DOCSIS 3.0 Multicast Support

The Cisco cBR Series Routers support multicast improvements based on Data-over-Cable Service Interface Specifications (DOCSIS) 3.0. DOCSIS 3.0 multicast support improves bandwidth efficiency and allows service providers to offer differentiated quality of service for different types of traffic.

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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Hardware Compatibility Matrix for Cisco cBR Series Routers

Note The hardware components 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-CCAP-SUP-160G • PID—CBR-CCAP-SUP-60G • PID—CBR-SUP-8X10G-PIC	**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-R Cisco cBR-8 Downstream PHY Modules: • PID—CBR-D30-DS-MOD • PID—CBR-D31-DS-MOD Cisco cBR-8 Upstream PHY Modules: • PID—CBR-D30-US-MOD • PID—CBR-D31-US-MOD

Prerequisites for the DOCSIS 3.0 Multicast Support

- DOCSIS 3.0-compliant Cisco CMTS and DOCSIS 3.0-enabled cable modems are required.
- Cisco CMTS must be MDF-enabled by default.
- Quality of service (QoS) parameters must be configured for various multicast sessions.

Restrictions for the DOCSIS 3.0 Multicast Support

- You cannot disable explicit tracking.
- For multicast QoS, you must define three objects and templates, Service-Class, Group-QoS-Config (GQC), and Group-Config, and associate them to a particular bundle or forwarding interface.
- You must define a default service class and GQC before defining objects and templates.
- Static multicast feature is always enabled and you cannot disable it.
- The service flow attribute-based selection will be ignored if the group configuration is configured on the default forwarding interface.
- The multicast DSID feature is supported only on DOCSIS 3.0-compliant cable modems.
- The cable multicast mdf-disable wb-incapable-cm command disables multicast downstream service identifier (DSID) forwarding capability on the cable modem, which impacts the DSID capability between the Cisco CMTS and the cable modem.
- The multicast traffic to CPE increases two-fold after changing the multicast QoS configuration or the service-flow attribute during an active session. The traffic replication will continue till the default session timeout period (180 seconds). After the session timeout, the multicast DSID is removed from both Cisco CMTS and CM, and normal multicast traffic flow is resumed.
- For the DOCSIS 3.0 Multicast support feature to function properly, the CPE and the CM must be in the same virtual routing and forwarding (VRF) interface.

Information About the DOCSIS 3.0 Multicast Support

IP multicast, an integral technology in networked applications, is the transmission of the same information to multiple recipients. Any network application, including cable networks, can benefit from the bandwidth efficiency of multicast technology. Two new technologies—Channel Bonding and Single Source Multicast (SSM)—are expected to dramatically accelerate multicast deployment.

The channel bonding and SSM technologies dramatically increase the operational efficiency of the existing hybrid fiber-coaxial (HFC) network. Using the multicast improvements, the cable operators can seamlessly deliver advanced services like video on demand (VoD), internet protocol television (IPTV), and facilitate interactive video and audio, and data services.

The following sections explain the benefits of DOCSIS 3.0 Multicast Support:

Multicast DSID Forwarding

DOCSIS 3.0 multicast support introduces centralized control at the Cisco CMTS to provide flexibility and scalability to support a large array of multicast protocols. It replaces the Internet Group Management Protocol (IGMP), version 2 snooping infrastructure, which was part of the DOCSIS 1.1 and 2.0 models. Now, the Cisco CMTS allocates an unique Downstream Service Identifier (DSID) to identify every multicast stream. These DSIDs are sent to the CMs that use these DSIDs to filter and forward Multicast traffic to the CPEs.

The multicast DSID forwarding (MDF) provides the following benefits:

- Unique identification of packet stream across bonding group within a MAC domain.
- Designation of packet stream as either Any Source Multicast (ASM) or Source Specific Multicast (SSM) per multicast channel.
- Implementation of multicast DSID management on the Route Processor (RP) makes it operate on a standalone basis.
- Snooping of all upstream signal control packets by the Cisco CMTS to find the customer premises equipment (CPE) on the Multicast DSID-based Forwarding (MDF) enabled CM and allocates DSID from the pool.
- Transmission of allocated DSIDs to the CM through Dynamic Bonding Change (DBC) message.
- Reuse of DSIDs on other MDF-enabled CMs in the same bonding group, joining the multicast session.
- Removal of DSIDs from the CM through a DBC message by the Cisco CMTS after a multicast session leave event.
- Release of DSID to the pool by the Cisco CMTS when the last member leaves the bonding group.
- The following DSIDs are preallocated for each primary downstream (modular and integrated cable interfaces) to forward general query messages. These DSIDs form part of the multicast group signaling protocol. Other multicast groups, do no use these DSIDs.
    - IGMPv2 general query (IPv4)
    - IGMPv3 general query (IPv4)
    - MLDv1 general query (IPv6)
    - MLDv2 general query (IPv6)
    - Preregistration of DSID (IPv6)
- Allocation of DSID ensures traffic segregation between virtual private networks (VPNs) for DOCSIS 3.0 MDF-enabled CMs. For example, two clients from two VPNs joining the same multicast will get two distinct DSIDs.

Multicast Forwarding on Bonded CM

Multicast packets to the DOCSIS 3.0-enabled CMs are transmitted as bonded packets with DSID extension header on the primary bonding group if the Secondary Multicast Bonding Group is disabled. Multicast packets for MDF-disabled or pre-DOCSIS 3.0 CMs are transmitted as non-bonded without DSID extension header. For more information on this feature, refer to Multicast Secondary Bonding Group, on page 6.

In a network, where only MDF-enabled or MDF-disabled CMs exist, the traffic is segregated using field types. The MDF-enabled CM forwards the frame with the field type and the MDF-disabled CM drops it. The DSID labeling ensures that MDF-enabled CM gets a copy of the multicast session to prevent “cross talk”.

For hybrid CMs (MDF-enabled and MDF-disabled CMs) that do not support field type forwarding, you should configure per session encryption or security association identifier (SAID) isolation to ensure traffic segregation. DOCSIS 3.0 mandates that if the hybrid CM fails to forward field type frames, the Cisco CMTS should employ multicast security association identifier (MSAID) isolation. This isolation is achieved by assigning different MSAID to each replication, one to bonded CM and another to the non-bonded or hybrid CM. This helps to prevent CMs from receiving duplicate traffic.

Static TLV Forwarding

As per DOCSIS 3.0 specifications, the Cisco CMTS must support Static Multicast. When the CM tries to register with the Cisco CMTS, the Cisco CMTS checks whether Static Multicast Encoding is present in the

CM configuration file. If the Static Multicast Encoding is present, the Cisco CMTS sends a DSID corresponding to each Static Multicast channel in the Registration-Response (REG-RSP) message.

The Multicast DSID management is located at Supervisor and the interface card has to contact the Supervisor for proper DSID assignment. The interface card also caches the response from Supervisor to eliminate the need to communicate to the Supervisor for subsequent Static Multicast encoding.

Explicit Tracking

The Cisco CMTS can perform explicit tracking with IGMPv3 support. The IGMPv3 removes the report suppression feature associated with the IGMPv2 specification enabling the Cisco CMTS to get the complete information on session and host information. This benefits the IGMP Fast Leave processing and DSID management for each CM.

A host or session database is used to track hosts (IP/MAC) joining a particular multicast session. From the host, you can track the CM based on the SID and cable downstream interface. This database also helps to determine whether the Cisco CMTS should remove the DSID from a particular CM when the multicast session is over.

Multicast Quality of Service Enhancement

DOCSIS 3.0 mandates that the CMTS should not admit any flow exceeding the session limit. Though the current Multicast QoS (MQoS) session limit admits the session, it fails to provide any QoS for sessions exceeding the session limit.

Note Multicast packets are sent using the default Group Service Flows (GSF) when the Multicast QoS feature is disabled.

As part of DOCSIS 3.0 requirements for Multicast QoS, Group Classifier Rules (GCR) is supported. The Cisco CMTS determines the set of Group Configurations (GCs) whose session range matches the multicast group address. For SSM, the source address is also used to identify the matching GCs. A GCR is created for each matching GC and linked to the multicast session. The GCR is assigned also with an unique identifier, SAID, and Group Service Flow (GSF).

The following conditions are used to select the GC entries:

- The GC entry with the highest rule priority is selected, if more than one GC entry matches.
- All matching GC entries are selected, when multiple GCs have the same highest rule priority.

The GCR classification is done based on type of service (TOS) fields. The TOS specifier in the GCR is used to choose the correct GCR when multiple GCRs match a single multicast session.

Note When two multicast group configurations (GCs) have the same session range and configuration (under global or bundle configuration), then the same forwarding interface selection is not guaranteed.

Non-IP multicasts and broadcast packets use GSF. They are similar to individual service flows and are shared by all the CMs on a particular Digital Command Signal (DCS) matching the same GCR. A single GSF is used for multicast sessions matching different GCs using the same aggregate GQC.

Multicast Secondary Bonding Group

The DOCSIS 3.0-compliant CM can receive multicast packets from non-primary (or bonded) channels using the MDF support at the CMTS.

The multicast secondary bonding group is defined as a shared bonding group or RF channel that feeds more than one fiber node through an optical split. This allows CMs from different primary bonding groups and channels to listen to one or more shared sets. The multicast packets are replicated only to the shared downstream channel set, which helps conserve the downstream bandwidth.

DOCSIS 3.0 defines attribute-based service flow creation, which allows the Cisco CMTS to make more "intelligent" decisions on the selection of bonding group or individual channel for unicast and multicast forwarding.

The Multicast Secondary Bonding Group provides the following benefits:

- New MQoS and attribute-based forwarding for Multicast Secondary Bonding Group.
- The primary downstream interface acts as a forwarding interface for narrowband CMs.
- The following algorithm is used to select a forwarding interface for wideband CMs:
    - A primary bonding group is selected if a group-config matching the session is present in it. MQoS parameters are taken from the group-config.
    - A primary bonding group is selected if a group-config is not present at the bundle level or at the global level.
    - A group-config found at the bundle level or global level is used to find the Group-QoS-Config (GQC) and eventually the attribute and forbidden bit-masks, which are then used to find the interface.
    - All Wideband Cable Modems (WCMs) in a bundle use the same secondary bonding group if a bundle-level group-config or global-level group-config is configured.
- The IGMP report ignores a source if the given source address fails to find a matching interface.
    - If a matching interface is found, that interface is used for forwarding and the MQoS parameters are taken from the matching group-config from the forwarding interface or bundle interface or global level.
    - If a matching interface is not found, then the IGMP report is ignored.
- For a static join, attribute-based forwarding is not supported, and only the primary downstream is used.

Load Balancing

The Load Balancing feature does not load balance a CM while a multicast stream is going on for that particular CM. It utilizes the Explicit Tracking Database, which holds complete information on the CM subscription to achieve this.

Multicast DSID Forwarding Disabled Mode

For any application that needs the cable modem to perform IGMP snooping, the MDF on the cable modem must be disabled. Cable modems registered in MDF-enabled mode by the Cisco CMTS do not perform IGMP snooping because MDF forwarding is based on DSID filtering. The **cable multicast mdf-disable** command disables the MDF capability on the cable modem.

This command is configured on the route processor and is downloaded to the cable line card via the configuration update. The configuration does not change the Cisco CMTS forwarding mechanism or DSID

allocation. The Cisco CMTS allocates the DSID and the multicast packet is encapsulated with the DSID header. This does not affect traffic forwarding on the MDF-disabled cable modem. According to DOCSIS3.0 specification, pre-DOCSIS2.0 or MDF-disabled cable modems ignore the DSID header and continue multicast forwarding based on the Group Media Access Control (GMAC) from IGMP snooping. When the cable modem runs in MDF-disabled mode, only IGMPv2 is supported and the Cisco CMTS drops IGMPv3 and MLD messages.

Multicast encryption based on BPI+ is not supported on non-MDF cable modems, if IGMP SSM mapping is used. A non-MDF cable modem is either a pre-DOCSIS 3.0 cable modem or a DOCSIS 3.0 cable modem running in MDF-disabled mode.

MDF1 Support for DOCSIS 2.0 Hybrid Cable Modems

The Cisco CMTS router enables MDF capability for DOCSIS 2.0 hybrid cable modems, IPv6, and other cable modems that advertise MDF capability to allow IPv6 packet forwarding. The **wb-incapable-cm** keyword in the **cable multicast mdf-disable** command disables MDF on all DOCSIS 2.0 hybrid cable modems including DOCSIS Set-Top Gateway (DSG) hybrid embedded cable modems to support IGMP snooping.

DSG Disablement for Hybrid STBs

The **cable multicast mdf-disable** command with the **wb-incapable-cm** keyword prevents all DOCSIS 2.0 DSG embedded cable modems from receiving DSG multicast traffic besides disabling MDF support.

The **wb-incapable-cm** keyword disables MDF capability only on non-DSG DOCSIS 2.0 hybrid cable modems. To disable MDF capability on all DSG embedded cable modems (DOCSIS 3.0 DSG and DOCSIS 2.0 DSG hybrid), a new keyword, DSG, is introduced.

Note After disabling MDF capability, you must run **clear cable modem reset** command to bring all DSG embedded cable modems online.

Benefits of MDF1 Support

- Supports IPv6 on different known cable modem firmware types.
- Disables the MDF capability on the Cisco CMTS.
- Supports In-Service Software Upgrade (ISSU) and line card high availability.

Dynamic Multicast Replication Sessions

When users enable IPTV service on the Cisco cBR routers, to enhance the performance, the following features are supported on Cisco cBR.

- Supports 8000 SIDs per bundle interface:

  The Cisco cBR supports 8000 SIDs per bundle, because each MQoS need one SID for each multicast session.

- Provides faster and efficient IP Communicator messages.
- Provides faster multicast forwarding.
- Enables caching of dynamic multicast sessions.

Cache Multicast Replication Sessions

Creating a new multicast replication session takes most of the CPU cycles when compared to joining an existing multicast replication session. Most resources associated with a multicast replication session can be cached after the session ends.

Hence, when a new IGMP join request is received later, these resources can be reused.

The multicast session replication cache is available only on an active SUP. When SUPSO happens, all cached sessions are lost, and are then recreated on the new active SUP when an IGMP/MLD join request is received.

When LCSO happens, all cache sessions of this LC are cleared and are recreated on the new active LC when an IGMP/MLD join request is received.

How to Configure the DOCSIS 3.0 Multicast Support

This section describes the following tasks that are required to implement DOCSIS 3.0 Multicast Support on Cisco CMTS Routers:

Configuring Basic Multicast Forwarding

To configure a basic multicast forwarding profile that can be applied to a DOCSIS 3.0 multicast configuration, use the **ip multicast-routing** command. You must configure a multicast routing profile before you can proceed with a multicast 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	**IP multicast-routing** [**vrf**] **Example:** `Router(config)# IP multicast-routing vrf`	Enables multicast routing globally or on a particular virtual routing and forwarding (VRF) interface.
Step 4	**interface bundle** *number* **Example:** `Router(config)# interface bundle 1`	Configures the interface bundle and enters interface configuration mode.
Step 5	**IP pim sparse-mode**	Configures sparse mode of operation.

	Command or Action	Purpose
	Example: `Router(config-if)# IP pim sparse-mode`	**Note** The Cisco CMTS router must have a Protocol Independent Multicast (PIM) rendezvous point (RP) configured for the PIM sparse mode. The Supervisor is configured using the **ip pim rp-address** command or Auto-Supervisor configuration protocol.
Step 6	**IP pim sparse-dense-mode** **Example:** `Router(config-if)# IP pim sparse-dense-mode`	Configures the interface for either sparse mode or dense mode of operation, depending on the mode in which the multicast group is operating.
Step 7	**IP igmp version version-number** **Example:** `Router(config-if)# IP igmp version 3`	Configures the interface to use IGMP version 3.
Step 8	**IP igmp v3-query-max-response-time** *response_time* **Example:** `Router(config-if)# IP igmp v3-query-max-response-time 500`	Configures the maximum query response time for igmp version 3.

Configuring Multicast DSID Forwarding

The multicast DSID forwarding is enabled by default. You cannot configure this feature.

Configuring Explicit Tracking

The Explicit Tracking feature is enabled by default. You cannot configure it.

Configuring Multicast QoS

To configure a Multicast QoS profile that can be applied to a DOCSIS 3.0 configuration, use the **cable multicast group-qos** command. You must configure a Multicast QoS profile before you can add a Multicast QoS profile to a QoS multicast 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	**configureterminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**cable service class** *class-index* **name** *service-class-name* **Example:** `Router(config)# cable service class 1 name MQOS_DEFAULT`	Configures the name of the cable service class.
Step 4	**cable service class** *class-index* **downstream** **Example:** `Router(config)# cable service class 1 downstream`	Configures the downstream for the cable service class.
Step 5	**cable service class** *class-index* **max-rate** *maximum-bandwidth-allowed* **Example:** `Router(config)# cable service class 1 max-rate 10000000`	Configures the maximum allowed bandwidth for the cable service class.
Step 6	**cable service class** *class-index* **min-rate** *cir* **Example:** `Router(config)# cable service class 1 min-rate 1000000`	Configures the minimum committed information rate for the cable service class.
Step 7	**cable multicast group-qos default scn** *service-class-name* **aggregate** **Example:** `Router(config)# cable multicast group-qos default scn MQOS_DEFAULT aggregate`	Specifies the default service class name for the QoS profile.
Step 8	**cable multicast qos group** *number* **priority** *value* **Example:** `Router(config)# cable multicast qos group 20 priority 1`	Configures a multicast QoS group and enters multicast QoS configuration mode, and specifies the priority of the cable multicast QoS group.
Step 9	**application-id** *app-id* **Example:** `Router(config-mqos)# application-id 10`	Specifies the application identification number of the multicast QoS group. This value is configured to enable admission control to the multicast QoS group.

	Command or Action	Purpose
Step 10	**session-range ip-address ip-mask** **Example:** `Router(config-mqos)# session-range 230.0.0.0 255.0.0.0`	Specifies the session range IP address and IP mask of the multicast QoS group. You can configure multiple session ranges.
Step 11	**cable multicast qos group** *number priority value* [**global**] **Example:** `Router(config)#cable multicast qos group 20 priority 63 global`	Specifies the multicast QoS group identifier.

Selecting a Forwarding Interface Based on Service Flow Attribute

The Service Flow Attribute feature allows a bonded CM to listen to multiple bonding groups, and using the interface-specific bit-masks, the CM can select the best route to receive multicast traffic.

The Service Flow Attribute feature allows selection of a forwarding interface based on the DOCSIS 3.0 construct named "service flow attribute mask." Every interface has an attribute bit-mask depicting attributes of that interface. The multicast service class specified in the group QoS configuration contains required and forbidden attribute bit-masks. If a bonded CM can listen to multiple bonding groups (wideband interfaces), using specific bit-masks in the service class as well as on the bonding group, then one of these bonding groups can be selected for forwarding of multicast traffic.

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 service class** *class-index* **name** *name* **Example:** `Router(config)# cable service class 10 name mcast10`	Configures the service class name.
Step 4	**cable service class** *class-index* **downstream** **Example:**	Configures the downstream for the selected service class.

	Command or Action	Purpose
	`Router(config)# cable service class 10 downstream`	
Step 5	**cable service class** *class-index* **max-rate** *maximum-rate* **Example:** `Router(config)# cable service class 10 max-rate 1000000`	Configures the maximum rate for the selected service class.
Step 6	**cable service class** *class-index* **min-rate** *minimum-rate* **Example:** `Router(config)#  cable service class 10 min-rate 100000`	Configures the minimum rate for the selected service class.
Step 7	**cable service class** *class-index* **req-attr-mask** *required-attribute-mask* **Example:** `Router(config)# cable service class 10 req-attr-mask 8000000F`	Configures the required attribute mask for the selected service class.
Step 8	**cable service class** *class-index* **forb-attr-mask** *forbidden-attribute-mask* **Example:** `Router(config)# cable service class 10 forb-attr-mask 7FFFFFF0`	Configures the forbidden attribute mask for the selected service class name.
Step 9	**cable multicast group-qos** *number* **scn** *service-class-name* **aggregate** **Example:** `Router(config)# cable multicast group-qos 1 scn 10 mcast10 aggregate`	Configures the cable multicast group QoS identifier, service class name, and multicast value.
Step 10	**cable multicast qos group** *group* **priority** *priority* **Example:** `Router(config)# cable multicast qos group 1 priority 1`	Configures the cable MQoS group and enters MQoS configuration mode.
Step 11	**session-range** *session-range mask* **Example:** `Router(config-mqos)# session-range 230.1.1.1 255.255.255.255`	Specifies session range.

	Command or Action	Purpose
Step 12	**group-qos** *qos* **Example:** `Router(config-mqos)# group-qos 1`	Specifies the group QoS.
Step 13	**exit** **Example:** `Router(config-mqos)# exit`	Returns to global configuration mode.

Step 14	**interface bundle** *number*
	• **ip address** *ip mask*
	• **ip pim sparse-mode**
	• **ip helper-address** *helper-address*
	• **cable multicast-qos group** *group*
	Example:
	`Router(config)# interface Bundle1`
	`Router(config-if)#ip address 40.1.1.1 255.255.255.0`
	`Router(config-if)#ip pim sparse-mode`
	`Router(config-if)#ip helper-address 2.39.16.1`
	`Router(config-if)#cable multicast-qos group 1`
		Configures the interface bundle with the IP address, helper address, and MQoS group.

Step 15	**exit** **Example:** `Router(config-if)# exit`	Returns to global configuration mode.

Step 16	**interface wideband-cable** *slot*/*subslot*/*port*:*wideband-channel*
	• **description** *description*
	• **cable bundle** *number*
	• **cable rf-channel channel-list** *grouplist* **bandwidth-percent** *bw-percent*
	• **cable downstream attribute-mask attribute-***mask*
	Example:
	`Router(config)# interface Wideband-Cable1/0/0:0`
	`Router(config-if)# description cable rf-channels channel-list 0-7 bandwidth-percent 20`
	`Router(config-if)# cable bundle 1`
	`Router(config-if)# cable rf-channels channel-list 0-7 bandwidth-percent 20`
	`Router(config-if)# cable downstream attribute-mask 8000000F`
		Selects the interface for forwarding based on the bit-masks specified in the service class and on the wideband interface.

	Command or Action	Purpose
Step 17	**end** **Example:** `Router(config-if)# end`	Returns to privileged EXEC mode.

Configuring Multicast DSID Forwarding Disabled Mode

To disable MDF on the cable modem, use the **cable multicast mdf-disable** command in global configuration mode.

Note Multicast encryption based on BPI+ is not supported on non-MDF cable modems, if IGMP SSM mapping is used.

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 multicast mdf-disable [wb-incapable-cm]** **Example:** `Router(config)# cable multicast mdf-disable`	Disables MDF capability on the cable modem.

Step 4	exit
	Example:
	`Router(config)# exit`
	`Router#`
		Exits the global configuration mode.

Configuring Multicast Replication Session Globally

Use the following command to configure the maximum number of multicast replication sessions globally and the value is configured per L2 forwarding interface.

If the operator does not configure a value for the maximum number, by default, is set to 0 for all L2 forwarding interfaces, and the cache function is not valid. Cisco cBR does not cache the multicast replication sessions.

If the value is changed from a number such as 10 to 0, all current caches is cleared. The value range is from 0 to 500.

The following example shows how to set the maximum number of cache to 0:

```
enable
configure terminal
cable multicast ses-cache 0
```

The following example shows how to change the current value:

```
enable
configure terminal
 [no|default] cable multicast ses-cache <0-500>
```

Configuring Multicast Replication Sessions on Forwarding Interface

Use the following command to enable the multicast replication session on each L2 forwarding interface.

The value range for the maximum number is 0 to 500. If the value is changed from a number such as 10 to 0, all current caches is cleared.

The configured value for the interface has higher priority than the system value. The following example shows how to configure session cache on forwarding interface and make Cisco cBR use the system values:

```
enable
configure terminal
interface wideband-Cable {slot /subslot /controller :wideband-channel}
[no|default] cable multicast ses-cache
```

The following example shows how to set the maximum number of cache for the interface:

```
enable
configure terminal
interface integrated-Cable {slot/subslot/port:rf-channel}
cable multicast ses-cache 500
```

The following example shows how to configure a value 0 for an interface:

```
enable
configure terminal
interface integrated-Cable {slot/subslot/port:rf-channel}
no cable multicast ses-cache
```

Clearing Multicast Replication Cache

Use the following command to clear the multicast replication session for all or for a specific L2 forwarding interface. The system deletes all current cache entries for all L2 forwarding interfaces or for a specific L2 interface.

```
enable
clear cable multicast ses-cache [interface xxx | all | counter]
```

How to Monitor the DOCSIS 3.0 Multicast Support

To monitor the DOCSIS 3.0 Multicast Support feature, use the following procedures:

Verifying the Basic Multicast Forwarding

To verify the configuration parameters for basic multicast forwarding, use the **show ip mroute** command as shown in the following example:

```
Router# show ip mroute

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry, E - Extranet,
       X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
       U - URD, I - Received Source Specific Host Report,
       Z - Multicast Tunnel, z - MDT-data group sender,
       Y - Joined MDT-data group, y - Sending to MDT-data group,
       V - RD & Vector, v - Vector
Outgoing interface flags: H - Hardware switched, A - Assert winner
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 230.1.1.1), 00:00:03/00:02:55, RP 30.1.1.1, flags: S
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Bundle1, Forward/Sparse, 00:00:03/00:02:55, H
(*, 224.0.1.40), 00:12:02/00:02:19, RP 30.1.1.1, flags: SJCL
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Bundle1, Forward/Sparse, 00:12:02/00:02:19
```

To verify the multicast information for the specified virtual interface bundle, based on IGMPv3, use the **show cable bundle multicast** command as shown in the following example:

```
Router# show cable bundle 1 multicast

CableBundle Interface Source IP  Multicast IP    MAC Address
1    Bundle1.1 *       230.1.1.1    0100.5e00.0001
```

To verify the MAC forwarding table for the specified virtual interface bundle, based on IGMPv3, use the **show cable bundle forwarding** command as shown in the following example:

```
Router# show cable bundle 1 forwarding

MAC address Interface Flags Location link sublink
00c0.5e01.0203 Cable8/0/0 3 64E5BF60 0 64E5BE00
00c0.5e01.0203 Cable7/0/0 3 64E5BE00 0 0
00c0.5e01.0101 Cable8/0/0 3 64E5BEE0 0 64E5BE40
```

Verifying the Multicast DSID Forwarding

To verify the entire DSID database content, use the **show cable multicast dsid** command as shown in the following example:

```
Router# show cable multicast dsid
Multicast Group    : 230.1.2.3
         Source    : *
         IDB       : Bu2         Interface: Mo1/1/0:0   Dsid: 0x1F078
         StatIndex : 2           SAID: DEFAULT
Multicast Group    : 230.1.2.3
         Source    : *
         IDB       : Bu2         Interface: Mo1/1/0:0   Dsid: 0x1F078
         StatIndex : 3           SAID: 8196
Multicast Group    : 230.1.2.3
         Source    : *
         IDB       : Bu2         Interface: Mo1/1/0:0   Dsid: 0x1F078
```

StatIndex : 4 SAID: 8197

To verify the entire database content, use the **show cable multicast db** command as shown in the following example:

Router# **show cable multicast db**

```
interface : Bundle1
Session (S,G) : (*,230.1.1.1)
Fwd Intfc Sub Intfc Host Intfc CM Mac Hosts
Wi1/1/0:0 Bundle1 Ca5/0/0 0018.6852.8056 1
```

To verify the information for the registered and unregistered CMs, use the **show cable modem verbose** command as shown in the following example:

Router# **show cable modem 0010.7bb3.fcd1 verbose**

```
MAC Address : 00C0.7bb3.fcd1
IP Address : 10.20.113.2
Prim Sid : 1
QoS Profile Index : 6
Interface : C5/0/U5
sysDescr : Vendor ABC DOCSIS 2.0 Cable Modem
Upstream Power : 0 dBmV (SNR = 33.25 dBmV)
Downstream Power : 0 dBmV (SNR = ----- dBmV)
Timing Offset : 1624
Initial Timing Offset : 2812
Received Power : 0.25
MAC Version : DOC1.0
Qos Provisioned Mode : DOC1.0
Enable DOCSIS2.0 Mode : Y
Phy Operating Mode : atdma
Capabilities : {Frag=N, Concat=N, PHS=N, Priv=BPI}
Sid/Said Limit : {Max Us Sids=0, Max Ds Saids=0}
Optional Filtering Support : {802.1P=N, 802.1Q=N}
Transmit Equalizer Support : {Taps/Symbol= 0, Num of Taps= 0}
Number of CPE IPs : 0(Max CPEs = 1)
CFG Max-CPE : 1
Flaps : 373(Jun 1 13:11:01)
Errors : 0 CRCs, 0 HCSes
Stn Mtn Failures : 0 aborts, 3 exhausted
Total US Flows : 1(1 active)
Total DS Flows : 1(1 active)
```

```
Total US Data : 1452082 packets, 171344434 bytes
Total US Throughput : 0 bits/sec, 0 packets/sec
Total DS Data : 1452073 packets, 171343858 bytes
Total DS Throughput : 0 bits/sec, 0 packets/sec
Active Classifiers : 0 (Max = NO LIMIT)
DSA/DSX messages : reject all
Dynamic Secret : A3D1028F36EBD54FDCC2F74719664D3F
Spoof attempt : Dynamic secret check failed
Total Time Online : 16:16
```

Verifying the Explicit Tracking Feature

To verify explicit tracking information, use the **show cable multicast db** command as shown in the following example:

Router# **show cable multicast db**

```
Interface : Bundle1
Session (S,G) : (*,230.1.1.1)
Fwd Intfc  Sub Intfc  Host Intfc   CM Mac           Hosts
Mo1/1/0:0  Bundle1    Ca5/0/0      0018.6852.8056       1
```

Verifying the Multicast QoS Feature

To verify the cable MQoS details, use the **show cable multicast qos** commands as shown in the following example:

```
Router# show cable multicast qos ?
group-config Display Multicast Group Config information
group-encryption Display Multicast Group Encryption information
group-qos Display Multicast Group QOS information
Router# show cable multicast qos group-config
Multicast Group Config 1 : Priority 1
Group QOS - 1
Group Encryption - 1
Session Range - Group Prefix 230.0.0.0 Mask 255.0.0.0 Source Prefix 0.0.0.0 Mask 0.0.0.0
Router# show cable multicast qos group-encryption
Multicast Group Encryption 1 : Algorithm 56bit-des
Router# show cable multicast qos group-qos
Group QOS Index Service Class Control Igmp Limit Override
DEFAULT MQOS_DEFAULT Aggregate NO-LIMIT 1 MQOS Aggregate NO-LIMIT
```

To verify the DOCSIS service flows on a given cable interface, use the **show interface service-flow** command as shown in the following example:

```
Router# show interface cable 6/0 service-flow

Sfid  Sid   Mac Address     QoS Param Index Type    Dir    Curr   Active
BG/CH
                            Prov  Adm  Act                 State  Time
4     8193  ffff.ffff.ffff  3     3    3   sec(S)  DS     act    21h57m
5     8196  ffff.ffff.ffff  4     4    4   sec(S)  DS     act    00:17
```

Verifying the Service Flow Attributes

To verify the configuration of service flow attributes on the service class configuration, use the show cable service-class verbose command as shown in the following example:

```
Router# show cable service-class 10 verbose
Index:                                  10
Name:                                   mcast10
Direction:                              Downstream
Traffic Priority:                       0
Maximum Sustained Rate:                 1000000 bits/sec
Max Burst:                              3044 bytes
Minimum Reserved Rate:                  1000000 bits/sec
Minimum Packet Size                     0 bytes
Admitted QoS Timeout                    200 seconds
Active QoS Timeout                      0 seconds
Required Attribute Mask                 8000000F
Forbidden Attribute Mask                7FFFFFF0
Scheduling Type:                        Undefined
Max Latency:                            0 usecs
Parameter Presence Bitfield:            {0x3148, 0x0}
```

To verify the configuration of SF attributes on the Wideband interface configuration, use the **show running-config interface** command as shown in the following example:

```
Router# show running-config interface Wideband-Cable 1/0/0:2
interface Wideband-Cable1/0/0:2
 cable bundle 1
 cable bonding-group-id 3
 cable rf-channel 3
 cable downstream attribute-mask 8000000F
end
```

Verifying the Multicast Group Classifiers

To verify the details of the Group Classifier Rule, use the **show interface wideband-cable multicast-gcr** command as shown in the following example:

```
Router# show interface wideband-cable 1/1/0:0 multicast-gcr
Group Classifier Rules on Wideband-Cable1/1/0:0:
Classifier_id  Group_id  Group_Qos_id  Sid   SFID   ref_count
7              1         1             8196  10     1
8              2         1             8197  11     1
```

Troubleshooting Tips

Make sure that CM can listen to the RF-frequencies specified for the Wideband interfaced chosen for forwarding multicast traffic.

Viewing Current Cache

Use this command to show the current multicast replication session per L2 forwarding interface.

- If you do not specify an interface, this command shows a summary of the current L2 forwarding interface. The summary includes the cache number.
- If you specify an interface, this command shows a summary of the interface. Add the verbose option for more detailed information of the cache.

```
Router#show cable multicast ses-cache global summary
```

```
Global Cache Config: 20
-----------------------------------------------------------------
Fwd             Cache      Cache     Cache      Cache
Intfc           Config     Used      Missed     Hitted
Wi7/0/0:1        10         4          4          12
-----------------------------------------------------------------
Total                           4             4             12


Router# show cable multicast ses-cache global

Fwd Intfc          Sub Intfc               Session (S,G)
Wi7/0/0:0          Bundle1                (30.30.30.30,227.0.0.20)
                   Bundle1                (30.30.30.30,227.0.0.22)

Wi7/0/0:1          Bundle1                (30.30.30.30,226.0.0.20)
                   Bundle1                (30.30.30.30,226.0.0.22)
                   Bundle1                (30.30.30.30,226.0.0.23)
                   Bundle1                (30.30.30.30,226.0.0.21)



Router#show cable multicast ses-cache interface wi7/0/0:1

Fwd Intfc          Sub Intfc              Session (S,G)
Wi7/0/0:1          Bundle1                (30.30.30.30,226.0.0.20)
                   Bundle1                (30.30.30.30,226.0.0.22)
                   Bundle1                (30.30.30.30,226.0.0.23)
                   Bundle1                (30.30.30.30,226.0.0.21)


Router# show cable multicast ses-cache interface wi7/0/0:1 summary

Global Cache Config: 20
-------------------------------------------------
Fwd             Cache       Cache    Cache      Cache
Intfc             Config      Used     Missed    Hitted
Wi7/0/0:1    10              4           4              12


Router# show cable multicast ses-cache wi8/0/0:0 verbose

Multicast Group    : 232.10.0.8

         Source    : 100.0.0.2

         Act GCRs  : 1

         Interface : Bu255 State: A GI: Bu255  RC: 0

         GCR       : GC   SAID    SFID    Key   GQC    GEn

                     10   8858    24      0     1      0


Multicast Group    : 232.10.0.16

         Source    : 100.0.0.2

         Act GCRs  : 1

         Interface : Bu255  State: A  GI: Bu255  RC: 0
```

```
          GCR       : GC   SAID    SFID    Key   GQC    GEn
                      10   8859    25      0     1      0
Total session cache num: 2
```

For the **Cache Missed** value, the value is increased for a new join request when cached entry is not available for reusing.

Configuration Examples for DOCSIS 3.0 Multicast Support

This section provides the following configuration examples:

Example: Configuring Basic Multicast Forwarding

Note The commands given below are required to enable the Cisco CMTS to forward multicast packets. However, Multicast QoS, and Authorization features are all optional for multicast packets to be forwarded correctly.

In the following example, a basic multicast forwarding profile is configured.

```
ip multicast-routing
interface TenGigabitEthernet4/1/0
  ip pim sparse-dense-mode
interface Bundle 1
  ip pim sparse-mode
  ip igmp version 3
```

Example: Configuring Multicast QoS

Note A default service class and GQC must be defined before proceeding with configuring Multicast QoS.

In the following example, Multicast QoS is configured. You should define three objects and templates and then associate these to a particular bundle or forwarding interface. The objects are Service-Class, Group-QoS-Config (GQC), and Group-Config.

```
cable service class 1 name MQOS_DEFAULT
cable service class 1 downstream
cable service class 1 max-rate 10000000
cable service class 1 min-rate 1000000
cable multicast group-qos default scn MQOS_DEFAULT aggregate
cable multicast group-qos 10 scn MQOS single
cable multicast qos group 20 priority 1
application-id 10
session-range 230.0.0.0 255.0.0.0
tos 1 6 15
vrf name1
cable multicast qos group 20 priority 63 global
```

Example: Configuring Forwarding Interface Selection Based on Service Flow Attribute

In the following example, the service flow attribute-based Forwarding Interface Selection is configured. To send multicast traffic for group 230.1.1.1, interface W6/0/0:0 is selected. The multicast QoS parameters are taken from group qos 1 (effectively from service class “mcast10”).

```
cable service class 10 name mcast10
cable service class 10 downstream
cable service class 10 max-rate 1000000
cable service class 10 min-rate 1000000
cable service class 10 req-attr-mask 8000000F
cable service class 10 forb-attr-mask 7FFFFFF0
cable multicast group-qos 1 scn mcast10 aggregate
cable multicast qos group 1 priority 1
session-range 230.1.1.1 255.255.255.255
 group-qos 1
interface Bundle1
 ip address 40.1.1.1 255.255.255.0
 ip pim sparse-mode
 ip helper-address 2.39.16.1
 cable multicast-qos group 1
end
interface Wideband-Cable6/0/0:0
cable bundle 10
cable rf-channels channel-list 0-7 bandwidth-percent 20
cable downstream attribute-mask 8000000F
end
```

Example: Configuring Multicast Replication Session

The following example shows how to enable the multicast replication session on each L2 forwarding interface.

```
enable
conf t
interface xxx

[no|default] cable multicast ses-cache
 cable multicast ses-cache 3
```

Additional References

The following sections provide references related to the DOCSIS 3.0 Multicast Support on the CMTS Routers.

Related Documents

Related Topic	Document Title
CMTS cable commands	http://www.cisco.com/en/US/docs/ios/cable/command/reference/cbl_book.htmlCisco IOS CMTS Cable Command Reference
Multicast VPN and DOCSIS 3.0 Multicast QoS	Multicast VPN and DOCSIS 3.0 Multicast QoS Support

Related Topic	Document Title
DOCSIS 3.0 QoS Support	DOCSIS WFQ Scheduler on the Cisco CMTS Routers

Standards

Standard	Title
CM-SP-CMCIv3-I01-080320	Cable Modem to Customer Premise Equipment Interface Specification
CM-SP-MULPIv3.0-I08-080522	MAC and Upper Layer Protocols Interface Specification
CM-SP-OSSIv3.0-I07-080522	Operations Support System Interface Specification
CM-SP-PHYv3.0-I07-080522	Physical Layer Specification
CM-SP-SECv3.0-I08-080522	Security Specification

MIBs

MIB[1]	MIBs Link
• DOCS-MCAST-AUTH-MIB • DOCS-MCAST-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

[1] Not all supported MIBs are listed.

RFCs

RFC	Title
No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature.	—

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 DOCSIS 3.0 Multicast Support

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 2: Feature Information for DOCSIS 3.0 Multicast Support

Feature Name	Releases	Feature Information
DOCSIS 3.0 Multicast Support	Cisco IOS XE Fuji 16.7.1	This feature was integrated into the Cisco cBR Series Converged Broadband Routers.
Dynamic Multicast Replication Sessions	Cisco IOS XE Fuji 16.7.1	This feature was integrated into the Cisco cBR Series Converged Broadband Routers.