QTECH
МИР ДОСТУПНЕЕ

РУКОВОДСТВО ПОЛЬЗОВАТЕЛЯ

Multicast Protocol

Оглавление

1. IPV4 MULTICAST PROTOCOL

1.1 IPv4 Multicast Protocol Overview

This chapter will give an introduction to the configuration of IPv4 Multicast Protocol.

1.1.1 Introduction to Multicast

Various transmission modes can be adopted when the destination of packet (including data, sound and video) transmission is the minority users in the network. One way is to use Unicast mode, i.e. to set up a separate data transmission path for each user; or, to use Broadcast mode, which is to send messages to all users in the network, and they will receive the Broadcast messages no matter they need or not. For example, if there are 200 users in a network who want to receive the same packet, then the traditional solution is to send this packet for 200 times separately via Unicast to guarantee the users who need the data can get all data wanted, or send the data in the entire domain via Broadcast. Transferring the data in the whole range of network .The users who need these data can get directly from the network. Both modes waste a great deal of valuable bandwidth resource, and furthermore, Broadcast mode goes against the security and secrecy.

The emergence of IP Multicast technology solved this problem in time. The Multicast source only sends out the message once, Multicast Routing Protocol sets up tree-routing for Multicast data packet, and then the transferred packet just starts to be duplicated and distributed in the bifurcate crossing as far as possible. Thus the packet can be sent to every user who needs it accurately and effectively.

It should be noticed that it is not necessary for Multicast source to join in Multicast group. It sends data to some Multicast groups, but it is not necessarily a receiver of the group itself. There can be more than one source sending packets to a Multicast group simultaneously. There may exist routers in the network which do not support Multicast, but a Multicast router can encapsulate the Multicast packets into Unicast IP packets with tunnel mode to send them to the Multicast router next to it, which will take off the Unicast IP header and continue the Multicast transmission process, thus a big alteration of network structure is avoided. The primary advantages of Multicast are:

1. Enhance efficiency: reduce network traffic, lighten the load of server and CPU
2. Optimize performance: reduce redundant traffic
3. Distributed application: Enable Multipoint Application

1.1.2 Multicast Address

The destination address of Multicast message uses class D IP address with range from 224.0.0.0 to 239.255.255.255. D class address can not appear in the source IP address field of

an IP message. In the process of Unicast data transmission, the transmission path of a data packet is from source address routing to destination address, and the transmission is performed with hop-by-hop principle. However, in IP Multicast environment, the destination addresses is a group instead of a single one, they form a group address. All message receivers will join in a group, and once they do, the data flowing to the group address will be sent to the receivers immediately and all members in the group will receive the data packets. The members in a Multicast group are dynamic, the hosts can join and leave the Multicast group at any time.

Multicast group can be permanent or temporary. Some of the Multicast group addresses are assigned officially; they are called Permanent Multicast Group. Permanent Multicast Group keeps its IP address fixed but its member structure can vary within. The member amount of Permanent Multicast Group can be arbitrary, even zero. The IP Multicast addresses which are not kept for use by Permanent Multicast Group can be utilized by temporary Multicast groups.

224.0.0.0～224.0.0.255 are reserved Multicast addresses (Permanent Group Address), address 224.0.0.0 is reserved but not assigned, and other addresses are used by Routing Protocol; 224.0.1.0～238.255.255.255 are Multicast addresses available to users（Temporary Group Address） and are valid in the entire domain of the network; 239.0.0.0～239.255.255.255 are local management Multicast addresses, which are valid only in specific local domain. Frequently used reserved multicast address list is as follows:

Benchmark address (reserved)

224.0.0.1 Address of all hosts

224.0.0.2 Address of all Multicast Routers

224.0.0.3 Unassigned

224.0.0.4 DVMRP Router

224.0.0.5 OSPF Router

224.0.0.6 OSPF DR

224.0.0.7 ST Router

224.0.0.8 ST host

224.0.0.9 RIP-2 Router

224.0.0.10 IGRP Router

224.0.0.11 Active Agent

224.0.0.12 DHCP Server/Relay Agent

224.0.0.13 All PIM Routers

224.0.0.14 RSVP Encapsulation

224.0.0.15 All CBT Routers

224.0.0.16 Specified SBM

224.0.0.17 All SBMS

224.0.0.18 VRRP

224.0.0.22 IGMP

When Ethernet transmits Unicast IP messages, the destination MAC address it uses is the receiver's MAC address. But in transmitting Multicast packets, the transmission destination is not a specific receiver any more, but a group with uncertain members, thus Multicast MAC address is used. Multicast MAC address is corresponding to Multicast IP address. It is prescribed in IANA (Internet Assigned Number Authority) that the higher 25 bits in Multicast MAC address is 0x01005e, and the lower 23bits in MAC address is the lower 23bits in Multicast IP address.

Since only 23bits out of the lower 28bits in IP Multicast address are mapped into MAC address, therefore there are 32 IP Multicast addresses which are mapped into the same MAC address.

1.1.3 IP Multicast Packet Transmission

In Multicast mode, the source host sends packets to the host group indicated by the Multicast group address in the destination address field of IP data packet. Unlike Unicast mode, Multicast data packet must be forwarded to a number of external interfaces to be sent to all receiver sites in Multicast mode, thus Multicast transmission procedure is more complicated than Unicast transmission procedure.

In order to guarantee that all Multicast packets get to the router via the shortest path, the receipt interface of the Multicast packet must be checked in some certain way based on Unicast router table; this checking mechanism is the basis for most Multicast Routing Protocol to forward in Multicast mode --- RPF (Reverse Path Forwarding) check. Multicast router makes use of the impressed packet source address to query Unicast Router Table or independent Multicast Router Table to determine if the packet ingress interface is on the shortest path from receipt site to source address. If shortest path Tree is used, then the source address is the address of source host which sends Multicast Data Packets; if Shared Tree is used, then the source address is the address of the root of the Shared-Tree. When Multicast data packet gets to the router, if RPF check passes, then the data packet is forwarded according to Multicast forward item, and the data packet will be discarded else wise.

1.1.4 IP Multicast Application

IP Multicast technology has effectively solved the problem of sending in single point and receiving in multipoint. It has achieved the effective data transmission from a point to multiple points, saved a great deal of network bandwidth and reduced network load. Making use of the Multicast property of network, some new value-added operations can be supplied conveniently. In Information Service areas such as online living broadcast, network TV, remote education, remote medicine, real time video/audio meeting, the following applications may be supplied:

1) Application of Multimedia and Streaming Media
2) Data repository, finance application (stock) etc

3) Any data distribution application of “one point to multiple points”

In the situation of more and more multimedia operations in IP network, Multicast has tremendous market potential and Multicast operation will be generalized and popularized.

1.2 DCSCM

1.2.1 Introduction to DCSCM

DCSCM (Destination control and source control multicast) technology mainly includes three aspects, i.e. Multicast Packet Source Controllable, Multicast User Controllable and Service-Oriented Priority Strategy Multicast.

The Multicast Packet Source Controllable technology of Security Controllable Multicast technology is mainly processed in the following manners:

1. On the edge switch, if source under-control multicast is configured, then only multicast data from specified group of specified source can pass.
2. For RP switch in the core of PIM-SM, for REGISTER information out of specified source and specified group, REGISTER_STOP is transmitted directly and table entry is not allowed to set up. (This task is implemented in PIM-SM model).

The implement of Multicast User Controllable technology of Security Controllable Multicast technology is based on the control over IGMP report message sent out by the user, thus the model being controlled is IGMP snooping and IGMPmodel, of which the control logic includes the following three, i.e. to take control based on VLAN+MAC address transmitting packets, to take control based on IP address of transmitting packets and to take control based on the port where messages enter, in which IGMP snooping can use the above three methods to take control simultaneously, while since IGMP model is located at layer 3, it only takes control over the IP address transmitting packets.

The Service-Oriented Priority Strategy Multicast of Security Controllable technology adopts the following mode: for multicast data in limit range, set the priority specified by the user at the join-in end so that data can be sent in a higher priority on TRUNK port, consequently guarantee the transmission is processed in user-specified priority in the entire network.

1.2.2 DCSCM Configuration Task List

1. Source Control Configuration
2. Destination Control Configuration
3. Multicast Strategy Configuration

1. Source Control Configuration

Source Control Configuration has three parts, of which the first is to enable source control. The command of source control is as follows:

Command	Explanation
Global Configuration Mode	
[no] ip multicast source-control (Required)	Enable source control globally, the "**no ip multicast source-control**" command disables source control globally. It is noticeable that, after enabling source control globally, all multicast packets are discarded by default. All source control configuration can not be processed until that it is enabled globally, while source control can not be disabled until all configured rules are disabled.

The next is to configure the rule of source control. It is configured in the same manner as for ACL, and uses ACL number of 5000-5099, every rule number can be used to configure 10 rules. It is noticeable that these rules are ordered, the front one is the one which is configured the earliest. Once the configured rules are matched, the following rules won't take effect, so rules of globally allow must be put at the end. The commands are as follows:

Command	Explanation
Global Configuration Mode	
[no] access-list *<5000-5099>* {deny|permit} ip {{*<source>* *<source-wildcard>*}|{host-source *<source-host-ip>*}|any-source} {{*<destination>* *<destination-wildcard>*}|{host-destination *<destination-host-ip>*}|any-destination}	The rule used to configure source control. This rule does not take effect until it is applied to specified port. Using the NO form of it can delete specified rule.

The last is to configure the configured rule to specified port.

Note: If the rules being configured will occupy the table entries of hardware, configuring too many rules will result in configuration failure caused by bottom table entries being full, so we suggest user to use the simplest rules if possible. The configuration rules are as follows:

Command	Explanation
Port Configuration Mode	
`[no] ip multicast source-control access-group <5000-5099>`	Used to configure the rules source control uses to port, the NO form cancels the configuration.

2. Destination Control Configuration

Like source control configuration, destination control configuration also has three steps.

First, enable destination control globally. Since destination control need to prevent unauthorized user from receiving multicast data, the switch won't broadcast the multicast data it received after configuring global destination control. Therefore, It should be avoided to connect two or more other Layer 3 switches in the same VLAN on a switch on which destination control is enabled. The configuration commands are as follows:

Command	Explanation
Global Configuration Mode	
`[no] multicast destination-control (required)`	Globally enable IPv4 and IPv6destination control. The no operation of this command will globally disable destination control. All of the other configuration can only take effect after globally enabled. The next is configuring destination control rules, which are similar.

Next is to configure the multicast destination control profile rule list and use the profile-id number of 1-50.

Command	Explanation
Global Configuration Mode	
`profile-id <1-50> {deny|permit} {{<source/M> }|{host-source <source-host-ip> (range <2-65535>|)}|any-source} {{<destination/M>}|{host-destination <destination-host-ip> (range <2-255>|)}|any-destination}` `no profile-id <1-50>`	Configure the destination control profile rule. The no command deletes it.

Then configure destination control rule. It is similar to source control, except to use ACL No. of 6000-7999.

Command	Explanation
Global Configuration Mode	
[no] access-list <6000-7999> {{{add | delete} profile-id WORD} | {{deny|permit} (ip) {{<source/M>}|{host-source <source-host-ip>} (range <2-65535>|)}|any-source} {{<destination/M>}|{host-destination <destination-host-ip> (range <2-255>|)}|any-destination}}	The rule used to configure destination control. This rule does not take effect until it is applied to source IP or VLAN-MAC and port. Using the NO form of it can delete specified rule.

The last is to configure the rule to specified source IP, source VLAN MAC or specified port. It is noticeable that, due to the above situations, these rules can only be used globally in enabling IGMP-SNOOPING. And if IGMP-SNOOPING is not enabled, then only source IP rule can be used under IGMP Protocol. The configuration commands are as follows:

Command	Explanation
Port Configuration Mode	
[no] ip multicast destination-control access-group *<6000-7999>*	Used to configure the rules destination control uses to port, the NO form cancels the configuration.
Global Configuration Mode	
[no] ip multicast destination-control *<1-4094>* *<macaddr>* access-group <6000-7999>	Used to configure the rules destination control uses to specify VLAN-MAC, the NO form cancels the configuration.
[no] ip multicast destination-control *<IPADDRESS/M>* access-group *<6000-7999>*	Used to configure the rules destination control uses to specified IP address/net mask, the NO form cancels the configuration.

3. Multicast Strategy Configuration

Multicast Strategy uses the manner of specifying priority for specified multicast data to achieve and guarantee the effects the specific user requires. It is noticeable that multicast data can not get a special care all along unless the data are transmitted at TRUNK port. The configuration is very simple, it has only one command, i.e. to set priority for the specified multicast. The commands are as follows:

Command	Explanation
Global Configuration Mode	
[no] ip multicast policy *<IPADDRESS/M>* *<IPADDRESS/M>* cos *<priority>*	Configure multicast strategy, specify priority for sources and groups in specific range, and the range is <0-7>.

1.2.3 DCSCM Configuration Examples

1. Source Control

In order to prevent an Edge Switch from putting out multicast data ad asbitsium, we configure Edge Switch so that only the switch at port Ethernet1/0/5 is allowed to transmit multicast, and the data group must be 225.1.2.3. Also, switch connected up to port Ethernet1/0/10 can transmit multicast data without any limit, and we can make the following configuration.

```
SWITCH(config)#access-list 5000 permit ip any host 225.1.2.3
SWITCH(config)#access-list 5001 permit ip any any
SWITCH(config)#ip multicast source-control
SWITCH(config)#interface ethernet1/0/5
SWITCH(Config-If-Ethernet1/0/5)#ip multicast source-control access-group 5000
SWITCH(config)#interface ethernet1/0/10
SWITCH(Config-If-Ethernet1/0/10)#ip multicast source-control access-group 5001
```

2. Destination Control

We want to limit users with address in 10.0.0.0/8 network segment from entering the group of 238.0.0.0/8, so we can make the following configuration:

Firstly enable IGMP snooping in the VLAN it is located (Here it is assumed to be in VLAN2)

```
SWITCH(config)#ip igmp snooping
SWITCH(config)#ip igmp snooping vlan 2
```

After that, configure relative destination control access-list, and configure specified IP address to use that access-list.

```
Switch(config)#access-list 6000 deny ip any 238.0.0.0 0.255.255.255
Switch(config)#access-list 6000 permit ip any any
Switch(config)#multicast destination-control
Switch(config)#ip multicast destination-control 10.0.0.0/8 access-group 6000
```

In this way, users of this network segment can only join groups other than 238.0.0.0/8.

Or configure the destination control access-list by adding the profile list.

```
Switch (config)#profile-id 1 deny ip any 238.0.0.0 0.255.255.255
```

```
Switch (config)#access-list 6000 add profile-id 1
Switch (config)#multicast destination-control
Switch (config)#ip multicast destination-control 10.0.0.0/8 access-group
6000
```

3. Multicast strategy

Server 210.1.1.1 is distributing important multicast data on group 239.1.2.3, we can configure on its join-in switch as follows:

```
Switch(config)#ip multicast policy 210.1.1.1/32 239.1.2.3/32 cos 4
```

In this way, the multicast stream will have a priority of value 4 (Usually this is pretty higher, the higher possible one is protocol data; if higher priority is set, when there is too many multicast data, it might cause abnormal behavior of the switch protocol) when it gets to other switches through this switch.

1.2.4 DCSCM Troubleshooting

The effect of DCSCM module itself is similar to ACL, and the problems occurred are usually related to improper configuration. Please read the descriptions above carefully. If you still can not determine the cause of the problem, please send your configurations and the effects you expect to the after-sale service staff of our company.

1.3 IGMP

1.3.1 Introduction to IGMP

IGMP (Internet Group Management Protocol) is the protocol in TCP/IP protocol family which is responsible for IP multicast member management. It is used to set up and maintain multicast group member relationship between IP host and its neighbor multicast switches. IGMP does not include the spread and maintenance of relation information of group members among multicast switches, this work is accomplished by each multicast routing protocol. All hosts participating in multicast must implement IGMP protocol.

Hosts participating IP multicast can join in and exit multicast group at any location, any time and without limit of member total. Multicast switch does not need and not likely to save all relationships of all hosts. It only gets to know if there are receivers of some multicast group, i.e. group member, on the network segment each interface connects to. And the host only needs to save which multicast groups it joined.

IGMP is asymmetric between host and router: the host needs to respond the IGMP query messages of multicast switches, i.e. to report message response in membership; the switch sends out membership query messages periodically, and then determine if there are hosts of some specific group joining in the sub-network it belongs to based on the received response message, and send out query of specific group (IGMP version2) when receiving the report of a host exiting the group to determine if there exists no member in some specific group.

Up to now, there are three versions of IGMP: IGMP version1 (defined by RFC1112), IGMP version2 (defined by RFC2236) and IGMP version3 (defined by RFC3376).

The main improvements of IGMP version2 over version1 are:

1. The election mechanism of multicast switches on the shared network segment

Shared network segment is the situation of there is more than one multicast switch on a network segment. Under this kind of situation, since all switches which runs IGMP under this network segment can get membership report message from the host, therefore, only one switch is required to transmit membership query message, so an exchange election mechanism is required to determine a switch as query machine. In IGMP version1, the selection of query machine is determined by Multicast Routing Protocol; IGMP version2 made an improvement for it, it prescribed that when there are more than one multicast switches on the same network segment, the multicast switch with the lowest IP address will be elected as the query machine.

2. IGMP version2 added Leave Group Mechanism

In IGMP version 1, the host leaves the multicast group silently without sending any notification to any multicast switch. This causes that the multicast switch can only determine the leave of multicast member by multicast group response time-out. But in version2, when a host decides to leave a multicast group, if it is the host which gives response to the latest membership query message, then it will send out a message implying it is leaving.

3. IGMP version 2 added the query to specific group

In IGMP version1, a query of multicast switch is for all multicast groups on the network segment. This query is called general group query. In IGMP version2, query of specific group is added besides general group query. The destination IP address of this kind of query message is the IP address of the multicast group, the group address field part of the message is also the IP address of the multicast group. Thus it is prevented that hosts which are other multicast group members transmit response message.

4. IGMP version2 added the biggest response time field

IGMP version2 added the biggest response time field to dynamically adjust the response time of the host to group query message.

The main features of version3 is allowing the host to choose receiving from or rejecting a certain source, which is the basis of SSM （Source-Specific Multicast）multicast. For example, when a host is sending a report of INCLUDE{10.1.1.1, 10.1.1.2} to some group G, that means the host needs the router to forward the flux from 10.1.1.1 and 10.1.1.2; when a host is sending a report of EXCLUDE{192.168.1.1} to some group G, that means the host needs the flux from all sources of group G except 192.168.1.1. This makes a great difference from the previous IGMP.

The main improvements of IGMP Version3 over IGMP Version1 and Version2 are:

1. The status to be maintained is group and source list, not only the groups in IGMPv2.

2. The interoperations with IGMPv1 and IGMPv2 are defined in IGMPv3 status.
3. IP service interface is modified to allow specific source list thereby.
4. The queried includes his/her Robustness Variable and Query Interval in query group to allow the synchronization with these variables of non-queries.
5. Max Response Time in Query Message has an exponential range, with maximum value from 25.5 secs of v2 to 53 mins, which can be used in links of great capacity.
6. In order to increase strength, the host retransmits State-Change message.
7. Additional data is defined to adapt future extension.
8. Report group is sent to 224.0.0.22 to help with IGMP Snooping of Layer 2 Switch.
9. Report group can include more than one group record, and it allows using small group to report complete current status.
10. The host does not restrain operation any more, which simplifies the implement and allows direct membership trace.
11. In querying messages, the new router side restraint process (S sign) modified the existing strength of IGMPv2.

1.3.2 IGMP Configuration Task List

1. Enable IGMP (Required)
2. Configure IGMP sub-parameters (Optional)
   1）Configure IGMP group parameters
      1. Configure IGMP group filtering conditions
      2. Configure IGMP to join in group
      3. Configure IGMP to join in static group
   2）Configure IGMP query parameters
      1. Configure the interval of IGMP sending query message
      2. Configure the maximum response time of IGMP query
      3. Configure time-out of IGMP query
   3）Configure IGMP version
3. Disable IGMP Protocol

1. Enable IGMP Protocol

There are not specific commands for enabling IGMP Protocol on the Layer 3 switch. Enabling any multicast protocol under corresponding interface will automatically enable IGMP.

Command	Explanation
Global Mode	
`ip dvmrp multicast-routing | ip pim multicast-routing`	To enable global multicast protocol is the prerequisite to enable IGMP protocol, the "**no ip dvmrp multicast-routing | no ip pim multicast-routing**" commands disable multicast protocol and IGMP protocol. (Required)

Command	Explanation
Interface Configuration Mode	
`ip dvmrp enable| ip pim dense-mode | ip pim sparse-mode`	Enable IGMP Protocol, the corresponding commands "**no ip dvmrp enable| no ip pim dense-mode | no ip pim sparse-mode**" disable IGMP Protocol. (Required)

2. Configure IGMP Sub-parameters

1) Configure IGMP group parameters

1. **Configure IGMP group filtering conditions**
2. **Configure IGMP to join in group**
3. **Configure IGMP to join in static group**

Command	Explanation
Interface Configuration Mode	
`ip igmp access-group {<acl_num | acl_name>}` `no ip igmp access-group`	Configure the filtering conditions of the interface to IGMP group; the "**no ip igmp access-group**" command cancels the filtering condition.
`ip igmp join-group <A.B.C.D >` `no ip igmp join-group <A.B.C.D >`	Configure the interface to join in some IGMP group, the "**no ip igmp join-group <A.B.C.D >**" command cancels the join.

ip igmp static-group <*A.B.C.D* > no ip igmp static-group <*A.B.C.D*>	Configure the interface to join in some IGMP static group; the "**no ip igmp static-group <*A.B.C.D* >**" command cancels the join.

2）Configure IGMP Query parameters

1. **Configure interval for IGMP to send query messages**
2. **Configure the maximum response time of IGMP query**
3. **Configure the time-out of IGMP query**

Command	Explanation
Interface Configuration Mode	
ip igmp query-interval <*time_val*> no ip igmp query-interval	Configure the interval of IGMP query messages sent periodically; the "**no ip igmp query-interval**" command restores default value.
ip igmp query-max-response-time <*time_val*> no ip igmp query-max-response-time	Configure the maximum response time of the interface for IGMP query; the "**no ip igmp query-max-response-time**" command restores default value.
ip igmp query-timeout <*time_val*> no ip igmp query-timeout	Configure the time-out of the interface for IGMP query; the "**no ip igmp query-timeout**" command restores default value.

3）Config IGMP version

Command	Explanation
Global Mode	
ip igmp version <*version*> no ip igmp version	Configure IGMP version on the interface; the "**no ip igmp version**" command restores the default value.

3. Disable IGMP Protocol

Command	Explanation
Interface Configuration Mode	
`no ip dvmrp | no ip pim dense-mode | no ip pim sparse-mode | no ip dvmrp multicast-routing | no ip pim multicast-routing`	Disable IGMP Protocol.

1.3.3 IGMP Configuration Examples

As shown in the following figure, add the Ethernet ports of Switch A and Switch B to corresponding VLAN, and start PIM-DM on each VLAN interface.

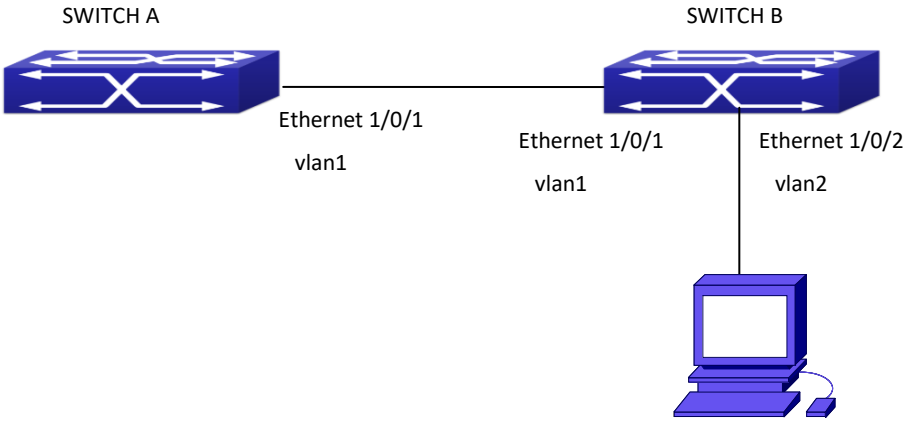

Fig 1-9 IGMP Network Topology Diagram

The configuration procedure for SwitchA and SwitchB is as follows:

1) Configure SwitchA:

```
Switch(config)#ip pim multicast-routing
Switch (config)#interface vlan 1
Switch(Config-if-Vlan1)#ip address 12.1.1.1 255.255.255.0
Switch(Config-if-Vlan1)#ip pim dense-mode
```

2) Configure SwitchB:

```
Switch(config)#ip pim multicast-routing
Switch(config)#interface vlan1
Switch(Config-if-Vlan1)#ip address 12.1.1.2 255.255.255.0
Switch(Config-if-Vlan1)#ip pim dense-mode
Switch(Config-if-Vlan1)#exit
```

```
Switch(config)#interface vlan2
Switch(Config-if-Vlan1)#ip address 20.1.1.1 255.255.255.0
Switch(Config-if-Vlan2)#ip pim dense-mode
Switch(Config-if-Vlan2)#ip igmp version 3
```

1.3.4 IGMP Troubleshooting

In configuring and using IGMP Protocol, IGMP Protocol might not operate normally caused by physical connection or incorrect configuration. Therefore, user should pay attention to the following issues:

- Firstly to assure that physical connection is correct;
- Next, to assure the Protocol of Interface and Link protocol is UP (use show interface command);
- Afterwards, to assure to start a kind of multicast protocol on the interface;
- Multicast Protocol requires RPF Check using unicast routing; therefore the correctness of unicast routing must be assured beforehand.

1.4 IGMP Snooping

1.4.1 Introduction to IGMP Snooping

IGMP (Internet Group Management Protocol) is a protocol used in IP multicast. IGMP is used by multicast enabled network device (such as a router) for host membership query, and by hosts that are joining a multicast group to inform the router to accept packets of a certain multicast address. All those operations are done through IGMP message exchange. The router will use a multicast address (224.0.0.1) that can address to all hosts to send an IGMP host membership query message. If a host wants to join a multicast group, it will reply to the multicast address of that a multicast group with an IGMP host membership reports a message.

IGMP Snooping is also referred to as IGMP listening. The switch prevents multicast traffic from flooding through IGMP Snooping, multicast traffic is forwarded to ports associated to multicast devices only. The switch listens to the IGMP messages between the multicast router and hosts, and maintains multicast group forwarding table based on the listening result, and can then decide to forward multicast packets according to the forwarding table.

Switch provides IGMP Snooping and is able to send a query from the switch so that the user can use switch in IP multicast.

1.4.2 IGMP Snooping Configuration Task List

1. Enable IGMP Snooping
2. Configure IGMP Snooping

1. Enable IGMP Snooping

Command	Explanation
Global Mode	
`ip igmp snooping` `no ip igmp snooping`	Enables IGMP Snooping. The no operation disables IGMP Snooping function.

2. Configure IGMP Snooping

Command	Explanation
Global Mode	
`ip igmp snooping vlan <vlan-id>` `no ip igmp snooping vlan <vlan-id>`	Enables IGMP Snooping for specified VLAN. The no operation disables IGMP Snooping for specified VLAN.
`ip igmp snooping proxy` `no ip igmp snooping proxy`	Enable IGMP Snooping proxy function, the no command disables the function.
`ip igmp snooping vlan < vlan-id > limit {group <g_limit> | source <s_limit>}` `no ip igmp snooping vlan < vlan-id > limit`	Configure the max group count of vlan and the max source count of every group. The “no **ip igmp snooping vlan <*vlan-id*> limit”** command cancels this configuration.
`ip igmp snooping vlan <1-4094> interface (ethernet | port-channel|) IFNAME limit {group <1-65535>| source <1-65535>} strategy (replace | drop)` `no ip igmp snooping vlan <1-4094> interface (ethernet | port-channel|) IFNAME limit group source strategy`	Configure the number of groups which are allowed joining and the maximum of the source in each group under the IGMP Snooping port. Configure the strategy when it is up to the upper limit, including “replace” and “drop”. No command configures as “no limitation”.
`ip igmp snooping vlan <vlan-id> l2-general-querier` `no ip igmp snooping vlan <vlan-id> l2-general-querier`	Set this vlan to layer 2 general querier. It is recommended to configure a layer 2 general querier on a segment. The “no **ip igmp snooping vlan <*vlan-id*> l2-general-querier”command** cancels this configuration.
`ip igmp snooping vlan <vlan-id> l2-general-querier-version`	Configure the version number of a general query from a layer 2 general

<version>	querier.
ip igmp snooping vlan <vlan-id> l2-general-querier-source <source>	Configure the source address of a general query from a layer 2 general querier.
ip igmp snooping vlan <vlan-id> mrouter-port interface <interface -name> no ip igmp snooping vlan <vlan-id> mrouter-port interface <interface -name>	Configure static mrouter port of vlan. The no form of the command cancels this configuration.
ip igmp snooping vlan <vlan-id> mrouter-port learnpim no ip igmp snooping vlan <vlan-id> mrouter-port learnpim	Enable the function that the specified VLAN learns mrouter-port (according to pim packets), the no command will disable the function.
ip igmp snooping vlan <vlan-id> mrpt <value > no ip igmp snooping vlan <vlan-id> mrpt	Configure this survive time of mrouter port. The "no **ip igmp snooping vlan <vlan-id> mrpt"** command restores the default value.
ip igmp snooping vlan <vlan-id> query-interval <value> no ip igmp snooping vlan <vlan-id> query-interval	Configure this query interval. The "no **ip igmp snooping vlan <vlan-id> query-interval"** command restores the default value.
ip igmp snooping vlan <vlan-id> immediately-leave no ip igmp snooping vlan <vlan-id> immediately-leave	Enable the IGMP fast leave function for the specified VLAN: the "no **ip igmp snooping vlan <vlan-id> immediate-leave"** command disables the IGMP fast leave function.
ip igmp snooping vlan <vlan-id> query-mrsp <value> no ip igmp snooping vlan <vlan-id> query-mrsp	Configure the maximum query response period. The "no **ip igmp snooping vlan <vlan-id> query-mrsp"** command restores to the default value.
ip igmp snooping vlan <vlan-id> query-robustness <value> no ip igmp snooping vlan <vlan-id> query-robustness	Configure the query robustness. The "no **ip igmp snooping vlan <vlan-id> query-robustness"** command restores to the default value.

ip igmp snooping vlan <*vlan-id*> suppression-query-time <*value*> no ip igmp snooping vlan <*vlan-id*> suppression-query-time	Configure the suppression query time. The "no **ip igmp snooping vlan <*vlan-id*> suppression-query-time"** command restores to the default value.
ip igmp snooping vlan <*vlan-id*> static-group <*A.B.C.D*> [source <*A.B.C.D*>] interface [ethernet | port-channel] <*IFNAME*> no ip igmp snooping vlan <*vlan-id*> static-group <*A.B.C.D*> [source <*A.B.C.D*>] interface [ethernet | port-channel] <*IFNAME*>	Configure static-group on specified port of the VLAN. The no form of the command cancels this configuration.
ip igmp snooping vlan <*vlan-id*> report source-address <*A.B.C.D*> no ip igmp snooping vlan <*vlan-id*> report source-address	Configure forwarding IGMP packet source address, The no operation cancels the packet source address.
ip igmp snooping vlan <*vlan-id*> specific-query-mrsp <value> no ip igmp snooping vlan <*vlan-id*> specific-query-mrspt	Configure the maximum query response time of the specific group or source, the no command restores the default value.

1.4.3 IGMP Snooping Examples

❖ **Scenario 1:** IGMP Snooping function

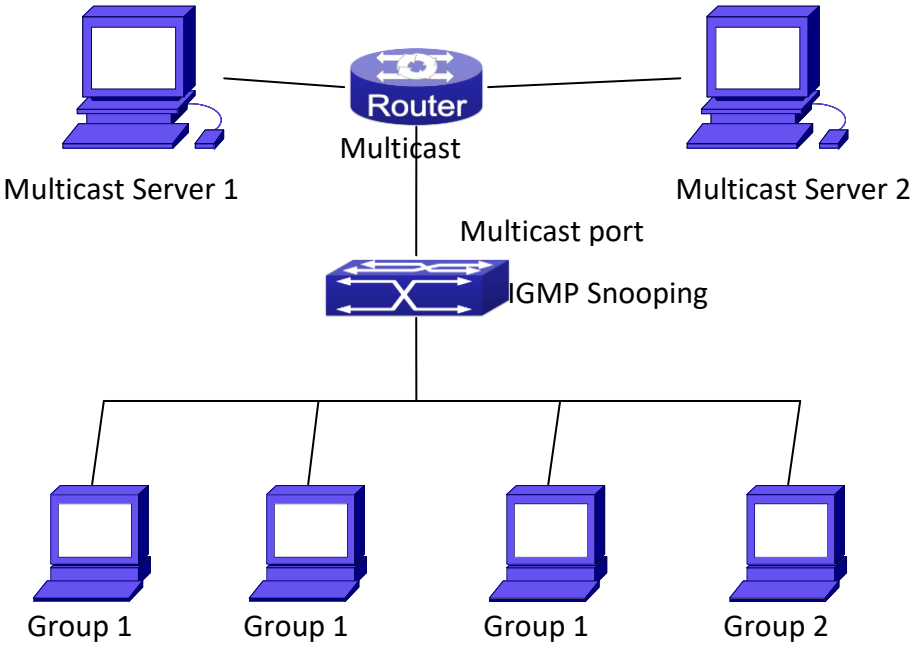

Fig 1-10 Enabling IGMP Snooping function

Example: As shown in the above figure, a VLAN 100 is configured in the switch and includes ports 1, 2, 6, 10 and 12. Four hosts are connected to port 2, 6, 10 and 12 respectively and the multicast router is connected to port 1. As IGMP Snooping is disabled by default either in the switch or in the VLANs, If IGMP Snooping should be enabled in VLAN 100, the IGMP Snooping should be first enabled for the switch in Global Mode and in VLAN 100 and set port 1 of VLAN 100 to be the mrouter port.

The configuration steps are listed below:

```
Switch(config)#ip igmp snooping
Switch(config)#ip igmp snooping vlan 100
Switch(config)#ip igmp snooping vlan 100 mrouter interface ethernet 1/0/1
```

Multicast Configuration

Suppose two programs are provided in the Multicast Server using multicast address Group1 and Group2, three of four hosts running multicast applications are connected to port 2, 6, 10 plays program1, while the host is connected to port 12 plays program 2.

IGMP Snooping listening result:

The multicast table built by IGMP Snooping in VLAN 100 indicates ports 1, 2, 6, 10 in Group1 and ports 1, 12 in Group2.

All the four hosts can receive the program of their choice: ports 2, 6, 10 will not receive the traffic of program 2 and port 12 will not receive the traffic of program 1.

❖ **Scenario 2:** L2-general-querier

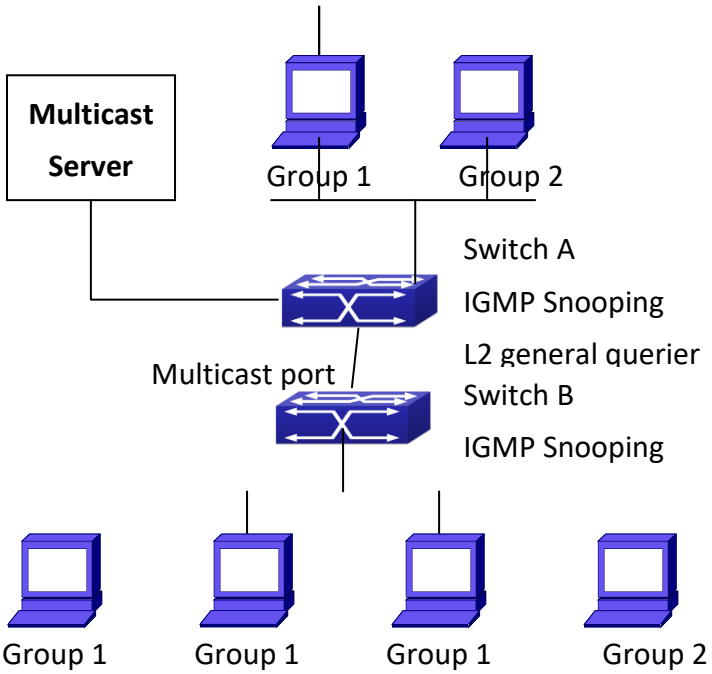

Fig 1-11 The switches as IGMP Queries

The configuration of Switch2 is the same as the switch in scenario 1, SwitchA takes the place of Multicast Router in scenario 1. Let's assume VLAN 60 is configured in SwitchA, including ports 1, 2, 10 and 12. Port 1 connects to the multicast server, and port 2 connects to Switch2. In order to send Query at regular interval, IGMP query must enabled in Global mode and in VLAN60.

The configuration steps are listed below:

```
SwitchA#config
SwitchA(config)#ip igmp snooping
SwitchA(config)#ip igmp snooping vlan 60
SwitchA(config)#ip igmp snooping vlan 60 L2-general-querier

SwitchB#config
SwitchB(config)#ip igmp snooping
SwitchB(config)#ip igmp snooping vlan 100
SwitchB(config)#ip igmp snooping vlan 100 mrouter interface ethernet 1/0/1
```

Multicast Configuration

The same as scenario 1

IGMP Snooping listening result:

Similar to scenario 1

❖ **Scenario 3:** To run in cooperation with layer 3 multicast protocols.

SWITCH which is used in Scenario 1 is replaced with ROUTER with specific configurations remains the same. And multicast and IGMP snooping configurations are the same with what it is in Scenario 1. To configure PIM-SM on ROUTER, and enable PIM-SM on vlan 100 (use the same PIM mode with the connected multicast router)

Configurations are listed as below:

```
switch#config
switch(config)#ip pim multicast-routing
switch(config)#interface vlan 100
switch(config-if-vlan100)#ip pim sparse-mode
```

IGMP snooping does not distribute entries when layer 3 multicast protocol is enabled. It only does the following tasks.

- Remove the layer 2 multicast entries.
  - Provide query functions to the layer 3 with vlan, S, and G as the parameters.
  - When layer 3 IGMP is disabled, re-enable distributing layer 2 multicast entries.

By looking up the layer 3 IPMC entries, it can be found that ports can be indicated by the layer 3 multicast entries. This ensures the IGMP snooping can work in cooperation with the layer 3 multicast protocols.

1.4.4 IGMP Snooping Troubleshooting

On IGMP Snooping function configuration and usage, IGMP Snooping might not run properly because of physical connection or configuration mistakes. So the users should note that:

- Make sure correct physical connection
- Activate IGMP Snooping on whole configuration mode (use **ip igmp snooping**)
- Configure IGMP Snooping at VLAN on whole configuration mode (use **ip igmp snooping vlan <vlan-id>**)
- Make sure one VLAN is configured as L2 common checker in same mask, or make sure configured static mrouter
- Use **show ip igmp snooping vlan <vid>** command check IGMP Snooping information

2. IPV6 MULTICAST PROTOCOL

2.1 MLD

2.1.1 Introduction to MLD

MLD (Multicast Listener Discovery) is the multicast group member (receiver) discovery protocol serving IPv6 multicast. It is similar to IGMP Protocol in IPv4 multicast application. Correspondingly, MLD Protocol version1 is similar to IGMP Protocol version2, and MLD Protocol version2 is similar to IGMP Protocol version3. Current firmware supports MLDv1/ MLDv2.

The IPv6 multicast hosts can join or leave from multicast group at any location, any time, regardless of the total number of group members. It is unnecessary and impossible for multicast switch to store the relationship among all host members. Multicast switch simply finds out via MLD protocol if there are receivers of certain multicast group on the network segment connected to each port. The only thing host need to do is to keep the record of which multicast groups it joined.

MLD is unsymmetrical between host and switch: the host needs to respond the MLD query message of multicast switch with membership report message; the switch periodically sends membership query message and determines if there is host joining a specific group in its subnetworks according to the response message received, and after it receives the report of a host quitting from the group, it sends out the query for the group to confirm if there is no member left in it.

There are three types of protocol messages of MLD Protocol, that is, Query, Report and Done (which is corresponding to Leave of IGMPv2). Like IGMPV2, the Query messages include General Query and Specific Group Query. General Query uses the multicast address FF02::1 of hosts as destination address, the group address is 0; and Specific Group Query use its group address as destination address. The multicast addresses of MLD use 130, 131 and 132 as data types denoting the three kinds of messages mentioned above. Other logic is basically same as IGMPv2.

MLD protocol version2 use FF02::16 as destination address of membership report, and 143 as data type. The other logic of MLD Protocol version2 is similar to IGMP Protocol version3.

2.1.2 MLD Configuration Task List

1、 Start MLD (Required)

2、 Configure MLD auxiliary parameters (Required)

1）Configure MLD group parameters

1. Configure MLD group filter conditions

2）Configure MLD query parameters

1. Configure the interval of MLD sending query message
2. Configure the maximum response time of MLD query
3. Configure overtime of MLD query

3、 Shut down MLD Protocol

1. Start MLD Protocol

There is no special command for starting MLD Protocol on EDGECORE series layer 3 switches. MLD Protocol will automatically start up as long as any IPv6 multicast protocol is started on corresponding interface.

Command	Explanation
Global Mode	
`Ipv6 pim multicast-routing`	To start Global IPv6 Multicast Protocol, the precondition of starting MLD Protocol. The NO operation of corresponding command shuts ipv6 multicast protocol and MLD Protocol. (Required)

Command	Explanation
Port Configuration Mode	
`ipv6 pim dense-mode | ipv6 pim sparse-mode`	Start MLD Protocol. The NO operation of corresponding command shuts MLD Protocol. (Required)

2. Configure MLD auxiliary parameters

1） Configure MLD group parameters

1. Configure MLD group filter conditions

Command	Explanation
Port Configuration Mode	
`ipv6 mld access-group <acl_name>` `no ipv6 mld access-group`	Configure the filter conditions of interface for MLD group; the NO operation of this command cancels filter conditions.

2） Configure MLD Query parameters

1. Configure interval time for MLD to send query messages
2. Configure the maximum response time of MLD query
3. Configure the overtime of MLD query

Command	Explanation
Port Configuration Mode	
`ipv6 mld query-interval <time_val>` `no ipv6 mld query-interval`	Configure the interval of MLD query messages sent periodically; the NO operation of this command restores the default value.
`ipv6 mld query-max-response-time <time_val>` `no ipv6 mld query-max-response-time`	Configure the maximum response time of the interface for MLD query; the NO operation of this command restores the default value.
`ipv6 mld query-timeout <time_val>` `no ipv6 mld query-timeout`	Configure the overtime of the interface for MLD query; the NO operation of this command restores the default value.

3. Shut down MLD Protocol

Command	Explanation
Port Configuration Mode	
`no ipv6 pim dense-mode | no ipv6 pim sparse-mode | no ipv6 pim multicast-routing (Global Mode)`	Shut down MLD Protocol

2.1.3 MLD Typical Application

As shown in the following figure, add the Ethernet interfaces of Switch A and Switch B to corresponding vlan, and start PIM6 on each vlan interface.

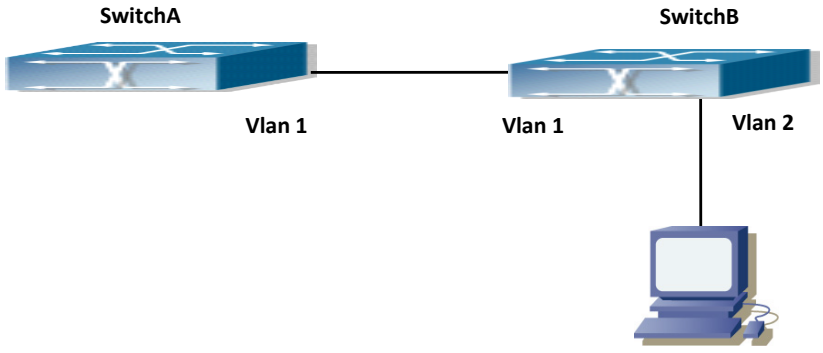

Fig 2-5 Network Topology Diagram

The configuration procedure for SwitchA and SwitchB is as below:

- Configure SwitchA:

```
Switch (config) #ipv6 pim multicast-routing
Switch (config) #ipv6 pim rp-address 3FFE::1
Switch (config) #interface vlan 1
Switch (Config-if-Vlan1) #ipv6 address 3FFE::1/64
Switch (Config-if-Vlan1) #ipv6 pim sparse-mode
```

- Configure SwitchB:

```
Switch (config) #ipv6 pim multicast-routing
Switch (config) #ipv6 pim rp-address 3FFE::1
Switch (config) #interface vlan1
Switch (Config-if-Vlan1) #ipv6 address 3FFE::2/64
Switch (Config-if-Vlan1) #ipv6 pim sparse-mode
Switch (Config-if-Vlan1) #exit
Switch (config) #interface vlan2
Switch (Config-if-Vlan2) #ipv6 address 3FFA::1/64
Switch (Config-if-Vlan2) #ipv6 pim sparse-mode
Switch (Config-if-Vlan2) #ipv6 mld query-timeout 150
```

2.1.4 MLD Troubleshooting Help

When configuring and using MLD protocol, MLD protocol may fail to work normally due to physical connections, incorrect configuration and so on. So, users shall note the following points:

- Assure the physical connection is correct.
- Assure the protocol of interface and link is UP (use show interface command)
- Assure to start one kind of multicast protocol on the interface
- Assure the time of the timers of each router on the same network segment is consistent; usually we recommend the default setting.
- Unicast route shall be used to carry out RPF examination for multicast protocol. So the correctness of unicast route shall be guaranteed above all.

If all attempts fail to solve the problems on MLD, please use debug commands such as debug ipv6 MLD event/packet, and copy DEBUG information in 3 minutes and send to Technology Service Center.

2.2 MLD Snooping

2.2.1 Introduction to MLD Snooping

MLD, the Multicast Listener Discovery Protocol, is used to realize multicasting in the IPv6. MLD is used by the network equipments such as routers which supports multicast for multicast listener discovery, also used by listeners looking forward to join certain multicast group informing the router to receive data packets from certain multicast address, all of which are done through MLD message exchange. First the router send an MLD Multicast listener Query message through a multicast address which can address all the listeners (namely ff02::1). Once there is a listener who wishes to join the multicast address, it will send a MLD Multicast listener Report back through the multicast address.

MLD Snooping is namely the MLD listening. The switch restricts the multicast traffic from flooding through MLD Snooping, and forward the multicast traffic to ports associated to multicast devices only. The switch listens to the MLD messages between multicast routers and listeners, and maintains the multicast group forwarding list based on the listening result. The switches forwards multicast packets according to the multicast forwarding list

The switch realizes the MLD Snooping function while supporting MLD v2. This way, the user can acquire IPv6 multicast with the switch.

2.2.2 MLD Snooping Configuration Task

1. Enable the MLD Snooping function

2. Configure the MLD Snooping

1. Enable the MLD Snooping function

Command	Explanation
Global Mode	
`ipv6 mld snooping` `no ipv6 mld snooping`	Enable global MLD Snooping, the "**no ipv6 mld snooping**" command disables the global MLD snooping.

2. Configure MLD Snooping

Command	Explanation
Global Mode	
`ipv6 mld snooping vlan <vlan-id>` `no ipv6 mld snooping vlan <vlan-id>`	Enable MLD Snooping on specific VLAN. The "no" form of this command disables MLD Snooping on specific VLAN.
`ipv6 mld snooping vlan <vlan-id> limit {group <g_limit> | source <s_limit>}`	Configure the number of the groups in which the MLD Snooping can join, and the maximum

no ipv6 mld snooping vlan <*vlan-id*> limit	number of sources in each group. The “no” form of this command restores to the default.
ipv6 mld snooping vlan <*vlan-id*> l2-general-querier no ipv6 mld snooping vlan <*vlan-id*> l2-general-querier	Set the VLAN level 2 general querier, which is recommended on each segment. The “no” form of this command cancels the level 2 general querier configuration.
ipv6 mld snooping vlan <*vlan-id*> mrouter-port interface <*interface –name*> no ipv6 mld snooping vlan <*vlan-id*> mrouter-port interface <*interface –name*>	Configure the static mrouter port in specific vlan. The “no” form of this command cancels the mrouter port configuration.
ipv6 mld snooping vlan <*vlan-id*> mrouter-port learnpim6 no ipv6 mld snooping vlan <*vlan-id*> mrouter-port learnpim6	Enable the function that the specified VLAN learns mrouter-port (according to pimv6 packets), the no command will disable the function.
ipv6 mld snooping vlan <*vlan-id*> mrpt <*value*> no ipv6 mld snooping vlan <*vlan-id*> mrpt	Configure the keep-alive time of the mrouter port. The “no” form of this command restores to the default.
ipv6 mld snooping vlan <*vlan-id*> query-interval <*value*> no ipv6 mld snooping vlan <*vlan-id*> query-interval	Configure the query interval. The “no” form of this command restores to the default.
ipv6 mld snooping vlan <*vlan-id*> immediate-leave no ipv6 mld snooping vlan <*vlan-id*> immediate-leave	Configure immediate leave multicast group function for the MLD Snooping of specific VLAN. The “no” form of this command cancels the immediate leave configuration.
ipv6 mld snooping vlan <*vlan-id*> query-mrsp <*value*> no ipv6 mld snooping vlan <*vlan-id*> query-mrsp	Configure the query maximum response period. The “no” form of this command restores to the default.
ipv6 mld snooping vlan <*vlan-id*> query-robustness <*value*> no ipv6 mld snooping vlan <*vlan-id*> query-robustness	Configure the query robustness, the “no” form of this command restores to the default.
ipv6 mld snooping vlan <*vlan-id*> suppression-query-time <*value*> no ipv6 mld snooping vlan <*vlan-id*> suppression-query-time	Configure the suppression query time. The “no” form of this command restores to the default
Ipv6 mld snooping vlan <*vlan-id*> static-group <*X:X::X:X*> [source	Configure static-group on specified port of the VLAN. The no form of the command cancels this

<X:X::X:X>] interface [ethernet | port-channel] <IFNAME> no ipv6 mld snooping vlan <vlan-id> static-group <X:X::X:X> [source <X:X::X:X>] interface [ethernet | port-channel] <IFNAME>	configuration.

2.2.3 MLD Snooping Examples

❖ **Scenario 1: MLD Snooping Function**

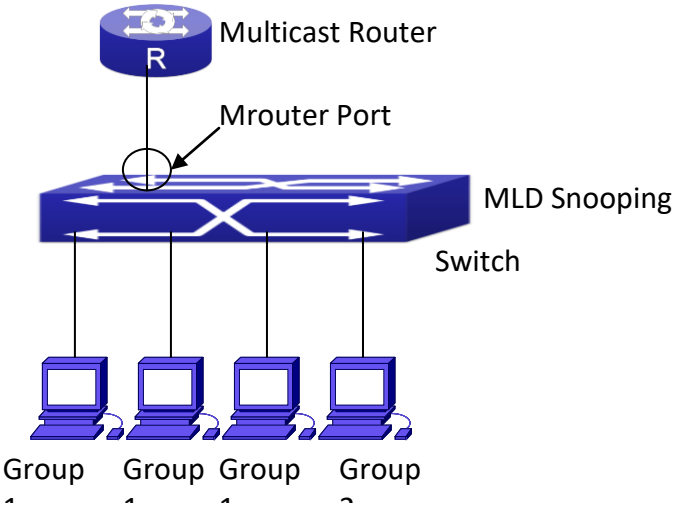

Fig 2-6 Open the switch MLD Snooping Function figure

As shown above, the vlan 100 configured on the switch consists of ports 1, 2, 6, 10 and 12. Four hosts are respectively connected to 2, 6, 10 and 12 while the multicast router on port 1. Suppose we need MLD Snooping on VLAN 100, however by default, the global MLD Snooping as well as the MLD Snooping on each VLAN are, therefore first we have to enable the global MLD Snooping at the same time enable the MLD Snooping on VLAN 100, furthermore we need to set the port 1 of VLAN 100 as a mrouter port.

Configuration procedure is as follows.

```
Switch#config
Switch(config)#ipv6 mld snooping
Switch(config)#ipv6 mld snooping vlan 100
Switch(config)#ipv6 mld snooping vlan 100 mrouter-port interface ethernet 1/0/1
```

Multicast configuration:

Assume there are two multicast servers: the Multicast Server 1 and the Multicast Server 2, amongst program 1 and 2 are supplied on the Multicast Server 1 while program 3 on the Multicast server 2, using group addresses respectively the Group 1, Group 2 and Group 3. Concurrently multicast application is operating on the four hosts. Two hosts connected to port

2, 6 are playing program 1 while the host connected to port 10 playing program 2, and the one to port 12 playing program 3.

MLD Snooping interception results:

The multicast table on vlan 100 shows: port 1, 2, 6 are in （Multicasting Server 1, Group1）, port1, 10 are in (Multicasting Server 1,Group2), and port1, 121, 12 are in (Multicasting Server 2, Group3）

All the four hosts successfully receive programs they are interested in. port2, 6 receives no traffic from program2 and 3; port10 receives no traffic from program 1 and 3, and port12 receives no traffic from program1 and 2.

❖ **Scenario 2: MLD L2-general-querier**

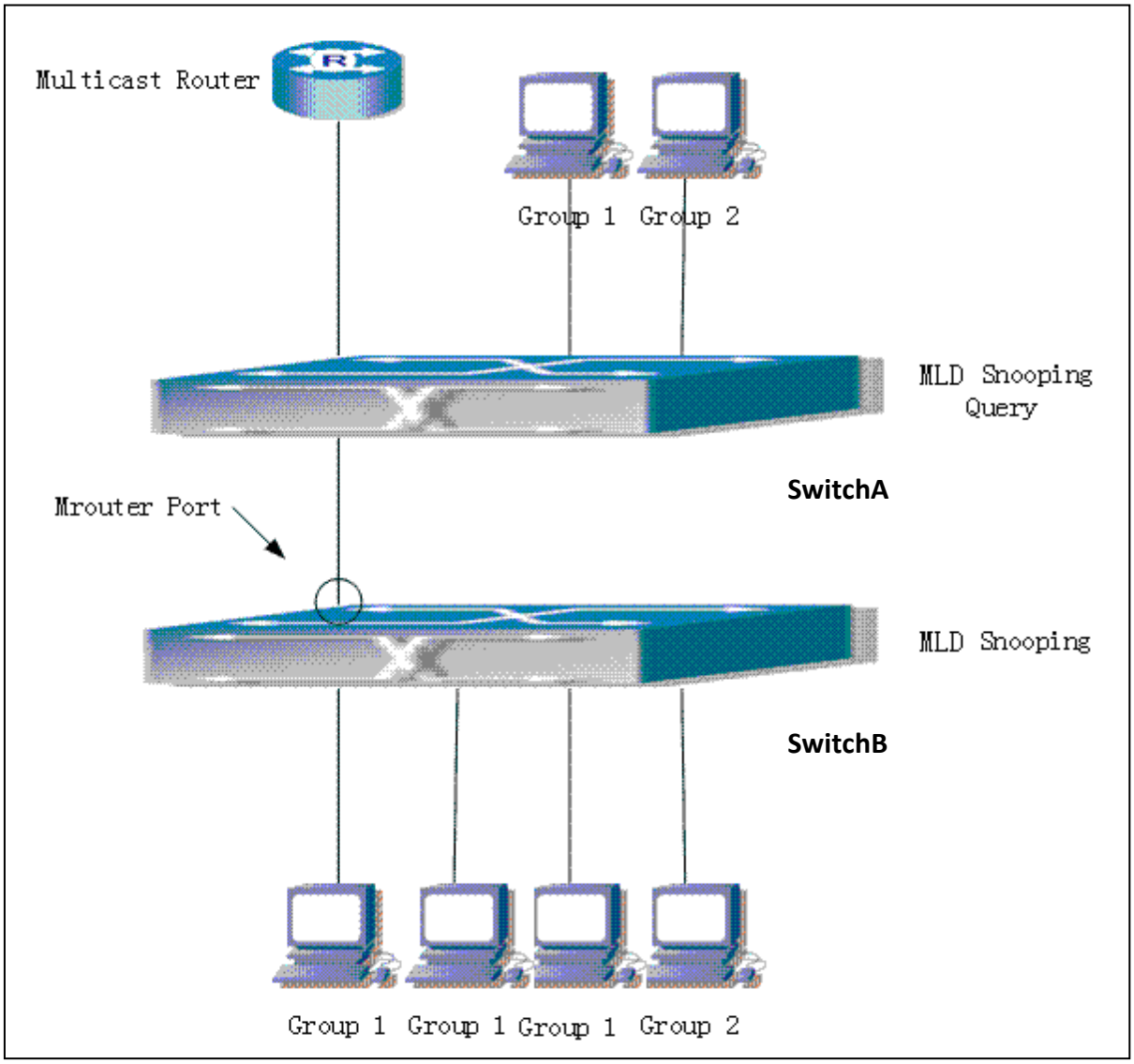

Fig 2-7 Switch as MLD Querier Function figure

Configuration of switch B is the same as the switches in case 1, and here the switch 1 replaces the Multicast Router in case 1. Assume the vlan 60 configured on it contains port 1, 2, 10 and

12, amongst port 1 is connected to multicast server, port 2 to switch2. To send Query periodically, global MLD Snooping has to be enabled while executing the mld snooping vlan 60 l2-general-querier, setting the vlan 60 to a Level 2 General Querier.

Configuration procedure is as follows:

```
SwitchA#config
SwitchA(config)#ipv6 mld snooping
SwitchA(config)#ipv6 mld snooping vlan 60
SwitchA(config)#ipv6 mld snooping vlan 60 l2-general-querier
SwitchB#config
SwitchB(config)#ipv6 mld snooping
SwitchB(config)#ipv6 mld snooping vlan 100
SwitchB(config)#ipv6 mld snooping vlan 100 mrouter interface ethernet 1/0/1
```

Multicast configuration:

Same as scenario 1

MLD Snooping interception results:

Same as scenario 1

- **Scenario 3: To run in cooperation with layer 3 multicast protocols**

SWITCH which is used in Scenario 1 is replaced with ROUTER with specific configurations remains the same. And multicast and IGMP snooping configurations are the same with what it is in Scenario 1. To configure PIM-SM6 on ROUTER, and enable PIM-SM6 on vlan 100 (use the same PIM mode with the connected multicast router)

The configurations are listed as below:

```
switch#config
switch(config)#ipv6 pim multicast-routing
switch(config)#interface vlan 100
switch(config-if-vlan100)#ipv6 pim sparse-mode
```

MLD snooping does not distribute entries when layer 3 multicast protocol is enabled. It only does the following tasks.

- To remove the layer 2 multicast entries.
- To provide query functions to the layer 3 with vlan, S, and G as the parameters.
- When layer 3 MLD is disabled, re-enable distributing layer 2 multicast entries.

By looking up the layer 3 IP6MC entries, it can be found that ports can be indicated by the layer 3 multicast entries. This ensures the MLD Snooping can work in cooperation with the layer 3 multicast protocols.

2.2.4 MLD Snooping Troubleshooting

In configuring and using MLD Snooping, the MLD Snooping server may fail to run properly due to physical connection failure, wrong configuration, etc. The user should ensure the following:

- Ensure the physical connection is correct
- Ensure the MLD Snooping is enabled under global mode (using ipv6 mld snooping)
- Ensure the MLD Snooping is configured on the vlan under global mode (using ipv6 mld snooping vlan <vlan-id>)
- Ensure there is a vlan configured as a L2 general querier, or there is a static mrouter configured in a segment,
- Use command to check if the MLD snooping information is correct

3. MULTICAST VLAN

3.1 Introductions to Multicast VLAN

Based on current multicast order method, when orders from users in different VLAN, each VLAN will copy a multicast traffic in this VLAN, which is a great waste of the bandwidth. By configuration of the multicast VLAN, we add the switch port to the multicast VLAN, with the IGMP Snooping/MLD Snooping functions enabled, users from different VLAN will share the same multicast VLAN. The multicast traffic only exists within a multicast VLAN, so the bandwidth is saved. As the multicast VLAN is absolutely separated from the user VLAN, security and bandwidth concerns can be met at the same time, after the multicast VLAN is configured, the multicast traffic will be continuously sent to the users.

3.2 Multicast VLAN Configuration Task List

1. Enable the multicast VLAN function
2. Configure the IGMP Snooping
3. Configure the MLD Snooping

1. Enable the multicast VLAN function

Command	Explanation
VLAN configuration mode	
`multicast-vlan` `no multicast-vlan`	Configure a VLAN and enable the multicast VLAN on it. The "**no multicast-vlan**" command disables the multicast function on the VLAN.
`multicast-vlan association <vlan-list>` `no multicast-vlan association <vlan-list>`	Associate a multicast VLAN with several VLANs. The no form of this command deletes the related VLANs associated with the multicast VLAN.
`multicast-vlan association interface (ethernet | port-channel|) IFNAME` `no multicast-vlan association interface (ethernet | port-channel|) IFNAME`	Associate the specified port with the multicast VLAN, so the associated ports are able to receive the multicast flow. The no command cancels the association between the ports and the multicast VLAN.
`multicast-vlan mode {dynamic|`	Configure the two modes of multicast

compatible} no multicast-vlan mode {dynamic| compatible}	vlan. The no command cancels the mode configuration.

2. Configure the IGMP Snooping

Command	Explanation
Global Mode	
ip igmp snooping vlan *<vlan-id>* no ip igmp snooping vlan *<vlan-id>*	Enable the IGMP Snooping function on the multicast VLAN. The no form of this command disables the IGMP Snooping on the multicast VLAN.
ip igmp snooping no ip igmp snooping	Enable the IGMP Snooping function. The no form of this command disables the IGMP snooping function.

3. **Configure the MLD Snooping**

ipv6 mld snooping vlan *<vlan-id>* no ipv6 mld snooping vlan *<vlan-id>*	Enable MLD Snooping on multicast VLAN; the no form of this command disables MLD Snooping on multicast VLAN.
ipv6 mld snooping no ipv6 mld snooping	Enable the MLD Snooping function. The no form of this command disables the MLD snooping function.

3.3 Multicast VLAN Examples

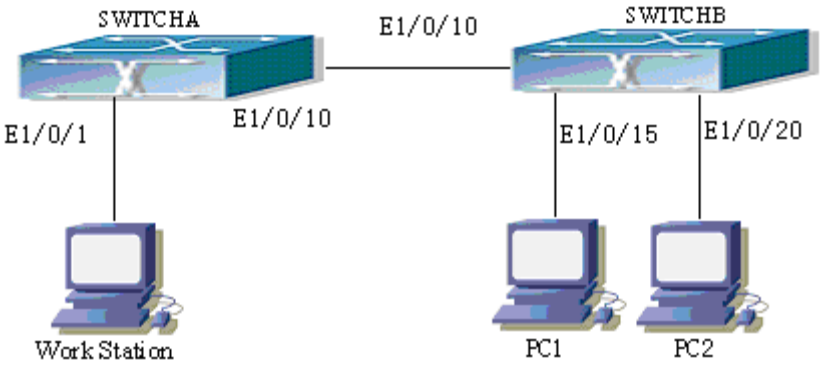

Fig 3-1 Function configuration of the Multicast VLAN

As shown in the figure, the multicast server is connected to the layer 3 switch switchA through port 1/0/1 which belongs to the VLAN10 of the switch. The layer 3 switch switchA is connected with layer 2 switches through the port1/0/10, which configured as trunk port. On the switchB the VLAN100 is configured set to contain port1/0/15, and VLAN101 to contain port1/0/20. PC1 and PC2 are respectively connected to port 1/0/15 and1/0/20. The switchB is connected with the switchA through port1/0/10, which configured as trunk port. VLAN 20 is a multicast VLAN. By configuring multicast vlan, the PC1 and PC2 will receives the multicast data from the multicast VLAN.

Following configuration is based on the IP address of the switch has been configured and all the equipment are connected correctly.

Configuration procedure

```
SwitchA#config
SwitchA(config)#vlan 10
SwitchA(config-vlan10)#switchport access ethernet 1/0/1
SwitchA(config-vlan10)exit
SwitchA(config)#interface vlan 10
Switch(Config-if-Vlan10)#ip pim dense-mode
Switch(Config-if-Vlan10)#exit
SwitchA(config)#vlan 20
SwitchA(config-vlan20)#exit
SwitchA(config)#interface vlan 20
SwitchA(Config-if-Vlan20)#ip pim dense-mode
SwitchA(Config-if-Vlan20)#exit
SwitchA(config)#ip pim multicast
SwitchA(config)# interface ethernet1/0/10
SwitchA(Config-If-Ethernet1/0/10)switchport mode trunk

SwitchB#config
SwitchB(config)#vlan 100
SwitchB(config-vlan100)#Switchport access ethernet 1/0/15
SwitchB(config-vlan100)exit
SwitchB(config)#vlan 101
SwitchB(config-vlan101)#Switchport access ethernet 1/0/20
SwitchB(config-vlan101)exit
SwitchB(config)# interface ethernet 1/0/10
SwitchB(Config-If-Ethernet1/0/10)#switchport mode trunk
SwitchB(Config-If-Ethernet1/0/10)#exit
SwitchB(config)#vlan 20
SwitchB(config-vlan20)#multicast-vlan
SwitchB(config-vlan20)#multicast-vlan association 100,101
```

```
SwitchB(config-vlan20)#exit
SwitchB(config)#ip igmp snooping
SwitchB(config)#ip igmp snooping vlan 20
```

When multicast VLAN supports IPv6 multicast, usage is the same with IPv4, but the difference is using with MLD Snooping, so does not give an example.