3-Tier Campus LAN Architecture with VLANs

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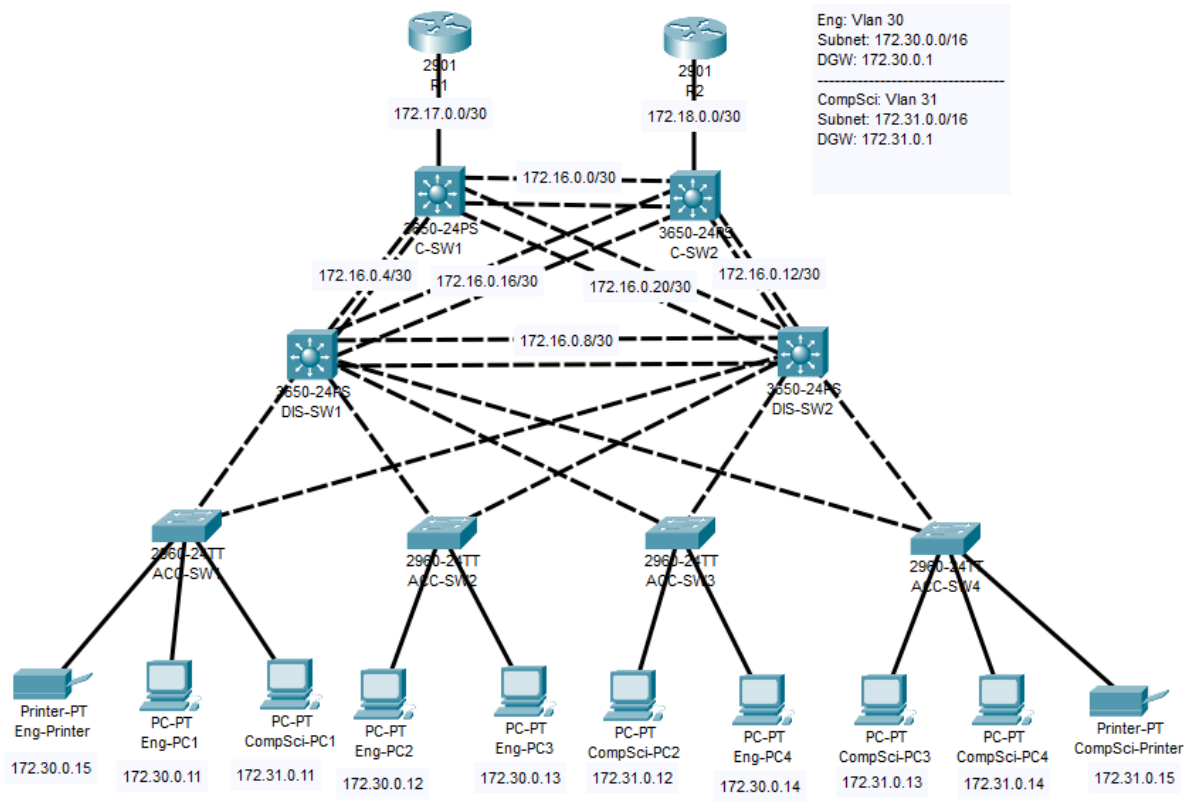
Abstract



This Packet Tracer project was designed to demonstrate the creation of different broadcast domains across multiple access layer switches in a 3-tier campus LAN architecture. Each VLAN was assigned a separate subnet. Each end host was configured with it's respective IP address and a corresponding default gateway for it's VLAN. Access layer switch ACC-SW1 was configured as the VTP server and the VLANs created forwarded to the other access layer switches configured as VTP clients (ACC-SW2, ACC-SW3, ACC-SW4), all in the same domain. The respective end host access ports were added to their respective VLANs. Next Inter-VLAN routing was configured on the layer 3 distribution switches, DIS-DW1 & DIS-SW2. FHRP was enabled on the distribution layer using HSRP in an Active/Active configuration with the interfaces for VLAN 30 and VLAN 31. The dual uplinks between the layer 3 switches were configured as port channels using the EtherChannel link aggregation protocol PAgP. OSPF was enabled on all active interfaces on all the Layer 3 devices to populate the routing tables with the optimal routes. Finally, layer 2 port security was enabled on the end host access ports creating a sticky mapping between access ports and the end host MAC addresses, with a default errdisable response if users tried to add there own devices to the network.

Introduction

Two VLANs will be created. One for the Computer Science department and the other for the Engineering department. Each department will have 4 PCs and 1 printer. Each VLAN will be on a different subnet, with Inter-VLAN routing enabled. Core/Distribution uplinks will be aggregated using the Port Aggregation Protocol (PAgP). Core/Distribution routing will be enabled with the OSPF routing protocol. Redundancy across a pair of distribution switches will be enforced using an Active/Active HSRP configuration. Each access and trunk port on the access layer switches in use will be secured at layer 2 using Port-Security.

Method and Equipment

Summary of Router and Switch connections

Device list 1	Connections	Device list 2
Routers -R1, R2	Straight-through Ethernet, point-point	Layer 3 Core Switches – C-SW1, C-SW2
Layer 3 Core Switches – C-SW1, C-SW2	Cross-over Ethernet, full mesh	Layer 3 Distribution Switches – DIS-SW1, DIS-SW2
Layer 3 Distribution Switches – DIS-SW1, DIS-SW2	Cross-over Ethernet, partial mesh	Layer 2 Access Switches – ACC-SW1, ACC-SW2, ACC-SW3, ACC-SW4

Table 1: Router and Switch Connections

Hostname configuration

R1

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname R1
R1(config)#exit
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

R2

```
Router>en
Router#config t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#hostname R2
R2(config)#exit
R2#
```

%SYS-5-CONFIG_I: Configured from console by console

R2#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]

C-SW1

Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname C-SW1
C-SW1(config)#exit
C-SW1#
%SYS-5-CONFIG_I: Configured from console by console

C-SW1#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]

C-SW2

Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname C-SW2
C-SW2(config)#exit
C-SW2#
%SYS-5-CONFIG_I: Configured from console by console

C-SW2#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]

DIS-SW1

Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname DIS-SW1
DIS-SW1(config)#exit
DIS-SW1#
%SYS-5-CONFIG_I: Configured from console by console

```
DIS-SW1#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

DIS-SW2

```
Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname DIS-SW2
DIS-SW2(config)#exit
DIS-SW2#
%SYS-5-CONFIG_I: Configured from console by console

DIS-SW2#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

ACC-SW1

```
Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname ACC-SW1
ACC-SW1(config)#exit
ACC-SW1#
%SYS-5-CONFIG_I: Configured from console by console

ACC-SW1#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

ACC-SW2

```
Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname ACC-SW2
ACC-SW2(config)#exit
ACC-SW2#
%SYS-5-CONFIG_I: Configured from console by console

ACC-SW2#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

ACC-SW3

```
Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname ACC-SW3
ACC-SW3(config)#exit
ACC-SW3#
%SYS-5-CONFIG_I: Configured from console by console

ACC-SW3#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

ACC-SW4

```
Switch>en
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname ACC-SW4
ACC-SW4(config)#exit
ACC-SW4#
%SYS-5-CONFIG_I: Configured from console by console

ACC-SW4#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

Router IP address configuration

R1

```
R1#config t
Enter configuration commands, one per line. End with CNTL/Z.
R1(config)#int g0/0
R1(config-if)#ip address 172.17.0.1 255.255.255.252
R1(config-if)#no shutdown
```

R2

```
R2#config t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)#int g0/0
R2(config-if)#ip address 172.18.0.1 255.255.255.252
R2(config-if)#no shutdown
```

C-SW1

```
C-SW1(config)#int range g1/0/1-24
C-SW1(config-if-range)#shutdown
C-SW1(config-if-range)#int range g1/1/1-4
C-SW1(config-if-range)#shutdown
C-SW1(config-if-range)#exit
C-SW1(config)#int g1/0/1
C-SW1(config-if)#no switchport
C-SW1(config-if)#ip address 172.17.0.2 255.255.255.252
C-SW1(config-if)#no shutdown
```

C-SW2

```
C-SW2(config)#int range g1/0/1-24
C-SW2(config-if-range)#shutdown
C-SW2(config-if-range)#int range g1/1/1-4
C-SW2(config-if-range)#shutdown
C-SW2(config-if-range)#exit
C-SW2(config)#int g1/0/1
C-SW2(config-if)#no switchport
C-SW2(config-if)#ip address 172.18.0.2 255.255.255.252
C-SW2(config-if)#no shutdown
```

Trunk Configuration

DIS-SW1

```
DIS-SW1#config t
DIS-SW1(config)#int g1/0/3
DIS-SW1(config-if)#switchport mode trunk
DIS-SW1(config-if)#no shutdown
DIS-SW1(config-if)#exit
DIS-SW1(config)#int range g1/0/4-6
DIS-SW1(config-if-range)#switchport mode trunk
DIS-SW1(config-if-range)#no shutdown
```

DIS-SW2

```
DIS-SW2#config t
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW2(config)#int range g1/0/3-6
DIS-SW2(config-if-range)#switchport mode trunk
DIS-SW2(config-if-range)#no shutdown
```

ACC-SW1

```
ACC-SW1#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW1(config)#int range f0/1-24
ACC-SW1(config-if-range)#shutdown
ACC-SW1(config-if-range)#exit
ACC-SW1(config)#int range g0/1-2
ACC-SW1(config-if-range)#switchport mode trunk
```

ACC-SW2

```
ACC-SW2#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW2(config)#int range f0/1-24
ACC-SW2(config-if-range)#shutdown
ACC-SW2(config-if-range)#exit
ACC-SW2(config)#int range g0/1-2
ACC-SW2(config-if-range)#switchport mode trunk
```

ACC-SW3

```
ACC-SW3#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW3(config)#int range f0/1-24
ACC-SW3(config-if-range)#shutdown
ACC-SW3(config-if-range)#exit
ACC-SW3(config)#int range g0/1-2
ACC-SW3(config-if-range)#switchport mode trunk
```

ACC-SW4

```
ACC-SW4#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW4(config)#int range f0/1-24
ACC-SW4(config-if-range)#shutdown
ACC-SW4(config-if-range)#exit
ACC-SW4(config)#int range g0/1-2
ACC-SW4(config-if-range)#switchport mode trunk
```

VLAN Configuration

ACC-SW1

```
ACC-SW1#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW1(config)#vtp domain Quogem
```

```
Changing VTP domain name from NULL to Quogem
ACC-SW1(config)#vtp mode server
Device mode already VTP SERVER.
ACC-SW1(config)#vlan 30
ACC-SW1(config-vlan)#name Eng
ACC-SW1(config-vlan)#exit
ACC-SW1(config)#vlan 31
ACC-SW1(config-vlan)#name CompSci
ACC-SW1(config-vlan)#exit
ACC-SW1(config)#int f0/1
ACC-SW1(config-if)#switchport mode access
ACC-SW1(config-if)#switchport access vlan 30
ACC-SW1(config-if)#no shutdown
ACC-SW1(config)#int f0/4
ACC-SW1(config-if)#switchport mode access
ACC-SW1(config-if)#switchport access vlan 31
ACC-SW1(config-if)#no shutdown
ACC-SW1(config)#int f0/2
ACC-SW1(config-if)#switchport mode access
ACC-SW1(config-if)#switchport access vlan 30
ACC-SW1(config-if)#no shutdown
```

ACC-SW2

```
ACC-SW2#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW2(config)#vtp mode client
ACC-SW2(config)#int f0/1
ACC-SW2(config-if)#switchport mode access
ACC-SW2(config-if)#switchport access vlan 30
ACC-SW2(config-if)#no shutdown
ACC-SW2(config-if)#int f0/4
ACC-SW2(config-if)#switchport mode access
ACC-SW2(config-if)#switchport access vlan 30
ACC-SW2(config-if)#no shutdown
```

ACC-SW3

```
ACC-SW3#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW3(config)#vtp mode client
ACC-SW3(config)#int f0/1
ACC-SW3(config-if)#switchport mode access
ACC-SW3(config-if)#switchport access vlan 31
ACC-SW3(config-if)#no shutdown
ACC-SW3(config-if)#int f0/4
ACC-SW3(config-if)#switchport mode access
ACC-SW3(config-if)#switchport access vlan 30
```

ACC-SW3(config-if)#no shutdown

ACC-SW4

ACC-SW4#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW4(config)#vtp mode client
Setting device to VTP CLIENT mode.
ACC-SW4(config)#int f0/1
ACC-SW4(config-if)#switchport mode access
ACC-SW4(config-if)#switchport access vlan 31
ACC-SW4(config-if)#no shutdown
ACC-SW4(config-if)#int f0/4
ACC-SW4(config-if)#switchport mode access
ACC-SW4(config-if)#switchport access vlan 31
ACC-SW4(config-if)#no shutdown
ACC-SW4(config)#int f0/5
ACC-SW4(config-if)#switchport mode access
ACC-SW4(config-if)#switchport access vlan 31
ACC-SW4(config-if)#no shutdown

DIS-SW1

DIS-SW1#config t
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW1(config)#vtp mode transparent

DIS-SW2

DIS-SW2#config t
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW2(config)#vtp mode transparent

Inter-VLAN Routing & HSRP Active/Active Configuration

DIS-SW1

DIS-SW1#config t
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW1(config)#ip routing
DIS-SW1(config)#int vlan 30
DIS-SW1(config-if)#ip address 172.30.0.9 255.255.0.0
DIS-SW1(config-if)#no shutdown
DIS-SW1(config-if)#
%LINK-5-CHANGED: Interface Vlan30, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan30, changed state to up
DIS-SW1(config-if)#standby 30 ip 172.30.0.1
DIS-SW1(config-if)#standby 30 priority 110
%HSRP-6-STATECHANGE: Vlan30 Grp 30 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan30 Grp 30 state Standby -> Active
DIS-SW1(config-if)#standby 30 preempt
DIS-SW1(config-if)#int vlan 31
DIS-SW1(config-if)#ip address 172.31.0.9 255.255.0.0
DIS-SW1(config-if)#no shutdown
DIS-SW1(config-if)#
%LINK-5-CHANGED: Interface Vlan31, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan31, changed state to up
DIS-SW1(config-if)#standby 31 ip 172.31.0.1
DIS-SW1(config-if)#standby 31 priority 90
%HSRP-6-STATECHANGE: Vlan31 Grp 31 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan31 Grp 31 state Standby -> Active

DIS-SW2

DIS-SW2(config)#ip routing
DIS-SW2(config-if)#interface Vlan30
DIS-SW2(config-if)# ip address 172.30.0.8 255.255.0.0
DIS-SW2(config-if)#no shutdown
DIS-SW2(config-if)# standby 30 ip 172.30.0.1
DIS-SW2(config-if)# standby 30 priority 90
%LINK-5-CHANGED: Interface Vlan30, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan30, changed state to up
DIS-SW2(config-if)#
%HSRP-6-STATECHANGE: Vlan30 Grp 30 state Speak -> Standby
DIS-SW2(config-if)#interface Vlan31
DIS-SW2(config-if)# ip address 172.31.0.8 255.255.0.0
DIS-SW2(config-if)#no shutdown
DIS-SW2(config-if)# standby 31 ip 172.31.0.1
DIS-SW2(config-if)# standby 31 priority 110
DIS-SW2(config-if)# standby 31 preempt
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan31, changed state to up
%HSRP-6-STATECHANGE: Vlan31 Grp 31 state Standby -> Active

EtherChannel Configuration

C-SW1

C-SW1(config)#ip routing
C-SW1(config)#int range g1/0/2-3
C-SW1(config-if-range)#channel-group 1 mode desirable
C-SW1(config-if-range)# no shutdown

Creating a port-channel interface Port-channel 1
C-SW1(config-if-range)#int port-channel 1
C-SW1(config-if)#no switchport
C-SW1(config-if)#ip address 172.16.0.5 255.255.255.252
C-SW1(config-if)#no shutdown
C-SW1(config)#int range g1/0/4-5
C-SW1(config-if-range)#channel-group 3 mode desirable
C-SW1(config-if-range)#no shutdown
Creating a port-channel interface Port-channel 3
C-SW1(config-if-range)#int po3
C-SW1(config-if)#no switchport
C-SW1(config-if)#ip address 172.16.0.21 255.255.255.252
C-SW1(config-if)#no shutdown
C-SW1(config)#int range g1/0/6-7
C-SW1(config-if-range)#channel-group 2 mode desirable
C-SW1(config-if-range)# no shutdown
Creating a port-channel interface Port-channel 2
C-SW1(config-if-range)#int po2
C-SW1(config-if)#no switchport
C-SW1(config-if)#ip address 172.16.0.1 255.255.255.252
C-SW1(config-if)#no shutdown

C-SW2

C-SW2(config)#ip routing
C-SW2(config)#int range g1/0/2-3
C-SW2(config-if-range)#channel-group 3 mode desirable
C-SW2(config-if-range)# no shutdown
Creating a port-channel interface Port-channel 3
C-SW2(config-if-range)#int port-channel 3
C-SW2(config-if)#no switchport
C-SW2(config-if)#ip address 172.16.0.17 255.255.255.252
C-SW2(config-if)#no shutdown
C-SW2(config)#int range g1/0/4-5
C-SW2(config-if-range)#channel-group 1 mode desirable
C-SW2(config-if-range)# no shutdown
Creating a port-channel interface Port-channel 1
C-SW2(config-if-range)#int po1
C-SW2(config-if)#no switchport
C-SW2(config-if)#ip address 172.16.0.13 255.255.255.252
C-SW2(config-if)#no shutdown
C-SW2(config)#int range g1/0/6-7
C-SW2(config-if-range)#channel-group 2 mode desirable
C-SW2(config-if-range)# no shutdown
Creating a port-channel interface Port-channel 2
C-SW2(config-if-range)#int po2

C-SW2(config-if)#no switchport
C-SW2(config-if)#ip address 172.16.0.2 255.255.255.252
C-SW2(config-if)#no shutdown

DIS-SW1

DIS-SW1(config)#int range g1/0/1-24
DIS-SW1(config-if-range)#shutdown
DIS-SW1(config-if-range)#int range g1/1/1-4
DIS-SW1(config-if-range)#shutdown
DIS-SW1(config)#int range g1/0/1-2
DIS-SW1(config-if-range)#channel-group 1 mode desirable
DIS-SW1(config-if-range)# no shutdown
Creating a port-channel interface Port-channel 1
DIS-SW1(config-if-range)#int port-channel 1
DIS-SW1(config-if)#no switchport
DIS-SW1(config-if)#ip address 172.16.0.6 255.255.255.252
DIS-SW1(config-if)#no shutdown
DIS-SW1(config)#int range g1/0/7-8
DIS-SW1(config-if-range)#channel-group 2 mode desirable
DIS-SW1(config-if-range)#int port-channel 2
DIS-SW1(config-if)#no switchport
DIS-SW1(config-if)#ip address 172.16.0.9 255.255.255.252
DIS-SW1(config-if)#no shutdown
DIS-SW1(config)#int range g1/0/9-10
DIS-SW1(config-if-range)#channel-group 3 mode desirable
DIS-SW1(config-if-range)# no shutdown
Creating a port-channel interface Port-channel 3
DIS-SW1(config-if-range)#int po3
DIS-SW1(config-if)#no switchport
DIS-SW1(config-if)#ip address 172.16.0.18 255.255.255.252
DIS-SW1(config-if)#no shutdown

DIS-SW2

DIS-SW2(config)#int range g1/0/1-24
DIS-SW2(config-if-range)#shutdown
DIS-SW2(config-if-range)#int range g1/1/1-4
DIS-SW2(config-if-range)#shutdown
DIS-SW2(config)#int range g1/0/1-2
DIS-SW2(config-if-range)#no shutdown
DIS-SW2(config-if-range)#channel-group 2 mode desirable
DIS-SW2(config-if-range)#
Creating a port-channel interface Port-channel 2
DIS-SW2(config-if-range)#int port-channel 2
DIS-SW2(config-if)#no switchport
DIS-SW2(config-if)#ip address 172.16.0.10 255.255.255.252

```
DIS-SW2(config-if)#no shutdown
DIS-SW2(config)#int range g1/0/7-8
DIS-SW2(config-if-range)#channel-group 1 mode desirable
DIS-SW2(config-if-range)# no shutdown
Creating a port-channel interface Port-channel 1
DIS-SW2(config-if-range)#int po1
DIS-SW2(config-if)#no switchport
DIS-SW2(config-if)#ip address 172.16.0.14 255.255.255.252
DIS-SW2(config-if)#no shutdown
DIS-SW2(config)#int range g1/0/9-10
DIS-SW2(config-if-range)#channel-group 3 mode desirable
DIS-SW2(config-if-range)# no shutdown
DIS-SW2(config-if-range)#int po3
DIS-SW2(config-if)#no switchport
DIS-SW2(config-if)#ip address 172.16.0.22 255.255.255.252
DIS-SW2(config-if)#no shutdown
```

OSPF Configuration

C-SW1

```
C-SW1(config)#router ospf 1
C-SW1(config-router)#network 172.16.0.0 0.0.255.255 area 0
C-SW1(config-router)#network 172.17.0.0 0.0.255.255 area 0
```

C-SW2

```
C-SW2#config t
Enter configuration commands, one per line. End with CNTL/Z.
C-SW2(config)#router ospf 1
C-SW2(config-router)#network 172.16.0.0 0.0.255.255 area 0
C-SW2(config-router)#network 172.18.0.0 0.0.255.255 area 0
```

DIS-SW1

```
DIS-SW1#config t
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW1(config)#router ospf 1
DIS-SW1(config-router)#network 172.0.0.0 0.255.255.255 area 0
```

DIS-SW2

```
DIS-SW2#config t
```

```
Enter configuration commands, one per line. End with CNTL/Z.
DIS-SW2(config)#router ospf 1
DIS-SW2(config-router)#network 172.0.0.0 0.255.255.255 area 0
```

Access Port Security Configuration

ACC-SW1

```
ACC-SW1>en
ACC-SW1#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW1(config)#int range fa0/1-2
ACC-SW1(config-if-range)#switchport port-security
ACC-SW1(config-if-range)#switchport port-security mac-address sticky
ACC-SW1(config-if-range)#exit
ACC-SW1(config)#int fa0/4
ACC-SW1(config-if)#switchport port-security
ACC-SW1(config-if)#switchport port-security mac-address sticky
```

ACC-SW2

```
ACC-SW2>en
ACC-SW2#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW2(config)#int fa0/1
ACC-SW2(config-if)#switchport port-security
ACC-SW2(config-if)#switchport port-security mac-address sticky
ACC-SW2(config-if)#exit
ACC-SW2(config)#int fa0/4
ACC-SW2(config-if)#switchport port-security
ACC-SW2(config-if)#switchport port-security mac-address sticky
```

ACC-SW3

```
ACC-SW3>en
ACC-SW3#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW3(config)#int fa0/1
ACC-SW3(config-if)#switchport port-security
ACC-SW3(config-if)#switchport port-security mac-address sticky
ACC-SW3(config-if)#exit
ACC-SW3(config)#int fa0/4
ACC-SW3(config-if)#switchport port-security
ACC-SW3(config-if)#switchport port-security mac-address sticky
```

ACC-SW4

```
ACC-SW4>en
ACC-SW4#config t
Enter configuration commands, one per line. End with CNTL/Z.
ACC-SW4(config)#int range fa0/4-5
ACC-SW4(config-if-range)#switchport port-security
ACC-SW4(config-if-range)#switchport port-security mac-address sticky
ACC-SW4(config-if-range)#exit
ACC-SW4(config)#int fa0/1
ACC-SW4(config-if)#switchport port-security
ACC-SW4(config-if)#switchport port-security mac-address sticky
```

Verification & Discussion

VLAN Configuration

```
ACC-SW1#show vtp status
VTP Version capable             : 1 to 2
VTP version running             : 1
VTP Domain Name                 : Quogem
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : 0001.64D4.7E00
Configuration last modified by 0.0.0.0 at 3-1-93 01:13:36
Local updater ID is 0.0.0.0 (no valid interface found)

Feature VLAN :
--------------
VTP Operating Mode                : Server
Maximum VLANs supported locally   : 255
Number of existing VLANs          : 7
Configuration Revision            : 4
MD5 digest                        : 0xF6 0xCC 0x49 0xD4 0xFB 0x51 0x8B 0x1F
                                    0x5C 0x8F 0x9B 0xBA 0xE2 0x26 0x63 0x36

ACC-SW1#
```

Figure 1- VTP Status of the VTP server

Access switch, ACC-SW1, is configured as the VTP server with domain name “Quogem”.

```
ACC-SW1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/3, Fa0/5, Fa0/6, Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                                Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                Fa0/20, Fa0/21, Fa0/22, Fa0/23
                                                Fa0/24
30   Eng                              active    Fa0/1, Fa0/2
31   CompSci                          active    Fa0/4
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
ACC-SW1#
```

Figure 2- VLAN database summary on the VTP server

The VLANs Eng and CompSci were created on the VTP server and are being to forwarded to the VTP clients (ACC-SW2, ACC-SW3, ACC-SW4) as seen below:

```
ACC-SW2>en
ACC-SW2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/2, Fa0/3, Fa0/5, Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                Fa0/23, Fa0/24
30   Eng                              active    Fa0/1, Fa0/4
31   CompSci                          active
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
ACC-SW2#
```

Figure 3-VLAN database summary on the VTP client, ACC-SW2

```
ACC-SW3>en
ACC-SW3#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/2, Fa0/3, Fa0/5, Fa0/6
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/10
                                                Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                Fa0/23, Fa0/24
30   Eng                              active    Fa0/4
31   CompSci                          active    Fa0/1
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
ACC-SW3#
```

Figure 4-VLAN database summary on the VTP client, ACC-SW3

```
ACC-SW4>en
ACC-SW4#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/2, Fa0/3, Fa0/6, Fa0/7
                                                Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                                Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                Fa0/20, Fa0/21, Fa0/22, Fa0/23
                                                Fa0/24
30   Eng                              active
31   CompSci                          active    Fa0/1, Fa0/4, Fa0/5
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active
ACC-SW4#
```

Figure 5-VLAN database summary on VTP client, ACC-SW4

Inter-VLAN Routing & HSRP Active/Active Configuration

```
DIS-SW1>en
DIS-SW1#show standby
Vlan30 - Group 30
  State is Active
    5 state changes, last state change 00:00:18
  Virtual IP address is 172.30.0.1
  Active virtual MAC address is 0000.0C07.AC1E
    Local virtual MAC address is 0000.0C07.AC1E (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.247 secs
  Preemption enabled
  Active router is local
  Standby router is 172.30.0.8, priority 90 (expires in 8 sec)
  Priority 110 (configured 110)
  Group name is hsrp-V13-30 (default)
Vlan31 - Group 31
  State is Standby
    6 state changes, last state change 00:00:39
  Virtual IP address is 172.31.0.1
  Active virtual MAC address is 0000.0C07.AC1F
    Local virtual MAC address is 0000.0C07.AC1F (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 2.77 secs
  Preemption disabled
  Active router is 172.31.0.8, priority 110 (expires in 8 sec)
    MAC address is 0000.0C07.AC1F
  Standby router is local
  Priority 90 (configured 90)
  Group name is hsrp-V13-31 (default)
DIS-SW1#
```

Figure 6-HSRP status on DIS-SW1

On Distribution switch, DIS-SW1, Interface VLAN30 with group number 30 is set as the active default gateway for VLAN 30 with virtual IP address 172.30.0.1. While Interface VLAN31 with group number 31 is set as the standby gateway for VLAN 31 with virtual IP address 172.31.0.1.

```
DIS-SW2>en
DIS-SW2#show standby
Vlan30 - Group 30
  State is Standby
    6 state changes, last state change 00:00:39
  Virtual IP address is 172.30.0.1
  Active virtual MAC address is 0000.0C07.AC1E
    Local virtual MAC address is 0000.0C07.AC1E (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 1.397 secs
  Preemption disabled
  Active router is 172.30.0.9, priority 110 (expires in 7 sec)
    MAC address is 0000.0C07.AC1E
  Standby router is local
  Priority 90 (configured 90)
  Group name is hsrp-V13-30 (default)
Vlan31 - Group 31
  State is Active
    4 state changes, last state change 00:00:19
  Virtual IP address is 172.31.0.1
  Active virtual MAC address is 0000.0C07.AC1F
    Local virtual MAC address is 0000.0C07.AC1F (v1 default)
  Hello time 3 sec, hold time 10 sec
    Next hello sent in 0.85 secs
  Preemption enabled
  Active router is local
  Standby router is 172.31.0.9, priority 90 (expires in 9 sec)
  Priority 110 (configured 110)
  Group name is hsrp-V13-31 (default)
DIS-SW2#
```

Figure 7-HSRP status on DIS-SW2

On Distribution switch, DIS-SW2, Interface VLAN30 with group number 30 is set as the standby default gateway for VLAN 30 with virtual IP address 172.30.0.1. While Interface VLAN31 with group number 31 is set as the active default gateway for VLAN 31 with virtual IP address 172.31.0.1.

The underlying IP addresses on the respective VLAN interfaces on DIS-SW1 & DIS-SW2 are:

Table 2-Summary of HSRP status, IP and virtual MAC addresses

	VLANs	Real Static IP	Virtual IP (HSRP)	Virtual MAC Addr.	HSRP Status
DIS-SW1	VLAN 30	172.30.0.9	172.30.0.1	0000.0C07.AC1E	Active
	VLAN 31	172.31.0.9	172.31.0.1	0000.0C07.AC1F	Standby
DIS-SW2	VLAN 30	172.30.0.8	172.30.0.1	0000.0C07.AC1E	Standby
	VLAN 31	172.31.0.8	172.31.0.1	0000.0C07.AC1F	Active

IP Routing Configuration

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: FE80::290:CFF:FEC0:D158
   IPv6 Address.....: ::
   IPv4 Address.....: 172.30.0.11
   Subnet Mask.....: 255.255.0.0
   Default Gateway.....: ::
                                 172.30.0.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.....: ::
   IPv6 Address.....: ::
   IPv4 Address.....: 0.0.0.0
   Subnet Mask.....: 0.0.0.0
   Default Gateway.....: ::
                                 0.0.0.0

C:\>ping 172.31.0.14

Pinging 172.31.0.14 with 32 bytes of data:

Reply from 172.31.0.14: bytes=32 time<1ms TTL=127
Reply from 172.31.0.14: bytes=32 time=10ms TTL=127
Reply from 172.31.0.14: bytes=32 time<1ms TTL=127
Reply from 172.31.0.14: bytes=32 time=10ms TTL=127

Ping statistics for 172.31.0.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 5ms

C:\>
```

Figure 8-Demonstration of Eng-PC1 pinging CompSci-PC4

Eng-PC1 at IP address 172.30.0.11 in VLAN 30 can ping CompSci-PC4 in VLAN 31 at IP address 172.31.0.14. Two-way communication between VLAN 30 & 31 is now enabled due to the configuration of inter-VLAN routing on the pair of distribution switches.

```
C:\>arp -a
  Internet Address      Physical Address      Type
  172.30.0.1            0000.0c07.acle        dynamic
  172.30.0.8            0001.631e.ee01        dynamic
```

Figure 9- Eng-PC1 now has the virtual IP and MAC address of the default gateway for VLAN 30 in it's ARP cache

Eng-PC1 now has the Virtual IP and Mac address in it's ARP cache, for the Virtual interface created by HSRP configured on the pair of distribution switches.

```
C:\>tracert 172.17.0.1

Tracing route to 172.17.0.1 over a maximum of 30 hops:

  1    0 ms      0 ms      0 ms      172.30.0.9
  2    0 ms      0 ms      0 ms      172.16.0.5
  3    0 ms      0 ms      0 ms      172.17.0.1

Trace complete.
```

Figure 10-Trace route to the WAN edge router with IP 172.17.0.1

After running the trace route command (tracert), we see that two way communication is now enabled between Eng-PC1 in VLAN 30 and the Active default gateway interface for VLAN 30, the uplink IP for the Core switch C-SW1 (172.16.0.5), and the WAN edge router gateway on router, R1 via 172.17.0.1. Wan edge connectivity is also achieved for CompSci-PC4 in VLAN 31 as seen below:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>tracert 172.18.0.1

Tracing route to 172.18.0.1 over a maximum of 30 hops:

  1    0 ms      0 ms      0 ms      172.31.0.8
  2    0 ms      0 ms      0 ms      172.16.0.13
  3    10 ms     0 ms      0 ms      172.18.0.1

Trace complete.
```

Figure 11-Trace route to the WAN edge router with IP 172.18.0.1

CompSci-PC4 in VLAN 31 now has two-way communication with the Active default gateway interface for VLAN 31, the uplink IP for the core switch C-SW2 (172.16.0.13), and the WAN edge router gateway on router, R2 via 172.18.0.1.