Load Balancing, Dynamic Channel Change, and Dynamic Bonding Change on the Cisco CMTS Routers

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Load Balancing (LB) for the Cisco CMTS allows system operators to distribute cable modems across radio frequency (RF) downstream (DS) and upstream (US) channels on the same cable interface line card, or across multiple cable interface line cards in some circumstances. Load balancing maximizes bandwidth and usage of the cable plant.

Note Cisco IOS Release 12.2(33)SCA integrates support for this feature on the Cisco CMTS routers. This feature is also supported in Cisco IOS Release 12.3BC, and this document contains information that references many legacy documents related to Cisco IOS 12.3BC. In general, any references to Cisco IOS Release 12.3BC also apply to Cisco IOS Release 12.2SC.

Load balancing supports multiple methods to achieve greater bandwidth availability and performance of the Cisco CMTS with subscriber benefits. These include static and dynamic load balancing schemes, inter-line card and intra-line card support, in some circumstances, configuration of load balancing groups (LBGs) that entail multiple interfaces, multiple load balancing policies, and the option to configure multiple additional load balancing parameters.

The load balancing policies can be configured on the Cisco CMTS, indexed by an ID, to limit the movement of CMs within a Load Balancing Group (LBG). The CM will forward TLV43.1 in its registration request (REG-REQ) message, which is then parsed and stored in the Cisco CMTS. A policy defines whether and when CMs can be moved within their load balancing groups.

During dynamic load balancing, the specified policy of the CM is checked to determine whether the CM is allowed to move. However, existing static load balancing using a frequency override technique and passive load balancing still take action at ranging time.

Effective with Cisco IOS Release 12.3(17a)BC, and later 12.3 BC releases, load balancing is enhanced and supported with Dynamic Channel Change (DCC). DCC in DOCSIS 1.1 dynamically changes cable modem upstream or downstream channels without forcing a cable modem to go offline, and without reregistration after the change.

EXHIBIT

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Effective with Cisco IOS Release 12.3(17b)BC4, and later releases, load balancing is enhanced to distribute downstream load balancing with upstream channel loads in the same upstream load balancing group. This improves upon the prior load balancing limitation, in which load balancing was implemented on the basis of the entire downstream channel load.

Effective with Cisco IOS Release 12.2(33)SCB, and later releases, load balancing is enhanced to use rules and policies to decide on moving the CMs within their LB groups. These policies are created on the Cisco CMTS and chosen on a per-CM basis using type-length-value (TLV) portion (43.1, Policy ID) of REG-REQ. These policies prohibit a modem from being moved or restricted.

A policy contains a set of rules. When the policy is defined by multiple rules, all rules apply in combinations. A rule can be defined as "enabled", "disabled", or "disabled during time period." Each rule can be used by more than one policy.

Effective with Cisco IOS Release 12.2(33)SCF1, DOCSIS 3.0 static modem count-based load balancing is enhanced to use the dynamic bonding change (DBC) to modify the following parameters of DOCSIS 3.0 cable modem with multiple transmit channel (MTC) mode or multiple receive channel (MRC) mode without primary channel change:

- Transmit channel set (TCS)
- Receive channel set (RCS)
- Downstream IDs (DSID) or DSID-associated attributes
- Security association for encrypting downstream traffic

These parameters and additional load balancing schemes are supported on the Cisco CMTS, and described in this document. This document describes all implementations of load balancing on the Cisco CMTS, dependent upon the Cisco IOS release installed and the desired parameters.

Effective with Cisco IOS Release 12.2(33)SCG1, the Cisco uBR-MC3GX60V line card and up to five shared port adapters (SPAs) can be configured to the same LBG. You can:

- Include all the downstreams and upstreams of the SPA cards and the Cisco uBR-MC3GX60V line card in the LBG.
- Configure the MAC domain to include the SPA cards and the Cisco uBR-MC3GX60V line card.
- Configure the fiber-node to include all the downstreams and upstreams of the SPA cards and the Cisco uBR-MC3GX60V line card.

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 for Configuring Load Balancing, Dynamic Channel Change, and Dynamic Bonding Change on the Cisco CMTS Routers" section on page 286

Use Cisco Feature Navigator to find information about platform support and Cisco IOS, Catalyst OS, and Cisco IOS XE software image support. To access Cisco Feature Navigator, go to http://www.cisco.com/go/cfn. An account on Cisco.com is not required.

Contents

Prerequisites

The Load Balancing, Dynamic Channel Change, and Dynamic Bonding Change feature is supported on the Cisco CMTS routers in Cisco IOS Releases 12.3BC and 12.2SC. Table 1 shows the hardware compatibility prerequisites for this feature.

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

Table 1 *Load Balancing, Dynamic Channel Change, and Dynamic Bonding Change Hardware Compatibility Matrix*

Cisco CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR10012 Universal Broadband Router	**Cisco IOS Release 12.2(33)SCA and later** - PRE2[1] **Cisco IOS Release 12.2(33)SCB and later** - PRE4	**Cisco IOS Release 12.2(33)SCA and later** - Cisco uBR10-MC5X20U/H **Cisco IOS Release 12.2(33)SCC and later** - Cisco UBR-MC20X20V **Cisco IOS Release 12.2(33)SCE and later** - Cisco uBR-MC3GX60V[2]

Table 1   Load Balancing, Dynamic Channel Change, and Dynamic Bonding Change Hardware Compatibility Matrix (continued)

Cisco CMTS Platform	Processor Engine	Cable Interface Cards
Cisco uBR7246VXR Universal Broadband Router	**Cisco IOS Release 12.2(33)SCA and later** • NPE-G1 • NPE-G2	**Cisco IOS Release 12.2(33)SCA and later** • Cisco uBR-MC28U **Cisco IOS Release 12.2(33)SCD and later** • Cisco uBR-MC88V[3]
Cisco uBR7225VXR Universal Broadband Router	**Cisco IOS Release 12.2(33)SCA and later** • NPE-G1 **Cisco IOS Release 12.2(33)SCB and later** • NPE-G2	**Cisco IOS Release 12.2(33)SCA and later** • Cisco uBR-MC28U **Cisco IOS Release 12.2(33)SCD and later** • Cisco uBR-MC88V

1. PRE = Processor Routing Engine

2. Cisco uBR-MC3GX60V cable interface line card is only compatible with PRE4.

3. Cisco uBR-MC88V cable interface line card is only compatible with NPE-G2.

Prerequisites for Load Balancing on the Cisco CMTS

The Load Balancing on the Cisco CMTS feature has the following prerequisites:

- Load balancing can be done only on upstreams and downstreams that share physical connectivity with the same group of cable modems.

- When performing load balancing among downstreams, you must also configure the known downstream center frequency to be used on each downstream interface, using the **cable downstream frequency** command. (This is an information-only configuration on cable interfaces that use an external upconverter, but it is still required for load balancing so that the Cisco CMTS knows what frequencies it should use when moving cable modems from one downstream to another.)

Prerequisites for Dynamic Channel Change for Load Balancing

- DCC can be done only to a cable modem that is physically connected to both source and target upstream or downstream channels, or both.

- Upstreams and downstream channels that share the same physical connectivity must have different center frequencies separated by channel width.

- The difference between the physical layer parameters on the source and target DCC channels must be within the threshold required by the desired DCC initialization technique.

- DOCSIS 1.1 must be enabled for a modem to behave properly for the DCC operation. Note that not all DOCSIS 1.1 certified modems are DCC-capable, as the CableLabs DCC ATP tests need enhancement for complete coverage.

Prerequisites for Dynamic Bonding Change for DOCSIS 3.0 Static Modem Count-Based Load Balancing

- Initialization techniques 1 to 4, when used, require the Cisco CMTS to include the upstream channel descriptor (UCD) TLV (TLV46.5) in the DBC-REQ message.
- Bandwidth must be sufficient on the target bonding group to support DBC. This is determined by the admission control APIs.
- Fiber nodes must be configured before configuring DOCSIS 3.0 static modem count-based load balancing

Restrictions

The following sections describes the restrictions applicable for the Load Balancing, Dynamic Channel Change, and Dynamic Bonding Change feature:

Restrictions for Load Balancing on the Cisco CMTS

The Load Balancing on the Cisco CMTS feature has the following restrictions:

- Load balancing can be done only on a per-chassis basis—all interfaces in a load balancing group must be provided by the same chassis.
- A downstream or upstream can belong to only one load balancing group.
- All downstreams and upstreams in a load balancing group must share physical connectivity to the same group of cable modems. Downstreams can be in a separate load balancing group than upstreams, but all downstreams or all upstreams that have the same RF physical connectivity must be members of the same load balancing group.
- You can configure only one load balancing group per shared physical domain (upstream or interface). You cannot configure multiple load balancing groups to distribute downstreams or upstreams that share physical connectivity.
- In later Cisco IOS releases, such as Cisco IOS Release 12.3(17a)BC, you can create a maximum of 80 load balancing groups on each chassis (the older limitation was 20). However, in prior Cisco IOS releases, you can reuse those load balancing groups on different sets of cable interfaces, as long as they are in different domains. If downstream channels are not included in a load balancing group, then each downstream channel can be considered a separate domain.
- If an upstream port is operational, using the **no shutdown** command, and is not being used and not connected, load balancing attempts to use the port even though there are no cable modems registered on that port. When the upstream port is up, it is put into INIT state and load balancing includes this port as a potential target. However, if the load balancing sees multiple failures moving to this upstream, it is set to DISABLE state and the port is avoided later on in load balancing processes.
- The load balancing algorithms assume a relatively even distribution of usage among modems. In the situation where one cable modem creates the bulk of the load on an interface, the load balancing thresholds should be configured for a value above the load created by that single modem.

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