Campus Architecture Network Portfolio

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Packet Tracer File:

The functional packet tracer file that has all of the following technologies implemented in a campus architecture network can be found in my git repository here: GitHub Repository

Overview:

The goal of this project is to implement the protocols and technologies used to build real-world enterprise networks using the campus network architecture. This project was completed to build a strong foundation in the core concepts of switching technologies and routing protocols, while also developing practical skills and critical thinking abilities that can be applied in real-world network environments.

Protocols and Technologies Implemented:

VLANs:

A VLAN is a network construct that allows network administrators to partition and isolate a single physical network into multiple distinct broadcast domains.

The Network has 10 VLANs:

VLAN ID	Name	10.vlan.0.0/16
1	Default	10.1.0.0/16
10	Admin	10.10.0.0/16
20	HR	10.20.0.0/16
30	Sales	10.30.0.0/16
40	Engineering	10.40.0/.016
90	Voice	10.90.0.0/16
100	Guest	10.100.0.0/16
180	Management	10.180.0.0/16
254	Native	10.254.0.0/16
255	Parking-Lot	10.255.0.0/16

Each VLAN is associated with a unique IP network so the devices within the same VLAN communicate with each other using IP addressing even if they are spread across different physical locations.

Trunking:

A trunk is a network link designed to carry multiple VLANs through a single interface by tagging frames with VLAN identification. This allows for efficient VLAN distribution across switches and network segments, enabling devices in different VLANs to communicate through the same physical link.

Spanning Tree Protocol (STP):

STP is a network protocol designed to prevent loops in a Layer 2 network. It achieves this by selectively blocking certain paths and allowing only one active path between switches. This ensures that there is a single, loop-free path for data traffic, thus preventing broadcast storms and ensuring network stability.

EtherChannel:

EtherChannel is a port link aggregation technology or protocol developed by Cisco. It allows the bundling of several physical Ethernet links to form a single logical link between two networking devices. This enhances the bandwidth by combining multiple links' capacities and provides redundancy for higher network resilience.

First Hop Redundancy Protocol (FHRP):

FHRP is a group of protocols used to ensure network availability by automatically forwarding traffic to a standby router or Layer 3 switch if the primary default gateway fails. FHRP with protocols like HSRP, allows for the configuration of a virtual router with a virtual IP and MAC address that network hosts use as their default gateway.

DHCPv4 and DHCPv4 Relay:

Dynamic Host Configuration Protocol version 4 (DHCPv4) is a network protocol used to automatically assign IP addresses and other network configuration parameters to devices on a network. It enables devices to request and receive an IP address, default gateway, and subnet mask automatically from a DHCP server. This eliminates the need for manual network configuration.

DHCPv4 Relay allows DHCP clients on different subnets/VLANs to communicate with a centralized DHCP server. When a client sends a request, the relay agent intercepts it and forwards the request to the DHCP server, adding the necessary information about the client's subnet, which enables the server to assign an appropriate IP address to the client.

Layer 3 Switching:

Layer 3 switching is a process where a switch uses IP addresses to make forwarding decisions. This effectively combines the functions of a switch and a router, which allows for high-speed touting of data within a network. This approach allows for inter-VLAN routing, as it lets devices on different VLANs communicate without the need for a separate router.

Switch Virtual Interfaces (SVIs):

An SVI is a virtual interface with an IP address that is associated with a specific VLAN. An SVI on a Layer 3 switch enables it to perform routing functions between VLANs and IP networks, without the need for an external router. The SVI on a Layer 3 switch is typically the default gateway for end devices on the same VLAN.

Management VLAN:

This network has a management VLAN for these reasons:

Security: VLAN 1 is the default VLAN on many switches, and it carries all untagged traffic.
Because of this, it's often targeted for VLAN hopping and other network attacks. By moving
important services like management interfaces (SVI) to another VLAN, you reduce the risk of
these services being compromised.

Traffic Segmentation: Using a separate VLAN for management traffic ensures that it is isolated from user data traffic, reducing the risk of congestion and performance issues on the
management interface. This segmentation also helps in prioritizing traffic, ensuring that management traffic is always accessible, even during high data traffic periods.

Best Practice and Compliance: Many network security standards and best practices recommend segregating management and user data traffic. This segregation helps in adhering
to compliance requirements for network security.

Network Organization: Having a dedicated VLAN for management purposes helps in organizing the network more efficiently. It allows network administrators to apply specific policies and controls to the management traffic without affecting the user data traffic

Open Shortest Path First (OSPF):

OSPF is a robust, link-state routing protocol widely used in IP networks. OSPF efficiently calculates the shortest path to each network destination by constructing a complete map or topology of the network using link-state advertisements (LSAs) from all participating routers. As an interior Gateway Protocol, OSPF is predominantly utilized within a single routing domain or autonomous system.

Example Configurations:

Access Switch (with DHCP Server Interface:

```
!
hostname access-1-1
!
no ip domain-lookup
!
enable secret class
!
line con 0
 logging synchronous
 exec-timeout 0 0
 exit
!
line vty 0 4
 password cisco
 login
 transport input telnet
 exit
!
!
vlan 10
 name admin
 exit
!
vlan 20
 name HR
 exit
!
vlan 30
 name Sales
 exit
!
vlan 40
 name Engineering
 exit
!
vlan 90
 name Voice
 exit
!
```

```
vlan 100
 name Guest
 exit
!
vlan 180
 name Management
 exit
!
vlan 254
 name Native
 exit
!
vlan 255
 name Parking-Lot
 exit
!
!
interface range fa0/1-24, g0/1-2
 switchport mode access
 switchport access vlan 255
 shutdown
 exit
!
!
interface fa0/10
 switchport mode access
 switchport access vlan 10
 no shutdown
 exit
!
interface fa0/20
 switchport mode access
 switchport access vlan 20
 no before shutdown
 exit
!
!
interface g 0/1
 no switchport access vlan 255
 switchport mode trunk
 switchport nonegotiate
 switchport trunk allowed vlan 1,10,20,30,40,90,100,180,254
 switchport trunk native vlan 254
 no shutdown
```

```
 exit
!
!
interface vlan 180
 ip address 10.180.1.10 255.255.255.0
 no shutdown
 exit
!
ip default-gateway 10.180.1.1
!
!
port-channel load-balance src-dst-ip
!
interface range fa 0/1-2
 shutdown
 channel-protocol lacp
 channel-group 1 mode active
 exit
!
!
interface range fa 0/1-2
 no shutdown
 exit
!
! The following port-channel1 command is only required for Packet Tracer
interface port-channel1
switchport trunk allowed vlan 1,10,20,30,40,90,100,180,254
exit !

!
interface g 0/1
 no switchport access vlan 255
 switchport mode access
 switchport access vlan 40
 no shutdown
 exit
!
!
interface fa 0/21
 no switchport access vlan 255
 switchport mode access
 switchport access vlan 40
 no shutdown
 exit
```

```
!
!
interface fa 0/21
 no switchport access vlan 255
 switchport mode access
 switchport access vlan 40
 spanning-tree portfast
 spanning-tree bpduguard enable
 no shutdown
 exit
!
!
interface fa 0/21
 no switchport access vlan 40
 switchport mode access
 switchport access vlan 255
 shutdown
 exit
!
!
interface GigabitEthernet0/1
 switchport trunk native vlan 254
 switchport trunk allowed vlan 1,10,20,30,40,90,100,180,254
 switchport mode trunk
 switchport nonegotiate
 exit
!
!
interface gig 0/2
 no switchport access vlan 255
 switchport trunk native vlan 254
 switchport trunk allowed vlan 1,10,20,30,40,90,100,180,254
 switchport mode trunk
 switchport nonegotiate
 no shutdown
 exit
!
```

Distribution Switch:

```
!
hostname distribution-1
!
no ip domain-lookup
!
enable secret class
!
line con 0
 logging synchronous
 exec-timeout 0 0
 exit
!
line vty 0 4
 password cisco
 login
 transport input telnet
 exit
!
!
vlan 10
 name admin
 exit
!
vlan 20
 name HR
 exit
!
vlan 30
 name Sales
 exit
!
vlan 40
 name Engineering
 exit
!
vlan 90
 name Voice
 exit
```

```
!
vlan 100
 name Guest
 exit
!
vlan 180
 name Management
 exit
!
vlan 254
 name Native
 exit
!
vlan 255
 name Parking-Lot
 exit
!
!
interface range g 1/0/1-24, g 1/1/1-4
 switchport mode access
 switchport access vlan 255
 shutdown
 exit
!
interface range g 1/0/1-2
 no switchport access vlan 255
 switchport mode trunk
 switchport nonegotiate
 switchport trunk allowed vlan 1,10,20,30,40,90,100,180,254
 switchport trunk native vlan 254
 no shutdown
 exit
!
!
interface vlan 10
 ip address 10.10.0.1 255.255.0.0
 no shutdown
 exit
!
interface vlan 20
 ip address 10.20.0.1 255.255.0.0
 no shutdown
 exit
!
```

```
!
interface vlan 10
 ip address 10.10.0.1 255.255.0.0
 no shutdown
 exit
!
interface vlan 20
 ip address 10.20.0.1 255.255.0.0
 no shutdown
 exit
!
interface vlan 180
 ip address 10.180.1.1 255.255.255.0
 no shutdown
 exit
!
!
interface g 1/0/24
 no ip address
 exit
!
interface Port-channel2
 no switchport
 ip address 10.111.1.1 255.255.255.0
 no shutdown
 exit
!
interface range gig 1/0/23-24
 no switchport
 channel-protocol lacp
 channel-group 2 mode active
 no shutdown
 exit
!
end
!
!
interface vlan 10
 ip helper-address 10.40.0.99
 no shutdown
 exit
!
interface vlan 20
 ip helper-address 10.40.0.99
```

```
 no shutdown
 exit
!
!
interface vlan 10
 no ip address
 ip address 10.10.0.5 255.255.0.0
 no shutdown
 exit
!
!
interface vlan 20
 no ip address
 ip address 10.20.0.5 255.255.0.0
 no shutdown
 exit
!
!
interface vlan 30
 ip address 10.30.0.5 255.255.0.0
 no shutdown
 exit
!
interface vlan 40
 ip address 10.40.0.5 255.255.0.0
 no shutdown
 exit
!
!
interface range gig 1/0/3 - 4
 shutdown
 no switchport access vlan 255
 switchport trunk native vlan 254
 switchport trunk allowed vlan 1,10,20,30,40,90,100,180,254
 switchport mode trunk
 switchport nonegotiate
 no shutdown
 exit
!
!
interface vlan 10
 standby 1 ip 10.10.0.1
 standby 1 priority 200
 standby 1 preempt
```

```
 no shutdown
 exit
!
interface vlan 20
 standby 1 ip 10.20.0.1
 standby 1 priority 200
 standby 1 preempt
 no shutdown
 exit
!
interface vlan 30
 standby 1 ip 10.30.0.1
 standby 1 priority 200
 standby 1 preempt
 no shutdown
 exit
!
interface vlan 40
 standby 1 ip 10.40.0.1
 standby 1 priority 200
 standby 1 preempt
 no shutdown
 exit
!
!
spanning-tree vlan 10 root primary
spanning-tree vlan 20 root primary
!
spanning-tree vlan 30 root secondary
spanning-tree vlan 40 root secondary
!
!
router ospf 1
router-id 5.5.5.5
log-adjacency-changes
redistribute connected
network 10.10.0.0 0.0.0.255 area 0
network 10.20.0.0 0.0.0.255 area 0
network 10.111.1.0 0.0.0.255 area 0
network 10.180.1.0 0.0.0.255 area 0
!
```

Core Switch:

```
!
no ip domain-lookup
!
line con 0
 logging synchronous
 exec-timeout 0 0
 exit
!
!
interface g1/0/1
 no switchport
 ip address 10.200.200.1 255.255.255.252
 exit
!
interface g1/0/3
 no switchport
 ip address 10.200.200.9 255.255.255.252
 exit
!
interface g1/0/6
 no switchport
 ip address 10.200.200.17 255.255.255.252
 exit
!
interface g1/0/24
 no switchport
 ip address 10.1.1.1 255.255.255.0
 exit
!
interface g1/0/23
 no switchport
 ip address 10.200.200.26 255.255.255.252
 exit
!
!
router ospf 1
 router-id 1.1.1.1
 network 10.1.1.0 0.0.0.255 area 0
 network 10.200.200.24 0.0.0.3 area 0
 network 10.200.200.8 0.0.0.3 area 0
 network 10.200.200.16 0.0.0.3 area 0
```

```
 network 10.200.200.0 0.0.0.3 area 0
 end
!
clear ip ospf process
Reset ALL OSPF processes? [no]: yes
!
!
interface g 1/0/3
 ip ospf hello-interval 5
 ip ospf dead-interval 20
 exit
!
!
interface gig 1/0/1
 ip ospf network point-to-point
 exit
!
interface gig 1/0/3
 ip ospf network point-to-point
 exit
!
interface gig 1/0/6
 ip ospf network point-to-point
 exit
!
interface gig 1/0/23
 ip ospf network point-to-point
 exit
!
!
router ospf 1
 passive-interface gig 1/0/24
 end
!
```

Edge Router:

```
!
```

```
interface GigabitEthernet0/0/0
 ip address 10.200.200.25 255.255.255.252
 no shutdown
 exit
!
interface GigabitEthernet0/0/1
 ip address 209.1.1.1 255.255.255.252
 no shutdown
 exit
!
!
router ospf 1
 router-id 10.10.10.10
 network 10.200.200.24 0.0.0.3 area 0
 end
!
clear ip ospf process
Reset ALL OSPF processes? [no]: yes
!
!
ip route 0.0.0.0 0.0.0.0 209.1.1.2
 end
!
!
router ospf 1
 default-information originate
 end
!
!
ip route 10.0.0.0 255.0.0.0 null0
 end
!
!
router ospf 1
 auto-cost reference-bandwidth 10000
 end
!
!
interface gig 0/0/0
 ip ospf network point-to-point
 exit
!
```

ISP Router:

```
!
interface GigabitEthernet0/0/1
 ip address 209.1.1.2 255.255.255.252
 no shutdown
 exit
!
interface Loopback0
 ip address 99.99.99.99 255.255.255.0
 no shutdown
 exit
!
!
ip route 10.0.0.0 255.0.0.0 209.1.1.1
 end
!
```