IP Multicast: MFIB Configuration Guide, Cisco IOS XE Everest 16.6.x

CONTENTS

CHAPTER 1

Read Me First

Important Information about Cisco IOS XE 16

Effective Cisco IOS XE Release 3.7.0E (for Catalyst Switching) and Cisco IOS XE Release 3.17S (for Access and Edge Routing) the two releases evolve (merge) into a single version of converged release—the Cisco IOS XE 16—providing one release covering the extensive range of access and edge products in the Switching and Routing portfolio.

Feature Information

Use Cisco Feature Navigator to find information about feature support, platform support, and Cisco software image support. An account on Cisco.com is not required.

Related References

- Cisco IOS Command References, All Releases

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see What's New in Cisco Product Documentation.

To receive new and revised Cisco technical content directly to your desktop, you can subscribe to the What's New in Cisco Product Documentation RSS feed. RSS feeds are a free service.

MulticastForwardingInformationBaseOverview

The Multicast Forwarding Information Base (MFIB) architecture provides modularity and separation between the multicast control plane (Protocol Independent Multicast [PIM] and Internet Group Management Protocol [IGMP]) and the multicast forwarding plane (MFIB). This architecture is used in Cisco IOS IPv6 multicast implementations. With the introduction of the IPv4 MFIB infrastructure, the Cisco IOS IPv4 multicast implementation has been enhanced, making the MFIB forwarding model the only forwarding engine used.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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

Information About the Multicast Forwarding Information Base

Benefits of the MFIB Architecture

• Simplifies multicast operation through the separation of the control and forwarding planes.

• Protects mission critical multicast applications by enabling new services such as multicast high availability (HA).

• Eliminates the need for the route cache maintenance associated with demand caching schemes such as multicast fast switching.

Types of Multicast Tables

The following tables are used for general multicast routing and forwarding:

• IGMP--Contains local IGMP memberships on the router.

• Multicast Route (Mroute)--Contains (*, G) and (S, G) multicast states on the router (including PIM mode, incoming interfaces, and outgoing interfaces).

• Multicast Source Discovery Protocol (MSDP)--Contains all Source-Active (SA) messages.

• Multicast Routing Information Base (MRIB)--Contains (*, G), (S, G), and (*, G/m) MRIB entries.

• MFIB--Contains (*, G), (S, G), and (*, G/m) MFIB entries.

Multicast tables can be further defined by the following contexts:

• Global--Non-VRF context.

• VRF--Layer-3 VPN context.

• IPv4--IPv4 address family context.

• IPv6--IPv6 address family context.

Types of Multicast Entries

• (*, G)--Shared tree entries used by PIM sparse mode (PIM-SM) and bidirectional PIM (bidir-PIM).

• (S, G)--Source tree entries used by PIM-SM and Source Specific Multicast (PIM-SSM).

• (*, G/mask)--Shared tree entries used by the bidir-PIM and the MFIB.

Note   For more information about (*, G/mask) entries, see the Introduction of New Multicast Forwarding Entries, on page 12 section.

MFIB Components

The following sections describe the components that make up the MFIB architecture:

The figure illustrates the components that make up the MFIB architecture.

Figure 1: IPv4 MFIB Architecture
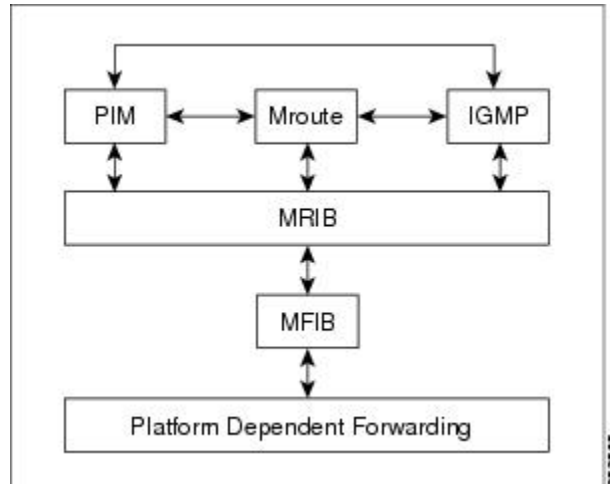
Note   When you enter the **show ip mrib client** command on a multicast router in an IP multicast network, PIM, the mroute table, and IGMP will appear as one client to the MRIB. For more information, see the Cisco IOS IP Multicast Command Reference.

The figure illustrates the IPv4 MFIB distributed architecture.

Figure 2: IPv4 MFIB Distributed Architecture
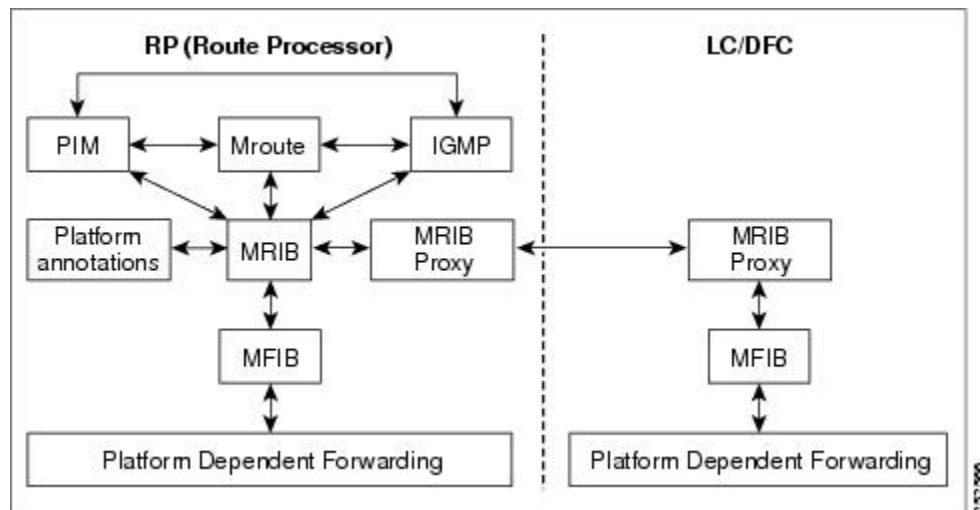
MFIB

The MFIB is a multicast routing protocol independent forwarding engine; that is, it does not depend on PIM or any other multicast routing protocol. It is responsible for:

- Forwarding multicast packets

- Registering with the MRIB to learn the entry and interface flags set by the control plane

- Handling data-driven events that must be sent to the control plane

- Maintaining counts, rates, and bytes of received, dropped, and forwarded multicast packets

Distributed MFIB

Distributed MFIB (dMFIB) is used to switch multicast packets on distributed platforms. dMFIB may also contain platform-specific information on replication across line cards. The basic MFIB routines that implement the core of the forwarding logic are common to all forwarding environments.

dMFIB implements the following functions:

- Distributes a copy of the MFIB to the line cards.

- Relays data-driven protocol events generated in the line cards to PIM.

- Provides an MFIB platform application program interface (API) to propagate MFIB changes to platform-specific code responsible for programming the hardware acceleration engine. This API also includes entry points to switch a packet in software (necessary if the packet is triggering a data-driven event) and to upload traffic statistics to the software.

- Provides hooks to allow clients residing on the Route Processor (RP) to read traffic statistics on demand. (dMFIB does not periodically upload these statistics to the RP.)

The combination of dMFIB and MRIB subsystem (MRIB proxy) also allows the router to have a "customized" copy of the MFIB database in each line card and to transport MFIB-related platform-specific information from the RP to the line cards.

MRIB

The MRIB is the communication channel between MRIB clients. Examples of MRIB clients are PIM, IGMP, the multicast routing (mroute) table, and the MFIB.

MRIB communication is based on the setting and clearing of entry and interface flags. MRIB entries are keyed on source, group, and group mask; and appear as (*, G), (S, G), and (*, G/m) multicast entries in the output of the **show ip mrib route** commands. In addition, every MRIB entry will have a list of interfaces associated with it and each interface will have flags set that describe its forwarding state.

The MRIB does not interpret any entry or interface flags. The flags are significant only to MRIB clients.

Note   The MRIB uses different tables for different contexts. MRIB tables are separated by address family to distinguish between IPv4 and IPv6 multicast entries. Each table can further be divided within a VRF or global context.

Multicast Control Plane

The multicast control plane is responsible for building and maintaining multicast distribution trees. It consists of PIM, IGMP, and the mroute table, which are MRIB clients in the MFIB architecture. Any changes, additions, and deletions to the mroute table (learned from either PIM or IGMP) are communicated across the MRIB and then distributed to the MFIB for multicast forwarding. Any events related to packet reception that require updates to the control plane are handled between the MRIB and MFIB. Such events include liveness checking, shortest path tree (SPT) switchover, and PIM asserts.

Multicast Packet Forwarding Using the MFIB

The core forwarding engine used by the MFIB is shared by both interrupt-level (fast switching) and process-level forwarding (process switching) as shown in the figure. Multicast packets received with a forwarding entry in the MFIB will be fast-switched by the MFIB, and multicast packets received without a forwarding entry that require the creation of a new forwarding entry will be process-switched by the MFIB.

Figure 3: Multicast Forwarding Engine
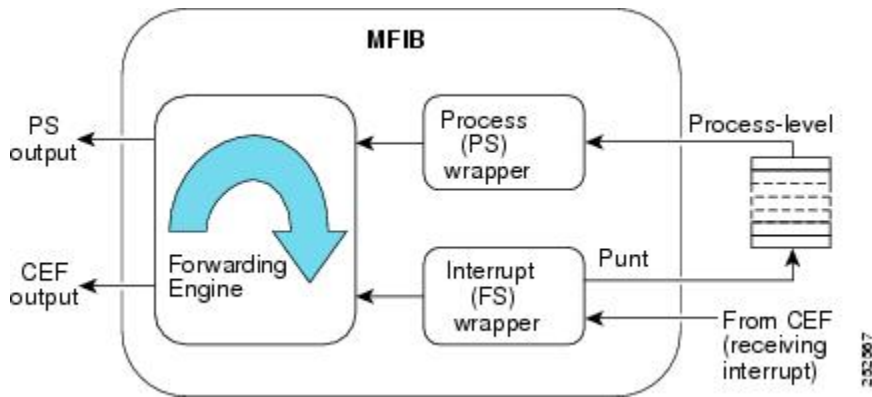
MFIB and MRIB Entry and Interface Flags

The table lists the significant MFIB and MRIB entry and interface flags used by IPv4 multicast.

Table 1: Significant MFIB and MRIB Flags

Entry Flag	Table	Description
C	MFIB/MRIB	Connected--Indicates that the MFIB will inform the multicast control plane when it receives traffic from a directly connected source. This flag is used for multicast groups running in PIM sparse mode (PIM-SM) or PIM dense mode (PIM-DM). For PIM-SM, it triggers PIM registration. For PIM-DM, it triggers dense mode flooding. **Note** MFIB entries with Source Specific Multicast (PIM-SSM) and bidirectional PIM (bidir-PIM) environments will not have the C flag set.
DDE	MFIB/MRIB	Data Driven Event--Set by the forwarding plane when an entry is created due to receiving traffic. This flag is used only for HA operations. When there is a RP switchover, entries with this flag set are replayed by the MFIB and signaled to PIM.
ET	MFIB/MRIB	Data Rate Exceeds a Threshold--Set by the forwarding plane when an entry surpasses the data multicast distribution tree (MDT) threshold in a Multicast VPN (MVPN) environment (configured using the **mdt data** command). This flag is used by PIM to initiate the switchover of the data MDT to the default MDT, and vice versa.

Entry Flag	Table	Description
IA	MFIB/MRIB	Inherit A Flag--(*, G) entries with the IA flag set indicate that the accept check be performed using its (*, G/mask) parent entry. In other words, the accept check is used to inherit interfaces with the A flag set in the (*, G/m) parent entry. **Note** The IA flag is used for bidir-PIM entries.
K	MFIB/MRIB	Keepalive--Set by PIM to indicate that the entry has been processed and should be stored in the MFIB.
S	MFIB/MRIB	Signal--Indicates the MFIB will notify the multicast control plane when traffic is received on any interface for this entry that does not have the NS flag set.
Interface Flag	Table	Description
A	MFIB/MRIB	Accept--Indicates that multicast data can be accepted on this interface. For example, for PIM-SM and PIM-SSM, the A flag would appear on the Reverse Path Forwarding (RPF) interface set in the mroute table. **Note** The A flag in the MFIB is cleared if MFIB forwarding has been disabled on the interface using the **no ip mfib forwarding input** command.

Entry Flag	Table	Description
F	MFIB/MRIB	Forward--Indicates that multicast data can be forwarded out this interface. For example, the interfaces that are in the outgoing interface list in the mroute table will have this flag set. **Note** The F flag in the MFIB is cleared if the MFIB forwarding has been disabled on the interface using the **no ip mfib forwarding output**command.
IC	MFIB/MRIB	Internal Copy--Indicates that a copy of the packet will be processed by the control plane. The IC flag applies to: • Static IGMP joins--Indicates that the **ip igmp join-group** interface command is configured. • Auto-RP groups (224.0.1.39 and 224.0.1.40)--Indicates that the router is participating in Auto-RP. • Linkscope multicast groups (224.0.0.0/24)--Indicates that the router is listening to linkscope multicast groups, which include PIM hellos, PIM joins and prunes, IGMPv2 /v3 reports, and IGP hello packets (Enhanced Interior Gateway Protocol [EIGRP], Open Shortest Path First [OSPF], and Routing Information Protocol Version 2 [RIPv2]).
NP	MFIB	Not Platform Switched--Indicates that this interface is not being hardware switched. The NP flag is an MFIB specific flag.

Entry Flag	Table	Description
NS	MFIB/MRIB	Negate Signal--Indicates that the MFIB will notify the multicast control plane when traffic is received on the specified interface, if the S flag is not set.
		The NS flag is used for:
		• SPT switchover in PIM-SM--The NS flag is set on the (*, G) accept interface towards the RP to trigger SPT switchover.
		• Asserts--The NS-flag is set on (*, G) and (S, G) forward interfaces to trigger PIM asserts.
		• Liveness checking for active sources in PIM-SM--The NS flag is set on the (S, G) accept interface toward the source to check for active sources.
		• Proxy registers that enable a PIM-DM domain to register within a PIM-SM domain--The NS flag is set on the (S, G) accept interface where the **ip pim dense-mode proxy-register** command is configured.
		Note For PIM-SSM, the accept interface entries will not have the NS flag set. PIM-SSM neither performs SPT-switchover nor liveness checking.
		Note For PIM-SM, entries that have the **ip pim spt-threshold infinity** command configured globally will not have the NS flag set on their accept interfaces because SPT switchover will be disabled.

Entry Flag	Table	Description
RA	MFIB	MRIB Accept--The RA flag is an MFIB-specific flag. The MFIB sets this flag when the MRIB sets the A flag on an interface.
RF	MFIB	MRIB Forward--The RF flag is an MFIB-specific flag. The MFIB sets this flag when the MRIB sets the F flag on an interface.

Introduction of New Multicast Forwarding Entries

The MFIB architecture introduces (*, G/mask) entries to describe a group range present in a router's local group-to-RP mapping cache (static, Auto-RP, Bootstrap Router [BSR]).

(*, G/mask) entries are used by the MFIB to:

- Create (S, G) entries if they are not already present in the MFIB table (for PIM-SM)
- Create (*, G) entries along source-only branches (for bidir-PIM)
- Forward multicast traffic along shared-tree branches (for bidir-PIM)

Note   (*, G/mask) entries are present until the group-to-RP mapping cache either times out or is cleared.

Introduction of PIM Tunnel Interfaces

The MFIB architecture introduces PIM tunnel interfaces. PIM tunnel interfaces are used by the MFIB for the PIM-SM registration process. Two types of PIM tunnel interfaces are used by the MFIB:

- A PIM encapsulation tunnel (PIM Encap Tunnel)
- A PIM decapsulation tunnel (PIM Decap Tunnel)

The PIM Encap Tunnel interface is dynamically created whenever a group-to-RP mapping is learned (via Auto-RP, BSR, or static RP configuration). The PIM Encap Tunnel interface is used to encapsulate multicast packets sent by first-hop designated routers (DRs) that have directly connected sources.

Similar to the PIM Encap Tunnel, the PIM Decap Tunnel interface is dynamically created--with the exception that it is created on the RP only whenever a group-to-rp mapping is learned. The PIM Decap Tunnel interface is used by the RP to decapsulate PIM registers.

Note PIM tunnels will not appear in the running configuration. To display information about PIM Tunnel interfaces, use the **show ip pim tunnel** command.

The following syslog message will appear when a PIM tunnel interface is created:

```
* %LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel<interface_number>, changed state
to up
```

MFIB Statistics Support

In the MFIB forwarding model, the MFIB maintains multicast state packet and byte counts and packet rates. The MFIB calculates these statistics as it forwards traffic. There is no periodic polling of these statistics by the control plane, nor does the MFIB periodically upload these statistics to the control plane. The MFIB has an API to these statistics allowing the control plane to query multicast counters when requested from the command-line interface (CLI) for the **show ip mroute count**command and for MIB statistics objects.

Where to Go Next

Proceed to the " Verifying IPv4 Multicast Forwarding Using the MFIB " module.

Additional References

Related Documents

Related Topic	Document Title
Multicast verification tasks and examples using the MFIB	" Verifying IPv4 Multicast Forwarding Using the MFIB " module
IP multicast commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS IP Multicast Command Reference*

Standards

Standard	Title
No new or modified standards are supported, and support for existing standards has not been modified.	--

MIBs

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for the Multicast Forwarding Information Base

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 2: Feature Information for Multicast Forwarding Information Base Overview

Feature Name	Releases	Feature Information
IPv4 Multicast Support of the MFIB	15.0(1)M	The MFIB architecture provides modularity and separation between the multicast control plane (PIM and IGMP) and the multicast forwarding plane (MFIB). This architecture is used in Cisco IOS IPv6 and Cisco IOS XR multicast implementations. With the introduction of the IPv4 MFIB infrastructure, the Cisco IOS IPv4 multicast implementation has been enhanced, making the MFIB forwarding model the only forwarding engine used. The following commands were introduced or modified: **clear ip mfib counters**, **debug ip mcache**, **debug ip mfib adjacency**, **debug ip mfib db**, **debug ip mfib fs**, **debug ip mfib init**, **debug ip mfib interface**, **debug ip mfib mrib**, **debug ip mfib pak**, **debug ip mfib platform**, **debug ip mfib ppr**, **debug ip mfib ps**, **debug ip mfib signal**, **debug ip mfib table**, **debug ip mpacket**, **debug ip mrib**, **ip mfib**, **ip mfib cef**, **ip mfib forwarding**, **ip mroute-cache**, **ip multicast cache-headers**, **ip multicast rate-limit**, **ip multicast ttl-threshold**, **ip pim register-rate-limit**, **show ip mcache**, **show ip mfib**, **show ip mfib active**, **show ip mfib count**, **show ip mfib interface**, **show ip mfib route**, **show ip mfib status**, **show ip mfib summary**, **show ip pim interface**, **show ip pim tunne**l.

Verifying IPv4 Multicast Forwarding Using the MFIB

This module describes how to verify IPv4 multicast forwarding using the Multicast Forwarding Information Base (MFIB) in multicast networks operating in Protocol Independent Multicast (PIM) sparse mode (PIM-SM), Source Specific Multicast (PIM-SSM) mode, or bidirectional PIM (bidir-PIM) mode.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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

Prerequisites for Verifying IPv4 Multicast Forwarding Using the MFIB

- Before performing the tasks in this module, you should be familiar with concepts described in the " Multicast Forwarding Information Base Overview " and " IP Multicast Technology Overview " modules.

- The tasks in this module assume that IP multicast has been enabled and that PIM-SM, PIM-SSM, or bidir-PIM have been configured using the relevant tasks described in the " Configuring Basic IP Multicast " module.

Restrictions for Verifying IPv4 Multicast Forwarding Using the MFIB

- You must be running a software image that supports the IPv4 MFIB infrastructure.

Information About Verifying IPv4 Multicast Forwarding Using the MFIB

Guidelines for Verifying IPv4 Multicast Forwarding Using the MFIB

When you verify IPv4 multicast forwarding using the MFIB in PIM network environments, a useful approach is to begin the verification process on the last-hop designated router (DR), and then continue the verification process on the routers along the SPT for PIM-SM or PIM-SSM (or on the shared tree for bidir-PIM) until the first-hop DR has been reached. The goal of the verification is to ensure that IP multicast traffic is being forwarded properly through an IP multicast network.

Common Commands for Verifying IPv4 Multicast Forwarding Using the MFIB

The table describes the common commands used to verify multicast forwarding using the MFIB.

Table 3: Common IP Multicast Commands for Verifying Multicast Forwarding

Command	Description and Purpose
show ip igmp groups	Displays the multicast groups with receivers that are directly connected to the router and that were learned through Internet Group Management Protocol (IGMP). • Use this command to confirm that the IGMP cache is being properly populated on the last-hop DR for the groups that receivers on the LAN have joined.
show ip mfib	Displays the multicast forwarding entries within the MFIB.
show ip mrib route	Displays entries in the Multicast Routing Information Base (MRIB) table set by PIM, IGMP, or the MFIB.
show ip mroute	Displays the contents of the multicast routing (mroute) table.
show ip pim rp mapping	Displays all group-to-Rendezvous Point (RP) mappings of which the router is aware (either configured or learned from Auto-RP or bootstrap router [BSR]). **Note** The **show ip pim rp mapping** command does not apply to routers in a PIM-SSM network because PIM-SSM does not use rendezvous points (RPs).

Common Mroute Flags

When you verify multicast forwarding, it is helpful to start by looking at the control plane using the **show ip mroute** command. The table describes some of the common flags that you will observe in the output of the **show ip mroute** command when verifying multicast forwarding.

Table 4: Common Mroute Flags

Flag	Description
Mode Flags (All Routers)	
S	Sparse—Entry is operating in sparse mode.
s	SSM—GroupEntry is operating in SSM mode.

Flag	Description
B	B Bidir—GroupEntry is operating in bidirectional mode.
Last-Hop DR Flags	
C	Connected—Indicates that an IGMPv2 report for the multicast group was received.
I	Received Source Specific Host Report—Indicates that an IGMPv3 report for the multicast group was received.
L	Local—Indicates that the router itself is a member of the multicast group. Examples are groups that are joined locally by the **ip igmp join-group** command, the **ip sap listen** commands, and the well-known Auto-RP groups, 224.0.1.39 and 224.0.1.40. **Note** Locally joined groups are process switched.
J	Joined SPT—Indicates that the SPT threshold is set to 0 kbps and the next (S, G) packet received down the shared tree will trigger an (S, G) join in the direction of the source. **Note** If the SPT threshold is set to infinity (using the **ip pim spt-threshold infinity** command), the J flag will not be set and all (S, G) packets will stay on the shared tree.
First-Hop DR Flags	
F	Register Flag—Indicates that the router is a candidate to register for the multicast group.
(S, G) Forwarding Flag (Routers Along SPT)	
T	SPT-bit Set—Indicates that packets have been received on the SPT.
Pruned Flag	
P	Pruned—Entry is in a prune state. Multicast traffic for the multicast group will be dropped by the router.

Common MRIB Flags

When you verify multicast forwarding, it is helpful to confirm the communication between the control plane and the MFIB by examining the MRIB using the **show ip mrib route** command. The table describes some of the common flags that you will encounter in the output of the **show ip mrib route** command when verifying multicast forwarding.

Table 5: Common MRIB Flags

Flag	Description
Entry Flags	
C	Connected--When set, this flag should also appear in the MFIB. For more information, see the C Flag, on page 22 description in the Common MFIB Flags, on page 21 section.
IA	Inherited Accept--When set, this flag should also appear in the MFIB. For more information, see the IA Flag, on page 24 description in the Common MFIB Flags, on page 21 section.
Interface Flags	
A	Accept--When set, this flag should also appear in the MFIB. For more information, see the A Flag, on page 25 description in the Common MFIB Flags, on page 21 section.
F	Forward--When set, this flag should also appear in the MFIB. For more information, see the F Flag, on page 26 description in the Common MFIB Flags, on page 21 section.
NS	Negate Signal--When set, this flag should also appear in the MFIB. For more information about this flag, see the NS Flag, on page 27 description in Common MFIB Flags, on page 21 section.

Common MFIB Flags

When you verify multicast forwarding, it is important to examine the MFIB using the **show ip mfib** command to ensure that multicast traffic is being forwarded as expected. This section describes some of the common flags that you will observe in the output of the **show ip mfib** command when verifying multicast forwarding.

C Flag

The table describes the C flag.

Table 6: C Flag Description

Entry Flag	Description
C	Connected--Indicates that the MFIB will inform the multicast control plane when it receives traffic from a directly connected source. This flag is used for multicast groups running in PIM-SM or PIM-DM. For PIM-SM, it triggers PIM registration. For PIM-DM, it triggers dense mode flooding.
	Note PIM-SSM and bidir-PIM MFIB entries will not have the C flag set.

C Flag Sample Output

The following is sample output from the **show ip mfib** command. In this example, the output has been filtered to display only entries that have the C flag set.

```
RP# show ip mfib | inc Flags: C
 (*,224.0.0.0/4) Flags: C
 (*,239.1.1.1) Flags: C
 (*,224.0.1.39) Flags: C
 (*,224.0.1.40) Flags: C
```

Well-Known Groups

(*, 224.0.0.0/4) Flags: C

This entry indicates that a directly connected check is being performed for the multicast range 224.0.0.0/4. The assumption is that this range is in the group-to-RP mapping cache. If it is not in the group-to-RP mapping cache, this entry will not appear. (*, G/m) parent entries, such as this entry, are used when a match for a (*, G) or (S, G) entry is not found. When traffic from a directly connected source matches a parent entry, the appropriate (*, G) and (S, G) entries in the MFIB, MRIB, and mroute tables will be created.

(*, 224.0.1.39) Flags: C

This entry indicates that a directly connected check is being performed for the Auto-RP Announce multicast group. When traffic from a directly connected source matches this entry and no corresponding (S, G) entry is found, the appropriate (S, G) entry will be created in the MFIB, MRIB, and mroute tables.

Note   (*, 224.0.1.39) appears in routers that are configured as an RP for Auto-RP using the **ip pim send-rp-announce** command. The C flag will always be set for this entry, whether the multicast group is running in PIM-DM or PIM-SM.

(*, 224.0.1.40) Flags: C

This entry indicates that a directly connected check is being performed for the Auto-RP Discovery multicast group. When traffic from a directly connected source matches this entry and no corresponding (S, G) entry is found, the appropriate (S, G) entry will be created in the MFIB, MRIB, and mroute table.

Note   (*, 224.0.1.40) appears on routers that are configured as a Mapping Agent using the **ip pim send-rp-discovery** command. The C flag will always be set for this entry, whether the multicast group is running in PIM-DM or PIM-SM.

Standard Multicast Group Entry

(*, 239.1.1.1) Flags: C

This entry indicates that a directly connected check is being performed for the multicast group 239.1.1.1.

Note   239.1.1.1 was arbitrarily chosen for this example to represent a standard multicast group entry in the **show ip mfib** output; in practice, the multicast group entries that will display in the output will depend upon your multicast network environment and application.

For this example, the (*, 224.0.0.0/4) entry will not be used because (*, 239.1.1.1) is more specific. When traffic from a directly connected source matches the (*, 239.1.1.1) entry and no (S, G) entry match is found, the MFIB will create the appropriate (S, G) entry then inform the multicast control plane to do the same in the mroute table. If the source is sending for the first time, the multicast control plane will then perform PIM registration or dense mode flooding based on the mode running for the multicast group.

K Flag

The table describes the K flag.

Table 7: K Flag Description

Entry Flag	Description
K	Keepalive--Set by PIM to indicate that the entry has been processed and should be stored in the MFIB.

K Flag Sample Output

The K flag is set to indicate that the control plane (PIM/IGMP/TRANS) owns this entry. When the K flag is set the entry stays in the MFIB until the control plane removes it.

If all flags on an entry (or interface) are removed, MFIB deletes the entry. Therefore, the K flag is used to ensure that MFIB keeps the entry in the absence of any other entry flags (or interfaces with flags on the entry).

The following is sample output from the **show ip mfib**command. In this example, the output has been filtered to display only entries that have the K flag set.

> **Note** The K flag is displayed only when the **verbose** keyword is also specified.

RP# **show ip mfib verbose | inc Flags: K**

```
ET - Data Rate Exceeds Threshold, K - Keepalive Forwarding Counts: Pkt Count/Pkts per
second/Avg Pkt Size/Kbits per second
 (*,224.0.0.0/4) Flags: K
 (*,224.0.1.40) Flags: C K
 (*,232.0.0.0/8) Flags: K
 (*,239.0.0.0/8) Flags: K
 (*,239.1.1.1) Flags: IA K
```

IA Flag

The table describes the IA flag.

Table 8: IA Flag Description

Entry Flag	Description
IA	Inherit A Flag--(*, G) entries with the IA flag set indicate that the accept check be performed using its (*, G/mask) parent entry. In other words, the accept check is used to inherit interfaces with the A flag set in the (*, G/m) parent entry. **Note** The IA flag is used for bidir-PIM entries.

IA Flag Sample Output

In the following output from the **show ip mfib** and **show ip pim rp-mapping**commands, the multicast group 239.195.1.1 is running bidir-PIM and there are two entries: (*, 239.195.1.1) and (*, 239.195.0.0/16). The (*, 239.195.1.1) entry indicates that there is an interested receiver in the network. The parent entry, (*, 239.195.0.0/16), indicates that there is a bidir-PIM group-to-RP mapping. The (*, 239.195.1.1) entry will be used for forwarding multicast traffic for the multicast group 239.195.1.1. The (*, 239.195.1.1) entry will also have the IA flag set, indicating it will inherit the following interfaces from its parent entry for performing accept checks: Serial interface 4/0, Serial interface 2/0, GigabitEthernet interface 0/0/0, and Null interface 0.

> **Note** The portions of output relevant to the IA flag are highlighted in bold.

```
Router# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial4/0 Flags: F
     Pkts: 0/0
   GigabitEthernet0/0/0 Flags: F
```

```
     Pkts: 0/0
Router# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial4/0
 Flags: A
 F
     Pkts: 0/0
   Serial2/0
Flags: A
   GigabitEthernet0/0/0
 Flags: A
   Null0
 Flags: A
Router# show ip pim rp mapping
     PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
     Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 00:49:10, expires: 00:02:19
```

A Flag

The table describes the A flag.

Table 9: A Flag Description

I/O Flag	Description
A	Accept--Indicates that multicast data can be accepted on this interface. For example, for PIM-SM and PIM-SSM, the A flag would appear on the Reverse Path Forwarding (RPF) interface set in the mroute table.
	Note The A flag in the MFIB is cleared if MFIB forwarding has been disabled on the interface using the **no ip mfib forwarding input** command.

A Flag Sample Output

Interfaces with the A flag set in the MFIB correspond to the incoming interfaces for their respective mroute entries, as shown in the following output for the multicast group 239.1.1.1:

Note The portions of sample output relevant to the A flag are highlighted in bold.

```
Router# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 366/0/28/0, Other: 0/0/0
   Serial4/0 Flags: A
NS
   GigabitEthernet0/0/0 Flags: F NS
     Pkts: 366/0
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 107/10/28/2, Other: 1/1/0
```

```
    Serial2/0 Flags: A
      GigabitEthernet0/0/0 Flags: F NS
        Pkts: 106/1
Router# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:00:40/stopped, RP 192.168.6.6, flags: SJC
  Incoming interface: Serial4/0
, RPF nbr 192.168.67.6
  Outgoing interface list:
    GigabitEthernet0/0/0, Forward/Sparse, 00:00:40/00:02:59
(192.168.1.2, 239.1.1.1), 00:00:03/00:02:56, flags: JT
  Incoming interface: Serial2/0
, RPF nbr 192.168.37.3
  Outgoing interface list:
    GigabitEthernet0/0/0, Forward/Sparse, 00:00:03/00:02:59
```

F Flag

The table describes the F flag.

Table 10: F Flag Description

I/O Flag	Description
F	Forward--Indicates that multicast data can be forwarded out this interface. For example, the interfaces that are in the outgoing interface list in the mroute table will have this flag set.
	Note The F flag in the MFIB is cleared if the MFIB forwarding has been disabled on the interface using the **no ip mfib forwarding output**command.

F Flag Sample Output

Interfaces with the F flag set in the MFIB correspond to interfaces in the outgoing interface list for their respective mroute entries, as shown in the following output for the multicast group 239.1.1.1:

Note   The portions of sample output relevant to the F flag are highlighted in bold.

```
Router# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 366/0/28/0, Other: 0/0/0
   Serial4/0 Flags: A NS
   GigabitEthernet0/0 Flags: F
 NS
     Pkts: 366/0
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 107/10/28/2, Other: 1/1/0
   Serial2/0 Flags: A
   GigabitEthernet0/0/0 Flags: F
 NS
     Pkts: 106/1
Router# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:00:40/stopped, RP 192.168.6.6, flags: SJC
  Incoming interface: Serial4/0, RPF nbr 192.168.67.6
  Outgoing interface list:
```

```
      GigabitEthernet0/0
, Forward/Sparse, 00:00:40/00:02:59
(192.168.1.2, 239.1.1.1), 00:00:03/00:02:56, flags: JT
  Incoming interface: Serial2/0, RPF nbr 192.168.37.3
  Outgoing interface list:
    GigabitEthernet0/0/0
, Forward/Sparse, 00:00:03/00:02:59
```

NS Flag

The table describes the NS flag.

Table 11: NS Flag Description

I/O Flag	Description
NS	Negate Signal--Indicates the MFIB will notify the multicast control plane when traffic is received on the specified interface, if the S flag is not set.
	The NS flag is used for:
	• SPT switchover in PIM-SM--The NS flag is set on the (*, G) accept interface toward the RP to trigger SPT switchover.
	• Asserts--The NS flag is set on (*, G) and (S, G) forward interfaces to trigger PIM asserts.
	• Liveness checking for active sources in PIM-SM--The NS flag is set on the (S, G) accept interface toward the source to check for active sources.
	• Proxy-registers that enable a PIM-DM domain to register within a PIM-SM domain--The NS flag is set on the (S, G) accept interface where the **ip pim dense-mode proxy-register** command is configured.
	Note For PIM-SSM, the accept interface entries will not have the NS flag set. PIM-SSM neither performs SPT-switchover nor liveness checking.
	Note For PIM-SM, entries that have **ip pim spt-threshold infinity** configured globally will not have the NS flag set on their accept interfaces because SPT switchover will be disabled.

IC Flag

The table describes the IC flag.

Table 12: IC Flag Description

I/O Flag	Description
IC	Internal Copy--Indicates that a copy of the packet will be processed by the control plane. The IC flag applies to: • Static IGMP joins--Indicates that the **ip igmp join-group** interface command is configured. • Auto-RP groups (224.0.1.39 and 224.0.1.40)--Indicates that the router is participating in Auto-RP. • Linkscope multicast groups (224.0.0.0/24)--Indicates that the router is listening to linkscope multicast groups, which include PIM hellos, PIM joins and prunes, IGMPv2 /v3 reports, and Interior Gateway Protocol hello packets (Enhanced Interior Gateway Routing Protocol [EIGRP], Open Shortest Path First [OSPF], and Routing Information Protocol version 2 [RIPv2]).

IC Flag Sample Output

Note The configuration lines and portions of sample output relevant to the IC flag are highlighted in bold.

Static IGMP Join

The following example configures a static IGMP join for multicast group 239.1.1.1 under GigabitEthernet interface 0/0/0:

```
interface GigabitEthernet0/0/0
 ip address 192.168.7.7 255.255.255.0
 ip pim sparse-mode
 ip igmp join-group 239.1.1.1
```
The following sample output from the **show ip mfib** command verifies that the IC flag is set for GigabitEthernet interface 0/0/0:

```
Router# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 366/0/28/0, Other: 0/0/0
   Serial4/0 Flags: A NS
   GigabitEthernet0/0/0
 Flags: F IC
 NS
     Pkts: 366/0
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 3978/10/28/2, Other: 1/1/0
```

```
      Serial2/0 Flags: A
      GigabitEthernet0/0/0
Flags: F IC
 NS
      Pkts: 3977/1
```

Note The **ip igmp static-group** command will not set the IC flag.

Auto-RP Groups 224.0.1.39 and 224.0.1.40

The following output from the **show ip igmp group**and **show ip mfib** command confirms that this router is both an RP and Mapping Agent and has the IC flag set to process switch Auto-RP multicast packets.

Note All routers, including the RP, will join the multicast group 224.0.1.40. In addition to the multicast group 224.0.1.40, Mapping Agents will also join 224.0.1.39.

```
Router# show ip igmp group
IGMP Connected Group Membership
Group Address    Interface            Uptime    Expires   Last Reporter   Group Accounted
224.0.1.39       Serial2/0
                 02:57:51  stopped   192.168.26.6
224.0.1.39       Serial1/0
                 02:57:51  stopped   192.168.67.6
224.0.1.39       GigabitEthernet0/0/0
    02:57:51  00:02:11  192.168.16.6
224.0.1.39       Loopback0
                 02:57:51  00:02:07  192.168.6.6
224.0.1.40       Loopback0
                 02:57:51  00:02:11  192.168.6.6
239.1.1.1        GigabitEthernet0/0/0   02:58:51  00:02:13  192.168.16.6
224.1.1.1        GigabitEthernet0/0/0   02:58:51  00:02:13  192.168.16.6
Router# show ip mfib 224.0.1.39
 (*,224.0.1.39) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: F IC NS
     Pkts: 0/0
   Serial2/0 Flags: F IC NS
     Pkts: 0/0
   Serial1/0 Flags: F IC NS
     Pkts: 0/0
   GigabitEthernet0/0/0 Flags: F IC NS
     Pkts: 0/0
 (192.168.6.6,224.0.1.39) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: A IC
   Serial2/0 Flags: F IC NS
     Pkts: 0/0
   Serial1/0 Flags: F IC NS
     Pkts: 0/0
   GigabitEthernet0/0/0 Flags: F IC NS
     Pkts: 0/0
Router# show ip mfib 224.0.1.40
 (*,224.0.1.40) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: F IC NS
     Pkts: 0/0
   Serial2/0 Flags: F NS
     Pkts: 0/0
   Serial1/0 Flags: F NS
     Pkts: 0/0
 (192.168.6.6,224.0.1.40) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: A IC
```

```
      Serial2/0 Flags: F NS
        Pkts: 0/0
      Serial1/0 Flags: F NS
        Pkts: 0/0
```

Linkscope Multicast Groups 224.0.0.0/24

The following output from the **show ip mfib linkscope** command confirms that the IC flag is set to process multicast control packets:

```
Router# show ip mfib linkscope
.
.
.
(*,224.0.0.1) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: IC
   Serial4/0 Flags: IC
   Serial3/0 Flags: IC
   Serial2/0 Flags: IC
   GigabitEthernet1/0/0 Flags: IC
   GigabitEthernet0/0/0 Flags: IC
 (*,224.0.0.2) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: IC
   Serial4/0 Flags: IC
   Serial3/0 Flags: IC
   Serial2/0 Flags: IC
   GigabitEthernet1/0/0 Flags: IC
   GigabitEthernet0/0/0 Flags: IC
 (*,224.0.0.13) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: IC
   Serial4/0 Flags: IC
   Serial3/0 Flags: IC
   Serial2/0 Flags: IC
   GigabitEthernet1/0/0 Flags: IC
   GigabitEthernet0/0/0 Flags: IC
 (*,224.0.0.22) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback0 Flags: IC
   Serial4/0 Flags: IC
   Serial3/0 Flags: IC
   Serial2/0 Flags: IC
   GigabitEthernet1/0/0 Flags: IC
   GigabitEthernet0/0/0 Flags: IC
```

PIM Tunnel Interfaces

PIM tunnel interfaces are used by MFIB for the PIM-SM registration process. Two types of PIM tunnel interfaces are used by the MFIB:

- A PIM encapsulation tunnel (PIM Encap Tunnel)
- A PIM decapsulation tunnel (PIM Decap Tunnel)

The PIM Encap Tunnel is dynamically created whenever a group-to-RP mapping is learned (via Auto-RP, BSR, or static RP configuration). The PIM Encap Tunnel is used to encapsulate multicast packets sent by first-hop DRs that have directly connected sources.

Similar to the PIM Encap Tunnel, the PIM Decap Tunnel interface is dynamically created--with the exception that it is created on the RP only whenever a group-to-RP mapping is learned. The PIM Decap Tunnel interface is used by the RP to decapsulate PIM registers.

Note   PIM tunnels will not appear in the running configuration.

The following syslog message will appear when a PIM tunnel interface is created:

```
* %LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel<interface_number>, changed state
to up
```

How to Verify IPv4 Multicast Forwarding Using the MFIB

Verifying IPv4 Multicast Forwarding Using the MFIB for PIM-SM PIM-SSM and Bidir-PIM

Perform this optional task to verify multicast forwarding using the MFIB in PIM-SM, PIM-SSM, and bidir-PIM networks.

When you verify IPv4 multicast forwarding using the MFIB in PIM network environments, a useful approach is to begin the verification process on the last-hop DR, and then continue the verification process on the routers along the SPT for PIM-SM or PIM-SSM (or on the shared tree for bidir-PIM) until the first-hop DR has been reached. The goal of the verification is to ensure that IP multicast traffic is being forwarded properly through an IP multicast network.

Before You Begin

The tasks in this module assume that IP multicast has been enabled and that PIM-SM, PIM-SSM, or bidir-PIM have been configured.

Note   You must be running a Cisco software image that supports the IPv4 MFIB infrastructure.

>

SUMMARY STEPS

1. **enable**
2. **show ip mroute**
3. **show ip mrib route**
4. **show ip mfib**
5. show ip pim rp mapping
6. show ip igmp groups

DETAILED STEPS

Step 1   **enable**

Enables privileged EXEC mode. Enter your password if prompted.

```
Router> enable
```

Step 2   **show ip mroute**
Displays the contents of the mroute table.

```
Router# show ip mroute
```

Step 3   **show ip mrib route**
Displays the MRIB table.

```
Router# show ip mrib route
```

Step 4   **show ip mfib**
Displays the forwarding entries and interfaces in the MFIB.

```
Router# show ip mfib
```

Step 5   show ip pim rp mapping
Displays all group-to-RP mappings of which the router is aware (either configured or learned from Auto-RP or BSR).
Use this command to confirm which router is acting as the RP.

Note   The **show ip pim rp mapping**command does not apply to routers in a PIM-SSM network because PIM-SSM
does not use RPs.

Sample Output from an RP

The following is sample output from the **show ip pim rp mapping** command. The output confirms that the router in
this example is the RP.

Example:

```
RP# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 01:04:03, expires: 00:02:53
```

Sample Output from a Non-RP

The following is sample output from the **show ip pim rp mapping** command. The output confirms that this router is
not the RP.

Example:

```
Non-RP# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
```

```
            Info source: 192.168.6.6 (?), elected via Auto-RP
                  Uptime: 00:40:55, expires: 00:02:45
```

Step 6   show ip igmp groups

Displays the multicast groups with receivers that are directly connected to the router and that were learned through IGMP.

Use this command to confirm that the IGMP cache is being properly populated on the last-hop DR for the groups that receivers on the LAN have joined.

```
Router# show ip igmp groups
```

Verifying PIM Tunnel Interfaces for PIM-SM

Perform this optional task verify to verify the PIM tunnel interfaces that are used by the MFIB for the PIM-SM registration process. This task can be performed if you suspect that there may be problems related to PIM-SM registration.

SUMMARY STEPS

1. **enable**
2. **show ip pim rp mapping**
3. **show ip pim tunnel**
4. **show ip mfib**

DETAILED STEPS

Step 1   **enable**

Enables privileged EXEC mode. Enter your password if prompted.

```
Router> enable
```

Step 2   **show ip pim rp mapping**

Displays all group-to-RP mappings of which the router is aware (either configured or learned from Auto-RP or BSR). Use this command to confirm which router is acting as the RP.

Sample Output from an RP

The following is sample output from the **show ip pim rp mapping** command. The output confirms that the router in this example is the RP.

Example:

```
RP# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
```

```
       Info source: 192.168.6.6 (?), elected via Auto-RP
           Uptime: 01:04:03, expires: 00:02:53
```

Sample Output from a Non-RP

The following is sample output from the **show ip pim rp mapping** command. The output confirms that this router is not the RP.

Example:

```
Non-RP# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 00:40:55, expires: 00:02:45
```

Step 3   **show ip pim tunnel**

Displays the PIM tunnel interfaces used by the MFIB for the PIM-SM registration process.

Sample Output from an RP (show ip pim tunnel)

The following is output from the **show ip pim tunnel** command. The output is used to verify the PIM Encap and Decap Tunnel on the RP.

Example:

```
RP# show ip pim tunnel
Tunnel0
  Type  : PIM Encap
  RP    : 192.168.6.6*
  Source: 192.168.6.6
Tunnel1
  Type  : PIM Decap
  RP    : 192.168.6.6*
  Source: -
```

Note   The asterisk (*) indicates that the router is the RP. The RP will always have a PIM Encap and Decap Tunnel interface.

Sample Output from a Non-RP (show ip pim tunnel) The following is output from the **show ip pim tunnel** command. The output is used to confirm that a PIM Encap Tunnel has been created on a non-RP router.

Example:

```
Non-RP# show ip pim tunnel
Tunnel0
  Type  : PIM Encap
  RP    : 192.168.6.6
  Source: 192.168.67.7
```

Step 4   **show ip mfib**

Displays the forwarding entries and interfaces in the MFIB.

or

show ip mrib route

Displays the MRIB table.

Use either the **show ip mfib** command or the **show ip mrib route** command to verify that the entries registering for PIM-SM have the F flag set for the PIM Encap Tunnel.

Configuration Examples for Verifying IPv4 Multicast Forwarding Using the MFIB

Examples Verifying IPv4 Multicast Forwarding Using the MFIB for PIM-SM

This section contains the following examples for verifying multicast forwarding using the MFIB for PIM-SM networks:

Note   The examples in this section were created in a test environment to provide a conceptual view of the multicast environment. The IP addresses, interfaces, and other values are shown as examples only. They do not show real-world deployment values.

PIM-SM Example Active Sources and Interested Receivers - SPT Switchover

The following example shows how to verify multicast forwarding using the MFIB for PIM-SM in a network environment where there are active sources with interested receivers. This verification example is based on the topology shown in the figure.

Figure 4: PIM-SM Example Topology: Active Sources and Interested Receivers (SPT Switchover)
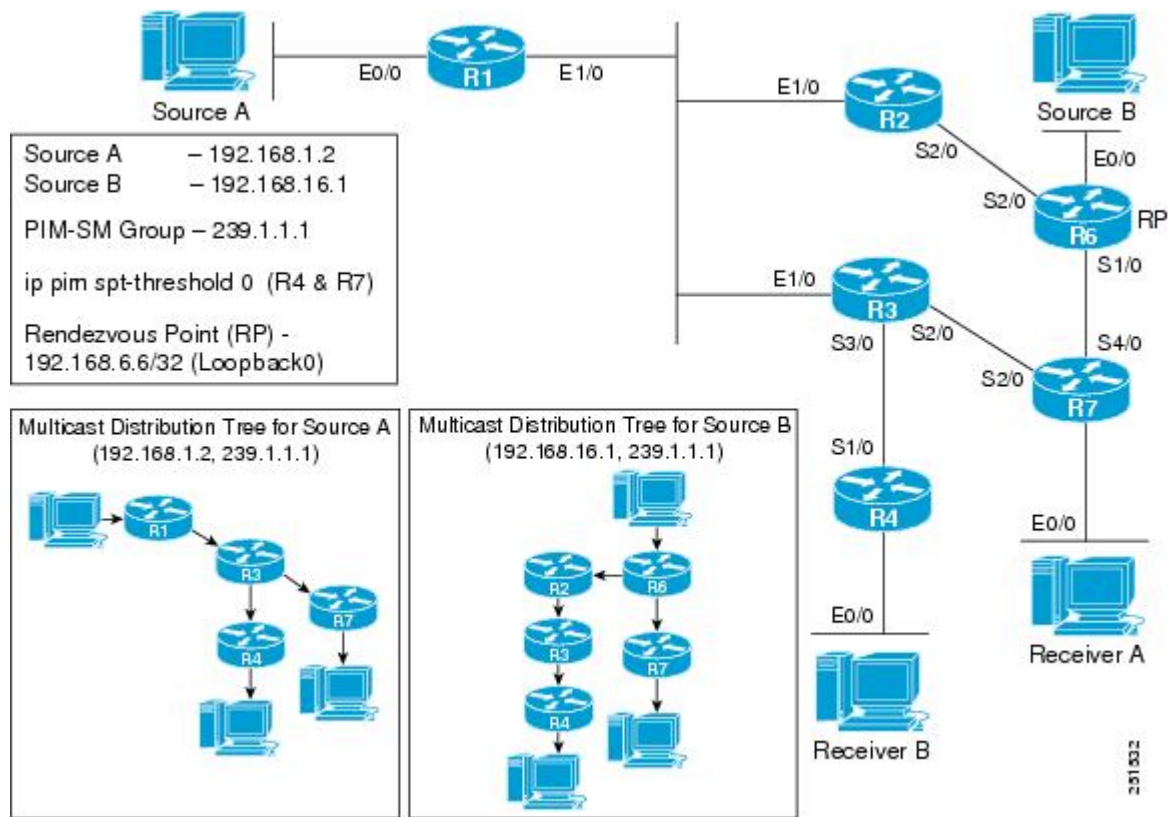
In this verification example, the following conditions apply:

- All routers have the SPT switchover set to the default (**ip pim spt-threshold 0**).

- Because the SPT threshold is set to 0, all last-hop DRs with interested receivers will perform an SPT switchover when multicast traffic is received on the shared tree.

- During the PIM-SM registration process between the first-hop DR and the RP, a PIM tunnel is used. First-hop DRs will have a PIM Encap Tunnel and the RP will have both a PIM Encap and Decap Tunnel. After the PIM-SM registration process completes, PIM tunnels will not be used for multicast forwarding. For more information, see the section.

R1 (First-Hop DR)

```
R1# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
```

```
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
      Uptime: 03:09:53, expires: 00:02:14
R1# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:53:08/stopped, RP 192.168.6.6, flags: SPF
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list: Null
(192.168.1.2, 239.1.1.1), 00:53:08/00:03:12, flags: FT
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 00:38:25/00:03:07
R1# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.123.2 Flags: C
  Ethernet1/0 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 0.0.0.0 Flags:
  Ethernet0/0 Flags: A
  Ethernet1/0 Flags: F NS
R1# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
  SW Forwarding: 0/0/0/0, Other: 23058/0/23058
  Ethernet1/0 Flags: A
 (192.168.1.2,239.1.1.1) Flags:
  SW Forwarding: 23059/10/28/2, Other: 8826/0/8826
  Ethernet0/0 Flags: A
  Ethernet1/0 Flags: F NS
    Pkts: 23058/0
```

R2 (Router Along the SPT)

```
R2# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
      Uptime: 03:09:53, expires: 00:02:14
R2# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:39:05/00:02:53, RP 192.168.6.6, flags: S
  Incoming interface: Serial2/0, RPF nbr 192.168.26.6
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 00:39:05/00:02:53
(192.168.16.1, 239.1.1.1), 00:03:31/00:02:54, flags: T
  Incoming interface: Serial2/0, RPF nbr 192.168.26.6
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 00:03:31/00:02:56
(192.168.1.2, 239.1.1.1), 00:39:05/00:02:42, flags: PT
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.1
  Outgoing interface list: Null
R2# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.26.6 Flags: C
  Ethernet1/0 Flags: F NS
  Serial2/0 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.123.1 Flags:
  Ethernet1/0 Flags: A
(192.168.16.1,239.1.1.1) RPF nbr: 192.168.26.6 Flags:
  Serial2/0 Flags: A
  Ethernet1/0 Flags: F NS
R2# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
  SW Forwarding: 21343/0/28/0, Other: 0/0/0
  Serial2/0 Flags: A
  Ethernet1/0 Flags: F NS
    Pkts: 21343/0
 (192.168.1.2,239.1.1.1) Flags:
  SW Forwarding: 21643/0/28/0, Other: 1812/1/1811
  Ethernet1/0 Flags: A
 (192.168.16.1,239.1.1.1) Flags:
  SW Forwarding: 2112/10/28/2, Other: 0/0/0
  Serial2/0 Flags: A
  Ethernet1/0 Flags: F NS
    Pkts: 2112/0
```

R3 (Router Along the SPT)

```
R3# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R3# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:40:32/00:03:19, RP 192.168.6.6, flags: S
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list:
    Serial3/0, Forward/Sparse, 00:40:32/00:03:19
(192.168.16.1, 239.1.1.1), 00:04:58/00:02:29, flags: T
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list:
    Serial3/0, Forward/Sparse, 00:04:58/00:03:26
(192.168.1.2, 239.1.1.1), 00:04:58/00:02:26, flags: T
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.1
  Outgoing interface list:
    Serial2/0, Forward/Sparse, 00:04:28/00:02:57
    Serial3/0, Forward/Sparse, 00:04:58/00:03:27
R3# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.123.2 Flags: C
  Serial3/0 Flags: F NS
  Ethernet1/0 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.123.1 Flags:
  Ethernet1/0 Flags: A
  Serial2/0 Flags: F NS
  Serial3/0 Flags: F NS
(192.168.16.1,239.1.1.1) RPF nbr: 192.168.123.2 Flags:
  Ethernet1/0 Flags: A
  Serial3/0 Flags: F NS
R3# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
  SW Forwarding: 42686/0/28/0, Other: 0/0/0
  Ethernet1/0 Flags: A
  Serial3/0 Flags: F NS
    Pkts: 42686/0
 (192.168.1.2,239.1.1.1) Flags:
  SW Forwarding: 2984/10/28/2, Other: 0/0/0
  Ethernet1/0 Flags: A
  Serial3/0 Flags: F NS
    Pkts: 2984/0
  Serial2/0 Flags: F NS
    Pkts: 2684/0
 (192.168.16.1,239.1.1.1) Flags:
  SW Forwarding: 2984/10/28/2, Other: 0/0/0
  Ethernet1/0 Flags: A
  Serial3/0 Flags: F NS
    Pkts: 2984/0
```

R4 (Last-Hop DR for Receiver B)

```
R4# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R4# show ip igmp groups 239.1.1.1
IGMP Connected Group Membership
Group Address    Interface       Uptime    Expires    Last Reporter    Group Accounted
239.1.1.1        Ethernet0/0     00:06:39  00:02:56   192.168.4.1
R4# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:42:12/stopped, RP 192.168.6.6, flags: SJC
  Incoming interface: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
```

```
      Ethernet0/0, Forward/Sparse, 00:42:12/00:02:02
(192.168.16.1, 239.1.1.1), 00:06:37/00:02:16, flags: JT
  Incoming interface: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
      Ethernet0/0, Forward/Sparse, 00:06:37/00:02:02
(192.168.1.2, 239.1.1.1), 00:06:37/00:02:19, flags: JT
  Incoming interface: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
      Ethernet0/0, Forward/Sparse, 00:06:37/00:02:02
R4# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.34.3 Flags: C
  Serial1/0 Flags: A NS
  Ethernet0/0 Flags: F NS
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.34.3 Flags:
  Serial1/0 Flags: A
  Ethernet0/0 Flags: F NS
(192.168.16.1,239.1.1.1) RPF nbr: 192.168.34.3 Flags:
  Serial1/0 Flags: A
  Ethernet0/0 Flags: F NS
R4# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 42684/0/28/0, Other: 0/0/0
   Serial1/0 Flags: A NS
   Ethernet0/0 Flags: F NS
     Pkts: 42684/0
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 3980/10/28/2, Other: 0/0/0
   Serial1/0 Flags: A
   Ethernet0/0 Flags: F NS
     Pkts: 3979/1
 (192.168.16.1,239.1.1.1) Flags:
   SW Forwarding: 3980/10/28/2, Other: 0/0/0
   Serial1/0 Flags: A
   Ethernet0/0 Flags: F NS
     Pkts: 3979/1
```

R6 (RP and First-Hop DR for Source B)

```
R6# show ip pim rp mapping

PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:10:53, expires: 00:02:06
R6# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:58:12/00:03:25, RP 192.168.6.6, flags: SF
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
      Serial1/0, Forward/Sparse, 00:43:25/00:03:22
      Serial2/0, Forward/Sparse, 00:43:29/00:03:25
(192.168.1.2, 239.1.1.1), 00:58:12/00:02:47, flags: PT
  Incoming interface: Serial2/0, RPF nbr 192.168.26.2
  Outgoing interface list: Null
(192.168.16.1, 239.1.1.1), 00:58:12/00:03:17, flags: FT
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
      Serial1/0, Forward/Sparse, 00:43:25/00:03:22
      Serial2/0, Forward/Sparse, 00:43:29/00:03:27
R6# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 0.0.0.0 Flags: C
  Serial1/0 Flags: F NS
  Serial2/0 Flags: F NS
  Tunnel1 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.26.2 Flags:
  Serial2/0 Flags: A NS
(192.168.16.1,239.1.1.1) RPF nbr: 0.0.0.0 Flags:
  Ethernet0/0 Flags: A
  Serial1/0 Flags: F NS
```

```
    Serial2/0 Flags: F NS
R6# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Tunnel1 Flags: A
   Serial2/0 Flags: F NS
     Pkts: 0/0
   Serial1/0 Flags: F NS
     Pkts: 0/0
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 21604/0/28/0, Other: 39/1/38
   Serial2/0 Flags: A NS
 (192.168.16.1,239.1.1.1) Flags:
   SW Forwarding: 26099/10/28/2, Other: 8827/0/8827
   Ethernet0/0 Flags: A
   Serial2/0 Flags: F NS
     Pkts: 26098/0
   Serial1/0 Flags: F NS
     Pkts: 26058/0
```

R7 (Last-Hop DR for Receiver A)

```
R7# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R7# show ip igmp groups 239.1.1.1
IGMP Connected Group Membership
Group Address    Interface      Uptime    Expires    Last Reporter   Group Accounted
239.1.1.1        Ethernet0/0    00:08:47  00:02:56   192.168.7.1
R7# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:44:45/stopped, RP 192.168.6.6, flags: SJC
  Incoming interface: Serial4/0, RPF nbr 192.168.67.6
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:44:45/00:02:47
(192.168.1.2, 239.1.1.1), 00:08:45/00:02:13, flags: JT
  Incoming interface: Serial2/0, RPF nbr 192.168.37.3
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:08:45/00:02:47
(192.168.16.1, 239.1.1.1), 00:08:45/00:02:10, flags: JT
  Incoming interface: Serial4/0, RPF nbr 192.168.67.6
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:08:45/00:02:47
R7# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.67.6 Flags: C
  Serial4/0 Flags: A NS
  Ethernet0/0 Flags: F NS
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.37.3 Flags:
  Serial2/0 Flags: A
  Ethernet0/0 Flags: F NS
(192.168.16.1,239.1.1.1) RPF nbr: 192.168.67.6 Flags:
  Serial4/0 Flags: A
  Ethernet0/0 Flags: F NS
R7# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 43204/0/28/0, Other: 0/0/0
   Serial4/0 Flags: A NS
   Ethernet0/0 Flags: F NS
     Pkts: 43204/0
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 5255/10/28/2, Other: 1/1/0
   Serial2/0 Flags: A
   Ethernet0/0 Flags: F NS
     Pkts: 5254/1
 (192.168.16.1,239.1.1.1) Flags:
   SW Forwarding: 5255/10/28/2, Other: 0/0/0
   Serial4/0 Flags: A
```

```
      Ethernet0/0 Flags: F NS
        Pkts: 5254/1
```

PIM-SM Example Active Sources and Interested Receivers - SPT Threshold Set to Infinity

The following example shows how to verify multicast forwarding using the MFIB for PIM-SM in a network environment where there are active sources with interested receivers. This verification example is based on the topology shown in the figure.

Figure 5: PIM-SM Example Topology: Active Sources and Interested Receivers (SPT Threshold Set to Infinity)
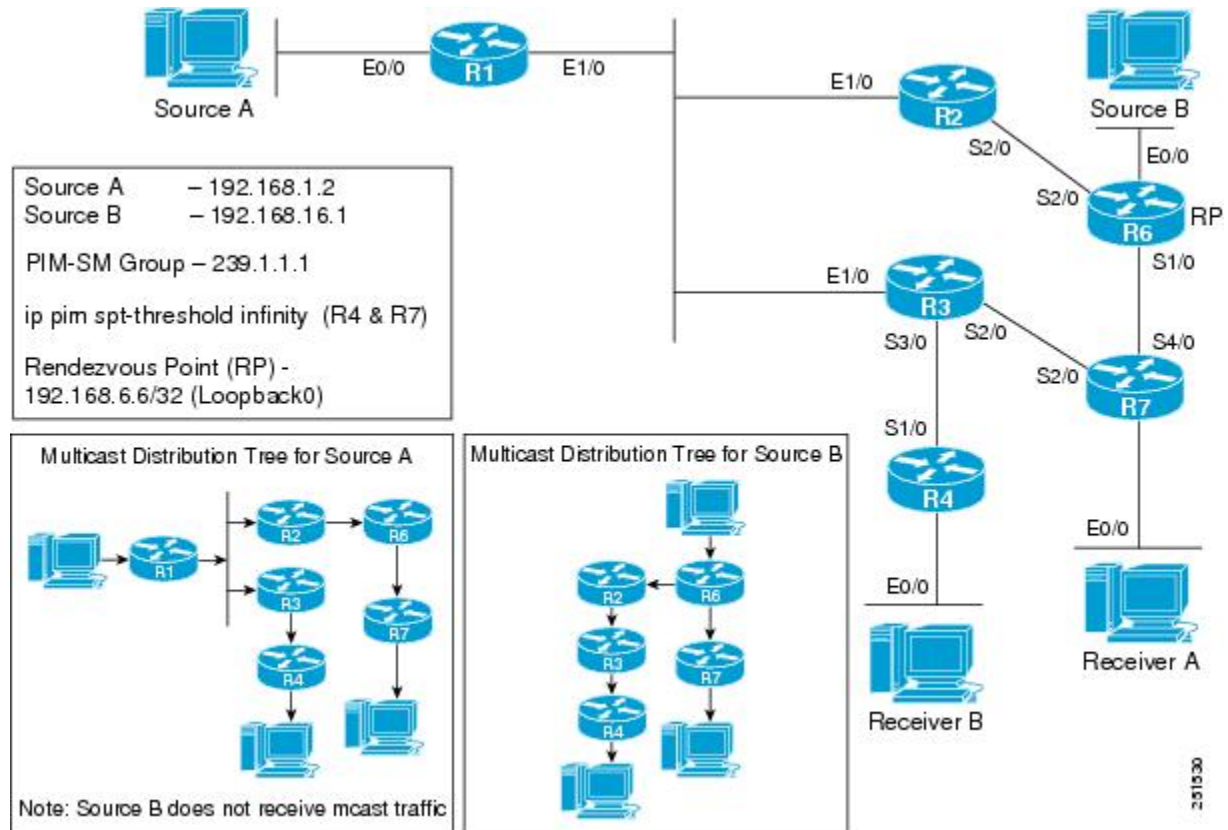
For this verification example, the following conditions apply:

  • Last-hop DRs R4 and R7 have the SPT threshold set to infinity (configured with the **ip pim spt-threshold infinity** command).

Note   When the SPT threshold is set to infinity, multicast traffic is configured to stay on the shared tree. Last-hop DRs will not perform an SPT switchover.

  • During the PIM-SM registration process between the first-hop DR and the RP, a PIM tunnel is used. First-hop DRs will have a PIM Encap Tunnel and the RP will have both a PIM Encap and Decap Tunnel.

After the PIM-SM registration process completes, PIM tunnels will not be used for multicast forwarding. For more information, see the section.

R1 (First-Hop DR for Source A)

```
R1# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R1# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:37:29/stopped, RP 192.168.6.6, flags: SPF
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list: Null
(192.168.1.2, 239.1.1.1), 00:37:29/00:02:53, flags: FT
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 00:22:46/00:03:19
R1# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.123.2 Flags: C
  Ethernet1/0 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 0.0.0.0 Flags:
  Ethernet0/0 Flags: A
  Ethernet1/0 Flags: F NS
R1# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 0/0/0/0, Other: 13688/0/13688
   Ethernet1/0 Flags: A
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 13689/10/28/2, Other: 8826/0/8826
   Ethernet0/0 Flags: A
   Ethernet1/0 Flags: F NS
     Pkts: 13688/0
```

R2 (Router Along SPT for Source A and Shared Tree for Source B)

```
R2# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R2# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:23:28/00:02:44, RP 192.168.6.6, flags: S
  Incoming interface: Serial2/0, RPF nbr 192.168.26.6
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 00:23:28/00:02:44
(192.168.1.2, 239.1.1.1), 00:23:28/00:02:54, flags: T
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.1
  Outgoing interface list:
    Serial2/0, Forward/Sparse, 00:23:28/00:02:40
R2# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.26.6 Flags: C
  Ethernet1/0 Flags: F NS
  Serial2/0 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.123.1 Flags:
  Ethernet1/0 Flags: A
  Serial2/0 Flags: F NS
R2# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 14084/10/28/2, Other: 0/0/0
   Serial2/0 Flags: A
   Ethernet1/0 Flags: F NS
     Pkts: 14084/0
 (192.168.1.2,239.1.1.1) Flags:
```

```
   SW Forwarding: 14083/10/28/2, Other: 1/1/0
   Ethernet1/0 Flags: A
   Serial2/0 Flags: F NS
     Pkts: 14083/0
```

R3 (Router Along the Shared Tree)

```
R3# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R3# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:23:57/00:03:10, RP 192.168.6.6, flags: S
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list:
    Serial3/0, Forward/Sparse, 00:23:57/00:03:10
R3# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.123.2 Flags: C
  Serial3/0 Flags: F NS
  Ethernet1/0 Flags: A
R3# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
  SW Forwarding: 28742/20/28/4, Other: 0/0/0
  Ethernet1/0 Flags: A
  Serial3/0 Flags: F NS
    Pkts: 28742/0
```

R4 (Last-Hop DR for Receiver B)

```
R4# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R4# show ip igmp groups 239.1.1.1
IGMP Connected Group Membership
Group Address    Interface      Uptime    Expires    Last Reporter   Group Accounted
239.1.1.1        Ethernet0/0    00:24:37  00:02:56   192.168.4.1
R4# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:24:35/00:02:35, RP 192.168.6.6, flags: SC
  Incoming interface: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:24:35/00:02:35
R4# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.34.3 Flags: C
  Ethernet0/0 Flags: F NS
  Serial1/0 Flags: A
R4# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
  SW Forwarding: 29517/20/28/4, Other: 0/0/0
  Serial1/0 Flags: A
  Ethernet0/0 Flags: F NS
    Pkts: 29517/0
```

R6 (RP and First-Hop DR for Source B)

```
R6# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
```

```
        Info source: 192.168.6.6 (?), elected via Auto-RP
             Uptime: 03:10:53, expires: 00:02:06
R6# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:39:44/00:03:09, RP 192.168.6.6, flags: SF
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Serial1/0, Forward/Sparse, 00:24:57/00:03:09
    Serial2/0, Forward/Sparse, 00:25:01/00:03:09
(192.168.1.2, 239.1.1.1), 00:39:44/00:03:18, flags: T
  Incoming interface: Serial2/0, RPF nbr 192.168.26.2
  Outgoing interface list:
    Serial1/0, Forward/Sparse, 00:24:57/00:03:09
(192.168.16.1, 239.1.1.1), 00:39:44/00:02:35, flags: FT
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Serial1/0, Forward/Sparse, 00:24:57/00:03:09
    Serial2/0, Forward/Sparse, 00:25:01/00:03:09
R6# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 0.0.0.0 Flags: C
  Serial1/0 Flags: F NS
  Serial2/0 Flags: F NS
  Tunnel1 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.26.2 Flags:
  Serial2/0 Flags: A
  Serial1/0 Flags: F NS
(192.168.16.1,239.1.1.1) RPF nbr: 0.0.0.0 Flags:
  Ethernet0/0 Flags: A
  Serial1/0 Flags: F NS
  Serial2/0 Flags: F NS
R6# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Tunnel1 Flags: A
   Serial2/0 Flags: F NS
     Pkts: 0/0
   Serial1/0 Flags: F NS
     Pkts: 0/0
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 14978/10/28/2, Other: 39/1/38
   Serial2/0 Flags: A
   Serial1/0 Flags: F NS
     Pkts: 14978/0
 (192.168.16.1,239.1.1.1) Flags:
   SW Forwarding: 15019/10/28/2, Other: 8827/0/8827
   Ethernet0/0 Flags: A
   Serial2/0 Flags: F NS
     Pkts: 15018/0
   Serial1/0 Flags: F NS
     Pkts: 14978/0
R6# show ip pim tunnel

Tunnel0
  Type  : PIM Encap
  RP    : 192.168.6.6*
  Source: 192.168.6.6
Tunnel1*
  Type  : PIM Decap
  RP    : 192.168.6.6*
  Source: -
```

R7 (Last-Hop DR for Receiver A)

```
R7# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 03:09:53, expires: 00:02:14
R7# show ip igmp groups 239.1.1.1
IGMP Connected Group Membership
```

```
Group Address    Interface       Uptime     Expires    Last Reporter   Group Accounted
239.1.1.1        Ethernet0/0     00:25:39   00:02:56   192.168.7.1
R7# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:25:37/00:02:58, RP 192.168.6.6, flags: SC
  Incoming interface: Serial4/0, RPF nbr 192.168.67.6
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:25:37/00:02:58
R7# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.67.6 Flags: C
  Ethernet0/0 Flags: F NS
  Serial4/0 Flags: A
R7# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 30756/20/28/4, Other: 0/0/0
   Serial4/0 Flags: A
   Ethernet0/0 Flags: F NS
     Pkts: 30756/0
```

PIM-SM Example Source Traffic Only with No Receivers

The following example shows how to verify multicast forwarding using the MFIB for PIM-SM in a network environment where sources are sending traffic without interested receivers. This verification example is based on the topology shown in the figure.

Figure 6: PIM-SM Example Topology: Source Traffic Only with No Receivers
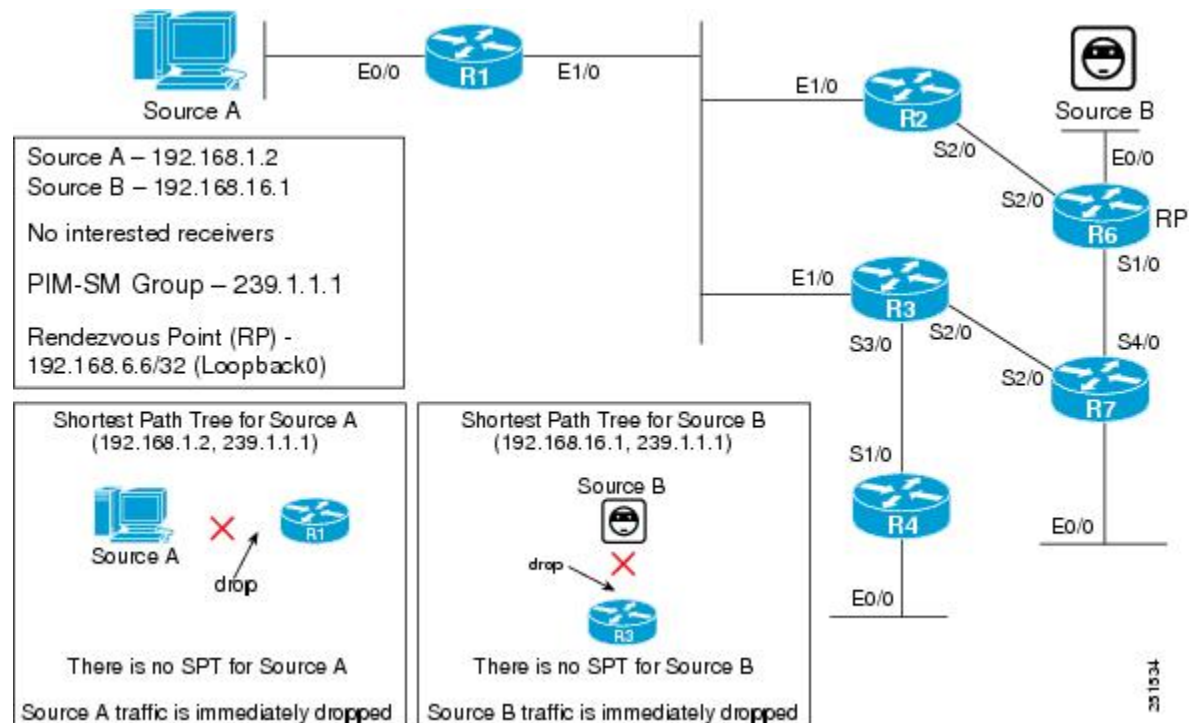
In this verification example, the following conditions apply:

- Source A and Source B are sending traffic for multicast group 239.1.1.1 to first-hop DRs R1 and R6, respectively.

- When R1 and R6 receive the source traffic, they will then check their group-to-RP mapping cache for multicast group 239.1.1.1 to determine the RP. In this case, R6 is the RP.

- After determining the RP, R1 and R6 will then create state and send PIM registers for (Source A, 239.1.1.1) and (Source B, 239.1.1.1) toward the RP.

- Because there are no interested receivers, the RP will send a register stop to R1 and R6 (itself).

- R1 and R6 are the only routers that will have (S, G) state for 239.1.1.1.

- Routers that are not the RP or directly connected to an active source will not create state for (*, 239.1.1.1).

R1 (First-Hop DR for Source A)

```
R1# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 03:09:53, expires: 00:02:14
R1# show ip mroute 239.1.1.1
Outgoing interface flags: H - Hardware switched, A - Assert winner
 Timers: Uptime/Expires
 Interface state: Interface, Next-Hop or VCD, State/Mode
(*, 239.1.1.1), 00:02:06/stopped, RP 192.168.6.6, flags: SPF
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list: Null
(192.168.1.2, 239.1.1.1), 00:02:06/00:02:53, flags: PFT
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list: Null
R1# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.123.2 Flags: C
  Ethernet1/0 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 0.0.0.0 Flags:
  Ethernet0/0 Flags: A
R1# show ip mfib 239.1.1.1
 (*,239.1.1.1) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Ethernet1/0 Flags: A
 (192.168.1.2,239.1.1.1) Flags:
   SW Forwarding: 1/0/28/0, Other: 1267/0/1267
   Ethernet0/0 Flags: A
```

R6 (RP and First-Hop DR for Source B)

```
R6# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 03:10:53, expires: 00:02:06
R6# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:02:48/stopped, RP 192.168.6.6, flags: SPF
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list: Null
(192.168.1.2, 239.1.1.1), 00:02:42/00:02:17, flags: P
  Incoming interface: Serial2/0, RPF nbr 192.168.26.2
  Outgoing interface list: Null
(192.168.16.1, 239.1.1.1), 00:02:48/00:02:11, flags: PFT
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list: Null
R6# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 0.0.0.0 Flags: C
  Tunnel1 Flags: A
(192.168.1.2,239.1.1.1) RPF nbr: 192.168.26.2 Flags:
  Serial2/0 Flags: NS
  Tunnel1 Flags: A
```

```
                            (192.168.16.1,239.1.1.1) RPF nbr: 0.0.0.0 Flags:
                              Ethernet0/0 Flags: A
                            R6# show ip mfib 239.1.1.1
                             (*,239.1.1.1) Flags: C
                               SW Forwarding: 0/0/0/0, Other: 0/0/0
                               Tunnel1 Flags: A
                             (192.168.1.2,239.1.1.1) Flags:
                               SW Forwarding: 0/0/0/0, Other: 0/0/0
                               Tunnel1 Flags: A
                               Serial2/0 Flags: NS
                             (192.168.16.1,239.1.1.1) Flags:
                               SW Forwarding: 1/0/28/0, Other: 1688/0/1688
                               Ethernet0/0 Flags: A
                            R6# show ip pim tunnel
                            Tunnel0
                              Type  : PIM Encap
                              RP    : 192.168.6.6*
                              Source: 192.168.6.6
                            Tunnel1*
                              Type  : PIM Decap
                              RP    : 192.168.6.6*
                              Source: -
```

In this scenario, R2, R3, R4, and R7 have no interested receivers; therefore, they are not on the multicast forwarding path and will not have multicast state. The output for the **show ip mroute**, **show ip mrib route**, and **show ip mfib route** commands would appear only on R2, R3, R4, and R7, as in this example (taken from R2):

R2 (Router Not Along the Multicast Forwarding Path)

```
R2# show ip mroute 239.1.1.1
Group 239.1.1.1 not found
R2# show ip mrib route 239.1.1.1
No matching routes in MRIB route-DB
R2# show ip mfib 239.1.1.1
Group 239.1.1.1 not found
```

Note   The output for the **show ip mroute**, **show ip mrib route**, and **show ip mfib** commands would be the same for R2, R3, R4, and R7 for this scenario.

PIM-SM Example Interested Receivers with No Active Sources

The following example shows how to verify multicast forwarding using the MFIB for PIM-SM in a network environment where there are interested receivers with no active sources. This verification example is based on the topology shown in the figure.

Figure 7: PIM-SM Example Topology: Interested Receivers with No Active Sources
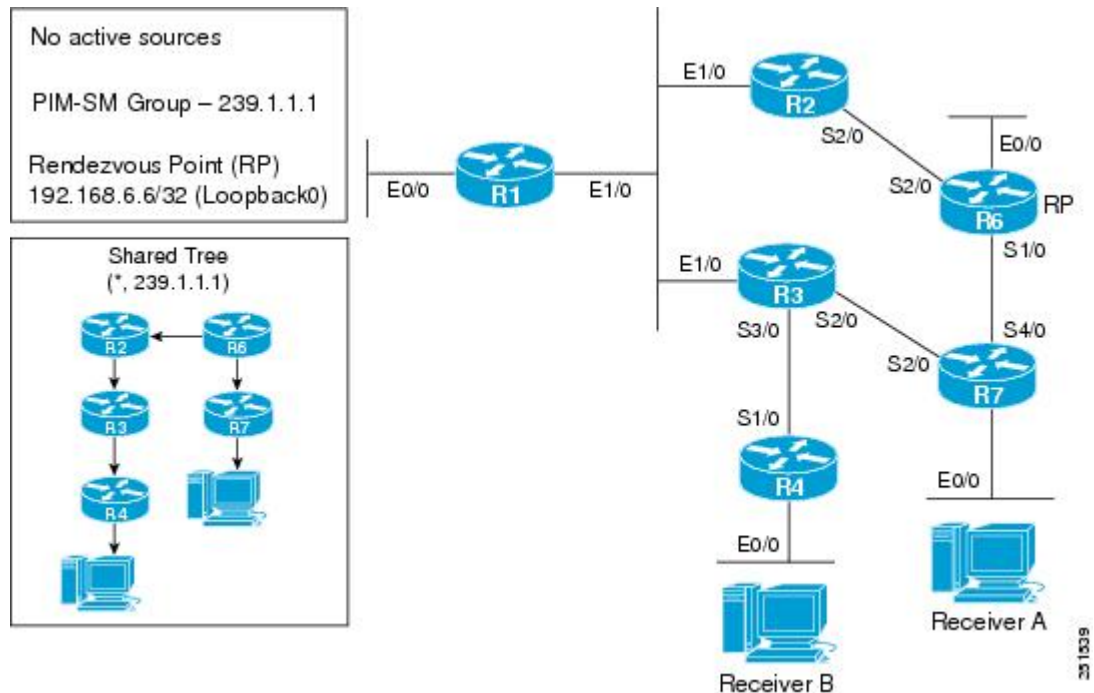
For this verification example, the following conditions apply:

• Last-hop DRs R4 and R7 also have the SPT threshold set to infinity (configured with the **ip pim spt-threshold infinity** command).

✎ **Note**   When the SPT threshold is set to infinity, multicast traffic is configured to stay on the shared tree. Last-hop DRs will not perform an SPT switchover.

• Receiver A and Receiver B are sending IGMP joins to R7 and R4, respectively, for multicast group 239.1.1.1.

• When R4 and R7 receive the IGMP joins, they will then check their group-to-RP mapping cache for multicast group 239.1.1.1 to determine the RP.

• After determining the RP, R4 and R7 will then create state and send PIM joins for (*, 239.1.1.1) toward the RP.

Note The unicast routing table is used to build the shared tree entry for (*, 239.1.1.1). Shared tree entries are always rooted at the RP. In this scenario, the shared tree from R4 to R6 is through R3 and R2 because R3's best unicast route (determined by the underlying IGP) is R2. The shared tree for R7 is directly upstream to R6.

- Routers that are not along the shared tree will not create state for (*, 239.1.1.1).

R4 (Last-Hop DR)

```
R4# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R4# show ip igmp groups 239.1.1.1
IGMP Connected Group Membership
Group Address    Interface       Uptime     Expires    Last Reporter    Group Accounted
239.1.1.1        Ethernet0/0     00:03:07   00:02:56   192.168.4.1
R4# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:03:05/00:02:47, RP 192.168.6.6, flags: SJC
  Incoming interface: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:03:05/00:02:47
R4# show ip mrib route 239.1.1.1
(*,239.1.1.1) RPF nbr: 192.168.34.3 Flags: C
  Ethernet0/0 Flags: F NS
  Serial1/0 Flags: A NS
R4# show ip mfib 239.1.1.1
(*,239.1.1.1) Flags: C
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  Serial1/0 Flags: A NS
  Ethernet0/0 Flags: F NS
    Pkts: 0/0
```

R3 (Router Along the Shared Tree)

```
R4# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R3# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:03:40/00:02:47, RP 192.168.6.6, flags: S
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list:
    Serial3/0, Forward/Sparse, 00:03:40/00:02:47
R3# show ip mrib route 239.1.1.1
 (*,239.1.1.1) RPF nbr: 192.168.123.2 Flags: C
  Serial3/0 Flags: F NS
  Ethernet1/0 Flags: A
R3# show ip mfib 239.1.1.1
(*,239.1.1.1) Flags: C
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  Ethernet1/0 Flags: A
  Serial3/0 Flags: F NS
    Pkts: 0/0
```

R2 (Router Along the Shared Tree)

```
R2# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R2# show ip mroute 239.1.1.1
 (*, 239.1.1.1), 00:04:05/00:03:20, RP 192.168.6.6, flags: S
  Incoming interface: Serial2/0, RPF nbr 192.168.26.6
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 00:04:05/00:03:20
R2# show ip mrib route 239.1.1.1
 (*,239.1.1.1) RPF nbr: 192.168.26.6 Flags: C
  Ethernet1/0 Flags: F NS
  Serial2/0 Flags: A
R2# show ip mfib 239.1.1.1
(*,239.1.1.1) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial2/0 Flags: A
   Ethernet1/0 Flags: F NS
     Pkts: 0/0
```

R7 (Last-Hop DR)

```
R7# show ip pim rp mapping

PIM Group-to-RP Mappings
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:09:53, expires: 00:02:14
R7# show ip igmp groups 239.1.1.1
IGMP Connected Group Membership
Group Address    Interface      Uptime     Expires    Last Reporter   Group Accounted
239.1.1.1        Ethernet0/0    00:04:33   00:02:56   192.168.7.1
R7# show ip mroute 239.1.1.1
 (*, 239.1.1.1), 00:04:31/00:02:36, RP 192.168.6.6, flags: SJC
  Incoming interface: Serial4/0, RPF nbr 192.168.67.6
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:04:31/00:02:36
R7# show ip mrib route 239.1.1.1
 (*,239.1.1.1) RPF nbr: 192.168.67.6 Flags: C
  Ethernet0/0 Flags: F NS
  Serial4/0 Flags: A NS
R7# show ip mfib 239.1.1.1
(*,239.1.1.1) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial4/0 Flags: A NS
   Ethernet0/0 Flags: F NS
     Pkts: 0/0
```

R6 (RP)

```
R6# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 224.0.0.0/4
  RP 192.168.6.6 (?), v2v1
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 03:10:53, expires: 00:02:06
R6# show ip mroute 239.1.1.1
(*, 239.1.1.1), 00:05:01/00:03:27, RP 192.168.6.6, flags: S
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
```

```
       Serial1/0, Forward/Sparse, 00:04:57/00:03:27
       Serial2/0, Forward/Sparse, 00:05:01/00:03:23
R6# show ip mrib route 239.1.1.1
 (*,239.1.1.1) RPF nbr: 0.0.0.0 Flags: C
  Serial1/0 Flags: F NS
  Serial2/0 Flags: F NS
  Tunnel1 Flags: A
R6# show ip mfib 239.1.1.1
(*,239.1.1.1) Flags: C
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Tunnel1 Flags: A
   Serial2/0 Flags: F NS
     Pkts: 0/0
   Serial1/0 Flags: F NS
     Pkts: 0/0
R6# show ip pim tunnel
Tunnel0
  Type  : PIM Encap
  RP    : 192.168.6.6*
  Source: 192.168.6.6
Tunnel1*
  Type  : PIM Decap
  RP    : 192.168.6.6*
  Source: -
```

R1 (Router Not Along the Multicast Forwarding Path)

```
R1# show ip mroute 239.1.1.1
Group 239.1.1.1 not found
R1# show ip mrib route 239.1.1.1
No matching routes in MRIB route-DB
R1# show ip mfib 239.1.1.1
Group 239.1.1.1 not found
```

Note   R1 does not have any state for 239.1.1.1 because it does not have an interested receiver, is not along the shared tree path, and does not have a directly connected source.

Examples Verifying IPv4 Multicast Forwarding Using the MFIB for PIM-SSM

Note   The examples in this section were created in a test environment to provide a conceptual view of the multicast environment. The IP addresses, interfaces, and other values are shown as examples only. They do not show real-world deployment values.

PIM-SSM Example Interested Receivers With or Without Active Sources

The following example shows how to verify multicast forwarding using the MFIB for PIM-SSM in a network environment where there are interested receivers with or without active sources. This verification example is based on the topology shown in the figure.

Figure 8: PIM-SSM Example Topology: Interested Receivers With or Without Active Sources
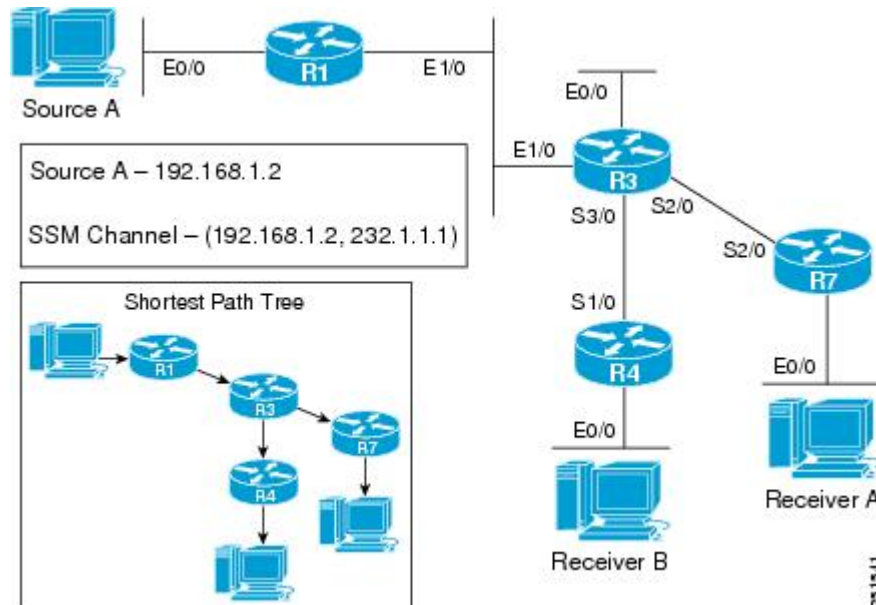
For this verification example, the following conditions apply:

- All routers in the network have been configured to run PIM-SSM and have the **ip pim ssm default** command configured globally.

- Source A is sending multicast packets to SSM group 232.1.1.1.

- Receiver A and Receiver B are interested in receiving multicast from Source A, (192.168.1.2, 232.1.1.1).

- Receiver A and Receiver B are using IGMPv3.

R1 (First-Hop DR for Source A)

```
R1# show ip mroute 232.1.1.1
(192.168.1.2, 232.1.1.1), 00:07:18/00:03:02, flags: sT
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 00:07:18/00:03:02
R1# show ip mrib route 232.1.1.1
(192.168.1.2,232.1.1.1) RPF nbr: 0.0.0.0 Flags:
  Ethernet1/0 Flags: F NS
  Ethernet0/0 Flags: A
R1# show ip mfib 232.1.1.1
 (192.168.1.2,232.1.1.1) Flags:
   SW Forwarding: 3039/10/28/2, Other: 0/0/0
   Ethernet0/0 Flags: A
   Ethernet1/0 Flags: F NS
     Pkts: 3039/0
```

R3 (Router Along the SPT)

```
R3# show ip mroute 232.1.1.1
(192.168.1.2, 232.1.1.1), 00:08:00/00:03:13, flags: sT
  Incoming interface: Ethernet1/0, RPF nbr 192.168.123.1
  Outgoing interface list:
    Serial3/0, Forward/Sparse, 00:08:00/00:03:13
    Serial2/0, Forward/Sparse, 00:08:00/00:02:59
R3# show ip mrib route 232.1.1.1
(192.168.1.2,232.1.1.1) RPF nbr: 192.168.123.1 Flags:
  Serial3/0 Flags: F NS
  Serial2/0 Flags: F NS
  Ethernet1/0 Flags: A
R3# show ip mfib 232.1.1.1
 (192.168.1.2,232.1.1.1) Flags:
  SW Forwarding: 3514/10/28/2, Other: 0/0/0
  Ethernet1/0 Flags: A
  Serial3/0 Flags: F NS
    Pkts: 3514/0
  Serial2/0 Flags: F NS
    Pkts: 3514/0
```

R4 (Last-Hop DR for Receiver B)

```
R4# show ip igmp groups 232.1.1.1
IGMP Connected Group Membership
Group Address    Interface         Uptime    Expires   Last Reporter    Group Accounted
232.1.1.1        Ethernet0/0       00:12:46  stopped   192.168.4.1
R4# show ip mroute 232.1.1.1
(192.168.1.2, 232.1.1.1), 00:08:42/stopped, flags: sTI
  Incoming interface: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:08:42/00:00:17
R4# show ip mrib route 232.1.1.1
(192.168.1.2,232.1.1.1) RPF nbr: 192.168.34.3 Flags:
  Serial1/0 Flags: A
  Ethernet0/0 Flags: F NS
R4# show ip mfib 232.1.1.1
 (192.168.1.2,232.1.1.1) Flags:
  SW Forwarding: 3786/10/28/2, Other: 0/0/0
  Serial1/0 Flags: A
  Ethernet0/0 Flags: F NS
    Pkts: 3786/0
```

R7 (Last-Hop DR for Receiver A)

```
R7# show ip igmp groups 232.1.1.1
IGMP Connected Group Membership
Group Address    Interface         Uptime    Expires   Last Reporter    Group Accounted
232.1.1.1        Ethernet0/0       00:12:24  stopped   192.168.7.1
R7# show ip mroute 232.1.1.1
(192.168.1.2, 232.1.1.1), 00:09:37/stopped, flags: sTI
  Incoming interface: Serial2/0, RPF nbr 192.168.37.3
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 00:09:37/00:02:22
R7# show ip mrib route 232.1.1.1
(192.168.1.2,232.1.1.1) RPF nbr: 192.168.37.3 Flags:
  Serial2/0 Flags: A
  Ethernet0/0 Flags: F NS
R7# show ip mfib 232.1.1.1
 (192.168.1.2,232.1.1.1) Flags:
  SW Forwarding: 4182/10/28/2, Other: 0/0/0
  Serial2/0 Flags: A
  Ethernet0/0 Flags: F NS
    Pkts: 4182/0
```

PIM-SSM Example Source Traffic Only with No Active Receivers

The following example shows how to verify multicast forwarding using the MFIB for PIM-SSM in a network environment where there is an active source with no interested receivers. This verification example is based on the topology shown in the figure.

Figure 9: PIM-SSM Example Topology: Source Traffic Only with No Active Receivers
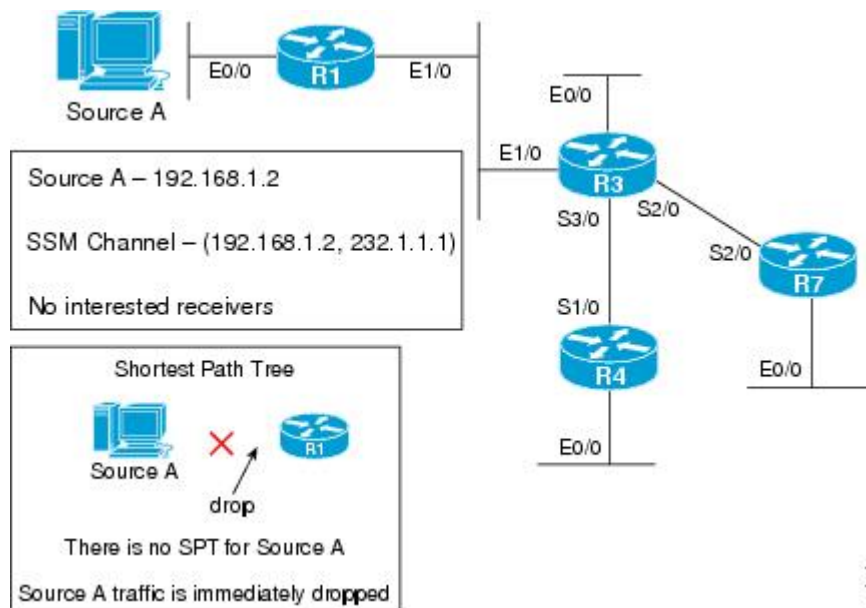
For this verification example, the following conditions apply:

- All routers in the network have been configured to run PIM-SSM and have the **ip pim ssm default** command configured globally.

- Source A is sending multicast packets to SSM group 232.1.1.1.

- Source B is not actively sending.

- There are no interested receivers in the network.

Routers that support the MFIB will not create state for SSM multicast groups until a join has been requested by an interested receiver, which means that any routers with active sources sending to an SSM group will not have multicast state. Because there are no interested receivers in this network, none of the routers will create state for (192.168.1.2, 232.1.1.1).

The following is output from the **show ip mroute**, **show ip mrib route**, and **show ip mfib** commands taken from R1:

R1

```
R1# show ip mroute 239.1.1.1
Group 239.1.1.1 not found
R1# show ip mrib route 239.1.1.1
No matching routes in MRIB route-DB
```

```
R1# show ip mfib 239.1.1.1
Group 239.1.1.1 not found
```

Note   Because there are no interested receivers in this network, the output from the **show ip mroute**, **show ip mrib route**, and **show ip mfib** commands would be the same on R3, R4, and R7 in this example scenario.

PIM-SSM Example Unwanted Sources in the SSM Network

The following example shows how to verify multicast forwarding using the MFIB for PIM-SSM in a network environment where there is an unwanted source. This verification example is based on the topology shown in the figure.

Figure 10: PIM-SSM Example Topology: Unwanted Sources in the SSM Network
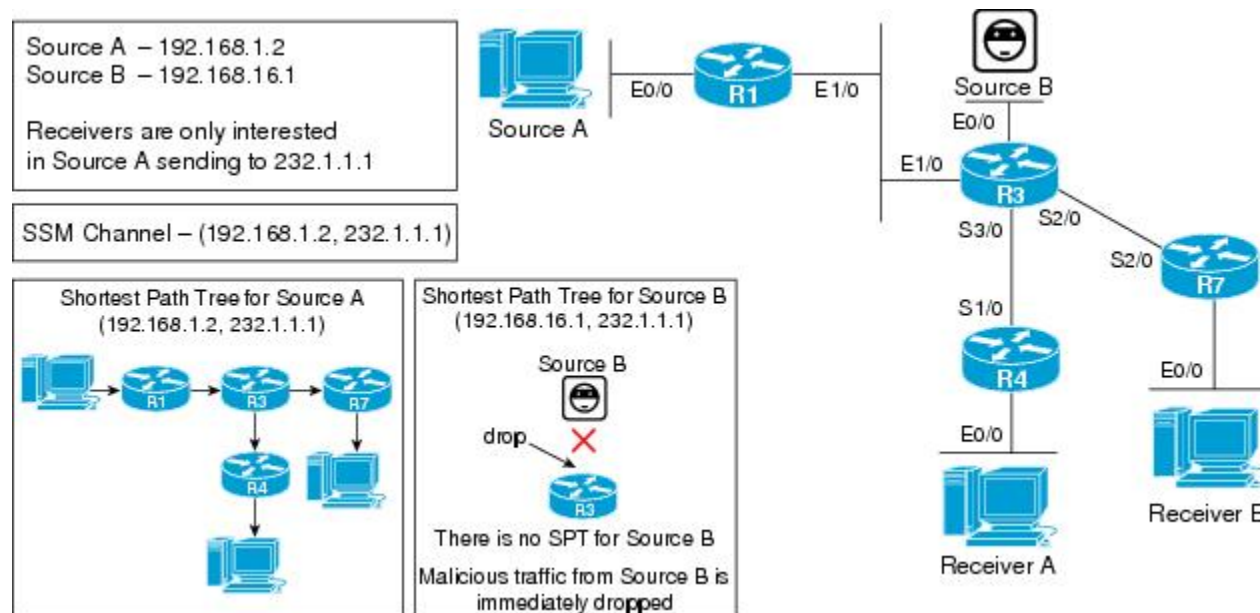
For this verification example, the following conditions apply:

- All routers in the network have been configured to run PIM-SSM and have the **ip pim ssm default** command configured globally.

- Receiver A and Receiver B are only interested in receiving multicast from Source A, (192.168.1.2, 232.1.1.1).

- Unwanted source, Source B, is sending traffic to 232.1.1.1.

Note   Even though Source B is directly connected to R3, R3 will not create state for 232.1.1.1. Multicast traffic from Source B sending to SSM group 232.1.1.1, thus, will be immediately dropped by the router.

R3 (First-Hop DR for Unwanted Source B)

```
R3# show ip mroute 232.1.1.1 192.168.3.1
R3# show ip mrib route 232.1.1.1 192.168.3.1
No matching routes in MRIB route-DB
R3# show ip mfib 232.1.1.1 192.168.3.1
(192.168.3.1,232.1.1.1) entry not found
```

Note   Likewise, R1, R4, and R7 will also have no multicast state for (192.168.3.1, 232.1.1.1) and any directly connected sources sending to 232.1.1.1 will be dropped.

Examples Verifying IPv4 Multicast Forwarding Using the MFIB for Bidir-PIM Networks

This section contains the following examples for verifying multicast forwarding using the MFIB for bidir-PIM networks:

Note   The examples in this section were created in a test environment to provide a conceptual view of the multicast environment. The IP addresses, interfaces, and other values are shown as examples only. They do not show real-world deployment values.

Bidir-PIM Example Active Sources with Interested Receivers

The following example shows how to verify multicast forwarding using the MFIB for bidir-PIM in a network environment where there are active sources and interested receivers. This verification example is based on the topology shown in the figures.

Figure 11: Bidir-PIM Example Topology: Active Sources with Interested Receivers
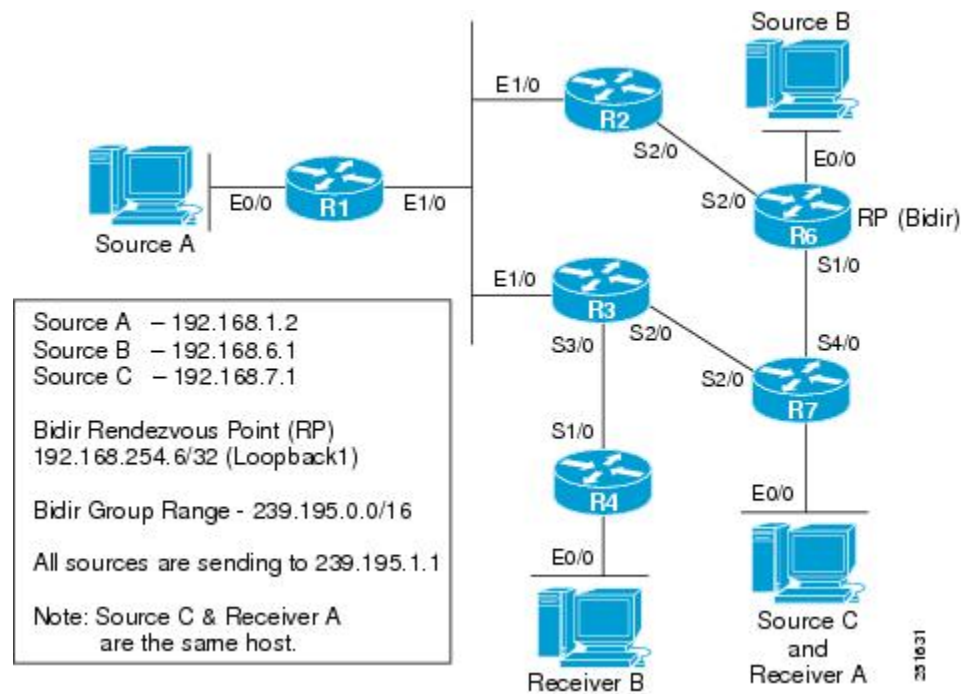
Figure 12: Bidir-PIM Distribution Trees and Multicast Forwarding Paths for the Active Sources with No Interested Receivers Example
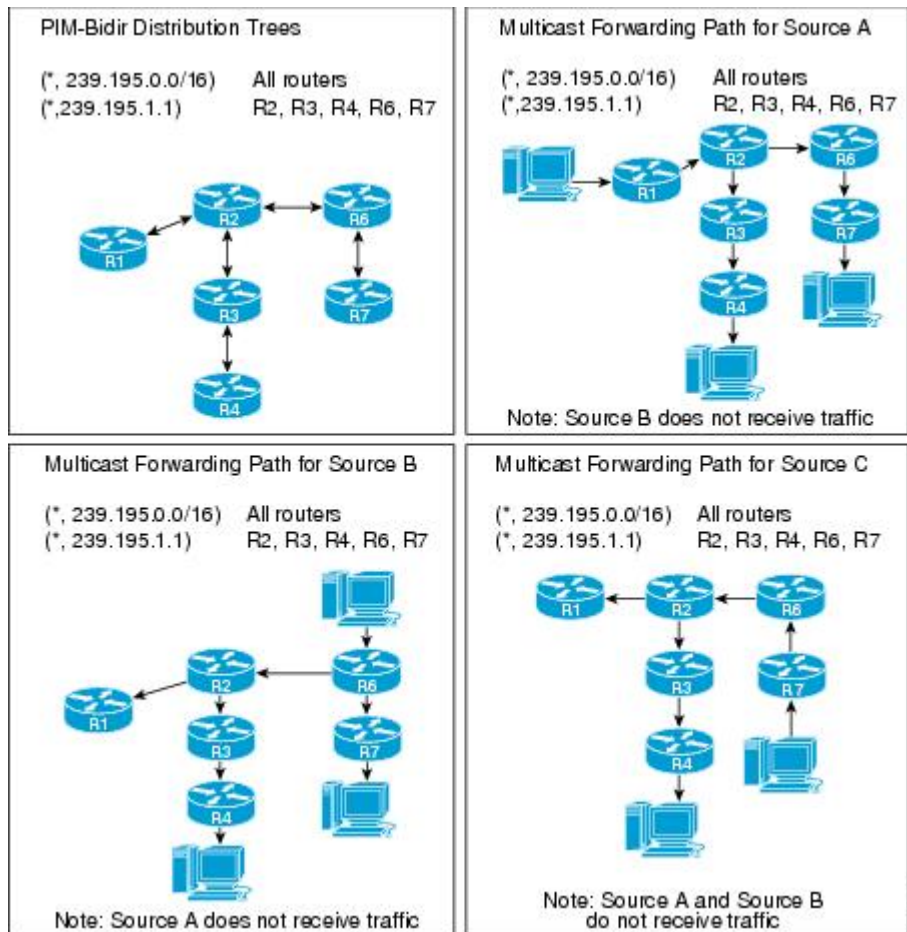
PIM-Bidir Distribution Trees

(*, 239.195.0.0/16)   All routers
(*,239.195.1.1)   R2, R3, R4, R6, R7

Multicast Forwarding Path for Source A

(*, 239.195.0.0/16)   All routers
(*,239.195.1.1)   R2, R3, R4, R6, R7

Note: Source B does not receive traffic

Multicast Forwarding Path for Source B

(*, 239.195.0.0/16)   All routers
(*, 239.195.1.1)   R2, R3, R4, R6, R7

Note: Source A does not receive traffic

Multicast Forwarding Path for Source C

(*, 239.195.0.0/16)   All routers
(*, 239.195.1.1)   R2, R3, R4, R6, R7

Note: Source A and Source B
do not receive traffic

For this verification example, the following conditions apply:

- Entries for (*, 239.195.0.0/16) are created by the control plane based on the PIM group-to-RP mappings on all routers.

- Entries for (*, 239.195.1.1) will only be created when IGMP joins are initiated by interested receivers joining this group. As a result, all routers along the shared tree between the RP and the last-hop DRs that have interested receivers will have state for (*, 239.195.1.1).

> **Note** R1 will not have state for (*, 239.195.1.1) because it is not between the RP and the last-hop DRs.

- If both (*,239.195.0.0/26) and (*,239.195.1.1) entries are present in a router, the more specific entry, (*,239.195.1.1) will be used for forwarding.

- All source traffic for this scenario will go to the RP and then out the appropriate interfaces where there are interested receivers.

- Source traffic received by the RP is never sent back out the same interface it was received on.

- In general, multicast packet forwarding can be verified by observing the "SW Forwarding" counter in the **show ip mfib** output for the most specific entry available in the MFIB. If multicast is being forwarded, this counter will increment.

R1 (First-Hop DR for Source A)

```
R1# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d02h, expires: 00:02:09
R1# show ip pim interface df
* implies this system is the DF
Interface              RP               DF Winner        Metric     Uptime
Ethernet0/0            192.168.254.6    *192.168.1.1       75        1d02h
Ethernet1/0            192.168.254.6    192.168.123.2      65        1d02h
R1# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R1# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R1# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
R1# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d02h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Ethernet1/0, Accepting/Sparse
R1# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R1# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 4677/10/28/2, Other: 9355/0/9355
   Ethernet1/0 Flags: A F
     Pkts: 4677/0
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R2 (Router Along the Multicast Forwarding Path)

```
R2# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d02h, expires: 00:02:45
R2# show ip pim interface df
* implies this system is the DF
Interface              RP               DF Winner        Metric     Uptime
Ethernet1/0            192.168.254.6    *192.168.123.2     65        1d02h
Serial2/0              192.168.254.6    192.168.26.6       0         1d02h
R2# show ip mroute 239.195.1.1
(*, 239.195.1.1), 02:13:50/00:02:36, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial2/0, RPF nbr 192.168.26.6
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 02:13:50/00:02:36
    Serial2/0, Bidir-Upstream/Sparse, 02:13:50/00:00:00
R2# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.26.6 Flags: IA
  Ethernet1/0 Flags: F
  Serial2/0 Flags: F
R2# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
```

```
      SW Forwarding: 14693/30/28/6, Other: 0/0/0
      Serial2/0 Flags: F
        Pkts: 4897/0
      Ethernet1/0 Flags: F
        Pkts: 9796/0
R2# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d02h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial2/0, RPF nbr: 192.168.26.6
  Incoming interface list:
    Ethernet1/0, Accepting/Sparse
    Serial2/0, Accepting/Sparse
R2# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.26.6 Flags:
  Ethernet1/0 Flags: A
  Null0 Flags: A
  Serial2/0 Flags: A F
R2# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial2/0 Flags: A F
     Pkts: 0/0
   Ethernet1/0 Flags: A
   Null0 Flags: A
```

R3 (Router Along the Multicast Forwarding Path)

```
R3# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d02h, expires: 00:02:25
R3# show ip pim interface df
* implies this system is the DF
Interface            RP              DF Winner       Metric   Uptime
Ethernet0/0          192.168.254.6   *192.168.3.3    75       1d02h
Ethernet1/0          192.168.254.6    192.168.123.2  65       1d02h
Serial2/0            192.168.254.6    192.168.37.7   65       1d02h
Serial3/0            192.168.254.6   *192.168.34.3   75       1d02h
R3# show ip mroute 239.195.1.1
(*, 239.195.1.1), 02:14:09/00:03:08, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list:
    Serial3/0, Forward/Sparse, 02:14:09/00:03:08
    Ethernet1/0, Bidir-Upstream/Sparse, 02:14:09/00:00:00
R3# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.123.2 Flags: IA
  Serial3/0 Flags: F
  Ethernet1/0 Flags: F
R3# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 15263/30/28/6, Other: 0/0/0
   Serial3/0 Flags: F
     Pkts: 15263/0
   Ethernet1/0 Flags: F
     Pkts: 0/0
R3# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d02h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
    Serial3/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Ethernet1/0, Accepting/Sparse
R3# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Serial3/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R3# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
```

```
    SW Forwarding: 0/0/0/0, Other: 0/0/0
    Serial3/0 Flags: A
    Ethernet1/0 Flags: A F
      Pkts: 0/0
    Ethernet0/0 Flags: A
    Null0 Flags: A
```

R4 (Last-Hop DR for Receiver B)

```
R4# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 1d02h, expires: 00:02:10
R4# show ip pim interface df
* implies this system is the DF
Interface              RP                DF Winner       Metric    Uptime
Ethernet0/0            192.168.254.6    *192.168.4.4      139       1d02h
Serial1/0              192.168.254.6     192.168.34.3      75       1d02h
R4# show ip igmp groups 239.195.1.1

IGMP Connected Group Membership
Group Address   Interface              Uptime    Expires  Last Reporter  Group Accounted
239.195.1.1     Ethernet0/0            02:14:25  00:02:25  192.168.4.1
R4# show ip mroute 239.195.1.1
(*, 239.195.1.1), 02:14:25/00:02:25, RP 192.168.254.6, flags: BC
  Bidir-Upstream: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 02:14:25/00:02:25
    Serial1/0, Bidir-Upstream/Sparse, 02:14:25/00:00:00
R4# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.34.3 Flags: IA
  Ethernet0/0 Flags: F
  Serial1/0 Flags: F
R4# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 15729/30/28/6, Other: 0/0/0
   Serial1/0 Flags: F
     Pkts: 0/0
   Ethernet0/0 Flags: F
     Pkts: 15729/0
R4# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d02h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial1/0, RPF nbr: 192.168.34.3
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
R4# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.34.3 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial1/0 Flags: A F
R4# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial1/0 Flags: A F
     Pkts: 0/0
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R6 (RP and First-Hop DR for Source B)

```
R6# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
```

```
           Info source: 192.168.254.6 (?), elected via Auto-RP
                 Uptime: 1d02h, expires: 00:02:55
R6# show ip pim interface df
* implies this system is the DF
Interface              RP                DF Winner        Metric    Uptime
Loopback0              192.168.254.6     *192.168.6.6      0        1d02h
Loopback1              192.168.254.6     *192.168.254.6    0        1d02h
Ethernet0/0            192.168.254.6     *192.168.16.6     0        1d02h
Serial1/0              192.168.254.6     *192.168.67.6     0        1d02h
Serial2/0              192.168.254.6     *192.168.26.6     0        1d02h
R6# show ip mroute 239.195.1.1
(*, 239.195.1.1), 02:14:43/00:02:49, RP 192.168.254.6, flags: B
  Bidir-Upstream: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Serial1/0, Forward/Sparse, 02:14:35/00:02:49
    Serial2/0, Forward/Sparse, 02:14:43/00:02:41
R6# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 0.0.0.0 Flags: IA
  Serial1/0 Flags: F
  Serial2/0 Flags: F
R6# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 16269/30/28/6, Other: 0/0/0
   Serial2/0 Flags: F
     Pkts: 10846/0
   Serial1/0 Flags: F
     Pkts: 10846/0
R6# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d02h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Loopback1, RPF nbr: 192.168.254.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Loopback0, Accepting/Sparse
    Loopback1, Accepting/Sparse
R6# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.254.6 Flags:
  Serial2/0 Flags: A
  Serial1/0 Flags: A
  Ethernet0/0 Flags: A
  Loopback0 Flags: A
  Null0 Flags: A
  Loopback1 Flags: A F
R6# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback1 Flags: A F
     Pkts: 0/0
   Loopback0 Flags: A
   Serial2/0 Flags: A
   Serial1/0 Flags: A
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R7 (First-Hop DR for Source C and Last-Hop DR for Receiver A)

```
R7# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
         Uptime: 1d02h, expires: 00:02:35
R7# show ip pim interface df
* implies this system is the DF
Interface              RP                DF Winner        Metric    Uptime
Ethernet0/0            192.168.254.6     *192.168.7.7      65       1d02h
Serial2/0              192.168.254.6     *192.168.37.7     65       1d02h
Serial4/0              192.168.254.6      192.168.67.6     0        1d02h
R7# show ip igmp groups 239.195.1.1
IGMP Connected Group Membership
```

```
Group Address    Interface              Uptime    Expires   Last Reporter   Group Accounted
239.195.1.1      Ethernet0/0                      02:14:51  00:02:44  192.168.7.1
R7# show ip mroute 239.195.1.1
(*, 239.195.1.1), 02:14:51/00:02:43, RP 192.168.254.6, flags: BC
  Bidir-Upstream: Serial4/0, RPF nbr 192.168.67.6
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 02:14:51/00:02:43
    Serial4/0, Bidir-Upstream/Sparse, 02:14:51/00:00:00
R7# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.67.6 Flags: IA
  Ethernet0/0 Flags: F
  Serial4/0 Flags: F
R7# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 16747/30/28/6, Other: 0/0/0
   Serial4/0 Flags: F
     Pkts: 5582/0
   Ethernet0/0 Flags: F
     Pkts: 11165/0
R7# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d02h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial4/0, RPF nbr: 192.168.67.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Serial4/0, Accepting/Sparse
R7# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.67.6 Flags:
  Serial2/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial4/0 Flags: A F
R7# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial4/0 Flags: A F
     Pkts: 0/0
   Serial2/0 Flags: A
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

Bidir-PIM Example Active Sources with No Interested Receivers

The following example shows how to verify multicast forwarding using the MFIB for bidir-PIM in a network environment where there are active sources with no interested receivers. This verification example is based on the topology shown in the figures.

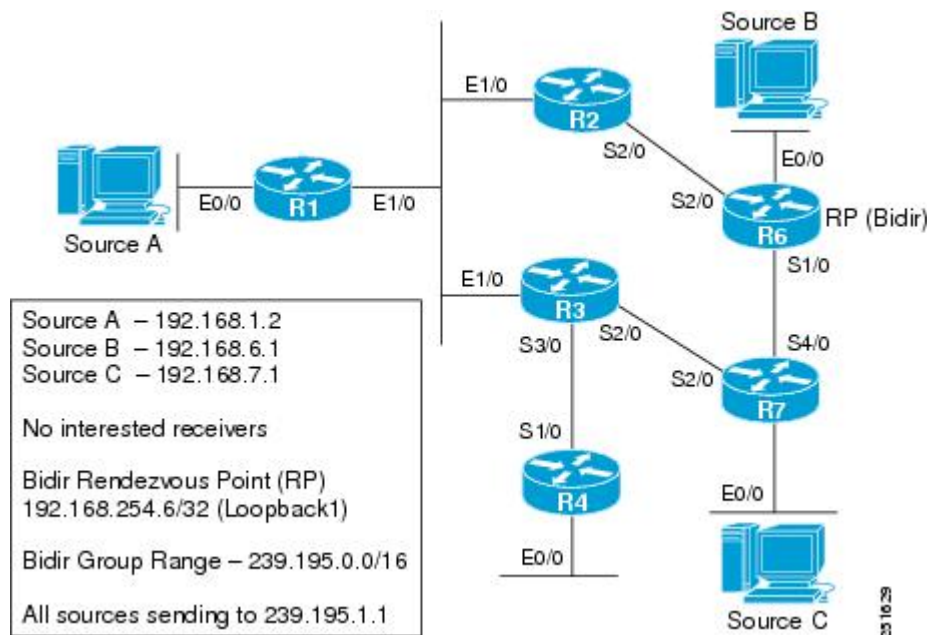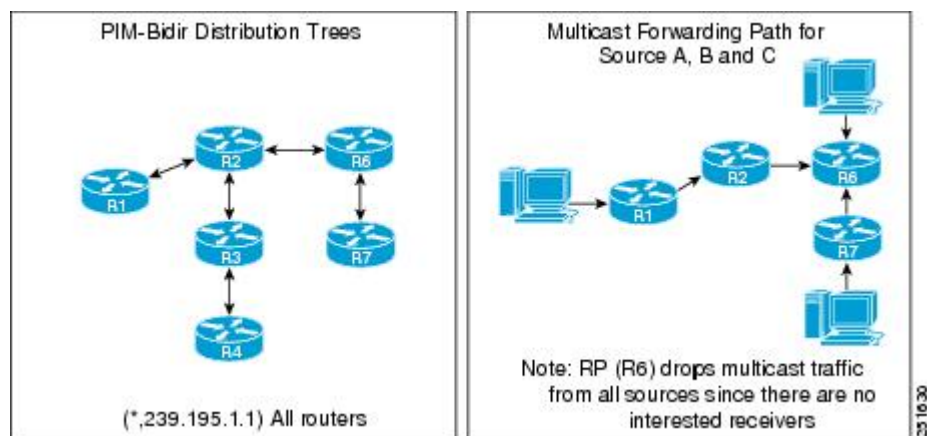*Figure 13: Bidir-PIM Example Topology: Active Sources with No Interested Receivers*

Figure 14: Bidir-PIM Distribution Trees and Multicast Forwarding Path for Active Sources with No Interested Receivers Example

For this verification example, the following conditions apply:

- Entries for (*, 239.195.0.0/16) are created by the control plane based on the PIM group-to-RP mappings on all routers.

- Because there are no interested receivers, (*, 239.195.0.0/16) will be the only state in the network on all routers.

- All source traffic for this example will go to the RP and then be dropped because there are no interested receivers in the network. In addition, source traffic received by the RP is never sent back out the same interface it was received on.

- In general, multicast packet forwarding can be verified by observing the "SW Forwarding" counter in the **show ip mfib** output for the most specific entry available in the MFIB. If multicast is being forwarded, this counter will increment.

- In this scenario, all traffic stops at the RP because there are no interested receivers. In addition, traffic received by the RP will be forwarded only to the bidir-PIM RP interface to be dropped.

R1 (First-Hop DR for Source A)

```
R1# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d03h, expires: 00:02:43
R1# show ip pim interface df
* implies this system is the DF
Interface               RP                DF Winner       Metric    Uptime
Ethernet0/0             192.168.254.6     *192.168.1.1    75        1d03h
Ethernet1/0             192.168.254.6      192.168.123.2  65        1d03h
R1# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R1# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R1# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
R1# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d03h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Ethernet1/0, Accepting/Sparse
R1# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R1# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 34754/10/28/2, Other: 58228/0/58228
   Ethernet1/0 Flags: A F
     Pkts: 34754/0
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R2

```
R2# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d03h, expires: 00:02:28
R2# show ip pim interface df
* implies this system is the DF
Interface               RP                DF Winner       Metric    Uptime
Ethernet1/0             192.168.254.6     *192.168.123.2  65        1d03h
Serial2/0               192.168.254.6      192.168.26.6   0         1d03h
```

```
R2# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R2# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R2# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
R2# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d03h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial2/0, RPF nbr: 192.168.26.6
  Incoming interface list:
    Ethernet1/0, Accepting/Sparse
    Serial2/0, Accepting/Sparse
R2# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.26.6 Flags:
  Ethernet1/0 Flags: A
  Null0 Flags: A
  Serial2/0 Flags: A F
R2# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 4211/10/28/2, Other: 0/0/0
   Serial2/0 Flags: A F
     Pkts: 4211/0
   Ethernet1/0 Flags: A
   Null0 Flags: A
```

R3

```
R3# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d03h, expires: 00:02:09
R3# show ip pim interface df
* implies this system is the DF
Interface              RP              DF Winner        Metric    Uptime
Ethernet0/0            192.168.254.6   *192.168.3.3     75        1d03h
Ethernet1/0            192.168.254.6    192.168.123.2   65        1d03h
Serial2/0              192.168.254.6    192.168.37.7     65        1d03h
Serial3/0              192.168.254.6   *192.168.34.3     75        1d03h
R3# show ip igmp groups 239.195.1.1

IGMP Connected Group Membership
Group Address    Interface              Uptime    Expires   Last Reporter   Group Accounted
R3# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R3# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R3# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
R3# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d03h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
    Serial3/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Ethernet1/0, Accepting/Sparse
R3# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Serial3/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R3# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0/0, Other: 3935/0/3935
   Serial3/0 Flags: A
   Ethernet1/0 Flags: A F
     Pkts: 0/0
```

```
    Ethernet0/0 Flags: A
    Null0 Flags: A
```

R4

```
R4# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d03h, expires: 00:02:54
R4# show ip pim interface df
* implies this system is the DF
Interface               RP                DF Winner          Metric     Uptime
Ethernet0/0             192.168.254.6     *192.168.4.4       139        1d03h
Serial1/0               192.168.254.6      192.168.34.3      75         1d03h
R4# show ip igmp groups 239.195.1.1

IGMP Connected Group Membership
Group Address   Interface             Uptime    Expires   Last Reporter   Group Accounted
R4# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R4# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R4# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
R4# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d03h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial1/0, RPF nbr: 192.168.34.3
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
R4# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.34.3 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial1/0 Flags: A F
R4# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial1/0 Flags: A F
     Pkts: 0/0
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R6 (RP and First-Hop DR for Source B)

```
R6# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.254.6 (?), elected via Auto-RP
        Uptime: 1d03h, expires: 00:01:59
R6# show ip pim interface df
* implies this system is the DF
Interface               RP                DF Winner          Metric     Uptime
Loopback0               192.168.254.6     *192.168.6.6       0          1d03h
Loopback1               192.168.254.6     *192.168.254.6     0          1d03h
Ethernet0/0             192.168.254.6     *192.168.16.6      0          1d03h
Serial1/0               192.168.254.6     *192.168.67.6      0          1d03h
Serial2/0               192.168.254.6     *192.168.26.6      0          1d03h
R6# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R6# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R6# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
```

```
R6# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d03h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Loopback1, RPF nbr: 192.168.254.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Loopback0, Accepting/Sparse
    Loopback1, Accepting/Sparse
R6# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.254.6 Flags:
  Serial2/0 Flags: A
  Serial1/0 Flags: A
  Ethernet0/0 Flags: A
  Loopback0 Flags: A
  Null0 Flags: A
  Loopback1 Flags: A F
R6# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 13951/30/28/6, Other: 0/0/0
   Loopback1 Flags: A F
     Pkts: 13951/0
   Loopback0 Flags: A
   Serial2/0 Flags: A
   Serial1/0 Flags: A
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R7 (First-Hop DR for Source C)

```
R7# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d03h, expires: 00:02:22
R7# show ip pim interface df
* implies this system is the DF
Interface               RP              DF Winner       Metric    Uptime
Ethernet0/0             192.168.254.6   *192.168.7.7    65        1d03h
Serial2/0               192.168.254.6   *192.168.37.7   65        1d03h
Serial4/0               192.168.254.6    192.168.67.6   0         1d03h
R7# show ip igmp groups 239.195.1.1
IGMP Connected Group Membership
Group Address    Interface          Uptime   Expires  Last Reporter   Group Accounted
R7# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R7# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R7# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
R7# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d03h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial4/0, RPF nbr: 192.168.67.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Serial4/0, Accepting/Sparse
R7# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.67.6 Flags:
  Serial2/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial4/0 Flags: A F
R7# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 4917/10/28/2, Other: 0/0/0
   Serial4/0 Flags: A F
     Pkts: 4917/0
   Serial2/0 Flags: A
```

```
      Ethernet0/0 Flags: A
      Null0 Flags: A
```

Bidir-PIM Example No Active Sources with Interested Receivers

The following example shows how to verify multicast forwarding using the MFIB for bidir-PIM in a network environment where there are no active sources with interested receivers. This verification example is based on the topology shown in the figure.

Figure 15: Bidir-PIM Example Topology: No Active Sources with Interested Receivers
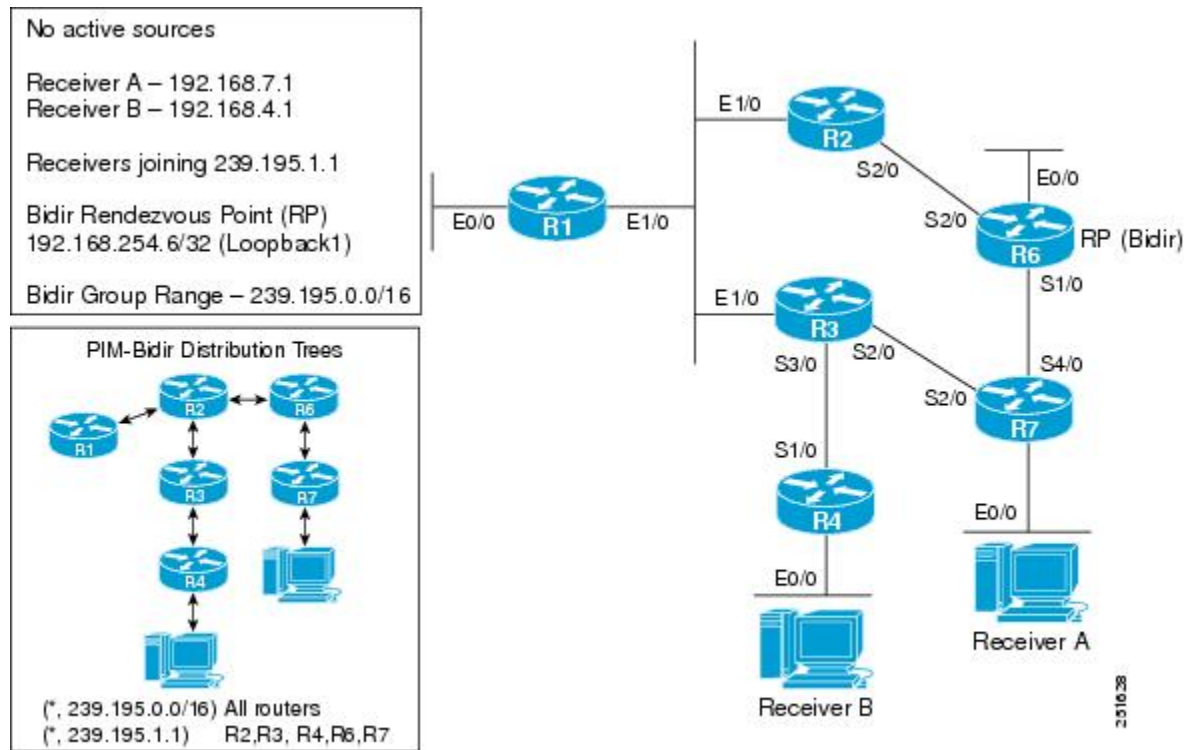
For this verification example, the following conditions apply:

- Entries for (*, 239.195.0.0/16) are created by the control plane based on the PIM group-to-RP mappings on all routers.

- Entries for (*, 239.195.1.1) will be created only when IGMP joins are initiated by interested receivers joining this group. As a result, all routers along the shared tree between the RP and the last-hop DRs that have interested receivers will have state for (*, 239.195.1.1).

Note R1 will not have state for (*, 239.195.1.1) because it is not between the RP and the last-hop DRs.

- In general, multicast packet forwarding can be verified by observing the "SW Forwarding" counter in **show ip mfib** command output for the most specific entry available in the MFIB. If multicast is being

forwarded, this counter will increment; however, because there are no active sources in this scenario, this counter will not increment.

R1

```
R1# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d01h, expires: 00:02:07
R1# show ip pim interface df
* implies this system is the DF
Interface              RP               DF Winner       Metric    Uptime
Ethernet0/0            192.168.254.6    *192.168.1.1    75        1d01h
Ethernet1/0            192.168.254.6    192.168.123.2   65        1d01h
R1# show ip mroute 239.195.1.1
Group 239.195.1.1 not found
R1# show ip mrib route 239.195.1.1
No matching routes in MRIB route-DB
R1# show ip mfib 239.195.1.1
Group 239.195.1.1 not found
R1# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d01h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Ethernet1/0, Accepting/Sparse
R1# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R1# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
  SW Forwarding: 0/0/0/0, Other: 0/0/0
  Ethernet1/0 Flags: A F
    Pkts: 0/0
  Ethernet0/0 Flags: A
  Null0 Flags: A
```

R2

```
R2# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d01h, expires: 00:02:32
R2# show ip pim interface df
* implies this system is the DF
Interface              RP               DF Winner       Metric    Uptime
Ethernet1/0            192.168.254.6    *192.168.123.2  65        1d01h
Serial2/0              192.168.254.6    192.168.26.6    0         1d01h
R2# show ip mroute 239.195.1.1
(*, 239.195.1.1), 01:30:22/00:02:50, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial2/0, RPF nbr 192.168.26.6
  Outgoing interface list:
    Ethernet1/0, Forward/Sparse, 01:30:22/00:02:50
    Serial2/0, Bidir-Upstream/Sparse, 01:30:22/00:00:00
R2# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.26.6 Flags: IA
  Ethernet1/0 Flags: F
  Serial2/0 Flags: F
R2# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
  SW Forwarding: 0/0/0/0, Other: 0/0/0
```

```
      Serial2/0 Flags: F
        Pkts: 0/0
      Ethernet1/0 Flags: F
        Pkts: 0/0
R2# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d01h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial2/0, RPF nbr: 192.168.26.6
  Incoming interface list:
    Ethernet1/0, Accepting/Sparse
    Serial2/0, Accepting/Sparse
R2# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.26.6 Flags:
  Ethernet1/0 Flags: A
  Null0 Flags: A
  Serial2/0 Flags: A F
R2# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial2/0 Flags: A F
     Pkts: 0/0
   Ethernet1/0 Flags: A
   Null0 Flags: A
```

R3

```
R3# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d01h, expires: 00:02:17
R3# show ip pim interface df
* implies this system is the DF
Interface               RP              DF Winner       Metric    Uptime
Ethernet0/0             192.168.254.6   *192.168.3.3    75        1d01h
Ethernet1/0             192.168.254.6    192.168.123.2  65        1d01h
Serial2/0               192.168.254.6    192.168.37.7   65        1d01h
Serial3/0               192.168.254.6   *192.168.34.3   75        1d01h
R3# show ip mroute 239.195.1.1
(*, 239.195.1.1), 01:30:36/00:03:21, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr 192.168.123.2
  Outgoing interface list:
    Serial3/0, Forward/Sparse, 01:30:36/00:03:21
    Ethernet1/0, Bidir-Upstream/Sparse, 01:30:36/00:00:00
R3# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.123.2 Flags: IA
  Serial3/0 Flags: F
  Ethernet1/0 Flags: F
R3# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial3/0 Flags: F
     Pkts: 0/0
   Ethernet1/0 Flags: F
     Pkts: 0/0
R3# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d01h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
    Serial3/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Ethernet1/0, Accepting/Sparse
R3# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Serial3/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R3# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
```

```
      Serial3/0 Flags: A
      Ethernet1/0 Flags: A F
        Pkts: 0/0
      Ethernet0/0 Flags: A
      Null0 Flags: A
```

R4 (Last-Hop DR for Receiver B)

```
R4# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d01h, expires: 00:02:02
R4# show ip pim interface df
* implies this system is the DF
Interface            RP              DF Winner        Metric     Uptime
Ethernet0/0          192.168.254.6   *192.168.4.4     139        1d01h
Serial1/0            192.168.254.6    192.168.34.3     75        1d01h
R4# show ip igmp groups 239.195.1.1
IGMP Connected Group Membership
Group Address   Interface            Uptime    Expires   Last Reporter   Group Accounted
239.195.1.1     Ethernet0/0          01:30:51  00:02:56  192.168.4.1
R4# show ip mroute 239.195.1.1
(*, 239.195.1.1), 01:30:51/00:02:56, RP 192.168.254.6, flags: BC
  Bidir-Upstream: Serial1/0, RPF nbr 192.168.34.3
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 01:30:51/00:02:56
    Serial1/0, Bidir-Upstream/Sparse, 01:30:51/00:00:00
R4# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.34.3 Flags: IA
  Ethernet0/0 Flags: F
  Serial1/0 Flags: F
R4# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial1/0 Flags: F
     Pkts: 0/0
   Ethernet0/0 Flags: F
     Pkts: 0/0
R4# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d01h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial1/0, RPF nbr: 192.168.34.3
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
R4# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.34.3 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial1/0 Flags: A F
R4# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial1/0 Flags: A F
     Pkts: 0/0
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R6 (RP)

```
R6# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.254.6 (?), elected via Auto-RP
        Uptime: 1d01h, expires: 00:02:30
```

```
R6# show ip pim interface df
* implies this system is the DF
Interface              RP              DF Winner       Metric    Uptime
Loopback0              192.168.254.6   *192.168.6.6    0         1d01h
Loopback1              192.168.254.6   *192.168.254.6  0         1d01h
Ethernet0/0            192.168.254.6   *192.168.16.6   0         1d01h
Serial1/0              192.168.254.6   *192.168.67.6   0         1d01h
Serial2/0              192.168.254.6   *192.168.26.6   0         1d01h
R6# show ip mroute 239.195.1.1
(*, 239.195.1.1), 01:31:08/00:03:00, RP 192.168.254.6, flags: B
  Bidir-Upstream: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Serial1/0, Forward/Sparse, 01:31:00/00:03:00
    Serial2/0, Forward/Sparse, 01:31:08/00:02:57
R6# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 0.0.0.0 Flags: IA
  Serial1/0 Flags: F
  Serial2/0 Flags: F
R6# show ip mfib 239.195.1.1
 (*,239.195.1.1) Flags: IA
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial2/0 Flags: F
     Pkts: 0/0
   Serial1/0 Flags: F
     Pkts: 0/0
R6# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d01h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Loopback1, RPF nbr: 192.168.254.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Loopback0, Accepting/Sparse
    Loopback1, Accepting/Sparse
R6# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.254.6 Flags:
  Serial2/0 Flags: A
  Serial1/0 Flags: A
  Ethernet0/0 Flags: A
  Loopback0 Flags: A
  Null0 Flags: A
  Loopback1 Flags: A F
R6# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback1 Flags: A F
     Pkts: 0/0
   Loopback0 Flags: A
   Serial2/0 Flags: A
   Serial1/0 Flags: A
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

R7 (Last-Hop DR for Receiver A)

```
R7# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 1d01h, expires: 00:02:33
R7# show ip pim interface df
* implies this system is the DF
Interface              RP              DF Winner       Metric    Uptime
Ethernet0/0            192.168.254.6   *192.168.7.7    65        1d01h
Serial2/0              192.168.254.6   *192.168.37.7   65        1d01h
Serial4/0              192.168.254.6    192.168.67.6   0         1d01h
R7# show ip igmp groups 239.195.1.1
IGMP Connected Group Membership
Group Address    Interface              Uptime    Expires   Last Reporter   Group Accounted
239.195.1.1      Ethernet0/0            01:31:14  00:02:22  192.168.7.1
```

```
R7# show ip mroute 239.195.1.1
(*, 239.195.1.1), 01:31:14/00:02:22, RP 192.168.254.6, flags: BC
  Bidir-Upstream: Serial4/0, RPF nbr 192.168.67.6
  Outgoing interface list:
    Ethernet0/0, Forward/Sparse, 01:31:14/00:02:22
    Serial4/0, Bidir-Upstream/Sparse, 01:31:14/00:00:00
R7# show ip mrib route 239.195.1.1
(*,239.195.1.1) RPF nbr: 192.168.67.6 Flags: IA
  Ethernet0/0 Flags: F
  Serial4/0 Flags: F
R7# show ip mfib 239.195.1.1
  (*,239.195.1.1) Flags: IA
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial4/0 Flags: F
     Pkts: 0/0
   Ethernet0/0 Flags: F
     Pkts: 0/0
R7# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 1d01h/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial4/0, RPF nbr: 192.168.67.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Serial4/0, Accepting/Sparse
R7# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.67.6 Flags:
  Serial2/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial4/0 Flags: A F
R7# show ip mfib 239.195.0.0/16
  (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial4/0 Flags: A F
     Pkts: 0/0
   Serial2/0 Flags: A
   Ethernet0/0 Flags: A
   Null0 Flags: A
```

Bidir-PIM Example No Active Sources with No Interested Receivers

The following example shows how to verify multicast forwarding using the MFIB for bidir-PIM in a network environment where there are no active sources and no interested receivers. This verification example is based on the topology shown in the figure.

Figure 16: Bidir-PIM Example Topology: No Active Sources with No Interested Receivers
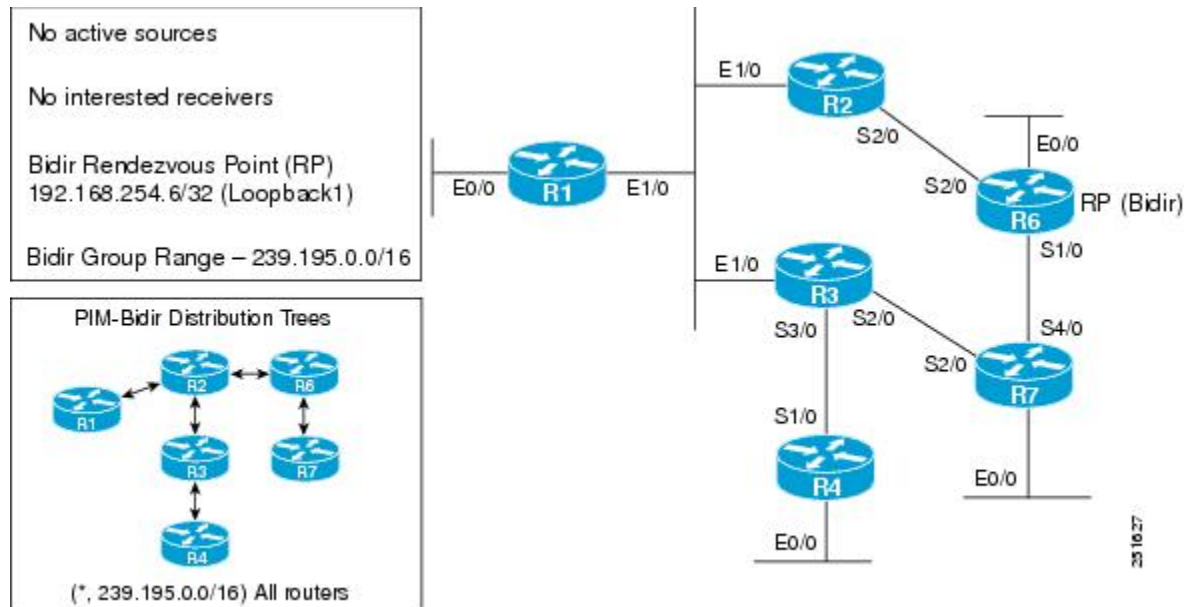
For this verification example, the following conditions apply:

- Entries for (*, 239.195.0.0/16) are created by the control plane based on the PIM group-to-RP mappings on all routers.

- Entries for any group within the range 239.195.0.0/16 will be created only when IGMP joins are initiated by interested receivers joining that particular group. For example, if a multicast receiver joins the group 239.195.1.1, an entry for (*, 239.195.1.1) will be created on all routers along the shared tree.

- Because there are no interested receivers, (*, 239.195.0.0/16) will be the only state in the network on all routers.

- In general, multicast packet forwarding can be verified by observing the "SW Forwarding" counter in **show ip mfib** command output for the most specific entry available in the MFIB. If multicast is being forwarded, this counter will increment; however, because there are no active sources in this scenario, this counter will not increment.

R1

```
R1# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
```

```
                    Uptime: 22:06:01, expires: 00:02:30
R1# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 22:06:01/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Ethernet1/0, Accepting/Sparse
R1# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R1# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Ethernet1/0 Flags: A F
     Pkts: 0/0
   Ethernet0/0 Flags: A
   Null0 Flags: A
R1# show ip pim interface df
* implies this system is the DF
Interface             RP               DF Winner      Metric     Uptime
Ethernet0/0           192.168.254.6    *192.168.1.1   75         22:06:01
Ethernet1/0           192.168.254.6    192.168.123.2  65         22:06:01
```

R2

```
R2# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 22:09:00, expires: 00:02:30
R2# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 22:09:00/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial2/0, RPF nbr: 192.168.26.6
  Incoming interface list:
    Ethernet1/0, Accepting/Sparse
    Serial2/0, Accepting/Sparse
R2# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.26.6 Flags:
  Ethernet1/0 Flags: A
  Null0 Flags: A
  Serial2/0 Flags: A F
R2# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial2/0 Flags: A F
     Pkts: 0/0
   Ethernet1/0 Flags: A
   Null0 Flags: A
R2# show ip pim interface df
* implies this system is the DF
Interface             RP               DF Winner       Metric     Uptime
Ethernet1/0           192.168.254.6    *192.168.123.2  65         22:09:00
Serial2/0             192.168.254.6    192.168.26.6    0          22:09:00
```

R3

```
R3# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 22:09:20, expires: 00:02:12
R3# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 22:09:20/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Ethernet1/0, RPF nbr: 192.168.123.2
  Incoming interface list:
```

```
      Serial3/0, Accepting/Sparse
      Ethernet1/0, Accepting/Sparse
R3# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.123.2 Flags:
  Serial3/0 Flags: A
  Null0 Flags: A
  Ethernet1/0 Flags: A F
R3# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial3/0 Flags: A
   Ethernet1/0 Flags: A F
     Pkts: 0/0
   Null0 Flags: A
R3# show ip pim interface df
* implies this system is the DF
Interface             RP                DF Winner         Metric    Uptime
Ethernet1/0           192.168.254.6     192.168.123.2     65        22:09:20
Serial2/0             192.168.254.6     192.168.37.7      65        22:09:20
Serial3/0             192.168.254.6     *192.168.34.3     75        22:09:20
```

R4

```
R4# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 22:09:47, expires: 00:02:42
R4# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 22:09:47/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial1/0, RPF nbr: 192.168.34.3
  Incoming interface list:
    Ethernet0/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
R4# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.34.3 Flags:
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial1/0 Flags: A F
R4# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial1/0 Flags: A F
     Pkts: 0/0
   Ethernet0/0 Flags: A
   Null0 Flags: A
R4# show ip pim interface df
* implies this system is the DF
Interface             RP                DF Winner         Metric    Uptime
Ethernet0/0           192.168.254.6     *192.168.4.4      139       22:09:47
Serial1/0             192.168.254.6     192.168.34.3      75        22:09:47
```

R6 (RP)

```
R6# show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent (Loopback0)
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.254.6 (?), elected via Auto-RP
        Uptime: 22:11:08, expires: 00:02:48
R6# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 22:11:08/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Loopback1, RPF nbr: 192.168.254.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Serial1/0, Accepting/Sparse
```

```
      Ethernet0/0, Accepting/Sparse
      Loopback1, Accepting/Sparse
R6# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.254.6 Flags:
  Serial2/0 Flags: A
  Serial1/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Loopback1 Flags: A F
R6# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Loopback1 Flags: A F
     Pkts: 0/0
   Serial2/0 Flags: A
   Serial1/0 Flags: A
   Ethernet0/0 Flags: A
   Null0 Flags: A
R6# show ip pim interface df
* implies this system is the DF
Interface              RP              DF Winner      Metric    Uptime
Loopback1              192.168.254.6   *192.168.254.6  0         22:11:08
Ethernet0/0            192.168.254.6   *192.168.16.6   0         22:11:08
Serial1/0              192.168.254.6   *192.168.67.6   0         22:11:08
Serial2/0              192.168.254.6   *192.168.26.6   0         22:11:08
```

R7

```
R7# show ip pim rp mapping
PIM Group-to-RP Mappings
Group(s) 239.195.0.0/16
  RP 192.168.254.6 (?), v2v1, bidir
    Info source: 192.168.6.6 (?), elected via Auto-RP
        Uptime: 22:10:23, expires: 00:02:04
R7# show ip mroute 239.195.0.0/16
(*,239.195.0.0/16), 22:10:23/-, RP 192.168.254.6, flags: B
  Bidir-Upstream: Serial4/0, RPF nbr: 192.168.67.6
  Incoming interface list:
    Serial2/0, Accepting/Sparse
    Ethernet0/0, Accepting/Sparse
    Serial4/0, Accepting/Sparse
R7# show ip mrib route 239.195.0.0/16
(*,239.195.0.0/16) RPF nbr: 192.168.67.6 Flags:
  Serial2/0 Flags: A
  Ethernet0/0 Flags: A
  Null0 Flags: A
  Serial4/0 Flags: A F
R7# show ip mfib 239.195.0.0/16
 (*,239.195.0.0/16) Flags:
   SW Forwarding: 0/0/0/0, Other: 0/0/0
   Serial4/0 Flags: A F
     Pkts: 0/0
   Serial2/0 Flags: A
   Ethernet0/0 Flags: A
   Null0 Flags: A
R7# show ip pim interface df
* implies this system is the DF
Interface              RP              DF Winner      Metric    Uptime
Ethernet0/0            192.168.254.6   *192.168.7.7    65        22:10:23
Serial2/0              192.168.254.6   *192.168.37.7   65        22:10:23
Serial4/0              192.168.254.6    192.168.67.6   0         22:10:23
```

Additional References

Related Documents

Related Topic	Document Title
MFIB overview concepts and MFIB/MRIB entry and interface flag descriptions	" Multicast Forwarding Information Base Overview "
Overview of the IP multicast technology area	" IP Multicast Technology Overview "
Concepts, tasks, and examples for configuring an IP multicast network using PIM	" Configuring Basic IP Multicast "
IP multicast commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS IP Multicast Command Reference*

Standards

Standard	Title
No new or modified standards are supported, and support for existing standards has not been modified.	--

MIBs

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco IOS software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported, and support for existing RFCs has not been modified.	--

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies.	http://www.cisco.com/cisco/web/support/index.html
To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds.	
Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	

Feature Information for Verifying IPv4 Multicast Forwarding Using the MFIB

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 13: Feature Information for Verifying IPv4 Multicast Forwarding Using the MFIB

Feature Name	Releases	Feature Information
IPv4 Multicast Support of the MFIB	15.0(1)M 12.2(33)SRE	The MFIB architecture provides modularity and separation between the multicast control plane (PIM and IGMP) and the multicast forwarding plane (MFIB). This architecture is used in Cisco IOS IPv6 and Cisco IOS XR multicast implementations. With the introduction of the IPv4 MFIB infrastructure, the Cisco IOS IPv4 multicast implementation has been enhanced, making the MFIB forwarding model the only forwarding engine used.
		The following commands were introduced or modified: **clear ip mfib counters**, **debug ip mcache**, **debug ip mfib adjacency**, **debug ip mfib db**, **debug ip mfib fs**, **debug ip mfib init**, **debug ip mfib interface**, **debug ip mfib mrib**, **debug ip mfib pak**, **debug ip mfib platform**, **debug ip mfib ppr**, **debug ip mfib ps**, **debug ip mfib signal**, **debug ip mfib table**, **debug ip mpacket**, **debug ip mrib**, **ip mfib**, **ip mfib cef**, **ip mfib forwarding**, **ip mroute-cache**, **ip multicast cache-headers**, **ip multicast rate-limit**, **ip multicast ttl-threshold**, **ip pim register-rate-limit**, **show ip mcache**, **show ip mfib**, **show ip mfib active**, **show ip mfib count**, **show ip mfib interface**, **show ip mfib route**, **show ip mfib status**, **show ip mfib summary**, **show ip pim interface**, **show ip pim tunne**l.

Distributed MFIB for IPv6 Multicast

Distributed MFIB (dMFIB) is used to switch multicast IPv6 packets on distributed platforms. The basic MFIB routines that implement the core of the forwarding logic are common to all forwarding environments.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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

Information About Distributed MFIB for IPv6 Multicast

Distributed MFIB

Distributed Multicast Forwarding Information Base (MFIB) is used to switch multicast IPv6 packets on distributed platforms. Distributed MFIB may also contain platform-specific information on replication across line cards. The basic MFIB routines that implement the core of the forwarding logic are common to all forwarding environments.

dMFIB implements the following functions:

• Distributes a copy of the MFIB to the line cards.

• Relays data-driven protocol events generated in the line cards to PIM.

• Provides an MFIB platform application program interface (API) to propagate MFIB changes to platform-specific code responsible for programming the hardware acceleration engine. This API also includes entry points to switch a packet in software (necessary if the packet is triggering a data-driven event) and to upload traffic statistics to the software.

• Provides hooks to allow clients residing on the RP to read traffic statistics on demand. Distributed MFIB does not periodically upload these statistics to the RP.

The combination of distributed MFIB and MRIB subsystems allows the device to have a "customized" copy of the MFIB database in each line card and to transport MFIB-related platform-specific information from the RP to the line cards.

How to Disable MFIB on a Distributed Platform

Before You Begin

Note

SUMMARY STEPS

1.

DETAILED STEPS

Example:

Example:

What to Do Next

Disabling MFIB on a Distributed Platform

Multicast forwarding is automatically enabled when IPv6 multicast routing is enabled. However, you may want to disable multicast forwarding on a distributed platform.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ipv6 mfib-mode centralized-only**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ipv6 mfib-mode centralized-only** **Example:** `Device(config)# ipv6 mfib-mode centralized-only`	Disables distributed forwarding on a distributed platform.

Configuration Example for Distributed MFIB for IPv6 Multicast

This example shows how to disable multicast forwarding on a distributed platform:

```
Device(config)# ipv6 mfib-mode centralized-only
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
IP multicast commands	Cisco IOS IP Multicast Command Reference

Related Topic	Document Title
IPv6 commands	*Cisco IOS IPv6 Command Reference*
IPv6 features	Cisco IOS IPv6 Feature Mapping
IPv6 addressing and connectivity	*IPv6 Configuration Guide*

Standards and RFCs

Standard/RFC	Title
RFCs for IPv6	*IPv6 RFCs*

MIBs

MIB	MIBs Link
No new or modified MIBs are supported, and support for existing MIBs has not been modified.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Distributed MFIB for IPv6 Multicast

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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

Table 14: Feature Information for Distributed MFIB for IPv6 Multicast

Feature Name	Releases	Feature Information
Distributed MFIB for IPv6 Multicast	12.0(26)S 12.2(25)S 12.2(28)SB 12.3(4)T 12.4 Cisco IOS XE Release 2.1	Distributed MFIB is used to switch multicast IPv6 packets on distributed platforms. The following command was introduced: **ipv6 mfib-mode centralized-only**.