Introduction

Multicasting allows a host to send data packets across the Internet to a set of hosts that can be on different, geographically dispersed subnets. The source host sends data to a pseudo destination called a multicast group, and does so efficiently, using less bandwidth than unicast or broadcast traffic. Unlike unicast transmission, which would copy a packet to send it to multiple destinations, multicast sources send a packet only once.

Multicast-aware routers on the Internet use multicast routing protocols like PIM to deliver packets across the Internet to subnets that have hosts in the multicast group. These routers build and maintain distribution trees to forward multicast traffic.

Multicast routers connected to subnets use multicast group membership protocols like IGMP to discover which local hosts are members of which multicast groups, and to deliver multicasted packets to member hosts.

Current applications of multicasting include email distribution lists, routing information flooding, and web-based training seminars and voice/video conferences.
Test Challenges

Routers supporting IGMP Version 3 must correctly implement the following new features:

<table>
<thead>
<tr>
<th>IGMP v3</th>
<th>IGMP v2</th>
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<tbody>
<tr>
<td>Source Specific Multicast (SSM): A host receives packets only from specified sources. Include/exclude filters are used to accept/deny traffic from sources.</td>
<td>The host simply received all packets sent to the multicast group.</td>
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<tr>
<td>Membership reports can contain multiple multicast groups, up to the MTU of the interface.</td>
<td>Membership reports can contain only one multicast group.</td>
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<td>Leave a multicast group using a Membership report that includes no sources.</td>
<td>Leave using a specific Leave message (which is no longer used in v3).</td>
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<tr>
<td>Hosts can also respond to group-source-specific queries.</td>
<td>Hosts can respond to group- or source-queries.</td>
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Other tests:
- Whether enabling IGMP Version 3 maintains backwards compatibility with older IGMP versions.
- Whether the performance of unicast traffic suffers while multicast traffic is being propagated.
- Scaling to find the maximum number of multicast groups before packet loss or excess latency occurs.

Test Description

This note describes how to use a 4-port Gigabit Ethernet module to simulate 3 different hosts and test a SUT’s implementation of IGMPv3 Source Specific Multicast and Include/Exclude filters:

Non-Member (test port 1A) Will send traffic to a multicast group, then later be added to a source-address exclusion list.

IGMP v3

IGMP v2

Non-Member (port 1B)

Should never receive traffic sent to the multicast group.

Group Member (port 1C)

Should receive traffic sent to the multicast group, then stop when the source is excluded.

Test Steps

1. Enable IGMPv3 on test ports (i.e. hosts) 1B and 1C.
2. Simulate a multicast group and enable test port 1C to become a member later.
3. Set up test port (i.e. host) 1A to send traffic to the multicast group.
4. Verify that port 1C receives multicast packets but port 1B does not.
5. Add port 1A’s address to the excluded sources list for the multicast group, and verify that port 1C no longer receives multicast packets.

This note does not illustrate these test preamble steps:
- Select test ports 1A, 1B, and 1C.
- Configure the IP addresses of the test ports and their connected SUT interfaces.
- Bring up the physical and link layers.

SUT Setup

Configure the SUT as follows:
- Enable IGMP Version 3 on the SUT interfaces connected to ports 1B and 1C.
- Enable PIM sparse or sparse-dense mode on the interfaces.

Note: On some routers you also need to distribute the Multicast cache to ensure that IGMP hosts receive traffic.
**Multicast Addresses**

Multicast groups are identified by a Class D IP address in the range 224.0.0.0 to 239.255.255.255. For details, see RFC 1112.

There are two types of reserved multicast addresses — those reserved for all multicast applications and those reserved from use by IGMP. With IGMPv3, these two lists now contain the same set of addresses:

- 224.0.0.0 — Base multicast address
- 224.0.0.1 — All systems on this subnet
- 224.0.0.2 — All routers on this subnet
- 224.0.0.4 — DVMRP routers
- 224.0.0.5 — OSPF routers
- 224.0.0.6 — OSPF designated routers
- 224.0.0.13 — PIM routers
- 224.0.0.14 — RSVP encapsulation
- 224.0.0.22 — IGMPv3 membership

Other address restrictions enforced by the tester:

A multicast address group’s first and last address must be within the valid range and not contain reserved addresses.

Each multicast group pool must contain a unique set of addresses, which can overlap but not intersect (i.e. 1, 3, 5 and 2, 4, 6 overlap but do not intersect).

If two multicast group pools have an address in common, the two pools cannot be used by the same test port at the same time. If the first then the second pool is enabled, the tester considers the second pool invalid. However, if the first pool is disabled, the second is no longer considered invalid and can be enabled.

Note: You can use the tester API to remove an address from the reserved list, after which you can send multicast traffic to the address. This is useful for testing how the SUT handles traffic sent to restricted multicast addresses. When addresses are reserved they cannot be used by multicast traffic or IGMP. When they are unreserved they can be used by traffic, but not by IGMP. We recommend that you do not change the list of reserved addresses.

**References**

- RFC 1112: Host Extensions for IP Multicasting (IGMP Version 1)
- RFC 2236: IGMP Version 2
- draft-ietf-idmr-igmp-v3-nn.txt: IGMP Version 3
- draft-holbrook-ssm-arch-nn.txt: SSM for IP
Step 1: Enable IGMPv3 on test ports (i.e. hosts) 1B and 1C

1. Click the Routing button to display the Routing dialog.
2. Click the Multicast tab, select port 1B, and click the Add Session button to display the Session dialog. Use this dialog to configure the test port (host) 1B’s IGMP emulation. On the Interface tab, IGMPv3 is the default.
3. On the Parameters tab, adjust the default IGMP settings as needed. Click the Help button for details about a parameter.
4. Repeat to enable IGMPv3 on test port (host) 1C.
Step 2: Simulate a multicast group and enable test port 1C to become a member later

1. Back on the Routing dialog, click the Group Membership Profiles button.

2. On the Group Membership Profiles dialog, select port 1C and click Add Group Pool.
   On the IGMP Group Pool dialog, click Add Pools.

3. On the Multicast Group Pools dialog, click the Add button to define a new multicast group.

4. On the Multicast Group Pool dialog, define the multicast group address.
   You can define a “pool” of several addresses to scale the test and see how the SUT handles up to 100,000 different multicast groups. This test requires only one group.

5. Back on the IGMP Group Pool dialog, select the newly defined multicast group from the pulldown menu.
   Back on the Group Membership Profiles dialog, under port 1C, this multicast group is shown with a checkbox so that you can dynamically join and leave the group.
   By default, the filter mode is Exclude with no addresses in the group’s source list.
Step 3: Set up test port (i.e. host) 1A to send traffic to the multicast group

1. In the Traffic area of the IP Performance window, select the Meshes tab, then click the Add button.
2. On the Traffic Class Configuration dialog, select the port from which to send multicast traffic. Click on a port in the Available Ports list and click the Add button to send traffic from the selected test port.
3. On the Traffic Class Configuration dialog, select the multicast group to receive traffic. The default AGT_MULTICAST_GROUP cannot be used to receive traffic. Select a multicast group you configured on the previous page from the pull-down menu.
4. Back on the IP Performance window’s Traffic area, click the Address button.
5. Specify the source address to use in multicast packets. Select the multicast traffic stream, select the destination “route” at the bottom, then click the Edit Source button.
6. Add a new source pool. Click Add Pools. On the Multicast Source Address Pools dialog, click Add. Then, on the Multicast Source Address Pool dialog, enter the source address(es) to use.
7. Back on the IP Performance window’s Test area, click the Start button to start generating the multicast traffic and measuring statistics.
Step 4: Verify that port 1C receives multicast packets but port 1B does not

1. On the Routing dialog, click Start Routing Engine. This begins the IGMP emulations on ports 1B and 1C. The button toggles to Stop Routing Engine. Each port’s State should transition from Disabled to Enabled.

2. Click Group Membership Profiles.

3. Click the checkbox to join the group.

4. Port 1C should begin receiving multicast packets.
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