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Multicast Source Discovery Protocol (MSDP) Deployment Scenarios
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Abstract

This document describes best current practices for intra-domain and inter-domain deployment of the Multicast Source Discovery Protocol (MSDP) in conjunction with Protocol Independent Multicast Sparse Mode (PIM-SM).

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1. Introduction

MSDP [MSDP] is used primarily in two deployment scenarios:

- o Between PIM Domains

  MSDP can be used between Protocol Independent Multicast Sparse Mode (PIM-SM) [RFC2362] domains to convey information about active sources available in other domains. MSDP peering used in such cases is generally one to one peering, and utilizes the deterministic peer-RPF (Reverse Path Forwarding) rules described in the MSDP specification (i.e., does not use mesh-groups). Peerings can be aggregated on a single MSDP peer. Such a peer can typically have from one to hundreds of peerings, which is similar in scale to BGP peerings.

- o Within a PIM Domain

  MSDP is often used between Anycast Rendezvous Points (Anycast-RPs) [RFC3446] within a PIM domain to synchronize information about the active sources being served by each Anycast-RP peer (by virtue of IGP reachability). MSDP peering used in this scenario is typically based on MSDP mesh groups, where anywhere from two to tens of peers can comprise a given mesh group, although more than ten is not typical. One or more of these mesh-group peers may then also have additional one-to-one peering with MSDP peers outside that PIM domain for discovery of external sources. MSDP for anycast-RP without external MSDP peering is a valid deployment option and common.

Current best practice for MSDP deployment utilizes PIM-SM and the Border Gateway Protocol with multi-protocol extensions (MBGP) [RFC1771, RFC2858]. This document outlines how these protocols work together to provide an intra-domain and inter-domain Any Source Multicast (ASM) service.

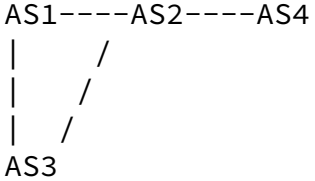
2. Inter-domain MSDP peering scenarios

The following sections describe the most common inter-domain MSDP peering possibilities and their deployment options.

2.1. Peering between PIM border routers

In this case, the MSDP peers within the domain have their own RP located within a bounded PIM domain. In addition, a domain has it's own Autonomous System (AS) number MBGP speakers. The domain may also have multiple MSDP speakers. Each border router has an MSDP and MBGP peering with its peer routers. These external MSDP peering deployments typically configure the MBGP peering and MSDP peering using the same directly connected next hop peer IP address or other IP address from the same router. Typical deployments of this type are providers who have a direct peering with other providers, providers peering at an exchange, or providers who use their edge router to MSDP/MBGP peer with customers.

For a direct peering inter-domain environment to be successful, the first AS in the MBGP best path to the originating RP should be the same as the AS of the MSDP peer. As an example, consider the following topology:

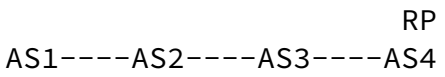


In this case, AS4 receives a Source Active (SA) message, originated by AS1, from AS2. AS2 also has an MBGP peering with AS4. The MBGP

first hop AS from AS4, in the best path to the originating RP, is AS2. The origin AS of the sending MSDP peer is also AS2. In this case, the peer-Reverse Path Forwarding check (peer-RPF check) passes and the SA message is forwarded.

A peer-RPF failure would occur in this topology when the MBGP first hop AS, in the best path to the originating RP, is AS2 while the origin AS of the sending MSDP peer is AS3. This reliance upon BGP AS PATH information prevents endless looping of SA packets.

Router code, which has adopted the latest rules in the MSDP draft, will relax the rules Between AS's a bit. In the following topology we have an MSDP peering between AS1<->AS3 and AS3<->AS4:



If the first AS in best path to the RP does not equal the MSDP peer, MSDP peer RPF fails. So AS1 cannot MSDP peer with AS3 since AS2 is the first AS in the MBGP best path to AS4 RP. With the latest MSDP draft compliant code, AS 1 will choose the peer in the closest AS along best AS path to the RP. AS1 will then accept SA's coming from AS3. If there are multiple MSDP peers to routers within the same AS, the peer with the highest IP address is chosen as the RPF peer.

2.2. Peering between non border routers

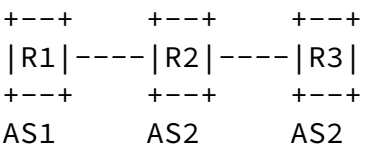
When MSDP peering between border routers, intra-domain MSDP scalability is restricted because it is necessary to also maintain MBGP and MSDP peerings internally towards their border routers. Within the intra-domain, the border router becomes the announcer of the next hop towards the originating RP. This requires that all intra-domain MSDP peerings must mirror the MBGP path back towards the border router. External MSDP (eMSDP) peerings rely upon AS path for peer rpf checking, while internal MSDP (iMSDP) peerings rely upon the announcer of the next hop.

While the eMBGP peer is typically directly connected between border routers, it is common for the eMSDP peer to be located deeper into the transit providers AS. Providers, which desire more flexibility in MSDP peering placement, commonly choose a few dedicated routers within their core network for the inter-domain MSDP peerings to their customers. These core MSDP routers will also typically be in the providers intra-domain MSDP mesh group and configured for Anycast RP. All multicast routers in the providers AS should statically point to the Anycast RP address. Static RP assignment is the most commonly used method for group to RP mapping due to its deterministic nature. Auto-RP [AUTORP] and/or the Bootstrap Router (BSR) [BSR] dynamic RP mapping mechanisms could be also used to disseminate RP information within the provider's network

For an SA message to be accepted in this (multi-hop peering) environment, we rely upon the next (or closest, with latest MSDP spec) AS in the best path towards originating RP for the rpf check. The MSDP peer address should be in the same AS as the AS of the border routers MBGP peer. The MSDP peer address should be advertised via MBGP.

For example, using the diagram below, if customer R1 router is MBGP peering with R2 router and if R1 is MSDP peering with R3 router, then R2 and R3 must be in the same AS. The MSDP peer with the highest IP address will be chosen as the MSDP RPF peer. R1 must also have the

MSDP peer address of R3 in its MBGP table.



From R3's perspective, AS1 (R1) is the MBGP next AS in the best path towards the originating RP. As long as AS1 is the next AS (or closest) in the best path towards the originating RP, RPF will succeed on SAs arriving from R1.

In contrast, with the single hop scenario, with R2 (instead of R3) border MSDP peering with R1 border, R2s MBGP address becomes the announcer of the next hop for R3, towards the originating RP, and R3

must peer with that R2 address. And all AS2 intra-domain MSDP peers need to follow iMBGP (or other IGP) peerings towards R2 since iMSDP has a dependence upon peering with the address of the MBGP (or other IGP) announcer of the next hop.

2.3. MSDP peering without BGP

In this case, an enterprise maintains its own RP and has an MSDP peering with their service provider, but does not BGP peer with them. MSDP relies upon BGP path information to learn the MSDP topology for the SA peer-RPF check. MSDP can be deployed without BGP, however, and as a result there are some special cases where the requirement to perform an peer-RPF check on the BGP path information is suspended. These cases are when there is only a single MSDP peer connection, a default peer (default MSDP route) is configured, the originating RP is directly connected, a mesh group is used, or an implementation is is used which allows for an MSDP peer RPF check using an IGP.

An enterprise will typically configure a unicast default route from their border router to the provider's border router and then MSDP peer with the provider's MSDP router. If internal MSDP peerings are also used within the enterprise, then an MSDP default peer will need to be configured on the border router pointing to the provider. In this way, all external multicast sources will be learned and internal sources can be advertised. If only a single MSDP peering was used (no internal MSDP peerings) towards the provider, then this stub site will MSDP default peer towards the provider and skip the BGP RPF check.

2.4. MSDP peering at a Multicast Exchange

Multicast exchanges allow multicast providers to peer at a common IP subnet (or by using point to point virtual LANs) and share MSDP SA updates. Each provider will MSDP and MBGP peer with each others directly connected exchange IP address. Each exchange router will send/receive SAs to/from their MSDP peers. They will then be able to forward SAs throughout their domain to their customers and any direct

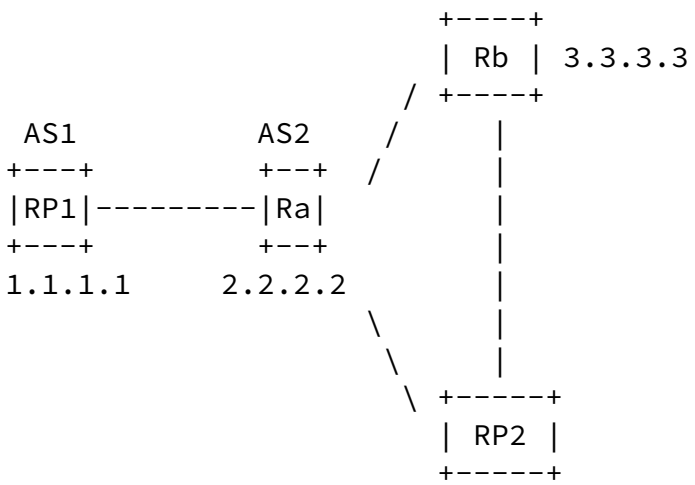
provider peerings.

3. Intra-domain MSDP peering scenarios

The following sections describe the different intra-domain MSDP peering possibilities and their deployment options.

3.1. Peering between MSDP and MBGP configured routers

The next hop IP address of the iBGP peer is typically used for the MSDP peer-RPF check (IGP can also be used). This is different from the inter-domain BGP/MSDP case, where AS path information is used for the peer-RPF check. For this reason, it is necessary for the IP address of the MSDP peer connection be the same as the internal MBGP peer connection whether or not the MSDP/MBGP peers are directly connected. A successful deployment would be similar to the following:



Where RP2 MSDP and MBGP peers with Ra (using 2.2.2.2) and with Rb (using 3.3.3.3). When the MSDP SA update arrives on RP2 from Ra, the

MSDP RPF check for 1.1.1.1 passes because RP2 receives the SA update from MSDP peer 2.2.2.2 which is also the correct MBGP next hop for 1.1.1.1.

When RP2 receives the same SA update from MSDP peer 3.3.3.3, the MBGP lookup for 1.1.1.1 shows a next hop of 2.2.2.2 so RPF correctly fails, preventing a loop.

was MBGP peering to an address other than 2.2.2.2 on Ra. Intra-domain deployments must have MSDP and MBGP (or other IGP) peering addresses which match, unless a method to skip the peer rpf check is deployed.

3.2. MSDP peer is not BGP peer (or no BGP peer)

This is a common MSDP intra-domain deployment in environments where few routers are running MBGP or where the domain is not running MBGP. The problem here is that the MSDP peer address needs to be the same as the MBGP peer address. To get around this requirement, the intra-domain MSDP RPF rules have been relaxed in the following topologies:

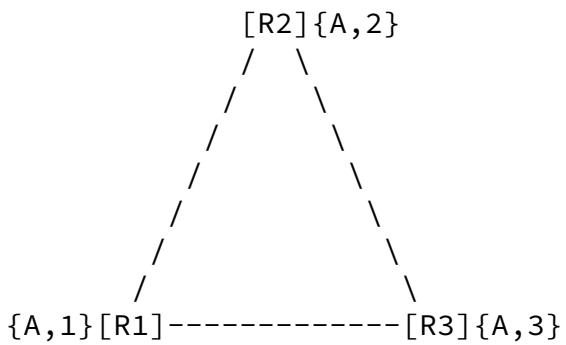
- By configuring the MSDP peer as a mesh group peer
- By having the MSDP peer be the only MSDP peer
- By configuring a default MSDP peer
- By peering with the originating RP.
- By relying upon an IGP for MSDP peer RPF

The common choice around the intra-domain BGP peering requirement, when more than one MSDP peer is configured, is to deploy MSDP mesh groups. When a MSDP mesh group is deployed, there is no RPF check on arriving SA messages when received from a mesh group peer. Subsequently, SA messages are always accepted from mesh group peers. MSDP mesh groups were developed to reduce the amount of SA traffic in the network since SAs, which arrive from a mesh group peer, are not flooded to peers within that same mesh group. Mesh groups must be fully meshed.

If recent (but not currently widely deployed) router code is running which is fully complaint with the latest MSDP draft, another option, to work around not having BGP to MSDP RPF peer, is to RPF using an IGP like OSPF, IS-IS, RIP, etc. This new capability will allow for Enterprise customers, who are not running BGP and who don't want to run mesh groups, to use their existing IGP to satisfy the MSDP peer RPF rules.

3.3. Hierarchical Mesh Groups

Hierarchal Mesh Groups are occasionally deployed in intra-domain environments where there are a large number of MSDP peers. Allowing multiple mesh groups to forward to one another can reduce the number of MSDP peerings per router (due to the full mesh requirement) and hence reduce router load. A good hierarchical mesh group implementation (one which prevents looping) contains a core mesh group in the backbone and these core routers serve as mesh group aggregation routers:



In this example, R1, R2, R3 are in MSDP mesh group A (the core mesh group) and each serves as MSDP aggregation routers for their leaf (or second tier) mesh groups 1, 2, and 3. Since SA messages received from a mesh group peer are not forwarded to peers within that same mesh group, SA messages will not loop. Do not create topologies which connect mesh-groups in a loop. In the above example for instance, second tier mesh-groups 1, 2, and 3 must not directly exchange SA messages with each other or an endless SA loop will occur.

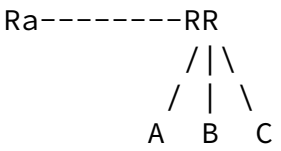
Redundancy, between mesh groups, will also cause a loop and is subsequently not available with Hierarchical mesh groups. For instance, assume R3 had two routers connecting it's leaf mesh group 3 with the core mesh group A. A loop would be created between mesh

group 3 and mesh group A because each mesh group must be fully meshed

between peers.

3.4. MSDP and Route Reflectors

or confederation members, be fully meshed to prevent loops. In the route reflector environment, MSDP requires that the route reflector clients peer with the route reflector since the RR is the BGP announcer of the next hop towards the originating RP. The RR is not the BGP next hop, but is the announcer of the BGP next hop. The announcer of the next hop is the address typically used for MSDP peer RPF checks. For example, consider the following case:



Ra is forwarding MSDP SAs to the route reflector RR. Routers A, B, and C also MSDP peer with RR. When RR forwards the SA to A, B, and C, these RR clients will accept the SA because RR is the announcer of the next hop to the originating RP address.

An SA will peer-RPF fail, if Ra MSDP peers directly with Routers A, B, or C, because the announcer of the next hop is RR, but the SA update came from Ra. Proper deployment is to have RR clients MSDP peer with the RR. MSDP mesh groups may be used to work around this requirement. External MSDP peerings will also prevent this requirement since the next AS is compared between MBGP and MSDP peerings, rather than the IP address of the announcer of the next hop.

Some recent MSDP implementations conform to the latest MSDP draft which relaxes the requirement of peering with the Advertiser of the Next Hop (the Route Reflector). This new rule allows for peering with

the Next-Hop, in addition to the Advertiser of the next hop. In the example above, for instance, if Ra is the Next-Hop (perhaps due to using BGP's Next hop self attribute) and if routers A,B,C are peering with Ra, the SA's received from Ra will now succeed.

3.5. MSDP and Anycast RPs

A network, with multiple RPs, can achieve RP load sharing and redundancy by using the Anycast RP mechanism in conjunction with MSDP mesh groups [RFC3446]. This mechanism is a common deployment technique used within a domain by service providers and Enterprises which deploy several RPs within their domain. These RPs will each have the same IP address configured on a Loopback interface (making this the Anycast address). These RPs will MSDP peer with each other using a separate loopback interface and are part of the same fully meshed MSDP mesh group. This loopback interface, used for MSDP peering, will typically also be used for the MBGP peering. All routers within the provider's domain will learn of the Anycast RP address either through Auto-RP, BSR, or a static RP assignment. Each designated router in the domain will send source registers and group joins to the Anycast RP address. Unicast routing will direct those registers and joins to the nearest Anycast RP. If a particular Anycast RP router fails, unicast routing will direct subsequent registers and joins to the nearest Anycast RP. That RP will then forward an MSDP update to all peers within the Anycast MSDP mesh group. Each RP will then forward (or receive) the SAs to (from) external customers and providers.

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5. Acknowledgments

The authors would like to thank John Zwiebel and Swapna Yelamanchi for their feedback on earlier versions of this document.

6. Security Considerations

An MSDP service should be secured by explicitly controlling the state which is created by, and passed within, the MSDP service. As with unicast routing state, MSDP state should be controlled locally, at the edge origination points. Selective filtering at the multicast service edge helps ensure that only intended sources result in sa-message creation, and this control helps to reduce the likelihood of state-aggregation related problems in the core. There are a variety of points where local policy should be applied to the MSDP service.

6.1. Filtering SA messages

The process of originating sa-messages should be filtered to ensure

only intended local sources are resulting in sa-message origination. In addition, MSDP speakers should filter on which sa-messages get received and forwarded.

Typically there is a fair amount of (S,G) state in a PIM-SM domain that is local to the domain. However, without proper filtering, sa-messages containing these local (S,G) announcements may be advertised to the global MSDP infrastructure. Examples of this includes domain local applications that use global IP multicast addresses and sources that use RFC 1918 addresses [RFC1918]. To improve on the scalability of MSDP and to avoid global visibility of domain local (S,G) information, the following external SA filter list is recommended to help prevent unnecessary creation, forwarding, and caching of some of these well-known domain local sources.

224.0.0.0/4	Specific local application packets	[IANA]
224.0.1.39	Auto-RP Announce	[AUTORP]
224.0.1.40	Auto-RP Discovery	[AUTORP]
239.0.0.0/8	Administratively Scoped IP Multicast	[RFC2365]
10.0.0.0/8	Private addresses	[RFC1918]
127.0.0.0/8	Private addresses	[RFC1918]

172.16.0.0/12	Private addresses	[RFC1918]
192.168.0.0/16	Private addresses	[RFC1918]
232.0.0.0/8	Default SSM-range	[SSM]

6.2. SA message state limits

Proper filtering on sa-message origination, receipt, and forwarding will significantly reduce the likelihood of unintended and unexpected spikes in MSDP state However, a sa-cache state limit SHOULD BE be configured as a final safeguard to state spikes.

7. IANA Considerations

This document creates a no new requirements on IANA namespaces [RFC2434].

8. References

8.1. Normative References

[MSDP] Meyer, D. and W. Fenner (Editors), "The Multicast Source Discovery Protocol (MSDP)", draft-ietf-msdp-spec-19.t May 2003. Work in Progress.

[SSM] Holbrook, H., and B. Cain, "Source-Specific Multicast for IP", draft-ietf-ssm-arch-03.txt, May, 2003. Work in Progress.

[RFC1771] Rekhter, Y., and T. Li, "A Border Gateway Protocol 4 (BGP-4)", RFC 1771, March 1995.

[RFC1918] Y. Rekhter, R. Moskowitz, D. Karrenberg, G. de Groot, E. Lear, "Address Allocation for Private Internets", RFC 1918, Feburary, 1996.

[RFC2362] D. Estrin, et. al., "Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification", RFC 2362, June, 1998.

[RFC2365] Meyer, D. "Administratively Scoped IP Multicast", RFC 2365, July, 1998.

[RFC2434] Narten, T., and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", RFC 2434/BCP 0026, October, 1998.

[RFC2858] Bates T., Y. Rekhter, R. Chandra, D. Katz, "Multiprotocol Extensions for BGP-4", RFC 2858, June 2000.

[RFC3446] Kim, D., et. al., "Anycast Rendezvous Point (RP) Mechanism using Protocol Independent Multicast (PIM) and Multicast Source Discovery Protocol (MSDP)", RFC 3446, January, 2003.

8.2. Informative References

[AUTORP] Fenner, W., et. al., " Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)", draft-ietf-pim-sm-v2-new-07.txt, March, 2003. Work in Progress.

[BSR] Fenner, W., et. al., "Bootstrap Router (BSR) Mechanism for PIM Sparse Mode", draft-ietf-pim-sm-bsr-03.txt February, 2003. Work in Progress.

[IANA] http://www.iana.org

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