AlliedWare™ OS

How To | Configure IGMP for Multicasting on Routers and Managed Layer 3 Switches

Introduction

Allied Telesis routers and managed layer 3 switches use IGMP—Internet Group Management Protocol—to track which multicast groups their clients belong to. This enables them to send the correct multimedia streams to the correct destination.

This How To Note describes basic and advanced IGMP configuration, in the following major sections:

- an overview of IGMP and definitions of some of the IGMP terminology
- examples and discussion of the most common IGMP functionality—IGMP snooping, IGMP Querier behaviour and selection, and IGMP proxy
- examples and discussion of the advanced functionality available through AlliedWare's feature-rich IGMP implementation
- information for debugging
- information about the STP state of the simple three-switch ring used in most examples

Contents

Products and software versions this note applies to

IGMP is available on all the following Allied Telesis routers and managed layer 3 switches:

- AR400 series routers
- AR700 series routers
- AT-8600 series switches
- AT-8700XL series switches
- Rapier and Rapier i series switches
- AT-8800 series switches
- AT-9800 series switches
- SwitchBlade 4000 series switches
- AT-8948 switches
- AT-9900 series switches
- AT-9900s series switches
- x900 series switches

The following table shows the software versions and products each feature is available on.

IGMP feature	Software versions	Products
Snooping	All	All except AR410, AR410S, AR725 and AR745
Multiple potential queriers	All	All
Proxy	AT-8948, x900-48: 2.8.1 and later Other products: all versions	All except AT-9800 and SwitchBlade
Filtering	2.7.5 and later	All that support this version
Filtering different message types	2.8.1 and later	All that support this version
Throttling	2.7.5 and later	All that support this version
Static IGMP	All	All switches
Configurable counters and timers	All	All
Snooping sub-features:		
Query Solicitation	281-03 and 2.9.1 and later	All switches that support this version
Fast Leave	2.7.5 and later	All that support this version and snooping
Controlling which addresses create All Groups entries	All	All that support snooping
Preventing All Groups entries	2.7.1 and later	All that support this version and snooping
Statically specifying router ports	281-04 and 291-04 and later	All that support this version and snooping

For most examples in this How To Note, we used:

- one AT-8948 switch, with Software Version 2.7.6
- two Rapier 24i switches, with Software Version 2.7.6
- one PC running VLC media player as the multicast server (see www.videolan.org)
- client PCs

IGMP overview

Clients in an IP subnetwork use IGMP to indicate that they are interested in receiving a multicast. IGMP then ensures that routers and switches forward multicast packets out the appropriate ports to the interested clients.

IGMP is very flexible, as the examples in this How To Note show, but the basic operation is simple. When a client wants to start receiving a multicast—which is also called *joining a multicast group*—the client sends an IGMP Membership Report message. When a router or switch is running IGMP and receives a Report message, it starts forwarding traffic for the relevant multicast group to the client.

IGMP periodically polls clients by sending General Query messages, to check that the clients still belong to their multicast groups.

To leave a group, a client sends an IGMP Leave message to indicate that it no longer needs to receive the group traffic.

Note that IGMP does not exchange multicast routing information between subnets. The multicast routing protocols PIM and DVMRP do this.

IGMP terms:

Multicast or Multicast stream

A flow of information—usually video or audio—that can go from one source to many destination clients.

Group

A multicast stream that clients can join. Groups have IP addresses in the 224.0.0.0/4 network.

Group member

A client that belongs to a particular multicast group.

IGMP Querier or Designated Router

A device in a subnetwork that is the coordinator for all multicast streams and IGMP membership information. Each subnetwork has only one Querier (see "Multiple potential IGMP queriers" on page 15). The Querier generates Membership Query messages to check which clients are group members, and processes Membership Reports and Leave messages.

IGMP Snooper

A device that spies on IGMP messages to create flow efficiencies by ensuring that multicast data streams are only sent to interested ports. A Snooper can decide on the best path to send multicast packets at Layer 2 but it cannot alter those packets or generate its own IGMP messages.

IGMP Proxy

A device that passes membership reports upstream and multicast streams and queries downstream. The proxy acts on behalf of clients and servers by altering packets.

Queriers and Snoopers

It is neither necessary nor desirable for every router or switch in an IP subnetwork to coordinate multicast traffic flows. Instead, a single router or switch does this and is called the *Querier* or the *Designated Router*. The Querier generates Query messages to check group membership, and processes Membership Reports and Leave messages.

However, other routers and switches in the network need to know whether to send multicasts out each of their ports. They find out this information by becoming *Snoopers*. Each Snooper checks IGMP messages before forwarding them to and from the Querier, and uses the information in the messages to determine which ports to send multicasts out of.

The key differences between a network's Querier and its Snoopers are:

- The Querier generates Query messages to find out which ports need to transmit each multicast stream. The Snoopers also use Query messages to find this out, but they use the Querier's messages—Snoopers cannot create Query messages themselves.
- The Querier has IGMP enabled as part of its IP configuration. Snoopers do not require any configuration because snooping is enabled by default on Allied Telesis routers and managed layer 3 switches.
- Querying is a layer 3 feature—the Querier looks into the IP headers of packets to determine whether to forward them. IGMP snooping is a layer 2 feature. It does not require an IP configuration.

Messages

The following table describes the different IGMP messages in more detail.

IGMP message types:

Membership Report

A client sends this when it wants to receive a multicast group. The Membership Report is essentially a message that declares an interest in listening to a specified group.

Leave

A client sends this when it wants to leave a group.

General Query

The Querier sends this to all clients—whether or not the Querier is currently sending multicasts to the client—to find out which groups they are listening to. Responses to General Queries ensure that the Querier's group membership information stays up to date.
The group address field for General Queries is set to 0.0.0.0. They are sent to a destination address of 224.0.0.1, and by default Allied Telesis routers and switches send them every 125 seconds.

Specific Query

The Querier sends this to a group address, to check whether clients are still listening to that group. The Querier sends a Specific Query after a client sends a Leave message for that group. Specific Queries enable the Querier to confirm when all downstream clients have left a group, so that the Querier can stop sending the multicast stream.

Membership Query

This is a general term for both Specific and General Queries.

Query Solicit

Switches send this when STP or EPSR detects a topology change. The Querier responds by sending a General Query immediately instead of waiting until groups time out. This remaps IGMP to the new topology as quickly as possible.

Choosing group addresses

This section describes things you need to be aware of when choosing addresses for your multicast groups.

Reserved IP addresses

IP addresses in the range 224.0.0.0-239.255.255.255 are multicast addresses, but many addresses in this range are reserved. Therefore, before choosing a multicast address, you should check its status in the "Internet Multicast Addresses" document at the IANA website at www.iana.org/assignments/multicast-addresses.

IPs using the same MAC

Another complication is that multicasting is designed to use each packet's group IP address to determine a multicast MAC address to send the packet to. However, multicasting does not have a 1:1 mapping of IP address to MAC address—instead each multicast MAC address corresponds to 32 multicast IP addresses. This means that different multicast IP addresses use the same MAC address.

The MAC address only uses the last 23 bits of the IP address; it ignores the IP's first octet and the first bit of the second octet. Note that all IP multicast MAC addresses start with 01-00-5E.

You need to avoid using multiple IP addresses that have the same MAC address. In practice, this means that **if you use x.0.y.z, then do not use x.128.y.z (or vice versa)**, where x is anything from 224-239, and y and z are the same in each IP address. For example, if y=6 and z=200 then these IP addresses use the same MAC: 224.0.6.200, 224.128.6.200, 225.0.6.200, 225.128.6.200, etc.

To see this in detail, consider 224.0.6.200. This has a multicast MAC of 01-00-5E-00-06-C8, like this:

IP address, decimal:	224. 0. 6. 200
IP address, binary:	11100000 00000000 00000110 11001000
MAC address, binary:	0000000 00000110 11001000
MAC address, hex:	01-00-5E -00 -06 -C8

Therefore, the following multicast IP addresses will all have the same MAC address as 224.0.6.200, because their last 23 bits are all the same:

IP address, decimal:	IP address, binary:	
224.0.6.200	11100000 0	0000000 00000110 11001000
224.128.6.200	11100000 1	0000000 00000110 11001000
225.0.6.200	11100001 0	0000000 00000110 11001000
225.128.6.200	11100001 1	0000000 00000110 11001000
226.0.6.200	11100010 0	0000000 00000110 11001000
226.128.6.200	11100010 1	0000000 00000110 11001000
227.0.6.200	11100011 0	0000000 00000110 11001000
227.128.6.200	11100011 1	0000000 00000110 11001000
...	...	...
239.0.6.200	11101111 0	0000000 00000110 11001000
239.128.6.200	11101111 1	0000000 00000110 11001000
	Different IPs	The same MAC

Avoid x.0.0.y, x.0.1.y, x.128.0.y, and x.128.1.y

It is particularly important to avoid using any address in the ranges x.0.0.y, x.128.0.y, x.0.1.y, or x.128.1.y (where x is 224-239 and y is 1-254).

This is because x.0.0.y and x.128.0.y will map to the same multicast MAC address as 224.0.0.y. Similarly, x.0.1.y and x.128.1.y will map to the same multicast MAC address as 224.0.1.y. Most addresses in the ranges 224.0.0.y and 224.0.1.y are reserved for contacting all routers, or for routing protocol messages, so they are always flooded out all ports in the relevant VLAN.

Therefore, all addresses in the ranges x.0.0.y, x.128.0.y, x.0.1.y, or x.128.1.y are flooded out every port in the relevant VLAN. Using these addresses can significantly increase multicast traffic in your network.

If you are debugging a situation where it seems that certain multicast groups are forwarded when you think they shouldn't be, check whether the choice of group addresses has violated any of the recommendations above.

IGMP snooping

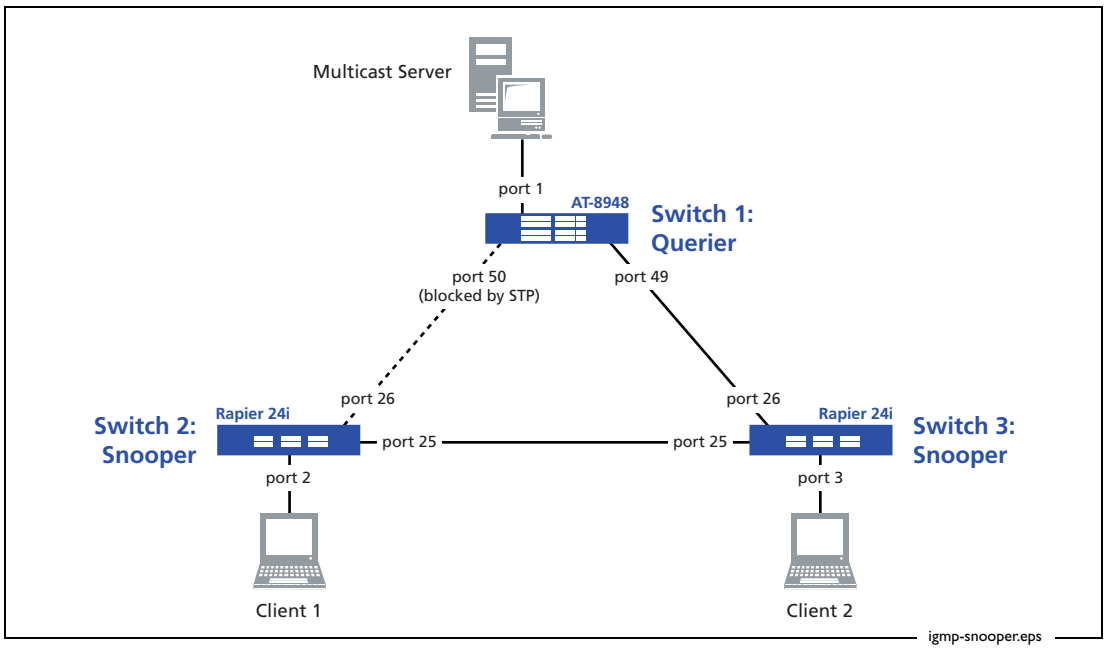
In this example, we discuss IGMP snooping, the key to efficient multicast traffic flow in a layer 2 network. IGMP snooping is enabled by default on switch ports in Allied Telesis managed layer 3 switches and routers—it does not require any configuration.

In a single-switch network, IGMP snooping makes multicasting happen with no configuration at all. All you need to do is connect your server and clients to the switch.

In a multi-switch network, at least one switch must also have an IGMP configuration. This switch is called the IGMP Querier and coordinates the flow of multicast information through the network. The following example describes a multi-switch configuration, so as well as discussing the effect of IGMP snooping, it outlines the actions that the Querier takes. "Multiple potential IGMP queriers" on page 15 discusses the role of the Querier in greater detail.

Example

This example has a 3-switch loop, as shown in the following figure. One of the switches is running IGMP and the other two switches are running IGMP snooping.



▶ Configure switch 1

Switch 1 is configured with IGMP, which makes it the IGMP Querier in this network. It is best practice to make the Querier the closest switch to the multicast source, and in this example switch 1 is closest. For more information about queriers see "Multiple potential IGMP queriers" on page 15.

```
set system name="Switch 1"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper. It forwards multicast packets and IGMP messages as required. IGMP snooping is enabled by default and does not need any configuration.

```
set system name="Switch 2"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes
```

▶ Configure switch 3

Switch 3 is also an IGMP Snooper. It forwards multicast packets and IGMP messages as required. IGMP snooping is enabled by default and does not need any configuration.

```
set system name="Switch 3"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes
```

Explanation of IGMP snooping

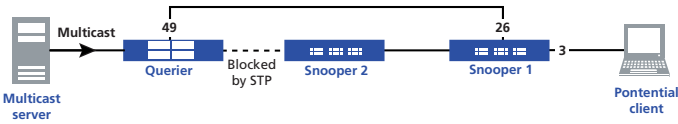
This section steps through the events that occur in a typical use of multicasting in this network: to stream multicast packets for a group.

IGMP learning process

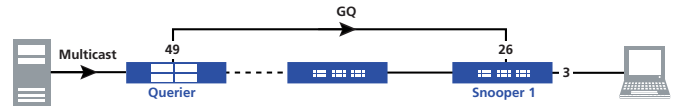
The following figure shows the process by which IGMP tracks multicast clients and ensures that the correct clients receive the stream.

What happens before a multicast client exists:

1. Querier starts receiving multicast stream from server. Querier has no interested clients so doesn't forward multicast.



2. Querier sends General Query (GQ) to find out if any would-be clients exist. Snooper 1 receives Query on port 26, snoops Query, and creates All Groups entry for port 26.



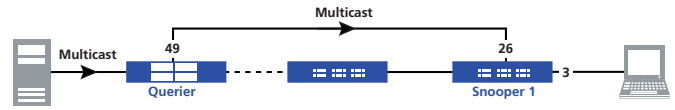
3. Snooper 1 forwards Query out all ports. No clients exist, so no clients reply to Query.

What happens when a client joins a multicast group:

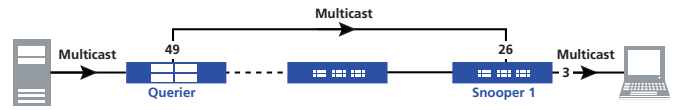
4. Client joins group by sending Membership Report to the group address.

5. Snooper 1 receives Report on port 3, snoops Report, and adds a group entry for port 3. Snooper 1 forwards Report out its All Groups port.

6. Querier receives Report on port 49 and adds a group entry for port 49. Querier starts forwarding multicast stream out port 49.



7. Snooper 1 receives multicast stream and forwards it out port 3.



8. Querier continues to send General Queries periodically. These keep All Groups entries alive on Snoopers.

igmp-join.eps

Using Show command output to investigate IGMP state

No group members

In the first stage of the figure above, the multicast server is turned on and is streaming group 224.12.13.14 to the Querier, switch 1. Switch 1 knows about the group, but has nobody interested in receiving it. You can see this by using the command **show igmpsnooping** on switch 1. The output of this command shows that switch 1 has an entry for the group, but no associated ports.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 136 secs
  Ports  None

------------------------------------------------------------------------
```

Client joins the group

When a client joins the group, the Group List changes for the Snooper that the client is attached to, and for the Querier. First, look at the output of the command **show igmpsnooping** on the Snooper.

```
Manager Switch 3> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 257 secs
  Ports  3

  All Groups                                 Entry timeout 235 secs
  Ports  26

------------------------------------------------------------------------
```

This output now shows two entries, one for each of the following:

- group 224.12.13.14 and port 3, which shows that the client is attached to the Snooper through port 3 and is listening to group 224.12.13.14. The Snooper created this entry at stage 5 in the process ("IGMP learning process" on page 11). This entry means that the Snooper forwards packets from 224.12.13.14 out port 3.
- All Groups and port 26, which shows that the Snooper is connected to the Querier through port 26. The Snooper created this entry at stage 2 in the process. This entry means that the Snooper forwards all IGMP Reports and Leave messages out port 26.

The All Groups entry means that the Snooper forwards the Report from the client out port 26 to the Querier, switch 1. The Querier receives the Report on port 49.

Next, look at the output of the command **show ip igmp** on the Querier.

```
Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval ........... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

 Group. 224.12.13.14      Last Adv. 172.31.0.223     Refresh time 256 secs
  Ports  49

------------------------------------------------------------------------
```

The output above shows an entry for group 224.12.13.14 and port 49. This entry shows that the Querier knows about a client for 224.12.13.14 which it reaches by forwarding the multicast out port 49. The Querier created this entry at stage 6 in the process.

Finally, look at the output of the command **show igmpsnooping** on the Querier. Even though switch 1 is the Querier for this network instead of a Snooper, this command shows that a client for group 224.12.13.14 is reached out port 49.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 247 secs
  Ports  49

--------------------------------------------------------------------------
```

When a client leaves a group

When a client wants to stop receiving a group's multicast stream, it sends an IGMP Leave message with a destination address of the group. The Snooper forwards the Leave message out its All Groups port, so the message arrives at the IGMP Querier. At this point, the IGMP Querier sends a series of Specific Queries (2 by default) to see if anybody else is still listening to this group.

If the Snooper receives a response to the Specific Queries, it forwards the response to the Querier and continues to forward the multicast stream to the ports that want to receive it. If the Snooper does not receive a response to the Specific Queries, it stops forwarding the stream.

For a detailed description of how the leave process works, see "How clients leave groups: queries and timers" on page 58.

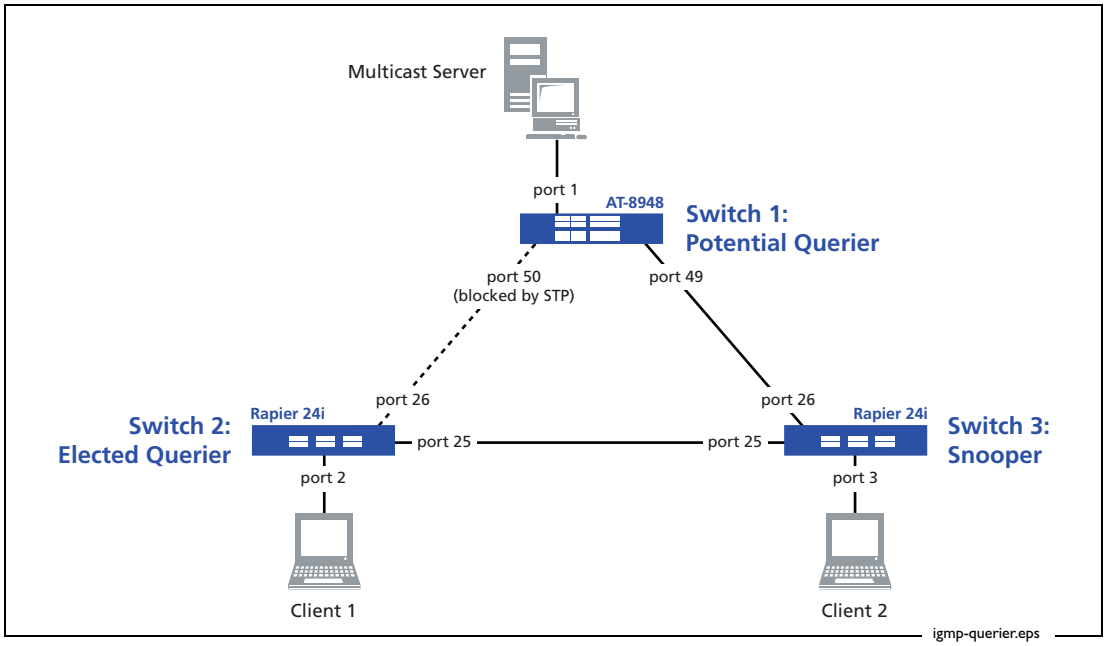
Multiple potential IGMP queriers

To find out more about IGMP, we next investigate what happens when more than one router or switch has an IGMP configuration.

RFC 2236, Internet Group Management Protocol, Version 2, says that each Layer 2 network should have only one IGMP Querier. You may configure IGMP on more than router or switch, perhaps for redundancy, but the routers and switches have a pseudo election and the device with the lower IP becomes the operating IGMP Querier. This example describes a network with two potential Queriers.

Example

The network for this example uses the same loop as for "IGMP snooping" on page 9 and is shown in the following figure.



Both switch 1 and switch 2 are configured with IGMP, making both of them potential Queriers. Switch 3, by default configuration, is an IGMP Snooper.

▶ Configure switch 1

Switch 1 is a potential IGMP Querier. It acts as a Snooper if it is not elected as the Querier.

```
set system name="Switch 1"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes
```

▶ Configure switch 2

Switch 2 is also a potential IGMP Querier. It acts as a Snooper if not elected as the Querier.

```
set system name="Switch 2"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.253 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes
```

▶ Configure switch 3

Switch 3 is an IGMP Snooper. It forwards multicast packets and IGMP messages as required. IGMP snooping is enabled by default and does not need any configuration.

```
set system name="Switch 3"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes
```

Explanation of Multiple potential IGMP queriers

When there are no group members

Switch 1 and switch 2 are both possible Queriers, and an election determines which switch becomes the actual Querier. We can see the results of the election by using the command **show ip igmp** on each switch.

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100
Other Querier timeout ... 209 secs
Group List ..............

-------------------------------------------------------------------------
```

```
Manager Switch 2> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100              (DR)
IGMP Proxy .............. Off
Group List ..............

-------------------------------------------------------------------------
```

In the output from switch 2 above, switch 2 reports that it has become the Querier by displaying *(DR)*—which stands for Designated Router—next to the interface name.

In the output from switch 1 above, switch 1 has an entry for *Other Querier timeout*, which indicates that it is aware that another device is the IGMP Querier. If the timer expires, switch 1 will decide that the other Querier no longer exists, and will become the Querier itself. The timer is refreshed by a Membership Query or an IGMP Querier election.

Note: Switch 2 shows an IGMP Proxy entry, which is set to Off (see "IGMP proxy" on page 21). Switch 1 does not show a Proxy entry because the AT-8948 did not support IGMP Proxy on Software Version 2.7.6 which this example used.

When a client joins a group

Now imagine that Client 1 sends a Membership Report to switch 2 for the group 224.12.13.14. If we check the group membership for switch 2 by using the command **show igmpsnooping**, we see a group entry for 224.12.13.14.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 225 secs
  Ports  2

------------------------------------------------------------------------
```

If we check the group membership for switches 1 and 3, we see no entries for 224.12.13.14, but see an All Groups entry on each switch. The All Groups entry points to the Querier, switch 2. The output for switch 1, for example, shows port 49 as the All Groups port, indicating that switch 1 reaches the Querier via port 49.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 25 secs
  Ports  None

  All Groups                                 Entry timeout 177 secs
  Ports  49

------------------------------------------------------------------------
```

Note: An All Groups port does not necessarily indicate that an IGMP Querier can be found via that port—it could be a router instead. See "Controlling which addresses create All Groups entries" on page 95 for more information.

To see the difference between a switch acting as a Snooper and a switch acting as a Querier, compare the IGMP snooping table for switch 1 (above) with its IGMP table (below). They seem to contradict each other. The IGMP snooping table tells us that switch 1 is aware that it is receiving the group 224.12.13.14 and will send all groups (including this one) out port 49 towards the IGMP Querier, switch 2. However, the IGMP table shows that IGMP has not registered any interested clients—the group list is empty.

```
Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100
Other Querier timeout ... 214 secs
Group List ..............

------------------------------------------------------------------------
```

This disparity between the IGMP snooping table and the IGMP table simply shows that switch 1 is acting as a Snooper because it did not become the Querier. The IGMP table on switch 1 has no entries because no Report message has been seen on switch 1. The disparity does not appear in the output for switch 2, because switch 2 is the Querier. The IGMP and IGMP snooping tables show the same group entries on switch 2.

```
Manager Switch 2> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
IGMP Proxy .............. Off
Group List ..............

  Group. 224.12.13.14      Last Adv. 172.31.0.222     Refresh time 228 secs
   Ports  2
------------------------------------------------------------------------
```

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                      Entry timeout 225 secs
  Ports  2

--------------------------------------------------------------------------
```

Also, note that *(DR)* appears in the output of **show ip igmp** on switch 2. This tells you that switch 2 is the Designated Router (the IGMP Querier) for vlan100.

IGMP proxy

In very simple tree-design networks, IGMP Proxy is a useful simple alternative to a multicast routing protocol for multicasting between VLANs.

An IGMP Proxy sends IGMP Membership Report and Leave group messages to an upstream subnetwork on behalf of downstream devices, and sends Queries downstream. In other words, an IGMP Proxy effectively ferries IGMP messages from one VLAN to another. The IGMP Proxy looks like an IGMP Querier to the downstream VLAN, and like a client to the upstream VLAN. Note that the Proxy can only have one configured upstream VLAN.

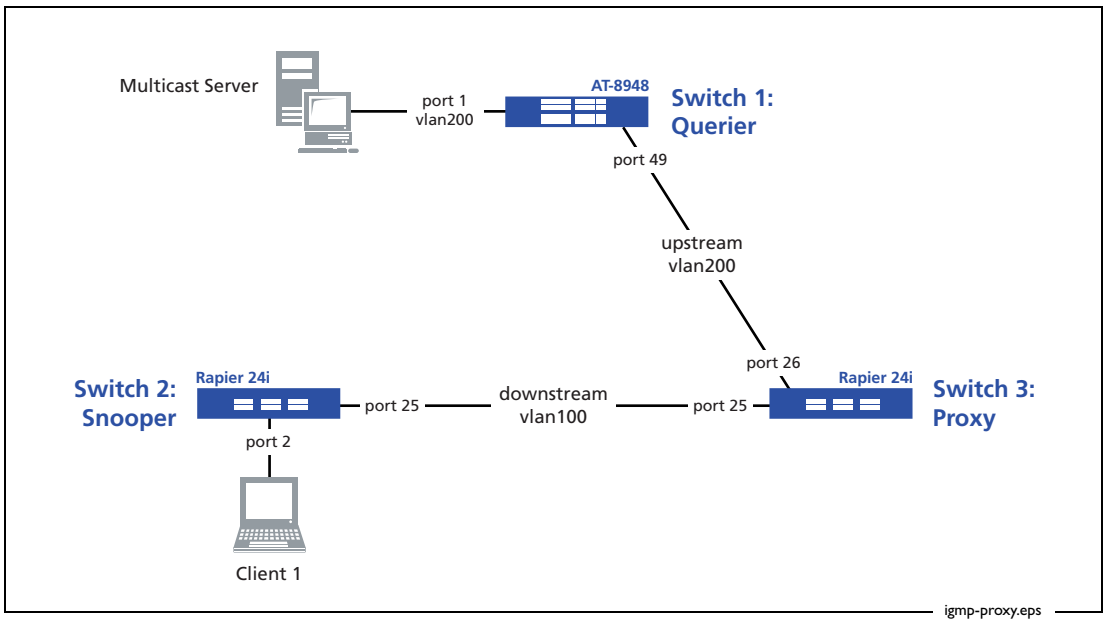
IGMP Proxy is available on all Allied Telesis routers and managed layer 3 switches except AT-9800 and SwitchBlade series. For AT-8948, AT-9900 and x900-48 series switches, it requires software version 2.8.1 or later.

If you use IGMP Proxy on a switch, multicast data packets are processed by the CPU so are not forwarded at wirespeed.

Example

IGMP Proxy only works in tree networks, so for this example we convert the network from a loop into a tree by disabling port 50 on the AT-8948 switch.

Switch 3 is the IGMP Proxy. Switch 1 is upstream of the Proxy. Switch 2 is downstream of the Proxy on vlan100. Therefore, the multicast server and client 1 are now in different VLANs and switch 3 sits on the boundary between the two VLANs. This network is shown in the following figure.



▶ Configure switch 1

Switch 1—the closest switch to the multicast source—is an IGMP Querier.

```
set system name="Switch 1"

# Switching configuration
disable switch port=50 link=disable

# VLAN general configuration
create vlan=vlan200 vid=200
add vlan=200 port=1-49

# IP configuration
enable ip
add ip int=vlan200 ip=172.31.1.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan200
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper. IGMP snooping is enabled by default and does not need any configuration.

```
set system name="Switch 2"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.252 mask=255.255.255.0
```

▶ Configure switch 3

Switch 3 is an IGMP Proxy.

```
set system name="Switch 3"

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-25
create vlan=vlan200 vid=200
add vlan=200 port=26

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.253 mask=255.255.255.0
igmpproxy=downstream
add ip int=vlan200 ip=172.31.1.253 mask=255.255.255.0 igmpproxy=upstream
enable ip igmp
enable ip igmp int=vlan100
enable ip igmp int=vlan200
```

Explanation of IGMP proxy

When there are no group members

The multicast server streams group 224.12.13.14 to switch 1 through port 1. IGMP snooping detects the stream, as you can see by using the command **show igmpsnooping** on switch 1.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan200 (200)
Group List ..............

  Group. 224.12.13.14                        Entry timeout 122 secs
  Ports  None

--------------------------------------------------------------------------
```

When a client joins a group

Client 1 (attached to switch 2, the Snooper) sends an IGMP Membership Report for the group 224.12.13.14. Switch 2 forwards that report message in an unmodified state out its All Groups ports—in this case port 25.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 256 secs
  Ports  2

  All Groups                                 Entry timeout 145 secs
  Ports  25

--------------------------------------------------------------------------
```

Switch 3—the Proxy—receives the report on its downstream interface, vlan100. Switch 3 then creates a new report with itself as the sender. It sends this report upstream to switch 1

through vlan200. Output of the commands **show ip igmp** and **show igmpsnooping** show that switch 3 knows of a client interested in the group 224.12.13.14 through port 25.

```
Manager Switch 3> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
IGMP Proxy .............. Downstream
Group List ..............

  Group. 224.12.13.14      Last Adv. 172.31.0.222     Refresh time 243 secs
  Ports  25


Interface Name .......... vlan200
Other Querier timeout ... 0 secs
IGMP Proxy .............. Upstream
Group List ..............

  No group memberships.

-------------------------------------------------------------------------
```

```
Manager Switch 3> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 239 secs
  Ports  25


Vlan Name (vlan id) ..... vlan200 (200)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 260 secs
  Ports  None

-------------------------------------------------------------------------
```

Switch 1 receives the proxied report from switch 3. Switch 1 notes that switch 3 is interested in the group 224.12.13.14 and sends the group multicast to switch 3 on port 49. Output of the command **show igmpsnooping** shows the membership that switch 1 is aware of.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan200 (200)
Group List ..............

  Group. 224.12.13.14                        Entry timeout 182 secs
  Ports  49
--------------------------------------------------------------------------
```

When a client leaves a group

When the client on switch 2 wants to stop receiving the group's multicast stream, it sends an IGMP Leave message. The switches use the above process to transfer the message to switch 1.

Note the following points about how IGMP Proxy deals with Leave messages:

- The Proxy sends an IGMP Leave Group message via its upstream interface only when the last interface on the Proxy leaves the group.
- The Proxy does not respond to IGMP Join or Leave Group messages received via its upstream interface, but only to those received via downstream interfaces.
- The Proxy does respond to IGMP query messages received via its upstream interface. When the Proxy—switch 3 in this example—sends a Leave Group message upstream, the upstream IGMP Querier—switch 1—sends a membership query. Switch 3 takes that query and proxies it to the downstream interface, vlan100, with its own IP as the source (172.31.0.253). This means any other interested clients on switch 2 can declare their interest in continuing to receive the multicast stream.

Query solicitation (rapid recovery from topology changes)

Query Solicitation minimises loss of multicast data after a topology change. It is a built-in feature of Allied Telesis managed layer 3 switches since software versions 281-03 and 2.9.1 when running EPSR or spanning tree (STP, RSTP, or MSTP) for loop protection.

Without Query Solicitation, when the underlying link layer topology changes, multicast data flow can stop for up to several minutes, depending on which port goes down and how much of the timeout period was left (see "Why convergence takes so long without query solicitation" on page 28). Query Solicitation greatly reduces this disruption.

Query Solicitation operates without configuration in networks of Allied Telesis managed layer 3 switches running STP, RSTP, MSTP or EPSR. You may find it helpful to manually enable it in the following other situations:

- loop-free networks running IGMP (see page 33)
- networks in which not all switches support Query Solicitation (see page 33)

How query solicitation works

Query Solicitation monitors STP, RSTP, MSTP and EPSR messages for topology changes. When it detects a change, it generates a special IGMP Leave message called a Query Solicit. The switch floods the Query Solicit message to all ports in every VLAN that Query Solicitation is enabled on. When the Querier receives the Query Solicit message, it sends out a General Query and waits for clients to respond with Membership Reports. These Reports update the snooping information throughout the network.

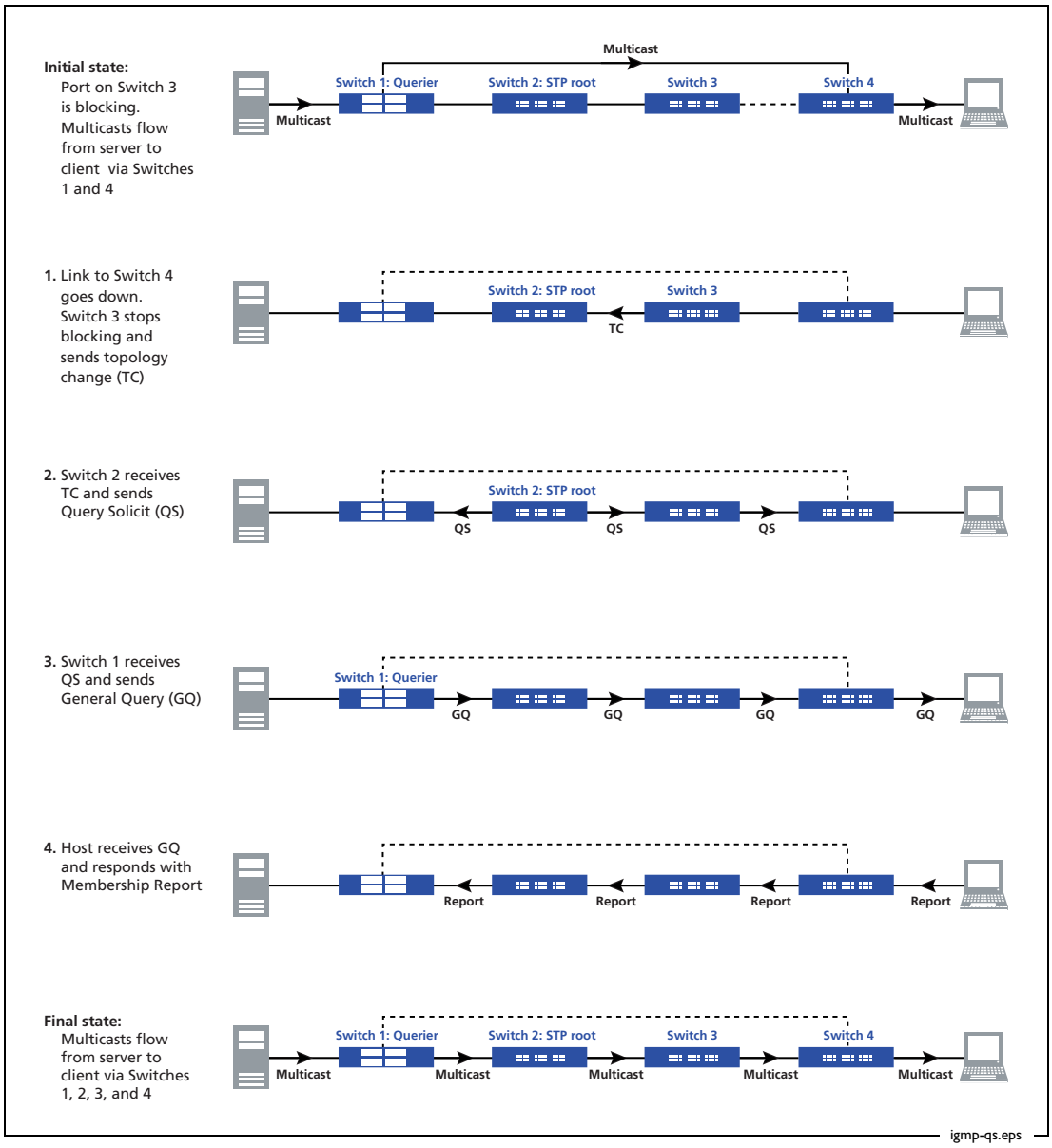
Query Solicit messages have a group address of 0.0.0.0.

Query Solicitation works by default (without you enabling it) on all VLANs on the root bridge in an STP instance and on all data VLANs on the master node in an EPSR instance. By default, the root bridge or master node always sends a Query Solicit message when any of the following events occur:

- an STP BPDU packet with the Topology Change (TC) flag arrives at the root bridge
- an STP port on a switch goes from a Discarding to Forwarding state
- the FDB gets flushed by EPSR

If necessary, you can make clients respond more quickly to the General Query by tuning the IGMP timers, especially the Query Response Interval—see page 77.

The following figure shows how Query Solicitation works when a port goes down.



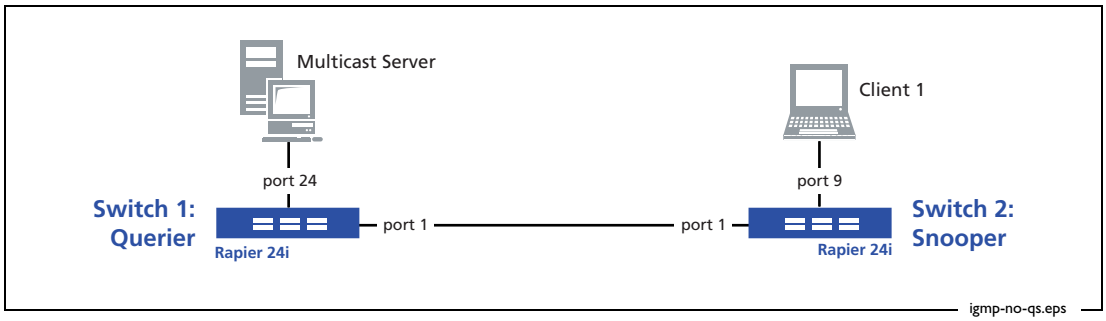
Why convergence takes so long without query solicitation

This section illustrates IGMP convergence in a simple network that does not need STP because it has no switch loops. Query Solicitation is disabled by default in networks like this, because no switch is an STP root bridge or an EPSR master node.

In this network, it takes up to 125 seconds for multicasting to recover after a port comes back up. This section explains the reason for the slow convergence. "Speeding up IGMP convergence in a non-looped topology" on page 33 explains the solution.

Example

The following figure shows the network for the example in this section.



The example considers what happens when a port comes up. When the port was down, the client stopped receiving multicasts, because there was no backup route available. The example shows how the network recovers. The multicast group is 224.12.13.14.

▶ Configure switch 1

Switch 1 is configured with IGMP, which makes it the IGMP Querier in this network.

```
set system name="Switch 1"

# IP configuration
enable ip
add ip int=vlan1 ip=10.13.2.191 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan1
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper. It forwards multicast packets and IGMP messages as required. IGMP snooping is enabled by default and does not need any configuration.

```
set system name="Switch 2"

# IP configuration
enable ip
add ip int=vlan1 ip=10.13.2.193 mask=255.255.255.0
```

Explanation from the perspective of switch 2, the snooper

When link is up

When the link is connected (all ports are up), the Snooper has entries for two ports:

- port 9, which is the Snooper's connection to the client. The Snooper sends the multicast stream out this port, as well as sending Queries (the Snooper floods Queries out all its ports)
- port 1, which is the Snooper's connection to the Querier. This is an All Groups entry, so the Snooper forwards Reports out this port.

The output of the command **show igmpsnooping** shows both entries.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ..............

  Group. 224.12.13.14                        Entry timeout 228 secs
  Ports  9

  All Groups                                 Entry timeout 232 secs
  Ports  1

-------------------------------------------------------------------------
```

When link goes down

When we disconnect port 1 on the Snooper, the All Groups entry disappears.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ..............

Group. 224.12.13.14                        Entry timeout 196 secs
  Ports  9

-------------------------------------------------------------------------
```

The Snooper still knows to send Queries and the multicast stream out port 9. However, it does not know where to send any IGMP Report messages.

When link comes up again

When we reconnect port 1 on the Snooper, the All Groups entry does **not** reappear.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ..............

Group. 224.12.13.14                        Entry timeout 140 secs
  Ports  9

--------------------------------------------------------------------------
```

Eventually, the Querier sends an IGMP Query, which the Snooper receives on port 1. This restores the All Groups port on the Snooper. By default the Querier sends General Queries every 125 seconds, so the IGMP convergence delay will be up to 125 seconds with the default settings. For more information about this timeout, see "Configurable IGMP timers and counters" on page 69—but do not change the timeout without very carefully considering the effect on your network.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ..............

  Group. 224.12.13.14                        Entry timeout 107 secs
  Ports  9

  All Groups                                 Entry timeout 236 secs
  Ports  1

--------------------------------------------------------------------------
```

When the Snooper receives the General Query, it forwards it out all its ports. The client responds with a Report. The Snooper forwards the Report out its All Groups port towards the Querier. The Querier responds by sending the multicast stream to the Snooper, which forwards the multicast stream out port 9 to the client.

Explanation from the perspective of switch 1, the querier

When link is up

When the link is connected (all ports are up), the Querier has an entry for port 1, so it sends the group 224.12.13.14 out port 1. The output of the command **show igmpsnooping** shows this entry.

```
Manager Switch 1> show igmpsnooping

Manager A> show igmpsnooping
IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave ............... Off
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ..............

  Group. 224.12.13.14                        Entry timeout 18 secs
  Ports  1

-------------------------------------------------------------------------
```

When link goes down

When we disconnect port 1 on the Snooper, the port disappears. The Querier is still receiving the multicast stream from the server, so the group entry remains.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave ............... Off
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ..............

  Group. 224.12.13.14                        Entry timeout 255 secs
  Ports  None

-------------------------------------------------------------------------
```

When link comes up again

When we reconnect port 1 on the Snooper, the port does not reappear because the Querier has not yet received a Report over it. Therefore, the Querier does not start forwarding the multicast stream out the port.

Eventually, the Querier sends an IGMP Query out all its ports. In response it receives a Report from the client (via the Snooper). This restores the port entry and the Querier starts sending the multicast stream again.

The output of the commands **show igmpsnooping** and **show ip igmp** both show this restored entry.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ..............

  Group. 224.12.13.14                        Entry timeout 115 secs
  Ports  1

--------------------------------------------------------------------------
```

```
Manager Switch 1> show ip igmp

IGMP Protocol
--------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name ..................... vlan1               (DR)
IGMP Status ........................ Enabled
IGMP Proxy ......................... Off
General Query Reception Timeout .... None
Group List ........................

  Group. 224.12.13.14      Last Adv. 10.13.2.11       Refresh time 110 secs
   Ports  1
--------------------------------------------------------------------------
```

Speeding up IGMP convergence in a non-looped topology

The previous section described how it can take up to 125 seconds for multicasting to recover in a non-looped topology after a port comes back up. You can speed up convergence simply by enabling RSTP. This enables the network to use Query Solicitation and means that multicasting resumes within 3 seconds of the link coming up.

Even though there is no loop in the network, one of the switches becomes the STP root bridge—it does not matter which switch does this. When the link comes up, the root bridge detects the topology change and sends a Query Solicitation.

So you just need to enter the following commands on all switches:

```
enable stp=default
set stp=default mode=rapid
```

Enabling query solicitation on multiple switches in a looped topology

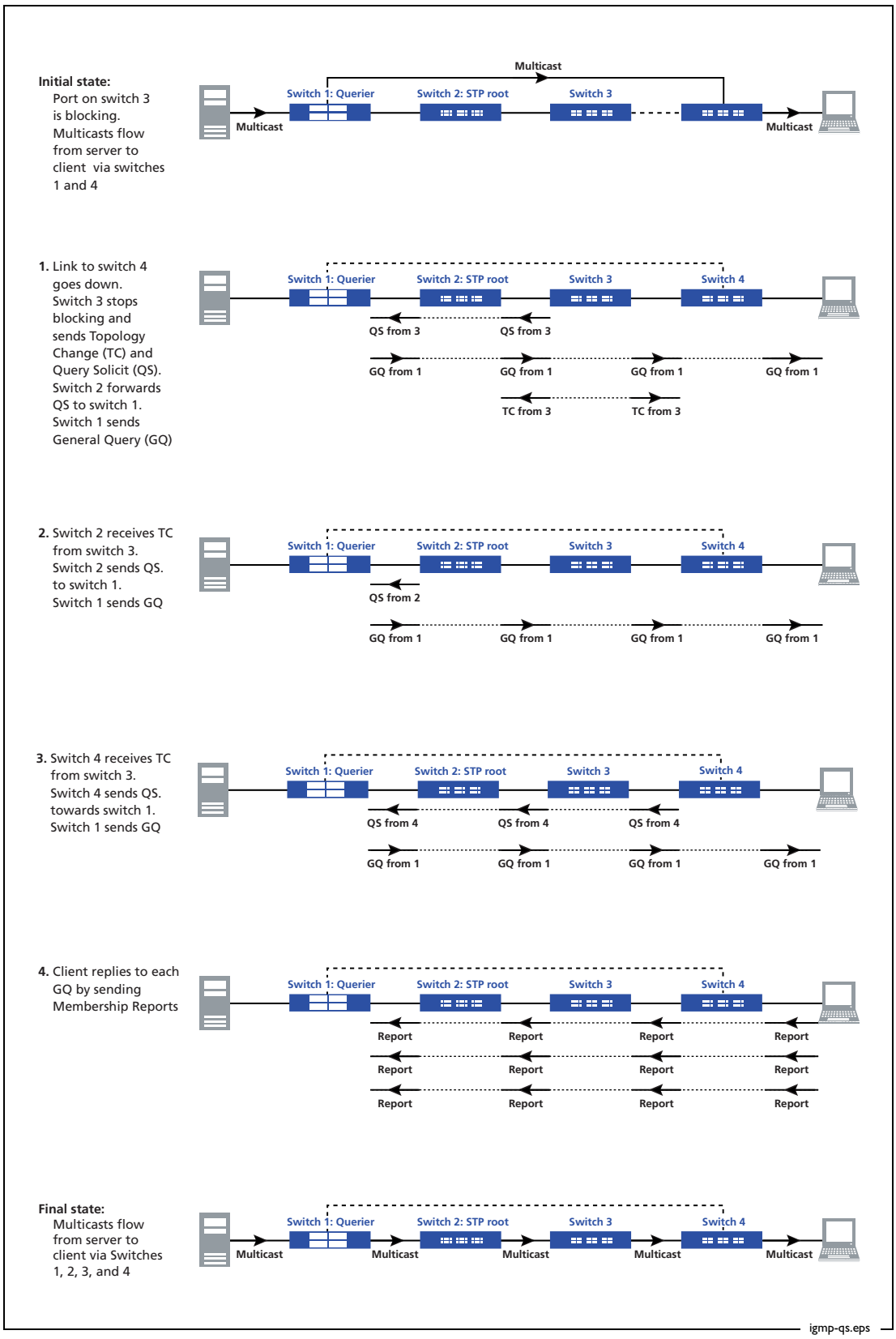
On networks that use spanning tree or EPSR, Query Solicitation is not normally required on switches other than the STP root bridge or EPSR master node. Therefore, it is only enabled by default on the root bridge and the master node.

However, in some networks you may need to turn on Query Solicitation on all switches—for example, if the network includes other switches that do not support Query Solicitation and therefore the STP root bridge may be a switch that does not send Query Solicit messages. To enable Query Solicitation, use the command:

```
set igmpsnooping vlan={vlan-name|1..4094|all} querysolicit={on|
   yes|true}
```

Every switch that has Query Solicitation enabled sends a Query Solicit message when it detects a topology change. Enabling it on multiple switches means you get multiple messages, but has no other disadvantage.

The following figure shows a the packet flow for a four-switch network with Query Solicitation enabled on all the switches.



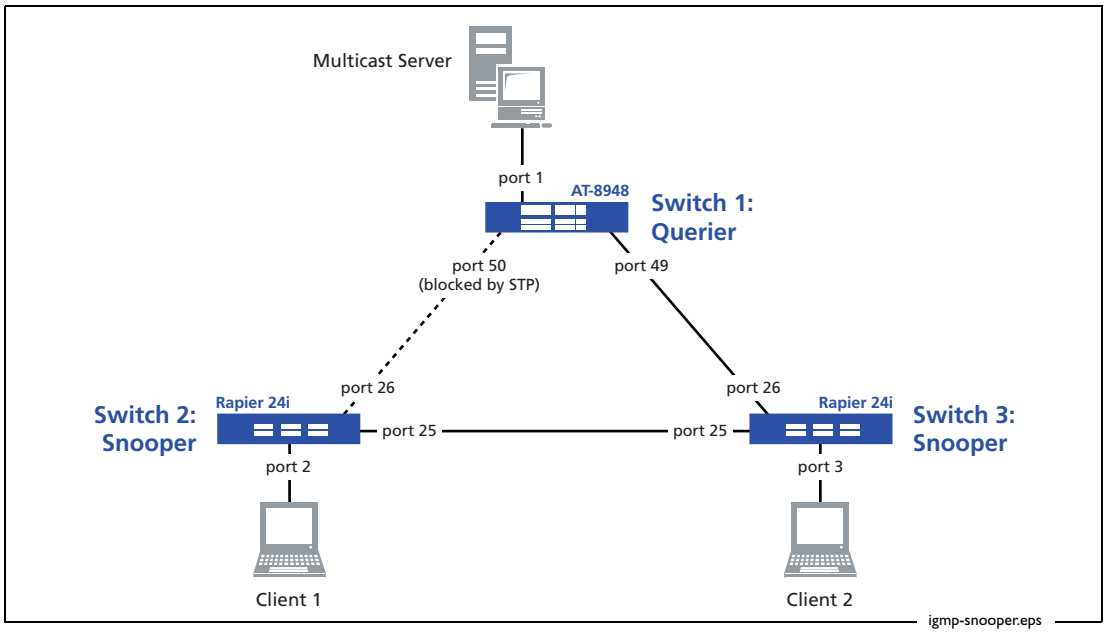
So one topology change caused three Query Solicits, three General Queries, and three Reports.

IGMP filtering (controlling multicast distribution)

IGMP filtering lets you control the distribution of multicast services on each switch port. Filtering is useful for subscription services when clients must be explicitly authorised to view a multicast stream. It is available in Software Version 2.7.5 or later.

Example

This example shows how to stop a host joining the Group 224.0.1.22 and allow it to join all other Groups. It uses the same network configuration as "IGMP snooping" on page 9. For convenience, the diagram is reproduced below.



The network contains a Windows 2000 workstation that regularly sends SVRLOC messages (an IGMP Membership Report for 224.0.1.22). This group gets added to the list of groups in vlan100 on switch 1, as shown in the following output of the **show ip igmp** command.

```
Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ............................ Enabled
Default Query Interval ............ 125 secs
Default Timeout Interval ......... 260 secs

...

Interface Name .......... vlan100              (DR)
Group List ..............

  Group. 224.0.1.22        Last Adv. 172.31.0.99       Refresh time 251 secs
   Ports  1

------------------------------------------------------------------------
```

We do not need to receive this multicast, so we will filter it out.

▶ Configure switch 1

Switch 1—the closest switch to the multicast source—is an IGMP Querier. The filter is configured on it, as shown in bold in the script below.

Note that the order of entries in a filter is important. When IGMP tries to match a message to a filter, it performs a linear search of the filter to find a matching entry, starting with the lowest-numbered entry. It stops processing the filter at the first match it finds. Therefore, this filter has an entry with one multicast group and an action of **exclude**, followed by an entry with all multicast groups and an (implicit) action of **include**.

Different message types

Also note that in software versions 2.8.1 and later, each entry filters only one type of IGMP message. To control the type of message, use the **msgtype** parameter in the following command:

```
add igmp filter=filter-id groupaddress={ipadd|ipadd-ipadd}
   [entry=1..65535] [action={include|exclude}] [msgtype={query|
   report|leave}]
```

In software version 2.8.1, this parameter is mandatory. Since software versions 281-01 and 2.9.1, the parameter is optional with a default of **report**. In this example we are filtering Reports, so we do not need to specify the message type.

```
set system name="Switch 1"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# Switching configuration
set switch port=1 igmpfilter=1

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100
create igmp filter=1
add igmp filter=1 entry=1 group=224.0.1.22 action=exclude
add igmp filter=1 entry=2 group=224.0.0.0-239.255.255.255
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper. IGMP snooping is enabled by default and does not need any configuration.

```
set system name="Switch 2"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

▶ Configure switch 3

Switch 3 is also an IGMP Snooper.

```
set system name="Switch 3"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

Explanation of IGMP filtering (controlling multicast distribution)

Immediately after applying the filter, we check the group entries on switch 1 by using the command **show ip igmp**, and see that the switch still has an entry for the group we are filtering out.

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval ........... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

  Group. 224.0.1.22       Last Adv. 172.31.0.99      Refresh time 192 secs
   Ports  1

-------------------------------------------------------------------------
```

This entry is still there because the switch had previously received a report for the group. Since applying the filter, there have not been any messages for the group, so the switch has not yet filtered the group out. We can see this by using the command **show igmp filter** to check the number of processed messages.

```
Manager Switch 1> show igmp filter=1

IGMP Filters
-------------------------------------------------------------------
No.  Entry  Group Address                    Action        Matches
-------------------------------------------------------------------
1    1      224.0.1.22      224.0.1.22       Exclude             0
     2      224.0.0.0       224.255.255.255  Include             0

  Received: 0           Passed: 0           Dropped: 0
-------------------------------------------------------------------
```

If we enter these commands again a few minutes later, we see that the filter has dropped packets and the group entry has expired and disappeared.

```
Manager Switch 1> show igmp filter=1

IGMP Filters
-------------------------------------------------------------------
No.  Entry  Group Address                    Action        Matches
-------------------------------------------------------------------
1    1      224.0.1.22      224.0.1.22       Exclude             2
     2      224.0.0.0       224.255.255.255  Include             0

  Received: 2            Passed: 0            Dropped: 2
-------------------------------------------------------------------
```

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

  No group memberships.

-------------------------------------------------------------------------------
```

IGMP throttling (limiting the number of streams for each subscriber)

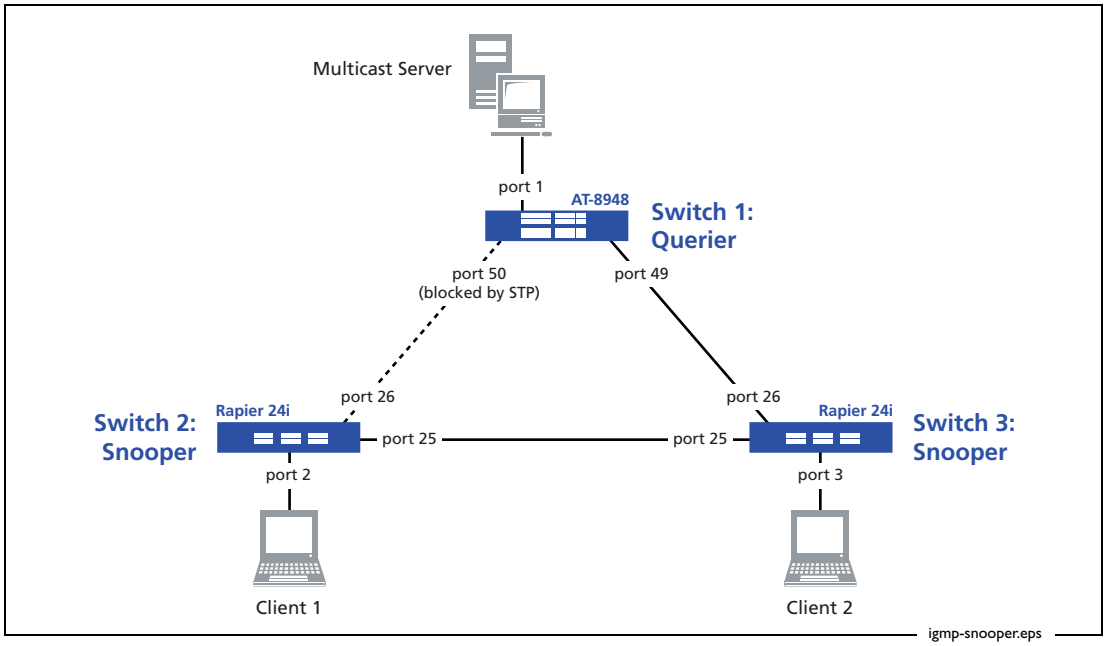
IGMP throttling allows you to limit the number of streams that subscribers may access at a given time, for example, to protect from bandwidth oversubscription. When the number of multicast group memberships associated with a switch port reaches the configured limit, the port can either deny further Membership Reports, or replace an existing membership with the new group.

IGMP filtering and throttling can be applied separately or together. The switch applies the filters first, then subjects any multicast group memberships passed by the filter to the limits imposed by throttling.

IGMP Throttling is available in Software Version 2.7.5 or later.

Example

This example builds on "IGMP filtering (controlling multicast distribution)" on page 35 and uses the same network configuration as "IGMP snooping" on page 9. For convenience, the diagram is reproduced below.



▶ Configure switch 1

Switch 1 is an IGMP Querier. Note that it has a filter configured on it, which is from the previous example.

```
set system name="Switch 1"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# Switching configuration
set switch port=1 igmpfilter=1

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100
create igmp filter=1
add igmp filter=1 entry=1 group=224.0.1.22 action=exclude
add igmp filter=1 entry=2 group=224.0.0.0-224.255.255.255
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper. IGMP snooping is enabled by default and does not need any configuration. Switch 2 is limited to six multicast groups on port 2.

```
set system name="Switch 2"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26

# Switching configuration
set switch port=2 igmpmaxgroup=6 igmpaction=replace
```

▶ Configure switch 3

Switch 3 is also an IGMP Snooper.

```
set system name="Switch 3"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

Explanation of IGMP throttling (limiting the number of streams for each subscriber)

In this example, switch 2's configuration limits port 2 to six concurrent multicast groups. The port has a throttling action of **replace**, meaning that any additional group replaces the oldest group.

Consider switch 2 after a client on port 2 has joined six groups from 224.12.13.11-224.12.13.16. Output from the command **show igmpsnooping** shows the six memberships.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.11                       Entry timeout 251 secs
  Ports  2

  Group. 224.12.13.12                       Entry timeout 251 secs
  Ports  2

  Group. 224.12.13.13                       Entry timeout 251 secs
  Ports  2

  Group. 224.12.13.14                       Entry timeout 251 secs
  Ports  2

  Group. 224.12.13.15                       Entry timeout 251 secs
  Ports  2

  Group. 224.12.13.16                       Entry timeout 251 secs
  Ports  2

  All Groups                                Entry timeout 257 secs
  Ports  25

-------------------------------------------------------------------------
```

Next, the client joins three more groups (224.12.13.17-224.12.13.19). Output from the command **show igmpsnooping** still shows six memberships, but the oldest three groups have been dropped.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                       Entry timeout 254 secs
  Ports  2

  Group. 224.12.13.15                       Entry timeout 254 secs
  Ports  2

  Group. 224.12.13.16                       Entry timeout 254 secs
  Ports  2

  Group. 224.12.13.17                       Entry timeout 256 secs
  Ports  2

  Group. 224.12.13.18                       Entry timeout 256 secs
  Ports  2

  Group. 224.12.13.19                       Entry timeout 256 secs
  Ports  2

  All Groups                                Entry timeout 243 secs
  Ports  25

------------------------------------------------------------------------
```

When switch 2 drops groups by throttling, it does not send a Leave message, because IGMP snooping cannot generate IGMP packets. Therefore, the Querier (switch 1) still believes that switch 2 is interested in the throttled groups, as output from the command **show ip igmp** on switch 1 shows.

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

  Group. 224.12.13.13     Last Adv. 172.31.0.222     Refresh time 215 secs
   Ports  49

  Group. 224.12.13.14     Last Adv. 172.31.0.222     Refresh time 215 secs
   Ports  49

  Group. 224.12.13.15     Last Adv. 172.31.0.222     Refresh time 215 secs
   Ports  49

  Group. 224.12.13.16     Last Adv. 172.31.0.222     Refresh time 215 secs
   Ports  49

  Group. 224.12.13.17     Last Adv. 172.31.0.222     Refresh time 217 secs
   Ports  49

  Group. 224.12.13.18     Last Adv. 172.31.0.222     Refresh time 217 secs
   Ports  49

  Group. 224.12.13.19     Last Adv. 172.31.0.222     Refresh time 217 secs
   Ports  49

  Group. 224.12.13.11     Last Adv. 172.31.0.222     Refresh time 238 secs
   Ports  49

  Group. 224.12.13.12     Last Adv. 172.31.0.222     Refresh time 238 secs
   Ports  49

-------------------------------------------------------------------------
```

This can cause the Querier to temporarily send more groups than necessary to a switch. The older groups will eventually time out.

Note that the group list is sorted by refresh time, not group address.

The output above also shows that the IGMP Querier only records the IP address of the last interested client—the *Last Adv* field shows the IP of the client who last sent an IGMP

Membership Report for that group. IGMP throttling cannot distinguish between different clients on the same port. For this reason, the limit is tied to the port, not to the client.

When we deny groups instead of replacing them

Finally, we will consider the effect of changing the IGMP throttle action to **deny**, by using the command below.

▶ Modify switch 2 Configuration

```
set switch port=2 igmpmaxgroup=6 igmpaction=deny
```

Once the six slots are filled, additional attempts to join other groups fail. Neither switch 2's IGMP snooping table nor switch 1's IGMP table register the new groups, because switch 2 drops the client's Membership Report without taking any further action.

However, if the client attempts to join a group that already occupies one of the six slots, this renews the IGMP Querier's refresh time and the IGMP Snooper's entry timeout for the

group. The following output for the command **show igmpsnooping** demonstrates this. Note that the timeout for the groups 224.12.13.11 and 224.12.13.12 has been reset.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.13                       Entry timeout 228 secs
  Ports  2

  Group. 224.12.13.14                       Entry timeout 228 secs
  Ports  2

  Group. 224.12.13.15                       Entry timeout 228 secs
  Ports  2

  Group. 224.12.13.16                       Entry timeout 228 secs
  Ports  2

  Group. 224.12.13.11                       Entry timeout 255 secs
  Ports  2

  Group. 224.12.13.12                       Entry timeout 255 secs
  Ports  2

  All Groups                                Entry timeout 168 secs
  Ports  25

-------------------------------------------------------------------------
```

Static IGMP

Static IGMP enables you to configure a switch with specified group-to-interface or group-to-port mappings, which you may want to do if:

- your network includes hosts that cannot send IGMP Membership Reports
- you need to guarantee that a specific multicast stream is instantly available on a port, without any delay from the joining process

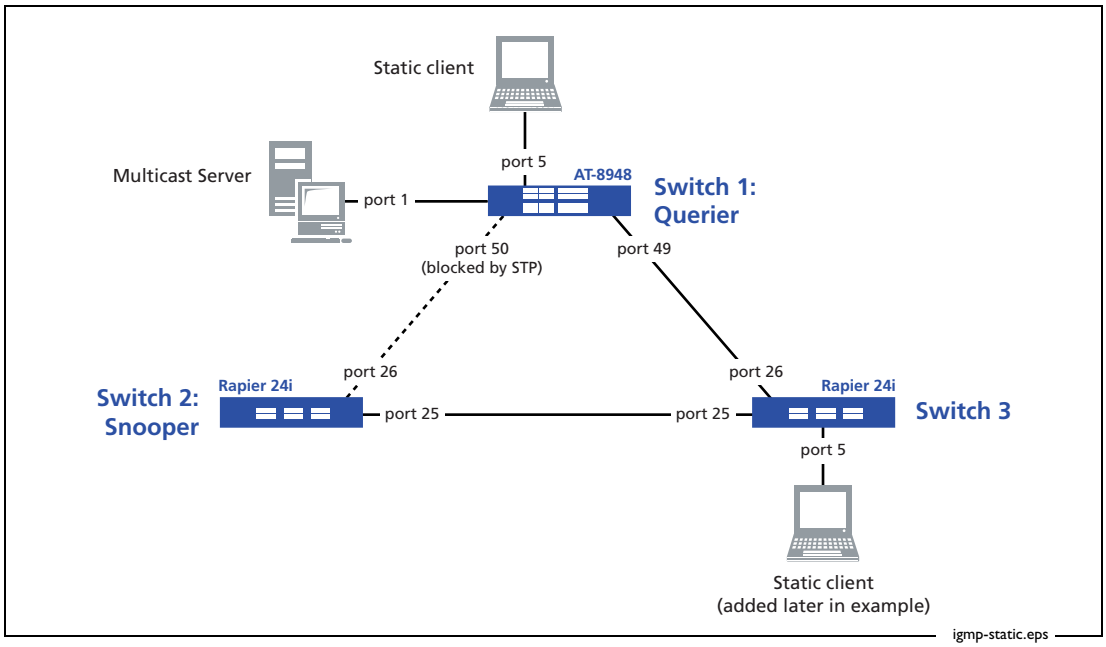
A common usage of Static IGMP is for protocols like Service Location Protocol (SLP). This protocol sends out multicast packets that need to be forwarded to designated ports. You may want SLP packets to be forwarded to ports that have servers who need to respond to these packets. Static IGMP allows you to specify that traffic for this group should go to hosts who will respond to, or are interested in, these messages. For detailed information about using Static IGMP and SLP, see *How to configure IGMP snooping with unregistered multicast addresses such as Service Location Protocol (SLP)* in the Allied Telesis website's Technical Library.

Static IGMP is available on all the Allied Telesis managed layer 3 switches listed on page 3.

Example

In this example, we will start by setting an IGMP static entry for the group 224.12.13.14 to go to port 5 on switch 1 (part of vlan100). On that port we have attached a host which has no multicast client software running. After examining the effect of static IGMP on switch 1, we will add a static IGMP entry to switch 3 and consider the effect this has on multicasting through the network.

The network for this example has three switches in a loop and is shown in the following figure.



▶ Configure switch 1

Switch 1 is an IGMP Querier and has the static IGMP entry. Static IGMP also requires you to:

- add an IP address to the interface to which you will attach the static entry
- enable IGMP
- enable the interface as an IGMP interface

```
set system name="Switch 1"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes
set stp=default port=5 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100
create ip igmp destination=224.12.13.14 int=vlan100 port=5
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper.

```
set system name="Switch 2"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

▶ Configure switch 3

Switch 3 is also an IGMP Snooper. Later in this example, we will add a static IGMP entry on this switch. "Modify switch 3 Configuration" on page 52 shows the extra commands for this.

```
set system name="Switch 3"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

Explanation of Static IGMP

When the IGMP static entry is created on switch 1, entries immediately appear in the IGMP snooping table and the IGMP table.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout Infinity
  Ports  5

------------------------------------------------------------------------
```

```
Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ............ 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

 Group. 224.12.13.14      Static association         Refresh time Infinity
  Ports  5
  Static Ports  5

------------------------------------------------------------------------
```

When the group 224.12.13.14 starts streaming into switch 1, we can use the command **show switch port=5 counter** to watch the number of multicast packets sent on port 5 increase. This means that the link is up and the static IGMP entry is working.

```
Manager Switch 1> show switch port=5 counter

Switch Port Counters
----------------------------------------------------------------------

Port 5. Ethernet MAC counters:
 Combined receive/transmit packets by size (octets) counters:
  64                            5502 512 - 1023                   160356
  65 - 127                    153355 1024 - MaxPktSz              109314
  128 - 255                   110102
  256 - 511                   137200

 General Counters:
 Receive                          Transmit
  Octets                        0 Octets                     341385876
  Pkts                          0 Pkts                          675829
  CRCErrors                     0
  MulticastPkts                 0 MulticastPkts                 675826
  BroadcastPkts                 0 BroadcastPkts                      3
  FlowCtrlFrms                  0 FlowCtrlFrms                       0
  OversizePkts                  0
  Fragments                     0
  Jabbers                       0
  UpsupportOpcode               0
  UndersizePkts                 0
                                  Collisions                         0
                                  LateCollisions                     0
                                  ExcessivCollsns                    0

 Miscellaneous Counters:
  MAC TxErr                     0
  MAC RxErr                     0
  Drop Events                   0

----------------------------------------------------------------------
```

When we add a static entry on another switch

Now we add a static IGMP entry on port 5 of switch 3, by adding the commands below.

▶ Modify switch 3 Configuration

```
set stp port=5 edgeport=yes

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.253 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100
create ip igmp destination=224.12.13.14 int=vlan100 po=5
```

Both switches are potential IGMP Queriers and switch 3 becomes the Querier. This is because we gave switch 3 a lower IP address (172.31.0.253) than switch 1 (173.31.0.254).

To see the effect that the new configuration has on switch 1, we can check the IGMP snooping and IGMP tables. The IGMP snooping table shows that switch 1 now has an All Groups entry because it is no longer the Querier. The IGMP table also shows that switch 1 is not the Querier.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                       Entry timeout Infinity
  Ports  5

  All Groups                                Entry timeout 247 secs
  Ports  49

-------------------------------------------------------------------------
```

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100
Other Querier timeout ... 239 secs
Group List ..............

 Group. 224.12.13.14     Static association        Refresh time Infinity
  Ports  5
  Static Ports  5

-------------------------------------------------------------------------
```

We can see the static entry on switch 3 by checking the IGMP snooping and IGMP tables.

```
Manager Switch 3> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout Infinity
  Ports  5

------------------------------------------------------------------------
```

```
Manager Switch 3> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
IGMP Proxy .............. Off
Group List ..............

 Group. 224.12.13.14     Static association        Refresh time Infinity
  Ports  5
  Static Ports  5

------------------------------------------------------------------------
```

Note that switch 3—the Querier—has no entry for port 26 and therefore does not send the multicast to switch 1. This is because the static entry joined switch 1 to the stream without any client sending a Membership Report.

If the multicast server was attached to switch 3 instead of switch 1, we would have to change switch 3's configuration. We would need to add a static entry for the port that switch 3 uses to connect to switch 1 (port 26). Although this is unnecessary in this scenario, we will do it to demonstrate the effect, by using the following commands.

▶ Modify switch 3 Configuration

```
destroy ip igmp destination=224.12.13.14 int=vlan100
create ip igmp destination=224.12.13.14 int=vlan100 port=5,26
```

To see the new static entry, we use the commands **show igmpsnooping** and **show ip igmp**, and to see multicast packets streaming, we use the command **show switch port=5,26 counter**.

```
Manager Switch 3> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout Infinity
  Ports  5,26

------------------------------------------------------------------------
```

```
Manager Switch 3> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
IGMP Proxy .............. Off
Group List ..............

 Group. 224.12.13.14      Static association         Refresh time Infinity
  Ports  5,26
  Static Ports  5,26

------------------------------------------------------------------------
```

```
Manager Switch 3> show switch port=5,26 counter

 Switch Port Counters
--------------------------------------------------------------------------

Port 5. Fast Ethernet MAC counters:
 Combined receive/transmit packets by size (octets) counters:
  64                              3027 512 - 1023                         0
  65 - 127                           0 1024 - MaxPktSz                33365
  128 - 255                          0 1519 - 1522                        0
  256 - 511                          0

 General Counters:
 Receive                             Transmit
  Octets                             0 Octets                      45636858
  Pkts                               0 Pkts                           36392
  FCSErrors                          0 FCSErrors                          0
  MulticastPkts                      0 MulticastPkts                  36350
  BroadcastPkts                      0 BroadcastPkts                     42
.
.
.

Port 26. Gigabit Ethernet MAC counters:
 Combined receive/transmit packets by size (octets) counters:
  64                              3099 512 - 1023                         0
  65 - 127                           6 1024 - MaxPktSz                18598
  128 - 255                          0 1519 - 1522                        0
  256 - 511                          0

 General Counters:
 Receive                             Transmit
  Octets                       9342286 Octets                      16186973
  Pkts                            6945 Pkts                           14758
  FCSErrors                          0 FCSErrors                          0
  MulticastPkts                   6905 MulticastPkts                  14756
  BroadcastPkts                     40 BroadcastPkts                      2
  PauseMACCtlFrms                    0 PauseMACCtrlFrm                    0
  OversizePkts                       0 OversizePkts                       0
.
.
.
--------------------------------------------------------------------------
```

When a static entry's port goes down

Finally, note that when the port attached to a static entry goes down, the static entry remains but no ports are attached to it. You can see this from the output of the commands **show igmpsnooping** and **show ip igmp** for switch 1 when port 5 has been disconnected.

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout Infinity
  Ports  None

  All Groups                                 Entry timeout 152 secs
  Ports  49

-------------------------------------------------------------------------
```

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100
Other Querier timeout ... 140 secs
Group List ..............

 Group. 224.12.13.14     Static association        Refresh time Infinity
  Ports  None
  Static Ports  None

-------------------------------------------------------------------------
```

How clients leave groups: queries and timers

When a client leaves a group, the Snoopers and the Querier check which ports now have clients that belong to that group. They will stop forwarding the group's traffic out any ports that are now unnecessary. In this section, we describe the process in detail.

Overview of leave process

The basic process when a client leaves a group is as follows:

1. The client sends a Leave message to indicate that it no longer needs to receive that multicast group.
2. The Snooper receives the Leave message and forwards it towards the Querier.
3. For all ports that belong to the group, the Querier changes its internal group membership timer to a short value (2 seconds by default—see Querier timer values below).
4. The Querier sends a Specific Query to ask which other clients still belong to that group.
5. The aforementioned Snooper receives the Specific Query. For all ports that belong to the group, the Snooper changes its internal group membership timer to a short value (2 seconds by default—see Snooper timer values below) unless the timer is already short. It forwards the Query out all its ports.
6. The Querier waits for the Last Member Query Interval time, 1 second by default, and then sends a second Specific Query.
7. The aforementioned Snooper snoops this second Specific Query and uses it to set the internal group membership timer for each port, unless the timer is already short (which it will be if the Snooper received the first Query). It forwards the Query out all its ports.
8. If the Snooper or Querier receives a Membership Report on a port, it sets the port timer to the Default Timeout Interval value and continues to forward the multicast stream out that port. Otherwise, the timers for that port expire and the Snooper and/or Querier stops forwarding the multicast stream out that port.

Querier timer values

As described in Step 3 above, when the Querier sends a Specific Query for a group in response to a Leave message, the Querier updates a timer for ports that forward that group. The timer is the following two values multiplied together:

- Last Member Query Count (LMQC)—the number of Specific Queries the Querier sends, 2 by default, and
- Last Member Query Interval (LMQI)—the time between the Specific Queries, 1 second by default

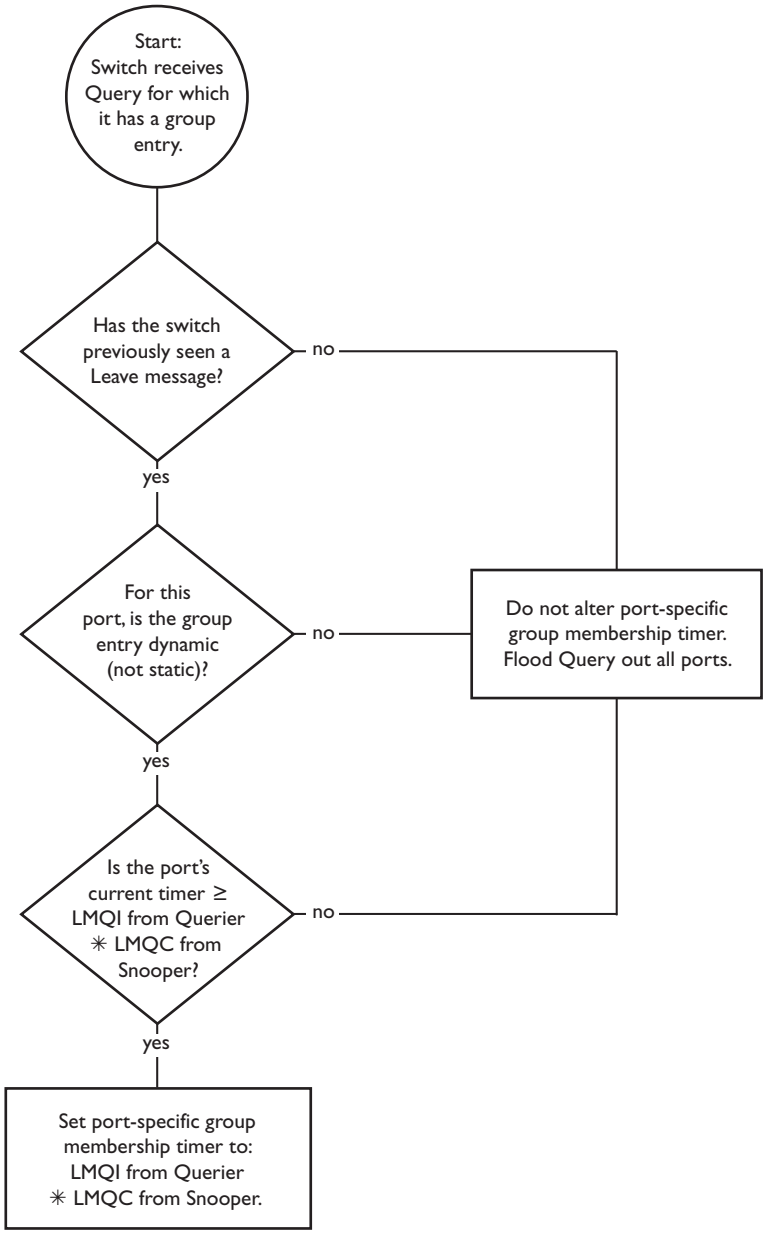
The default LMQC and LMQI give a timeout of 2 seconds. Therefore, by default the Querier must see the client response within 2 seconds of sending the first Specific Query.

Because of this process, sensible values for LMQC and LMQI are essential. In most networks, the defaults are appropriate and you should not change them. If you need to change them, see "Last Member Query Count and Last Member Query Interval" on page 72.

The command **show ip igmp** displays the timer for the most recently updated port as the group's **Refresh Time**. From Software Version 291-08, the command **show igmpsnooping vlan={<*vid*>|all} detail** displays the timers for each individual port.

Snooper timer values

As described in Step 5 above, when the Snooper receives a Specific Query from the Querier, it may update a timer for ports that forward that group. The following flow chart describes the decision-making process for updating the timer.



Note that:

- The command **show igmpsnooping** displays the timer for the most recently updated port as the group's **Timeout in ...** value. From Software Version 291-08, the command **show igmpsnooping vlan={<*vid*>|all} detail** displays the timers for each individual port.

- To calculate the timer, the Snooper takes **the LMQI value that it receives from the Querier** and multiplies it by **the Snooper's own LMQC**.
- The Snooper only reduces the timer if it receives a Leave message followed by a Specific Query—one of the messages is not enough.

Changes with 281-03 and 2.9.1

In software versions earlier than 281-03, the Snooper reset the group timer for all its ports when it received a Specific Query. Since versions 281-03 and 2.9.1, each port has a separate timer and the Snooper only changes those which exceed the threshold. The flow chart above describes the new behaviour.

Comparing the Querier and Snooper timers

By default, the Querier and Snooper port-specific group timers have the same value (2 seconds). This is because the LMQC is the same for the Querier and the Snoopers.

Consequences for high-loss and high-lag networks

If packet loss or lag time is an issue in your network, we recommend increasing the Robustness Variable on the Snoopers and the Querier.

On Allied Telesis Snoopers and Queriers, LMQC = Robustness Variable. For Snoopers, not all vendors make these counters the same. RFC 2236 requires that LMQC and Robustness Variable have the same value on Queriers, but the IGMP timer rules for IGMP Snoopers are less well-defined.

Increasing the Querier LMQC (or Robustness Variable) increases the number of Specific Queries that the Querier sends. This increases the probability that an interested client will receive a Query.

Increasing the Snooper LMQC (or Robustness Variable) increases the length of time that the Snooper waits before aging out the port. This gives the client more time to reply to the Queries.

For example, if you increase the LMQC to 5 (the maximum) on the Querier and the Snooper, then the Querier sends 5 Queries and the Snooper waits for 5 * LMQI, which is 5 seconds with the default LMQI.

Make sure that the values on the Querier and the Snoopers match, so that the Snooper has time to forward all the Queries. For example, if you changed the Querier's Robustness Variable to 5 but left the Snooper unchanged, the Querier would send out 5 Queries 1 second apart but the Snooper would age out the group entry after only the first 2 Queries.

For more information about setting the Robustness Variable, and the consequences of this, see "Robustness Variable" on page 75.

IGMP fast leave

IGMP Fast Leave enhances your control over router or switch bandwidth. Enabling Fast Leave tells IGMP snooping to stop the transmission of a group multicast stream to a port as soon as it receives a Leave message on that port. No timeouts are observed.

Ordinarily, when IGMP snooping sees a Leave message, it waits for a Membership Query message before setting the entry timeout to 2 seconds. Fast Leave tells IGMP to drop the entry from the port as soon as the Leave message is seen. For this reason, Fast Leave should only be configured on interfaces that have one client per port.

Availability

IGMP Fast Leave is available in **Software Version 2.7.5 or later**. In Software Versions earlier than 281-03 and 2.9.1, configure it by using the command:

```
set igmpsnooping fastleave={on|off} interface=vlanx
```

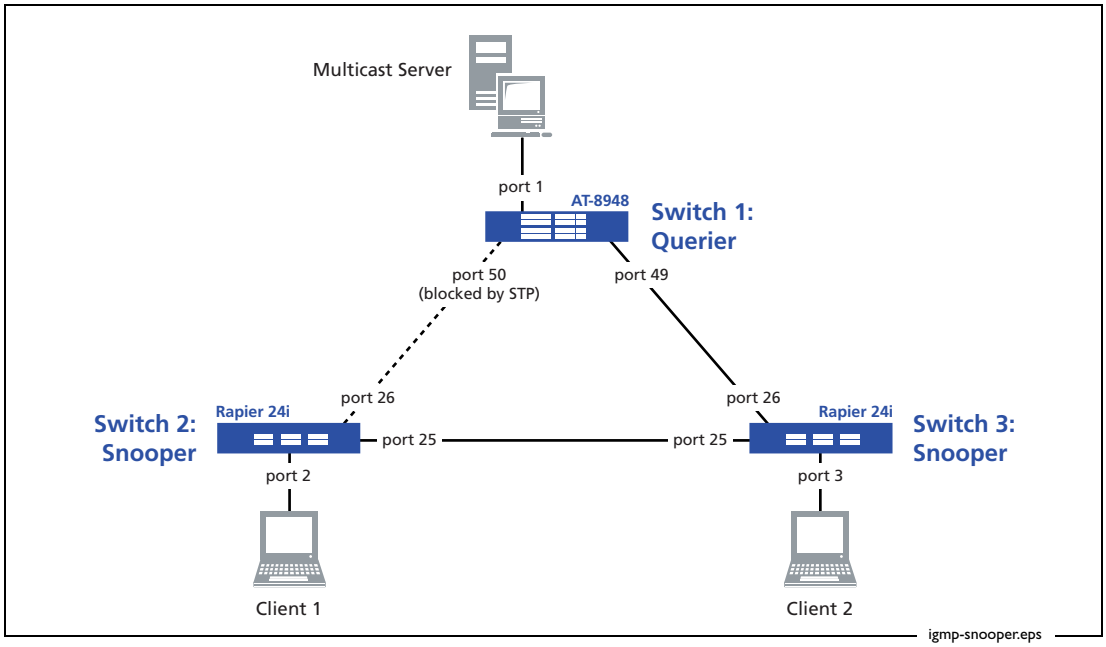
In **Software Versions 281-03 and 2.9.1**, the syntax changed to make it consistent with Query Solicitation. Therefore, the above syntax is still valid but the recommended syntax is now:

```
set igmpsnooping vlan=vlanx fastleave={on|off}
```

Software Version 291-08 introduced multiple mode for Fast Leave. See "Multiple host mode for fast leave" on page 67.

Example

This example uses the same network configuration as "IGMP snooping" on page 9. For convenience, the diagram is reproduced below.



▶ Configure switch 1

Switch 1 is an IGMP Querier.

```
set system name="Switch 1"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper. IGMP snooping is enabled by default and does not need any configuration.

```
set system name="Switch 2"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

▶ Configure switch 3

Switch 3 is also an IGMP Snooper. Fast leave is enabled on this switch.

```
set system name="Switch 3"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26

# IP configuration
set igmpsnooping vlan=vlan100 fastleave=on
```

Explanation of IGMP fast leave

Imagine that client 2 on switch 3 sends a Membership Report to join the group 224.12.13.14. The Snooper, switch 3, adds this to its the IGMP snooping table. When the same client then sends a Leave message, the IGMP Querier responds with a Membership Query and waits for a configured time for a response.

The next sections describe in detail the differences between having Fast Leave disabled and enabled, but in summary:

- Without Fast Leave, the IGMP Snooper waits the same length of time as the Querier, then expires the entry if there was no response.
- With Fast Leave, the IGMP Snooper expires the entry as soon as it sees the Leave message from the client. By the time the Querier sends the Membership Query, the Snooper will have already expired the entry and therefore stopped sending the stream to the client.

When fast leave is disabled

The IGMP Snooper sees the Membership Query from the Querier and accordingly sets its expiry time to match the Querier. Output of the command **show igmpsnooping** on switch 3 shows that the timeout for the group 224.12.13.14 has dropped to 2 seconds and that port 3 is still attached to the group. Likewise, output of the command **show ip igmp** on switch 1 shows a timeout of 2 seconds.

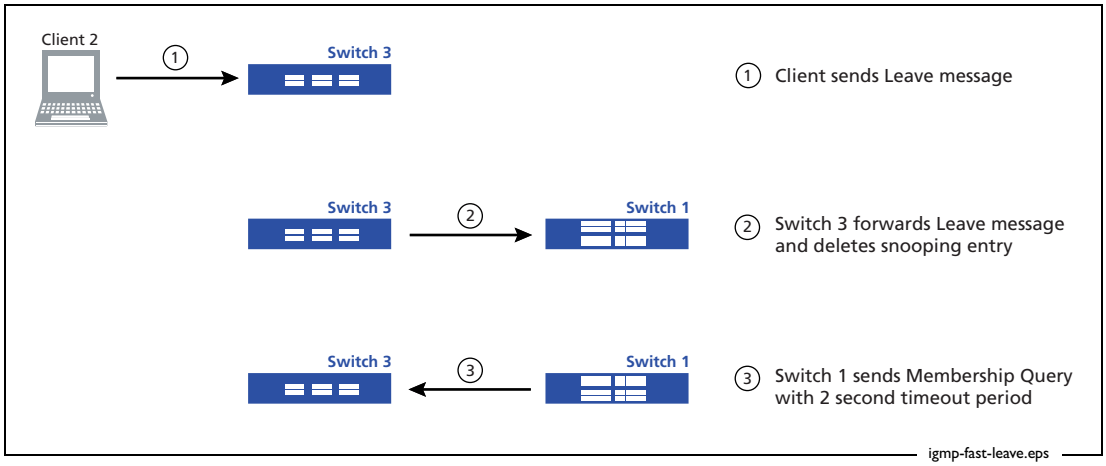
```
Manager Switch 3> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                       Entry timeout 2 secs
  Ports  3

  All Groups                                Entry timeout 258 secs
  Ports  26

-------------------------------------------------------------------------
```

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

  Group. 224.12.13.14      Last Adv. 172.31.0.222      Refresh time 2 secs
  Ports  49

-------------------------------------------------------------------------
```

If no Membership Report is received by the time the counters go to zero, then the client's entry is dropped from both the IGMP Querier and Snooper.

When you enable fast leave on switch 3

When Fast Leave is enabled on switch 3, but not on switch 1, an interesting chain of events occurs when the client sends a Leave message, as shown in the following diagram.



The result of this is that switch 3 adds the group back into its snooping table (with the same timeout as the IGMP Querier) but has no ports interested in receiving the group. Because Fast Leave is enabled on port 3, that port was removed from the group as soon as switch 3 received the Leave message.

```
Manager Switch 3> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ............................ Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. On
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. On
Group List ..............

  Group. 224.12.13.14                        Entry timeout 2 secs
  Ports  None

  All Groups                                 Entry timeout 258 secs
  Ports  26

--------------------------------------------------------------------------
```

Adding Fast Leave to switch 1 would not be sensible, since there may be clients attached to other ports on switch 3. If you enabled Fast Leave on switch 1, one Leave message from switch 3 would drop the multicast stream for everyone on that switch.

It is safe to ignore the group entry on switch 3.

When you set fast leave on all interfaces

Fast leave is enabled on a per-interface basis, but if you do not specify an interface, it is enabled on all interfaces. In this example, that means that if no VLAN is specified when enabling Fast Leave, it is enabled on all VLANs (vlan1 and vlan100). The configuration resulting from the **create config** and **show config dynamic** commands always reflects the per-interface nature of Fast Leave, as the following output shows.

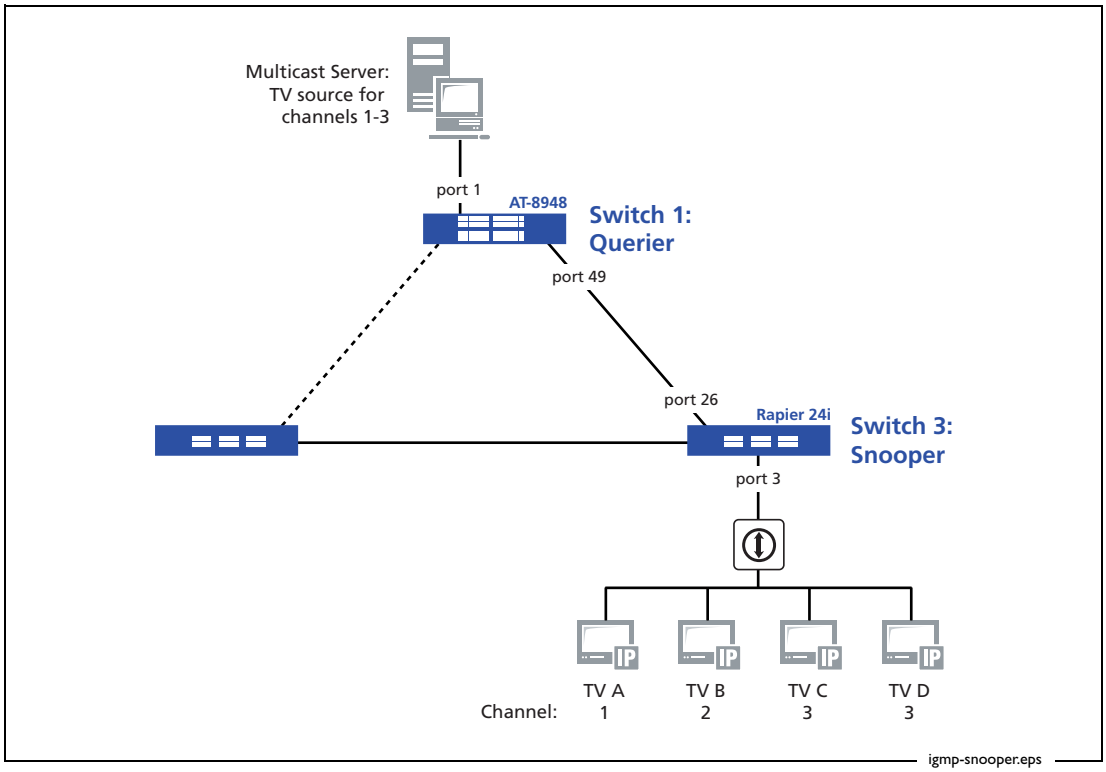
```
Manager Switch 3> set igmpsnooping fastleave=on

Info (1005420): IGMPSnooping 'Fast Leave' was successfully set on for all
vlans.

Manager Switch 3> show conf dyn=ip

# IP configuration
set igmpsnooping fastleave=on interface=vlan1
set igmpsnooping fastleave=on interface=vlan100
```

Similarly, we can easily disable Fast Leave on all interfaces.

```
Manager Switch 3> set igmpsnooping fastleave=off

Info (1005420): IGMPSnooping 'Fast Leave' was successfully set off for all
vlans.

Manager Switch 3> show conf dyn=ip

# IP configuration
```

Multiple host mode for fast leave

The previous discussion assumes that only one client is attached to the port on the Snooper. Imagine instead a situation where multiple clients are attached to a single port on the snooping switch, as the following figure shows.



In this situation, you need to use fast leave in **multiple host mode**. In multiple host mode, the Snooper tracks which clients are joined to a given IP multicast group on a given port. The Snooper shuts off the multicast group to that port as soon as the **last** client leaves the group on the port.

Multiple host mode is available in Software Version 291-08 and later.

The alternative mode is called **single host mode**. In single host mode, as soon as the Snooper receives a leave message for a group on a port, it shuts off the multicast. This mode assumes that there are no other clients on the port that are still interested in receiving the multicast, so is suitable only when clients are directly attached to the Snooper.

To specify multiple mode, use the command:

```
set igmpsnooping vlan={name|1..4094|all} fastleave=multiple
```

To specify single mode, use either of the commands:

```
set igmpsnooping vlan={name|1..4094|all} fastleave=single
set igmpsnooping vlan={name|1..4094|all} fastleave=on
```

You can see the list of hosts for each port by entering the command **show igmpsnooping** and specifying the **detail** parameter:

```
show igmpsnooping vlan={name|1..4094|all}
   [group={multicast-ip-address|allgroups}] detail
```

The **group** parameter lets you display information for only one group or for only the All Groups port (the **allgroups** option).

The following example shows output when the **detail** parameter has been specified.

```
IGMP Snooping
-------------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave ............... Multiple Host Topology
Query Solicitation ...... Off
Static Router Ports ..... None
Group List ............... 3 groups

  Group 224.12.13.14                          Timeout in 256 secs
    Port 3                                    Timeout in 257 secs
      Hosts: 1
        00-00-cd-12-34-56 (172.20.176.200)    Timeout in 257 secs

  Group 224.12.13.15                          Timeout in 204 secs
    Port 3                                    Timeout in 205 secs
      Hosts: 1
        00-00-ab-ab-cd-ef (172.20.176.201)    Timeout in 205 secs

  Group 224.12.13.16                          Timeout in 192 secs
    Port 3                                    Timeout in 193 secs
      Hosts: 2
        00-00-ab-27-be-f5 (172.20.176.202)    Timeout in 193 secs
        00-00-cd-12-34-ab (172.20.176.203)    Timeout in 100 secs
```

Configurable IGMP timers and counters

This section looks at some of the timers and counters that control how often IGMP sends queries and how quickly entries time out. First, it gives background information in the following subsections:

Then it looks at each of the configurable timers and counters, in the following subsections:

RFC 2236 also describes other counters and timers that this section does not describe, because this section only describes the counters and timers that you can directly set. The router or switch derives other counters and timers from the above subset.

Timer and counter relationships

The above timers and counters are related to each other and to others in RFC 2236 by the following formulae:

- Last Member Query Count = Robustness Variable
- Default Timeout Interval = (Robustness Variable * Default Query Interval) + one Query Response Interval in seconds
- Startup Query Count = Robustness Variable

  The Startup Query Count is the number of General Queries that the Querier sends when it starts up.
- Other Querier Timeout = (Robustness Variable * Default Query Interval) + (Query Response Interval in seconds/2)

  The Other Querier Timeout is the length of time that a potential Querier waits after receiving a Query before it assumes that it should become the Querier.

These relationships mean you need to take care if you change timers or counters. "Example of bad choices for timer values" on page 83 describes the consequences of a bad combination of values.

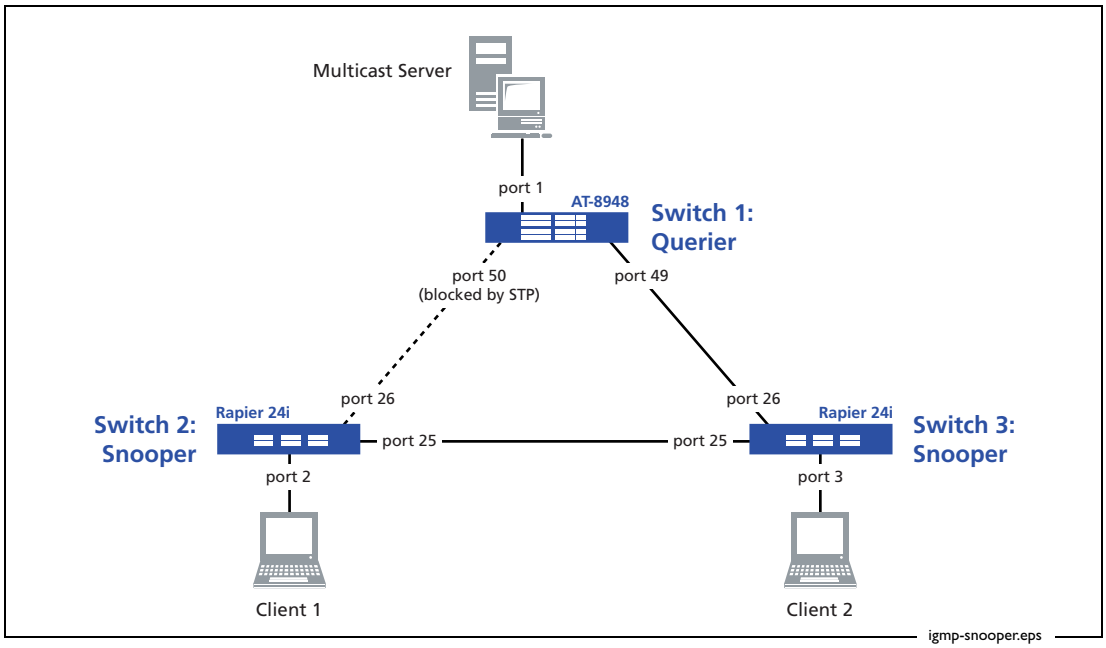
Software versions

Since software versions 281-03 and 2.9.1, IGMP automatically sets the Default Timeout Interval to the value from the formula in the section above. Therefore, if you change any of the Robustness Variable, the LMQC, the Default Query Interval, or the Query Response Interval, IGMP changes the Default Timeout Interval to match. You can override the Default Timeout Interval if necessary, but we do not recommend doing so.

The examples in this section come from version 2.9.1, so the Default Query Interval automatically changes.

Initial configuration

These examples use the same network configuration as "IGMP snooping" on page 9. For convenience, the diagram is reproduced below.



Each example modifies the following base configuration.

▶ Configure switch 1

Switch 1 is an IGMP Querier.

```
set system name="Switch 1"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper.

```
set system name="Switch 2"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

▶ Configure switch 3

Switch 3 is also an IGMP Snooper.

```
set system name="Switch 3"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

Default values

Output of the command **show ip igmp** shows the values of the configurable IGMP settings. The following output shows the default values.

```
Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
.
.
.
```

Note that units for Last Member Query Interval (LMQI) and Query Response Interval are 0.1 seconds. Therefore, the default LMQI is 1 second and the default Query Response Interval is 10 seconds.

Last Member Query Count and Last Member Query Interval

The Last Member Query Count (LMQC) is the number of Specific Queries the Querier sends after receiving a Leave message—1 to 5 messages.

The Last Member Query Interval (LMQI) is the time between the Specific Queries—1 to 255 in units of 0.1 seconds.

These counters determine how quickly a group times out when the last client leaves the group. You should read this section in conjunction with "How clients leave groups: queries and timers" on page 58, which has an outline of the leave process and a detailed discussion of the timers.

What these counters do

On the Querier and all Snoopers, IGMP keeps group membership timeout values on each port. During general multicasting, these timeouts are (by default) 260 seconds. When a client leaves a group, these timeouts are reduced to make multicasting stop quickly after the last client leaves. The LMQC and LMQI determine the value of the timeout during this leave process (2 seconds with the default LMQC and LMQI).

On the Querier, the timeout during the leave process = LMQC * LMQI

On Snoopers, the timeout during the leave process =
LMQI from Querier * LMQC from Snooper

From Software Version 291-08, the command **show igmpsnooping vlan={<*vid*>|all} detail** displays the timers for each individual port.

Potential problems with changing these counters

For most networks, the default LMQI and LMQC values work. You should only change them if you are aware of the likely effect on the network. In particular, note that:

- Changing the LMQC automatically changes the Robustness Variable. Therefore, we do not recommend setting the LMQC to 1, because it removes the system's allowance for packet loss. See page 75 for more information about the consequences of changing the Robustness Variable.
- If you set the LMQI (or LMQC, or both) too low, clients will not be able to reply to Specific Queries quickly enough and the Querier and Snoopers may delete group entries for ports that still need to receive multicasts. If this happens, some or all clients briefly lose the multicast stream.

  The default values of LMQI (10) and LMQC (2) mean that the Querier must receive client Membership Reports within 2 seconds of the first Query. This is already quite a short time and we do not recommend reducing it even more. For example, reducing the LMQI to 5 would allow only 1 second for responses, which may be too little.

How to change these counters

The following example increases LMQI a lot, and then shows the resulting changed refresh time.

```
Manager Switch 1> set ip igmp lmqi=255

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 255 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100              (DR)
Group List ..............

  Group. 224.12.13.14      Last Adv. 172.31.0.222      Refresh time 49 secs
   Ports  49

------------------------------------------------------------------------
```

The refresh time in seconds is (LMQI/10) * LMQC = 255/10 * 2 = 51 seconds

So with the new LMQI setting of 255 and the default LMQC setting of 2, the IGMP Querier waits 51 seconds for a Membership Report to arrive before it ages out the IGMP entry. Note that the output above displays 49 seconds, because it took us 2 seconds to enter the command **show ip igmp**.

Similarly, if we change the LMQC from 2 to 3, the refresh time also changes.

```
Manager Switch 1> set ip igmp lmqc=3

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------
Status ............................ Enabled
Default Query Interval ............ 125 secs
Default Timeout Interval ......... 385 secs

Last Member Query Interval ....... 255 (1/10secs)
Last Member Query Count .......... 3
Robustness Variable ............... 3
Query Response Interval ........... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

  Group. 224.12.13.14      Last Adv. 172.31.0.222      Refresh time 74 secs
   Ports  49

-------------------------------------------------------------------------
```

The refresh time in seconds is (LMQI/10) * LMQC = 255/10 * 3 = 76.5 seconds

Robustness Variable

What this counter does

The Robustness Variable (RV) allows you to tune for the expected packet loss on a subnet. If you expect a subnet to be lossy, you can increase the RV. IGMP is robust to packet loss of one packet less than the RV. The RV is an integer from 1 to 5 and should not be set to 1.

If packet loss or lag time is an issue in your network, we recommend increasing the Robustness Variable on the Snoopers and the Querier. This increases the following:

- the number of Queries that the Querier sends out (by increasing the LMQC)
- the amount of time that the Querier and the Snoopers wait for clients to reply

For more details, see "Consequences for high-loss and high-lag networks" on page 60.

Potential problems with changing this counter

The RV is the counter you are most likely to need to change. However, you need to appreciate the effect this has on your network, as described in RFC 2236. Changing the RV changes other values from the RFC, as follows:

- **Last Member Query Count** = Robustness Variable
- **Default Timeout Interval** = (Robustness Variable * Default Query Interval) + one Query Response Interval in seconds

  Since software versions 281-03 and 2.9.1, the Default Timeout Interval automatically changes to match the above formula. For earlier versions, you must change it yourself, as described on page 82.
- **Startup Query Count** = Robustness Variable
- **Other Querier Timeout** = (Robustness Variable * Default Query Interval) + (Query Response Interval in seconds/2)

How to change this counter

The following example changes RV to 5, which is suitable for an extremely lossy network. Note that the Last Member Query Count and Default Timeout Interval also change.

```
Manager Switch 1> set ip igmp robustness=5

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ............................ Enabled
Default Query Interval ............ 125 secs
Default Timeout Interval .......... 635 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 5
Robustness Variable ............... 5
Query Response Interval ........... 100 (1/10secs)
.
.
.
```

Default Query Interval

What this timer does

To maintain an accurate picture of group membership, the Querier periodically sends General Queries to all its IGMP interfaces. The Default Query Interval is the gap between General Queries.

Note that General Queries are quite different from Specific Queries, which the Querier sends to a group address when it receives a Leave message for that group.

The router or switch only sends General or Specific Queries if it is the Querier. If another router or switch is elected as the Querier, the non-elected router or switch ignores the Default Query Interval and other such settings.

Potential problems with changing this timer

If you change the Default Query Interval, the Default Timeout Interval also needs to change so that clients have an appropriate amount of time to reply to the Query. Since software versions 281-03 and 2.9.1, this happens automatically. For earlier versions, you need to change it yourself as described on page 82.

How to change this timer

The Default Query Interval is an integer from 1 to 65535 seconds, specified using the **queryinterval** parameter. The default is 125 seconds. The following example tweaks the interval. Note that the Default Timeout Interval also changes.

```
Manager Switch 1> set ip igmp queryinterval=120

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ............................ Enabled
Default Query Interval ........... 120 secs
Default Timeout Interval ......... 250 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
.
.
.
```

Query Response Interval

What this timer does

The Query Response Interval determines the longest time clients can take to reply to a General Query. The Querier inserts the Query Response Interval into General Query messages. Clients randomly choose a time between 0 and the Query Response Interval at which to respond to a General Query. Increasing the Query Response Interval spreads IGMP messages over a longer time period, which reduces the burstiness of traffic on the network.

The Query Response Interval is also referred to as the *Max Response Time* in RFC 2236.

It may be useful to decrease the Query Response Interval if you are running EPSR or RSTP. Decreasing the Query Response Interval reduces the recovery time after a topology change. For more information, see "Query solicitation (rapid recovery from topology changes)" on page 26.

Potential problems with changing this timer

If your network has many multicast clients and you make the Query Response Interval too short, you may congest the Snoopers and Querier with too many Report messages in a short time.

If you change the Query Response Interval, the Default Timeout Interval also needs to change, so that clients have an appropriate amount of time to reply to the Query. Since software versions 281-03 and 2.9.1, this happens automatically. For earlier versions, you need to change it yourself as described on page 82.

How to change this timer

The Query Response Interval is an integer from 1 to 255 in units of 0.1 seconds, specified using the **queryresponseinterval** parameter. The default is 100 (10 seconds). The following example would return a modified Query Response Interval to its default value.

```
Manager Switch 1> set ip igmp queryresponseinterval=100

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
.
.
.
```

In this example, the Querier sends a General Query every 125 seconds. The General Query contains the Query Response Interval of 100, which tells clients that they have 10 seconds to reply to this General Query message.

Default Timeout Interval

The Default Timeout Interval is referred to as the *Group Membership Interval* in RFC 2236.

What this timer does

The Default Timeout Interval specifies the length of time before the router or switch deletes a group from its multicast group database after the router or switch last receives a Membership Report for that group. All IGMP routers and switches in a network use this interval to maintain their group membership databases, not just the Querier.

The Querier also uses this interval to close down multicasting if it receives no replies to all General Queries for a group. If the Querier sends a General Query and does not receive any Membership Reports in response, it continues to send any existing multicast streams. In the meanwhile, the Default Timeout Interval counts down until it hits zero, at which point the Querier stops propagating the multicast streams through the LAN.

Potential problems with changing this timer

Make the Default Timeout Interval too short has serious consequences. You remove the network's ability to cope with losing a General Query and you may not give enough time for client responses to reach the Querier. These problems would cause multicasting to stop for some or all clients. For more information, see "Example of bad choices for timer values" on page 83.

Synchronisation of timers

The Default Timeout Interval is a function of several other timers, according to the following formula from RFC 2236:

```
Default Timeout Interval = (Robustness Variable * Default Query
                    Interval) +
                    one Query Response Interval in seconds
```

Since software versions 281-03 and 2.9.1, the Default Timeout Interval changes automatically if you change any of the Robustness Variable, the LMQC, the Default Query Interval, or the Query Response Interval. You can override the Default Timeout Interval value, but the router or switch displays a warning message if you do so.

For earlier versions, you need to calculate and change the interval yourself.

The following examples show how changing the timers changes the Default Timeout Interval.

Defaults First, the following output shows the default settings.

```
Manager Switch 1> show ip igmp

IGMP Protocol
--------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
.
.
.
```

The Default Timeout Interval = (2*125) + (100/10) = 260 seconds.

Increase Default Query Interval Next, change the Default Query Interval to 130 seconds.

```
Manager Switch 1> set ip igmp queryinterval=130

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
--------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 130 secs
Default Timeout Interval ......... 270 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
.
.
.
```

The Default Timeout Interval = (2*130) + (100/10) = 270 seconds.

Increase Query Response Interval

Next, change the Query Response Interval to 200 tenths of a second.

```
Manager Switch 1> set ip igmp queryresponseinterval=200

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
--------------------------------------------------------------------------
Status ............................ Enabled
Default Query Interval ............ 130 secs
Default Timeout Interval ......... 280 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable ............... 2
Query Response Interval .......... 200 (1/10secs)
.
.
.
```

The Default Timeout Interval = (2*130) + (200/10) = 280 seconds.

Reduce Intervals

Next, reduce the Default Query Interval to 125 seconds and the Query Response Interval to 100 tenths of a second again.

```
Manager Switch 1> set ip igmp queryinterval=125

Info (1005003): Operation successful.

Manager Switch 1> set ip igmp queryresponseinterval=100

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
--------------------------------------------------------------------------
Status ............................ Enabled
Default Query Interval ............ 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable ............... 2
Query Response Interval .......... 100 (1/10secs)
.
.
.
```

The Default Timeout Interval = (2*125) + (100/10) = 260 seconds.

Override Default Timeout Interval

To support existing configurations and for maximum flexibility, you can manually override the Default Timeout Interval. We do not recommend this.

```
Manager Switch 1> set ip igmp timeout=180

Warning (2005430): The Default Timeout Interval is below the default safe value of
(Default Query Interval * Robustness ) + (Query Response Interval / 10).

Manager Switch 1> show ip igmp

IGMP Protocol
-------------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 180 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 100 (1/10secs)
.
.
.
```

The warning message also displays when the router or switch starts up and in the log file, as the following output shows.

```
Manager Switch 1> show log tail

Date/Time   S Mod  Type  SType Message
-------------------------------------------------------------------------------
02 01:22:17 4 ENCO ENCO  STAC  STAC SW Initialised
02 01:22:17 7 SYS  REST  NORM  Router startup, ver 2.9.2-00, 30-Mar-2003, Clock
                               Log: 01:22:03 on 02-Dec-2006
02 01:22:19 6 SWIT PINT  UP    Port1: interface is UP
02 01:22:19 6 SWIT PINT  UP    Port16: interface is UP
02 01:22:19 3 USER USER  LON   manager login on port0
02 01:36:59 3 CH   MSG   WARN  The Default Timeout Interval is below the
                               default safe value of (Default Query Interval *
                               Robustness ) + (Query Response Interval / 10)
-------------------------------------------------------------------------------
```

Earlier software versions

With software versions earlier than 281-03 and 2.9.1, you need to manually calculate and change the Default Timeout Interval if you change any of the Robustness Variable, the LMQC, the Default Query Interval, or the Query Response Interval. Simply use the formula

```
Default Timeout Interval =
   (Robustness Variable * Default Query Interval)
   + one Query Response Interval in seconds
```

Note that the Query Response Interval is in seconds in this formula, instead of tenths of seconds as displayed in the output of the command **show ip igmp**.

For example, if you set a Default Query Interval of 200 seconds (and otherwise have default settings), you also need to set the Default Timeout Interval to:

```
Default Timeout Interval = 2 * 200 + 10 = 410 seconds
```

```
Manager Switch 1> set ip igmp queryinterval=200

Info (1005003): Operation successful.

Manager Switch 1> set ip igmp timeout=410

Info (1005003): Operation successful.

Manager Switch 1> show ip igmp

IGMP Protocol
------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 200 secs
Default Timeout Interval ......... 410 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval ........... 100 (1/10secs)
.
.
.
```

Example of bad choices for timer values

It is generally unwise to change any of the default IGMP settings unless you have advanced knowledge of how IGMP works. As "Timer and counter relationships" on page 69 describes, most of the timers and counters are related. This means setting timers can cause problems unless you understand the potential impact on the IGMP process.

This example sets three timers to excessively short values and discusses the potential consequences.

Example

Imagine the following changes to the configuration:

Timer	New value
Last Member Query Interval	5
Query Response Interval	5
Default Timeout Interval	126

The commands to configure these settings are:

```
set ip igmp lmqi=5
set ip igmp queryresponseinterval=5
set ip igmp timeout=126
```

The resulting values are displayed in the following output.

```
Manager Switch 1> show ip igmp

IGMP Protocol
--------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 126 secs

Last Member Query Interval ....... 5 (1/10secs)
Last Member Query Count .......... 2
Robustness Variable .............. 2
Query Response Interval .......... 5 (1/10secs)
.
.
.
```

Problem 1: Last Member Query Interval too short

The Last Member Query Interval was set to 5, using the command:

```
set ip igmp lmqi=5
```

This value is incredibly low—actually 5 tenths of a second (half a second). A Last Member Query Count of 2 (the default), gives your clients 1 second to get their Report back to the Querier before the Snooper and Querier stop sending the data stream. Using too low a Last Member Query Interval may mean that some or all clients briefly lose the multicast stream.

Problem 2: Query Response Interval short

The Query Response Interval was also set to 5, using the command:

```
set ip igmp queryresponseinterval=5
```

This value is also half a second. This value means that clients randomly pick a time between 0 and 0.5 seconds to respond (send a Report) to a Query. Using a short time here congests the Snoopers and Querier with Reports in a short space of time. This is not necessarily a problem if you only have a few clients, but 0.5 seconds is definitely a short window of time.

Problem 3: Default Timeout Interval too short

The Default Timeout Interval was set to 126, using the command:

```
set ip igmp timeout=126
```

There are two issues with having the Default Timeout Interval so short:

- There is no longer any allowance for packet loss in the network.

  The Querier sends a General Query every Default Query Interval seconds and waits for the Default Interval Timeout seconds for replies. Then it deletes any existing group entries that did not get refreshed. Therefore, if the Default Interval Timeout is less than twice the Default Query Interval, the Querier deletes entries if they do not reply to one General Query. A single dropped General Query causes multicasting to stop for the whole Layer 2 network.

- Clients may not have time to reply.

  In this example, the Default Timeout Interval (126 seconds) is only 1 second longer than the Default Query Interval (125). There is only 1 second for clients to receive the General Query and generate a Report and all Snoopers and the Querier to receive the Report. Depending on the network, this may not be long enough. If a client Report does not get back to the Querier in time, the Querier deletes that port's entry and multicasting stops briefly for the client.

RFC 2236 says that the Default Timeout Interval (the Group Membership Interval) must be:

```
(Robustness Variable * Default Query Interval) + one Query
                    Response Interval
```

For the settings in this example, that means (2*125) + 0.5 = 250.5 seconds.

Note that the Query Response Interval is specified in 1/10 second units on the command line and in output of **show ip igmp**, but in units of seconds in the above formula. In this example, the Query Response Interval was set with **queryresponseinterval=5**, so is 0.5 seconds.

Automatic changes

Since software versions 281-03 and 2.9.1, IGMP automatically changes the Default Timeout Interval if you change any of the Robustness Variable, the LMQC, the Default Query Interval, or the Query Response Interval. You can override the setting, as in this example, but we do not recommend this.

Before these releases, if you changed any of these other timers or counters, you had to manually calculate and change the Default Timeout Interval yourself.

For more information, see "Synchronisation of timers" on page 78.

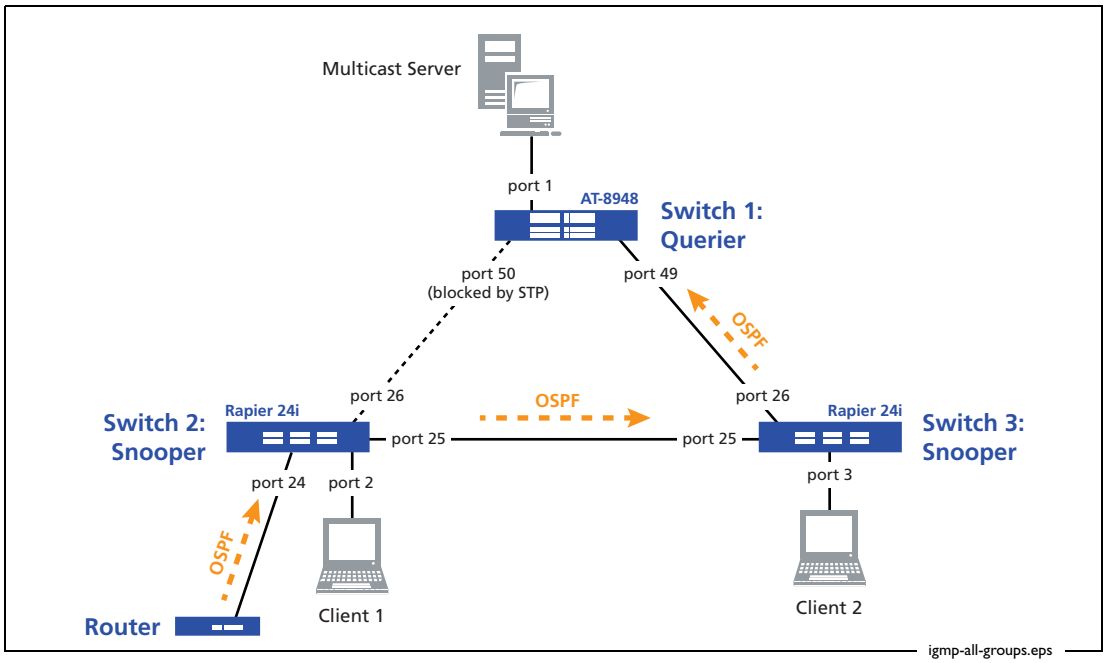
Stopping snoopers from snooping non-IGMP messages

Some networks include routers that have no interest in IGMP, but still generate multicast messages by running protocols like OSPF. When a Snooper receives multicast messages from such a router, the Snooper adds the router's port to its All Groups port list. This means the router is unnecessarily sent IGMP and multicast traffic. Using IGMP features to prevent the excess traffic is particularly helpful when you cannot or do not want to control the traffic at the router.

This example describes how to use AlliedWare's advanced IGMP features to prevent this behaviour, by limiting the ports that the Snooper adds to the All Groups list, or by stopping particular types of traffic from adding ports to the All Groups list.

Example

The example is based around a network that has a router running OSPF. The router is connected to a LAN through a switch. The LAN is a single subnet with no OSPF routers inside it. The network for this example uses the same loop as for "IGMP snooping" on page 9, with a router attached to switch 2. The network is shown in the following figure.



We used an AR410 router, but the router configuration works on any AR400 or AR700 series router.

Each example in this section modifies the following base configuration.

▶ Configure switch 1

Switch 1 is an IGMP Querier.

```
set system name="Switch 1"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp=default port=1 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-52

# IP configuration
enable ip
add ip int=vlan100 ip=172.31.0.254 mask=255.255.255.0
enable ip igmp
enable ip igmp int=vlan100
```

▶ Configure switch 2

Switch 2 is an IGMP Snooper.

```
set system name="Switch 2"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=2 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

▶ Configure switch 3

Switch 3 is also an IGMP Snooper.

```
set system name="Switch 3"

# STP general configuration
enable stp=default
set stp=default mode=rapid
set stp port=3 edgeport=yes

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-26
```

▶ Configure the router

The router uses OSPF.

```
set system name=Router

# VLAN general configuration
create vlan=vlan100 vid=100
add vlan=100 port=1-4

# IP configuration
enable ip
set ip autonomous=65000
add ip int=vlan100 ip=172.31.0.1 mask=255.255.255.0
add ip int=eth0 ip=10.0.0.1

# OSPF configuration
set ospf routerid=172.31.0.1
add ospf area=0.0.0.1
add ospf range=172.31.0.0 area=0.0.0.1 mask=255.255.255.0
add ospf interface=vlan100 area=0.0.0.1
enable ospf
```

With the above configuration, the router sends OSPF messages to switch 2. As the following outputs show, this means that:

- switch 2 designates port 24 an All Groups port
- switch 2 forwards the OSPF packets to uplink port 25 on switch 3, so switch 3 designates port 25 an All Groups port
- switch 3 forwards the OSPF packets to uplink port 49 on switch 1, so switch 1 designates port 49 an All Groups port

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  All Groups                                  Entry timeout 256 secs
  Ports  24-25

------------------------------------------------------------------------
```

```
Manager Switch 3> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  All Groups                                Entry timeout 257 secs
  Ports  25-26

--------------------------------------------------------------------------
```

```
Manager Switch 1> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  All Groups                                Entry timeout 260 secs
  Ports  49

--------------------------------------------------------------------------
```

Preventing an All Groups entry for a port

This section stops port 24 from being in switch 2's All Groups entry, then adds it back again.

Disabling All Groups entry for a port

You can avoid the All Groups entries shown above by simply disabling the All Groups entry for the port that switch 2 uses to connect to the router.

```
Manager Switch 2> disable ip igmp allgroups=24

Info (1005003): Operation successful.

Manager Switch 2> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ 24

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                       Entry timeout 164 secs
  Ports  None

  All Groups                                Entry timeout 251 secs
  Ports  24#,25

-------------------------------------------------------------------------
```

Port 24 is now accompanied by a hash. This is because All Groups was disabled for the port while the port was part of All Groups. The switch will keep sending port 24 traffic for the group 224.12.13.14 until either port 24's internal timer or the timer for the group 224.12.13.14 hits zero.

Note: The switch keeps an internal timer for each port in its All Groups list, which is separate from the All Groups entry timeout displayed in output of the command **show igmpsnooping**. There are no commands to view the internal timer, but every time the switch receives a new IGMP (or in this case OSPF) message the timer resets. This timer means that if the router stopped sending OSPF messages to the port, the switches would eventually drop the relevant entries from their All Groups lists.

Enabling All Groups entry again

To further explore the system we will next reverse the process and follow switch 2 while group entries time out and the switch starts transmitting traffic for the group 224.12.13.14 to the router again. This sequence illustrates the time delay between when you change a port's All Groups configuration and when multicast traffic flow changes.

1. Permit port 24 to be an All Groups port again.

```
Manager Switch 2> enable ip igmp allgroups=24

Info (1005003): Operation successful.
```

2. Check the group entry timeout values.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                        Entry timeout 216 secs
  Ports  None

  All Groups                                 Entry timeout 254 secs
  Ports  24-25

-------------------------------------------------------------------------
```

Port 24 is now an All Groups port. However, this not mean that it immediately starts receiving multicast packets for the group 224.12.13.14, as the next few steps show.

3. Reset port 24's packet counters.

```
Manager Switch 2> reset switch port=24 counter

Info (1087003): Operation successful.
```

4. Display port 24's packet counters, which show that only a few multicast packets have been transmitted on the port.

```
Manager Switch 2> show switch port=24 counter

 Switch Port Counters
------------------------------------------------------------------------

Port 24. Fast Ethernet MAC counters:
 Combined receive/transmit packets by size (octets) counters:
  64                                2 512 - 1023                          0
  65 - 127                          0 1024 - MaxPktSz                     0
  128 - 255                         0 1519 - 1522                         0
  256 - 511                           0

 General Counters:
 Receive                             Transmit
  Octets                           0 Octets                            128
  Pkts                             0 Pkts                                2
  FCSErrors                        0 FCSErrors                           0
  MulticastPkts                    0 MulticastPkts                       2
  BroadcastPkts                    0 BroadcastPkts                       0
  PauseMACCtlFrms                  0 PauseMACCtrlFrm                     0
  OversizePkts                     0 OversizePkts                        0
  Fragments                        0 Fragments                           0
  Jabbers                          0 Jabbers                             0
.
.
.
------------------------------------------------------------------------
```

5. Check the group entry timeout values again.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ............................ Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                      Entry timeout 3 secs
  Ports  None

  All Groups                               Entry timeout 255 secs
  Ports  24-25

------------------------------------------------------------------------
```

6. Enable IGMP debugging.

```
Manager Switch 2> enable ip igmp debug

Info (1005003): Operation successful.
```

7. Observe the debugging output, which shows that the group 224.12.13.14 was deleted when its timer expired, then was immediately added in again.

```
Manager Switch 2> IGMP Snoop Timeout: group=224.12.13.14 (0) is deleted
Deleting all ports for group 224.12.13.14 on vlan100
IGMP Snoop Unregistered Multicast: Source 172.31.0.99, Group 224.12.13.14
-> snd group 224.0.0.2 added
Adding port 24 for group 224.0.0.2 on vlan100
IGMP Snoop: added all router membership
```

8. Check the group entry timeout values again.

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                       Entry timeout 259 secs
  Ports  None

  All Groups                                Entry timeout 259 secs
  Ports  24-25

--------------------------------------------------------------------------
```

9. Display port 24's packet counters, which show that many multicast packets have been transmitted on the port.

```
Manager Switch 2> show switch port=24 counter

 Switch Port Counters
------------------------------------------------------------------------

Port 24. Fast Ethernet MAC counters:
 Combined receive/transmit packets by size (octets) counters:
  64                              84 512 - 1023                        0
  65 - 127                        16 1024 - MaxPktSz                 830
  128 - 255                        0 1519 - 1522                       0
  256 - 511                          0

 General Counters:
 Receive                             Transmit
  Octets                        1312 Octets                      1135836
  Pkts                            16 Pkts                            914
  FCSErrors                        0 FCSErrors                         0
  MulticastPkts                   16 MulticastPkts                   914
  BroadcastPkts                    0 BroadcastPkts                     0
  PauseMACCtlFrms                  0 PauseMACCtrlFrm                   0
  OversizePkts                     0 OversizePkts                      0
  Fragments                        0 Fragments                         0
  Jabbers                          0 Jabbers                           0
.
.
.
------------------------------------------------------------------------
```

In summary, when a port receives the All Groups designation, a stream is sent to that port when either:

- the stream's group entry times out and is refreshed, or
- the port's internal timer hits zero and is refreshed

It is most likely that the group entry will time out first.

Controlling which addresses create All Groups entries

The router or switch adds a port to its All Groups list when it determines that the port has a router attached to it. This example shows how to influence the router or switch's process in determining who is a router, and therefore when to add a port to the All Groups list.

You can control the criteria for deciding which packets actually indicate the presence of a router on a particular port, by using the command:

```
set igmpsnooping routermode={all|default|ip|multicastrouter|
   none}
```

With this command, you specify (in effect) a list of IP addresses. When the router or switch receives a multicast packet on a port, it compares the packet's destination IP address with the list. If they match, the router or switch considers the packet to be from a "router", and adds the port to the All Groups list.

The following table shows the address lists that each command option gives.

This option...	**means that the port is treated as a multicast router port if it receives packets from...**
all	any reserved multicast addresses (224.0.0.1 to 224.0.0.255)
default	224.0.0.1 (IGMP Queries) 224.0.0.2 (all routers on this subnet) 224.0.0.4 (DVMRP routers) 224.0.0.5 (all OSPFIGP routers) 224.0.0.6 (OSPFIGP designated routers) 224.0.0.9 (RIP2 routers) 224.0.0.13 (all PIM routers) 224.0.0.15 (all CBT routers)
multicastrouter	224.0.0.4 (DVMRP routers) 224.0.0.13 (all PIM routers)
ip	the current list of addresses, *plus* addresses specified using the command **add igmpsnooping routeraddress**, *minus* addresses specified using the command **delete igmpsnooping routeraddress**.

Configuring switch 2

The example below shows how to tailor the list of router addresses on switch 2. In summary, you do this by using the commands:

```
set igmpsnooping routermode=ip
delete igmpsnooping routeraddress=224.0.0.5
```

The example removes 224.0.0.5 because it is the address for OSPF messages, as the table above shows.

```
Manager Switch 2> set igmpsnooping routermode=ip

Info (1005282): IGMPSnooping Routermode successfully updated.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... ip

Router Address List
-----------------------------------------------------------
224.0.0.1       224.0.0.4       224.0.0.6       224.0.0.13
224.0.0.2       224.0.0.5       224.0.0.9       224.0.0.15

------------------------------------------------------------------------
```

```
Manager Switch 2> enable ip igmp debug

Info (1005003): Operation successful.
```

```
Manager Switch 2> delete igmpsnooping routeraddress=224.0.0.5

Info (1005272): Multicast addresses successfully deleted.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... ip

Router Address List
-----------------------------------------------------------
224.0.0.1       224.0.0.4       224.0.0.9       224.0.0.15
224.0.0.2       224.0.0.6       224.0.0.13

------------------------------------------------------------------------
```

```
Manager Switch 2> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  All Groups                                Entry timeout 214 secs
  Ports  24-25

------------------------------------------------------------------------
```

```
Manager Switch 2> Timing out port 24 from group 224.0.0.2 on vlan100
Deleting port 24 from group 224.0.0.2 on vlan100
Reconstructing snooping entries: 24,

Manager Switch 2> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  Group. 224.12.13.14                       Entry timeout 224 secs
  Ports  None

  All Groups                                Entry timeout 242 secs
  Ports  25

------------------------------------------------------------------------
```

Looking at the above outputs, note that debugging did not print out any messages about the OSPF router after we removed the address, but it did tell us when the port had been removed from the All Groups list. Also, remember that port 24 only times out of the All Groups list when its internal IGMP message timer counts down to zero.

Configuring switches 1 and 3

The output of the command **show igmpsnooping**, above, shows that switch 2 is still receiving the multicast group 224.12.13.14 even though it has no ports interested in receiving it. This is because switch 2 still switches the OSPF Hello packet, which it received on port 24, to switch 3. Switch 3 receives this Hello packet on port 25, adds port 25 to its All Groups list and forwards the packet on to switch 1.

The best solution to this is to remove 224.0.0.5 from switch 3 and switch 1 as well, by using the following commands on each switch:

```
set igmpsnooping routermode=ip
delete igmpsnooping routeraddress=224.0.0.5
```

Adding other router addresses

If you want to specify that other addresses belong to routers, you can use the commands:

```
set igmpsnooping routermode=ip
add igmpsnooping routeraddress=ipadd
```

The *ipadd* must be of the form 224.0.0.x, and can be a comma-separated list of addresses.

The example below starts again with the default configuration, and first removes the OSPF router address, then adds another address—224.0.0.254—to illustrate use of the command.

```
Manager Switch 2> set igmpsnooping routerm=ip

Info (1005282): IGMPSnooping Routermode successfully updated.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... ip

Router Address List
-----------------------------------------------------------
224.0.0.1       224.0.0.4       224.0.0.6       224.0.0.13
224.0.0.2       224.0.0.5       224.0.0.9       224.0.0.15

------------------------------------------------------------------------
```

```
Manager Switch 2> del igmpsnooping routeraddress=224.0.0.5

Info (1005272): Multicast addresses successfully deleted.
```

```
Manager Switch 2> add igmpsnooping routeraddress=224.0.0.254

Info (1005275): Multicast addresses successfully added.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... ip

Router Address List
-----------------------------------------------------------
224.0.0.1       224.0.0.4       224.0.0.9       224.0.0.15
224.0.0.2       224.0.0.6       224.0.0.13      224.0.0.254

------------------------------------------------------------------------
```

Returning to the default list

To return to the default list, change the router mode to **default**.

```
Manager Switch 2> set igmpsnooping routermode=default

Info (1005282): IGMPSnooping Routermode successfully updated.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... default

Router Address List
-----------------------------------------------------------
224.0.0.1       224.0.0.4       224.0.0.6       224.0.0.13
224.0.0.2       224.0.0.5       224.0.0.9       224.0.0.15

------------------------------------------------------------------------
```

If we then go back to **routermode=ip**, we are still left with the default set of IPs—changing the router mode to **ip** does not make the switch change the list of router addresses. Instead, it puts the switch into a mode in which we can add or delete addresses in the list, which lets us customise the list afresh.

```
Manager Switch 2> set igmpsnooping routermode=ip

Info (1005282): IGMPSnooping Routermode successfully updated.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... ip

Router Address List
-----------------------------------------------------------
224.0.0.1       224.0.0.4       224.0.0.6       224.0.0.13
224.0.0.2       224.0.0.5       224.0.0.9       224.0.0.15

------------------------------------------------------------------------
```

Using the other routermode options

As described earlier, **routermode=multicastrouter** is just a shortcut for the two IP addresses for DVMRP and PIM.

```
Manager Switch 2> set igmpsnooping routermode=multicastrouter

Info (1005282): IGMPSnooping Routermode successfully updated.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... multicastrouter

Router Address List
-----------------------------------------------------
224.0.0.4      224.0.0.13

------------------------------------------------------------------------
```

The mode **routermode=none** stops any reserved multicast addresses from being identified as coming from routers.

```
Manager Switch 2> set igmpsnooping routerm=none

Info (1005282): IGMPSnooping Routermode successfully updated.
```

```
Manager Switch 2> show igmpsnooping routeraddress

IGMP Snooping Router Address
------------------------------------------------------------------------
IGMP Snooping Router Mode ......... none

Router Address List
-----------------------------------------------------
No reserved multicast addresses configured

------------------------------------------------------------------------
```

Conversely, the mode **routermode=all** means that all reserved multicast addresses (224.0.0.1 to 224.0.0.255) are identified as coming from routers.

Statically specifying that a port is a router port

Since software versions 281-04 and 291-04, you can statically configure particular ports as multicast router ports. This feature is useful in some unusual network configurations in which the learning process cannot identify all router ports. You could also use it creatively in special circumstances, when a Querier is unnecessary.

To specify router ports, use the command:

```
add igmpsnooping vlan={vlan-name|1..4094}
   routerport={port-list|all}
```

This command causes the switch to immediately forward all IGMP and multicast data packets to the designated router port.

Note that this is an IGMP snooping command, designed to give administrators greater control of layer 2 multicasting. It does not provide static multicast routing.

Example

The following sequence explores the effect of adding a static router port on a Rapier 48i switch.

1. Enable IGMP debugging so you can see some of the mechanics behind the commands.

```
Manager Rapier 48i> enable ip igmp debug

Info (1005003): Operation successful.
```

2. Check the current IGMP snooping entries.

Note that there is one All Groups entry for port 50.

```
Manager Rapier 48i> show igmpsnooping

IGMP Snooping
------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Query Solicitation ...... On
Static Router Ports ..... None
Group List ..............

  Group. 239.255.255.250                    Entry timeout 190 secs
  Ports  7

  All Groups                                Entry timeout 255 secs
  Ports  50

------------------------------------------------------------------------
```

3. Statically add port 6 as a router port attached to VLAN 1.

```
Manager Rapier 48i> add igmpsnooping vlan=1 routerport=6

snooped group 224.0.0.2 added
Adding port 6 for group 224.0.0.2 on default

Info (1005003): Operation successful.
```

```
Manager Rapier 48i> show igmpsnooping

IGMP Snooping
-------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Query Solicitation ...... On
Static Router Ports ..... 6
Group List ..............

  Group. 239.255.255.250                    Entry timeout 184 secs
  Ports  7

  All Groups                                Entry timeout Infinity
  Ports  6,50

-------------------------------------------------------------------------
```

The above output shows that port 6 has joined port 50 as an All Groups port. Also note that the Entry timeout is infinity. This timeout of infinity only applies to the static entry—port 50 will time out as normal if Queries stop arriving on that port.

4. Stop port 6 from being a static router port.

To remove the static configuration, simply delete it.

```
Manager Rapier 48i> delete igmpsnooping vlan=1 routerport=6

Deleting port 6 from group 224.0.0.2 on default
Reconstructing snooping entries(224.0.0.2/vlan1): 49,

Info (1005003): Operation successful.
```

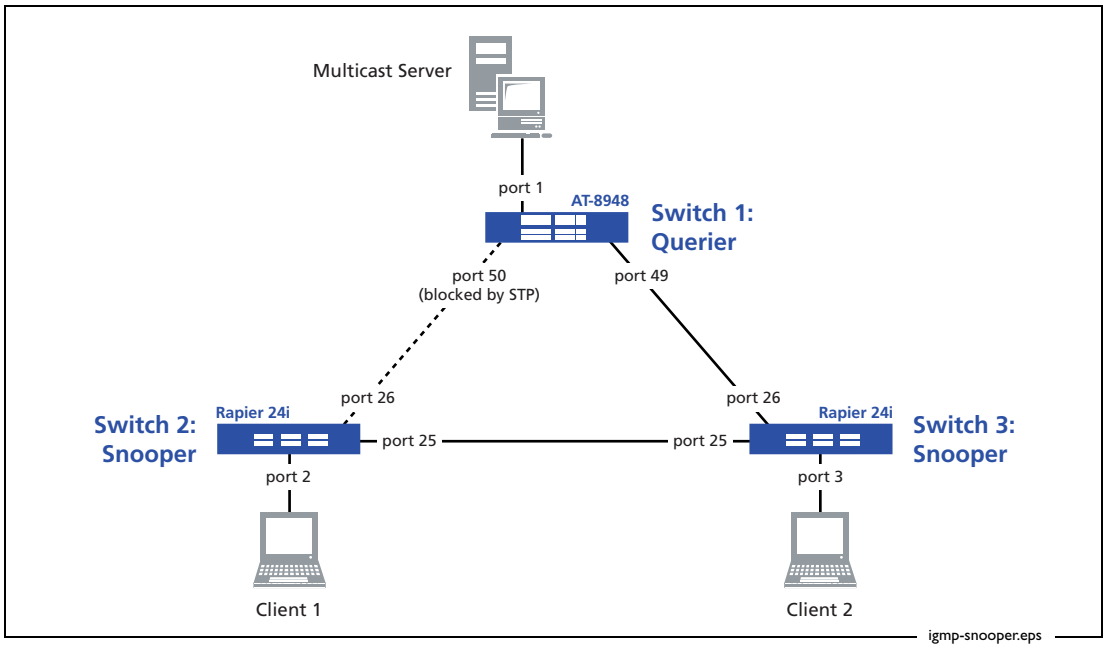
IGMP debugging

In this section, we shall examine the debugging messages that the router or switch outputs when certain events occur while debugging is enabled. To enable debugging, use the command:

```
enable ip igmp debug
```

Example

This example uses the same network configuration as "IGMP snooping" on page 9. For convenience, the diagram is reproduced below.



▶ A client joins a group

Client 2 sends a Membership Report for group 224.12.13.14. Switch 1 sees the report on vlan100 (port 49), and adds the port to its IGMP and IGMP snooping tables.

```
Manager Switch 1> IGMP Snoop(48): Report -> snooped group 224.12.13.14 added
Adding port 49 for group 224.12.13.14 on vlan100
IGMP Rx(48): Report -> group 224.12.13.14 added
```

Note that the debugging output does not identify which client sent the Membership Report.

▶ A client leaves a group

Client 2 sends a Leave message for group 224.12.13.14. Switch 1 sees the Leave message on vlan100 (port 49). The port is in a state of "deferred deletion" because of the Last Member Query process (see "Last Member Query Count and Last Member Query Interval" on page 72).

Switch 1 is an IGMP Querier, so it sends out two Membership Queries and waits 2 seconds for a response. None arrives, so switch 1 deletes the entry.

```
Manager Switch 1> IGMP Snoop(48) on vlan100: Leave -> IGMP Snoop(48): Leave g.
group 224.12.13.14 - Port 49 in deferred deletion.
IGMP Rx(48) on vlan100: Leave -> IGMP Rx(48): Leave group=224.12.13.14 -> group .
```

Several minutes later the group entry times out.

```
Manager Switch 1> IGMP Snoop Timeout: group=224.12.13.14 (0) is deleted
Deleting all ports for group 224.12.13.14 on vlan100
IGMP Timeout: group=224.12.13.14 (0) is deleted
```

Meanwhile, switch 3, which has the client attached to it, sees the same sequence but debugs it differently. Like switch 1, switch 3 logs the Leave message, but its output also includes the port on which it received the Leave message. This enables you to identify the client. Switch 3 also logs the two Specific Queries and notes the 2 second timeout. After 2 seconds it also deletes the entry from its IGMP snooping table.

```
Manager Switch 3> IGMP Snoop: resending pkt to vlan
  utPorts: 1-4,6-26 fwdPorts: 26
IGMP Snoop(2) on vlan100: Leave -> IGMP Snoop(2): Leave group=224.12.13.14-> gr.
group 224.12.13.14 - Port 3 in deferred deletion.
IGMP MVR Snoop: discard - no MVR snooper for code 23

IGMP Snoop: resending pkt to vlan
  utPorts: 1-4,6-26 fwdPorts: 3,26
IGMP Snoop(25) on vlan100: Query -> code 10
igmpSnoopMembershipQuery >> setting timer at 2 secs for group 224.12.13.14
snooped group 224.0.0.2 added
Adding port 26 for group 224.0.0.2 on vlan100
IGMP MVR Snoop: discard - no MVR snooper for code 17

Manager Switch 3> IGMP Snoop: resending pkt to vlan
  utPorts: 1-4,6-26 fwdPorts: 3,26
IGMP Snoop(25) on vlan100: Query -> code 10
igmpSnoopMembershipQuery >> setting timer at 2 secs for group 224.12.13.14
snooped group 224.0.0.2 added
Adding port 26 for group 224.0.0.2 on vlan100
IGMP MVR Snoop: discard - no MVR snooper for code 17

Manager Switch 3> IGMP Snoop Timeout: group=224.12.13.14 (0) is deleted
Deleting all ports for group 224.12.13.14 on vlan100
```

A port entry times out

Client 2 sends a Membership Report for group 224.12.13.14. Switch 1 sees the report on vlan100 (port 49) and adds an entry. The entry eventually expires.

```
Manager Switch 1> IGMP Snoop(48): Report -> snooped group 224.12.13.14 added
Adding port 49 for group 224.12.13.14 on vlan100
IGMP Rx(48): Report -> group 224.12.13.14 added

Manager Switch 1> IGMP Snoop Timeout: group=224.12.13.14 (0) is deleted
Deleting all ports for group 224.12.13.14 on vlan100
IGMP Timeout: group=224.12.13.14 (0) is deleted
```

Snooped ports change

Switch 3—a Snooper—sees a Version 2 Membership Query message on vlan100 from the Querier and forwards it to all ports in the same VLAN. In the debugging output, the list of ports is the *fwdports* list. If we take a port out of the VLAN, the *fwdports* list changes.

```
Manager Switch 3> IGMP Snoop: resending pkt to vlan
  utPorts: 1-26 fwdPorts: 1-26
IGMP Snoop(25) on vlan100: Query -> code 100
snooped group 224.0.0.2 added
Adding port 26 for group 224.0.0.2 on vlan100
IGMP MVR Snoop: discard - no MVR snooper for code 17

Manager Switch 3> del vlan=100 port=5

Info (1089003): Operation successful.

Manager Switch 3> IGMP Snoop: resending pkt to vlan
  utPorts: 1-4,6-26 fwdPorts: 1-4,6-26
IGMP Snoop(25) on vlan100: Query -> code 100
snooped group 224.0.0.2 added
Adding port 26 for group 224.0.0.2 on vlan100
IGMP MVR Snoop: discard - no MVR snooper for code 17
```

This example also shows what debugging output looks like when the Snooper receives a General Query. The Querier sends the General Query to the destination address 224.0.0.1 (the IGMP Query address) and the Snooper tells us that it has added the "router" port to its All Groups list. In the IGMP standards, "All routers on this subnet" are identified with the group address of 224.0.0.2, so the debugging output refers to that address.

```
Manager Switch 3> show igmpsnooping

IGMP Snooping
--------------------------------------------------------------------------
Status ........................... Enabled
Disabled All-groups ports ........ None

Vlan Name (vlan id) ..... default (1)
Fast Leave .............. Off
Group List ..............

  No group memberships.

Vlan Name (vlan id) ..... vlan100 (100)
Fast Leave .............. Off
Group List ..............

  All Groups                                  Entry timeout 144 secs
  Ports  26

--------------------------------------------------------------------------
```

For more information about router addresses, see "Controlling which addresses create All Groups entries" on page 95.

▶ A report is filtered out

The switch drops a Membership Report because of an IGMP filter. See "Explanation of IGMP filtering (controlling multicast distribution)" on page 38 for more information about filters.

```
Manager Switch 1>
IGMP filter: discarded report for group 224.0.1.22 on port 1
```

▶ A port in the All Groups list is unplugged

The switch deletes a port from the All Groups list after the port is disconnected.

```
Manager Switch 3> Deleting port 24 from group 224.0.0.2 on vlan100
Reconstructing snooping entries: 25,
```

▶ Output for **show ip igmp** changes

When IGMP debugging is enabled, the command **show ip igmp** gives more information about static IGMP associations, as shown in bold in the following output. See "Explanation of Static IGMP" on page 51 for more information about static associations.

```
IGMP Protocol
-------------------------------------------------------------------------
Status ........................... Enabled
Default Query Interval ........... 125 secs
Default Timeout Interval ......... 260 secs

Last Member Query Interval ....... 10 (1/10secs)
Last Member Query Count ........... 2
Robustness Variable .............. 2
Query Response Interval ........... 100 (1/10secs)
Disabled All-groups ports ........ None

Interface Name .......... vlan100             (DR)
Group List ..............

  Group. 224.12.13.14      Static association         Refresh time Infinity
   Ports  5
   Static Ports  5

  User-created static IGMP associations:
  --------------------------------------
  Group. 224.12.13.14      Static association         Refresh time Infinity
  Static Ports  5

-------------------------------------------------------------------------
```

Appendix: STP state

In most of the examples in this document, the switches are configured in a loop and are all in the same VLAN. To prevent packets from looping the network, STP is configured. The STP state on each switch is given in the following output screens.

Switch 1

Note that port 50 on switch 1 is in a discarding state.

```
Manager Switch 1> show stp=default port=49-50

 STP Port Information
-------------------------------------------------------------------------
 STP ..................... default
   STP Status ............ ON

   Port .................. 49
     RSTP Port Role ...... Root
     State ............... Forwarding
     Point To Point ...... Yes (Auto)
     Port Priority ....... 128
     Port Identifier ..... 8031
     Pathcost ............ 20000 (auto configured)
     Designated Root ..... 32768 : 00-00-cd-01-4b-10
     Designated Cost ..... 0
     Designated Bridge ... 32768 : 00-00-cd-01-4b-10
     Designated Port ..... 801a
     EdgePort ............ No
     VLAN membership ..... 1
     Counters:
       Loopback Disabled            0

   Port .................. 50
     RSTP Port Role ...... Alternate
     State ............... Discarding
     Point To Point ...... Yes (Auto)
     Port Priority ....... 128
     Port Identifier ..... 8032
     Pathcost ............ 20000 (auto configured)
     Designated Root ..... 32768 : 00-00-cd-01-4b-10
     Designated Cost ..... 20000
     Designated Bridge ... 32768 : 00-00-cd-02-e5-40
     Designated Port ..... 801a
     EdgePort ............ No
     VLAN membership ..... 1
     Counters:
       Loopback Disabled            0

-------------------------------------------------------------------------
```

Switch 2

```
Manager Switch 2> show stp=default port=25-26

 STP Port Information
--------------------------------------------------------------------------------
 STP ..................... default
   STP Status ............ ON

   Port .................. 25
     RSTP Port Role ...... Root
     State ............... Forwarding
     Point To Point ...... Yes (Auto)
     Port Priority ....... 128
     Port Identifier ..... 8019
     Pathcost ............ 20000 (auto configured)
     Designated Root ..... 32768 : 00-00-cd-01-4b-10
     Designated Cost ..... 0
     Designated Bridge ... 32768 : 00-00-cd-01-4b-10
     Designated Port ..... 8019
     EdgePort ............ No
     Counters:
       Loopback Disabled            0

   Port .................. 26
     RSTP Port Role ...... Designated
     State ............... Forwarding
     Point To Point ...... Yes (Auto)
     Port Priority ....... 128
     Port Identifier ..... 801a
     Pathcost ............ 20000 (auto configured)
     Designated Root ..... 32768 : 00-00-cd-01-4b-10
     Designated Cost ..... 20000
     Designated Bridge ... 32768 : 00-00-cd-02-e5-40
     Designated Port ..... 801a
     EdgePort ............ No
     Counters:
       Loopback Disabled            0

--------------------------------------------------------------------------------
```

Switch 3

```
Manager Switch 3> show stp port=25-26

 STP Port Information
--------------------------------------------------------------------------
 STP ..................... default
   STP Status ............ ON

   Port .................. 25
     RSTP Port Role ...... Designated
     State ............... Forwarding
     Point To Point ...... Yes (Auto)
     Port Priority ....... 128
     Port Identifier ..... 8019
     Pathcost ............ 20000 (auto configured)
     Designated Root ..... 32768 : 00-00-cd-01-4b-10
     Designated Cost ..... 0
     Designated Bridge ... 32768 : 00-00-cd-01-4b-10
     Designated Port ..... 8019
     EdgePort ............ No
     Counters:
       Loopback Disabled            0

   Port .................. 26
     RSTP Port Role ...... Designated
     State ............... Forwarding
     Point To Point ...... Yes (Auto)
     Port Priority ....... 128
     Port Identifier ..... 801a
     Pathcost ............ 20000 (auto configured)
     Designated Root ..... 32768 : 00-00-cd-01-4b-10
     Designated Cost ..... 0
     Designated Bridge ... 32768 : 00-00-cd-01-4b-10
     Designated Port ..... 801a
     EdgePort ............ No
     Counters:
       Loopback Disabled            0

--------------------------------------------------------------------------
```

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