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Considerations for IGMP and MLD Snooping Switches
<draft-ietf-magma-snoop-07.txt>

Status of this Memo

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Abstract

This memo describes the requirements for IGMP- and MLD-snooping switches. These are based on best current practices for IGMPv2, with further considerations for IGMPv3- and MLDv2-snooping. Additional areas of relevance, such as link layer topology changes and Ethernet-specific encapsulation issues, are also considered.

Interoperability issues that arise between different versions of

IGMP are not the focus of this document. Interested readers are directed to [IGMPv3] for a thorough description of problem areas.

1. Introduction

When processing a packet whose destination MAC address is a multicast address, the switch will forward a copy of the packet into each of the remaining network interfaces that are the forwarding state in accordance with [BRIDGE]. The spanning tree algorithm ensures that the application of this rule at every switch in the network will make the packet accessible to all nodes connected to the network.

This approach works well for broadcast packets that are intended to be seen or processed by all connected nodes. In the case of multicast packets, however, this approach could lead to less efficient use of network bandwidth, particularly when the packet is intended for only a small number of nodes. Packets will be flooded into network segments where no node has any interest in receiving the packet. While nodes will rarely incur any processing overhead to filter packets addressed to unrequested group addresses, they are unable to transmit new packets onto the shared media for the period of time that the multicast packet is flooded. In general, significant bandwidth can be wasted by flooding.

In recent years, a number of commercial vendors have introduced products described as "IGMP snooping switches" to the market. These devices do not adhere to the conceptual model that provides the strict separation of functionality between different communications layers in the ISO model, and instead utilize information in the upper level protocol headers as factors to be considered in the processing at the lower levels. This is analogous to the manner in which a router can act as a firewall by looking into the transport protocol's header before allowing a packet to be forwarded to its destination address.

In the case of multicast traffic, an IGMP snooping switch provides the benefit of conserving bandwidth on those segments of the network where no node has expressed interest in receiving packets addressed to the group address. This is in contrast to normal switch behavior where multicast traffic is typically forwarded on all interfaces.

Many switch datasheets state support for IGMP snooping, but no requirements for this exist today. It is the authors' hope that the information presented in this draft will supply this foundation.

The requirements presented here are based on the following information sources: The IGMP specifications [RFC1112], [RFC2236] and [IGMPv3], vendor-supplied technical documents [CISCO], bug reports [MSOFT], discussions with people involved in the design of IGMP snooping switches, MAGMA mailing list discussions, and on replies by switch vendors to an implementation questionnaire.

The suggestions in this document are based on IGMP, which applies only to IPv4. For IPv6, Multicast Listener Discovery [MLD] must be used instead. Because MLD is based on IGMP, we do not repeat the entire description and requirements for MLD snooping switches. Instead, we point out the few cases where there are differences from IGMP.

Note that the IGMP snooping function should apply only to IPv4 multicasts. Other multicast packets, such as IPv6, might be suppressed by IGMP snooping if additional care is not taken in the implementation. It is desired not to restrict the flow of non-IPv4 multicasts other than to the degree which would happen as a result of regular bridging functions. Likewise, MLD snooping switches are discouraged from using topological information learned from IPv6 traffic to alter the forwarding of IPv4 multicast packets.

2. IGMP Snooping Requirements

The following sections list the requirements for an IGMP snooping switch. The requirement is stated and is supplemented by a description of a possible implementation approach. All implementation discussions are examples only and there may well be other ways to achieve the same functionality.

2.1. Forwarding rules

The IGMP snooping functionality is here separated into a control

section (IGMP forwarding) and a data section (Data forwarding).

2.1.1. IGMP Forwarding Rules

1) A snooping switch should forward IGMP Membership Reports only to those ports where multicast routers are attached. Alternatively stated: a snooping switch should not forward IGMP Membership Reports to ports on which only hosts are attached. An administrative control may be provided to override this restriction, allowing the report messages to be flooded to other ports.

This is the main IGMP snooping functionality. Sending membership reports (as described in IGMP versions 1 and 2) to other hosts can result in unintentionally preventing a host from joining a specific multicast group. This is not a problem in an IGMPv3-only network because there is no message suppression of IGMP Membership reports.

The administrative control allows IGMP Membership Report messages to be processed by network monitoring equipment such as packet analyzers or port replicators.

The switch supporting IGMP snooping must maintain a list of multicast routers and the ports on which they are attached. This list can be constructed in any combination of the following ways:

a) This list should be built by the snooping switch sending Multicast Router Solicitation messages as described in IGMP Multicast Router Discovery [MRDISC]. It may also snoop Multicast Router Advertisement messages sent by and to other nodes.

b) The arrival port for IGMP Queries (sent by multicast routers) where the source address is not 0.0.0.0.

c) Ports explicitly configured by management to be IGMP-forwarding ports, in addition to or instead of any of the above methods to detect router ports.

2) IGMP snooping switches may also implement "proxy-reporting" in which reports received from downstream hosts are summarized and used to build internal membership states as described in [PROXY]. The IGMP proxy-reporting switch would then report its own state in response to upstream queriers. If the switch does not already have an IP address assigned to it, the source address for these reports should be set to all-zeros.

   An IGMP proxy-reporting switch may act as Querier for the downstream hosts while proxy reporting to the 'real' upstream queriers.

   It should be noted that there may be multiple IGMP proxy-reporting switches in the network all using the 0.0.0.0 source IP address. In this case the switches can be uniquely identified through their link layer source MAC address.

   IGMP membership reports must not be rejected by an IGMP snooping switch because of a source IP address of 0.0.0.0.

3) The switch that supports IGMP snooping must flood all unrecognized IGMP messages to all other ports and must not attempt to make use of any information beyond the end of the network layer header.

   In addition, earlier versions of IGMP should interpret IGMP fields as defined for their versions and must not alter these fields when forwarding the message. When generating new messages, a given IGMP version should set fields to the appropriate values for its own version. If any fields are reserved or otherwise undefined for a given IGMP version, the fields should be ignored when parsing the message and must be set to zeroes when new messages are generated by implementations of that IGMP version. An exception may occur if the switch is performing a spoofing function, and is aware of the settings for new or reserved fields that would be required to correctly spoof for a different IGMP version.

4) An IGMP snooping switch should be aware of link layer topology changes caused by Spanning Tree operation. When a port is enabled or disabled by Spanning Tree, a General Query may be sent on all active non-router ports in order to reduce network

convergence time. Non-Querier switches should be aware of whether the Querier is in IGMPv3 mode. If so, the switch should not spoof any General Queries unless it is able to send an IGMPv3 Query that adheres to the most recent information sent by the true Querier. In no case should a switch introduce a spoofed IGMPv2 Query into an IGMPv3 network, as this may create excessive network disruption.

If the switch is not the Querier, it should use the 'all-zeros' IP Source Address in these proxy queries (even though some hosts may elect to not process queries with a 0.0.0.0 IP Source Address). When such proxy queries are received, they must not be included in the Querier election process.

5) An IGMP snooping switch must not make use of information in IGMP packets where the IP or IGMP headers have checksum or integrity errors. The switch should not flood such packets but if it does, it should also take some note of the event (i.e., increment a counter). These errors and their processing are further discussed in [IGMPv3], [MLD] and [MLDv2].

6) The snooping switch must not rely exclusively on the appearance of IGMP Group Leave announcements to determine when entries should be removed from the forwarding table. It should implement a membership timeout mechanism such as the router-side functionality of the IGMP protocol as described in

[IGMPv3] on all its non-router ports. This timeout value should be configurable.

2.1.2. Data Forwarding Rules

1) Packets with a destination IP (DIP) address in the 224.0.0.X range which are not IGMP must be forwarded on all ports.

This requirement is based on fact that many host systems do not send Join IP multicast addresses in this range before sending or listening to IP multicast packets. Furthermore, since the 224.0.0.X address range is defined as link-local (not to be routed) it seems unnecessary to keep state for each address in this range. Additionally, some routers operate in the

224.0.0.X address range without issuing IGMP Joins, and these applications would break if the switch were to prune them due to not having seen a Join Group message from the router.

2) Packets with a destination IP address outside 224.0.0.X which are not IGMP should be forwarded according to group-based port membership tables and must also be forwarded on router ports. This is the core IGMP snooping requirement for the data path. One approach that an implementation could take would be to maintain separate membership and multicast router tables in software and then "merge" these tables into a forwarding cache.

3) If a switch receives a non-IGMP IPv4 multicast packet without having first processed Membership Reports for the group address, it may forward the packet on all ports but it must forward the packet on router ports. A switch may forward an unregistered packet only on router ports, but the switch must have a configuration option that suppresses this restrictive operation and forces flooding of unregistered packets on selected ports.

   In an environment where IGMPv3 hosts are mixed with snooping switches that do not yet support IGMPv3, the switch's failure to flood unregistered streams could prevent v3 hosts from receiving their traffic. Alternatively, in environments where the snooping switch supports all of the IGMP versions that are present, flooding unregistered streams may cause IGMP hosts to be overwhelmed by multicast traffic, even to the point of not receiving Queries and failing to issue new membership reports for their own groups.

   It is encouraged that snooping switches at least recognize and process IGMPv3 Join Reports, even if this processing is limited

to the behavior for IGMPv2 Joins, i.e., is done without considering any additional "include source" or "exclude source" filtering. When IGMPv3 Joins are not recognized, a snooping switch may incorrectly prune off the unregistered data streams for the groups (as noted above); alternatively, it may fail to add in forwarding to any new IGMPv3 hosts if the group has previously been joined as IGMPv2 (because the data stream is seen as already having been registered).

4) All non-IPv4 multicast packets should continue to be flooded out all remaining ports in the forwarding state as per normal IEEE bridging operations.

   This requirement is a result of the fact that groups made up of IPv4 hosts and IPv6 hosts are completely separate and distinct groups. As a result, information gleaned from the topology between members of an IPv4 group would not be applicable when forming the topology between members of an IPv6 group.

5) IGMP snooping switches may maintain forwarding tables based on either MAC addresses or IP addresses. If a switch supports both types of forwarding tables then the default behavior should be to use IP addresses. IP address based forwarding is preferred because the mapping between IP multicast addresses and link-layer multicast addresses is ambiguous. In the case of Ethernet, there is a multiplicity of 1 Ethernet address to 32 IP addresses [RFC1112].

6) Switches which rely on information in the IP header should verify that the IP header checksum is correct. If the checksum fails, the information in the packet must not be incorporated into the forwarding table. Further, the packet should be discarded.

7) When IGMPv3 "include source" and "exclude source" membership reports are received on shared segments, the switch needs to forward the superset of all received membership reports onto the shared segment. Forwarding of traffic from a particular source S to a group G must happen if at least one host on the shared segment reports an IGMPv3 membership of the type INCLUDE(G, Slist1) or EXCLUDE(G, Slist2) where S is an element of Slist1 and not an element of Slist2.

2.2. IGMP snooping-related problems

A special problem arises in networks consisting of IGMPv3 routers as well as IGMPv2 and IGMPv3 hosts interconnected by an IGMPv2

snooping switch as recently reported [IETF56]. The router will

continue to maintain IGMPv3 even in the presence of IGMPv2 hosts, and thus the network will not converge on IGMPv2. But it is likely that the IGMPv2 snooping switch will not recognize or process the IGMPv3 membership reports. Groups for these unrecognized reports will then either be flooded (with all of the problems that may create for hosts in a network with a heavy multicast load) or pruned by the snooping switch.

Therefore, it is recommended that in such a network, the multicast router be configured to use IGMPv2. If this is not possible, and if the snooping switch cannot recognize and process the IGMPv3 membership reports, it is instead recommended that the switch's IGMP snooping functionality be disabled, as there is no clear solution to this problem.

3. IPv6 Considerations

In order to avoid confusion, the previous discussions have been based on the IGMP protocol which only applies to IPv4 multicast. In the case of IPv6 most of the above discussions are still valid with a few exceptions which we will describe here.

The control and data forwarding rules in the IGMP section can, with a few considerations, also be applied to MLD. This means that the basic functionality of intercepting MLD packets, and building membership lists and multicast router lists, is the same as for IGMP.

In IPv6, the data forwarding rules are more straight forward because MLD is mandated for addresses with scope 2 (link-scope) or greater. The only exception is the address FF02::1 which is the all hosts link-scope address for which MLD messages are never sent. Packets with the all hosts link-scope address should be forwarded on all ports.

MLD messages are also not sent to packets in the address range FF00::/15 (which encompasses both the reserved FF00::/16 and node-local FF01::/16 IPv6 address spaces). These addresses should never appear in packets on the link.

Equivalent to the IPv4 behaviors regarding the null IP Source address, MLD membership reports must not be rejected by an MLD snooping switch because of an unspecified IP source address (::). Additionally, if a non-Querier switch spoofs any General Queries (as addressed in Section 2.1 above, for Spanning Tree topology changes), the switch should use the null IP source address (::)

when sending said queries. When such proxy queries are received, they must not be included in the Querier election process.

The three major differences between IPv4 and IPv6 in relation to multicast are:

- The IPv6 protocol for multicast group maintenance is called Multicast Listener Discovery [MLDv2]. MLDv2 uses ICMPv6 message types instead of IGMP message types.

- The RFCs [IPV6-ETHER] and [IPV6-FDDI] describe how 24 of the 128 bit DIP address are used to form the 48 bit DMAC addresses for multicast groups, while [IPV6-TOKEN] describes the mapping for token ring DMAC addresses by using three low-order bits. The specification [IPV6-1394] makes use of a 6 bit channel number.

- Multicast router discovery is accomplished using Neighbor Discovery Protocol [NDP] for IPv6. NDP uses ICMPv6 message types.

The IPv6 packet header does not include a checksum field. Nevertheless, the switch should detect other packet integrity issues. When the snooping switch detects such an error, it must not include information from the corresponding packet in the MLD forwarding table. The forwarding code should instead drop the packet and take further reasonable actions as advocated above.

The fact that MLDv2 is using ICMPv6 adds new requirements to a snooping switch because ICMPv6 has multiple uses aside from MLD. This means that it is no longer sufficient to detect that the next-header field of the IP header is ICMPv6 in order to identify packets relevant for MLD snooping. A software-based implemention which treats all ICMPv6 packets as candidates for MLD snooping could easily fill its receive queue and bog down the CPU with irrelevant packets. This would prevent the snooping functionality from performing its intended purpose and the non-MLD packets destined for other hosts could be lost.

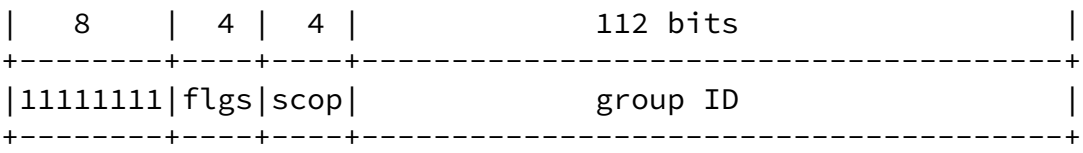
A solution is either to require that the snooping switch looks further into the packets, or to be able to detect a multicast DMAC address in conjunction with ICMPv6. The first solution is desirable when a configuration option allows the administrator to specify which ICMPv6 message types should trigger a CPU redirect and which should not. The reason is that a hardcoding of message types is inflexible for the introduction of new message types. The second solution introduces the risk that new protocols which use

ICMPv6 and multicast DMAC addresses could be incorrectly identified as MLD. It is suggested that solution one is preferred when the

administrative switch is provided. If this is not the case, then the implementator should seriously consider making this switch available since Neighbor Discovery messages would be among those that fall into this false positive case and are vital for the operational integrity of IPv6 networks.

The mapping from IP multicast addresses to multicast DMAC addresses introduces a potentially enormous overlap. The structure of an IPv6 multicast address is shown in the figure below. As a result, there are 2 ** (112 - (32 - 8)), or more than 7.9e28 unique DIP addresses which map into a single DMAC address in Ethernet and FDDI. This should be compared to 2**5 in the case of IPv4.

Initial allocation of IPv6 multicast addresses as described in [RFC2735], however, cover only the lower 24 bits of group ID. While this reduces the problem of address ambiguity to group IDs with different flag and scope values for now, it should be noted that the allocation policy may change in the future. Because of the potential overlap it is recommended that IPv6 address based forwarding is preferred to MAC address based forwarding.



4. IGMP Questionnaire

As part of this work the following questions were asked both on the MAGMA discussion list and sent to known switch vendors implementing IGMP snooping. The individual contributions have been anonymized upon request and do not necessarily apply to all of the vendors' products.

The questions were:

Q1 Does your switches perform IGMP Join aggregation? In other words, are IGMP joins intercepted, absorbed by the

hardware/software so that only one Join is forwarded to the querier?

Q2 Is multicast forwarding based on MAC addresses? Would datagrams addressed to multicast IP addresses 224.1.2.3 and 239.129.2.3 be forwarded on the same ports-groups?

Q3 Is it possible to forward multicast datagrams based on IP addresses (not routed)? In other words, could 224.1.2.3 and

239.129.2.3 be forwarded on different port-groups with unaltered TTL?

Q4 Are multicast datagrams within the range 224.0.0.1 to 224.0.0.255 forwarded on all ports whether or not IGMP Joins have been sent?

Q5 Are multicast frames within the MAC address range 01:00:5E:00:00:01 to 01:00:5E:00:00:FF forwarded on all ports whether or not IGMP joins have been sent?

Q6 Does your switch support forwarding to ports on which IP multicast routers are attached in addition to the ports where IGMP Joins have been received?

Q7 Is your IGMP snooping functionality fully implemented in hardware?

Q8 Is your IGMP snooping functionality partly software implemented?

Q9 Can topology changes (for example spanning tree configuration changes) be detected by the IGMP snooping functionality so that for example new queries can be sent or tables can be updated to ensure robustness?

The answers were:

	Switch Vendor					
	1	2	3	4	5	6
Q1 Join aggregation	x	x	x		x	x
Q2 Layer-2 forwarding	x	x	x	x	(1)	
Q3 Layer-3 forwarding	(1)		(1)		(1)	x
Q4 224.0.0.X aware	(1)	x	(1)	(2)	x	x
Q5 01:00:5e:00:00:XX aware	x	x	x	(2)	x	x
Q6 Mcast router list	x	x	x	x	x	x
Q7 Hardware implemented						
Q8 Software assisted	x	x	x	x	x	x
Q9 Topology change aware	x	x	x	x		(2)

x Means that the answer was Yes.
(1) In some products (typically high-end) Yes; in others No.
(2) Not at the time that the questionnaire was received
but expected in the near future.

Revision History

This section, while incomplete, is provided as a convenience to the working group members. It will be removed when the document is released in its final form.

draft-ietf-magma-snoop-07.txt: May 2003

The current version reflects comments made at the 56'th IETF meeting and from the previous WG last call. The majority of changes appear in sections 2.1 and 2.2, and even the changes here are in reality not substantial.

Substantial comments

Section 2.1.1.(4): Changed wording for IGMP forwarding section on when spoofing of General Queries should occur. Added description of how to avoid IGMP version incompatibility problems when doing said spoofing.

Section 2.1.2.(3): Clarification of incompatibility problems in mixed IGMPv2 and IGMPv3 networks. Added recommendation for switches to implement some level of

IGMPv3 Join recognition to reduce these problems.

Section 2.2: Advice following the briefing [IETF56], that in some cases disabling IGMP snooping functionality is the only 'solution'

Section 6, IPv6 Considerations: added descriptions of behavior involving the IPv6 version of the null IP Source Address (to parallel the IPv4 behaviors).

Added reference to [IGMPv3] in stead of [PROXY] for group membership maintenance and timeout.

Editorial Changes

Really minor stuff such as change of authors email address, addition of references, draft name increment and date changes.

draft-ietf-magma-snoop-06.txt: March 2003

Changes in response to comments made during WG last call and assessment by the WG chairs:

Substantial comments

Clarification in IGMP forwarding section on the acceptance of membership reports with source IP address 0.0.0.0 as being a switch requirement.

Section 2.1.1.(4): Allow the router port to be excluded from the General Query messages

Section 2.1.1.(6): Replace description of timing out older entries with a reference to IGMP/MLD Proxying.

Section 2.1.2.(3): Replaced description of timeout mechanism with a reference to IGMP/MLD.

Section 2.1.2.(4) Expanded rationale to discourage leaking info between IPv4 and IPv6 groups.

Section 3: more strongly encourage the use of a configuration option for selection of ICMPv6 message types.

Editorial comments.

Hyphenation problem resolved for groff by setting then ms HY register to zero, disabling all forms for the entire document
(".hy 0" and ".nr" worked only as far as the following ms macro).

Sections moved around - again - to comply with rfc2223bis-03 draft. Added copyright notice after memo status. Removed table of contents as the draft is fairly short. Corrected a reference typo.

Section 2.1.2.(3): Requirement and rationale broken into separate paragraphs.

Added references to other IPv6 encapsulation documents,

Corrected estimates for MAC address collisions for Ethernet and FDDI: both specification take the low-order four (not six) bytes from the IPv6 group addresses.

draft-ietf-magma-snoop-05.txt: January 2003

Changes in wording of IGMP forwarding rule 6) and Data forwarding rule 7). Corrections in the references section.

Apart from above, no substantial changes has occured in the document. Several editorial changes, however, have been made to comply with the rfc editors requirements:

References splitted in normative and informative sections, other related references added.

Abstract shortened.

Changed all occurances of MUST, MAY etc. to lowercase to reflect that this is not a standards track document.

Sections moved around so they appear in the required order.

draft-ietf-magma-snoop-04.txt: November 2002

Editorial changes only.

draft-ietf-magma-snoop-03.txt: October 2002

IGMP Forwarding rules:
Add references to and become consistant with the current IGMP proxy draft,

Unrecognized IGMP packets should not be ignored because "mbz" fields are not zero since packets from future versions are expected to maintain consistency.

Corrections related to IGMP Querier election process.

Add clarification to how lists of router ports may be assembled.

Data Forwarding rules:
Added discussion of the problems for different IGMP environments in choosing whether to flood or to prune unregistered multicasts.

Added refinements for how to handle NON-IPv4 multicasts, to keep IGMP-snooping functionality from interfering with IPv6 and other multicast traffic. Any filtering for non-IPv4 multicasts should be based on bridge behavior and not IGMP snooping behavior.

IGMP snooping related problems:
Fixed description of interoperability issues in environments with v3 routers and hosts, and v2 snooping switches.

Added discussion of the IGMPv3 "include source" and "exclude source" options, and the inability to support them on shared segments.

IPv6 Considerations:
Clarifications regarding address ranges FF00::, FF01:: and all hosts FF02::1 in relation to data forwarding.

draft-ietf-magma-snoop-02.txt: June 2002

Status section removes document history; moved into this section instead.

Introduction restores text from the -00 revision that describes snooping and its goals

IGMP flooding rules eased, allowing management option to broaden beyond "routers only".

Removed a should/MAY inconsistancy between IPv4 Forwarding and IPv6 processing of checksums.

IGMP Forwarding Rules: clarify text describing processing of non-zero reserved fields.

Data Forwarding Rules, item 3 is changed from "MUST forward to all ports" to "MAY"; item 4 default changes from "MUST" to "should use network addresses".

Added two sets of additional responses to the questionnaire and text indicating that responses don't cover all products.

Removed (commented out) description of IPR issues: IESG is aware of them.

draft-ietf-magma-snoop-01.txt: January 2002

Extensive restructuring of the original text.

draft-ietf-idmr-snoop-01.txt: 2001

Added several descriptions of cases where IGMP snooping implementations face problems. Also added several network topology figures.

draft-ietf-idmr-snoop-00.txt: 2001

Initial snooping draft. An overview of IGMP snooping and the problems to be solved.

5. References

5.1. Normative References

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[IGMPv3] Cain, B., "Internet Group Management Protocol, Version 3", RFC3376, October 2002.

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[IPV6-TOKEN] Crawford, M., Narten, T. and Thomas, S., "Transmission of IPv6 Packets over Token Ring Networks", RFC2470, December 1998.

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[NDP] Narten, T., Nordmark, E. and Simpson, W., "Neighbor Discovery for IP Version 6 {IPv6)", RFC2461, December 1998.

[PROXY] Fenner, B. et al, "IGMP/MLD-based Multicast Forwarding (IGMP/MLD Proxying)", draft-ietf-magma-igmp-proxy-02.txt, November 2002.

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[RFC2236] Fenner, W., "Internet Group Management Protocol, Version 2", RFC2236, November 1997.

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5.2. Informative References

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[CISCO] Cisco Tech Notes, "Multicast In a Campus Network: CGMP and IGMP snooping", http://www.cisco.com/warp/public/473/22.html

[MSOFT] Microsoft support article Q223136, "Some LAN Switches with IGMP Snooping Stop Forwarding Multicast Packets on RRAS Startup", http://support.microsoft.com/support/kb/articles/Q223/1/36.ASP

[IETF56] Briefing by Dave Thaler, Microsoft, presented to the MAGMA WG at the 56'th IETF meeting in San Francisco.

6. Security Considerations

Security considerations for IGMPv3 are accounted for in [IGMPv3]. The introduction of IGMP snooping switches adds the following considerations with regard to IP multicast.

- The exclude source failure, which could cause traffic from sources that are 'black listed' to reach hosts that have requested otherwise. This can also occur in certain network topologies without IGMP snooping.

- It is possible to generate packets which make the switch wrongly believe that there is a multicast router on the segment on which the source is attached. This will potentially lead to excessive flooding on that segment. The authentication methods discussed in [IGMPv3] will also provide protection in this case.

- IGMP snooping switches which rely on the IP header of a packet for their operation and which do not validate the header checksum potentially will forward packets on the wrong ports. Even though the IP headers are protected by the Ethernet checksum this is a potential vulnerability.

- In IGMP, there is no mechanism for denying recipients access to groups (i.e. no "exclude receiver" functionality). Hence, apart from IP-level security configuration outside the scope of IGMP, any multicast stream may be received by any host without restriction.

Generally, IGMP snooping must be considered insecure due to the issues above. However, none of the these issues are any worse for IGMP snooping than for IGMP implementations in

general.

7. Acknowledgements

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