# Understanding Cisco's Implementation of IP Multicast Routing



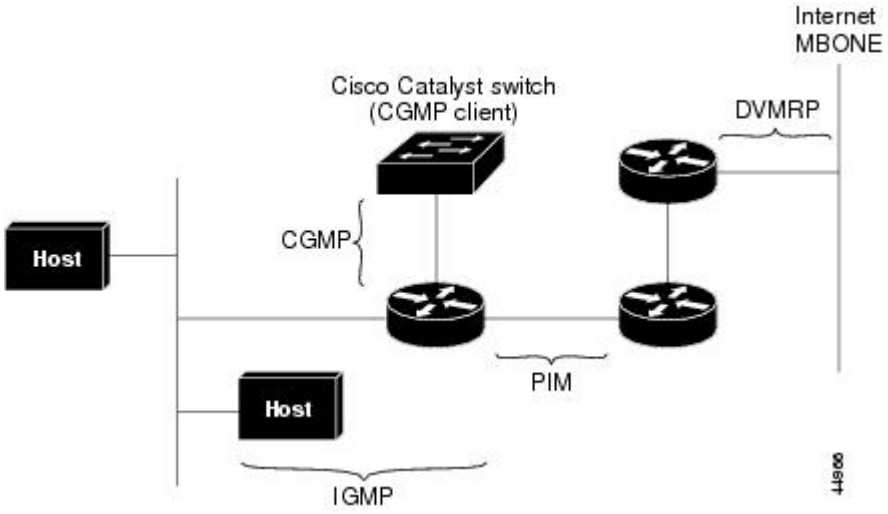
## Cisco's Implementation of IP Multicast Routing

Cisco IOS software supports the following protocols to implement IP multicast routing:

- Internet Group Management Protocol (IGMP) is used among hosts on a LAN and the routers (and multilayer switches) on that LAN to track the multicast groups of which hosts are members.
- Protocol-Independent Multicast (PIM) protocol is used among routers and multilayer switches to track which multicast packets to forward to each other and to their directly connected LANs.
- Distance Vector Multicast Routing Protocol (DVMRP) is used on the multicast backbone of the Internet (MBONE). The software supports PIM-to-DVMRP interaction.
- Cisco Group Management Protocol (CGMP) is used on Cisco routers and multilayer switches connected to Layer 2 Catalyst switches to perform tasks similar to those performed by IGMP.

The following figure shows where these protocols operate within the IP multicast environment.

***Figure 1: IP Multicast Routing Protocols***




According to IPv4 multicast standards, the MAC destination multicast address begins with 0100:5e and is appended by the last 23 bits of the IP address. For example, if the IP destination address is 239.1.1.39, the MAC destination address is 0100:5e01:0127.

A multicast packet is unmatched when the destination IPv4 address does not match the destination MAC address. The switch forwards the unmatched packet in hardware based on the MAC address table. If the destination MAC address is not in the MAC address table, the switch floods the packet to the all port in the same VLAN as the receiving port.

# Information About IGMP

To participate in IP multicasting, multicast hosts, routers, and multilayer switches must have the Internet Group Management Protocol (IGMP) operating. This protocol defines the querier and host roles:

- A querier is a network device that sends query messages to discover which network devices are members of a given multicast group.
- A host is a receiver that sends report messages (in response to query messages) to inform a querier of a host membership.

A set of queriers and hosts that receive multicast data streams from the same source is called a multicast group. Queriers and hosts use IGMP messages to join and leave multicast groups.

Any host, regardless of whether it is a member of a group, can send to a group. However, only the members of a group receive the message. Membership in a multicast group is dynamic; hosts can join and leave at any time. There is no restriction on the location or number of members in a multicast group. A host can be a member of more than one multicast group at a time. How active a multicast group is and what members it has can vary from group to group and from time to time. A multicast group can be active for a long time, or it can be very short-lived. Membership in a group can constantly change. A group that has members can have no activity.

# IGMP Versions

The switch supports IGMP version 1, IGMP version 2, and IGMP version 3. These versions are interoperable on the switch. For example, if IGMP snooping is enabled and the querier's version is IGMPv2. and the switch receives an IGMPv3 report from a host, then the switch can forward the IGMPv3 report to the multicast router.

## IGMP Version 1

IGMP version 1 (IGMPv1) primarily uses a query-response model that enables the multicast router and multilayer switch to find which multicast groups are active (have one or more hosts interested in a multicast group) on the local subnet. IGMPv1 has other processes that enable a host to join and leave a multicast group. For more information, see RFC 1112.

## IGMP Version 2

IGMPv2 extends IGMP functionality by providing such features as the IGMP leave process to reduce leave latency, group-specific queries, and an explicit maximum query response time. IGMPv2 also adds the capability for routers to elect the IGMP querier without depending on the multicast protocol to perform this task. For more information, see RFC 2236.

**Note** IGMP version 2 is the default version for the switch.

# Default IGMP Configuration

This table displays the default IGMP configuration for the switch.

***Table 1: Default IGMP Configuration***

| Feature | Default Setting |
|---|---|
| Multilayer switch as a member of a multicast group | No group memberships are defined. |
| Access to multicast groups | All groups are allowed on an interface. |
| IGMP version | Version 2 on all interfaces. |
| IGMP host-query message interval | 60 seconds on all interfaces. |
| IGMP query timeout | 60 seconds on all interfaces. |
| IGMP maximum query response time | 10 seconds on all interfaces. |
| Multilayer switch as a statically connected member | Disabled. |

# Configuring Optional IGMP Features

## Configuring the Switch as a Member of a Group

You can configure the switch as a member of a multicast group and discover multicast reachability in a network. If all the multicast-capable routers and multilayer switches that you administer are members of a multicast group, pinging that group causes all of these devices to respond. The devices respond to ICMP echo-request packets addressed to a group of which they are members. Another example is the multicast trace-route tools provided in the software.

**Caution** Performing this procedure might impact the CPU performance because the CPU will receive all data traffic for the group address.

This procedure is optional.

### SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp join-group** *group-address*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

### DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br><br>**Example:**<br>`Switch# configure terminal` | Enters the global configuration mode. |
| **Step 2** | **interface** *interface-id*<br><br>**Example:**<br>`Switch(config)# interface gigabitethernet 1/0/1` | Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode. |
| **Step 3** | **ip igmp join-group** *group-address*<br><br>**Example:**<br>`Switch(config-if)# ip igmp` | Configures the switch to join a multicast group.<br>By default, no group memberships are defined.<br>For *group-address*, specify the multicast IP address in dotted decimal notation. |

| | Command or Action | Purpose |
|---|---|---|
| | `join-group 225.2.2.2` | **Note** To cancel membership in a group, use the **no ip igmp join-group** *group-address* interface configuration command. |
| **Step 4** | **end**<br><br>**Example:**<br><br>`Switch(config-if)# end` | Returns to privileged EXEC mode. |
| **Step 5** | **show ip igmp interface** [*interface-id*]<br><br>**Example:**<br><br>`Switch# show ip igmp interface` | Verifies your entries. |
| **Step 6** | **copy running-config startup-config**<br><br>**Example:**<br><br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

### Related Topics

Example: Configuring the Switch as a Member of a Multicast Group, on page 14

# Controlling Access to IP Multicast Group

The switch sends IGMP host-query messages to find which multicast groups have members on attached local networks. The switch then forwards to these group members all packets addressed to the multicast group. You can place a filter on each interface to restrict the multicast groups that hosts on the subnet serviced by the interface can join.

This procedure is optional.

## SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp access-group** *access-list-number*
4. **exit**
5. **access-list** *access-list-number* {**deny** | **permit**} *source* [*source-wildcard*]
6. **end**
7. **show ip igmp interface** [*interface-id*]

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br><br>**Example:**<br><br>`Switch# configure terminal` | Enters the global configuration mode. |
| **Step 2** | **interface** *interface-id*<br><br>**Example:**<br><br>`Switch(config)# interface GigabitEthernet 1/0/12` | Specifies the interface to be configured, and enters interface configuration mode. |
| **Step 3** | **ip igmp access-group** *access-list-number*<br><br>**Example:**<br><br>`Switch(config-if)# ip igmp access-group 10` | Specifies the multicast groups that hosts on the subnet serviced by an interface can join.<br><br>By default, all groups are allowed on an interface.<br><br>For *access-list-number*, specify an IP standard access list number.<br><br>The range is 1 to 199.<br><br>**Note** To disable groups on an interface, use the **no ip igmp access-group** interface configuration command. |
| **Step 4** | **exit**<br><br>**Example:**<br><br>`Switch(config-if)# exit` | Returns to global configuration mode. |
| **Step 5** | **access-list** *access-list-number* {**deny** \| **permit**} *source* [*source-wildcard*]<br><br>**Example:**<br><br>`Switch(config)# access-list 10 permit` | Creates a standard access list.<br><br>• For *access-list-number*, specify the access list created in Step 3.<br><br>• The **deny** keyword denies access if the conditions are matched. The **permit** keyword permits access if the conditions are matched.<br><br>• For *source*, specify the multicast group that hosts on the subnet can join.<br><br>• (Optional) For *source-wildcard*, enter the wildcard bits in dotted decimal notation to be applied to the source. Place ones in the bit positions that you want to ignore.<br><br>Recall that the access list is always terminated by an implicit deny statement for everything. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 6** | **end**<br><br>**Example:**<br>`Switch(config-igmp-profile)# end` | Returns to privileged EXEC mode. |
| **Step 7** | **show ip igmp interface** [*interface-id*]<br><br>**Example:**<br>`Switch# show ip igmp interface` | Verifies your entries. |

**Related Topics**

Example: Controlling Access to IP Multicast Groups, on page 15

# Changing the IGMP Version

By default, the switch uses IGMP Version 2, which provides features such as the IGMP query timeout and the maximum query response time.

All systems on the subnet must support the same version. The switch does not automatically detect Version 1 systems and switch to Version 1. You can mix Version 1 and Version 2 hosts on the subnet because Version 2 routers or switches always work correctly with IGMPv1 hosts.

Configure the switch for Version 1 if your hosts do not support Version 2.

This procedure is optional.

## SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp version** {**1** | **2** | **3** }
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

**DETAILED STEPS**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br><br>**Example:**<br><br>`Switch# configure terminal` | Enters the global configuration mode. |
| **Step 2** | **interface** *interface-id*<br><br>**Example:**<br><br>`Switch(config)# interface gigabitethernet 1/0/1` | Specifies the interface to be configured, and enters the interface configuration mode. |
| **Step 3** | **ip igmp version** {**1** \| **2** \| **3** }<br><br>**Example:**<br><br>`Switch(config-if)# ip igmp version 2` | Specifies the IGMP version that the switch uses.<br>**Note** If you change to Version 1, you cannot configure the **ip igmp query-interval** or the **ip igmp query-max-response-time** interface configuration commands.<br>To return to the default setting, use the **no ip igmp version** interface configuration command. |
| **Step 4** | **end**<br><br>**Example:**<br><br>`Switch(config-if)# end` | Returns to privileged EXEC mode. |
| **Step 5** | **show ip igmp interface** [*interface-id*]<br><br>**Example:**<br><br>`Switch# show ip igmp interface` | Verifies your entries. |
| **Step 6** | **copy running-config startup-config**<br><br>**Example:**<br><br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

# Modifying the IGMP Host-Query Message Interval

The switch periodically sends IGMP host-query messages to discover which multicast groups are present on attached networks. These messages are sent to the all-hosts multicast group (224.0.0.1) with a time-to-live

(TTL) of 1. The switch sends host-query messages to refresh its knowledge of memberships present on the network. If, after some number of queries, the software discovers that no local hosts are members of a multicast group, the software stops forwarding multicast packets to the local network from remote origins for that group and sends a prune message upstream toward the source.

The switch elects a PIM designated router (DR) for the LAN (subnet). The DR is the router or multilayer switch with the highest IP address for IGMPv2. For IGMPv1, the DR is elected according to the multicast routing protocol that runs on the LAN. The designated router is responsible for sending IGMP host-query messages to all hosts on the LAN. In sparse mode, the designated router also sends PIM register and PIM join messages toward the RP router.

This procedure is optional.

## SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp query-interval** *seconds*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br><br>**Example:**<br><br>`Switch# configure terminal` | Enters the global configuration mode. |
| **Step 2** | **interface** *interface-id*<br><br>**Example:**<br><br>`Switch(config)# interface gigabitethernet 1/0/1` | Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode. |
| **Step 3** | **ip igmp query-interval** *seconds*<br><br>**Example:**<br><br>`Switch(config-if)# ip igmp query-interval 75` | Configures the frequency at which the designated router sends IGMP host-query messages.<br><br>By default, the designated router sends IGMP host-query messages every 60 seconds to keep the IGMP overhead very low on hosts and networks.<br><br>The range is 1 to 18000.<br><br>**Note** To return to the default setting, use the **no ip igmp query-interval** interface configuration command. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 4** | **end**<br><br>**Example:**<br>`Switch(config-if)# end` | Returns to privileged EXEC mode. |
| **Step 5** | **show ip igmp interface** [*interface-id*]<br><br>**Example:**<br>`Switch# show ip igmp interface` | Verifies your entries. |
| **Step 6** | **copy running-config startup-config**<br><br>**Example:**<br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

# Changing the IGMP Query Timeout for IGMPv2

If you are using IGMPv2, you can specify the period of time before the switch takes over as the querier for the interface. By default, the switch waits twice the query interval period controlled by the **ip igmp query-interval** interface configuration command. After that time, if the switch has received no queries, it becomes the querier.

This procedure is optional.

## SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp querier-timeout** *seconds*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

**DETAILED STEPS**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br><br>**Example:**<br><br>`Switch# configure terminal` | Enters the global configuration mode. |
| **Step 2** | **interface** *interface-id*<br><br>**Example:**<br><br>`Switch(config)# interface gigabitethernet 1/0/1` | Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode. |
| **Step 3** | **ip igmp querier-timeout** *seconds*<br><br>**Example:**<br><br>`Switch(config-if)# ip igmp querier-timeout 120` | Specifies the IGMP query timeout.<br><br>The default is 60 seconds (twice the query interval). The range is 60 to 300.<br><br>**Note** To return to the default setting, use the **no ip igmp querier-timeout** interface configuration command. |
| **Step 4** | **end**<br><br>**Example:**<br><br>`Switch(config-if)# end` | Returns to privileged EXEC mode. |
| **Step 5** | **show ip igmp interface** [*interface-id*]<br><br>**Example:**<br><br>`Switch# show ip igmp interface` | Verifies your entries. |
| **Step 6** | **copy running-config startup-config**<br><br>**Example:**<br><br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

# Changing the Maximum Query Response Time for IGMPv2

If you are using IGMPv2, you can change the maximum query response time advertised in IGMP queries. The maximum query response time enables the switch to quickly detect that there are no more directly connected group members on a LAN. Decreasing the value enables the switch to prune groups faster.

This procedure is optional.

## SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp query-max-response-time** *seconds*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br><br>**Example:**<br><br>`Switch# configure terminal` | Enters the global configuration mode. |
| **Step 2** | **interface** *interface-id*<br><br>**Example:**<br><br>`Switch(config)# interface gigabitethernet 1/0/1` | Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode. |
| **Step 3** | **ip igmp query-max-response-time** *seconds*<br><br>**Example:**<br><br>`Switch(config-if)# ip igmp query-max-response-time 15` | Changes the maximum query response time advertised in IGMP queries.<br><br>The default is 10 seconds. The range is 1 to 25.<br><br>**Note** To return to the default setting, use the **no ip igmp query-max-response-time** interface configuration command. |
| **Step 4** | **end**<br><br>**Example:**<br><br>`Switch(config-if)# end` | Returns to privileged EXEC mode. |
| **Step 5** | **show ip igmp interface** [*interface-id*]<br><br>**Example:**<br><br>`Switch# show ip igmp interface` | Verifies your entries. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 6** | **copy running-config startup-config**<br><br>**Example:**<br><br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

# Configuring the Switch as a Statically Connected Member

At various times, either there is not a group member on a network segment or a host that cannot report its group membership by using IGMP. However, you may want multicast traffic to be sent to that network segment. The following commands are used to pull multicast traffic down to a network segment:

- **ip igmp join-group—**The switch accepts the multicast packets in addition to forwarding them. Accepting the multicast packets prevents the switch from fast switching.
- **ip igmp static-group—**The switch does not accept the packets itself, but only forwards them. This method enables fast switching. The outgoing interface appears in the IGMP cache, but the switch itself is not a member, as evidenced by lack of an L (local) flag in the multicast route entry.

This procedure is optional.

## SUMMARY STEPS

1. **configure terminal**
2. **interface** *interface-id*
3. **ip igmp static-group** *group-address*
4. **end**
5. **show ip igmp interface** [*interface-id*]
6. **copy running-config startup-config**

## DETAILED STEPS

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure terminal**<br><br>**Example:**<br><br>`Switch# configure terminal` | Enters the global configuration mode. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 2** | **interface** *interface-id*<br><br>**Example:**<br><br>`Switch(config)# interface gigabitethernet 1/0/1` | Specifies the interface on which you want to enable multicast routing, and enters interface configuration mode. |
| **Step 3** | **ip igmp static-group** *group-address*<br><br>**Example:**<br><br>`Switch(config-if)# ip igmp static-group 239.100.100.101` | Configures the switch as a statically connected member of a group.<br><br>By default, this feature is disabled.<br><br>**Note** To remove the switch as a member of the group, use the **no ip igmp static-group** *group-address* interface configuration command. |
| **Step 4** | **end**<br><br>**Example:**<br><br>`Switch(config-if)# end` | Returns to privileged EXEC mode. |
| **Step 5** | **show ip igmp interface** [*interface-id*]<br><br>**Example:**<br><br>`Switch# show ip igmp interface gigabitethernet 1/0/1` | Verifies your entries. |
| **Step 6** | **copy running-config startup-config**<br><br>**Example:**<br><br>`Switch# copy running-config startup-config` | (Optional) Saves your entries in the configuration file. |

# Configuration Examples for IGMP Features

## Example: Configuring the Switch as a Member of a Multicast Group

This example shows how to enable the switch to join multicast group 255.2.2.2:

```
Switch(config)# interface gigabitethernet1/0/1
Switch(config-if)# ip igmp join-group 255.2.2.2
Switch(config-if)#
```

### Related Topics

Configuring the Switch as a Member of a Group, on page 4

## Example: Controlling Access to IP Multicast Groups

This example shows how to configure hosts attached to a port as able to join only group 255.2.2.2:

```
Switch(config)# access-list 1 255.2.2.2 0.0.0.0
Switch(config-if)# interface gigabitethernet1/0/1
Switch(config-if)# ip igmp access-group 1
```

### Related Topics

Controlling Access to IP Multicast Group, on page 5

# Where to Go Next

You can configure the following for your IP multicast configuration:

- CGMP feature support
- PIM feature support
- SSM feature support
- IP Multicast Routing

# Additional References

### Related Documents

| Related Topic | Document Title |
|---|---|
| For complete syntax and usage information for the commands used in this book. | *Catalyst 2960-XR Switch IP Multicast Command Reference* |

### Standards and RFCs

| Standard/RFC | Title |
|---|---|
| RFC 1112 | *Host Extensions for IP Multicasting* |
| RFC 2236 | *Internet Group Management Protocol, Version 2* |

### MIBs

| MIB | MIBs Link |
|---|---|
| All supported MIBs for this release. | To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:<br>http://www.cisco.com/go/mibs |

### 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.<br>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.<br>Access to most tools on the Cisco Support website requires a Cisco.com user ID and password. | http://www.cisco.com/support |