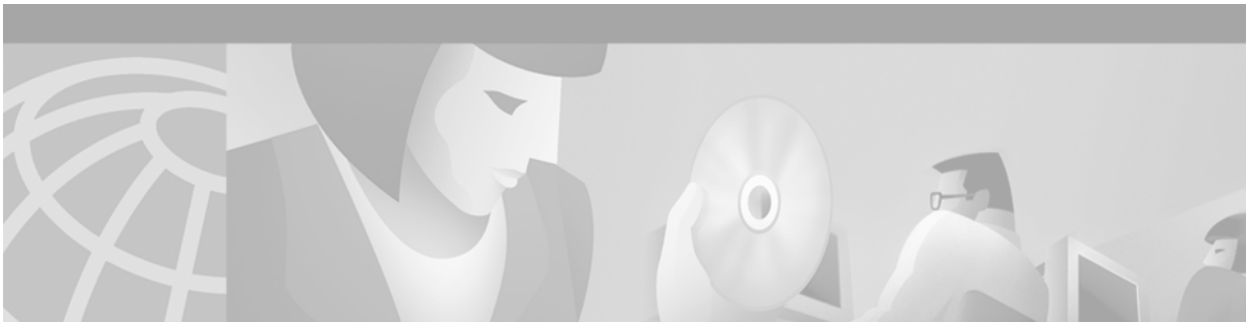


Configuring Multicast Source Discovery Protocol

This chapter describes the Multicast Source Discovery Protocol (MSDP) feature. For a complete description of the MSDP commands in this chapter, refer to the "Multicast Source Discovery Protocol Commands" chapter of the *Cisco IOS IP Command Reference, Volume 3 of 3: Multicast* publication. To locate documentation of other commands in this chapter, use the command reference master index, or search online.

MSDP is a mechanism to connect multiple Protocol Independent Multicast sparse mode (PIM-SM) domains. MSDP allows multicast sources for a group to be known to all rendezvous points (RPs) in different domains. Each PIM-SM domain uses its own RPs and need not depend on RPs in other domains. An RP runs MSDP over TCP to discover multicast sources in other domains.

An RP in a PIM-SM domain has an MSDP peering relationship with MSDP-enabled routers in another domain. The peering relationship occurs over a TCP connection, where primarily a list of sources sending to multicast groups is exchanged. The TCP connections between RPs are achieved by the underlying routing system. The receiving RP uses the source lists to establish a source path.

The purpose of this topology is to have domains discover multicast sources in other domains. If the multicast sources are of interest to a domain that has receivers, multicast data is delivered over the normal, source-tree building mechanism in PIM-SM.

MSDP is also used to announce sources sending to a group. These announcements must originate at the RP of the domain.

MSDP depends heavily on BGP or MBGP for interdomain operation. We recommend that you run MSDP in RPs in your domain that are RPs for sources sending to global groups to be announced to the internet.

To identify the hardware platform or software image information associated with a feature, use the Feature Navigator on Cisco.com to search for information about the feature or refer to the software release notes for a specific release. For more information, see the "Identifying Supported Platforms" section in the "Using Cisco IOS Software" chapter.

How MSDP Works

Figure 78 illustrates MSDP operating between two MSDP peers. PIM uses MSDP as the standard mechanism to register a source with the RP of a domain.

When MSDP is configured, the following sequence occurs. When the first data packet of a source is registered by the first hop router, that same data packet is decapsulated by the RP and forwarded down the shared tree. That packet is also reencapsulated in a Source-Active (SA) message that is immediately forwarded to all MSDP peers. The SA message identifies the source, the group the source is sending to,

and the address or the originator ID of the RP, if configured. If the peer is an RP and has a member of that multicast group, the data packet is decapsulated and forwarded down the shared-tree in the remote domain.

The PIM designated router (DR) directly connected to the source sends the data encapsulated in a PIM register message to the RP in the domain.

Note The DR sends the encapsulated data to the RP only once per source, when the source goes active. If the source times out, this process happens again when it goes active again. This situation is different from the periodic SA message that contains all sources that are registered to the originating RP. These messages have no data.

Each MSDP peer receives and forwards the SA message away from the originating RP to achieve *peer-RPF flooding*. The concept of peer-RPF flooding is with respect to forwarding SA messages. The router examines the BGP or MBGP routing table to determine which peer is the next hop toward the originating RP of the SA message. Such a peer is called an "RPF peer" (Reverse Path Forwarding peer). The router forwards the message to all MSDP peers other than the RPF peer.

If the MSDP peer receives the same SA message from a non-RPF peer toward the originating RP, it drops the message. Otherwise, it forwards the message on to all its MSDP peers.

When an RP for a domain receives an SA message from an MSDP peer, it determines if it has any group members interested in the group the SA message describes. If the (*, G) entry exists with a nonempty outgoing interface list, the domain is interested in the group, and the RP triggers an (S, G) join toward the source.

Figure 78 MSDP Running Between RP Peers

Benefits

MSDP has the following benefits:

- It breaks up the shared multicast distribution tree. You can make the shared tree local to your domain. Your local members join the local tree, and join messages for the shared tree never need to leave your domain.
- PIM-SM domains can rely on their own RPs only, thus decreasing reliance on RPs in another domain. This increases security because you can prevent your sources from being known outside your domain.
- Domains with only receivers can receive data without globally advertising group membership.
- Global source multicast routing table state is not required, thus saving on memory.

Prerequisites

Before configuring MSDP, the addresses of all MSDP peers must be known in BGP or MBGP. If that does not occur, you must configure MSDP default peering when you configure MSDP.

MSDP Configuration Task List

To configure an MSDP peer and various MSDP options, perform the tasks described in the following sections. The tasks in the first section are required; the tasks in the remaining sections are optional.

- Configuring an MSDP Peer (Required)
- Caching SA State (Optional)
- Requesting Source Information from an MSDP Peer (Optional)
- Controlling Source Information That Your Router Originates (Optional)
- Controlling Source Information That Your Router Forwards (Optional)
- Controlling Source Information That Your Router Receives (Optional)
- Configuring a Default MSDP Peer (Optional)
- Configuring an MSDP Mesh Group (Optional)
- Shutting Down an MSDP Peer (Optional)
- Including a Bordering PIM Dense Mode Region in MSDP (Optional)
- Configuring an Originating Address Other Than the RP Address (Optional)

See the "MSDP Configuration Examples" section later in this chapter for configuration examples.

Configuring an MSDP Peer

You enable MSDP by configuring an MSDP peer to the local router.

Note The router you specify by Domain Naming System (DNS) name or IP address as an MSDP peer is probably a Border Gateway Protocol (BGP) neighbor. If it is not, see the section "Configuring a Default MSDP Peer" later in this document.

To configure an MSDP peer, use the following commands in global configuration mode as needed. The second command is optional.

Command	Purpose
`Router(config)# ip msdp peer {peer-name | peer-address} [connect-source type number] [remote-as as-number]`	Enables MSDP and configures an MSDP peer as specified by the DNS name or IP address. If you specify the **connect-source** keyword, the primary address of the specified local interface *type* and *number* values are used as the source IP address for the TCP connection. The **connect-source** keyword is recommended, especially for MSDP peers on a border that peer with a router inside the remote domain.
`Router(config)# ip msdp description {peer-name | peer-address} text`	Configures a description for a specified peer to make it easier to identify in a configuration or in **show** command output.

Caching SA State

By default, the router does not cache source/group pairs from received SA messages. Once the router forwards the MSDP SA information, it does not store it in memory. Therefore, if a member joins a group soon after an SA message is received by the local RP, that member will need to wait until the next SA message to hear about the source. This delay is known as join latency.

If you want to sacrifice some memory in exchange for reducing the latency of the source information, you can configure the router to cache SA messages. To have the router cache source/group pairs, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ip msdp cache-sa-state [list access-list]`	Creates SA state (cache source/group pairs). Those pairs that pass the access list are cached.

An alternative to caching the SA state is to request source information from a peer, which is described in the following section, "Requesting Source Information from an MSDP Peer." If you cache the information, you need not trigger a request for it.

Requesting Source Information from an MSDP Peer

Local RPs can send SA requests and get immediate response for all active sources for a given group. By default, the router does not send any SA request messages to its MSDP peers when a new member joins a group and wants to receive multicast traffic. The new member just waits to receive the next periodic SA message.

If you want a new member of a group to learn the current, active multicast sources in a connected PIM-SM domain that are sending to a group, configure the router to send SA request messages to the specified MSDP peer when a new member joins a group. Doing so reduces join latency, but requires some memory.

Note that information can be requested only from caching peers.

To configure this feature, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ip msdp sa-request {peer-address | peer-name}`	Configures the router to send SA request messages to the specified MSDP peer when a receiver becomes active, so the receiver can learn about multicast sources in a group. The peer replies with the information it is SA cache. If the peer does not have a cache configured, this command provides nothing.

Repeat the preceding command for each MSDP peer that you want to supply you with SA messages.

An alternative to requesting source information is to cache the SA state, which is described in the section "Caching SA State" earlier in this chapter. If you cache the information, you need not trigger a request for it.

Controlling Source Information That Your Router Originates

There are two ways to control the multicast source information that originates with your router. You can control the following:

- Which sources you will advertise (based on your sources)
- Whom you will provide source information to (based on knowing who is asking you for information)

To control which sources you will advertise, see the following section, "Redistributing Sources." To control whom you will provide source information to, see the section "Controlling Source Information That Your Router Forwards" later in this chapter.

Redistributing Sources

SA messages are originated on RPs to which sources have registered. By default, any source that registers with an RP will be advertised. The "A flag" is set in the RP when a source is registered. This flag indicates that the source will be advertised in an SA unless it is filtered with the following command.

To further restrict which registered sources are advertised, use the following command in global configuration mode. The access list or autonomous system path access list determines which (S, G) pairs are advertised.

Command	Purpose
`Router(config)# ip msdp redistribute [list access-list] [asn as-access-list] [route-map map-name]`	Advertises (S, G) pairs that pass the access list or route map to other domains.

Note The **ip msdp redistribute** global configuration command could also be used to advertise sources that are known to the RP but not registered. However, we strongly recommend that you NOT originate advertisements for sources that have not registered with the RP.

Filtering SA Request Messages

By default, only routers that are caching SA information can respond to SA request messages. By default, such a router honors all SA request messages from its MSDP peers. That is, it will supply the IP addresses of the sources that are active.

However, you can configure the router to ignore all SA request messages from an MSDP peer. Or, you can honor only those SA request messages from a peer for groups described by a standard access list. If the access list passes, SA request messages will be accepted. All other such messages from the peer for other groups will be ignored.

To configure one of these options, use either of the following commands in global configuration mode:

Command	Purpose
`Router(config)# ip msdp filter-sa-request {peer-address | peer-name}`	Filters all SA request messages from the specified MSDP peer.
`Router(config)# ip msdp filter-sa-request {peer-address | peer-name} list access-list`	Filters SA request messages from the specified MSDP peer for groups that pass the standard access list. The access list describes a multicast group address.

Controlling Source Information That Your Router Forwards

By default, the router forwards all SA messages it receives to all of its MSDP peers. However, you can prevent outgoing messages from being forwarded to a peer by using a filter or by setting a time-to-live (TTL) value. These methods are described in the following sections.

Using an MSDP Filter

By creating an MSDP filter, you can do one of the following:

- Filter all source/group pairs
- Specify an extended access list to pass only certain source/group pairs
- Filter based on match criteria in a route map

To apply an MSDP filter, use the following commands in global configuration mode as needed:

Command	Purpose
`Router(config)# ip msdp sa-filter out {peer-address | peer-name}`	Filters all SA messages to the specified MSDP peer.
`Router(config)# ip msdp sa-filter out {peer--address | peer-name} list access-list`	To the specified MSDP peer, passes only those SA messages that pass the extended access list.
`Router(config)# ip msdp sa-filter out {peer-address | peer-name} route-map map-name`	To the specified MSDP peer, passes only those SA messages that meet the match criteria in the route map *map-tag* value.

Using TTL to Limit the Multicast Data Sent in SA Messages

You can use TTL to control what data will be encapsulated in the first SA message for every source. For example, you could limit internal traffic to a TTL of 8. If you want other groups to go to external locations, you would need to send those packets with a TTL greater than 8.

To establish a TTL threshold, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ip msdp ttl-threshold {peer-address | peer-name} ttl-value`	Limits which multicast data will be encapsulated in the first SA message to the specified MSDP peer.

Controlling Source Information That Your Router Receives

By default, the router receives all SA messages its MSDP RPF peers send to it. However, you can control the source information you receive from MSDP peers by filtering incoming SA messages. In other words, you can configure the router not to accept them.

You can do one of the following to control the source information you receive from MSDP peers:

- Filter all incoming SA messages from an MSDP peer
- Specify an extended access list to pass certain source/group pairs
- Filter based on match criteria in a route map

To apply a filter, use the following commands in global configuration mode as needed:

Command	Purpose
`Router(config)# ip msdp sa-filter in {peer-address | peer-name}`	From the specified MSDP peer, filters all SA messages received.
`Router(config)# ip msdp sa-filter in {peer-address | peer-name} list access-list`	From the specified MSDP peer, passes incoming SA messages that pass the extended access list.
`Router(config)# ip msdp sa-filter in {peer-address | peer-name} route-map map-name`	From the specified MSDP peer, passes only those SA messages that meet the match criteria in the route map *map-name* value.

Configuring a Default MSDP Peer

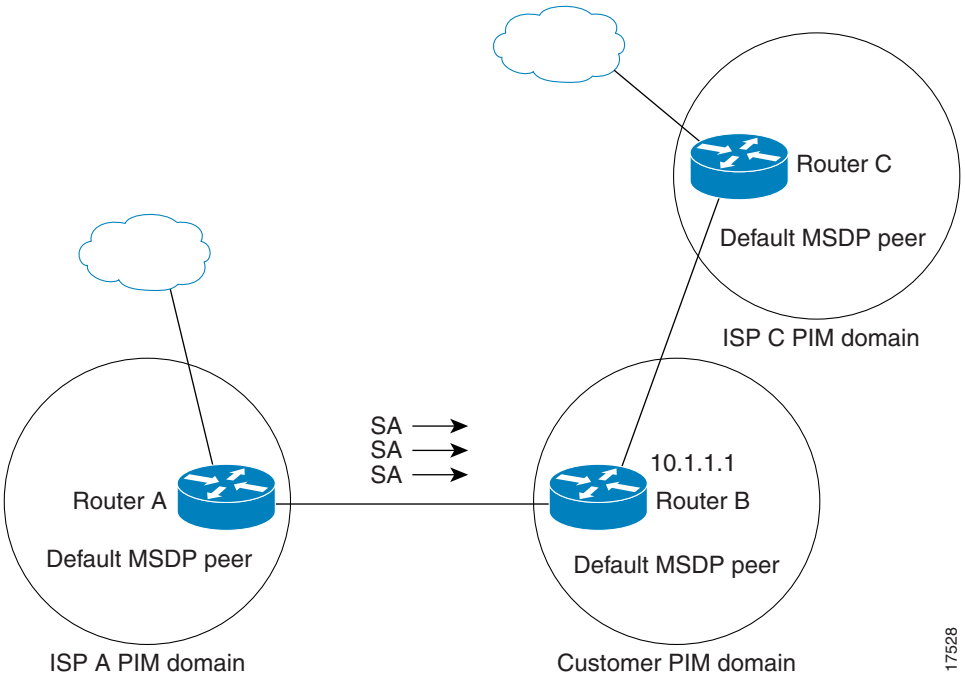
An MSDP peer of the local router is probably a BGP peer also. However, if you do not want to have or cannot have a BGP peer, you could define a default MSDP peer from which to accept all SA messages. The default MSDP peer must be a previously configured MSDP peer. Configure a default MSDP peer when you are not BGP- or multiprotocol BGP-peering with an MSDP peer. If a single MSDP peer is configured, a router will always accept all SA messages sent to it from that peer.

Figure 79 illustrates a scenario where default MSDP peers might be used. In the figure, a customer that owns Router B is connected to the internet via two Internet service providers (ISPs), one that owns Router A and the other that owns Router C. They are not running BGP or MBGP between them. In order for the customer to learn about sources in the ISP domain or in other domains, Router B identifies Router A as its default MSDP peer. Router B advertises SA messages to both Router A and Router C, but accepts SA messages either from Router A only or Router C only. If Router A is first in the configuration file, it will be used if it is up and running. If Router A is not running, then and only then will Router B accept SA messages from Router C.

The ISP will also likely use a prefix list to define which prefixes it will accept from the customer router. The customer will define multiple default peers, each having one or more prefixes associated with it.

The customer has two ISPs to use. The customer defines both ISPs as default peers. As long as the first default peer identified in the configuration is up and running, it will be the default peer and the customer will accept all SA messages it receives from that peer.

Figure 79 Default MSDP Peer Scenario



Router B advertises SAs to Router A and Router C, but uses only Router A or Router C to accept SA messages. If Router A is first in the configuration file, it will be used if it is up and running. If Router A is not running, then and only then will Router B accept SAs from Router C. This is the behavior without a prefix list.

If you specify a prefix list, the peer will be a default peer only for the prefixes in the list. You can have multiple active default peers when you have a prefix list associated with each. When you do not have any prefix lists, you can configure multiple default peers, but only the first one is the active default peer as long as the router has connectivity to this peer and the peer is alive. If the first configured peer goes down or the connectivity to this peer goes down, the second configured peer becomes the active default, and so on.

To specify a default MSDP peer, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ip msdp default-peer {peer-address | peer-name} [prefix-list list]`	Defines a default MSDP peer.

See the section "Default MSDP Peer" later in this chapter for a sample configuration.

Configuring an MSDP Mesh Group

An MSDP mesh group is a group of MSDP speakers that have fully meshed MSDP connectivity between one another. Any SA messages received from a peer in a mesh group are not forwarded to other peers in the same mesh group. Thus, you reduce SA message flooding and simplify peer-RPF flooding. The following command is used when multiple RPs are within a domain. It is especially used to send SA messages across a domain.

You can configure multiple mesh groups (with different names) in a single router.

To create a mesh group, use the following command in global configuration mode for each MSDP peer in the group:

Command	Purpose
`Router(config)# ip msdp mesh-group mesh-name {peer-address | peer-name}`	Configures an MSDP mesh group and indicates that an MSDP peer belongs to that mesh group.

Shutting Down an MSDP Peer

If you want to configure many MSDP commands for the same peer and you do not want the peer to go active, you can shut down the peer, configure it, and later bring it up.

You might also want to shut down an MSDP session without losing configuration information for the peer.

When a peer is shut down, the TCP connection is terminated and not restarted.

To shut down a peer, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ip msdp shutdown {peer-name | peer address}`	Administratively shuts down the specified MSDP peer.

Including a Bordering PIM Dense Mode Region in MSDP

You might have a router that borders a PIM-SM region with a dense mode region. By default, sources in the dense mode region are not included in MSDP. You could configure this border router to send SA messages for sources active in the dense mode region. If you do so, it is very important to also configure the **ip msdp redistribute** global configuration command to apply to only local sources. Not configuring this command can result in (S, G) state remaining long after a source in the dense mode domain has stopped sending.

To configure the border router to send SA messages for sources active in the dense mode region, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ip msdp border sa-address type number`	Configures the router on the border between a dense mode and sparse mode region to send SA messages about active sources in the dense mode region. The IP address of the interface is used as the originator ID, which is the RP field in the SA message.

Note The **ip msdp border** command is not recommended. It is better to configure the border router in the sparse mode domain to proxy-register sources in the dense mode domain to the RP of the sparse mode domain and have the sparse mode domain use standard MSDP procedures to advertise these sources.

Configuring an Originating Address Other Than the RP Address

If you want to change the originator ID for any reason, use the **ip msdp originator-id** global configuration command in this section. For example, you might change the originator ID in one of these cases:

- If you configure a logical RP on multiple routers in an MSDP mesh group. For an example of a logical RP, see the section "Logical RP" later in this document.
- If you have a router that borders a PIM sparse mode domain and a dense mode domain. If a router borders a dense mode domain for a site, and sparse mode is being used externally, you might want dense mode sources to be known to the outside world. Because this router is not an RP, it would not have an RP address to use in an SA message. Therefore, this command provides the RP address by specifying the address of the interface.

To allow an MSDP speaker that originates an SA message to use the IP address of its interface as the RP address in the SA message, use the following command in global configuration mode:

Command	Purpose
`Router(config)# ip msdp originator-id type number`	Configures the RP address in SA messages to be the address of the originating router's interface.

Monitoring and Maintaining MSDP

To monitor MSDP SA messages, peers, state, or peer status, use the following commands in EXEC mode as needed:

Command	Purpose
Router# **debug ip msdp** [*peer-address* | *peer-name*] [**detail**] [**routes**]	Debugs an MSDP activity.
Router# **debug ip msdp resets**	Debugs MSDP peer reset reasons.
Router# **show ip msdp count** [*as-number*]	Displays the number of sources and groups originated in SA messages from each autonomous system. The **ip msdp cache-sa-state** global configuration command must be configured for this command to produce any output.
Router# **show ip msdp peer** [*peer-address* | *peer-name*]	Displays detailed information about an MSDP peer.
Router# **show ip msdp sa-cache** [*group-address* | *source-address* | *group-name* | *source-name*] [*as-number*]	Displays (S, G) state learned from MSDP peers.
Router# **show ip msdp summary**	Displays MSDP peer status and SA message counts.

To clear MSDP connections, statistics, or SA cache entries, use the following commands in EXEC modeas needed:

Command	Purpose
Router# **clear ip msdp peer** [*peer-address* | *peer-name*]	Clears the TCP connection to the specified MSDP peer, resetting all MSDP message counters.
Router# **clear ip msdp statistics** [*peer-address* | *peer-name*]	Clears the TCP connection to the specified MSDP peer, resetting all MSDP message counters.
Router# **clear ip msdp sa-cache** [*group-address* | *peer-name*]	Clears the SA cache entries for all entries, all sources for a specific group, or all entries for a specific source/group pair.

To enable Simple Network Management Protocol (SNMP) monitoring of MSDP, use the following commands in global configuration mode:

	Command	Purpose
Step 1	Router# **snmp-server enable traps msdp**	Enables the sending of MSDP notifications for use with SNMP. The **snmp-server enable traps** command enables both traps and informs.
Step 2	Router# **snmp-server host** *host* [**traps** | **informs**] [**version** {**1** | **2c** | **3** [**auth** | **priv** | **noauth**]}] *community-string* [**udp-port** *port-number*] **msdp**	Specifies the recipient (host) for MSDP traps or informs.

For more information about network monitoring using SNMP, refer to the "Configuring Simple Network Management Protocol (SNMP)" chapter in the *Cisco IOS Configuration Fundamentals Configuration Guide*.

MSDP Configuration Examples

This section contains the following MSDP configurations examples:

- Default MSDP Peer
- Logical RP

Default MSDP Peer

The following example is a partial configuration of Router A and Router C in Figure 79. Each of these ISPs may have more than one customer like the customer in Figure 79 that use default peering (no BGP or MBGP). In that case, they may have similar configurations. That is, they will only accept SAs from a default peer if the SA is permitted by the corresponding prefix list.

Router A Configuration

```
ip msdp default-peer 10.1.1.1
ip msdp default-peer 10.1.1.1 prefix-list site-a ge 32
ip prefix-list site-b permit 10.0.0.0/8
```

Router C Configuration

```
ip msdp default-peer 10.1.1.1 prefix-list site-a ge 32
ip prefix-list site-b permit 10.0.0.0/8
```

Logical RP

The following example configures a logical RP using an MSDP mesh group. The four routers that are logical RPs are RouterA, RouterB, RouterC, and RouterD. RouterE is an MSDP border router that is not an RP. Figure 80 illustrates the logical RP environment in this example; the configurations for routers A, B, and E follow the figure.

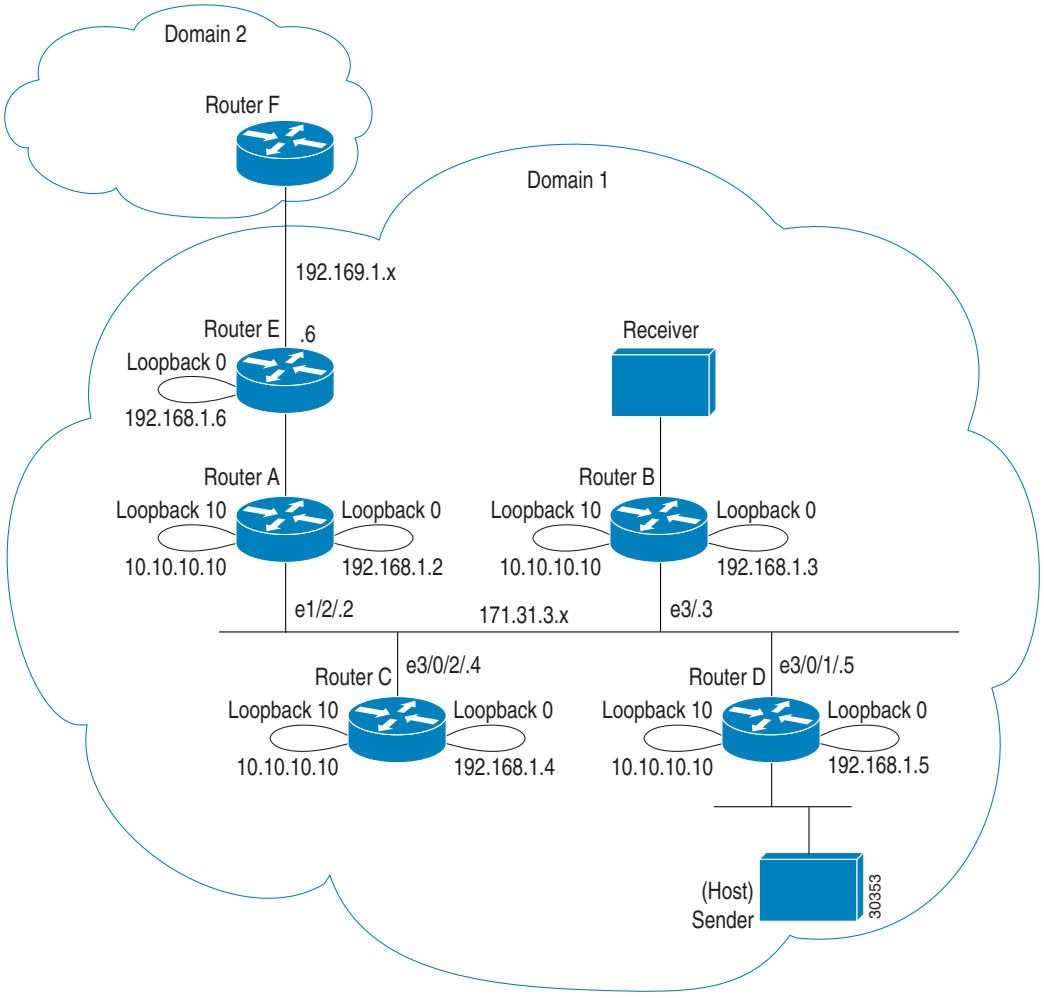
It is important to note the use of the loopback interface and how those host routes are advertised in Open Shortest Path First (OSPF). It is also important to carefully choose the OSPF router ID loopback so the ID does not use the logical RP address.

In this example, all the logical RPs are on the same LAN, but this situation is not typical. The host route for the RP address is advertised throughout the domain and each PIM designated router (DR) in the domain joins to the closest RP. The RPs share (S, G) information with each other by sending SA messages. Each logical RP must use a separate originator ID.

Note There are two MSDP mesh groups on RouterA. The routes for the loopback interfaces are in OSPF. Loopback 0 is the Router ID and is used as the connect source/update source for MBGP/MSDP. Loopback 10 is the same on all routers in the example.

All networks are 171.69.0.0. The RP address is 10.10.10.10 on Loopback 10 on all RPs. BGP connections are 192.168.1.x on Loopback 0. Loopback 0 is put into BGP with network 192.168.1.3 mask 255.255.255.255 NLRI unicast multicast.

Figure 80 Logical RP Using MSDP



RouterA Configuration

```
!
hostname RouterA
!
ip routing
!
ip subnet-zero
ip multicast-routing
!
!
interface Loopback0
 ip address 192.168.1.2 255.255.255.255
 no shutdown
!
interface Loopback10
 ip address 10.10.10.10 255.255.255.255
 no ip directed-broadcast
 ip pim sparse-dense-mode
 no shutdown
!
interface Ethernet1/2
 description LANethernet2
```

```
 ip address 171.69.2.2 255.255.255.0
ip pim sparse-dense-mode
no  shutdown
!
interface Ethernet4/0/0
 description LANethernet3
 ip address 171.69.3.2 255.255.255.0
ip pim sparse-dense-mode
no shutdown
!
router ospf 10
 network 171.69.0.0 0.0.255.255 area 0
 network 10.10.10.10 0.0.0.0 area 0
 network 192.168.1.2 0.0.0.0 area 0
!
router bgp 1
 no synchronization
 network 171.69.0.0 nlri unicast multicast
 network 192.168.1.2 mask 255.255.255.255 nlri unicast multicast
 neighbor 192.168.1.3 remote-as 1 nlri unicast multicast
neighbor description routerB
 neighbor 192.168.1.3 next-hop-self
neighbor 192.168.1.3 update-source loopback0
neighbor 192.168.1.4 remote-as 1 nlri unicast multicast
neighbor  description routerC
neighbor 192.168.1.4 update-source loopback0
neighbor 192.168.1.5 remote-as 1 nlri unicast multicast
neighbor  description routerD
 neighbor 192.168.1.5 next-hop-self
neighbor 192.168.1.5 update-source loopback0
neighbor 192.168.1.6 remote-as 1 nlri unicast multicast
neighbor description routerE
 neighbor 192.168.1.6 update-source Loopback0
 neighbor 192.168.1.6 next-hop-self
!
!
ip msdp peer 192.168.1.3 connect-source loopback 0
ip msdp peer 192.168.1.5 connect-source loopback 0
ip msdp peer 192.168.1.4 connect-source loopback 0
ip msdp peer 192.168.1.6 connect-source Loopback0
ip msdp mesh-group inside-test 192.168.1.3
ip msdp mesh-group inside-test 192.168.1.4
ip msdp mesh-group inside-test 192.168.1.5
ip msdp mesh-group outside-test 192.168.1.6
ip msdp cache-sa-state
ip msdp originator-id loopback0
!
ip classless
ip pim send-rp-disc scope 10
ip pim send-rp-anno loopback 10 scope 10
!
```

RouterB Configuration

```
!
hostname RouterB
!
ip routing
!
ip multicast-routing
ip dvmrp route-limit 20000
!
interface Loopback0
 ip address 192.168.1.3 255.255.255.255
```

```
 no shutdown
!
interface Loopback10
 ip address 10.10.10.10 255.255.255.255
ip pim sparse-dense-mode
 no shutdown
!
interface Ethernet2
 description LANethernet 0
 ip address 171.69.0.3 255.255.255.0
ip pim sparse-dense-mode
no shutdown
!
interface Ethernet3
 description LANethernet 2
 ip address 171.69.2.3 255.255.255.0
ip pim sparse-dense
!
router ospf 10
 network 171.69.0.0 0.0.255.255 area 0
 network 10.10.10.10 0.0.0.0 area 0
 network 192.168.1.3 0.0.0.0 area 0
!
router bgp 1
 no synchronization
 network 171.69.0.0 nlri unicast multicast
 network 192.168.1.3 mask 255.255.255.255 nlri unicast multicast
 neighbor 192.168.1.2 remote-as 1 nlri unicast multicast
neighbor  description routerA
neighbor 192.168.1.2 update-source loopback0
neighbor 192.168.1.4 remote-as 1 nlri unicast multicast
neighbor  description routerC
neighbor 192.168.1.4 update-source loopback0
neighbor 192.168.1.5 remote-as 1 nlri unicast multicast
neighbor  description routerD
neighbor 192.168.1.5 update-source loopback0
neighbor 192.168.1.5 soft-recon in
!
ip msdp peer 192.168.1.2 connect-source loopback 0
ip msdp peer 192.168.1.5 connect-source loopback 0
ip msdp peer 192.168.1.4 connect-source loopback 0
ip msdp mesh-group inside-test 192.168.1.2
ip msdp mesh-group inside-test 192.168.1.4
ip msdp mesh-group inside-test 192.168.1.5
ip msdp cache-sa-state
ip msdp originator-id loopback0
!
ip classless
ip pim send-rp-disc scope 10
ip pim send-rp-anno loopback 10 scope 10
!
```

RouterE Configuration

```
!
hostname RouterE
!
ip routing
!
ip subnet-zero
ip routing
ip multicast-routing
ip dvmrp route-limit 20000
!
```

```
interface Loopback0
 ip address 192.168.1.6 255.255.255.255
no shutdown
!
interface Ethernet2
 description LANethernet 3
 ip address 171.69.3.6 255.255.255.0
ip pim sparse-dense-mode
no shutdown
!
interface Ethernet5
 description LANethernet 6
 ip address 192.169.1.6 255.255.255.0
ip pim sparse-dense-mode
 ip multicast boundary 20
no shutdown
!
router ospf 10
 network 171.69.0.0 0.0.255.255 area 0
 network 192.168.1.6 0.0.0.0 area 0
 default-information originate metric-type 1
!
router bgp 1
 no synchronization
 network 171.69.0.0 nlri unicast multicast
 network 192.168.1.6 mask 255.255.255.255 nlri unicast multicast
 network 192.168.1.0
 neighbor 192.168.1.2 remote-as 1 nlri unicast multicast
 neighbor 192.168.1.2 update-source Loopback0
 neighbor 192.168.1.2 next-hop-self
neighbor 192.168.1.2 route-map 2-intern out
neighbor 192.169.1.7 remote-as 2 nlri unicast multicast
neighbor 192.169.1.7 route-map 2-extern out
 neighbor 192.169.1.7 default-originate
!
ip classless
ip msdp peer 192.168.1.2 connect-source Loopback0
ip msdp peer 192.169.1.7
ip msdp mesh-group outside-test 192.168.1.2
ip msdp cache-sa-state
ip msdp originator-id Loopback0
!
access-list 1 permit 192.168.1.0
access-list 1 deny 192.168.1.0 0.0.0.255
access-list 1 permit any
!
route-map 2-extern permit 10
 match ip address 1
!
route-map 2-intern deny 10
 match ip address 1
!
```