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IP Multicast Troubleshooting Guide

Introduction

Prerequisites

- Requirements
- Components Used
- Conventions

Background Information

Router Does Not Forward Multicast Packets to Host Due to RPF Failure

- Diagnose the Problem
- Possible Fixes

Router Does Not Forward Multicast Packets to Host Due to TTL Setting of Source

- Diagnose the Problem
- Possible Fixes

Router Does Not Forward Multicast Packets Due to TTL Threshold of Router

- Diagnose the Problem
- Possible Fixes

Multiple Equal Cost Paths Result in Unwanted Return Path Forwarding Behavior

- Diagnose the Problem
- Possible Fixes

Why Does IP Multicast Not Load Balance Across All Available Equal Cost Paths?

- Possible Fixes

Why Are We Receiving IP Multicast "INVALID_RP_JOIN" Error Messages on the Router?

- Diagnose the Problem – Part 1
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CGMP Does Not Prevent the Flood of Multicast Packets

- Diagnose the Problem
- Observations
- Possible Fixes

CGMP Does Not Prevent the Flooding of Multicast Packets, Due to Source/Receiver Placement

- Diagnose the Problem
- Possible Fixes

CGMP Does Not Prevent the Flooding of Multicast Packets for Certain Group Addresses

- Possible Fixes

Related Information

Introduction

This document describes common problems and solutions for IP multicast.

Prerequisites

Requirements

There are no specific requirements for this document.

Components Used

This document is not restricted to specific software and hardware versions.

Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

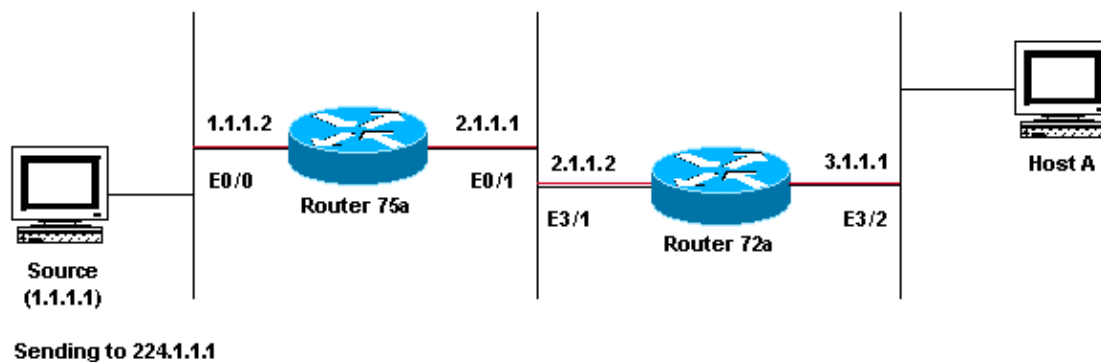
Background Information

When troubleshooting multicast routing, the primary concern is the source address. Multicast has a concept of Reverse Path Forwarding check (RPF check). When a multicast packet arrives on an interface, the RPF process checks to ensure that this incoming interface is the outgoing interface used by unicast routing to reach the source of the multicast packet. This RPF check process prevents loops. Multicast routing does not forward a packet unless the source of the packet passes a reverse path forwarding (RPF) check. Once a packet passes this RPF check, multicast routing forwards the packet based only upon the destination address.

Like unicast routing, multicast routing has several available protocols, such as Protocol Independent Multicast dense mode (PIM-DM), PIM sparse mode (PIM-SM), Distance Vector Multicast Routing Protocol (DVMRP), Multicast Border Gateway Protocol (MBGP), and Multicast Source Discovery Protocol (MSDP). The case studies in this document walk you through the process of troubleshooting various problems. You will see which commands are used to quickly pinpoint the problem and learn how to resolve it. The case studies listed here are generic across the protocols, except where noted.

Router Does Not Forward Multicast Packets to Host Due to RPF Failure

This section provides a solution to the common problem of an IP multicast Reverse Path Forwarding (RPF) failure. This network diagram is used as an example.



In the figure above, multicast packets come into E0/0 of Router 75a from a server whose IP address is 1.1.1.1 and sends to group 224.1.1.1. This is known as an (S,G) or (1.1.1.1, 224.1.1.1).

Diagnose the Problem

Hosts directly connected to Router 75a receive the multicast feed, but hosts directly connected to Router 72a do not. First, issue the **show ip mroute 224.1.1.1** command to see what is going on with Router 75a. This command examines the multicast route (mroute) for the group address 224.1.1.1:

```

75a#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 00:01:23/00:02:59, RP 0.0.0.0, flags: D
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:01:23/00:00:00

(1.1.1.1, 224.1.1.1), 00:01:23/00:03:00, flags: TA
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:01:23/00:00:00

```

Since the router is running PIM dense mode (we know it is dense mode because of the D flag), ignore the *,G entry and focus on the S,G entry. This entry tells you that the multicast packets are sourced from a server whose address is 1.1.1.1, which sends to a multicast group of 224.1.1.1. The packets are coming in the Ethernet0/0 interface and are forwarded out the Ethernet0/1 interface. This is a perfect scenario.

Issue the **show ip pim neighbor** command to see whether Router 72a is showing the upstream router (75a) as a PIM neighbor:

```

ip22-72a#show ip pim neighbor
PIM Neighbor Table
Neighbor Address  Interface      Uptime    Expires    Ver  Mode
2.1.1.1          Ethernet3/1    2d00h     00:01:15  v2

```

From the **show ip pim neighbor** command output, the PIM neighborhood look good.

Use this **show ip mroute** command to see whether Router 72a has good mroute:

```

ip22-72a#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, B - Bidir Group, s - SSM Group, C - Connected,
       L - Local, P - Pruned, R - RP-bit set, F - Register flag,
       T - SPT-bit set, J - Join SPT, M - MSDP created entry,
       X - Proxy Join Timer Running, A - Candidate for MSDP Advertisement,
       U - URD, I - Received Source Specific Host Report, Z - Multicast Tunnel
       Y - Joined MDT-data group, y - Sending to MDT-data group
Outgoing interface flags: H - Hardware switched, A - Assert winner
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 00:10:42/stopped, RP 0.0.0.0, flags: DC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet3/1, Forward/Dense, 00:10:42/00:00:00
    Ethernet3/2, Forward/Dense, 00:10:42/00:00:00

(1.1.1.1, 224.1.1.1), 00:01:10/00:02:48, flags:
  Incoming interface: Ethernet2/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet3/1, Forward/Dense, 00:01:10/00:00:00
    Ethernet3/2, Forward/Dense, 00:00:16/00:00:00

ip22-72a#

```

You can see from the **show ip mroute 224.1.1.1** command that the incoming interface is Ethernet2/0, while Ethernet3/1 is expected.

Issue the **show ip mroute 224.1.1.1 count** command to see if any multicast traffic for this group arrives to the Router 72a and what happens next:

```
ip22-72a#show ip mroute 224.1.1.1 count
IP Multicast Statistics
3 routes using 2032 bytes of memory
2 groups, 0.50 average sources per group
Forwarding Counts: Pkt Count/Pkts per second/Avg
Pkt Size/Kilobits per second
Other counts: Total/RPF failed/Other drops(OIF-null,
rate-limit etc)

Group: 224.1.1.1, Source count: 1, Packets forwarded:      0, Packets received: 471
Source:      1.1.1.1/32, Forwarding: 0/0/0/0, Other: 471/471/0
ip22-72a#
```

You can see from the Other counts that traffic gets dropped due to RPF failure: total 471 drops, due to RPF failure 471&

Issue the **show ip rpf <source>** command to see if there is an RPF error:

```
ip22-72a#show ip rpf 1.1.1.1
RPF information for ? (1.1.1.1)
RPF interface: Ethernet2/0
RPF neighbor: ? (0.0.0.0)
RPF route/mask: 1.1.1.1/32
RPF type: unicast (static)
RPF recursion count: 0
Doing distance-preferred lookups across tables
ip22-72a#
```

Cisco IOS® calculates the RPF interface in this way. Possible sources of RPF information are Unicast Routing Table, MBGP routing table, DVMRP routing table and Static Mroute table. When you calculate the RPF interface, primarily administrative distance is used to determine exactly which source of information the RPF calculation is based on. The specific rules are:

- All preceding sources of RPF data are searched for a match on the source IP address. When using Shared Trees, the RP address is used instead of the source address.
- If more than one matching route is found, the route with the lowest administrative distance is used.
- If the admin distances are equal, then this order of preference is used:
 1. Static mroutes
 2. DVMRP routes
 3. MBGP routes
 4. Unicast routes
- If multiple entries for a route occur within the same route table, the longest match route is used.

The **show ip rpf 1.1.1.1** command output shows the RPF interface being E2/0, but the incoming interface should be E3/1.

Issue the **show ip route 1.1.1.1** command to see why the RPF interface is different from what was expected.

```
ip22-72a#show ip route 1.1.1.1
Routing entry for 1.1.1.1/32
```

```
Known via "static", distance 1, metric 0 (connected)
Routing Descriptor Blocks:
* directly connected, via Ethernet2/0
  Route metric is 0, traffic share count is 1
```

You can see from this **show ip route 1.1.1.1** command output that there is a static /32 route, which makes the wrong interface to be chosen as RPF interface.

Issue some further **debug** commands:

```
ip22-72a#debug ip mpacket 224.1.1.1
*Jan 14 09:45:32.972: IP: s=1.1.1.1 (Ethernet3/1)
d=224.1.1.1 len 60, not RPF interface
*Jan 14 09:45:33.020: IP: s=1.1.1.1 (Ethernet3/1)
d=224.1.1.1 len 60, not RPF interface
*Jan 14 09:45:33.072: IP: s=1.1.1.1 (Ethernet3/1)
d=224.1.1.1 len 60, not RPF interface
*Jan 14 09:45:33.120: IP: s=1.1.1.1 (Ethernet3/1)
d=224.1.1.1 len 60, not RPF interface
```

The packets are coming in on E3/1, which is correct. However, they are being dropped because that is not the interface the unicast routing table uses for the RPF check.

Note: Debugging packets is dangerous. Packet debugging triggers process switching of the multicast packets, which is CPU intensive. Also, packet debugging can produce huge output which can hang the router completely due to slow output to the console port. Before debugging packet, special care must be taken to disable logging output to the console, and enable logging to the memory buffer. In order to achieve this, configure **no logging console** and **logging buffered debugging**. The results of the debug can be seen with the **show logging** command.

Possible Fixes

You can either change the unicast routing table to satisfy this requirement or you can add a static mroute to force multicast to RPF out a particular interface, regardless of what the unicast routing table states. Add a static mroute:

```
ip22-72a(config)#ip mroute 1.1.1.1 255.255.255.255 2.1.1.1
```

This static mroute states that to get to the address 1.1.1.1, for RPF, use 2.1.1.1 as the next hop, which is out interface E3/1.

```
ip22-72a#show ip rpf 1.1.1.1
RPF information for ? (1.1.1.1)
  RPF interface: Ethernet3/1
  RPF neighbor: ? (2.1.1.1)
  RPF route/mask: 1.1.1.1/32
  RPF type: static mroute
  RPF recursion count: 0
  Doing distance-preferred lookups across tables
```

The output of **show ip mroute** and **debug ip mpacket** looks good, the number of sent packets in the **show ip mroute count** increases and HostA receives packets.

```
ip22-72a#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
```

```

M - MSDP created entry, X - Proxy Join Timer Running
A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 00:01:15/00:02:59, RP 0.0.0.0, flags: DJC
Incoming interface: Null, RPF nbr 0.0.0.0
Outgoing interface list:
  Ethernet3/1, Forward/Sparse-Dense, 00:01:15/00:00:00
  Ethernet3/2, Forward/Sparse-Dense, 00:00:58/00:00:00

(1.1.1.1, 224.1.1.1), 00:00:48/00:02:59, flags: CTA
Incoming interface: Ethernet3/1, RPF nbr 2.1.1.1, Mroute
Outgoing interface list:
  Ethernet3/2, Forward/Sparse-Dense, 00:00:48/00:00:00

ip22-72a#show ip mroute 224.1.1.1 count
IP Multicast Statistics
3 routes using 2378 bytes of memory
2 groups, 0.50 average sources per group
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per second
Other counts: Total/RPF failed/Other drops(OIF-null, rate-limit etc)

Group: 224.1.1.1, Source count: 1, Packets forwarded: 1019, Packets received: 1019
Source: 1.1.1.1/32, Forwarding: 1019/1/100/0, Other: 1019/0/0

ip22-72a#show ip mroute 224.1.1.1 count
IP Multicast Statistics
3 routes using 2378 bytes of memory
2 groups, 0.50 average sources per group
Forwarding Counts: Pkt Count/Pkts per second/Avg Pkt Size/Kilobits per second
Other counts: Total/RPF failed/Other drops(OIF-null, rate-limit etc)

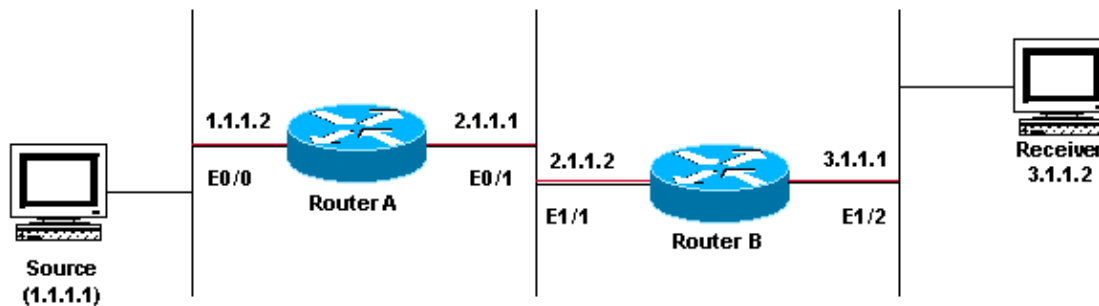
Group: 224.1.1.1, Source count: 1, Packets forwarded: 1026, Packets received: 1026
Source: 1.1.1.1/32, Forwarding: 1026/1/100/0, Other: 1026/0/0
ip22-72a#

ip22-72a#debug ip mpacket 224.1.1.1
*Jan 14 10:18:29.951: IP: s=1.1.1.1 (Ethernet3/1)
d=224.1.1.1 (Ethernet3/2) len 60, mforward
*Jan 14 10:18:29.999: IP: s=1.1.1.1 (Ethernet3/1)
d=224.1.1.1 (Ethernet3/2) len 60, mforward
*Jan 14 10:18:30.051: IP: s=1.1.1.1 (Ethernet3/1)
d=224.1.1.1 (Ethernet3/2) len 60, mforward

```

Router Does Not Forward Multicast Packets to Host Due to TTL Setting of Source

This section provides a solution to the common problem of IP multicast packets not being forwarded because the Time To Live (TTL) value is decremented to zero. This is a common problem, as there are many multicast applications. These multicast applications are designed primarily for the LAN usage, and thus set the TTL to a low value or even 1. Use this network diagram as an example. .



Sending to 224.1.1.1

Diagnose the Problem

In the figure above, Router A does not forward packets from source(S) to Router B's directly connected Receiver. Look at the output of the **show ip mroute** command on Router A to see the multicast routing state:

```
ROUTERA#show ip mroute
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.0.1.40), 00:00:01/00:00:00, RP 0.0.0.0, flags: DJCL
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:00:01/00:00:00

(*, 224.1.1.1), 00:00:02/00:02:57, RP 0.0.0.0, flags: D
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:00:02/00:00:00
```

You can ignore the 224.0.1.40 in the output above since all routers join this Auto-RP Discovery group. But there is no source listed for 224.1.1.1. In addition to "***, 224.1.1.1**" you should see "**1.1.1.1, 224.1.1.1**".

Issue the **show ip rpf** command to see if it is a Reverse Path Forwarding (RPF) issue:

```
ROUTERA#show ip rpf 1.1.1.1
RPF information for ? (1.1.1.1)
  RPF interface: Ethernet0/0
  RPF neighbor: ? (0.0.0.0) - directly connected
  RPF route/mask: 1.1.1.0/24
  RPF type: unicast (connected)
  RPF recursion count: 0
  Doing distance-preferred lookups across tables
```

From the output above, you see that it is not an RPF issue. The RPF check correctly points out E0/0 to get to the source's IP address.

Check whether PIM is configured on the interfaces using the **show ip pim interface** command:

```
ROUTERA#show ip pim interface

Address          Interface          Version/Mode      Nbr  Query  DR
```

			Count	Intvl	
1.1.1.2	Ethernet0/0	v2/Sparse-Dense	0	30	1.1.1.2
2.1.1.1	Ethernet0/1	v2/Sparse-Dense	2	30	2.1.1.2

The output looks good, so this is not the problem. Check whether the router recognizes any active traffic using the **show ip mroute active** command:

```
ROUTERA#show ip mroute active
Active IP Multicast Sources - sending >= 4 kbps
```

Based on the output above, the router does not recognize any active traffic.

```
ROUTERA#debug ip mpacket
IP multicast packets debugging is on
```

Perhaps the Receiver is not sending any Internet Group Management Protocol (IGMP) reports (joins) for group 224.1.1.1. You can check it using the **show ip igmp group** command:

```
ROUTERB#show ip igmp group
IGMP Connected Group Membership
Group Address      Interface          Uptime    Expires    Last Reporter
224.0.1.40         Ethernet1/1        00:34:34  never      2.1.1.2
224.1.1.1          Ethernet1/2        00:30:02  00:02:45  3.1.1.2
```

224.1.1.1 has been joined on E1/2, which is fine.

PIM dense mode is a flood and prune protocol, so there are no joins, but there are grafts. Since Router B has not received a flood from Router A, it does not know where to send a graft.

You can check to see if it is a TTL issue with the sniffer capture and also seen with **show ip traffic** command:

```
ROUTERA#show ip traffic
IP statistics:
  Rcvd: 248756 total, 1185 local destination
        0 format errors, 0 checksum errors, 63744 bad hop count
        0 unknown protocol, 0 not a gateway
        0 security failures, 0 bad options, 0 with options
```

The output above shows 63744 bad hop counts. Each time you type this command, the bad hop count increases. This is a strong indication that the sender is sending packets with a TTL=1, which Router A decrements to zero. This results in an increase of the bad hop count field.

Possible Fixes

To solve the issue, you need to increase the TTL. This is done at the application level on the Sender. For more information, refer to your multicast application instruction manual.

Once this is done, Router A looks like this:

```
ROUTERA#show ip mroute
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode
```

```

(*, 224.0.1.40), 01:16:32/00:00:00, RP 0.0.0.0, flags: DJCL
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 01:16:32/00:00:00

(*, 224.1.1.1), 00:28:42/00:02:59, RP 0.0.0.0, flags: D
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:28:42/00:00:00

(1.1.1.1, 224.1.1.1), 00:19:24/00:02:59, flags: TA
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:19:24/00:00:00

```

This is the sort of output you want to see.

On Router B you see:

```

ROUTERB#show ip mroute
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.0.1.40), 01:23:57/00:00:00, RP 0.0.0.0, flags: DJCL
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/1, Forward/Sparse-Dense, 01:23:57/00:00:00

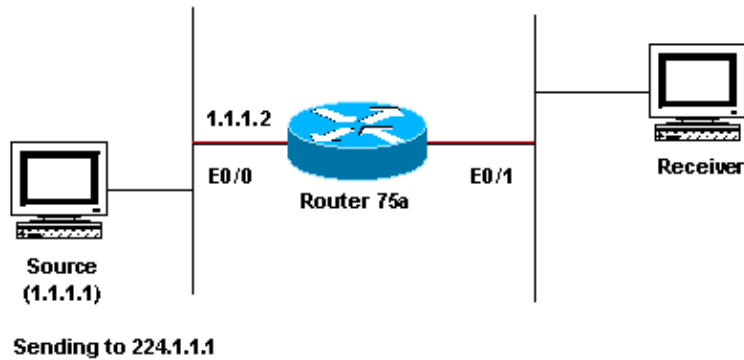
(*, 224.1.1.1), 01:19:26/00:02:59, RP 0.0.0.0, flags: DJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/1, Forward/Sparse-Dense, 01:19:26/00:00:00
    Ethernet1/2, Forward/Sparse-Dense, 01:19:26/00:00:00

(1.1.1.1, 224.1.1.1), 00:17:46/00:02:59, flags: CTA
  Incoming interface: Ethernet1/1, RPF nbr 2.1.1.1
  Outgoing interface list:
    Ethernet1/2, Forward/Sparse-Dense, 00:17:46/00:00:00

```

Router Does Not Forward Multicast Packets Due to TTL Threshold of Router

This section provides a solution to the common problem of the TTL threshold being set too low, so that IP multicast traffic does not reach the receiver. This network diagram is used as an example.



Diagnose the Problem

In the figure above, the Receiver does not receive multicast packets from the Source. There may be several routers between the source and Router 75a. First look at Router 75a, since it is directly connected to the Receiver.

```
ip22-75a#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 00:32:05/00:02:59, RP 0.0.0.0, flags: DJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:08:17/00:00:00

(1.1.1.1, 224.1.1.1), 00:01:02/00:01:57, flags: CTA
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/1, Forward/Sparse-Dense, 00:01:02/00:00:00
```

The output above shows Router 75a is forwarding packets out Ethernet0/1. To be absolutely sure Router 75a is forwarding the packets, turn on **debug** just for this source and multicast group:

```
ip22-75a#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
ip22-75a(config)#access-list 101 permit udp host 1.1.1.1 host 224.1.1.1
ip22-75a(config)#end
ip22-75a#debug ip mpacket 101
IP multicast packets debugging is on for access list 101
ip22-75a#
*Jan 17 09:04:08.714: IP: s=1.1.1.1 (Ethernet0/0) d=224.1.1.1 len 60, threshold denied
*Jan 17 09:04:08.762: IP: s=1.1.1.1 (Ethernet0/0) d=224.1.1.1 len 60, threshold denied
*Jan 17 09:04:08.814: IP: s=1.1.1.1 (Ethernet0/0) d=224.1.1.1 len 60, threshold denied
```

The above **debug** messages indicate that Router 75a does not forward the multicast packets because the TTL threshold has been reached. Look at the router configuration to see whether you can find the reason. This output shows the culprit:

```
interface Ethernet0/1
 ip address 2.1.1.1 255.255.255.0
 ip pim sparse-dense-mode
```

```
ip multicast ttl-threshold 15
```

The router has a TTL threshold of 15, but this does not mean that anything greater than a TTL of 15 is not sent. Actually, the opposite is true. The application is being sent with a TTL of 15. By the time it gets to Router 75a, the multicast packets have a TTL less than 15.

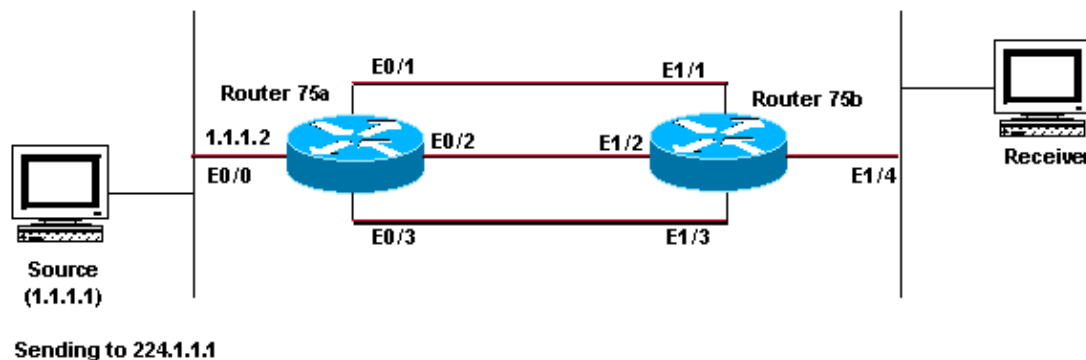
The **ip multicast ttl-threshold <value>** command means that any packets with a TTL lower than the specified threshold, in this case, 15, are not forwarded. This command is usually used to provide a border to keep internal multicast traffic from drifting out of the intranet.

Possible Fixes

Either remove the **ip multicast ttl-threshold <value>** command by using the **no** form of this command, which reverts to the default TTL threshold value of 0, or lower the TTL threshold so that the traffic can pass.

Multiple Equal Cost Paths Result in Unwanted Return Path Forwarding Behavior

This sections shows how equal cost paths to a multicast source can cause unwanted Return Path Forwarding (RPF) behavior. It also describes how to configure IP multicast to avoid this behavior. This network diagram is used as an example.



Diagnose the Problem

In the figure above, Router 75b has three equal cost paths back to the Source (1.1.1.1), and it chooses a link that you do not want to be its first choice as the RPF link.

When faced with multiple equal cost paths to a source, IP multicast chooses the interface that has a Protocol Independent Multicast (PIM) neighbor with the highest IP address as the incoming interface and then sends prunes to PIM neighbors on the other links.

Possible Fixes

To change the interface IP multicast chooses as its incoming interface, you can do one of these:

- Only configure PIM on the interfaces that you want multicast to traverse, which means you lose multicast redundancy.
- Change the subnets so the highest IP address is on the link you want to be the primary multicast link.

- Create a static multicast route (mroute) pointing out the preferred multicast interface, which means you lose multicast redundancy.

As an example, a static mroute is created.

Before installing a static mroute, you see in the output below that the routing table has three equal cost routes for the source address 1.1.1.1. The RPF information indicates that the RPF interface is E1/3:

```
ip22-75b#show ip route 1.1.1.1
Routing entry for 1.1.1.0/24
  Known via "ospf 1", distance 110, metric 20, type intra area
  Redistributing via ospf 1
  Last update from 3.1.1.1 on Ethernet1/2, 00:26:21 ago
  Routing Descriptor Blocks:
  * 4.1.1.1, from 10.0.119.66, 00:26:21 ago, via Ethernet1/3
    Route metric is 20, traffic share count is 1
  2.1.1.1, from 10.0.119.66, 00:26:21 ago, via Ethernet1/1
    Route metric is 20, traffic share count is 1
  3.1.1.1, from 10.0.119.66, 00:26:21 ago, via Ethernet1/2
    Route metric is 20, traffic share count is 1

ip22-75b#show ip rpf 1.1.1.1
RPF information for ? (1.1.1.1)
  RPF interface: Ethernet1/3
  RPF neighbor: ? (4.1.1.1)
  RPF route/mask: 1.1.1.0/24
  RPF type: unicast (ospf 1)
  RPF recursion count: 0
  Doing distance-preferred lookups across tables

ip22-75b#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 01:30:34/00:02:59, RP 0.0.0.0, flags: DJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/4, Forward/Sparse-Dense, 01:30:34/00:00:00
    Ethernet1/1, Forward/Sparse-Dense, 01:30:35/00:00:00
    Ethernet1/2, Forward/Sparse-Dense, 01:30:35/00:00:00
    Ethernet1/3, Forward/Sparse-Dense, 00:24:22/00:00:00

(1.1.1.1, 224.1.1.1), 01:30:35/00:02:59, flags: CT
  Incoming interface: Ethernet1/3, RPF nbr 4.1.1.1
  Outgoing interface list:
    Ethernet1/1, Prune/Sparse-Dense, 01:30:35/00:02:32
    Ethernet1/4, Forward/Sparse-Dense, 01:30:35/00:00:00
    Ethernet1/2, Prune/Sparse-Dense, 00:24:22/00:02:42
```

After configuring the static mroute, you see in this output the RPF interface has changed to E1/1:

```
ip22-75b#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
ip22-75b(config)#ip mroute 0.0.0.0 0.0.0.0 2.1.1.1
ip22-75b(config)#end

ip22-75b#show ip rpf 1.1.1.1
```

```

RPF information for ? (1.1.1.1)
  RPF interface: Ethernet1/1
  RPF neighbor: ? (2.1.1.1)
  RPF route/mask: 1.1.1.1/0
  RPF type: static mroute
  RPF recursion count: 0
  Doing distance-preferred lookups across tables

ip22-75b#show ip route 1.1.1.1
Routing entry for 1.1.1.0/24
  Known via "ospf 1", distance 110, metric 20, type intra area
  Redistributing via ospf 1
  Last update from 3.1.1.1 on Ethernet1/2, 00:26:21 ago
  Routing Descriptor Blocks:
  * 4.1.1.1, from 10.0.119.66, 00:26:21 ago, via Ethernet1/3
    Route metric is 20, traffic share count is 1
  2.1.1.1, from 10.0.119.66, 00:26:21 ago, via Ethernet1/1
    Route metric is 20, traffic share count is 1
  3.1.1.1, from 10.0.119.66, 00:26:21 ago, via Ethernet1/2
    Route metric is 20, traffic share count is 1

ip22-75b#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

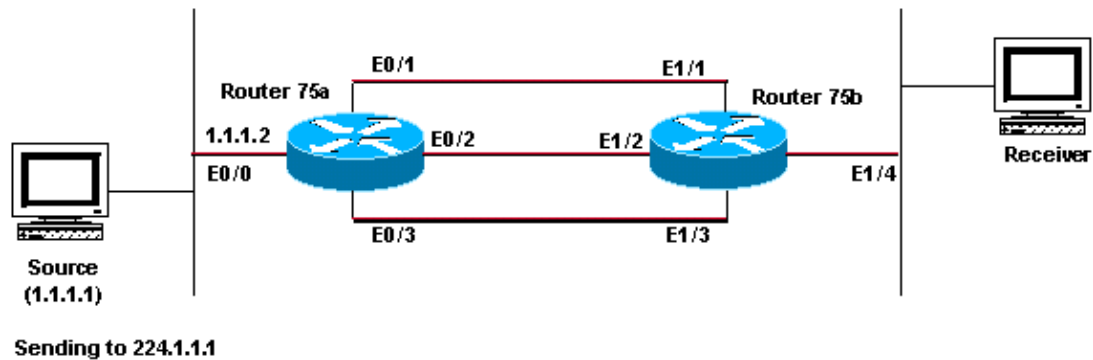
(*, 224.1.1.1), 01:31:29/00:02:59, RP 0.0.0.0, flags: DJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/4, Forward/Sparse-Dense, 01:31:29/00:00:00
    Ethernet1/1, Forward/Sparse-Dense, 01:31:30/00:00:00
    Ethernet1/2, Forward/Sparse-Dense, 01:31:30/00:00:00
    Ethernet1/3, Forward/Sparse-Dense, 00:25:17/00:00:00

(1.1.1.1, 224.1.1.1), 01:31:30/00:02:59, flags: CT
  Incoming interface: Ethernet1/1, RPF nbr 2.1.1.1, Mroute
  Outgoing interface list:
    Ethernet1/4, Forward/Sparse-Dense, 01:31:30/00:00:00
    Ethernet1/2, Prune/Sparse-Dense, 00:25:17/00:01:47
    Ethernet1/3, Prune/Sparse-Dense, 00:00:31/00:02:28

```

Why Does IP Multicast Not Load Balance Across All Available Equal Cost Paths?

This section provides a solution to the common problem of configuring IP multicast to load balance across all available equal-cost paths. This network diagram is used as an example.



In the figure above, Router 75b has three equal-cost paths back to the Source (1.1.1.1). You want to load-balance the multicast traffic across all three links.

Possible Fixes

As you saw in the Multiple Equal Cost Paths Result in Unwanted Return Path Forwarding Behavior section above, Protocol Independent Multicast (PIM) only chooses one interface for the Return Path Forwarding (RPF) check and prunes the others. This means load balancing does not occur. In order to load-balance, you need to remove PIM from the redundant links and create a tunnel between Router 75a and Router 75b. You can then load-balance at the link level, and IP runs over the tunnel.

These are the configurations for the tunnel.

```

Router 75a
interface Tunnel0
 ip address 6.1.1.1 255.255.255.0
 ip pim sparse-dense-mode
 tunnel source Ethernet0/0
 tunnel destination 5.1.1.1
!
interface Ethernet0/0
 ip address 1.1.1.2 255.255.255.0
 ip pim sparse-dense-mode
!
interface Ethernet0/1
 ip address 2.1.1.1 255.255.255.0
!
interface Ethernet0/2
 ip address 3.1.1.1 255.255.255.0
!
interface Ethernet0/3
 ip address 4.1.1.1 255.255.255.0

```

```

Router 75b
interface Tunnel0
 ip address 6.1.1.2 255.255.255.0
 ip pim sparse-dense-mode
 tunnel source Ethernet1/4
 tunnel destination 1.1.1.2
!
interface Ethernet1/1
 ip address 2.1.1.2 255.255.255.0
!

```

```

interface Ethernet1/2
 ip address 3.1.1.2 255.255.255.0
!
interface Ethernet1/3
 ip address 4.1.1.2 255.255.255.0
!
interface Ethernet1/4
 ip address 5.1.1.1 255.255.255.0
 ip pim sparse-dense-mode
!
ip mroute 0.0.0.0 0.0.0.0 Tunnel0

```

After you configure the tunnel, use the **show ip mroute** command to see the multicast route (mroute) for the group:

```

ip22-75a#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 02:40:31/00:02:59, RP 0.0.0.0, flags: D
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Tunnel0, Forward/Sparse-Dense, 00:20:55/00:00:00

(1.1.1.1, 224.1.1.1), 02:40:32/00:03:29, flags: TA
  Incoming interface: Ethernet0/0, RPF nbr 0.0.0.0
  Outgoing interface list:
    Tunnel0, Forward/Sparse-Dense, 00:20:55/00:00:00

ip22-75b#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 02:42:20/00:02:59, RP 0.0.0.0, flags: DJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Tunnel0, Forward/Sparse-Dense, 00:22:53/00:00:00
    Ethernet1/4, Forward/Sparse-Dense, 02:42:20/00:00:00

(1.1.1.1, 224.1.1.1), 00:22:53/00:02:59, flags: CT
  Incoming interface: Tunnel0, RPF nbr 6.1.1.1, Mroute
  Outgoing interface list:
    Ethernet1/4, Forward/Sparse-Dense, 00:22:53/00:00:00

```

To check that the multicast data is being load balanced equally across the three links, look at the interface data of Router 75a.

The incoming interface is 9000 bits/sec:

```

ip22-75a#show interface e0/0
:
.
```

```
5 minute input rate 9000 bits/sec, 20 packets/sec
```

The three outgoing interfaces each show 3000 bits/sec:

```
ip22-75a#show interface e0/1
.
.
5 minute output rate 3000 bits/sec, 7 packets/sec

ip22-75a#show interface e0/2
.
.
5 minute output rate 3000 bits/sec, 7 packets/sec

ip22-75a#show interface e0/3
.
.
5 minute output rate 3000 bits/sec, 7 packets/sec
```

Why Are We Receiving IP Multicast "INVALID_RP_JOIN" Error Messages on the Router?

This section provides solutions to the common problem of the IP multicast "INVALID_RP_JOIN" error message.

Diagnose the Problem – Part 1

This error messages is received on the Rendezvous Point (RP):

```
00:55:15: %PIM-6-INVALID_RP_JOIN: Received (*, 224.1.1.1)
Join from 1.1.6.2 for invalid RP 1.1.5.4
00:56:15: %PIM-6-INVALID_RP_JOIN: Received (*, 224.1.1.1)
Join from 1.1.6.2 for invalid RP 1.1.5.4
```

The Cisco IOS Software System Error Messages explains what causes this error: a downstream PIM router sent a join message for the shared tree, which this router does not want to accept. This behavior indicates that this router allows only downstream routers join to a specific RP.

It is suspected that some kind of filtering is going on. You need to take a look at the configuration of the router:

```
interface Ethernet0/0
 ip address 1.1.5.4 255.255.255.0
 ip pim sparse-dense-mode
!
ip pim accept-rp 10.2.2.2 8
ip pim send-rp-announce Ethernet0/0 scope 15
ip pim send-rp-discovery scope 15
!
access-list 8 permit 224.0.0.0 0.255.255.255
```

What is the **accept-rp** statement in the configuration supposed to accomplish? CCO Documentation states that "to configure a router to accept Joins or Prunes destined for a specified RP and for a specific list of groups, use the **ip pim accept-rp** global configuration command. To remove that check, use the **no** form of

this command."

When you remove the **ip pim accept-rp** command, the messages disappear. The command that is causing the problem was found, but what if you want to keep that command in the configuration? You may be permitting the wrong RP address. Using the **show ip pim rp mapping** command, you can see the correct RP address:

```
ip22-75a#show ip pim rp mapping
PIM Group-to-RP Mappings
This system is an RP (Auto-RP)
This system is an RP-mapping agent

Group(s) 224.0.0.0/4
  RP 1.1.5.4 (?), v2v1
    Info source: 1.1.5.4 (?), via Auto-RP
    Uptime: 01:00:48, expires: 00:02:07
```

According to the output above, 1.1.5.4 is the only RP learned via Auto-RP or otherwise. However, this router is only the RP for the groups 224.0.0.0/4. So, the **pim accept-rp** statement in the configuration above is wrong.

Possible Fixes

The solution is to correct the IP address in the **ip pim accept-rp** statement as follows:

Change this statement:

```
ip pim accept-rp 10.2.2.2 8
```

To the following:

```
ip pim accept-rp 1.1.5.4 8
```

You can also change the statement to accept what is in the auto-rp cache, and make certain that the access list (8 in this example) is permitting the necessary multicast group range. This is an example:

```
ip pim accept-rp auto-rp
access-list 8 permit 224.0.0.0 0.255.255.255
```

Diagnose the Problem – Part 2

This error message is seen on router2.

```
router2#
*Aug 12 15:18:17.891:
  %PIM-6-INVALID_RP_JOIN: Received (*, 224.0.1.40)
  Join from 0.0.0.0 for invalid RP 2.1.1.1
```

Check to see if router2 is the RP for group 224.1.1.1:

```
router2#show ip pim rp map
PIM Group-to-RP Mappings

Group(s) 224.0.0.0/4
  RP 1.1.1.1 (?), v2v1
    Info source: 1.1.1.1 (?), elected via Auto-RP
    Uptime: 00:21:26, expires: 00:02:24
```

```
router2#
```

The RP for 224.1.1.1 is 1.1.1.1.

Check if this is one of the interfaces of router2:

```
router2#show ip interface brief
Interface                IP-Address      OK? Method Status      Protocol
Ethernet0/0              1.1.1.2         YES NVRAM   up          up
Ethernet1/0              2.1.1.1         YES NVRAM   up          up
Ethernet2/0              unassigned      YES NVRAM   administratively down down
router2#
```

Since router2 is not an RP, it should have not received this RP-Join packet. Check why the downstream router sent the Join to router2, while it should not:

```
router3#show ip pim rp map
PIM Group-to-RP Mappings

Group(s) 224.0.0.0/4
  RP 1.1.1.1 (?), v2v1
    Info source: 1.1.1.1 (?), elected via Auto-RP
    Uptime: 00:24:30, expires: 00:02:16
Group(s): 224.0.0.0/4, Static-Override
  RP: 2.1.1.1 (?)
router3#
```

As you see, router3 has statically configured RP information, pointing to router2, which is incorrect. This explains why router3 is sending RP-Join to router2.

Possible Fixes

Either make router2 the RP for the group 224.1.1.1 or change the configuration on router3 so it refers to the correct RP address.

```
router3#show run | i rp
ip pim rp-address 2.1.1.1 override
router3#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
router3(config)#no ip pim rp-address 2.1.1.1 override
router3(config)#exit
router3#
```

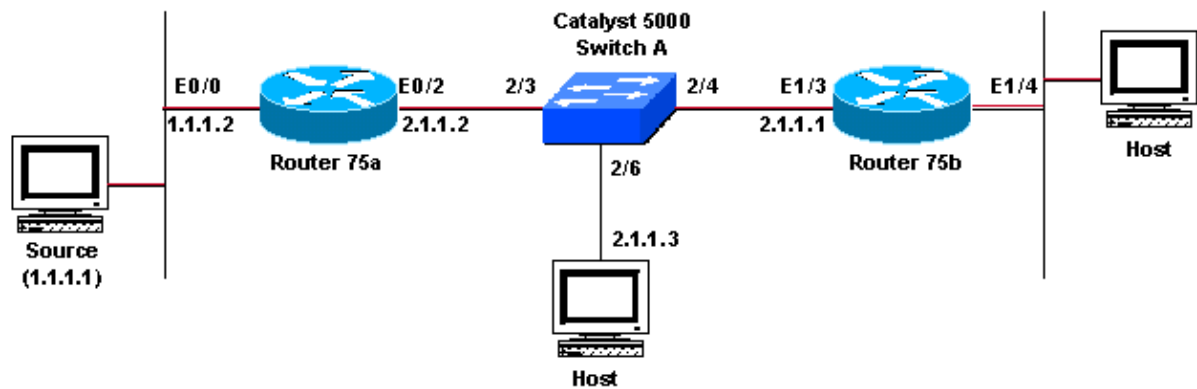
After the configuration on router3 is corrected, router3 refers to the correct RP address and the error message stops appearing.

```
router3#show ip pim rp map
PIM Group-to-RP Mappings

Group(s) 224.0.0.0/4
  RP 1.1.1.1 (?), v2v1
    Info source: 1.1.1.1 (?), elected via Auto-RP
    Uptime: 00:30:45, expires: 00:02:02
router3#
```

CGMP Does Not Prevent the Flood of Multicast Packets

This section explains how unwanted flooding of multicast packets can occur when Cisco Group Management Protocol (CGMP) is not enabled on all routers on a particular subnet, and how this problem can be avoided. This network diagram is used as an example.



Diagnose the Problem

In the figure above, the static CAM table in the Catalyst 5000 Switch A does not show any of the correct ports that are populated. The CGMP-configured router does not send CGMP packets.

CGMP is correctly configured with the **set cgmp enable** command on Switch A and the **ip cgmp** command on the E0/2 interface of Router 75a. However no multicast groups are seen on Switch A when the **show multicast group** command is issued:

```
Console> (enable) show multicast group
CGMP enabled
IGMP disabled
IGMP fastleave disabled
GMRP disabled

VLAN  Dest  MAC/Route Des   [CoS]  Destination Ports or VCs / [Protocol Type]
----  -
Total Number of Entries = 0
```

The output of this command should show each port that has a CGMP-configured router on it (port 2/3) and each port that has an interested receiver on it (port 2/6). Since 0 is listed, you can assume all ports are needlessly being flooded with multicast traffic whether they want it or not.

Observations

Check to see whether there are any Protocol Independent Multicast (PIM) neighbors on Router 75a:

```
ip22-75a#show ip pim neighbor
PIM Neighbor Table
Neighbor Address  Interface          Uptime    Expires    Ver  Mode
2.1.1.1          Ethernet0/2        00:07:41  00:01:34  v2
```

The output above shows that Router 75a is able to see Router 75b as a valid PIM neighbor through Switch A.

Now check whether you are receiving the correct multicast route (mroute) information on the routers:

```
ip22-75a#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 00:14:55/00:02:59, RP 0.0.0.0, flags: DJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/2, Forward/Sparse-Dense, 00:14:55/00:00:00

(1.1.1.1, 224.1.1.1), 00:14:56/00:02:59, flags: CTA
  Incoming interface: Ethernet0/1, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet0/2, Forward/Sparse-Dense, 00:14:56/00:00:00
```

The output above shows Router 75a is forwarding the multicast packets out E0/2 toward Switch A. The following output shows Router 75b is getting the multicast packets and forwarding them correctly:

```
ip22-75b#show ip mroute 224.1.1.1
IP Multicast Routing Table
Flags: D - Dense, S - Sparse, C - Connected, L - Local, P - Pruned
       R - RP-bit set, F - Register flag, T - SPT-bit set, J - Join SPT
       M - MSDP created entry, X - Proxy Join Timer Running
       A - Advertised via MSDP
Timers: Uptime/Expires
Interface state: Interface, Next-Hop or VCD, State/Mode

(*, 224.1.1.1), 00:17:57/00:02:59, RP 0.0.0.0, flags: DJC
  Incoming interface: Null, RPF nbr 0.0.0.0
  Outgoing interface list:
    Ethernet1/3, Forward/Sparse-Dense, 00:17:57/00:00:00
    Ethernet1/4, Forward/Sparse-Dense, 00:17:57/00:00:00

(1.1.1.1, 224.1.1.1), 00:00:35/00:02:59, flags: CTA
  Incoming interface: Ethernet1/3, RPF nbr 2.1.1.2
  Outgoing interface list:
    Ethernet1/4, Forward/Sparse-Dense, 00:00:35/00:00:00
```

Looking from Switch A's point of view, you see that it sees Router 75a off of port 2/3.

```
Console> (enable) show multicast router
CGMP enabled
IGMP disabled
IGMP fastleave disabled

Port      Vlan
-----  -
2/3      6

Total Number of Entries = 1
```

Everything seen so far seems fine. Issue some **debug** commands on Router 75a to see what you can find out:

```
ip22-75a#debug ip cgmp
CGMP debugging is on
*Feb  8 12:45:22.206: CGMP: Sending self Join on Ethernet0/2
```

```
*Feb  8 12:45:22.206:      GDA 0000.0000.0000, USA 00d0.ff2f.a002
*Feb  8 12:46:22.234: CGMP: Sending self Join on Ethernet0/2
*Feb  8 12:46:22.234:      GDA 0000.0000.0000, USA 00d0.ff2f.a002
*Feb  8 12:47:22.262: CGMP: Sending self Join on Ethernet0/2
*Feb  8 12:47:22.262:      GDA 0000.0000.0000, USA 00d0.ff2f.a002
```

In the output above, 0000.0000.0000 is the all-groups address and is used when routers send CGMP Join/Leave messages so switches can populate router ports. GDA stands for Group Destination Address in Media Access Control (MAC) level format and USA stands for Unicast Source Address. This is the address of the host that originated the IGMP report for which this CGMP message is being generated. In this case, it is the MAC address for the Router 75a interface E0/2. The MAC address for E0/2 of Router 75a can be seen with the **show interface** command as seen here:

```
ip22-75a#show interface e0/2
Ethernet0/2 is up, line protocol is up
  Hardware is cxBus Ethernet, address is 00d0.ff2f.a002 (bia 00d0.ff2f.a002)
```

In addition, you may periodically see this when the **debug ip igmp** command is turned on:

```
*Feb  8 12:51:41.854: IGMP: Received v2 Report from 2.1.1.3 (Ethernet0/2) for 224.1.1.1
```

However, you do not subsequently see a corresponding CGMP packet from Router 75a. This means Router 75a is receiving IGMP reports, but not generating the necessary CGMP packets to help Switch A know which ports to block. This is something that is expected of Router 75a if it is the IGMP querier. This output from Router 75a tells us why the expected behavior is not happening:

```
ip22-75a#show ip igmp interface e0/2
Ethernet0/2 is up, line protocol is up
  Internet address is 2.1.1.2/24
  IGMP is enabled on interface
  Current IGMP version is 2
  CGMP is enabled
  IGMP query interval is 60 seconds
  IGMP querier timeout is 120 seconds
  IGMP max query response time is 10 seconds
  Last member query response interval is 1000 ms
  Inbound IGMP access group is not set
  IGMP activity: 3 joins, 1 leaves
  Multicast routing is enabled on interface
  Multicast TTL threshold is 0
  Multicast designated router (DR) is 2.1.1.2 (this system)
  IGMP querying router is 2.1.1.1
  No multicast groups joined
```

If you have two routers on the same subnet, and you configure both for CGMP, only one will send CGMP packets. The router that sends the CGMP packets is the IGMP querying router. This means the router with the lowest unicast IP address of the IGMP-enabled routers.

In this case, both Routers 75a and Router 75b have IGMP enabled (Router 75b became the IGMP querying router), but only Router 75a has CGMP enabled. Since Router 75a is not the IGMP querying router, no CGMP packets are being sent.

Possible Fixes

To solve the problem, you need to configure CGMP on the IGMP querying router. In this case, Router 75b. First, turn on debug commands on Router 75b:

```

ip22-75b#conf t
Enter configuration commands, one per line. End with CNTL/Z.
ip22-75b(config)#int e 1/3
ip22-75b(config-if)#ip cgmp
ip22-75b(config-if)#end
ip22-75b#debug ip cgmp
ip22-75b#debug ip igmp
*Feb  8 12:58:42.422: IGMP: Received v2 Report from 2.1.1.3 (Ethernet1/3) for 224.1.1.1
*Feb  8 12:58:42.422: CGMP: Received IGMP Report on Ethernet1/3
*Feb  8 12:58:42.422:      from 2.1.1.3 for 224.1.1.1
*Feb  8 12:58:42.422: CGMP: Sending Join on Ethernet1/3
*Feb  8 12:58:42.422:      GDA 0100.5e01.0101, USA 0030.b655.a859

```

Router 75b receives an IGMP report from 2.1.1.3 for group 224.1.1.1. It subsequently sends a CGMP Join to Switch A for the MAC equivalent of 224.1.1.1 with the MAC address (USA) of the 2.1.1.3 interested host. Switch A knows which port that host is on, so marks it as open and blocks the others.

Things should now work on Switch A:

```

Console> (enable) show multicast group
CGMP enabled
IGMP disabled
IGMP fastleave disabled
GMRP disabled

```

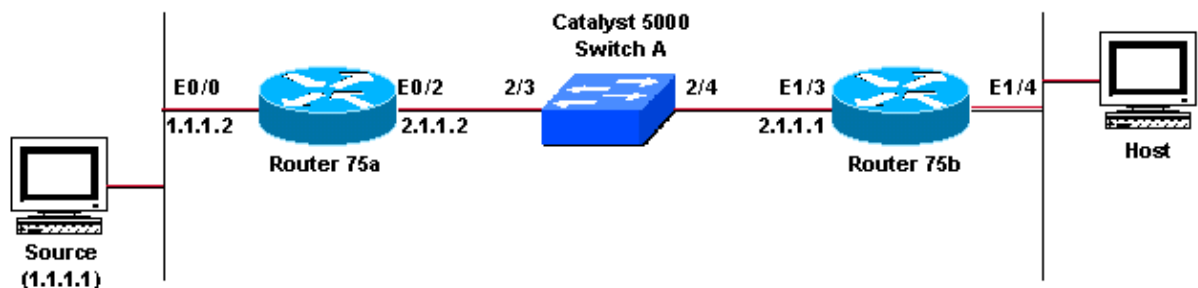
VLAN	Dest MAC/Route Des	[CoS]	Destination Ports or VCs / [Protocol Type]
6	01-00-5e-00-01-28		2/3-4
6	01-00-5e-01-01-01		2/3-4,2/6

Total Number of Entries = 2

This is much better. The 224.1.1.1 (01-00-5e-01-01-01) packets are only being sent out ports 2/3, 2/4, and 2/6 on Switch A, as they should. Flooding to all other ports has stopped. The total number of entries is now listed correctly as 2. The MAC address 01-00-5e-00-01-28 is mapped from the multicast address 224.0.1.40, which is used for CGMP self joins.

CGMP Does Not Prevent the Flooding of Multicast Packets, Due to Source/Receiver Placement

This section provides a solution to the common problem of a Catalyst Switch flooding traffic to every port, instead of just to the correct host. This network diagram is used as an example.



Diagnose the Problem

In the figure above, Routers 75a and 75b and the Catalyst 5000 (Switch A) are properly configured for multicast and Cisco Group Management Protocol (CGMP). The host is getting the multicast traffic. However, so is every other host off of Switch A. Switch A is flooding the traffic out every port, which means that CGMP is not working.

The output of the **show multicast group** command on Switch A looks like:

```
Console> (enable) show multicast group
CGMP enabled
IGMP disabled
IGMP fastleave disabled
GMRP disabled

VLAN  Dest MAC/Route Des      [CoS]  Destination Ports or VCs / [Protocol Type]
----  -
6      01-00-5e-00-01-28          -----  -----
Total Number of Entries = 1
```

You can see from the output above that the only group is 224.0.1.40, which is used by the router when it sends CGMP self-joins for the auto-RP group. How come there are no other groups?

Possible Fixes

To understand the solution, you need to understand how CGMP behaves under certain conditions. A CGMP-enabled router sends CGMP joins to a switch informing the switch of hosts interested in a particular multicast group. The switch looks up the MAC addresses for these hosts in its CAM table, then forwards multicast packets out the ports with interested hosts and blocks all other ports from forwarding multicast packets.

A router sends CGMP self-joins out a CGMP-enabled interface if it receives multicast packets from a source that is on the same interface on which it (the router) has CGMP enabled.

For example, if the source was on the same subnet (VLAN), 2.1.1.0/24, as Routers 75a and 75b, CGMP would work perfectly. The router, upon seeing packets from the source, would send a CGMP self-join to the switch, which would then dynamically learn which ports the router is on and block all other ports from forwarding multicast packets.

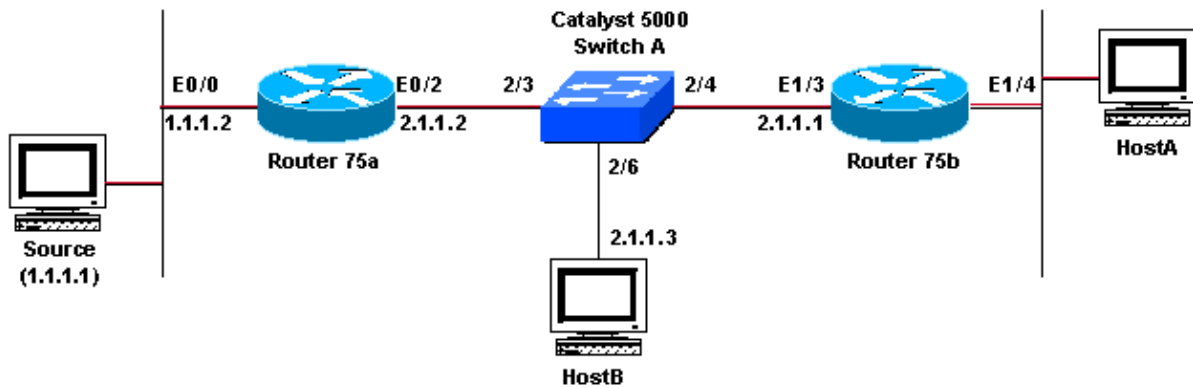
A router sends CGMP joins out a CGMP-enabled interface if it receives IGMP reports from a host on the same interface that it (the router) has CGMP enabled.

Another example is if we had an interested host on this same VLAN. In that case, when a CGMP-enabled router received an Internet Group Management Protocol (IGMP) report from a host that's interested in a particular multicast group, the router would send a CGMP join. The join would indicate the Media Access Control (MAC) address of the host that wanted to join and the group it wanted to join. The Catalyst 5000 would then check its CAM table for the host's MAC address, put the associated port on the multicast group list, and block all other uninterested ports.

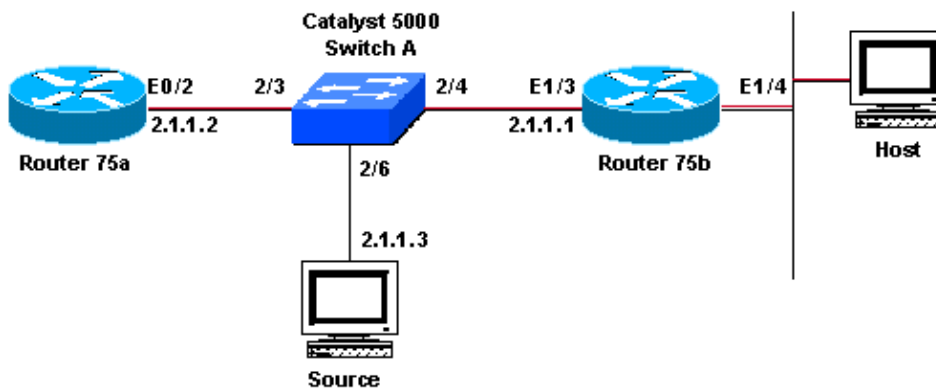
The same is not true when the source and interested host(s) are on a subnet other than the CGMP-enabled subnet (VLAN). Multicast packets, coming from the source, do not trigger the router to send CGMP self-joins to the switch. Therefore the packets hit the switch and get flooded everywhere within the VLAN. This scenario continues until a host in the VLAN, coming off a port on the switch, sends an IGMP join. Only

with the receipt of an IGMP report does the router send a CGMP packet, which then causes the switch to add the appropriate host port as forwarding and all other ports are blocked (aside from the router ports).

So for CGMP to work in this transit-type topology, you could either add a host to the same VLAN as Routers 75a and 75b, as in this network diagram.



Or move the source on the same subnet as Routers 75a and 75b, as in this example.



Move the source to the same subnet and then check the output from Switch A:

```
Console> (enable) show multicast router
CGMP enabled
IGMP disabled
IGMP fastleave disabled
```

Port	Vlan
2/3	6
2/4	6

```
Total Number of Entries = 2
'*' - Configured
Console> (enable)
```

```
Console> (enable) show multicast group
CGMP enabled
IGMP disabled
IGMP fastleave disabled
GMRP disabled
```

```
VLAN  Dest MAC/Route Des  [CoS]  Destination Ports or VCs / [Protocol Type]
```

```

-----
6      01-00-5e-00-01-28      2/3-4
6      01-00-5e-01-01-01      2/3-4

Total Number of Entries = 2

```

Now 224.1.1.1 (01-00-5e-01-01-01) is only flooded to the router ports 2/3 and 2/4, and not to every port off Switch A.

CGMP Does Not Prevent the Flooding of Multicast Packets for Certain Group Addresses

This section explains why some multicast IP addresses cause Cisco Group Management Protocol (CGMP) to flood multicast traffic out all ports on a local area network (LAN). When you use the multicast group address 225.0.0.1, Cisco Group Management Protocol (CGMP) does not work. It floods the multicast stream out all switch ports and wastes bandwidth. However, if you change the address to 225.1.1.1 CGMP works fine. What is wrong with using 225.0.0.1, since it is not a registered address for a routing protocol?

Possible Fixes

First, it is important to understand how Layer 3 multicast addresses are mapped to Layer 2 multicast addresses. All IP multicast frames use IEEE Media Access Control (MAC) layer addresses beginning with the 24-bit prefix of 0x0100.5e. When mapping Layer 3 to Layer 2 addresses, the low-order 23 bits of the Layer 3 multicast address are mapped into the low-order 23 bits of the IEEE MAC address.

Another important fact to understand is there are 28 bits of unique address space for an IP multicast address (32 bits minus the first 4 bits containing the 1110 class D prefix). Since there are only 23 bits plugged into the IEEE MAC address, 5 bits of overlap remain. This means that multiple Layer 3 multicast addresses can map to the same Layer 2 multicast address.

For example:

```

224.0.0.1 = 1110 0000.0000 0000.0000 0000.0000 0001 in binary
low order 23 bits =      000 0000.0000 0000.0000 0001
hex equivalent    =      0   0   0   0   0   1
result of mapping = 0x0100.5e00.0001

```

```

224.128.0.1 = 1110 0000.1000 0000.0000 0000.0000 0001 in binary
low order 23 bits =      000 0000.0000 0000.0000 0001
hex equivalent    =      0   0   0   0   0   1
result of mapping = 0x0100.5e00.0001

```

Notice in the above example both 224.0.0.1 and 224.128.0.1 map to the same Layer 2 multicast address.

Now that you know how Layer 3 to Layer 2 multicast addresses are mapped, proceed to the specific solution to the above problem.

Switch A floods multicast packets to 224.0.0.x because those addresses are link-local and we want to make sure link-local addresses get to all devices on the local area network (LAN). Catalyst switches also flood multicast packets to other multicast addresses that are MAC level ambiguous with 224.0.0.x (for instance, 224.0.0.1 and 225.0.0.1 both map to 0100.5e00.0001). The switch floods the multicast packets destined for these link local addresses whether CGMP is enabled or not.

Therefore, the multicast application must avoid the use of class D addresses that map to a Layer 2 multicast address of 0100.5e00.00xx, where xx can be 00 through FF in hexadecimal. This consists of these class D addresses:

```
224.0.0.x (x = 0 to 255)
225.0.0.x
.
239.0.0.x

224.128.0.x (x = 0 to 255)
225.128.0.x
.
239.128.0.x
```

Related Information

- [Basic Multicast Troubleshooting Tools](#)
- [Multicast Quick-Start Configuration Guide](#)
- [IPC: Part 3: IP Multicast](#)
- [TCP/IP Multicast Support Page](#)
- [IP Routing Protocols Support Pages](#)
- [Technical Support – Cisco Systems](#)

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