

IP Multicasting Simulation Technology Based on eNSP

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Abstract: Due to lacking the practical network engineering cases in the teaching process of network engineering major both in colleges and universities, therefore it selects IP multicasting technology as the researching object, which is based on eNSP network simulator, so as to construct the topology of IP multicasting network, combined with the application of IGMP, PIM-SM, OSPF protocol and VLC player, constructing a dynamic case of running IP multicasting network that can simulate the real IP multicasting network. On this basis, the operation can simulate the normal network behavior between the multicasting servers and the received sites, which can analyze the basic characteristics of all kinds of multicasting packets on the network link. Moreover, the testing results can verify the correctness of the practical feature of this method.

Keywords IP multicast, eNSP, IGMP, PIM-SM, Simulation

INTRODUCTION

IP multicasting technology can solve the interconnection communication problem of one point to multipoint in network, compared with the traditional unicasting communication, adopting multicasting technology can effectively reduce network traffic and improve the efficiency of network communication, which can reduce the load of server [Wu, et. al., 2006]. In the multicasting network, even if the number of users is increased exponentially, the amount of network backbone traffic will not be increased, therefore, the increase in network size will not increase the burden of the network. So, the effective application of IP multicasting technology is very important to optimize the network service and improve the network performance. However, due to the limitation of the textbooks [Wu, 2013][Yi, 2012] and the limited contents of the curriculum, so far the teaching of network engineering in many universities only paid attention to the general teaching and experiment that is based on point-to-point unicasting network technology, which is lack of a comprehensive introduction to the IP multicasting technology, especially lacking the real running IP multicasting network teaching case, which can not be connected with the related concept and technology with comprehensive application and comprehensive understanding, therefore it can seriously affect the effect of professional teaching. In this paper, through the analysis of IP multicasting technology and protocol, based on in-depth study on eNSP network simulator^[4], it proposed IP multicasting network design and configuration method based on virtual network environment, constructing a IP multicasting network case based on eNSP, simulating the real network engineering in the design of IP multicasting

network, which can be widely used in the practical teaching and occupation training for network engineering major both in colleges and universities, with the advantages of being flexible and convenient, practical and efficient with low cost.

ANALYSIS OF IP MULTICASTING TECHNOLOGY

Architecture of IP Multicasting Network

IP multicasting network is built on the basis of the connectivity of unicasting network, which can be divided into three parts: multicasting source, multicasting routing network and group membership network, which can be shown in Fig.1. From the perspective of unicasting network, multicasting source is a multicasting service network server, which owns specific unicasting IP address; from the perspective of multicasting network, multicasting source can define a multicasting group, with a specific multicasting IP address identification. Members of the group are composed by the host network and edge router (e.g. AR3 and AR6) or three-layer switch, running IGMP protocol, IGMP on the host computer can be used to the propose the operation application of joining the group or leaving the group to the edge router, IGMP on the edge router can respond to the application of each host computer's joining or leaving in this sub-network. Thus it can maintain a list of members of the group, so as to realize the management on the members in this sub-network; multicasting routing network is compose by several interconnected routers (e.g. AR1, AR2, AR3, AR4, AR5, AR6), running the multicasting routing protocol. Since the edge routers can connect the connection member in the sub-

network with multicasting routing network, therefore, the edge routers must run IGMP protocol and multicasting routing protocol at the same time, when the first group member of the group takes part in the group, the edge routers and the other multicasting routers can form the multicasting tree

through exchanging information with other routers. When the last member of the group leaves the multicasting group, the connected multicasting routers with the other multicasting routers can leave the multicasting tree through exchanging information with other routers.

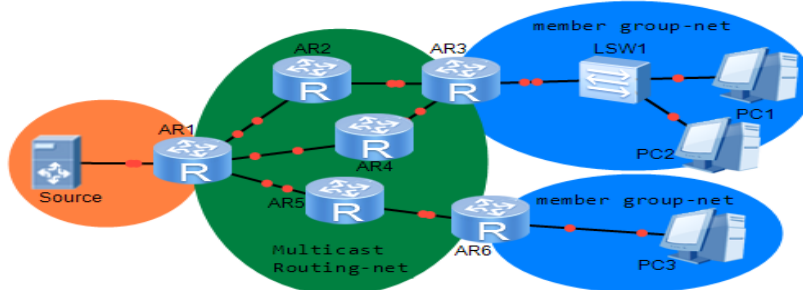


Fig. 1 Typical Topology of IP Multicasting Network

PIM Routing Protocol

PIM (Protocol Independent Multicast) is a multicasting routing protocol that does not depend on the unicasting routing protocol. It can provide two kinds of application modes and two kinds of specific protocols, namely, PIM-DM and PIM-SM. PIM-SM protocol can be applied to the group members with the sparse distribution mode, assuming that all host nodes in the network are not multicasting group members, the host computer must join the multicasting group through IGMP so that it can become a member of the multicasting group, while edge routers and other running PIM-SM protocol routers can send Hello message periodically, in order to discover the neighboring PIM-SM routers, constructing and maintaining the multicasting distribution tree according to the information of group members. PIM-SM multicasting distribution tree can have two kinds, one is sharing tree which takes RP of the multicasting group as the root, the other is the shortest path tree which takes the multicasting source as the root. PIM-SM can complete the establishment and maintenance of the multicasting distribution tree through joining and pruning mechanism. During this process, PIM-SM needs to determine DR in the network of the group members as well as RP and BSR in the multicasting routing networks. While PIM-DM can be applied to the group members with the dense distribution mode, assuming that all host nodes in the multicasting network are multicasting group members, when the multicasting source sends multicasting data, all group members need to receive multicasting data. The routers transfer the multicasting packets to all interfaces except RPF interface, which is corresponded to the multicasting source, thus all network nodes in PIM-DM domain can receive multicasting packets. If there is no multicasting group member in the network, the router in this area will send a "prune message" to the forwarding interface for pruning the area and establish the pruning state. When a host computer wants to join a multicasting group in the pruning area, it sends a "graft" message

to the upstream positively, so as to change the pruning state to the transferring state.

Group Membership Management Techniques for IP Multicasting Networks

The management function of group members is mainly realized by running the protocol between the edge router and host IGMP (Internet Group Management Protocol), through IGMP protocol, the host computer can notify the edge routers positively with the information of joining or leaving a specific multicasting group, the edge routers can periodically query LAN members of one known group to see whether it is active, namely, whether this network still has the members belonging to the multicasting group to achieve even network group membership information collection and maintenance. As for the multiple accessing network group members, there exist multiple edge routers, IGMP must elect one router to be responsible for querying Lan group membership information periodically, this router can be called as the querying machine for group members of the network, while the other routers become the non querying machines, which can not issue periodic group membership query information any longer.

SIMULATION TECHNOLOGY OF IP MULTICAST IN CAMPUS NETWORK

Constructing IP Multicasting Network Topology

Fig.2 is IP multicasting network topology that is constructed by the basic elements of IP multicasting technology and the application scenarios in campus network, the distribution of unicasting IP address can be signed as the map, MultiCast-Server is as the multicasting sever, which can simulate the multicasting source of the multicasting network; AR1220 router can simulate the multicasting router, S5700 switch is a three-layer switch, which can simulate the edge router of the multicasting network; while PC1, PC2, PC3 can simulate the host computer of the network, which can apply for joining or leaving the multicasting group at any time. On

MultiCast-Server and PC host computers, VLC Media Player can be installed on the open source

media player, which can constitute the basic environment of streaming media network.

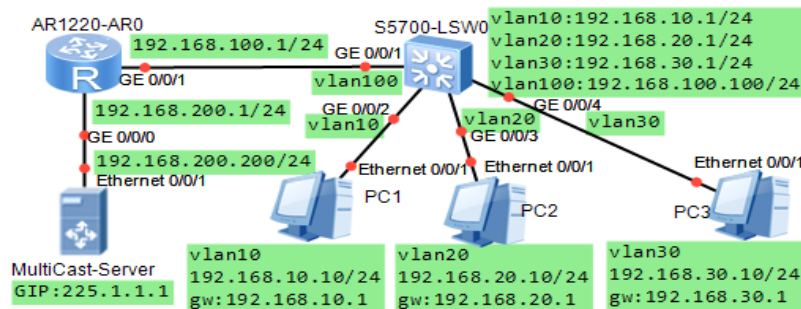


Fig. 2 IP Multicasting Network Topology

Configuring IP Multicasting Network

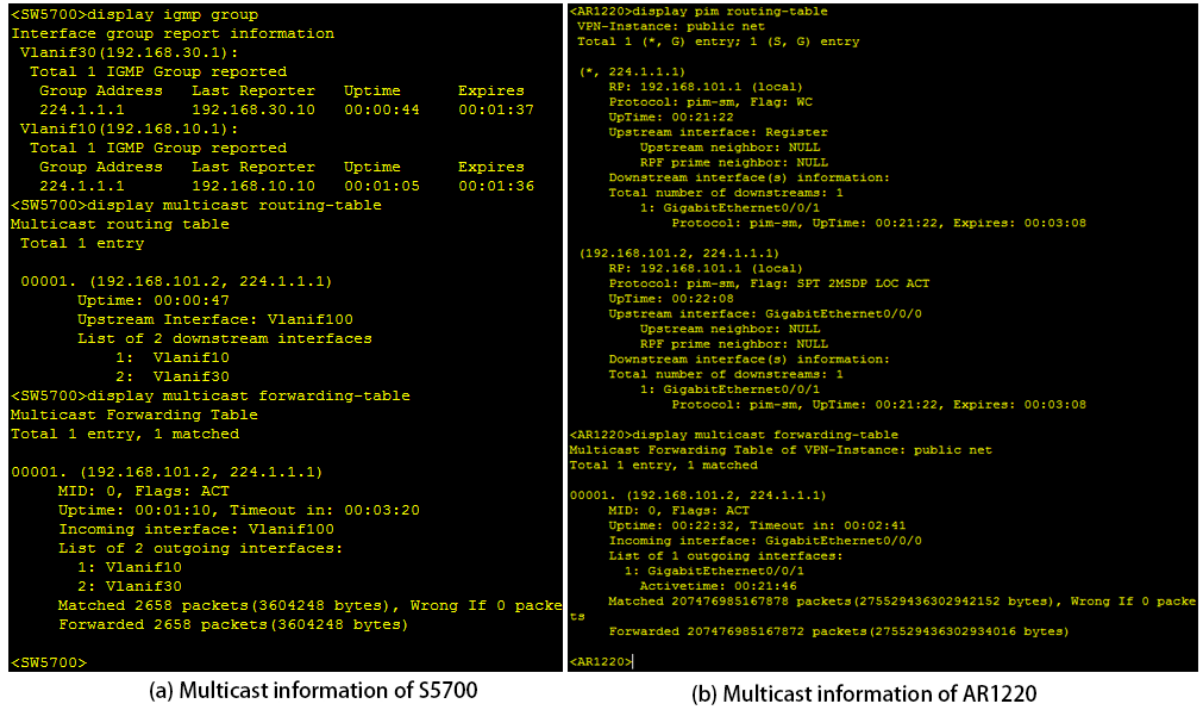
According to the logic function of IP multicasting network, the configuration of IP multicasting can mainly include the four parts, namely, configuration of unicasting network, the configuration of multicasting source, the configuration of multicasting network as well as the configuration of group members. During the process of configuration, both multicasting IP address and unicasting IP address can be used. The configuration of unicasting IP network mainly includes the IP configuration of each device port and routing configuration. In this example, each host is connected to different VLAN virtual interface, adopting OSPF routing protocol. The configuration of multicasting source is mainly to assign the unicasting IP of MultiCast-Server, namely, 192.168.101.1/24, the designated multicasting group IP address is 224.1.1.1, meanwhile it can specify the video playback content of VLC player. The network configuration of group members is mainly to configure the IP address that host computers want to take part in the multicasting group, the corresponding multicasting MAC address as well as the VLC player, etc.. The configuration of multicasting network is mainly about the configuration of AR1220 router and the configuration of S5700 switch multicasting routing, the configuration points can be including:

- 1) Use the multicasting routing-enable command to enable the multicasting routing function of the router and the switch.
- 2) Use the pim sm command to configure the pim-sm multicasting routing protocol on GE0/0/0 and GE0/0/1 ports of AR1220 router.
- 3) Configure RP and BSR candidates on GE0 / 0/0 port of AR1220 router.
- 4) Use the pim sm command to configure the pim-

sm multicasting routing protocol, meanwhile using the igmp enable command to activate the group member management protocol of each VLAN interface of S5700 switch that is connected to the network host computer.

TEST AND ANALYSIS OF IP MULTICASTING NETWORK

The test of IP multicasting network is carried on the connectivity of unicasting network, which mainly test the connectivity of multicast forwarding-table of each equipment, so as to determine whether the multicasting forwarding tree is established or not, this process involves the information of IGMP Group, protocol routing-table of multicasting router, multicast routing table multicast forwarding-table. In theory, IGMP query in IP multicasting network can form a group membership information table according to the host application information of joining or exiting the multicast group. Each multicasting routing protocol maintains a multicast routing table for the protocol, such as pim routing-table. The multicasting router can form multicasting routing table after combining the information of the multicasting router, based on this, the multicasting router can form the router's forwarding table by selecting the most multicast routing according to the multicasting routing and forwarding strategy, so as to control the transferring of multicasting data packet. The multicast forwarding table of all multicasting routers is analyzed comprehensively, the whole network can set up a transferring route that is from one point to multipoint, which takes the multicasting source as the root and group member as the leaf. On HUAWEI devices, you can use the display command to view the response information.



From the above multicasting information we can see, PC1 and PC3 joined 224.1.1.1 multicasting group, the multicasting transferring root is GE0/0/0 port of AR1220 router, downstream port is GE0/0/1; in the transferring table of S5700 switch, the upstream interface for is vlanif100, while the downstream transferring ports are respectively

vlanif10 and vlanif30, which can form a transferring multicasting tree, both host PC1 and PC3 can see video multicast, shown in Fig.4. During the process of multicasting, waresnark can be used to capture data packets in different links in the network to monitor the multicasting data flow.



Fig. 4 IP multicasting video

At the same time, S5700 can query whether there is host to join in the multicasting group in the local area network periodically, it can observe the specific query packet from the unjoined the multicasting group's VLANIF20 port to capture data packets.

CONCLUSION

In this paper, it takes the basic principle of IP multicasting technology as the basis, combined with network engineering practice, putting forward the basic framework of the application case of IP multicasting network, so as to realize the simulation of operation under the eNSP virtual network

environment, testing and analyzing the reliable relationship of transferring information among the IP multicasting network, which also can verify the transmission of IP multicasting packet as well as the effect of the actual experience of video multicast, experiencing the operation of network hosts joining the multicasting group and exiting the multicasting group, observing the characteristics of the corresponding IGMP data packet. Multicasting data streams and other unicasting data flows can go through normally. Thus this simulation method and case can be used as reference in the practice teaching of network engineering major, which is helpful for

students to fully understand multicasting technology as well as the specific use of multicasting IP address.

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