Multi VLAN reliable and efficient campus network design

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ABSTRACT

A campus network with a certain scale will be divided into multiple functional areas according to different business functions, and these functional areas are distinguished by different VLANs. In order to ensure the reliability of each VLAN connection and achieve efficient collaboration, this paper proposes link backup and load balancing technology of route design to realize the construction and operation and maintenance of reliable and efficient Park networks under multi VLANs.

Keywords: Route backup, load balancing

1. INTRODUCTION

1.1 Analysis of access problems of campus network

When the number of network access users in the park is small, the network coverage is only limited to one place, the network does not have a hierarchical structure, and the network construction meets the mutual access of internal resources. With the increase of the number of network users, the network architecture needs to be partitioned according to functions, that is, the modular design idea can be applied to flexibly partition according to business needs. In the large-scale park network, it may be a network covering multiple buildings, or a network connecting multiple parks in a city through Wan. It needs to provide access services, allowing business employees to access the company's internal network through VPN and other technologies.[1] The typical network architecture is shown in Figure 1.

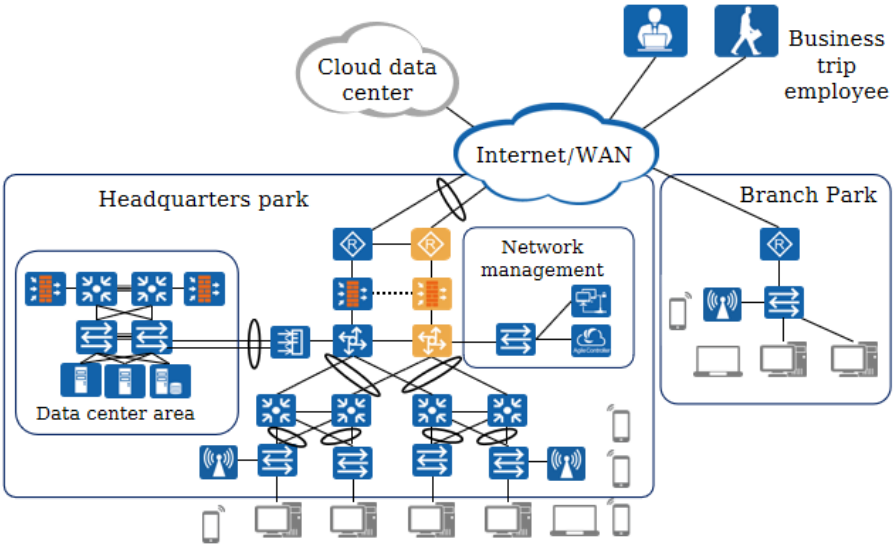

Figure 1. Typical park network architecture.

User terminals in the local area network of the park network usually access the external network by configuring a default gateway. If the default gateway device fails, the traffic of all user terminals accessing the external network will be interrupted. Redundancy can be achieved by configuring multiple gateway devices, and a single point of failure can be solved by deploying multiple gateways. However, conflicts among multiple gateways need to be solved.[2]

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1.2 VRRP technology realizes link redundancy

VRRP (Virtual Router Redundancy Protocol) can not only realize the backup of gateways, but also solve the problem of conflicts between multiple gateways, thus improving the network reliability, as shown in Figure 2.

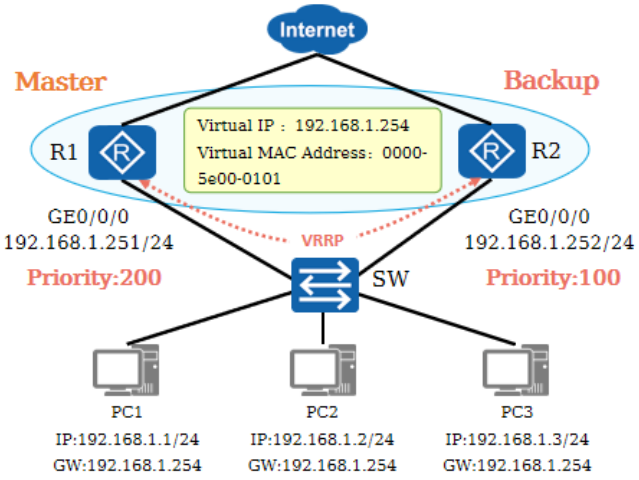

Figure 2. Schematic diagram of link redundancy realized by VRRP Technology.

A VRRP group is composed of multiple routers (interfaces) that work together, and is identified by the same VRID (virtual router identifier). Routers belonging to the same VRRP group exchange VRRP protocol messages and generate a virtual "router". Only one master router can appear in a VRRP group.[3]

VRRP abstracts a virtual "router" for each group. The router is not a real physical device, but a virtual logical device created by VRRP. A VRRP group can only generate one virtual router.

The virtual router has its own IP address and MAC address. The IP address is specified by the network administrator when configuring VRRP. A virtual router can have one or more IP addresses, which is usually used by the user as the gateway address. The format of the virtual MAC address is "0000-5e00-01xx", where XX is VRID.

The master router undertakes the task of packet forwarding in a VRRP group. In each VRRP group, only the master router will respond to the ARP request for the virtual IP address. The master router will periodically send VRRP messages at certain time intervals to notify the backup routers in the same VRRP group about their survival.

Backup router is also called backup router. The backup router will listen to the VRRP message sent by the master router in real time, and it is ready to take over the work of the master router at any time.

The priority value is the basis for selecting the master router and the backup router. The value range of the priority is 0-255. The larger the value, the higher the priority. If the value is equal, the size of the interface IP address will be compared, and the larger the priority.

By combining several routing devices to form a virtual "routing device", a certain mechanism is used to ensure that when the next hop routing device of the host fails, the service is switched to the backup routing device in time, so as to maintain the continuity and reliability of communication.[4]

1.3 Load balancing with VRRP Technology

The application of load balancing technology can realize the balanced sharing of traffic by using multiple network device channels. Load balancing can use multiple network devices to work at the same time. On the one hand, it can accelerate the processing capacity of network information and optimize the performance of network devices; On the other hand, when one device is abnormal, other devices can assume the network communication function, ensure the reliability of the network, and enhance the robustness. This can be achieved in two ways.

Method 1: two physical links are set with different priorities. The one with the highest priority is the primary link and the other is the standby link. However, if the backup link is only used for backup, it will waste the link resources. How can the backup link be brought into full play? Let the two links have the same priority and can work at the same time, so as

to achieve load balancing. By creating multiple virtual routers, each physical router plays different roles in different VRRP groups. The virtual IP of different virtual routers can be used as different intranet gateway addresses to realize traffic forwarding load sharing, as shown in Figure 3.

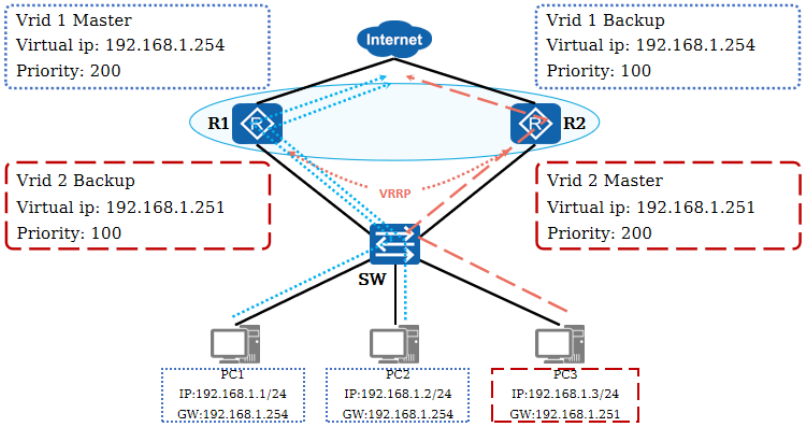

Figure 3. Same as the technical schematic diagram of VLAN load balancing.

Mode 2: VRRP + MSTP can ensure network redundancy and backup while realizing load sharing. [5]MSTP is used to prevent loops, and VRRP realizes active / standby switching. MSTP is an instance of mapping one or more VLANs to a spanning tree. Several VLANs share a spanning tree. MSTP can realize load balancing. The VRRP configured gateway can flexibly switch automatically according to the change of network topology to improve the reliability of the network, as shown in Figure 4.

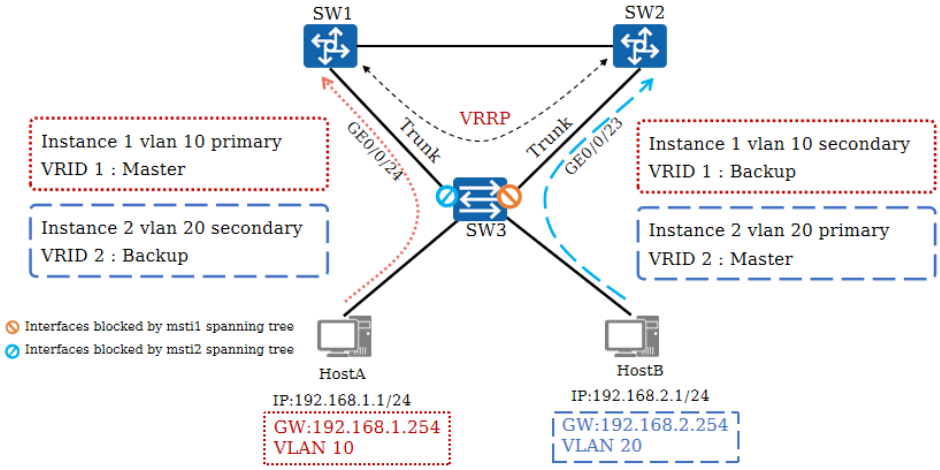

Figure 4. Schematic diagram of load balancing with VRRP+MSTP.

2. PARK NETWORK IMPLEMENTATION CASE

2.1 Network system construction

The construction of the park network project needs to ensure the reliability of the network. Two routers R1 and R2 are configured. The two routers R1 and R2 use VRRP to configure redundant backups of virtual gateways and realize load sharing of the underlying PCs. In addition, it is necessary to ensure that when the master device goes online again after hanging up, it may run the BGP protocol. In order to give the BGP protocol running and routing outflow time, VRRP enables the preemption function, and the preemption delay is not more than 30s.

The project requires not only redundant links, but also full use of resources to improve network performance. Therefore, the project design makes full use of backup links for load balancing, so as to improve network performance. Associate R1 and R2 to the same virtual router, which uses 192.168.1.254 as the port IP address. R1 and R2 form a VRRP backup

group, where R1 is the master and R2 is the backup; The master device adopts the preemptive mode during fault recovery, and the preemptive delay is 10 seconds; The master device monitors the status of the uplink interface to realize the automatic switching between the active and standby VRRP. All PCs use 192.168.1.254 as the default gateway. to configure

The device that initially created the VRRP works in the initialize state. After receiving the message of interface up, if the priority of this device is less than 255, it will switch to the backup state first and wait for master_ Switch to the master state after the down timer expires.

According to the project construction requirements, the network topology of building a single VLAN using VRRP technology is shown in Fig. 5, and the configuration information of R1 and R2 is shown in Fig. 6.

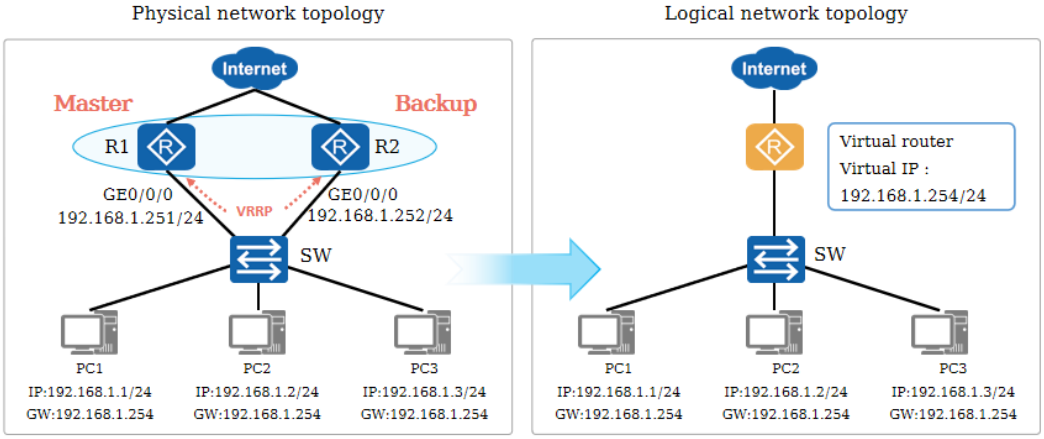

Figure 5. Project VRRP technology network topology diagram.

R1 is configured as follows:

```
[R1] interface GigabitEthernet0/0/0
[R1-GigabitEthernet0/0/0] ip address 192.168.1.251  24
[R1-GigabitEthernet0/0/0] vrrp vrid 1 virtual-ip 192.168.1.254
[R1-GigabitEthernet0/0/0] vrrp vrid 1 priority 120
[R1-GigabitEthernet0/0/0] vrrp vrid 1 preempt-mode timer delay 10
[R1-GigabitEthernet0/0/0] vrrp vrid 1 track interface
GigabitEthernet0/0/1 reduced 30
```

R2 is configured as follows:

```
[R2] interface GigabitEthernet0/0/0
[R2-GigabitEthernet0/0/0] ip address 192.168.1.252 24
[R2-GigabitEthernet0/0/0] vrrp vrid 1 virtual-ip 192.168.1.254
[R2-GigabitEthernet0/0/0] vrrp vrid 1 priority 110
```

Figure 6. Configuration information of R1 and R2.

If the device with high priority starts first and the device with low priority starts later, the device with high priority enters the master state first. The device with low priority receives the VRRP notification message with high priority and is still in the backup state.

If the device with low priority starts first and the device with high priority starts later, the device with low priority switches from backup state to master state first. The device with high priority receives the VRRP notification message with low priority, elects again, and switches the device with high priority to master state.

In addition, the method of building device configuration under multi VLAN is the same as before.

2.2 Configuration validation

The status of the set router R1 in the group is master, the priority of the interface in the VRRP group is 120, the preemptive mode is enabled, and the delay time is 10 seconds. The verification results are shown in Fig. 7.

The status of router R2 in the group is backup, the priority in this VRRP group is 110, the preemptive mode is enabled, and the delay time is 0 seconds. The verification result is shown in Fig. 8.

```
[R1]display vrrp
  GigabitEthernet0/0/0 | Virtual Router 1          #VRRP group ID is 1
  State : Master        #The status of this device in the group is master
  Virtual IP : 192.168.1.254
  Master IP : 192.168.1.251
  PriorityRun : 120     #The priority of the interface in this VRRP group is 120
  PriorityConfig : 120
  MasterPriority : 120
  Preempt : YES
  Delay Time : 10s   #Enable preemptive mode with a delay time of 10 seconds
  TimerRun : 1s
  TimerConfig : 1s
  Auth type : NONE
  Virtual MAC : 0000-5e00-0101
  Check TTL : YES
  Config type : normal-vrrp
  Track IF : GigabitEthernet0/0/1
  Priority reduced : 30
  IF state : UP
```

Figure 7. Verification information of R1 configuration.

```
[R2]display vrrp
  GigabitEthernet0/0/0 | Virtual Router 1
  State : Backup              #The status of this device in the group is backup
  Virtual IP : 192.168.1.254
  Master IP : 192.168.1.251
  PriorityRun : 110     #The priority of the interface in this VRRP group is 110
  PriorityConfig : 110
  MasterPriority : 120
  Preempt : YES
  Delay Time : 0s       #Enable preemptive mode with a delay time of 0 seconds
  TimerRun : 1s
  TimerConfig : 1s
  Auth type : NONE
  Virtual MAC : 0000-5e00-0101
  Check TTL : YES
  Config type : normal-vrrp
```

Figure 8. Verification information of R2 configuration.

2.3 Data capture verification

Test the network architecture using the ENSP virtual simulation platform, and capture the packets from the G0 / 0 / 0 port of R1 through Wireshark. It can be seen that the virtual gateway 192.168.1.254 is enabled, as shown in Figure 9.

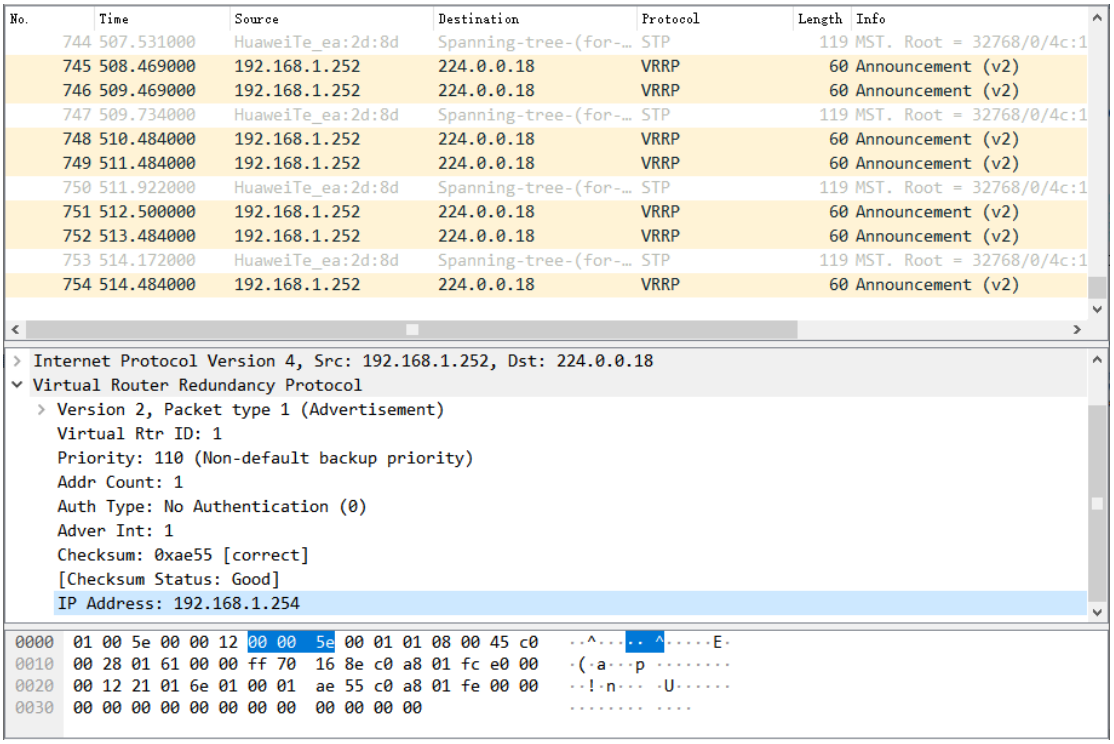

Figure 9. Data capture verification virtual gateway enabled.

Virtual gateways of vlan1 and vlan2 on PC1 and PC3, 192.168.1.254 and 192.168.1.251 respectively, and realize load balancing of multiple VLANs through Ping commands.

3. CONCLUSION

Route backup can be realized by setting different priorities of routers. Once a router fails, the system can enable backup routes by itself, and the robustness of network links is very high. The application of the combination of VRRP and MSTP technology virtualizes different virtual gateways through routers, which can ensure the reliability of the network, simplify the construction of the campus network, and achieve the efficiency and load balance of the network link.

In the implementation of this case, only the configuration of active and standby routes in a single VLAN is shown. The division of VLANs in multiple VLANs is transparent to users. The router mate and backup roles can be configured in different VLANs, which effectively realizes the load balancing of links in multiple VLANs and ensures the coordinated and efficient operation of devices.

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