0/4/U0        up         1      0%              0%    1      1     1.2
Cable5/0/4/U1        up         1      0%              0%    2      2     1.2
Cable5/0/4/U2        up         1      0%              0%    2      2     1.2
Cable5/0/4/U3        up         1      0%              0%    2      2     1.2
Mo1/0/0:0 (555 MHz)  down       1      0%(0%/0%)       0%    0      0     0
Router# show cable load-balance fiber-node-validation
DOCSIS LBG ID    Match    Channel    Fiber-node list
1                match    Ca5/0/0/U0 {1}
                          Ca5/0/0/U1 {1}
                          Ca5/0/0/U2 {1}
                          Ca5/0/0/U3 {1}
                          Mo1/0/0:0  {1}
                          Mo1/0/0:1  {1}
2                mismatch Ca5/0/0/U0 {1}
                          Ca5/0/0/U1 {1}
                          Ca5/0/0/U2 {1}
                          Ca5/0/0/U3 {1}
                          Ca5/0/0    {}
```

The following example shows the output of the **show cable modem** command:

```
Router# show cable modem 40.3.160.19 verbose
LB group ID assigned(index)         : 1(81)
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                                 :
```

DOCSIS 3.0 GLBG is generated dynamically by the fiber node configuration, if a valid fiber node is configured.

For example, if the fiber node configuration is:

```
cable fiber-node 2
 downstream Modular-Cable 1/0/0 rf-channel 0-3
 downstream Cable7/0/0
 upstream Cable 7/0 connector 0-3
!
```

The GLBG generated by this fiber node is similar to:

```
Router# show cable load-balance docsis-group fn 2 md cable 7/0/0
DOCSIS 3.0 General LB
MD       FN  Group S Intv DCC mask  Policy     Mtd MD-CM-SG Threshold
             Index        /UCC                 D/U          M/E/U/P/S
Ca7/0/0  2   48129 E 30   0xF8(0)/N 0          m/m 0x3C0101 5/10/70/70/50
```

```
Router# show cable load-balance docsis-group fn 2 md cable 7/0/0 all
DOCSIS 3.0 General LB
MD       FN  Group S Intv DCC mask  Policy     Mtd MD-CM-SG Threshold
             Index        /UCC                 D/U          M/E/U/P/S
Ca7/0/0  2   48129 E 30   0xF8(0)/N 0          m/m 0x3C0101 5/10/70/70/50
Current load:
DOCSIS load-balancing load
Interface            State   Group  Utilization Rsvd NBCM  WB/UB Flows Weight
                             Index                    Total Total
Cable7/0/0 (333 MHz) up      48129  0%(0%/0%)   0%   2     8     7     37
Cable7/0/0/U0        up      48129  0%          0%   22    7     29    7.6
Cable7/0/0/U1        up      48129  0%          0%   21    8     28    7.6
Cable7/0/0/U2        up      48129  0%          0%   21    8     28    7.6
Cable7/0/0/U3        up      48129  0%          0%   20    10    30    7.6
Mo1/0/0:0 (501 MHz)  up      48129  0%(0%/0%)   0%   2     63    2     36
Mo1/0/0:0/U0         up      48129  0%          0%   22    7     29    7.6
Mo1/0/0:0/U1         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:0/U2         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:0/U3         up      48129  0%          0%   20    10    30    7.6
Mo1/0/0:1 (507 MHz)  up      48129  0%(0%/0%)   0%   1     58    1     36
Mo1/0/0:1/U0         up      48129  0%          0%   22    7     29    7.6
Mo1/0/0:1/U1         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:1/U2         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:1/U3         up      48129  0%          0%   20    10    30    7.6
Mo1/0/0:2 (513 MHz)  up      48129  0%(0%/0%)   0%   2     59    2     36
Mo1/0/0:2/U0         up      48129  0%          0%   22    7     29    7.6
Mo1/0/0:2/U1         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:2/U2         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:2/U3         up      48129  0%          0%   20    10    30    7.6
Mo1/0/0:3 (519 MHz)  up      48129  0%(0%/0%)   0%   1     61    1     36
Mo1/0/0:3/U0         up      48129  0%          0%   22    7     29    7.6
Mo1/0/0:3/U1         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:3/U2         up      48129  0%          0%   21    8     28    7.6
Mo1/0/0:3/U3         up      48129  0%          0%   20    10    30    7.6
Target assignments:
Interface            State      Group   Target
                                Index
Cable7/0/0 (333 MHz) up         48129
Cable7/0/0/U0        up         48129
Cable7/0/0/U1        up         48129
Cable7/0/0/U2        up         48129
Cable7/0/0/U3        up         48129
Mo1/0/0:0 (501 MHz)  up         48129   Mo1/0/0:1 (507 MHz)
Mo1/0/0:0/U0         up         48129
Mo1/0/0:0/U1         up         48129
Mo1/0/0:0/U2         up         48129
Mo1/0/0:0/U3         up         48129
Mo1/0/0:1 (507 MHz)  up         48129
Mo1/0/0:1/U0         up         48129
Mo1/0/0:1/U1         up         48129
Mo1/0/0:1/U2         up         48129
Mo1/0/0:1/U3         up         48129
```

```
Mo1/0/0:2 (513 MHz)  up         48129
Mo1/0/0:2/U0         up         48129
Mo1/0/0:2/U1         up         48129
Mo1/0/0:2/U2         up         48129
Mo1/0/0:2/U3         up         48129
Mo1/0/0:3 (519 MHz)  up         48129
Mo1/0/0:3/U0         up         48129
Mo1/0/0:3/U1         up         48129
Mo1/0/0:3/U2         up         48129
Mo1/0/0:3/U3         up         48129
Statistics:
Target interface       State      Transfers
                                  Complete  Pending   Retries   Failures
Cable7/0/0 (333 MHz)   up         8         0         0         0
Cable7/0/0/U0          up         30        0         0         0
Cable7/0/0/U1          up         83        0         0         0
Cable7/0/0/U2          up         48        0         0         0
Cable7/0/0/U3          up         34        0         0         0
Mo1/0/0:0 (501 MHz)    up         19        0         0         0
Mo1/0/0:0/U0           up         33        0         0         0
Mo1/0/0:0/U1           up         46        0         0         0
Mo1/0/0:0/U2           up         22        0         0         0
Mo1/0/0:0/U3           up         22        0         0         0
Mo1/0/0:1 (507 MHz)    up         22        0         0         0
Mo1/0/0:1/U0           up         9         0         0         0
Mo1/0/0:1/U1           up         19        0         0         0
Mo1/0/0:1/U2           up         15        0         0         0
Mo1/0/0:1/U3           up         21        0         0         0
Mo1/0/0:2 (513 MHz)    up         21        0         0         0
Mo1/0/0:2/U0           up         4         0         0         0
Mo1/0/0:2/U1           up         3         0         0         0
Mo1/0/0:2/U2           up         6         0         0         0
Mo1/0/0:2/U3           up         7         0         0         0
Mo1/0/0:3 (519 MHz)    up         9         0         0         0
Mo1/0/0:3/U0           up         1         0         0         0
Mo1/0/0:3/U1           up         2         0         0         0
Mo1/0/0:3/U2           up         4         0         0         0
Mo1/0/0:3/U3           up         4         0         0         0
Pending:
Modem          Grp Idx Primary RF/RCC              MD/TCS        Action Active Retries
                       Src           Target        Src    Target         Time
```

Additional References

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/support

Feature Information for DOCSIS Load Balancing Groups

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

Table 6: Feature Information for DOCSIS Load Balancing Groups

Feature Name	Releases	Feature Information
DOCSIS Load Balancing Groups	Cisco IOS XE Fuji 16.7.1	This feature was integrated on the cisco cBR Series Converged Broadband Routers.
Load Balancing with Operational Simplification	Cisco IOS XE Gibraltar 16.10.1d.	This feature was integrated on the cisco cBR Series Converged Broadband Routers.