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IGMPv3 for SSM

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Using IGMPv3 For Source-Specific Multicast
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IGMPv3 for SSM

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Abstract

This document describes changes to the Internet Group Management Protocol Version 3 (IGMPv3) [[IGMPv3](#)] to support source-specific multicast (SSM) [[SSM](#)].

1. Overview and Rationale

The Internet Group Management Protocol (IGMP) [[RFC1112](#),[IGMPv2](#),[IGMPv3](#)], is the standard mechanism for communicating IP multicast group membership requests from a host to its locally attached routers. IGMP version 3 (IGMPv3) [[IGMPv3](#)] provides the ability for a host to selectively request or filter traffic from individual sources within a multicast group. The IGMPv3 algorithms and message processing rules require small changes to support the source-specific multicast model. This document defines the modifications required to the host and router portions of IGMPv3 to support source-specific multicast.

2. IGMP Host Requirements for Source-Specific Multicast

This document does not strictly require the IP layer or IGMP module of an IGMPv3-enabled host to treat SSM destination addresses specially. For correct operation of SSM, however, a host applications must

- know the range of destination addresses that have SSM semantics
- use ONLY the source-specific APIs to request delivery of packets sent to SSM destination addresses

The 232/8 address range is currently allocated for SSM by IANA [IANA-ALLOCATION], however hosts and routers may be configured to force SSM semantics for other addresses as well. A IGMP module on a host or router SHOULD have a configuration mechanism to set the SSM address range(s). If this configuration option exists, it MUST default to the IANA-allocated SSM range. The mechanism for setting this configuration option MUST at least allow for manual configuration. Protocol mechanisms to set this option may be defined in subsequent documents. If a host that does not have this option, applications on that host may be denied SSM service by other non-compliant applications on the same host or by other non-compliant hosts on the same network, as described below.

It is strongly recommended that the multicast source filtering (MSF) APIs of [\[MSFAPI\]](#) be used to implement SSM. If the host IP module receives a non source-specific request for an SSM destination address, it SHOULD return an error to the application. If the host IP module is not configured with the SSM address range, the non-source-specific (RFC

1112) APIs will not return an error when passed an SSM destination addresses. On these hosts, applications that mistakenly use the wrong APIs (e.g., "join(G)", or "IPMulticastListen(G,EXCLUDE(S1))" for IGMPv3) to request delivery of packets sent to an SSM address will not receive the requested service, as routers will refuse to process any such request, as per [section 10.2](#).

This section documents the behavior of hosts with respect to sending and receiving the following IGMP message types:

- IGMPv1/v2 Reports
- IGMPv3 Reports
- IGMPv1/v2 Queries
- IGMPv2 Leave
- IGMPv2 Group Specific Query
- IGMPv3 Group Specific Query
- IGMPv3 Group-and-Source Specific Query

[2.1](#). IGMPv1/v2 Reports

A compliant host SHOULD NOT send IGMPv1 or IGMPv2 host reports for SSM addresses. If an SSM-unaware IGMPv3-enabled host receives an IGMPv1 or IGMPv2 host report for SSM destination address G, its IGMP module will revert to IGMPv1/v2 compatibility mode for address G. This will prevent the host from sending source-specific joins, and consequently the SSM service model will not be provided for destination address G. Therefore, it is important that the SSM address range be used only in conjunction with the SSM APIs.

[2.2](#). IGMPv3 Reports

Source-specific multicast destination-and-source pairs (channels) are reported using IGMPv3 with the IGMPv3 INCLUDE report. A host implementation MAY report either one or multiple channels in a single IGMPv3 report.

When source-specific channels are reported in an IGMPv3 Report, the report may contain one or more group records of the following types:

- MODE_IS_INCLUDE as part of a Current-State Record
- ALLOW_NEW_SOURCES as part of a State-Change Record
- BLOCK_OLD_SOURCES as part of a State-Change Record

The source list for any individual Group Record may be of length one or more than one. If a host implementation so chooses, it may report both SSM destination addresses and [RFC 1112](#) multicast (henceforth termed Any-Source Multicast or ASM as in [[SSM](#)]) destination addresses in the same message.

If all applications on a host use the SSM APIs for SSM addresses, then a host would not normally send any of the following group record types for addresses in the source-specific range:

- MODE_IS_EXCLUDE as part of a Current-State Record
- CHANGE_TO_INCLUDE_MODE as part of a Filter-Mode-Change Record
- CHANGE_TO_EXCLUDE_MODE as part of a Filter-Mode-Change Record

EXCLUDE mode does not apply to SSM addresses, and the filter mode used for a SSM address should never change to or from EXCLUDE mode under correct application behavior. [Note: please see [Section 4](#), Outstanding Issues.] A host that is configured with the SSM address range MUST NOT send any of the above record types for an SSM address.

[2.3.](#) IGMPv1/IGMPv2 Queries

If an IGMPv1 or IGMPv2 query is received, the IGMPv3 protocol specification requires the host to revert to the older (IGMPv1 or IGMPv2) mode of operation for that destination address. If this occurs, the host will stop reporting source-specific subscriptions for that

destination address and start using either IGMPv1 or IGMPv2 to report interest in the SSM destination address, unqualified by a source address. If this occurs, SSM semantics will no longer be applied for G.

A router compliant with this document would never generate an IGMPv1 or IGMPv2 query for an address in the SSM range, so this situation would only occur if some router is not compliant with this document for an address that the host believes to have SSM semantics.

When a host reverts to an older version of operation for some destination address, it will no longer be able to send source-specific IGMPv3 messages and applications on that host will not be able to subscribe to SSM channels using that destination address. A host that is configured with the SSM address range MAY have a configuration option to allow it continue to refuse to revert to the older (IGMPv1 or IGMPv2) mode of operation for addresses in the source-specific range, even if an IGMPv1 or IGMPv2 query is heard.

These problems only arise on a shared-medium link that has both SSM-aware and non-SSM-aware routers present. Therefore, it SHOULD be administratively assured that all routers on a given shared-medium network are compliant with this document.

[2.4.](#) IGMPv2 Leave

IGMP Leave messages are not processed by hosts. IGMPv2 Leave messages are not sent for SSM addresses.

[2.5.](#) IGMPv2 Group Specific Query

If a host receives an IGMPv2 Group Specific Query for an address in its configured source-specific range, it MUST silently discard the query, even if the group listed matches the source-specific destination address of some locally subscribed source-specific group. The transmission of such a query indicates that the sender is not compliant with this document.

[2.6.](#) IGMPv3 Group Specific Query

If a host receives an IGMPv3 Group-Specific Query in its configured source-specific range, it MUST respond with a report if the group matches the source-specific destination address of any of its subscribed source-specific groups.

Although in the current IGMPv3 protocol specification, routers would have no reason to send one, the semantics of such a query are well-defined in this range and future implementations may have reason to send such a query. Be liberal in what you accept.

[2.7.](#) IGMPv3 Group-and-Source Specific Query

An IGMPv3 router will query a source-specific channel that a host has requested to leave (via a BLOCK_OLD_SOURCES record) with a group-and-source specific query. A host MUST respond to a group-and-source specific query for which the group and source in the query match any channel for which the host has a subscription.

Hosts MUST be able to process a query with multiple sources listed per group.

[3.](#) IGMP Router Requirements for Support Source-Specific Multicast

Routers must be aware of the SSM address range. The 232/8 address range is currently allocated for SSM by IANA [[IANA-ALLOCATION](#)]. However, an SSM router may be configured to force SSM semantics for other addresses as well. If this configuration option exists, it MUST default to the IANA-allocated range.

This section documents the behavior of routers with respect to the following types of IGMP messages for source-specific destination addresses:

- IGMPv3 Reports
- IGMPv3 General Query
- IGMPv3 Group-Specific Query

- IGMPv3 Group-and-Source Specific Query
- IGMPv1/v2 Reports
- IGMPv1/v2 Queries
- IGMPv2 Leave

[3.1.](#) IGMPv3 Reports

IGMPv3 Reports are used to report source-specific subscriptions in the SSM address range. If a router receives an IGMPv3 report that contains a group record for a destination address in source-specific range that matches one of the types listed below, then it MUST ignore that group record, however, it MUST process other group records within that same report.

- Any Current-State Record with MODE_IS_EXCLUDE
- A CHANGE_TO_INCLUDE_MODE Filter-Mode-Change Record
- A CHANGE_TO_EXCLUDE_MODE Filter-Mode-Change Record

[3.2.](#) IGMPv3 General Queries

IGMPv3 General Queries are used to periodically build the total desired membership state on a subnet. These queries are used for the same purpose in the source-specific address range -- no change in behavior is required. An SSM router sends periodic IGMPv3 General Queries as per the IGMPv3 specification.

[3.3.](#) IGMPv3 Group Specific Queries

IGMPv3 routers that support source-specific multicast MAY send group-specific queries for addresses in the source-specific range, although, in the current IGMPv3 protocol spec, there is no scenario under which this would occur.

[3.4.](#) IGMPv3 Group-and-Source Specific Queries

IGMPv3 Group-and-Source Specific Queries are used to verify that there are no locally attached listeners when a receiver has indicated that it is no longer interested in receiving traffic from a particular (S,G) pair. Group-and-Source Specific Queries are used within the source-specific address range when a router receives a BLOCK_OLD_SOURCES Record for one or more source-specific groups.

[3.5.](#) IGMPv1/v2 Reports

An IGMPv1/v2 report for an address in the source-specific range could be sent by a host that does not support the source-specific model. A router MUST ignore all IGMPv1 and IGMPv2 reports in the source-specific address range and specifically MUST NOT use them to establish IP forwarding state.

[3.6.](#) IGMPv1/v2 Queries

The IGMP querier on a shared-medium network is elected to be the one with lowest source IP address. Therefore, an IGMPv3 router will yield to an IGMPv1 or v2 querier with a lower IP address. IGMPv3 routers that lose the querier election to a lower version router MUST log an error, as per the IGMPv3 specification. However, IGMPv3 routers MUST NOT revert into previous version compatibility mode for the source-specific address range. An IGMPv3 router that loses the querier election to an IGMPv1 or v2 querier SHOULD continue to process source-specific reports in the source-specific address range.

[3.7.](#) IGMPv2 Leave

An IGMPv2 Leave may be received for a source-specific address from a host that does not support the source-specific model. A router MUST ignore all IGMPv2 leaves in the source-specific address range.

[To be removed before going to the IESG.]

The IGMPv3 specification formerly indicated that a host should convert to EXCLUDE mode operation when it no longer has enough memory to record INCLUDE mode requests. This would cause SSM working applications to suddenly break when the router runs out of memory for subsequent joins. The IGMPv3 protocol specification was subsequently changed to say that a host MUST NOT transition to EXCLUDE mode as a result of running out of resources.

5. Acknowledgments

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