Chapter 7
Configuring IP Multicast Protocols

This chapter describes how to configure HP routing switches for Protocol Independent Multicast (PIM) and Distance Vector Multicast Routing Protocol (DVMRP). HP routing switches support RFC 1075 for DVMRP and PIM Dense (PIM-DM). They also support RFC 2362 for PIM Sparse (PIM-SM).

A summary of all CLI commands discussed in this chapter can also be found in the *Command Line Interface Reference*.

Overview of IP Multicasting

Multicast protocols allow a group or channel to be accessed over different networks by multiple stations (clients) for the receipt and transmit of multicast data.

Distribution of stock quotes, video transmissions such as news services and remote classrooms, and video conferencing are all examples of applications that use multicast routing.

The HP 9304M, HP 9308M, and HP 6208M-SX routing switches support two different multicast routing protocols—Distance Vector Multicast Routing Protocol (DVMRP) and Protocol-Independent Multicast (PIM) protocol along with the Internet Group Membership Protocol (IGMP).

PIM and DVMRP are broadcast and pruning multicast protocols that deliver IP multicast datagrams. The protocols employ reverse path lookup check and pruning to allow source-specific multicast delivery trees to reach all group members. DVMRP and PIM build a different multicast tree for each source and destination host group.

NOTE: Both DVMRP and PIM can concurrently operate on different ports of a routing switch.

Multicast Terms

The following are commonly used terms in discussing multicast-capable routers. These terms are used throughout this chapter:

Node: Refers to a router.

Root Node: The node that initiates the tree building process. It is also the router that sends the multicast packets down the multicast delivery tree.

Upstream: Represents the direction from which a router receives multicast data packets. An ***upstream router*** is a node that sends multicast packets.

Downstream: Represents the direction to which a router forwards multicast data packets. A ***downstream router*** is a node that receives multicast packets from upstream transmissions.

Group Presence: Means that a mulitcast group has been learned from one of the directly connected interfaces. Members of the multicast group are present on the router.

Intermediate nodes: Routers that are in the path between source routers and leaf routers.

Leaf nodes: Routers that do not have any downstream routers.

Multicast Tree: A unique tree is built for each source group (S,G) pair. A multicast tree is comprised of a root node and one or more nodes that are leaf or intermediate nodes.

Changing Global IP Multicast Parameters

IGMP allows routers to limit the multicast of IGMP packets to only those ports on the router that are identified as IP Multicast members.

The router actively sends out host queries to identify IP Multicast groups on the network, inserts the group information in an IGMP packet, and forwards the packet to IP Multicast neighbors.

The following parameters apply to PIM and DVMRP:

- IGMP query interval – Specifies how often the routing switch queries an interface for group membership. Possible values are 1 – 3600. The default is 60.
- IGMP group membership time – Specifies how many seconds an IP Multicast group can remain on a routing switch interface in the absence of a group report. Possible values are 1 – 7200. The default is 60.
- IGMP maximum response time – Specifies how many seconds the routing switch will wait for an IGMP response from an interface before concluding that the group member on that interface is down and removing the interface from the group. Possible values are 1 – 10. The default is 10.

To change these parameters, you must first enter the following CLI command at the global CLI level:

```
HP9300(config)# ip multicast-routing
```

Syntax: [no] ip multicast-routing

NOTE: You must enter the **ip multicast-routing** command before changing the global IP Multicast parameters. Otherwise, the changes do not take effect and the software uses the default values.

Modifying IGMP Query Interval Period

The IGMP query interval period defines how often a router will query an interface for group membership. Possible values are 1 – 3,600 seconds and the default value is 60 seconds.

USING THE CLI

To modify the default value for the IGMP query interval, enter the following:

```
HP9300(config)# ip igmp query 120
```

Syntax: ip igmp query-interval <1-3600>

USING THE WEB MANAGEMENT INTERFACE

To modify the default value for the IGMP query interval:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Click on the plus sign next to DVMRP in the tree view to display the DVMRP configuration options.
4. Select the IGMP link to display the IGMP configuration panel.
5. Enter a value from 1 – 3600 in the Query Interval field.
6. Click the Apply button to save the change to the device's running-config file.

7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying IGMP Membership Time

Group membership time defines how long a group will remain active on an interface in the absence of a group report. Possible values are from 1 – 7200 seconds and the default value is 140 seconds.

USING THE CLI

To define an IGMP membership time of 240 seconds, enter the following:

```
HP9300(config)# ip igmp group-membership-time 240
```

Syntax: ip igmp group-membership-time <1-7200>

USING THE WEB MANAGEMENT INTERFACE

To modify the default value for the IGMP membership time, you would do the following:

1. Log on to the device using a valid user name and password for read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Configure in the tree view to display the configuration options.
3. Click on the plus sign next to DVMRP in the tree view to display the DVMRP configuration options.
4. Select the IGMP link to display the IGMP configuration panel.
5. Enter a value from 1 – 7200 in the Group Membership Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying IGMP Maximum Response Time

Maximum response time defines how long the routing switch will wait for an IGMP response from an interface before concluding that the group member on that interface is down and removing the interface from the group. Possible values are 1 – 10. The default is 10.

USING THE CLI

To change the maximum response time to 5 seconds, enter the following:

```
HP9300(config)# ip igmp max-response-time 5
```

Syntax: ip igmp max-response-time <1-10>

USING THE WEB MANAGEMENT INTERFACE

You cannot change this parameter using the Web management interface.

Disabling IGMP Queries on Individual Ports

By default, all ports are enabled to send and receive IGMP queries. To disable IGMP queries on a port, enter commands such as the following:

USING THE CLI

```
HP9300(config)# int e 1/5

HP9300(config-if-1/5) ip-multicast-disable
```

Syntax: [no] ip-multicast-disable

USING THE WEB MANAGEMENT INTERFACE

You cannot disable IGMP queries on a port using the Web management interface.

PIM Dense Overview

NOTE: This section describes the "dense" mode of PIM, described in RFC 1075. See "PIM Sparse Overview" on page 7-12 for information about PIM Sparse.

PIM was introduced to simplify some of the complexity of the routing protocol at the cost of additional overhead tied with a greater replication of forwarded multicast packets. PIM is similar to DVMRP in that PIM builds source-routed multicast delivery trees and employs reverse path check when forwarding multicast packets.

There are two modes in which PIM operates: Dense and Sparse. The Dense Mode is suitable for densely populated multicast groups, primarily in the LAN environment. The Sparse Mode is suitable for sparsely populated multicast groups with the focus on WAN.

PIM primarily differs from DVMRP by using the IP routing table instead of maintaining its own, thereby being routing protocol independent.

Initiating PIM Multicasts on a Network

Once PIM is enabled on each router, a network user can begin a video conference multicast from the server on R1. When a multicast packet is received on a PIM-capable router interface, the interface checks its IP routing table to determine whether the interface that received the message provides the shortest path back to the source. If the interface does provide the shortest path back to the source, the multicast packet is then forwarded to all neighboring PIM routers. Otherwise, the multicast packet is discarded and a prune message is sent back upstream.

In Figure 7.1, the root node (R1) is forwarding multicast packets for group 229.225.0.1, which it receives from the server, to its downstream nodes, R2, R3, and R4. Router R4 is an intermediate router with R5 and R6 as its downstream routers. Because R5 and R6 have no downstream interfaces, they are leaf nodes. The receivers in this example are those workstations that are resident on routers R2, R3, and R6.

Pruning a Multicast Tree

As multicast packets reach these leaf routers, the routers check their IGMP databases for the group. If the group is not in a router's IGMP database, the router discards the packet and sends a prune message to the upstream router. The router that discarded the packet also maintains the prune state for the source, group (S,G) pair. The branch is then pruned (removed) from the multicast tree. No further multicast packets for that specific (S,G) pair will be received from that upstream router until the prune state expires. You can configure the PIM Prune Timer (the length of time that a prune state is considered valid).

For example, in Figure 7.1 the sender with address 207.95.5.1 is sending multicast packets to the group 229.225.0.1. If a PIM router receives any groups other than that group, the router discards the group and sends a prune message to the upstream PIM router.

In Figure 7.2, Router R5 is a leaf node with no group members in its IGMP database. Therefore, the router must be pruned from the multicast tree. R5 sends a prune message upstream to its neighbor router R4 to remove itself from the multicast delivery tree and install a prune state, as seen in Figure 7.2. Router 5 will not receive any further multicast traffic until the prune age interval expires.

When a node on the multicast delivery tree has all of its downstream branches (downstream interfaces) in the prune state, a prune message is sent upstream. In the case of R4, if both R5 and R6 are in a prune state at the same time, R4 becomes a leaf node with no downstream interfaces and sends a prune message to R1. With R4 in a prune state, the resulting multicast delivery tree would consist only of leaf nodes R2 and R3.

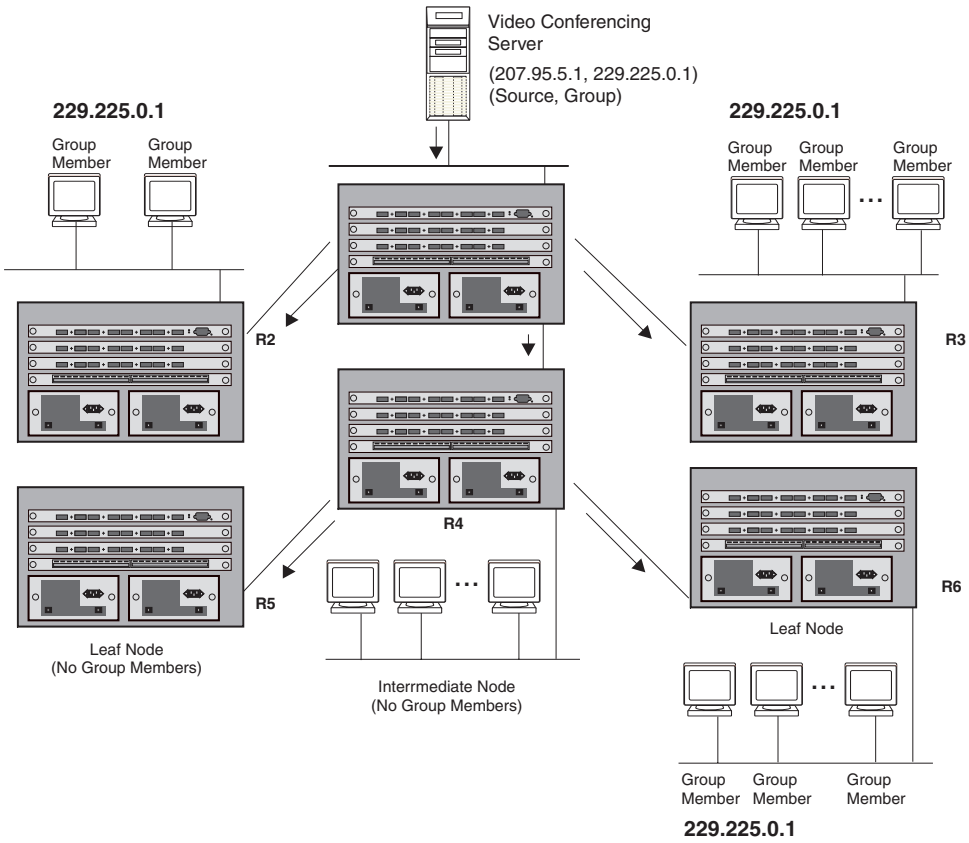


Figure 7.1 Transmission of multicast packets from the source to host group members

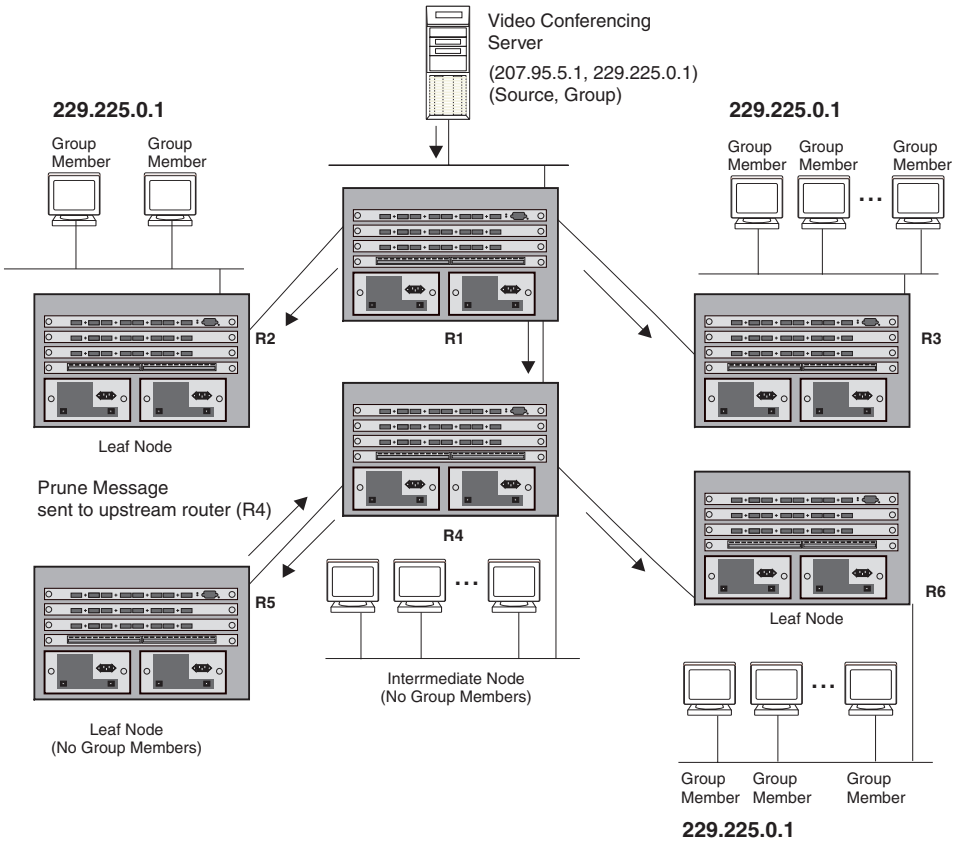


Figure 7.2 Pruning leaf nodes from a multicast tree

Grafts to a Multicast Tree

A PIM router restores pruned branches to a multicast tree by sending graft messages towards the upstream router. Graft messages start at the leaf node and travel up the tree, first sending the message to its neighbor upstream router.

In the example above, if a new 229.255.0.1 group member joins on router R6, which was previously pruned, a graft is sent upstream to R4. Since the forwarding state for this entry is in a prune state, R4 sends a graft to R1. Once R4 has joined the tree, R4 along with R6 once again receive multicast packets.

Prune and graft messages are continuously used to maintain the multicast delivery tree. No configuration is required on your part.

Configuring PIM

NOTE: This section describes how to configure the "dense" mode of PIM, described in RFC 1075. See "Configuring PIM Sparse" on page 7-14 for information about configuring PIM Sparse.

Enabling PIM on the Routing Switch and an Interface

By default, PIM is disabled. To enable PIM:

- Enable the feature globally.
- Configure the IP interfaces that will use PIM.
- Enable PIM locally on the ports that contain the IP interfaces you are using for PIM.
- Reload the software to place PIM into effect.

EXAMPLE:

Suppose you want to initiate the use of desktop video for fellow users on a sprawling campus network. All destination workstations have the appropriate hardware and software but the routers that connect the various buildings need to be configured to support PIM multicasts from the designated video conference server as shown in Figure 7.1.

PIM is enabled on each of the routing switches shown in Figure 7.1, on which multicasts are expected. You can enable PIM on each routing switch independently or remotely from one of the routing switches with a Telnet connection. Follow the same steps for each routing switch. A reset of the routing switch is required when PIM is first enabled. Thereafter, all changes are dynamic.

USING THE CLI

EXAMPLE:

To enable PIM on router1 and interface 3, enter the following:

```
HP9300(config)# router pim
HP9300(config)# int e 3
HP9300(config-if-3)# ip address 207.95.5.1/24
HP9300(config-if-3)# ip pim
HP9300(config-if-3)# end
HP9300# reload
```

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the Virtual Interface link to display the PIM Interface configuration panel.

   NOTE: If the device already has PIM interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Virtual Interface link to display the PIM Interface configuration panel.

6. Select the interface type. You can select Subnet or Tunnel.
7. Select the IP address of the interface being configured from the Local Address pulldown menu.

8. If you are configuring an IP Tunnel, enter the IP address of the destination interface, the end point of the IP Tunnel, in the Remote Address field. IP tunneling must also be enabled and defined on the destination router interface as well.

   NOTE: The Remote Address field applies only to tunnel interfaces, not to sub-net interfaces.

9. Modify the time to live threshold (TTL) if necessary. The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface.

   NOTE: For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible values are 1 – 64. The default value is 1.

10. Click the Add button to save the change to the device's running-config file.
11. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
12. Click on the plus sign next to Command in the tree view to list the command options.
13. Select the Reload link and select Yes when prompted to reload the software. You must reload after enabling PIM to place the change into effect. If PIM was already enabled when you added the interface, you do not need to reload.

Modifying PIM Global Parameters

PIM global parameters come with preset values. The defaults work well in most networks, but you can modify the following parameters if you need to:

- Neighbor timeout
- Hello timer
- Prune timer
- Graft retransmit timer
- Inactivity timer

Modifying Neighbor Timeout

Neighbor timeout is the interval after which a PIM router will consider a neighbor to be absent. Absence of PIM hello messages from a neighboring router indicates that a neighbor is not present.

The default value is 180 seconds.

USING THE CLI

To apply a PIM neighbor timeout value of 360 seconds to all ports on the routing switch operating with PIM, enter the following:

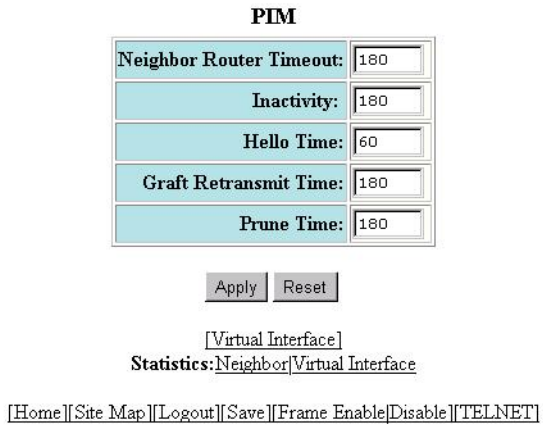
```
HP9300(config)# router pim
HP9300(config-pim-router)# pim-nbr-timeout 360
```

Syntax: pim-nbr-timeout <60-8000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.

4. Click on the General link to display the PIM configuration panel, as shown in the following example.



5. Click the Apply button to save the change to the device's running-config file.
6. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Hello Timer

This parameter defines the time interval at which periodic hellos are sent out PIM interfaces. Routers use hello messages to inform neighboring routers of their presence. The default rate is 60 seconds.

USING THE CLI

To apply a PIM hello timer of 120 seconds to all ports on the routing switch operating with PIM, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# pim-hello-timer 120
```

Syntax: pim-hello-timer <10-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 in the Hello Time field.
7. Click the Apply button to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Prune Timer

This parameter defines how long a PIM router will maintain a prune state for a forwarding entry.

The first received multicast interface is forwarded to all other PIM interfaces on the routing switch. If there is no presence of groups on that interface, the leaf node sends a prune message upstream and stores a prune state. This prune state travels up the tree and installs a prune state.

A prune state is maintained until the prune timer expires or a graft message is received for the forwarding entry. The default value is 180 seconds.

USING THE CLI

To set the PIM prune timer to 90, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# pim-prune-timer 90
```

Syntax: pim-prune-timer <10-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 into the Prune Time field.
7. Click the Apply button to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Graft Retransmit Timer

The Graft Retransmit Timer defines the interval between the transmission of graft messages.

A graft message is sent by a router to cancel a prune state. When a router receives a graft message, the router responds with a Graft Ack (acknowledge) message. If this Graft Ack message is lost, the router that sent the graft message will resend it.

USING THE CLI

To change the graft retransmit timer from the default of 180 to 90 seconds, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# pim-graft-retransmit-timer 90
```

Syntax: pim-graft-retransmit-timer <10-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 into the Graft Retransmit Time field.
7. Click the Apply button to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Inactivity Timer

The routing switch deletes a forwarding entry if the entry is not used to send multicast packets. The PIM inactivity timer defines how long a forwarding entry can remain unused before the routing switch deletes it.

USING THE CLI

To apply a PIM inactivity timer of 90 seconds to all PIM interfaces, enter the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# pim-inactivity-timer 90
```

Syntax: pim-inactivity-timer <10-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled PIM, enable it by clicking on the Enable radio button next to PIM on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
5. Click on the General link to display the PIM configuration panel
6. Enter a value from 10 – 3600 into the Inactivity field.
7. Click the Apply button to save the change to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying PIM Interface Parameters

TTL is the only interface parameter for PIM. TTL defines the minimum value required in a packet for it to be forwarded out of the interface.

For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible TTL values are 1 to 64. The default TTL value is 1.

USING THE CLI

To configure a TTL of 45, enter the following:

```
HP9300(config-pim-router)# ip pim ttl 45
```

Syntax: ip pim ttl <1-64>

USING THE WEB MANAGEMENT INTERFACE

To modify the PIM interface parameters:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
4. Select the Virtual Interface link to display a table listing the configured PIM Interfaces.
5. Click on the Modify button next to the interface you want to modify. The PIM Interface configuration panel is displayed.
6. Modify the parameters as needed.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

PIM Sparse Overview

Software release 06.x contains support for Protocol Independent Multicast (PIM) Sparse version 2. PIM Sparse provides multicasting that is especially suitable for widely distributed multicast environments. The HP implementation is based on RFC 2362.

In a PIM Sparse network, a PIM Sparse router that is connected to a host that wants to receive information for a multicast group must explicitly send a join request on behalf of the receiver (host).

PIM Sparse routers are organized into domains. A PIM Sparse domain is a contiguous set of routers that all implement PIM and are configured to operate within a common boundary. Figure 7.3 shows a simple example of a PIM Sparse domain. This example shows three routing switches configured as PIM Sparse routers. The configuration is described in detail following the figure.

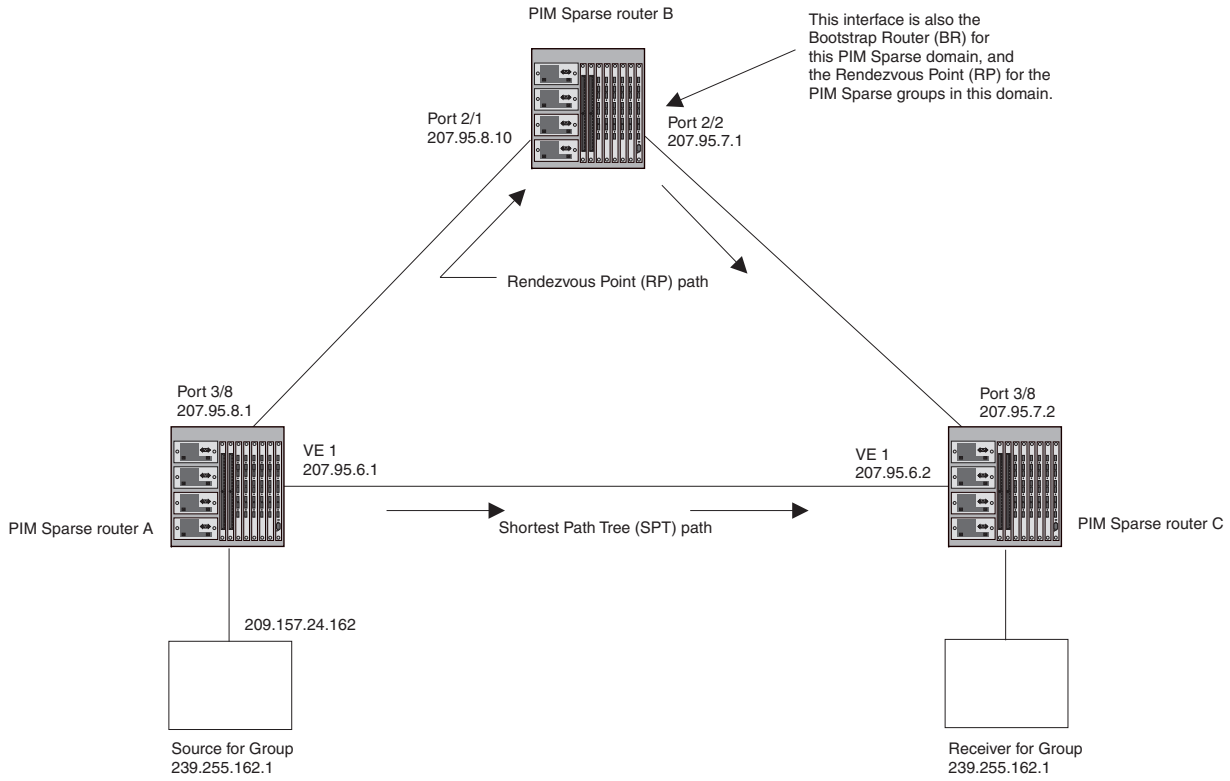


Figure 7.3 Example PIM Sparse domain

PIM Sparse Router Types

Routers that are configured with PIM Sparse interfaces also can be configured to fill one or more of the following roles:

- PMBR – A PIM router that has some interfaces within the PIM domain and other interface outside the PIM domain. PBMRs connect the PIM domain to the Internet.

  NOTE: You cannot configure an HP routing interface as a PMBR interface for PIM Sparse in the current software release.

- BSR – The Bootstrap Router (BSR) distributes RP information to the other PIM Sparse routers within the domain. Each PIM Sparse domain has one active BSR. For redundancy, you can configure ports on multiple routers as candidate BSRs. The PIM Sparse protocol uses an election process to select one of the candidate BSRs as the BSR for the domain. The BSR with the highest BSR priority (a user-configurable parameter) is elected. If the priorities result in a tie, then the candidate BSR interface with the highest IP address is elected**.** In the example in Figure 7.3, PIM Sparse router B is the BSR. Port 2/2 is configured as a candidate BSR.
- RP – The RP is the meeting point for PIM Sparse sources and receivers. A PIM Sparse domain can have multiple RPs, but each PIM Sparse multicast group address can have only one active RP. PIM Sparse routers learn the addresses of RPs and the groups for which they are responsible from messages that the BSR sends to each of the PIM Sparse routers. In the example in Figure 7.3, PIM Sparse router B is the RP. Port 2/2 is configured as a candidate Rendezvous Point (RP).

  To enhance overall network performance, HP routing switches use the RP to forward only the first packet from a group source to the group's receivers. After the first packet, the routing switch calculates the shortest path between the receiver and source (the Shortest Path Tree, or SPT) and uses the SPT for subsequent packets from the source to the receiver. The routing switch calculates a separate SPT for each source-receiver pair.

  NOTE: HP recommends that you configure the same ports as candidate BSRs and RPs.

RP Paths and SPT Paths

Figure 7.3 shows two paths for packets from the source for group 239.255.162.1 and a receiver for the group. The source is attached to PIM Sparse router A and the recipient is attached to PIM Sparse router C. PIM Sparse router B in is the RP for this multicast group. As a result, the default path for packets from the source to the receiver is through the RP. However, the path through the RP sometimes is not the shortest path. In this case, the shortest path between the source and the receiver is over the direct link between router A and router C, which bypasses the RP (router B).

To optimize PIM traffic, the protocol contains a mechanism for calculating the Shortest Path Tree (SPT) between a given source and receiver. PIM Sparse routers can use the SPT as an alternative to using the RP for forwarding traffic from a source to a receiver. By default, HP routing switches forward the first packet they receive from a given source to a given receiver using the RP path, but forward subsequent packets from that source to that receiver through the SPT. In Figure 7.3, routing switch A forwards the first packet from group 239.155.162.1's source to the destination by sending the packet to router B, which is the RP. Router B then sends the packet to router C. For the second and all future packets that router A receives from the source for the receiver, router A forwards them directly to router C using the SPT path.

Configuring PIM Sparse

Limitations in this Release

The implementation of PIM Sparse in the current software release has the following limitations:

- PIM Border Routers (PMBRs) are not supported. Thus, you cannot configure an HP routing interface as a PMBR interface for PIM Sparse.
- PIM Sparse and regular PIM (dense mode) cannot be used on the same interface.
- You cannot configure or display PIM Sparse information using the Web management interface. (You can display some general PIM information, but not specific PIM Sparse information.)

To configure an HP routing switch for PIM Sparse, perform the following tasks:

- Configure the following global parameters:
  - Enable the PIM Sparse mode of multicast routing.
  - If you have not already done so, enable a unicast routing protocol (RIP or OSPF).
- Configure the following interface parameters:
  - Configure an IP address on the interface
  - Enable PIM Sparse.
  - Identify the interface as a PIM Sparse border, if applicable.

  NOTE: You cannot configure an HP routing interface as a PMBR interface for PIM Sparse in the current software release.
- Configure the following PIM Sparse global parameters:
  - Identify the routing switch as a candidate PIM Sparse Bootstrap Router (BSR), if applicable.
  - Identify the routing switch as a candidate PIM Sparse Rendezvous Point (RP), if applicable.
  - Specify the IP address of the RP (if you want to statically select the RP).

  NOTE: HP recommends that you configure the same routing switch as both the BSR and the RP.

Configuring Global Parameters

To configure the PIM Sparse global parameters, use either of the following methods.

USING THE CLI

To configure basic global PIM Sparse parameters, enter commands such as the following on each routing switch within the PIM Sparse domain:

```
HP9300(config)# router pim
HP9300(config-pim-router)# router rip
HP9300(config-rip-router)#
```

Syntax: [no] router pim

NOTE: You do not need to globally enable IP multicast routing when configuring PIM Sparse.

The commands in this example enable IP multicast routing, enable the PIM Sparse mode of IP multicast routing, and then enable RIP. For simplicity, this example does not show configuration of specific RIP parameters. In addition, the commands in this example do not configure the routing switch as a candidate PIM Sparse Bootstrap Router (BSR) and candidate Rendezvous Point (RP). You can configure an HP routing switch as a PIM Sparse router without configuring the routing switch as a candidate BSR and RP. However, if you do configure the routing

switch as one of these, HP recommends that you configure the routing switch as both of these. See “Configuring PIM Sparse Global Parameters” on page 7-15.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Configuring PIM Interface Parameters

After you enable IP multicast routing and PIM Sparse at the global level, you must enable it on the individual interfaces connected to the PIM Sparse network. To do so, use the following CLI method.

USING THE CLI

To enable PIM Sparse mode on an interface, enter commands such as the following:

```
HP9300(config)# interface ethernet 2/2
HP9300(config-if-2/2)# ip address 207.95.7.1 255.255.255.0
HP9300(config-if-2/2)# ip pim-sparse
```

Syntax: [no] ip pim-sparse

The commands in this example add an IP interface to port 2/2, then enable PIM Sparse on the interface.

If the interface is on the border of the PIM Sparse domain, you also must enter the following command:

```
HP9300(config-if-2/2)# ip pim border
```

Syntax: [no] ip pim border

NOTE: You cannot configure an HP routing interface as a PMBR interface for PIM Sparse in the current software release.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Configuring PIM Sparse Global Parameters

In addition to the global and interface parameters in the sections above, you need to identify an interface on at least one routing switch as a candidate PIM Sparse Bootstrap router (BSR) and candidate PIM Sparse Rendezvous Point (RP).

NOTE: It is possible to configure the routing switch as only a candidate BSR or RP, but HP recommends that you configure the same interface on the same routing switch as both a BSR and an RP.

To configure the routing switch as a candidate BSR and RP, use the following CLI method.

USING THE CLI

To configure the routing switch as a candidate BSR, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# bsr-candidate ethernet 2/2 30 255
BSR address: 207.95.7.1, hash mask length: 30, priority: 255
```

This command configures the PIM Sparse interface on port 2/2 as a BSR candidate, with a hash mask length of 30 and a priority of 255. The information shown in italics above is displayed by the CLI after you enter the candidate BSR configuration command.

Syntax: [no] router pim

Syntax: [no] bsr-candidate ethernet | ve <portnum> | <num> <hash-mask-length> [<priority>]

The **ethernet | ve** <portnum> | <num> parameter specifies the interface. Enter **ethernet** <portnum> for a physical interface (port). enter **ve** <num> for a virtual interface. The routing switch will advertise the specified interface’s IP address as a candidate BSR.

The <hash-mask-length> parameter specifies the number of bits in a group address that are significant when calculating the group-to-RP mapping. You can specify a value from 1 – 32.

NOTE: HP recommends you specify 30 for IP version 4 (IPv4) networks.

The <priority> specifies the BSR priority. You can specify a value from 0 – 255. When the election process for BSR takes place, the candidate BSR with the highest priority becomes the BSR. The default is 0.

Enter a command such as the following to configure the routing switch as a candidate RP:

```
HP9300(config-pim-router)# rp-candidate ethernet 2/2
```

Syntax: [no] rp-candidate ethernet | ve <portnum> | <num>

The **ethernet | ve** <portnum> | <num> parameter specifies the interface. Enter **ethernet** <portnum> for a physical interface (port). enter **ve** <num> for a virtual interface. The routing switch will advertise the specified interface's IP address as a candidate RP.

By default, this command configures the routing switch as a candidate RP for all group numbers beginning with 224. As a result, the routing switch is a candidate RP for all valid PIM Sparse group numbers. You can change this by adding or deleting specific address ranges. The following example narrows the group number range for which the routing switch is a candidate RP by explicitly adding a range.

```
HP9300(config-pim-router)# rp-candidate add 224.126.0.0 16
```

Syntax: [no] rp-candidate add <group-addr> <mask-bits>

The <group-addr> <mask-bits> specifies the group address and the number of significant bits in the sub-net mask. In this example, the routing switch is a candidate RP for all groups that begin with 224.126. When you add a range, you override the default. The routing switch then becomes a candidate RP only for the group address range(s) you add.

You also can change the group numbers for which the routing switch is a candidate RP by deleting address ranges. For example, to delete all addresses from 224.126.22.0 – 224.126.22.255, enter the following command:

```
HP9300(config-pim-router)# rp-candidate delete 224.126.22.0 32
```

Syntax: [no] rp-candidate delete <group-addr> <mask-bits>

The usage of the <group-addr> <mask-bits> parameter is the same as for the **rp-candidate add** command.

If you enter both commands shown in the example above, the net effect is that the routing switch becomes a candidate RP for groups 224.126.0.0 – 224.126.21.255 and groups 224.126.23.0 – 224.126.255.255.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Statically Specifying the RP

HP recommends that you use the PIM Sparse protocol's RP election process so that a backup RP can automatically take over if the active RP router becomes unavailable. However, if you do not want the RP to be selected by the RP election process but instead you want to explicitly identify the RP by its IP address, you can do using the following CLI method.

If you explicitly specify the RP, the routing switch uses the specified RP for all group-to-RP mappings and overrides the set of candidate RPs supplied by the BSR.

NOTE: Specify the same IP address as the RP on all PIM Sparse routers within the PIM Sparse domain. Make sure the router is on the backbone or is otherwise well connected to the rest of the network.

USING THE CLI

To specify the IP address of the RP, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# rp-address 207.95.7.1
```

Syntax: [no] rp-address <ip-addr>

The <ip-addr> parameter specifies the IP address of the RP.

The command in the example above identifies the router interface at IP address 207.95.7.1 as the RP for the PIM Sparse domain. The routing switch will use the specified RP and ignore group-to-RP mappings received from the BSR.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Changing the Shortest Path Tree (SPT) Threshold

In a typical PIM Sparse domain, there may be two or more paths from a DR (designated router) for a multicast source to a PIM group receiver.

- Path through the RP – This is the path the routing switch uses the first time it receives traffic for a PIM group. However, the path through the RP may not be the shortest path from the routing switch to the receiver.
- Shortest Path – Each PIM Sparse router that is a DR for a multicast source calculates a shortest path tree (SPT) to all the PIM Sparse group receivers within the domain, with the routing switch itself as the root of the tree. The first time an HP routing switch configured as a PIM router receives a packet for a PIM receiver, the routing switch sends the packet to the RP for the group. The routing switch also calculates the SPT from itself to the receiver. The next time the routing switch receives a PIM Sparse packet for the receiver, the routing switch sends the packet toward the receiver using the shortest route, which may not pass through the RP.

By default, the routing switch switches from the RP to the SPT after receiving the first packet for a given PIM Sparse group. The routing switch maintains a separate counter for each PIM Sparse source-group pair.

After the routing switch receives a packet for a given source-group pair, the routing switch starts a PIM data timer for that source-group pair. If the routing switch does not receive another packet for the source-group pair before the timer expires, the routing switch reverts to using the RP for the next packet received for the source-group pair. In accordance with the PIM Sparse RFC's recommendation, the timer is 210 seconds and is not configurable. The counter is reset to zero each time the routing switch receives a packet for the source-group pair.

You can change the number of packets that the routing switch sends using the RP before switching to using the SPT. To do so, use the following CLI method.

USING THE CLI

To change the number of packets the routing switch sends using the RP before switching to the SPT, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# spt-threshold 1000
```

Syntax: [no] spt-threshold infinity | <num>

The **infinity** | <num> parameter specifies the number of packets. If you specify **infinity**, the routing switch sends packets using the RP indefinitely and does not switch over to the SPT. If you enter a specific number of packets, the routing switch does not switch over to using the SPT until the routing switch has sent the number of packets you specify using the RP.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Changing the PIM Join and Prune Message Interval

By default, the routing switch sends PIM Sparse Join/Prune messages every 60 seconds. These messages inform other PIM Sparse routers about clients who want to become receivers (Join) or stop being receivers (Prune) for PIM Sparse groups.

You can change the Join/Prune message interval using the following CLI method.

NOTE: Use the same Join/Prune message interval on all the PIM Sparse routers in the PIM Sparse domain. If the routers do not all use the same timer interval, the performance of PIM Sparse can be adversely affected.

USING THE CLI

To change the Join/Prune interval, enter commands such as the following:

```
HP9300(config)# router pim
HP9300(config-pim-router)# message-interval 30
```

Syntax: [no] message-interval <num>

The <num> parameter specifies the number of seconds and can from 1 – 65535. The default is 60.

USING THE WEB MANAGEMENT INTERFACE

You cannot configure PIM Sparse parameters using the Web management interface.

Displaying PIM Sparse Configuration Information and Statistics

You can display the following PIM Sparse information:

- Basic PIM Sparse configuration information
- Group information
- BSR information
- Candidate RP information
- RP-to-group mappings
- RP information for a PIM Sparse group
- RP set list
- PIM Neighbor information
- The PIM flow cache
- The PIM multicast cache
- PIM traffic statistics

Displaying Basic PIM Sparse Configuration Information

To display basic configuration information for PIM Sparse, use the following CLI method.

USING THE CLI

To display PIM Sparse configuration information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim sparse

Global PIM Sparse Mode Settings
  Hello interval: 60, Neighbor timeout: 180
  Bootstrap Msg interval: 130, Candidate-RP Advertisement interval: 60
  Join/Prune interval: 60, SPT Threshold: 1

Interface Ethernet e3/8
TTL Threshold: 1, Enabled
Local Address: 207.95.8.1

Interface Ve 1
TTL Threshold: 1, Enabled
Local Address: 207.95.6.1
```

Syntax: show ip pim sparse

This example shows the PIM Sparse configuration information on PIM Sparse router A in Figure 7.3.

This display shows the following information.

Table 7.1: PIM Sparse Information

This Field...	Displays...
Global PIM Sparse Mode Settings	
Hello interval	How frequently the routing switch sends PIM Sparse hello messages to its PIM Sparse neighbors. This field show the number of seconds between hello messages. PIM Sparse routers use hello messages to discover one another.
Neighbor timeout	How many seconds the routing switch will wait for a hello message from a neighbor before determining that the neighbor is no longer present and removing cached PIM Sparse forwarding entries for the neighbor.
Bootstrap Msg interval	How frequently the BSR configured on the routing switch sends the RP set to the RPs within the PIM Sparse domain. The RP set is a list of candidate RPs and their group prefixes. A candidate RP's group prefix indicates the range of PIM Sparse group numbers for which it can be an RP. **Note**: This field contains a value only if an interface on the routing switch is elected to be the BSR. Otherwise, the field is blank.
Candidate-RP Advertisement interval	How frequently the candidate PR configured on the routing switch sends candidate RP advertisement messages to the BSR. **Note**: This field contains a value only if an interface on the routing switch is configured as a candidate RP. Otherwise, the field is blank.

Table 7.1: PIM Sparse Information (Continued)

This Field...	Displays...
Join/Prune interval	How frequently the routing switch sends PIM Sparse Join/Prune messages for the multicast groups it is forwarding. This field show the number of seconds between Join/Prune messages. The routing switch sends Join/Prune messages on behalf of multicast receivers who want to join or leave a PIM Sparse group. When forwarding packets from PIM Sparse sources, the routing switch sends the packets only on the interfaces on which it has received join requests in Join/Prune messages for the source's group. You can change the Join/Prune interval if needed. See "Changing the PIM Join and Prune Message Interval" on page 7-18.
SPT Threshold	The number of packets the routing switch sends using the path through the RP before switching to using the SPT path.
PIM Sparse Interface Information **Note**: You also can display IP multicast interface information using the **show ip pim interface** command. However, this command lists all IP multicast interfaces, including regular PIM (dense mode) and DVMRP interfaces. The **show ip pim sparse** command lists only the PIM Sparse interfaces.	
Interface	The type of interface and the interface number. The interface type can be one of the following: • Ethernet • VE The number is either a port number (and slot number if applicable) or the virtual interface (VE) number.
TTL Threshold	Following the TTL threshold value, the interface state is listed. The interface state can be one of the following: • Disabled • Enabled
Local Address	Indicates the IP address configured on the port or virtual interface.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying a List of Multicast Groups

To display a list of the IP multicast groups the routing switch is forwarding, use the following CLI method.

USING THE CLI

To display PIM Sparse configuration information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim group

Total number of Groups: 2
Index 1         Group 239.255.162.1       Ports e3/11
```

Syntax: show ip pim group

This display shows the following information.

Table 7.2: Multicast Group Information

This Field...	Displays...
Total number of Groups	Lists the total number of IP multicast groups the routing switch is forwarding. **Note**: This list can include groups that are not PIM Sparse groups. If interfaces on the routing switch are configured for regular PIM (dense mode) or DVMRP, these groups are listed too.
Index	The index number of the table entry in the display.
Group	The multicast group address
Ports	The routing switch ports connected to the receivers of the groups.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying BSR Information

To display information about the BSR, use the following CLI method.

USING THE CLI

To display BSR information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim bsr
PIMv2 Bootstrap information

This system is the elected Bootstrap Router (BSR)
  BSR address: 207.95.7.1
  Uptime: 00:33:52, BSR priority: 5, Hash mask length: 32
  Next bootstrap message in 00:00:20

Next Candidate-RP-advertisement in 00:00:10
  RP: 207.95.7.1
    group prefixes:
    224.0.0.0 / 4
Candidate-RP-advertisement period: 60
```

This example show information displayed on a routing switch that has been elected as the BSR. The following example shows information displayed on a routing switch that is not the BSR. Notice that some fields shown in the example above do not appear in the example below.

```
HP9300(config-pim-router)# show ip pim bsr
PIMv2 Bootstrap information
 local BSR address  = 207.95.7.1
 local BSR priority = 5
```

Syntax: show ip pim bsr

This display shows the following information.

Table 7.3: PIM BSR Information

This Field...	Displays...
BSR address or local BSR address	The IP address of the interface configured as the PIM Sparse Bootstrap Router (BSR). **Note**: If the word “local” does not appear in the field, this routing switch is the BSR. If the word “local” does appear, this routing switch is not the BSR.
Uptime	The amount of time the BSR has been running. **Note**: This field appears only if this routing switch is the BSR.
BSR priority or local BSR priority	The priority assigned to the interface for use during the BSR election process. During BSR election, the priorities of the candidate BSRs are compared and the interface with the highest BSR priority becomes the BSR. **Note**: If the word “local” does not appear in the field, this routing switch is the BSR. If the word “local” does appear, this routing switch is not the BSR.
Hash mask length	The number of significant bits in the IP multicast group comparison mask. This mask determines the IP multicast group numbers for which the routing switch can be a BSR. The default is 32 bits, which allows the routing switch to be a BSR for any valid IP multicast group number. **Note**: This field appears only if this routing switch is the BSR.
Next bootstrap message in	Indicates how many seconds will pass before the BSR sends its next Bootstrap message. **Note**: This field appears only if this routing switch is the BSR.
Next Candidate-PR-advertisement message in	Indicates how many seconds will pass before the BSR sends its next candidate PR advertisement message. **Note**: This field appears only if this routing switch is the BSR.
RP	Indicates the IP address of the Rendezvous Point (RP). **Note**: This field appears only if this routing switch is the BSR.
group prefixes	Indicates the multicast groups for which the RP listed by the previous field is a candidate RP. **Note**: This field appears only if this routing switch is the BSR.
Candidate-RP-advertisement period	Indicates how frequently the BSR sends candidate RP advertisement messages. **Note**: This field appears only if this routing switch is the BSR.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying Candidate RP Information

To display candidate RP information, use the following CLI method.

USING THE CLI

To display candidate RP information, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-candidate

Next Candidate-RP-advertisement in 00:00:10
  RP: 207.95.7.1
    group prefixes:
    224.0.0.0 / 4

  Candidate-RP-advertisement period: 60
```

This example show information displayed on a routing switch that is a candidate RP. The following example shows the message displayed on a routing switch that is not a candidate RP.

```
HP9300(config-pim-router)# show ip pim bsr

This system is not a Candidate-RP.
```

Syntax: show ip pim rp-candidate

This display shows the following information.

Table 7.4: PIM RP Information

This Field...	Displays...
Candidate-RP-advertisement in	Indicates how many seconds will pass before the BSR sends its next RP message. **Note**: This field appears only if this routing switch is a candidate RP.
RP	Indicates the IP address of the Rendezvous Point (RP). **Note**: This field appears only if this routing switch is a candidate RP.
group prefixes	Indicates the multicast groups for which the RP listed by the previous field is a candidate RP. **Note**: This field appears only if this routing switch is a candidate RP.
Candidate-RP-advertisement period	Indicates how frequently the BSR sends candidate RP advertisement messages. **Note**: This field appears only if this routing switch is a candidate RP.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying RP-to-Group Mappings

To display RP-to-group mappings, use the following CLI method.

USING THE CLI

To display RP-to-group-mappings, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-map

Group address        RP address
------------------------------
239.255.162.1        207.95.7.1
```

Syntax: show ip pim rp-map

This display shows the following information.

Table 7.5: PIM RP-Group Mappings

This Field...	Displays...
Group address	Indicates the PIM Sparse multicast group address using the listed RP.
RP address	Indicates the IP address of the Rendezvous Point (RP) for the listed PIM Sparse group.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying RP Information for a PIM Sparse Group

To display RP information for a specific PIM Sparse group, use the following CLI method.

USING THE CLI

To display RP information for a PIM Sparse group, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-hash 239.255.162.1

  RP: 207.95.7.1, v2
    Info source: 207.95.7.1, via bootstrap
```

Syntax: show ip pim rp-hash <group-addr>

The <group-addr> parameter is the address of a PIM Sparse IP multicast group.

This display shows the following information.

Table 7.6: PIM RP-Group Information

This Field...	Displays...
RP	Indicates the IP address of the Rendezvous Point (RP) for the specified PIM Sparse group. Following the IP address is the port or virtual interface through which this routing switch learned the identity of the RP.
Info source	Indicates the IP address on which the RP information was received. Following the IP address is the method through which this routing switch learned the identity of the RP.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying the RP Set List

To display the RP set list, use the following CLI method.

USING THE CLI

To display the RP set list, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim rp-set

Number of group prefixes = 1

Group prefix = 224.0.0.0/4      # RPs expected/received: 1
            RP 1: 207.95.7.1    priority=0    age=0
```

Syntax: show ip pim rp-set

This display shows the following information.

Table 7.7: PIM RP Set List

This Field...	Displays...
Number of group prefixes	The number f PIM Sparse group prefixes for which the RP is responsible.
Group prefix	Indicates the multicast groups for which the RP listed by the previous field is a candidate RP.
RPs expected/received	Indicates how many RPs were expected and received in the latest Bootstrap message.
RP <num>	Indicates the RP number. If there are multiple RPs in the PIM Sparse domain, a line of information for each of them is listed, and they are numbered in ascending numerical order.
priority	The RP priority of the candidate RP. During the election process, the candidate RP with the highest priority is elected as the RP.
age	The age (in seconds) of this RP-set. **Note**: If this routing switch is not a BSR, this field contains zero. Only the BSR ages the RP-set.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM Sparse information using the Web management interface.

Displaying Multicast Neighbor Information

To display information about the routing switch's IP Multicast neighbors, use either of the following methods.

USING THE CLI

To display information about the routing switch's PIM neighbors, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim nbr

Port Neighbor        Holdtime Age   UpTime
                     sec      sec   sec
e3/8   207.95.8.10     180      60    900
Port Neighbor        Holdtime Age   UpTime
                     sec      sec   sec
v1     207.95.6.2      180      60    900
```

Syntax: show ip pim nbr

This display shows the following information.

Table 7.8: Multicast Neighbor Information

This Field...	Displays...
Port	The interface through which the routing switch is connected to the neighbor.
Neighbor	The IP interface of the PIM neighbor interface.
Holdtime sec	Indicates how many seconds the neighbor wants this routing switch to hold the entry for this neighbor in memory. The neighbor sends the Hold Time in its Hello packets. • If the routing switch receives a ne w Hello packet before the Hold Time received in the previous packet expires, the routing switch updates its table entry for the neighbor. • If the routing switch does not receive a new Hello packet from the neighbor before the Hold time expires, the routing switch assumes the neighbor is no longer available and removes the entry for the neighbor.
Age sec	The number of seconds since the routing switch received the last hello message from the neighbor.
UpTime sec	The number of seconds the PIM neighbor has been up. This timer starts when the routing switch receives the first Hello messages from the neighbor.

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-only or read-write access. The System configuration panel is displayed.
2. Click on the plus sign next to Monitor in the tree view.
3. Click on the plus sign next to PIM in the tree view to expand the list of PIM option links.
4. Click on the Neighbor link to display the IP interface table.

Displaying the PIM Flow Cache

To display the PIM flow cache, use the following CLI method.

USING THE CLI

To display the PIM flow cache, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim flowcache

     Source          Group           Parent CamFlags CamIndex  Fid     Flags
1    209.157.24.162  239.255.162.1   v2     00000700 2023      00004411 F
2    209.157.24.162  239.255.162.1   v2     00000700 201b      00004411 F
3    209.157.24.162  239.255.162.1   v2     00000700 201d      00004411 F
4    209.157.24.162  239.255.162.1   v2     00000700 201e      00004411 F
```

Syntax: show ip pim flowcache

This display shows the following information.

Table 7.9: PIM Flow Cache Information

This Field...	Displays...
Source	Indicates the source of the PIM Sparse group.
Group	Indicates the PIM Sparse group.
Parent	Indicates the port or virtual interface from which the routing switch receives packets from the group's source.
CamFlags	This field is used by HP technical support for troubleshooting.
CamIndex	This field is used by HP technical support for troubleshooting.
Fid	This field is used by HP technical support for troubleshooting.
Flags	This field is used by HP technical support for troubleshooting.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the PIM flow cache using the Web management interface.

Displaying the PIM Multicast Cache

To display the PIM multicast cache, use the following CLI method.

USING THE CLI

To display the PIM multicast cache, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim mcache

1    (*,239.255.162.1) RP207.95.7.1 forward port v1, Count 2
     member ports ethe 3/3
     virtual ports v2
     prune ports
     virtual prune ports

2    (209.157.24.162,239.255.162.4) forward port v2, flags 00004900 Count 130
     member ports
     virtual ports
     prune ports
     virtual prune ports
```

```
3     (209.157.24.162,239.255.162.1) forward port v2, flags 00005a01 Count 12
      member ports ethe 3/8
      virtual ports
      prune ports
      virtual prune ports
```

Syntax: show ip pim mcache

This display shows the following information.

Table 7.10: PIM Multicast Cache Information

This Field...	Displays...
(*<source>*, *<group>*)	The comma-separated values in parentheses is a source-group pair. The *<source>* is the PIM source for the multicast *<group>*. For example, the following entry means source 209.157.24.162 for group 239.255.162.1: (209.157.24.162,239.255.162.1) If the *<source>* value is * (asterisk), this cache entry uses the RP path. The * value means “all sources”. If the *<source>* is a specific source address, this cache entry uses the SPT path.
RP<ip-addr>	Indicates the RP for the group for this cache entry. **Note**: The RP address appears only if the RPT flag is set to 1 and the SPT flag is set to 0 (see below).
forward port	The port through which the routing switch reaches the source.
Count	The number of packets forwarded using this cache entry.
Sparse Mode	Indicates whether the cache entry is for regular PIM (dense mode) or PIM Sparse. This flag can have one of the following values: • 0 – The entry is not for PIM Sparse (and is therefore for the dense mode of PIM). • 1– The entry is for PIM Sparse.
RPT	Indicates whether the cache entry uses the RP path or the SPT path. The RPT flag can have one of the following values: • 0 – The SPT path is used instead of the RP path. • 1– The RP path is used instead of the SPT path. **Note**: The values of the RP and SPT flags are always opposite (one is set to 0 and the other is set to 1).
SPT	Indicates whether the cache entry uses the RP path or the SPT path. The SP flag can have one of the following values: • 0 – The RP path is used instead of the SPT path. • 1– The SPT path is used instead of the RP path. **Note**: The values of the RP and SPT flags are always opposite (one is set to 0 and the other is set to 1).

Table 7.10: PIM Multicast Cache Information (Continued)

This Field...	Displays...
Register Suppress	Indicates whether the Register Suppress timer is running. This field can have one of the following values: • 0 – The timer is not running. • 1 – The timer is running.
member ports	Indicates the routing switch physical ports to which the receivers for the source and group are attached. The receivers can be directly attached or indirectly attached through other PIM Sparse routers.
virtual ports	Indicates the routing switch virtual interfaces to which the receivers for the source and group are attached. The receivers can be directly attached or indirectly attached through other PIM Sparse routers.
prune ports	Indicates the physical ports on which the routing switch has received a prune notification (in a Join/Prune message) to remove the receiver from the list of recipients for the group.
virtual prune ports	Indicates the virtual interfaces ports on which the routing switch has received a prune notification (in a Join/Prune message) to remove the receiver from the list of recipients for the group.

USING THE WEB MANAGEMENT INTERFACE

You cannot display the PIM multicast cache using the Web management interface.

Displaying PIM Traffic Statistics

To display PIM traffic statistics, use the following CLI method.

USING THE CLI

To display PIM traffic statistics, enter the following command at any CLI level:

```
HP9300(config-pim-router)# show ip pim traffic

Port    Hello           J/P          Register       RegStop          Assert
     [Rx     Tx]    [Rx     Tx]    [Rx     Tx]    [Rx     Tx]    [Rx     Tx]
e3/8   19     19      32     0       0      0       37     0       0      0

Port    Hello           J/P          Register       RegStop          Assert
     [Rx     Tx]    [Rx     Tx]    [Rx     Tx]    [Rx     Tx]    [Rx     Tx]
v1     18     19      0      20      0      0       0      0       0      0

Port    Hello           J/P          Register       RegStop          Assert
     [Rx     Tx]    [Rx     Tx]    [Rx     Tx]    [Rx     Tx]    [Rx     Tx]
v2     0      19      0      0       0      16      0      0       0      0

Total 37      57     32      0       0      0       0      0       0      0
IGMP Statistics:
  Total Recv/Xmit 85/110
  Total Discard/chksum  0/0
```

Syntax: show ip pim traffic

NOTE: If you have configured interfaces for standard PIM (dense mode) on the routing switch, statistics for these interfaces are listed first by the display.

This display shows the following information.

Table 7.11: PIM Traffic Statistics

This Field...	Displays...
Port	The port or virtual interface on which the PIM interface is configured.
Hello	The number of PIM Hello messages sent or received on the interface.
J/P	The number of Join/Prune messages sent or received on the interface. **Note**: Unlike PIM dense, PIM Sparse uses the same messages for Joins and Prunes.
Register	The number of Register messages sent or received on the interface.
RegStop	The number of Register Stop messages sent or received on the interface.
Assert	The number of Assert messages sent or received on the interface.
Total Recv/Xmit	The total number of IGMP messages sent and received by the routing switch.
Total Discard/chksum	The total number of IGMP messages discarded, including a separate counter for those that failed the checksum comparison.

USING THE WEB MANAGEMENT INTERFACE

You cannot display PIM statistics using the Web management interface.

DVMRP Overview

The HP 9304M, HP 9308M, and HP 6208M-SX routing switches provide multicast routing with the ***Distance Vector Multicast Routing Protocol (DVMRP)*** routing protocol. DVMRP uses ***Internet Group Membership Protocol (IGMP)*** to manage the IP multicast groups.

DVMRP is a broadcast and pruning multicast protocol that delivers IP multicast datagrams to its intended receivers. The receiver registers the interested groups using IGMP. DVMRP builds a multicast delivery tree with the sender forming the root. Initially, multicast datagrams are delivered to all nodes on the tree. Those leaves that do not have any group members send ***prune messages*** to the upstream router, noting the absence of a group. The upstream router maintains a prune state for this group for the given sender. A prune state is aged out after a given configurable interval, allowing multicasts to resume.

DVMRP employs ***reverse path forwarding*** and ***pruning*** to keep source specific multicast delivery trees with the minimum number of branches required to reach all group members. DVMRP builds a multicast tree for each source and destination host group.

Initiating DVMRP Multicasts on a Network

Once DVMRP is enabled on each router, a network user can begin a video conference multicast from the server on R1. ***Multicast Delivery Trees*** are initially formed by source-originated multicast packets that are propagated to downstream interfaces as seen in Figure 7.4. When a multicast packet is received on a DVMRP-capable router interface, the interface checks its DVMRP routing table to determine whether the interface that received the message provides the shortest path back to the source. If the interface does provide the shortest path, the interface forwards the multicast packet to adjacent peer DVMRP routers, except for the router interface that originated the packet. Otherwise, the interface discards the multicast packet and sends a prune message back upstream. This process is known as ***reverse path forwarding***.

In Figure 7.4, the root node (R1) is forwarding multicast packets for group 229.225.0.2 that it receives from the server to its downstream nodes, R2, R3, and R4. Router R4 is an intermediate router with R5 and R6 as its downstream routers. Because R5 and R6 have no downstream interfaces, they are leaf nodes.

The receivers in this example are those workstations that are resident on routers R2, R3, and R6.

Pruning a Multicast Tree

After the multicast tree is constructed, ***pruning*** of the tree will occur after IP multicast packets begin to traverse the tree.

As multicast packets reach leaf networks (sub-nets with no downstream interfaces), the local IGMP database checks for the recently arrived IP multicast packet address. If the local database does not contain the address (the address has not been learned), the router prunes (removes) the address from the multicast tree and no longer receives multicasts until the prune age expires.

In Figure 7.5, Router 5 is a leaf node with no group members in its local database. Consequently, Router 5 sends a prune message to its upstream router. This router will not receive any further multicast traffic until the prune age interval expires.

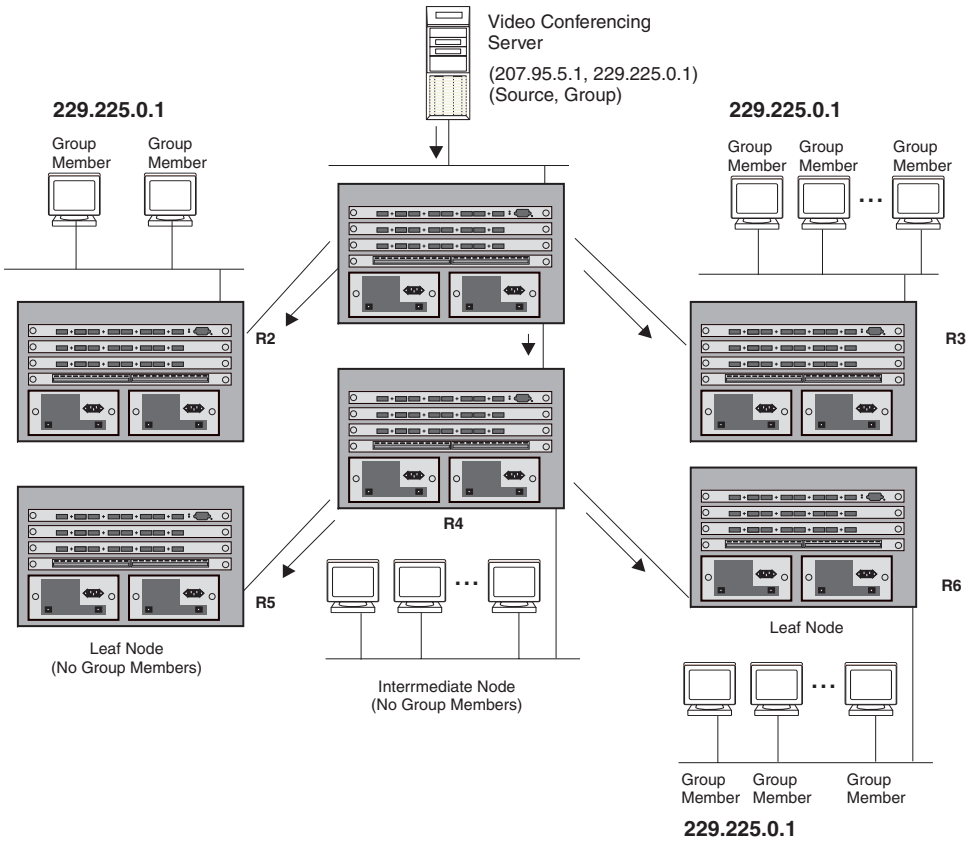


Figure 7.4 Downstream broadcast of IP multicast packets from source host

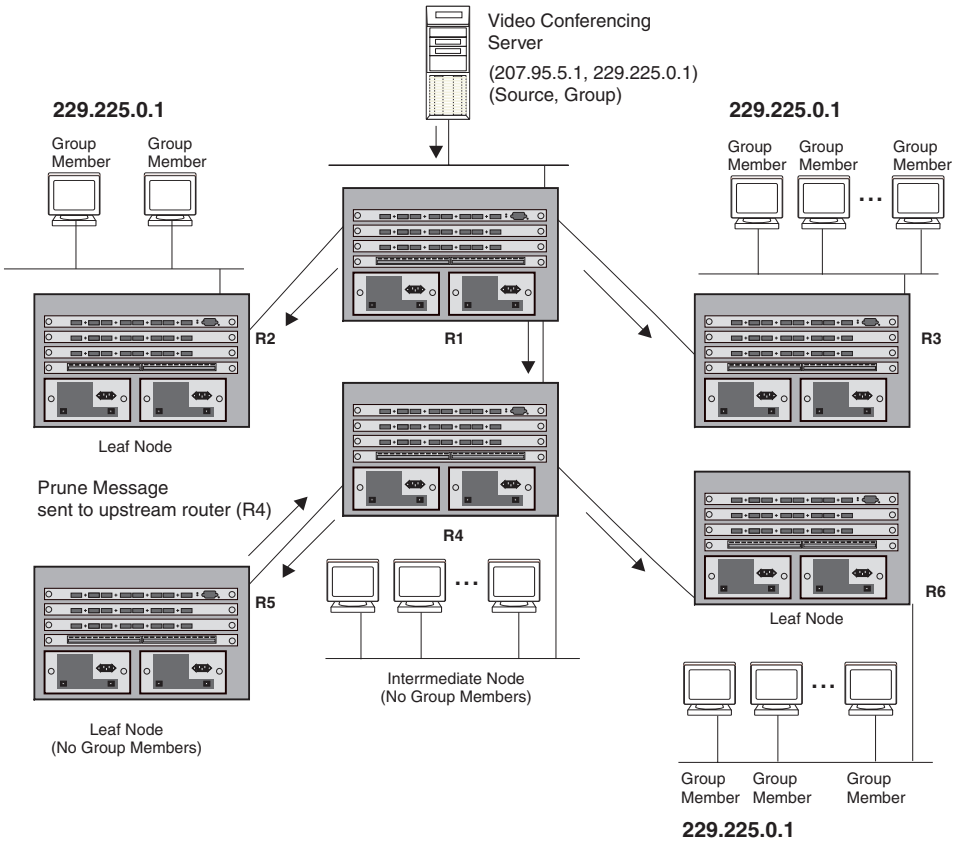


Figure 7.5 Pruning leaf nodes from a multicast tree

Grafts to a Multicast Tree

A DVMRP router restores pruned branches to a multicast tree by sending graft messages towards the upstream router. Graft messages start at the leaf node and travel up the tree, first sending the message to its neighbor upstream router.

In the example above, if a new 229.255.0.1 group member joins on router R6, which had been pruned previously, a graft will be sent upstream to R4. Since the forwarding state for this entry is in a prune state, R4 sends a graft to R1. Once R4 has joined the tree, it along with R6 will once again receive multicast packets.

You do not need to perform any configuration to maintain the multicast delivery tree. The prune and graft messages automatically maintain the tree.

Configuring DVMRP

Enabling DVMRP on the Routing Switch and Interface

Suppose you want to initiate the use of desktop video for fellow users on a sprawling campus network. All destination workstations have the appropriate hardware and software but the routers that connect the various buildings need to be configured to support DVMRP multicasts from the designated video conference server as seen in Figure 7.4.

DVMRP is enabled on each of the routers shown in Figure 7.4, on which multicasts are expected. You can enable DVMRP on each router independently or remotely from one of the routers by a Telnet connection. Follow the same steps for each router. A reset of the router is required when DVMRP is first enabled. Thereafter, all changes are dynamic.

NOTE: By default, the DVMRP feature is disabled. To enable DVMRP on router1, enable DVMRP at the global level and then on each interface that will support the protocol.

USING THE CLI

To enable DVMRP on Router 1 and interface 3, enter the following:

```
HP9300(config)# router dvmrp
HP9300(config)# int e 3
HP9300(config-if-3)# ip dvmrp
```

USING THE WEB MANAGEMENT INTERFACE

To enable DVMRP on Router 1 and interface 3, enter the following:

1. Log on to the device using a valid user name and password for read-write access.
2. If you have not already enabled DVMRP, enable it by clicking on the Enable radio button next to DVMRP on the System configuration panel, then clicking Apply to apply the change.
3. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
4. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
5. Click on the Virtual Interface link to display the DVMRP Interface configuration panel.

   NOTE: If the device already has DVMRP interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Virtual Interface link to display the DVMRP Interface configuration panel.

6. Select the interface type. You can select Subnet or Tunnel.
7. Select the IP address of the interface being configured from the Local Address pulldown menu.
8. If you are configuring an IP Tunnel, enter the IP address of the destination interface, the end point of the IP Tunnel, in the Remote Address field. IP tunneling must also be enabled and defined on the destination router interface as well.

   NOTE: The Remote Address field applies only to tunnel interfaces, not to sub-net interfaces.

9. Modify the time to live threshold (TTL) if necessary. The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface.

   NOTE: For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible values are 1 – 64. The default value is 1.

10. Click Enable or Disable next to Advertise Local to enable or disable the feature.
11. Click Enable or Disable next to Encapsulation to enable or disable the feature.
12. Click the Add button to save the change to the device's running-config file.
13. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
14. Click on the plus sign next to Command in the tree view to list the command options.
15. Select the Reload link and select Yes when prompted to reload the software. You must reload after enabling DVMRP to place the change into effect. If DVMRP was already enabled when you added the interface, you do not need to reload.

Modifying DVMRP Global Parameters

DVMRP global parameters come with preset values. The defaults work well in most networks, but you can modify the following global parameters if you need to:

- Neighbor router timeout
- Route expire time
- Route discard time
- Prune age
- Graft retransmit time
- Probe interval
- Report interval
- Trigger interval
- Default route

Modifying Neighbor Router Timeout

The Neighbor Route Timeout specifies the period of time that a router will wait before it defines an attached DVMRP neighbor router as down. Possible values are 40 – 8000 seconds. The default value is 180 seconds.

USING THE CLI

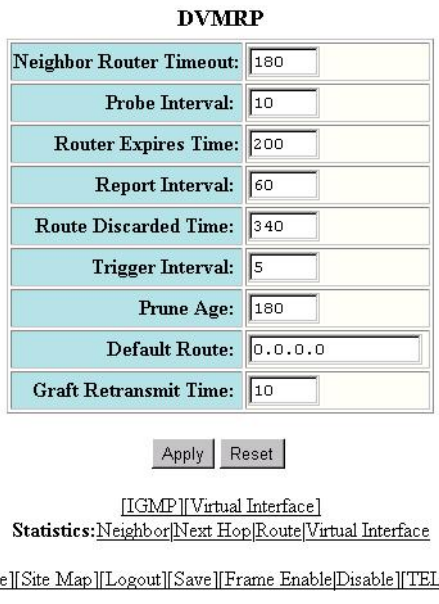
To modify the neighbor timeout value to 100, enter the following:

```
HP9300(config-dvmrp-router)# nbr 100
```

Syntax: nbr-timeout <40-8000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel, as shown in the following example.



5. Enter a value from 40 – 8000 into the Neighbor Router Timeout field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Route Expire Time

The Route Expire Time defines how long a route is considered valid in the absence of the next route update. Possible values are from 20 – 4000 seconds. The default value is 200 seconds.

USING THE CLI

To modify the route expire setting to 50, enter the following:

```
HP9300(config-dvmrp-router)# route-exp 50
```

Syntax: route-expire <20-4000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 20 – 4000 in the Route Expire Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Route Discard Time

The Route Discard Time defines the period of time before a route is deleted. Possible values are from 40 – 8000 seconds. The default value is 340 seconds.

USING THE CLI

To modify the route discard setting to 150, enter the following:

```
HP9300(config-dvmrp-router)# route dis 150
```

Syntax: route-discard <40-8000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 40 – 8000 in the Route Discard Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Prune Age

The Prune Age defines how long a prune state will remain in effect for a source-routed multicast tree. After the prune age period expires, flooding will resume. Possible values are from 20 – 3600 seconds. The default value is 180 seconds.

USING THE CLI

To modify the prune age setting to 150, enter the following:

```
HP9300(config-dvmrp-router)# prune 25
```

Syntax: prune-age <20-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 20 – 3600 in the Prune Age field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Graft Retransmit Time

The Graft Retransmit Time defines the initial period of time that a router sending a graft message will wait for a graft acknowledgment from an upstream router before re-transmitting that message.

Subsequent retransmissions are sent at an interval twice that of the preceding interval. Possible values are from 5 – 3600 seconds. The default value is 10 seconds.

USING THE CLI

To modify the setting for graft retransmit time to 120, enter the following:

```
HP9300(config-dvmrp-router)# graft 120
```

Syntax: graft-retransmit-time <5-3600>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 5 – 3600 in the Graft Retransmit Time field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Probe Interval

The Probe Interval defines how often neighbor probe messages are sent to the ALL-DVMRP-ROUTERS IP multicast group address. A router's probe message lists those neighbor DVMRP routers from which it has received probes. Possible values are from 5 – 30 seconds. The default value is 10 seconds.

USING THE CLI

To modify the probe interval setting to 10, enter the following:

```
HP9300(config-dvmrp-router)# probe 10
```

Syntax: probe-interval <5-30>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 5 – 30 in the Probe Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Report Interval

The Report Interval defines how often routers propagate their complete routing tables to other neighbor DVMRP routers. Possible values are from 10 – 2000 seconds. The default value is 60 seconds.

USING THE CLI

To support propagation of DVMRP routing information to the network every 90 seconds, enter the following:

```
HP9300(config-dvmrp-router)# report 90
```

Syntax: report-interval <10-2000>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 10 – 2000 in the Report Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Trigger Interval

The Trigger Interval defines how often trigger updates, which reflect changes in the network topology, are sent. Example changes in a network topology include router up or down or changes in the metric. Possible values are from 5 – 30 seconds. The default value is 5 seconds.

USING THE CLI

To support the sending of trigger updates every 20 seconds, enter the following:

```
HP9300(config-dvmrp-router)# trig 20
```

Syntax: trigger interval <5-30>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter a value from 5 – 30 in the Trigger Interval field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying Default Route

This defines the default gateway for IP multicast routing.

USING THE CLI

To define the default gateway for DVMRP, enter the following:

```
HP9300(config-dvmrp-router)# default-gateway 192.35.4.1
```

Syntax: default-gateway <ip-addr>

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the General link to display the DVMRP configuration panel.
5. Enter the IP address of the default gateway in the Default Route field.
6. Click the Apply button to save the change to the device's running-config file.
7. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying DVMRP Interface Parameters

DVMRP global parameters come with preset values. The defaults work well in most networks, but you can modify the following interface parameters if you need to:

- TTL
- Metric
- Advertising
- Encapsulation

Modifying the TTL

The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface. For example, if the TTL for an interface is set at 10 it means that only those packets with a TTL value of 10 or more are forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface are forwarded. Possible values are from 1 – 64. The default value is 1.

USING THE CLI

To set a TTL of 64, enter the following:

```
HP9300(config)# int e 1/4
HP9300(config-if-1/4)# ip dvmrp ttl 60
```

Syntax: ttl-threshold <1-64>

USING THE WEB MANAGEMENT INTERFACE

To modify a DVMRP interface's TTL:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.
6. Enter a value from 1 – 64 in the Time To Live Threshold (TTL) field.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Modifying the Metric

The routing switch uses the metric when establishing reverse paths to some networks on directly attached interfaces. Possible values are from 1 – 31 hops. The default is 1.

USING THE CLI

To set a metric of 15 for a DVMRP interface, enter the following:

```
HP9300(config)# interface 3/5
HP9300(config-if-3/5)# ip dvmrp metric 15
```

Syntax: ip dvmrp metric <1-31>

USING THE WEB MANAGEMENT INTERFACE

To modify a DVMRP interface's metric:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.
6. Enter a value from 1 – 31 in the Metric field.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Advertising

You can turn the advertisement of a local route on (enable) or off (disable) on the interface. By default, advertising is enabled.

USING THE CLI

```
To enable advertising on an interface, enter the following:
HP9300(config-if-1/4)# ip dvmrp advertise-local on
```

Syntax: advertise-local on | off

USING THE WEB MANAGEMENT INTERFACE

To enable local advertising on a DVMRP interface:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.
6. Select Enable next to Advertise Local.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Enabling Encapsulation

Encapsulation varies based on the interface type. For type "IP tunnel", DVMRP control messages such as probe and route report are encapsulated within the IP packet. For type "sub-net", the IP data is encapsulated within an IP packet. Encapsulation is disabled by default.

USING THE CLI

To enable and define encapsulation type for DVMRP, enter the following:

```
HP9300(config)# int e 1/6
HP9300(config-if-1/6)# ip dvmrp encap ethernet-2
```

Syntax: ip dvmrp encapsulation ethernet-2 | snap

USING THE WEB MANAGEMENT INTERFACE

To enable encapsulation on a DVMRP interface:

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Select the Virtual Interface link to display a table listing the configured DVMRP Interfaces.
5. Click on the Modify button next to the interface you want to modify. The DVMRP Interface configuration panel is displayed.
6. Select Enable next to Encapsulation.
7. Click the Add button to save the changes to the device's running-config file.
8. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.

Configuring an IP Tunnel

IP tunnels are used to send traffic through routers that do not support PIM or DVMRP multicasting. IP multicast datagrams are encapsulated within an IP packet and then sent to the remote address. Routers that are not configured for PIM or DVMRP route that packet as a normal IP packet. When the DVMRP or PIM router at the remote end of the tunnel receives the packet, the router strips off the IP encapsulation and forwards the packet as an IP Multicast packet.

NOTE: An IP tunnel must have a remote IP interface at each end. Also, for IP tunneling to work, the remote routers must be reachable by an IP routing protocol.

NOTE: Multiple tunnels configured on a routing switch cannot share the same remote address.

EXAMPLE:

To configure an IP tunnel as seen in Figure 7.6, enter the IP tunnel destination address on an interface of the routing switch.

USING THE CLI

To configure an IP address on Router A, enter the following:

```
HP9300(config)# int e1/1
HP9300(config-if-1/1)# ip tunnel 192.3.45.6
```

NOTE: The IP tunnel address represents the configured IP tunnel address of the destination router. In the case of Router A, its destination router is Router B. Router A is the destination router of Router B.

For router B, enter the following:

```
HP9300(config-if-1/1)# ip tunnel 192.58.4.1
```

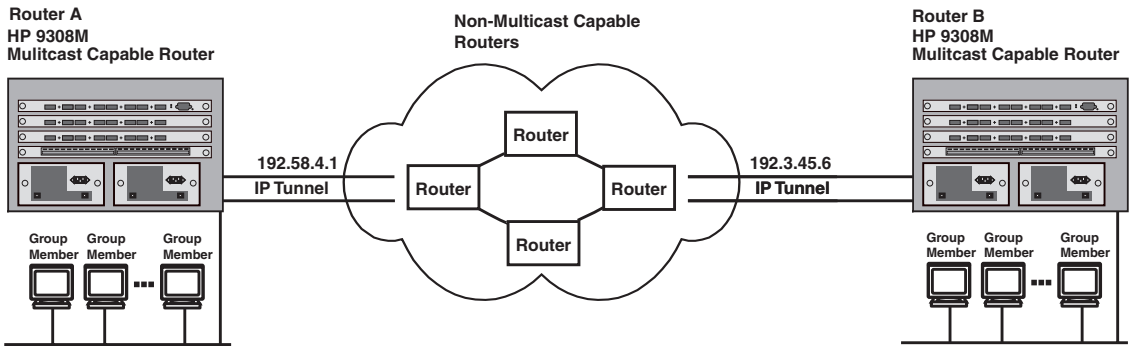


Figure 7.6 IP in IP tunneling on multicast packets in a unicast network

USING THE WEB MANAGEMENT INTERFACE

1. Log on to the device using a valid user name and password for read-write access.
2. Click on the plus sign next to Configure in the tree view to expand the list of configuration options.
3. Click on the plus sign next to DVMRP in the tree view to expand the list of DVMRP option links.
4. Click on the Virtual Interface link to display the DVMRP Interface configuration panel.

NOTE: If the device already has DVMRP interfaces, a table listing the interfaces is displayed. Click the Modify button to the right of the row describing an interface to change its configuration, or click the Add Virtual Interface link to display the DVMRP Interface configuration panel.

5. Select the interface type. You can select Subnet or Tunnel. In this case, select Tunnel.
6. Select the IP address of the interface being configured from the Local Address pulldown menu.
7. Enter the IP address of the destination interface, the end point of the IP Tunnel, in the Remote Address field. IP tunneling must also be enabled and defined on the destination router interface as well.
8. Modify the time to live threshold (TTL) if necessary. The TTL defines the minimum value required in a packet in order for the packet to be forwarded out the interface.

NOTE: For example, if the TTL for an interface is set at 10, it means that only those packets with a TTL value of 10 or more will be forwarded. Likewise, if an interface is configured with a TTL Threshold value of 1, all packets received on that interface will be forwarded. Possible values are 1 – 64. The default value is 1.

9. Click Enable or Disable next to Advertise Local to enable or disable the feature.
10. Click Enable or Disable next to Encapsulation to enable or disable the feature.
11. Click the Add button to save the change to the device's running-config file.
12. Select the Save link at the bottom of the dialog. Select Yes when prompted to save the configuration change to the startup-config file on the device's flash memory.
13. Repeat the steps above on the router that has the interface on the remote end of the IP tunnel.

Configuring a Static Multicast Route

Static multicast routes allow you to control the network path used by multicast traffic. Static multicast routes are especially useful when the unicast and multicast topologies of a network are different. You can avoid the need to make the topologies similar by instead configuring static multicast routes.

NOTE: This feature is not supported for DVMRP.

You can configure more than one static multicast route. The routing switch always uses the most specific route that matches a multicast source address. Thus, if you want to configure a multicast static route for a specific multicast source and also configure another multicast static route for all other sources, you can configure two static routes as shown in the examples below.

To add a static route for a multicast source network, use one of the following methods.

USING THE CLI

To add static routes to multicast router A (see Figure 7.7), enter commands such as the following:

```
PIMRouterA(config)# ip mroute 1 207.95.10.0 255.255.255.0 interface ethernet 1/2
distance 1
PIMRouterA(config)# ip mroute 2 0.0.0.0 0.0.0.0 interface ethernet 2/3 distance 1
PIMRouterA(config)# write memory
```

Syntax: mroute <route-num> <ip-addr> interface ethernet <portnum> | ve <num> [distance <num>]

Or

Syntax: mroute <route-num> <ip-addr> rpf_address <rpf-num>

The <route-num> parameter specifies the route number.

The <ip-addr> command specifies the PIM source for the route.

NOTE: In IP multicasting, a route is handled in terms of its source, rather than its destination.

You can use the **ethernet** <portnum> parameter to specify a physical port or the **ve** <num> parameter to specify a virtual interface.

The **distance** <num> parameter sets the administrative distance for the route. When comparing multiple paths for a route, the routing switch prefers the path with the lower administrative distance.

NOTE: Regardless of the administrative distances, the routing switch always prefers directly connected routes over other routes.

The **rpf_address** <rpf-num> parameter specifies an RPF number.

The example above configures two static multicast routes. The first route is for a specific source network, 207.95.10.0/24. If the routing switch receives multicast traffic for network 207.95.10.0/24, the traffic must arrive on port 1/2. The second route is for all other multicast traffic. Traffic from multicast sources other than 207.95.10.0/24 must arrive on port 2/3.

Figure 7.7 shows an example of an IP Multicast network. The two static routes configured in the example above apply to this network. The commands in the example above configure PIM router A to accept PIM packets from 207.95.10.0/24 when they use the path that arrives at port 1/2, and accept all other PIM packets only when they use the path that arrives at port 2/3.

The distance parameter sets the administrative distance. This parameter is used by the software to determine the best path for the route. Thus, to ensure that the routing switch uses the default static route, assign a low administrative distance value. When comparing multiple paths for a route, the routing switch prefers the path with the lower administrative distance.

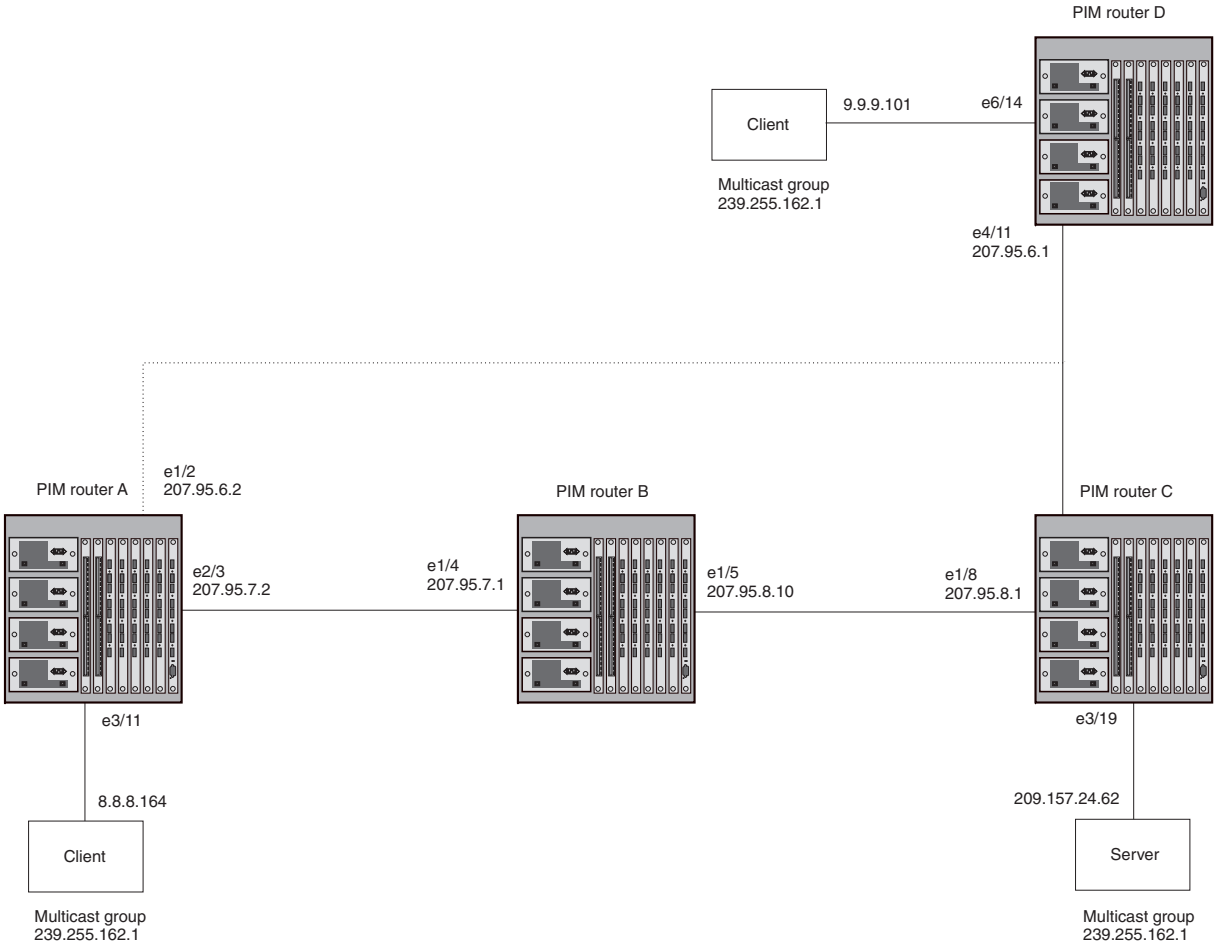


Figure 7.7 Example multicast static routes

To add a static route to a virtual interface, enter commands such as the following:

```
HP9300(config)# mroute 3 0.0.0.0 0.0.0.0 int ve 1 distance 1
HP9300(config)# write memory
```

USING THE WEB MANAGEMENT INTERFACE

You cannot configure a static multicast route using the Web management interface.

Tracing a Multicast Route

The HP implementation of Mtrace is based on “A ‘traceroute’ facility for IP Multicast”, an Internet draft by S. Casner and B. Fenner. To trace a PIM route, use the following CLI method.

NOTE: This feature is not supported for DVMRP.

USING THE CLI

To trace a PIM route to PIM source 209.157.24.62 in group 239.255.162.1, enter a command such as the following:

```
HP9300# mtrace source 209.157.24.62 group 239.255.162.1

Type Control-c to abort
```

```
Tracing the route for tree 209.157.23.188

  0  207.95.7.2
  0  207.95.7.2 Thresh 0
  1  207.95.7.1 Thresh 0
  2  207.95.8.1 Thresh 0
  3  207.157.24.162
```

Syntax: mtrace source <ip-addr> group <multicast-group>

The **source** <ip-addr> parameter specifies the address of the route's source.

NOTE: In IP multicasting, a route is handled in terms of its source, rather than its destination. When you trace an IP route, you specify its destination, but when you trace a PIM route, you specify its source.

The **group** <multicast-group> parameter specifies the PIM group the source IP address is in.

Figure 7.8 shows an example of an IP multicast group. The command example shown above is entered on PIM router A.

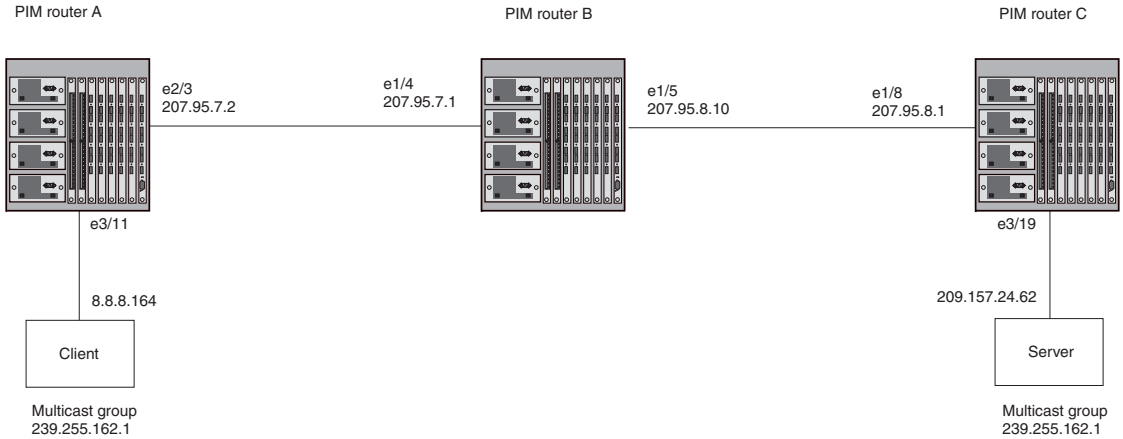


Figure 7.8 Example PIM Group

The command example above indicates that the source address 209.157.24.62 is three hops (three PIM routers) away from PIM router A. In PIM terms, each of the three routers has a forwarding state for the specified source address and multicast group. The value following "Thresh" in some of the lines indicates the TTL threshold. The threshold 0 means that all multicast packets are forwarded on the interface. If an administrator has set the TTL threshold to a higher value, only packets whose TTL is higher than the threshold are forwarded on the interface. The threshold is listed only for the PIM router hops between the source and destination.

USING THE WEB MANAGEMENT INTERFACE

You cannot trace a PIM route using the Web management interface.

Displaying Another Multicast Router's Multicast Configuration

The HP implementation of Mrinfo is based on the DVMRP Internet draft by T. Pusateri, but applies to PIM and not to DVMRP. To display the PIM configuration of another PIM router, use the following CLI method.

NOTE: This feature is not supported for DVMRP.

USING THE CLI

To display another PIM router's PIM configuration, enter a command such as the following:

```
HP9300# mrinfo 207.95.8.1
207.95.8.1 -> 207.95.8.10 [PIM/0 /1 ]
```

```
207.95.10.2 -> 0.0.0.0 [PIM/0 /1 /leaf]
209.157.25.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
209.157.24.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
207.95.6.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
128.2.0.1 -> 0.0.0.0 [PIM/0 /1 /leaf]
```

Syntax: mrinfo <ip-addr>

The <ip-addr> parameter specifies the IP address of the PIM router.

The output in this example is based on the PIM group shown in Figure 7.8 on page 7-45. The output shows the PIM interfaces configured on PIM router C (207.95.8.1). In this example, the PIM router has six PIM interfaces. One of the interfaces goes to PIM router B. The other interfaces go to leaf nodes, which are multicast end nodes attached to the router's PIM interfaces. (For simplicity, the figure shows only one leaf node.)

When the arrow following an interface in the display points to a router address, this is the address of the next hop PIM router on that interface. In this example, PIM interface 207.95.8.1 on PIM router 207.95.8.1 is connected to PIM router 207.95.8.10. The connection can be a direct one or can take place through non-PIM routers. In this example, the PIM routers are directly connected.

When the arrow following an interface address points to zeros (0.0.0.0), the interface is not connected to a PIM router. The interface is instead connected to a leaf node.

NOTE: This display shows the PIM interface configuration information, but does not show the link states for the interfaces.

The information in brackets indicates the following:

- The multicast interface type (always PIM; this display is not supported for DVMRP)
- The Time-to-Live (TTL) for the interface.
- The metric for the interface
- Whether the interface is connected to a leaf node ("leaf" indicates a leaf node and blank indicates another PIM router)

For example, the information for the first interface listed in the display is "PIM/0 /1". This information indicates that the interface is a PIM interface, has a TTL of 0, and a metric of 1. The interface is not a leaf node interface and thus is an interface to another PIM router.

The information for the second interface in the display is "PIM/0 /1/leaf". This information indicates that the interface is a PIM interface, has a TTL of 0 and a metric of 1, and is connected to a leaf node.

USING THE WEB MANAGEMENT INTERFACE

You cannot display another router's PIM configuration using the Web management interface.