Multi-VRF CE Configuration

Model: S5900-24S4T2Q
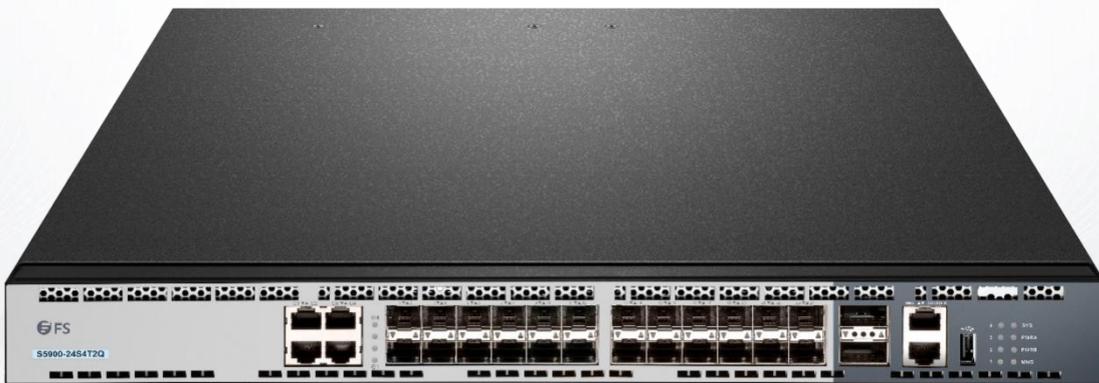
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1. Multi-VRF CE Intro

1.1 Overview

The Virtual Private Network (VPN) provides a secure method for multiple client networks to share the ISP-supplied bandwidth. In general, one VPN comprises a team of client networks that share a public routing table on the ISP's routers. Each client network is connected to the interface of the network devices of ISP, while ISP's device will relate each interface to a VPN routing table. One VPN routing table is also called as a VRF (VPN Routing /Forwarding table).

VRF is usually deployed on a Provider Edge (PE) device, such as MPLS VRF VPN. A PE supports multiple VPNs, and each VPN has its independent IP address space among which IP addresses can be overlapped. The VPN of a different client connects a different interface of PE, while PE differentiates the to-be-checked routing tables according to the incoming port of the packet.

Multi-VRF CE is to remove the task of connecting multiple client networks from PE to CE, which only requires a physical link to connect CE and PE. In this way, the port resource of PE is saved. CE also maintains the VRF routing table for each VPN. The packets from the client network are first forwarded on CE and then transmitted to PE after the packets pass through the ISP network.

The switch which serves as MCE connects different client networks through different ports and then relates these ports to a VPN routing table. MY COMPANY switches only support VRF settings on the VLAN port.

The MCE function is usually deployed at the edge of the large-scale MPLS-VRF VPN network. The three functions, Multi-VRF CE, MPLS label switching and the function of MPLS control layer, are independent. Figure 1.1 shows an MPLS-VRF VPN network.
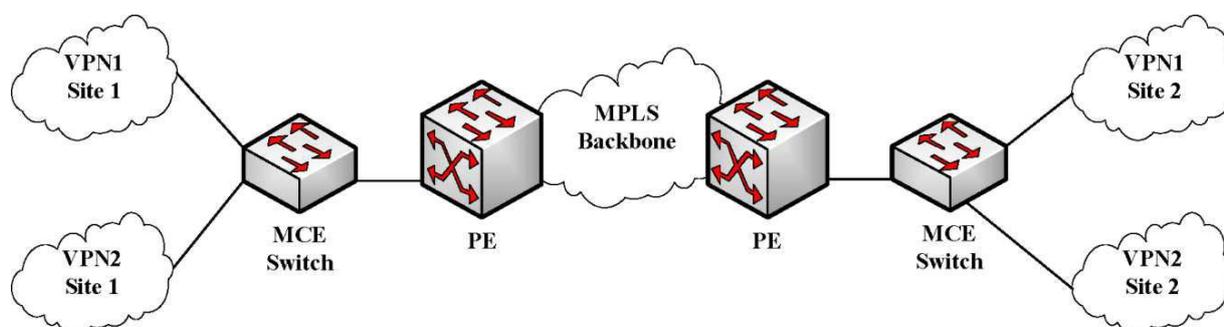

Figure 1.1 MCE in the MPLS-VRF VPN network

1.1.1 Establishing Routes with CE

The Multi-VRF CE switch can establish routes with CE through multiple dynamic routing protocols. CE can be routers or the Ethernet switches. The routing protocols which are supported include OSPF, RIP and BEIGRP. The MCE switch also supports static routing configuration.

The MCE switch generally needs different VLAN ports to connect CEs that belong to different VPNs. The VLAN ports that are used to connect the VPNs require to be related to a VRF. CE does not need to support VRF.

1.1.2 Establishing Routes with PE

The MCE switch (MCE) can connect one or multiple PEs, but both MCE and the connected PEs have to get VRF configured. MCE will provide PE the routes which MCE learns from CE and learns the routes of remote client networks from PE.

The VRF route can be established between MCE and PE through dynamic routing protocols such as BGP, OS PF, RIP and BEIGRP. Of course, the VRF route can also be established statically.

In general, MCE and PE belong to different autonomous systems. Hence, the method to establish the VRF route between MCE and PE by using EBGP is the key point in this document.

2. Multi-VRF CE Configuration

2.1 Default VRF Configuration

Function	Purpose
VRF	There is no configuration. All routes are added to the default routing table.
VPN expansibility of VRF	There is no Routing Distinguisher (RD). There is no input/output Routing Target (RT).
Maximum number of VRF routes	10240
VRF port	N/A. None of VLAN ports is related with VRF, and the routes of ports are added to the default routing table.
IP Express Forwarding	The hardware IP routing is not enabled.

2.2 MCE Configuration Tasks

· Configuring VRF

· Configuring a VPN Route

· Configuring BGP Route Between PE and CE

· Testifying the VRF Connectivity between PE and CE

2.3 MCE Configuration

2.3.1 Configuring VRF

Refer to the following steps to configure one or multiple VRFs.

Command	Purpose
Switch# **config**	Enters the switch configuration mode.
Switch_config# **ip vrf** *vrf-name*	Creates VRF and enters the VRF configuration mode. vrf-name: VRF name with up to 31 characters
Switch_config_vrf# **rd** *route-distinguisher*	Sets the route distinguisher of VRF. route-distinguisher: Stands for the distinguisher of the route. It consists of autonomous domain ID and random numbers, or IP and random numbers.
Switch_config_vrf# route-target { export | import | both } route-target-extened-community	Creates the expanded VPN attributes of input/output VRF objects. route-target-extended-community: It consists of autonomous domain ID and random numbers, or IP and random numbers.
Switch config_vrf# interface intf-name	Enters the interface configuration mode. intf-name: Stands for the name of an interface.
Switch_config_intf# ip vrf forwarding vrf-name	Relates the L3 interface with VRF. vfi-name: Means the name of VRF.

Switch_config_intf# exit	Exits from interface configuration mode.
Switch_config# ip exf	Enables ip hardware routing.
Switch_config# show ip vrf [brief | detail | interface] [vrf-name]	Browses the VRF information.
Switch_config#no ip vrf vrf-name	Deletes the configured VRF and the relation between VRF and the L3 interface. vfi-name: Means the name of VRF.
Switch_config_intf# no ip vrf forwarding [vrf-name]	Deletes the relation between the L3 interface and VRF.

2.3.2 Configuring VPN Route

The route can be established between MCE and customer device through the configuration of BGP, OSPF, RIP, BEIGRP or static route. The following takes OSPF configuration as an example, which is similar to other routes' configurations.

Note:
When a route is configured on MCE to connect the client network, the VRF attributes of the routing protocol need be specified. VRF need not be configured on the customer device.

Command	Purpose
Switch# config	Enters the switch configuration mode.
Switch_config# router ospf process-id vrf vrf-name	Starts the OSPF-VRF route and enters the configuration mode.
Switch_config_ospf# network network-number network-mask area area-id	Defines the OSPF network, mask and area ID.
Switch_config_ospf# redistribute bgp ASN	Forwards the designated BGP network to the OSPF network.
Switch_config_ospf# exit	Exits from the OSPF configuration mode.
Switch_config# show ip ospf	Browses the information about the OSPF protocol.
Switch_config# no router ospf process-id	Deletes the OSPF-VRF routing configuration.

2.3.3 Configuring the BGP Route Between PE and CE

Refer to the following configuration commands:

Command	Purpose
Switch# config	Enters the switch configuration mode.
Switch_config# router bgp autonomous-system-number	Starts the BGP protocol by designating autonomous system number and enters the BGP configuration mode.
Switch_config_bgp# bgp log-neighbor-changes	Starts the record about BGP neighbor change.
Switch_config_bgp# address-family ipv4 vrf vrf-name	Enters the configuration mode of VRF address-family.

Command	Purpose
Switch_config_bgp_af# redistribute ospf ospf-process-id	Forwards the OSPF routing information to the BGP network.
Switch_config_bgp_af# network network-number/prefix-length	Configures the network number and the mask's length that are distributed by BGP.
Switch_config bgp af# neighbor address remote-as ASN	Configures the BGP neighbor and the autonomous system number of a neighbor.
Switch_config_bgp_af# exit-address-family	Exits from the configuration mode of address-family.
Switch_config_bgp# exit	Exits from the BGP configuration mode.
Switch_config# show ip bgp vpnv4 [all | rd | vrf]	Browses the BGP-VRF routing information.
Switch_config# no router bgp ASN	Deletes the BGP routing configuration.

2.3.4 Testifying the VRF Connectivity Between PE and CE

Use the PING command with the VRF option to testify the VRF connectivity of PE and CE.

Command	Purpose
Switch# ping –vrf vrf-name ip-address	Conducts the PING operation to the addresses in VRF.

3. Multi-VRF CE Configuration

Figure 2.1 shows a simple VRF network. Both S1 and S2 are the Multi-VRF CE switches. S11, S12 and S13 belong to VPN1, S21 and S22 belong to VPN2, and all of them are customer devices. The OSPF route should be configured between CE and customer device, while the BGP route is configured between CE and PE.
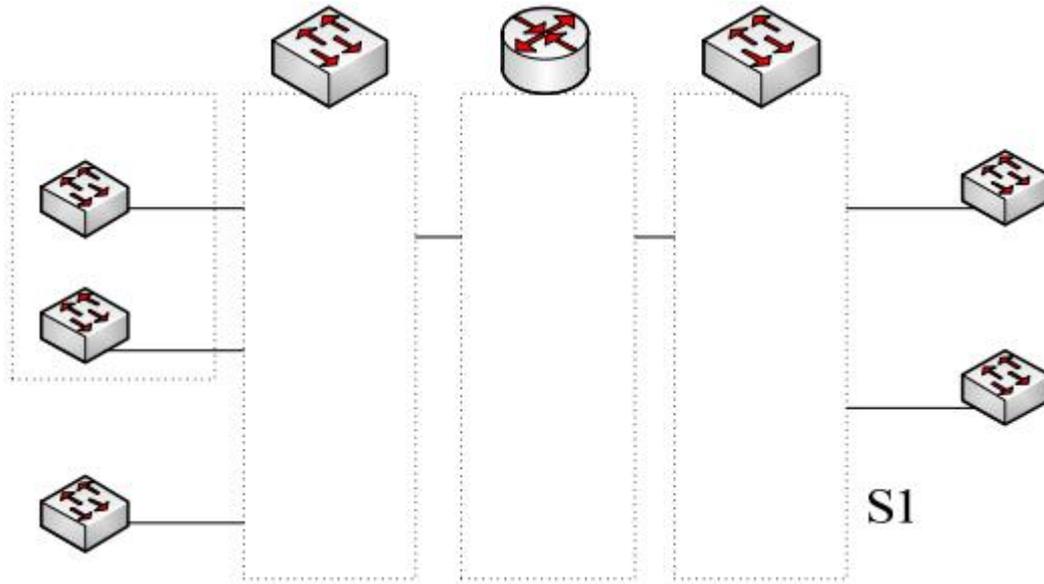

Figure 2.1 MCE configuration example

3.1 Configuring S11

Set the VLAN attributes of the physical interface that connects CE:

Switch_config# interface gigaEthernet 0/1

Switch_config_g0/1# switchport pvid 11

Switch_config_g0/1# exit

Sets the IP address and the VLAN interface.

Switch_config# interface VLAN11

Switch_config_v11# ip address 11.0.0.2 255.0.0.0

Switch_config_v11# exit

Set the routing protocol between CE and customer's device:

Switch_config# router ospf 101

Switch_config_ospf_101# network 11.0.0.0 255.0.0.0 area 0

Switch_config_ospf_101# exit

3.2 Configuring MCE-S1

Configures VRF on the Multi-VRF CE device.

Switch#config

Switch_config# ip vrf vpn1

Switch_config_vrf_vpn1# rd 100:1

Switch_config_vrf_vpn1# route-target export 100:1

Switch_config_vrf_vpn1# route-target import 100:1 Switch_config_vrf_vpn1# exit

Switch_config# ip vrf vpn2 Switch_config_vrf_vpn2# rd 100:2 Switch_config_vrf_vpn2# route-target export 100:2

Switch_config_vrf_vpn2# route-target import 100:2

Switch_config_vrf_vpn2# exit

Configure the loopback port and the physical port, and use the address of the loopback port as the router ID of the BGP protocol.

Switch_config# interface loopback 0

Switch_config_l0# ip address 101.0.0.1 255.255.255.255

Switch_config_l0# exit

S1 connects S11 through the F0/1 port, S21 through the G0/4 port and PE through the G0/2 port.

Switch_config# interface gigaEthernet 0/1

Switch_config_g0/1# switchport pvid 11

Switch_config_g0/1# exit

Switch_config# interface gigaEthernet 0/4

Switch_config_g0/4# switchport pvid 15

Switch_config_g0/4# exit

Switch_config# interface gigaEthernet 0/2

Switch_config_g0/2# switchport mode trunk

Switch_config_g0/2# exit

Set the L3 VLAN port of a switch, bind the VRF to the VLAN port and set the IP address. S1 connects PE through two logical ports, VLAN21 and VLAN22. The two ports, VLAN11 and VLAN15, connect VPN1 and VPN2 respectively

Switch_config# interface VLAN11

Switch_config_v11# ip vrf forwarding vpn1

Switch_config_v11# ip address 11.0.0.1 255.0.0.0

Switch_config_v11# exit

Switch_config# interface VLAN15

Switch_config_v15# ip vrf forwarding vpn2

Switch_config_v15# ip address 15.0.0.1 255.0.0.0

Switch_config_v15# exit

Switch_config# interface VLAN21

Switch_config_v21# ip vrf forwarding vpn1

Switch_config_v21# ip address 21.0.0.2 255.0.0.0

Switch_config_v21# exit

Switch_config# interface VLAN22

Switch_config_v22# ip vrf forwarding vpn2

Switch_config_v22# ip address 22.0.0.2 255.0.0.0

Switch_config_v22# exit

Configure the OSPF route between CE and customer device.

Switch_config# router ospf 1 vrf vpn1

Switch_config_ospf_1# network 11.0.0.0 255.0.0.0 area 0

Switch_config_ospf_1# redistribute bgp 100

Switch_config_ospf_1#exit

Switch_config# router ospf 2 vrf vpn2

Switch_config_ospf_2# network 15.0.0.0 255.0.0.0 area 0

Switch_config_ospf_2# redistribute bgp 100

Switch_config_ospf_2#exit

Configure the EBGP route between PE and CE.

Switch_config# router bgp 100

Switch_config_bgp# bgp log-neighbor-changes

Switch_config_bgp# address-family ipv4 vrf vpn1

Switch_config_bgp_vpn1# no synchronization

Switch_config_bgp_vpn1# redistribute ospf 1

Switch_config_bgp_vpn1# neighbor 21.0.0.1 remote-as 200

Switch_config_bgp_vpn1# exit-address-family

Switch_config_bgp# address-family ipv4 vrf vpn2

Switch_config_bgp_vpn2# no synchronization

Switch_config_bgp_vpn2# redistribute ospf 2

Switch_config_bgp_vpn2# neighbor 22.0.0.1 remote-as 200

Switch_config_bgp_vpn2# exit-address-family

Switch_config_bgp# exit

Create VLAN. Switch_config# vlan 1,11-12,21-22

Enables the forwarding of subnet route of the switch.

Switch_config# ip exf

3.3 Configuring PE

Set VRF on PE:

Switch#config

Switch_config# ip vrf vpn1

Switch_config_vrf_vpn1# rd 200:1

Switch_config_vrf_vpn1# route-target export 200:1

Switch_config_vrf_vpn1# route-target import 200:1

Switch_config_vrf_vpn1# exit

Switch_config# ip vrf vpn2

Switch_config_vrf_vpn2# rd 200:2

Switch_config_vrf_vpn2# route-target export 200:2

Switch_config_vrf_vpn2# route-target import 200:2

Switch_config_vrf_vpn2# exit

Set the loopback interface as the router identifier:

Switch_config# interface loopback 0

Switch_config_l0# ip address 102.0.0.1 255.255.255.255

Switch_config_l0# exit

Set the physical interface which connects PE and CE: G1/1 and G1/2 connect S1 and S2 respectively:

Switch_config# interface gigaEthernet 1/1

Switch_config_g1/1# switchport mode trunk

Switch_config_g1/1# interface gigaEthernet 1/2

Switch_config_g1/2# switchport mode trunk

Switch_config_g1/2# exit

Set the L3 VLAN interface of PE, which connects S1:

Switch_config# interface VLAN21

Switch_config_v21# ip vrf forwarding vpn1

Switch_config_v21# ip address 21.0.0.1 255.0.0.0

Switch_config_v21# exit

Switch_config# interface VLAN22

Switch_config_v22# ip vrf forwarding vpn2

Switch_config_v22# ip address 22.0.0.1 255.0.0.0

Switch_config_v22# exit

Set the L3 VLAN interface of PE, which connects S2:

Switch_config# interface VLAN31

Switch_config_v31# ip vrf forwarding vpn1

Switch_config_v31# ip address 31.0.0.1 255.0.0.0

Switch_config_v31# exit

Switch_config# interface VLAN32

Switch_config_v32# ip vrf forwarding vpn2

Switch_config_v32# ip address 32.0.0.1 255.0.0.0

Switch_config_v32# exit

Set the EBGP of PE:

Switch_config# router bgp 200

Switch_config_bgp# bgp log-neighbor-changes

Switch_config_bgp# address-family ipv4 vrf vpn1

Switch_config_bgp_vpn1# no synchronization

Switch_config_bgp_vpn1# neighbor 21.0.0.2 remote-as 100

Switch_config_bgp_vpn1# neighbor 31.0.0.2 remote-as 300

Switch_config_bgp_vpn1# exit-address-family

Switch_config_bgp# address-family ipv4 vrf vpn2

Switch_config_bgp_vpn2# no synchronization

Switch_config_bgp_vpn2# neighbor 22.0.0.2 remote-as 100

Switch_config_bgp_vpn2# neighbor 32.0.0.2 remote-as 300

Switch_config_bgp_vpn2# exit-address-family

Switch_config_bgp# exit

Set VLAN and enable the subnet routing forwarding.

Switch_config# vlan 1,21-22,31-32

Switch_config# ip exf

3.4 Configuring MCE-S2

Configures VRF:

Switch#config Switch_config# ip vrf vpn1

Switch_config_vrf_vpn1# rd 300:1

Switch_config_vrf_vpn1# route-target export 300:1

Switch_config_vrf_vpn1# route-target import 300:1

Switch_config_vrf_vpn1# exit

Switch_config# ip vrf vpn2

Switch_config_vrf_vpn2# rd 300:2

Switch_config_vrf_vpn2# route-target export 300:2

Switch_config_vrf_vpn2# route-target import 300:2

Switch_config_vrf_vpn2# exit

Configure the loopback port and the physical port, and use the address of the loopback port as the router ID of the BGP protocol.

Switch_config# interface loopback 0

Switch_config_l0# ip address 103.0.0.1 255.255.255.255

Switch_config_l0# exit

S2 connects S13 through the F0/1 port, S22 through the G0/3 port and PE through the G0/2 port.

Switch_config# interface gigaEthernet 0/1

Switch_config_g0/1# switchport pvid 41

Switch_config_g0/1# exit

Switch_config# interface gigaEthernet 0/3

Switch_config_g0/3# switchport pvid 46

Switch_config_g0/3# exit

Switch_config# interface gigaEthernet 0/2

Switch_config_g0/2# switchport mode trunk

Switch_config_g0/2# exit

Set the L3 VLAN port of a switch, bind the VRF to the VLAN port and set the IP address. S2 connects PE through two logical ports, VLAN31 and VLAN32. The two ports, VLAN41 and VLAN46, connect VPN1 and VPN2 respectively.

Switch_config# interface VLAN41

Switch_config_v41# ip vrf forwarding vpn1

Switch_config_v41# ip address 41.0.0.1 255.0.0.0

Switch_config_v41# exit

Switch_config# interface VLAN46

Switch_config_v46# ip vrf forwarding vpn2

Switch_config_v46# ip address 46.0.0.1 255.0.0.0

Switch_config_v46# exit

Switch_config# interface VLAN31

Switch_config_v31# ip vrf forwarding vpn1

Switch_config_v31# ip address 31.0.0.2 255.0.0.0

Switch_config_v31# exit

Switch_config# interface VLAN32

Switch_config_v32# ip vrf forwarding vpn2

Switch_config_v32# ip address 32.0.0.2 255.0.0.0

Switch_config_v32# exit

Configure the OSPF route between CE and customer device.

Switch_config# router ospf 1 vrf vpn1

Switch_config_ospf_1# network 41.0.0.0 255.0.0.0 area 0

Switch_config_ospf_1# redistribute bgp 300

Switch_config_ospf_1#exit

Switch_config# router ospf 2 vrf vpn2

Switch_config_ospf_2# network 46.0.0.0 255.0.0.0 area 0

Switch_config_ospf_2# redistribute bgp 300

Switch_config_ospf_2# exit

Configure the EBGP route between PE and CE.

Switch_config# router bgp 300

Switch_config_bgp# bgp log-neighbor-changes

Switch_config_bgp# address-family ipv4 vrf vpn1

Switch_config_bgp_vpn1# no synchronization

Switch_config_bgp_vpn1# redistribute ospf 1

Switch_config_bgp_vpn1# neighbor 31.0.0.1 remote-as 200

Switch_config_bgp_vpn1# exit-address-family

Switch_config_bgp# address-family ipv4 vrf vpn2

Switch_config_bgp_vpn2# no synchronization

Switch_config_bgp_vpn2# redistribute ospf 2

Switch_config_bgp_vpn2# neighbor 32.0.0.1 remote-as 200

Switch_config_bgp_vpn2# exit-address-family

Switch_config_bgp# exit

Create VLAN.

Switch_config# vlan 1,31-32,41,46

Enables the forwarding of subnet route of the switch.

Switch_config# ip exf

3.5 Setting S22

Set the VLAN attributes of the physical interface of CE, and connect S22 and S2 through interface f0/1:

Switch_config# interface gigaEthernet 0/1

Switch_config_g0/1# switchport pvid 46

Switch_config_g0/1# exit

Sets the IP address and the VLAN interface.

Switch_config# interface VLAN46

Switch_config_v46# ip address 46.0.0.2 255.0.0.0

Switch_config_v46# exit

Set the routing protocol between CE and customer's device:

Switch config# router ospf 103

Switch_config_ospf_103# network 46.0.0.0 255.0.0.0 area 0

Switch_config_ospf_103# exit

3.6 Testifying VRF Connectivity

Run the PING command on S1 to testify the connectivity of VPN1 between S1 and S11:

Switch# ping -vrf vpn1 11.0.0.2

!!!!!

--- 11.0.0.2 ping statistics ---

5 packets transmitted, 5 packets received, 0% packet loss

round-trip min/avg/max = 0/0/0 ms

Testify the connectivity between S1 and PE:

Switch# ping -vrf vpn1 21.0.0.1

!!!!!

--- 21.0.0.1 ping statistics ---

5 packets transmitted, 5 packets received, 0% packet loss

round-trip min/avg/max = 0/0/0 ms