CCNP SWITCH CASE STUDY

Rushi Patel (100615230)
Yash Patel (100621177)

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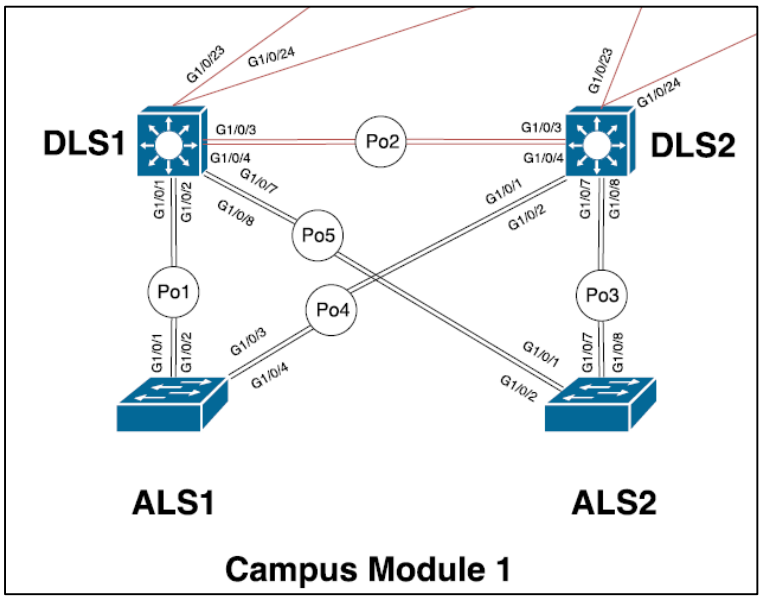
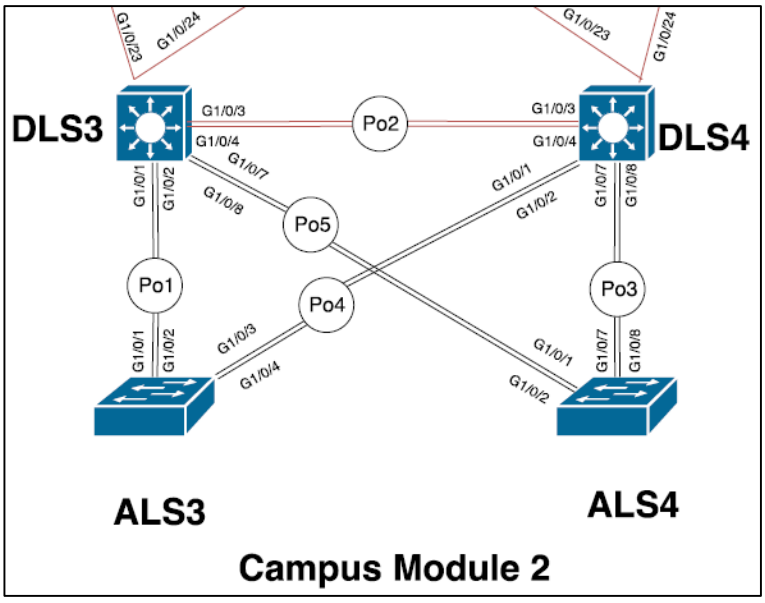
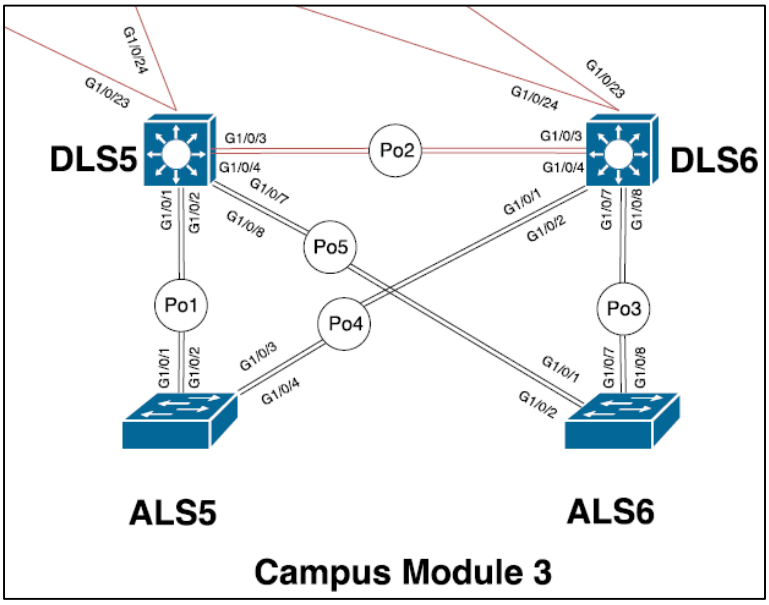
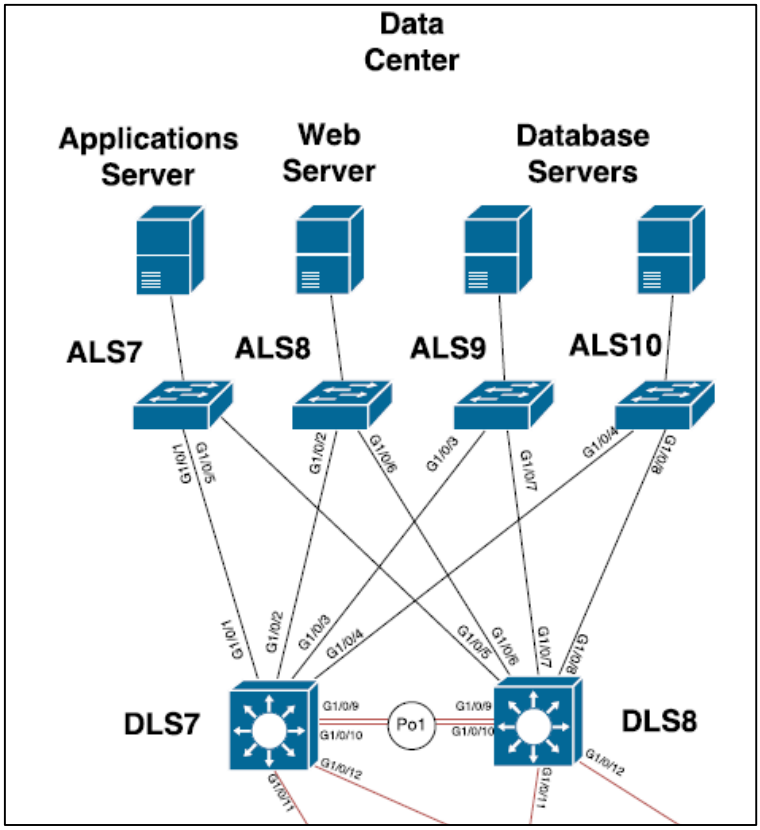
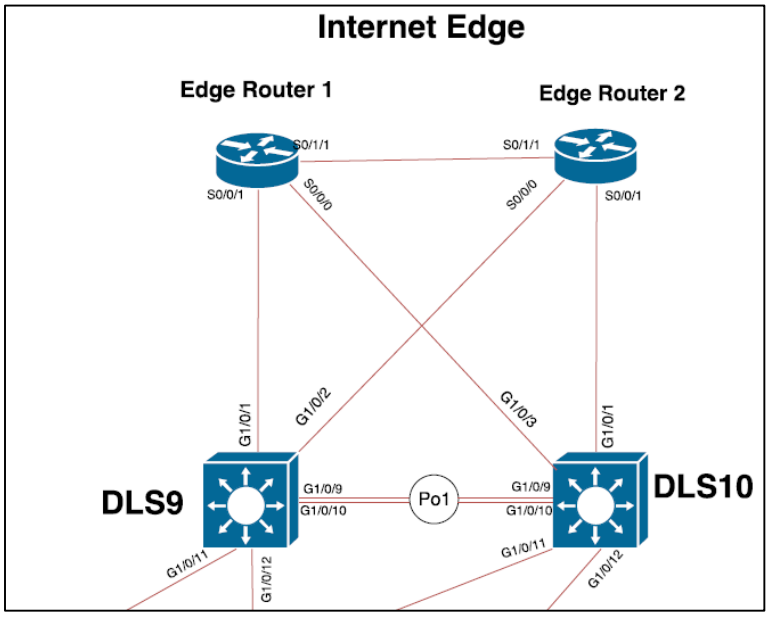
TOPOLOGY DIAGRAMS



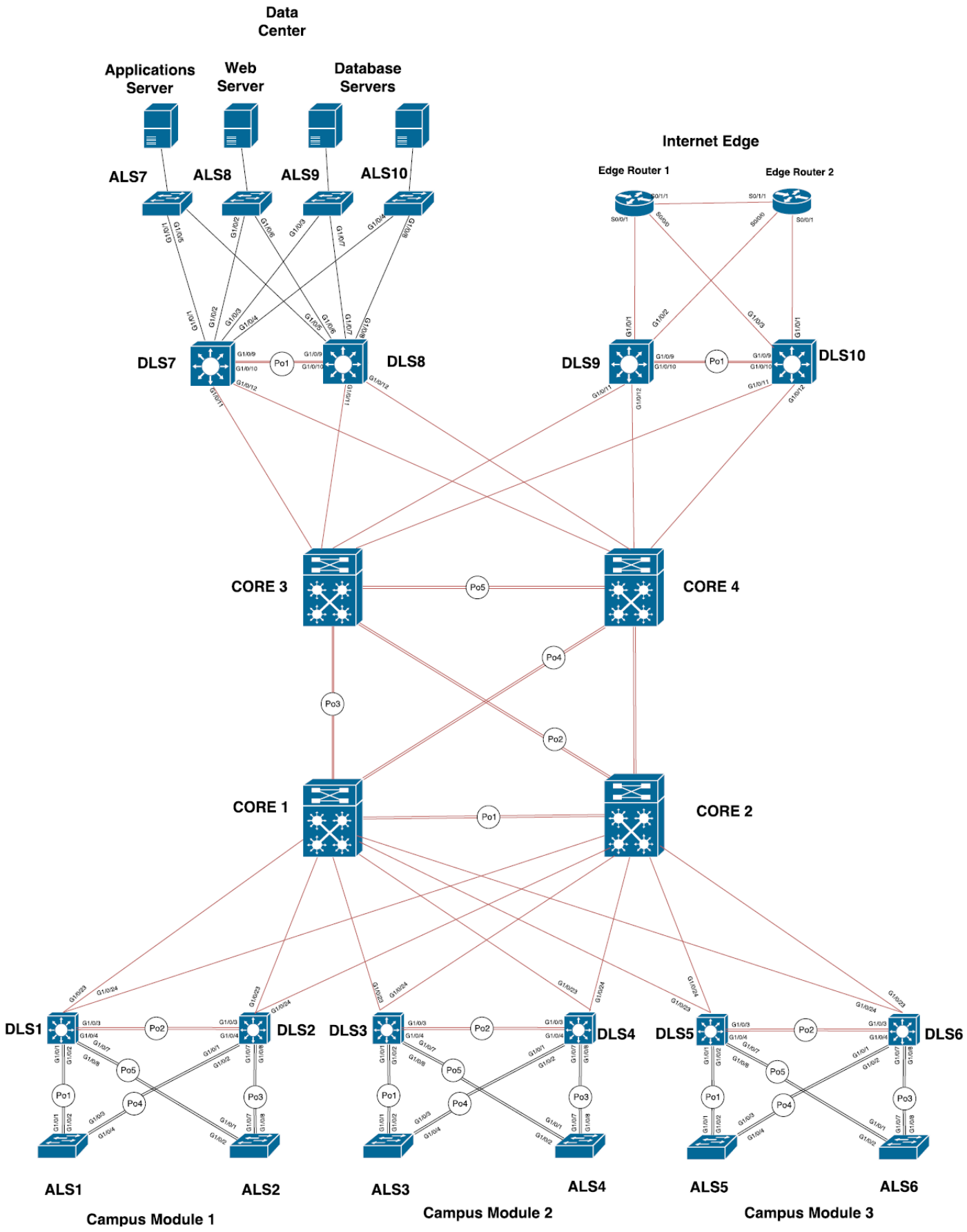








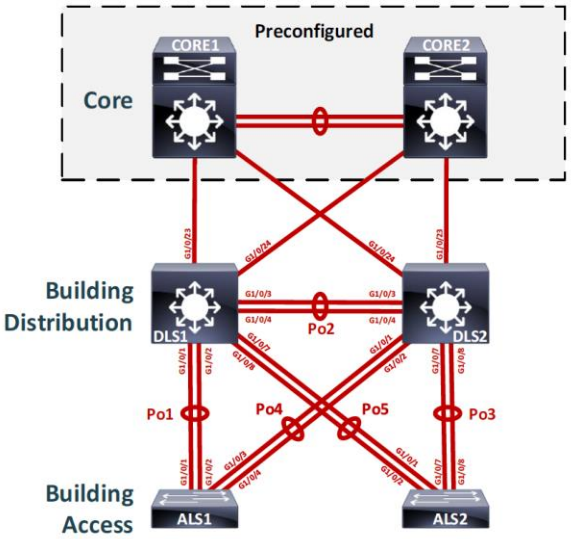
ENTERPRISE CAMPUS NETWORK



Abstract

The objective of this case study is to plan, design, and implement the UOIT student Help Desk switched network. In this case study you will find the configurations of the given campus module network. Alongside with the configurations, there are pictures for each individual step that prove that each step was done correctly. After completing the configuration segment, we are asked to design and plan a enterprise network. We are asked to include 2 more campus modules, alongside a data center module, internet edge module and an expanded core. Enterprise network was designed using an online website “draw.io”. Upon completion of the design, we planned the number of vlans needed for each module. IP subnets were also planned for layer 3 ports (distribution and core). After completing the design and plan portion there are explanations on the design choices which tells why we made such a network.

Campus Module 1 Topology and Addressing



ALS 1:	Vlan	Subnet
Data 1	70	10.7.0.2/24
Voice 1	71	10.7.1.2/24
Management	79	10.7.9.2/24

ALS 2	Vlan	Subnet
Data 2	72	10.7.2.3/24
Voice 2	73	10.7.3.3/24
Management	79	10.7.9.3/24

DLS 1 - to - DLS 2 subnet	10.99.7.1 - 10.99.7.255/24
DLS 1- to - Core 1 subnet	10.100.7.1 - 10.100.7.255/16
DLS 1- to - Core 2 subnet	10.200.7.1 - 10.200.7.255/16
DLS 2 - to - Core 1 subnet	10.100.7.129-255/16
DLS 2 - to - Core 2 subnet	10.200.7.129-255/16

Campus Module 1 Configurations

1. Disable all unused links between the switches – use your own methods of discovery to learn which ports these are.

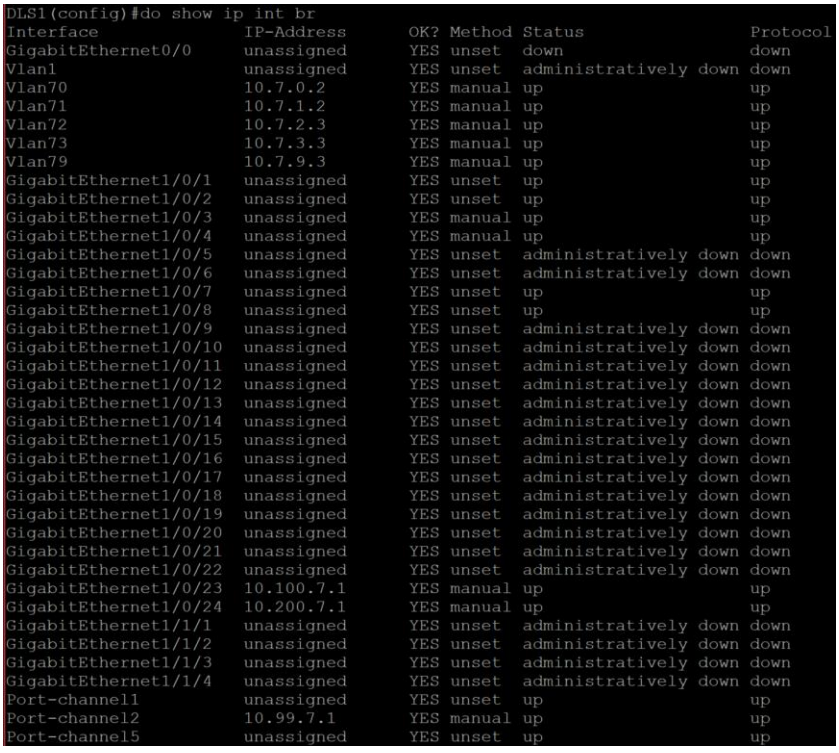
- By looking at the given topology we saw all the ports that were used and the ones that were not used were put in the "int range" command to be shutdown.

Configuration for DLS1 and DLS2

```
int range G1/0/5-6, G1/0/9-22, G1/1/1-4

shutdown
```

DLS1 Output



```
DLS1(config)#do show ip int br
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  down                  down
Vlan1                  unassigned      YES unset  administratively down down
Vlan70                 10.7.0.2        YES manual up                    up
Vlan71                 10.7.1.2        YES manual up                    up
Vlan72                 10.7.2.3        YES manual up                    up
Vlan73                 10.7.3.3        YES manual up                    up
Vlan79                 10.7.9.3        YES manual up                    up
GigabitEthernet1/0/1   unassigned      YES unset  up                    up
GigabitEthernet1/0/2   unassigned      YES unset  up                    up
GigabitEthernet1/0/3   unassigned      YES manual up                    up
GigabitEthernet1/0/4   unassigned      YES manual up                    up
GigabitEthernet1/0/5   unassigned      YES unset  administratively down down
GigabitEthernet1/0/6   unassigned      YES unset  administratively down down
GigabitEthernet1/0/7   unassigned      YES unset  up                    up
GigabitEthernet1/0/8   unassigned      YES unset  up                    up
GigabitEthernet1/0/9   unassigned      YES unset  administratively down down
GigabitEthernet1/0/10  unassigned      YES unset  administratively down down
GigabitEthernet1/0/11  unassigned      YES unset  administratively down down
GigabitEthernet1/0/12  unassigned      YES unset  administratively down down
GigabitEthernet1/0/13  unassigned      YES unset  administratively down down
GigabitEthernet1/0/14  unassigned      YES unset  administratively down down
GigabitEthernet1/0/15  unassigned      YES unset  administratively down down
GigabitEthernet1/0/16  unassigned      YES unset  administratively down down
GigabitEthernet1/0/17  unassigned      YES unset  administratively down down
GigabitEthernet1/0/18  unassigned      YES unset  administratively down down
GigabitEthernet1/0/19  unassigned      YES unset  administratively down down
GigabitEthernet1/0/20  unassigned      YES unset  administratively down down
GigabitEthernet1/0/21  unassigned      YES unset  administratively down down
GigabitEthernet1/0/22  unassigned      YES unset  administratively down down
GigabitEthernet1/0/23  10.100.7.1      YES manual up                    up
GigabitEthernet1/0/24  10.200.7.1      YES manual up                    up
GigabitEthernet1/1/1   unassigned      YES unset  administratively down down
GigabitEthernet1/1/2   unassigned      YES unset  administratively down down
GigabitEthernet1/1/3   unassigned      YES unset  administratively down down
GigabitEthernet1/1/4   unassigned      YES unset  administratively down down
Port-channel1          unassigned      YES unset  up                    up
Port-channel2          10.99.7.1       YES manual up                    up
Port-channel5          unassigned      YES unset  up                    up
```

DLS2 Output

```
DLS2(config)#do show ip int br
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  down                  down
Vlan1                  unassigned      YES unset  administratively down down
Vlan70                 10.7.0.3        YES manual up                    up
Vlan71                 10.7.1.3        YES manual up                    up
Vlan72                 10.7.2.2        YES manual up                    up
Vlan73                 10.7.3.2        YES manual up                    up
Vlan79                 10.7.9.2        YES manual up                    up
GigabitEthernet1/0/1   unassigned      YES unset  up                    up
GigabitEthernet1/0/2   unassigned      YES unset  up                    up
GigabitEthernet1/0/3   unassigned      YES manual up                    up
GigabitEthernet1/0/4   unassigned      YES manual up                    up
GigabitEthernet1/0/5   unassigned      YES unset  administratively down down
GigabitEthernet1/0/6   unassigned      YES unset  administratively down down
GigabitEthernet1/0/7   unassigned      YES unset  up                    up
GigabitEthernet1/0/8   unassigned      YES unset  up                    up
GigabitEthernet1/0/9   unassigned      YES unset  administratively down down
GigabitEthernet1/0/10  unassigned      YES unset  administratively down down
GigabitEthernet1/0/11  unassigned      YES unset  administratively down down
GigabitEthernet1/0/12  unassigned      YES unset  administratively down down
GigabitEthernet1/0/13  unassigned      YES unset  administratively down down
GigabitEthernet1/0/14  unassigned      YES unset  administratively down down
GigabitEthernet1/0/15  unassigned      YES unset  administratively down down
GigabitEthernet1/0/16  unassigned      YES unset  administratively down down
GigabitEthernet1/0/17  unassigned      YES unset  administratively down down
GigabitEthernet1/0/18  unassigned      YES unset  administratively down down
GigabitEthernet1/0/19  unassigned      YES unset  administratively down down
GigabitEthernet1/0/20  unassigned      YES unset  administratively down down
GigabitEthernet1/0/21  unassigned      YES unset  administratively down down
GigabitEthernet1/0/22  unassigned      YES unset  administratively down down
GigabitEthernet1/0/23  10.200.7.129    YES manual up                    up
GigabitEthernet1/0/24  10.100.7.129    YES manual up                    up
GigabitEthernet1/1/1   unassigned      YES unset  administratively down down
GigabitEthernet1/1/2   unassigned      YES unset  administratively down down
GigabitEthernet1/1/3   unassigned      YES unset  administratively down down
GigabitEthernet1/1/4   unassigned      YES unset  administratively down down
Port-channel2          10.99.7.2       YES manual up                    up
Port-channel3          unassigned      YES unset  up                    up
Port-channel4          unassigned      YES unset  up                    up
```

Configuration for ALS1 and ALS2

```
int range G1/0/5-6, G1/0/9-27

shutdown
```

ALS1 Output

```
ALS1#show ip int brief | include down
FastEthernet0          unassigned      YES unset  administratively down down
GigabitEthernet1/0/5   unassigned      YES unset  down                  down
GigabitEthernet1/0/6   unassigned      YES unset  down                  down
GigabitEthernet1/0/9   unassigned      YES unset  down                  down
GigabitEthernet1/0/10  unassigned      YES unset  down                  down
GigabitEthernet1/0/11  unassigned      YES unset  down                  down
GigabitEthernet1/0/12  unassigned      YES unset  down                  down
GigabitEthernet1/0/13  unassigned      YES unset  down                  down
GigabitEthernet1/0/14  unassigned      YES unset  down                  down
GigabitEthernet1/0/15  unassigned      YES unset  down                  down
GigabitEthernet1/0/16  unassigned      YES unset  down                  down
GigabitEthernet1/0/17  unassigned      YES unset  down                  down
GigabitEthernet1/0/18  unassigned      YES unset  down                  down
GigabitEthernet1/0/19  unassigned      YES unset  down                  down
GigabitEthernet1/0/20  unassigned      YES unset  down                  down
GigabitEthernet1/0/21  unassigned      YES unset  down                  down
GigabitEthernet1/0/22  unassigned      YES unset  down                  down
GigabitEthernet1/0/23  unassigned      YES unset  down                  down
GigabitEthernet1/0/24  unassigned      YES unset  down                  down
GigabitEthernet1/0/25  unassigned      YES unset  down                  down
GigabitEthernet1/0/26  unassigned      YES unset  down                  down
GigabitEthernet1/0/27  unassigned      YES unset  down                  down
GigabitEthernet1/0/28  unassigned      YES unset  down                  down
```

ALS2 Output

```
ALS2#show ip int brief | include down
FastEthernet0          unassigned      YES unset  administratively down down
GigabitEthernet1/0/5   unassigned      YES unset  down                  down
GigabitEthernet1/0/6   unassigned      YES unset  down                  down
GigabitEthernet1/0/9   unassigned      YES unset  down                  down
GigabitEthernet1/0/10  unassigned      YES unset  down                  down
GigabitEthernet1/0/11  unassigned      YES unset  down                  down
GigabitEthernet1/0/12  unassigned      YES unset  down                  down
GigabitEthernet1/0/13  unassigned      YES unset  down                  down
GigabitEthernet1/0/14  unassigned      YES unset  down                  down
GigabitEthernet1/0/15  unassigned      YES unset  down                  down
GigabitEthernet1/0/16  unassigned      YES unset  down                  down
GigabitEthernet1/0/17  unassigned      YES unset  down                  down
GigabitEthernet1/0/22  unassigned      YES unset  down                  down
GigabitEthernet1/0/23  unassigned      YES unset  down                  down
GigabitEthernet1/0/24  unassigned      YES unset  down                  down
GigabitEthernet1/0/25  unassigned      YES unset  down                  down
GigabitEthernet1/0/26  unassigned      YES unset  down                  down
GigabitEthernet1/0/27  unassigned      YES unset  down                  down
GigabitEthernet1/0/28  unassigned      YES unset  down                  down
```

2. Place all switches in the VTP domain UOIT and set all switches to VTP mode transparent.

Configuration for DLS1/2 & ALS1/2

```
vtp domain UOIT

vtp transparent mode
```

DLS1 Output

```
DLS1(config)#do show vtp status
VTP Version capable             : 1 to 3
VTP version running             : 1
VTP Domain Name                 : UOIT
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : d8b1.902f.b580
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

Feature VLAN:
--------------
VTP Operating Mode                : Transparent
```

DLS2 Output

```
DLS2(config)#do show vtp status
VTP Version capable             : 1 to 3
VTP version running             : 1
VTP Domain Name                 : UOIT
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : d8b1.9004.1080
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

Feature VLAN:
--------------
VTP Operating Mode                : Transparent
```

ALS1 Output

```
ALS1>show vtp status
VTP Version capable             : 1 to 3
VTP version running             : 1
VTP Domain Name                 : UOIT
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : 84b5.177b.1200
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

Feature VLAN:
--------------
VTP Operating Mode               : Transparent
```

ALS2 Output

```
ALS2>show vtp status
VTP Version capable             : 1 to 3
VTP version running             : 1
VTP Domain Name                 : UOIT
VTP Pruning Mode                : Disabled
VTP Traps Generation            : Disabled
Device ID                       : dceb.94d7.4a80
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

Feature VLAN:
--------------
VTP Operating Mode               : Transparent
```

3. Configure all switches for Rapid PVST+. Make DLS1 the root bridge for VLANs **x**0 and **x**1, and make DSL2 the root bridge for VLANs **x**2, **x**3, and x9. Manipulate the spanning tree port costs so that Po5 on DLS1 will always become the root port for VLANx9.

Rapid PVST+ Configuration on DLS1/2 and ALS1/2 [Configured in global config mode]

```
spanning-tree mode rapid-pvst
```

DLS1 Root Bridge Configuration [Configured in global config mode]

```
spanning-tree vlan 70, 71 root primary
```

DLS2 Root Bridge Configuration [Configured in global config mode]

spanning-tree vlan 72, 73, 79 root primary

DLS1 Root Port Manipulation

```
int port-channel 5

spanning-tree vlan 79 cost 2
```

Rapid-Pvst Configuration

DLS1 Output:

```
DLS1(config)#do show spanning-tree summary
Switch is in rapid-pvst mode
```

DLS2 Output:

```
DLS2(config)#do show spanning-tree summary
Switch is in rapid-pvst mode
```

ALS1 Output:

```
ALS1#show spanning-tree summary
Switch is in rapid-pvst mode
```

ALS2 Output:

```
ALS2#show spanning-tree summary
Switch is in rapid-pvst mode
```

By using the commands listed above for spanning tree configuration we can now see from the output above that the switches are running on rapid-pvst.

DLS1 Root cost manipulation on port-channel 5

```
DLS1(config)#do show spanning-tree vlan 79

VLAN0079
  Spanning tree enabled protocol rstp
  Root ID     Priority    24655
              Address     d8b1.9004.1080
              Cost        5
              Port        2319 (Port-channel5)
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID   Priority    32847  (priority 32768 sys-id-ext 79)
              Address     d8b1.902f.b580
              Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
              Aging Time  300 sec

Interface           Role Sts Cost      Prio.Nbr Type
------------------- ---- --- --------- -------- --------------------------------
Po1                 Altn BLK 3         128.2315 P2p
Po5                 Root FWD 2         128.2319 P2p
```

Root cost manipulation on vlan 79 in port-channel 5. Port-Channel 5 for Vlan 79 will always become the root port whenever there is a election.

4. Configure all Access-to-Distribution links statically as 802.1q trunk links and disable DTP negotiation. Enable LACP EtherChannels along links between the Access Layer switches and DLS1. Enable PAgP EtherChannel between the Access Layer switches and DLS2. Configure the EtherChannel between the Distribution Layer switches to be statically defined and Layer 3, using the subnet specified in the table above. It's your decision on how the dynamic channel groups are formed.

- Enabling 802.1q trunk and disabling DTP negotiation on all Access-to-Distribution links.

DLS1	interface port-channel 1 switchport mode trunk switchport nonegotiate exit interface port-channel 5 switchport mode trunk switchport nonegotiate
DLS2	interface port-channel 3 switchport mode trunk switchport nonegotiate exit interface port-channel 5 switchport mode trunk switchport nonegotiate
ALS1	interface port-channel 1 switchport mode trunk switchport nonegotiate exit interface port-channel 4 switchport mode trunk switchport nonegotiate
ALS2	interface port-channel 3 switchport mode trunk switchport nonegotiate exit interface port-channel 5

	switchport mode trunk switchport nonegotiate

ALS1 and ALS2 configured as 802.1q trunk link

```
ALS1#show int trunk

Port        Mode             Encapsulation  Status        Native vlan
Po1         on               802.1q         trunking      1
Po4         on               802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-4094
Po4         1-4094

Port        Vlans allowed and active in management domain
Po1         1,70-71,79
Po4         1,70-71,79

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1,70-71,79
Po4         1,70-71,79
```

```
ALS2#show int trunk

Port        Mode             Encapsulation  Status        Native vlan
Po3         on               802.1q         trunking      1
Po5         on               802.1q         trunking      1

Port        Vlans allowed on trunk
Po3         1-4094
Po5         1-4094

Port        Vlans allowed and active in management domain
Po3         1,72-73,79
Po5         1,72-73,79

Port        Vlans in spanning tree forwarding state and not pruned
Po3         72-73,79
Po5         72-73,79
```

DLS1 and DLS2 configured as 802.1q trunk link

```
DLS1#show int trunk

Port        Mode             Encapsulation  Status        Native vlan
Po1         on               802.1q         trunking      1
Po5         on               802.1q         trunking      1

Port        Vlans allowed on trunk
Po1         1-4094
Po5         1-4094

Port        Vlans allowed and active in management domain
Po1         1,70-73,79
Po5         1,70-73,79

Port        Vlans in spanning tree forwarding state and not pruned
Po1         1,70-73
Po5         1,70-73,79
```

```
DLS2#show int trunk

Port        Mode             Encapsulation  Status        Native vlan
Po3         on               802.1q         trunking      1
Po4         on               802.1q         trunking      1

Port        Vlans allowed on trunk
Po3         1-4094
Po4         1-4094

Port        Vlans allowed and active in management domain
Po3         1,70-73,79
Po4         1,70-73,79

Port        Vlans in spanning tree forwarding state and not pruned
Po3         1,70-73,79
Po4         1,70-73,79
```

Disable DTP negotiation on ALS switches. Example from interface G1/0/1

ALS1 Output

```
ALS1#show dtp int
DTP information for GigabitEthernet1/0/1:
  TOS/TAS/TNS:                              TRUNK/NONEGOTIATE/TRUNK
  TOT/TAT/TNT:                              802.1Q/802.1Q/802.1Q
  Neighbor address 1:                       000000000000
  Neighbor address 2:                       000000000000
  Hello timer expiration (sec/state):       never/STOPPED
  Access timer expiration (sec/state):      never/STOPPED
  Negotiation timer expiration (sec/state): never/STOPPED
  Multidrop timer expiration (sec/state):   never/STOPPED
  FSM state:                                S6:TRUNK
  # times multi & trunk                     0
  Enabled:                                  yes
  In STP:                                   no
```

ALS2 Output

```
ALS2#show dtp int g1/0/2
DTP information for GigabitEthernet1/0/2:
  TOS/TAS/TNS:                              TRUNK/NONEGOTIATE/TRUNK
  TOT/TAT/TNT:                              802.1Q/802.1Q/802.1Q
  Neighbor address 1:                       000000000000
  Neighbor address 2:                       000000000000
  Hello timer expiration (sec/state):       never/STOPPED
  Access timer expiration (sec/state):      never/STOPPED
  Negotiation timer expiration (sec/state): never/STOPPED
  Multidrop timer expiration (sec/state):   never/STOPPED
  FSM state:                                S6:TRUNK
  # times multi & trunk                     0
  Enabled:                                  yes
  In STP:                                   no
```

Sample: Disable DTP negotiation on DLS switches

DLS1 Output

```
DLS1(config)#do show dtp int
DTP information for GigabitEthernet1/0/1:
  TOS/TAS/TNS:                              TRUNK/NONEGOTIATE/TRUNK
  TOT/TAT/TNT:                              802.1Q/802.1Q/802.1Q
  Neighbor address 1:                       000000000000
  Neighbor address 2:                       000000000000
  Hello timer expiration (sec/state):       never/STOPPED
  Access timer expiration (sec/state):      never/STOPPED
  Negotiation timer expiration (sec/state): never/STOPPED
  Multidrop timer expiration (sec/state):   never/STOPPED
  FSM state:                                S6:TRUNK
  # times multi & trunk                     0
  Enabled:                                  yes
  In STP:                                   no
```

DLS2

```
DLS2(config)#do show dtp int
DTP information for GigabitEthernet1/0/1:
  TOS/TAS/TNS:                              ACCESS/NONEGOTIATE/ACCESS
  TOT/TAT/TNT:                              802.1Q/802.1Q/802.1Q
  Neighbor address 1:                       000000000000
  Neighbor address 2:                       000000000000
  Hello timer expiration (sec/state):       never/STOPPED
  Access timer expiration (sec/state):      never/STOPPED
  Negotiation timer expiration (sec/state): never/STOPPED
  Multidrop timer expiration (sec/state):   never/STOPPED
  FSM state:                                S1:OFF
  # times multi & trunk                     0
  Enabled:                                  no
  In STP:                                   no
```

Enabling LACP on DLS1, ALS1 and ALS2 switches

Enable LACP on DLS1:	int port channel 1 int range G1/0/1-2 no shut int port channel 5 int range G1/0/7-8 no shut interface range g1/0/1-g1/0/2 channel-group 1 mode active exit exit interface range g1/0/7-g1/0/8 channel-group 5 mode active exit

Enable LACP on ALS1:	int port channel 1 int range G1/0/1-2 no shut interface range g1/0/1-g1/0/2 channel-group 1 mode passive
Enable LACP on ALS2:	int port channel 5 int range G1/0/1-2 no shut interface range g1/0/1-g1/0/2 channel-group 5 mode passive

Enabling PAgP on ALS switches

Enable PAgP on ALS1:	int port channel 4 int range G1/0/3-4 no shut interface range g1/0/3-g1/0/4 channel-group 4 mode auto
Enable PAgP on DLS2:	int port channel 3 int range G1/0/7-8 no shut int port channel 4 int range G1/0/1-2 no shut interface range g1/0/7-g1/0/8 channel-group 3 mode desirable interface range g1/0/1-g1/0/2

	channel-group 4 mode desirable
Enable PAgP on ALS2: lecture 4	int port channel 3 int range G1/0/7-8 no shut interface range g1/0/7-g1/0/8 channel-group 3 mode auto

Enable etherchannel on layer 3 (DLS1 and DLS2)	**DLS1** interface port-channel 2 no switchport ip address 10.99.7.1 exit interface range g1/0/3-4 channel-group 2 mode active exit **DLS2** interface port-channel 2 no switchport ip address 10.99.7.1 exit interface range g1/0/3-4 channel-group 2 mode active exit

ALS 1 LACP/PAGP Proof

```
ALS1#show etherchannel summary
Flags:  D - down        P - bundled in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator

        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------
1      Po1(SU)         LACP      Gi1/0/1(P)  Gi1/0/2(P)
4      Po4(SU)         PAgP      Gi1/0/3(P)  Gi1/0/4(P)
```

ALS 2 LACP/PAGP Proof

```
ALS2#show etherchannel summary
Flags:  D - down        P - bundled in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator

        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port


Number of channel-groups in use: 2
Number of aggregators:           2

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------
3      Po3(SU)         PAgP      Gi1/0/7(P)  Gi1/0/8(P)
5      Po5(SU)         LACP      Gi1/0/1(P)  Gi1/0/2(P)
```

DLS 1 LACP Proof

```
DLS1#show etherchannel summary
Flags:  D - down        P - bundled in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator

        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port

        A - formed by Auto LAG


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
1      Po1(SU)         LACP      Gi1/0/1(P)  Gi1/0/2(P)
2      Po2(RU)         LACP      Gi1/0/3(P)  Gi1/0/4(P)
5      Po5(SU)         LACP      Gi1/0/7(P)  Gi1/0/8(P)
```

DLS 2 PAGP Proof

```
DLS2#show etherchannel summary
Flags:  D - down        P - bundled in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator

        M - not in use, minimum links not met
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port

        A - formed by Auto LAG


Number of channel-groups in use: 3
Number of aggregators:           3

Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
2      Po2(RU)         LACP      Gi1/0/3(P)  Gi1/0/4(P)
3      Po3(SU)         PAgP      Gi1/0/7(P)  Gi1/0/8(P)
4      Po4(SU)         PAgP      Gi1/0/1(P)  Gi1/0/2(P)
```

5. Create the required VLANs on each switch as specified in the table above. Configure DLS1 and DLS2 SVIs for each VLAN and assign addresses in the appropriate subnets as specified in the table above.

- Vlan Configurations done for ALS and DLS Switches so they appear in the vlan database.

ALS1 VLAN Configuration	`vlan 70`
	`name Data1`
	`vlan 71`
	`name Voice1`
	`vlan 79`
	`name MANAGEMENT`

ALS2 VLAN Configuration	`vlan 72`
	`name Data2`
	`vlan 73`
	`name Voice2`
	`vlan 79`
	`name MANAGEMENT`

DLS1 VLAN and SVI Configuration	`vlan 70`
	`exit`
	`vlan 71`
	`exit`
	`vlan 79`

	exit int vlan 70 ip address 10.7.0.2 255.255.255.0 no shut exit int vlan 71 ip address 10.7.1.2 255.255.255.0 no shut exit int vlan 79 ip address 10.7.9.2 255.255.255.0 no shut exit
DLS2 VLAN and SVI Configuration	vlan 70 exit vlan 71 exit vlan 79 Exit int vlan 72 ip address 10.7.2.2 255.255.255.0 no shut exit int vlan 73 ip address 10.7.3.2 255.255.255.0 no shut exit int vlan 79 ip address 10.7.9.3 255.255.255.0 no shut exit

ALS 1 VLAN Proof

```
ALS1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/7, Gi1/0/8, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/25
                                                Gi1/0/26, Gi1/0/27, Gi1/0/28
70   Data1                            active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
71   Voice1                           active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
79   MANAGEMENT                       active
```

ALS2 VLAN Proof

```
ALS2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/3, Gi1/0/4, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/25
                                                Gi1/0/26, Gi1/0/27, Gi1/0/28
72   Data2                            active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
73   Voice2                           active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
79   MANAGEMENT                       active
```

DLS1 VLAN Proof

```
DLS1#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/5, Gi1/0/6, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/1/1, Gi1/1/2
                                                Gi1/1/3, Gi1/1/4
70   VLAN0070                         active
71   VLAN0071                         active
72   VLAN0072                         active
73   VLAN0073                         active
79   VLAN0079                         active
```

DLS1 SVI Proof

```
DLS1#show ip int br
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  down                  down
Vlan1                  unassigned      YES unset  administratively down down
Vlan70                 10.7.0.2        YES manual up                    up
Vlan71                 10.7.1.2        YES manual up                    up
Vlan72                 10.7.2.3        YES manual up                    up
Vlan73                 10.7.3.3        YES manual up                    up
Vlan79                 10.7.9.3        YES manual up                    up
```

DLS2 VLAN Proof

```
DLS2#show vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/5, Gi1/0/6, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/1/1, Gi1/1/2
                                                Gi1/1/3, Gi1/1/4
70   VLAN0070                         active
71   VLAN0071                         active
72   VLAN0072                         active
73   VLAN0073                         active
79   VLAN0079                         active
```

DLS2 SVI Proof

```
DLS2#show ip int br
Interface              IP-Address      OK? Method Status                Protocol
GigabitEthernet0/0     unassigned      YES unset  down                  down
Vlan1                  unassigned      YES unset  administratively down down
Vlan70                 10.7.0.3        YES manual up                    up
Vlan71                 10.7.1.3        YES manual up                    up
Vlan72                 10.7.2.2        YES manual up                    up
Vlan73                 10.7.3.2        YES manual up                    up
Vlan79                 10.7.9.2        YES manual up                    up
```

6. Configure DLS1 and DLS2 to use HSRP for VLANS **x**0, **x**1, **x**2, **x**3 and x9. Make DLS1 the primary gateway for VLAN **x**0 and **x**1 and DLS2 the primary gateway for VLAN **x**2, **x**3, and x9. Enable preemption on both switches.

- Enabling HSRP on DLS switches and manipulating vlans to be active/standby by adjusting the priority.

DLS1 HSRP Configuration	`int vlan 70`
	`Ip address 10.7.0.2 255.255.255.0`
	`standby 7 ip 10.7.0.1`
	`standby 7 preempt`
	`standby 7 priority 110`
	`exit`
	
	`int vlan 71`
	`Ip address 10.7.1.2 255.255.255.0`
	`standby 7 ip 10.7.1.1`
	`standby 7 preempt`
	`standby 7 priority 110`
	`exit`
	
	`int vlan 72`
	`Ip address 10.7.2.3 255.255.255.0`
	`standby 7 ip 10.7.2.1`
	`standby 7 preempt`
	`exit`
	
	`int vlan 73`
	`Ip address 10.7.3.3 255.255.255.0`

	standby 7 ip 10.7.3.1 standby 7 preempt exit int vlan 79 Ip address 10.7.9.2 255.255.255.0 standby 7 ip 10.7.9.1 standby 7 preempt exit
DLS2 HSRP Configuration	int vlan 70 Ip address 10.7.0.3 255.255.255.0 standby 7 ip 10.7.0.1 standby 7 preempt exit int vlan 71 Ip address 10.7.1.3 255.255.255.0 standby 7 ip 10.7.1.1 standby 7 preempt exit int vlan 72 Ip address 10.7.2.2 255.255.255.0 standby 7 ip 10.7.2.1 standby 7 preempt standby 7 priority 110 exit int vlan 73 Ip address 10.7.3.2 255.255.255.0 standby 7 ip 10.7.3.1 standby 7 preempt standby 7 priority 110 exit int vlan 79 Ip address 10.7.9.3 255.255.255.0 standby 7 ip 10.7.9.1 standby 7 preempt standby 7 priority 110 exit

DLS1 HSRP Proof

```
DLS1#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Vl70        7    110 P Active  local           10.7.0.3        10.7.0.1
Vl71        7    110 P Active  local           10.7.1.3        10.7.1.1
Vl72        7    100 P Standby 10.7.2.2        local           10.7.2.1
Vl73        7    100 P Standby 10.7.3.2        local           10.7.3.1
Vl79        7    100 P Standby 10.7.9.2        local           10.7.9.1
```

DLS2 HSRP

```
DLS2#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Vl70        7    100 P Standby 10.7.0.2        local           10.7.0.1
Vl71        7    100 P Standby 10.7.1.2        local           10.7.1.1
Vl72        7    110 P Active  local           10.7.2.3        10.7.2.1
Vl73        7    110 P Active  local           10.7.3.3        10.7.3.1
Vl79        7    110 P Active  local           10.7.9.3        10.7.9.1
```

7. Using the table provided, assign ALS1 and ALS2 ports G1/0/5, G1/0/6, and G1/0/12-24 as access ports in the Data VLAN.

- In this scenario we are assigning interfaces G1/0/5-6, G1/0/12-24 as access ports in VLAN 70 and 72

ALS1	`interface range g1/0/12-24`
	`switchport mode access`
	`switchport access vlan 70`
	
	`interface range g1/0/5-6`
	`switchport mode access`
	`switchport access vlan 70`

ALS2	`interface range g1/0/12-24`
	`switchport mode access`
	`switchport access vlan 72`
	
	`interface g1/0/5-6`
	`switchport mode access`
	`switchport access vlan 72`

Assign ALS1 and ALS2 ports G1/0/5, G1/0/6, and G1/0/12-24

Show vlan brief command was issued to show that G1/0/5-6, G1/0/12-24 ports were added to VLAN 70 and 72

```
ALS1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/7, Gi1/0/8, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/25
                                                Gi1/0/26, Gi1/0/27, Gi1/0/28
70   Data1                            active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
71   Voice1                           active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
79   MANAGEMENT                       active
```

```
ALS2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/3, Gi1/0/4, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/25
                                                Gi1/0/26, Gi1/0/27, Gi1/0/28
72   Data2                            active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
73   Voice2                           active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
79   MANAGEMENT                       active
```

8. Enable PortFast and BPDU guard on all access ports. Shutdown any unused ports at the Distribution layer. By using default key term in the configuration, switch enables PortFast and BPDU guard on all access ports only.

ALS1	`spanning-tree portfast default` `spanning-tree portfast bpduguard default`

```
ALS1#show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for: VLAN0001, VLAN0070-VLAN0071
EtherChannel misconfig guard is enabled
Extended system ID           is enabled
Portfast Default             is enabled
PortFast BPDU Guard Default  is enabled
```

ALS2	`spanning-tree portfast default` `spanning-tree portfast bpduguard default`

```
ALS2#show spanning-tree summary
Switch is in rapid-pvst mode
Root bridge for: none
EtherChannel misconfig guard is enabled
Extended system ID           is enabled
Portfast Default             is enabled
PortFast BPDU Guard Default  is enabled
```

Show spanning-tree summary command was used to verify the functionality of Portfast default and Portfast BPDU guard default

9. Configure ALS1 and ALS2 ports G1/0/5, G1/0/6, and G1/0/12-24 for use with Cisco IP phones using the corresponding voice VLANs. **2 points**

- In this scenario we are assigning interfaces G1/0/5-6, G1/0/12-24 in VLAN 71 and 73 for the use of Cisco IP phones

ALS1 Voice VLAN configuration

ALS1	`interface range g1/0/12-24`
	`switchport voice vlan 71`
	
	`interface range g1/0/5-6`
	`switchport voice vlan 71`

```
ALS1#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/7, Gi1/0/8, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/25
                                                Gi1/0/26, Gi1/0/27, Gi1/0/28
70   Data1                            active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
71   Voice1                           active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
79   MANAGEMENT                       active
```

Proof of Voice VLAN Configuration

ALS2 Voice VLAN configuration

ALS2	`interface range g1/0/12-24`
	`switchport voice vlan 73`
	
	`interface g1/0/5-6`
	`switchport voice vlan 73`

Proof of Voice VLAN configuration

```
ALS2#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Gi1/0/3, Gi1/0/4, Gi1/0/9
                                                Gi1/0/10, Gi1/0/11, Gi1/0/25
                                                Gi1/0/26, Gi1/0/27, Gi1/0/28
72   Data2                            active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
73   Voice2                           active    Gi1/0/5, Gi1/0/6, Gi1/0/12
                                                Gi1/0/13, Gi1/0/14, Gi1/0/15
                                                Gi1/0/16, Gi1/0/17, Gi1/0/18
                                                Gi1/0/19, Gi1/0/20, Gi1/0/21
                                                Gi1/0/22, Gi1/0/23, Gi1/0/24
79   MANAGEMENT                       active
```

Show vlan brief command was issued to show that G1/0/5-6, G1/0/12-24 ports were added to VLAN 71 and 73

10. Configure ALS2 G1/0/5 and G1/0/6 for port security. Allow only up to three MAC addresses to be learned on each port and then drop any traffic from other MAC addresses and set the violate mode to protect.

- Limiting the number of MAC addresses (MAX 3) allowed/learned on ports G1/0/5-6 on ALS2 and dropping traffic from other MAC addresses.

Configuring ALS2 for port-security

ALS2	`interface range g1/0/5-6`
	`switchport port-security`
	`switchport port-security maximum 3`
	`switchport port-security violation protect`

Proof of port-security on gigabitEthernet1/0/5

```
ALS2#show port-security int g1/0/5
Port Security              : Enabled
Port Status                : Secure-down
Violation Mode             : Protect
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 3
Total MAC Addresses        : 0
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0000.0000.0000:0
Security Violation Count   : 0
```

Proof of port-security on gigabitEthernet1/0/6

```
ALS2#show port-security int g1/0/6
Port Security              : Enabled
Port Status                : Secure-down
Violation Mode             : Protect
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 3
Total MAC Addresses        : 0
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0000.0000.0000:0
Security Violation Count   : 0
```

11. Configure ALS1 G1/0/5 and G1/0/6 to only allow the MAC addresses of the two supervisor laptops (aka the two team members completing this case study). Assign only one MAC address per port and **shutdown** if a violation occurs.

- Limiting the number of MAC addresses allowed/learned on ports G1/0/5-6 on ALS2 and shutdown the port if violated. Allowing only one MAC address per port.

ALS1	`interface g1/0/5`
	`switchport port-security`
	`switchport port-security mac-address [70-88-6B-82-20-C7]`
	`switchport port-security maximum 1`
	`switchport port-security violation shutdown`

Proof of assigning only one MAC address per port on gigabitEthernet1/0/5

```
ALS1#show port-security int g1/0/5
Port Security              : Enabled
Port Status                : Secure-down
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 0
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0000.0000.0000:0
Security Violation Count   : 0
```

ALS1	`interface range g1/0/6`
	`switchport port-security`
	`switchport port-security mac-address 28-F1-0E-13-EA-4D`
	`switchport port-security maximum 1`
	`switchport port-security violation shutdown`

Proof of assigning only one MAC address per port on gigabitEthernet1/0/6

```
ALS1#show port-security int g1/0/6
Port Security              : Enabled
Port Status                : Secure-down
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 1
Total MAC Addresses        : 0
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0000.0000.0000:0
Security Violation Count   : 0
```

12. Create routed ports on DLS1 and DLS2 ports G1/0/23 and G1/0/24 that lead to CORE1 and CORE2. Configure addresses using the subnets specified in the table above.

- No switchport command was issued to assign that port as a routed port. This command enables routing mode that specific interface

DLS1 routed port configuration

DLS1	interface g1/0/23 **no switchport** ip address 10.100.7.1 255.255.0.0 no shut exit interface g1/0/24 **no switchport** ip address 10.200.7.1 255.255.0.0 no shut exit

```
DLS1#show run | begin interface GigabitEthernet1/0/23
interface GigabitEthernet1/0/23
 no switchport
 ip address 10.100.7.1 255.255.0.0
!
interface GigabitEthernet1/0/24
 no switchport
 ip address 10.200.7.1 255.255.0.0
```

DLS2 routed port configuration

DLS2	interface g1/0/23 **no switchport** ip address 10.200.7.129 255.255.0.0 no shut exit interface g1/0/24 **no switchport** ip address 10.100.7.129 255.255.0.0 no shut

	exit

```
DLS2#show run | begin interface GigabitEthernet1/0/23
interface GigabitEthernet1/0/23
 no switchport
 ip address 10.200.7.129 255.255.0.0
!
interface GigabitEthernet1/0/24
 no switchport
 ip address 10.100.7.129 255.255.0.0
```

13. Enable EIGRP routing on DLS1, DLS2, and advertise all connected networks. Ensure that neighbor relationships form with both CORE1 and CORE2 on both DLS switches.

- In this step we are enabling eigrp routing on distribution switches, and summarizing IP addresses of all the neighbor routes.

EIGRP Configuration on DLS1

DLS1	router eigrp 100 network 10.0.0.0 0.255.255.255 network 10.100.7.0 0.0.255.255 network 10.200.7.0 0.0.255.255

DLS1 Routes

```
DLS1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      1.0.0.0/32 is subnetted, 1 subnets
D        1.1.1.1 [90/130816] via 10.200.0.1, 01:18:06, GigabitEthernet1/0/24
                 [90/130816] via 10.100.0.1, 01:18:06, GigabitEthernet1/0/23
      10.0.0.0/8 is variably subnetted, 16 subnets, 3 masks
C        10.7.0.0/24 is directly connected, Vlan70
L        10.7.0.2/32 is directly connected, Vlan70
C        10.7.1.0/24 is directly connected, Vlan71
L        10.7.1.2/32 is directly connected, Vlan71
C        10.7.2.0/24 is directly connected, Vlan72
L        10.7.2.3/32 is directly connected, Vlan72
C        10.7.3.0/24 is directly connected, Vlan73
L        10.7.3.3/32 is directly connected, Vlan73
C        10.7.9.0/24 is directly connected, Vlan79
L        10.7.9.3/32 is directly connected, Vlan79
C        10.99.7.0/24 is directly connected, Port-channel2
L        10.99.7.1/32 is directly connected, Port-channel2
C        10.100.0.0/16 is directly connected, GigabitEthernet1/0/23
L        10.100.7.1/32 is directly connected, GigabitEthernet1/0/23
C        10.200.0.0/16 is directly connected, GigabitEthernet1/0/24
L        10.200.7.1/32 is directly connected, GigabitEthernet1/0/24
```

Above output shows all the routes learned after applying the EIGRP network commands

DLS1 EIGRP Neighbor's

```
DLS1#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
4   10.7.2.2                Vl72                     14 01:16:47    1  4500  0  114
2   10.7.0.3                Vl70                     11 02:02:46    2   100  0  112
7   10.99.7.2               Po2                      12 02:04:58    3   100  0  111
6   10.7.9.2                Vl79                     12 02:04:58    3   100  0  110
5   10.7.3.2                Vl73                     12 02:04:58    2   100  0  109
3   10.7.1.3                Vl71                     13 02:04:58    2   100  0  106
1   10.200.0.1              Gi1/0/24                 10 02:10:07   10   100  0  46
0   10.100.0.1              Gi1/0/23                 13 02:10:07  426  2556  0  45
```

EIGRP configuration on DLS2

DLS2	router eigrp 100 network 10.0.0.0 0.255.255.255 network 10.100.7.0 0.0.255.255 network 10.200.7.0 0.0.255.255

DLS2 Routes

```
DLS2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      1.0.0.0/32 is subnetted, 1 subnets
D        1.1.1.1 [90/130816] via 10.200.0.1, 01:19:53, GigabitEthernet1/0/23
                 [90/130816] via 10.100.0.1, 01:19:53, GigabitEthernet1/0/24
      10.0.0.0/8 is variably subnetted, 16 subnets, 3 masks
C        10.7.0.0/24 is directly connected, Vlan70
L        10.7.0.3/32 is directly connected, Vlan70
C        10.7.1.0/24 is directly connected, Vlan71
L        10.7.1.3/32 is directly connected, Vlan71
C        10.7.2.0/24 is directly connected, Vlan72
L        10.7.2.2/32 is directly connected, Vlan72
C        10.7.3.0/24 is directly connected, Vlan73
L        10.7.3.2/32 is directly connected, Vlan73
C        10.7.9.0/24 is directly connected, Vlan79
L        10.7.9.2/32 is directly connected, Vlan79
C        10.99.7.0/24 is directly connected, Port-channel2
L        10.99.7.2/32 is directly connected, Port-channel2
C        10.100.0.0/16 is directly connected, GigabitEthernet1/0/24
L        10.100.7.129/32 is directly connected, GigabitEthernet1/0/24
C        10.200.0.0/16 is directly connected, GigabitEthernet1/0/23
L        10.200.7.129/32 is directly connected, GigabitEthernet1/0/23
```

DLS2 EIGRP Neighbor's

```
DLS2#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(100)
H   Address                 Interface              Hold Uptime   SRTT   RTO  Q  Seq
                                                   (sec)         (ms)       Cnt Num
4   10.7.2.3                Vl72                     12 01:14:52   10   100  0  105
2   10.7.0.2                Vl70                     13 02:00:52    4   100  0  99
7   10.99.7.1               Po2                      11 02:03:04    6   100  0  100
6   10.7.9.3                Vl79                     14 02:03:04    6   100  0  101
5   10.7.3.3                Vl73                     10 02:03:04    6   100  0  102
3   10.7.1.2                Vl71                     13 02:03:04    6   100  0  103
1   10.100.0.1              Gi1/0/24                 11 02:03:04   11   100  0  63
0   10.200.0.1              Gi1/0/23                 11 02:03:04   11   100  0  64
```

14. Implement one additional upgrade that you have learned in this course. Suggestions include monitoring (IP SLAs), private VLANs, security, etc.

The security we decided to implement was storm control. Storm control allows us to monitor the incoming traffic over a 1 second interval, may it be broadcast, multicast or unicast. In this case study we will monitor the broadcast traffic on access switches. During the interval, the traffic "percentage" is compared with the traffic storm control level percentage configured on the port. If the ingress traffic reaches the configured percentage level, then the storm control will drop the traffic until the interval ends. Also, if the ingress traffic percentage goes past the configured percentage, it will send SNMP trap message to an SNMP manager. This is done so there is less strain on the access switches and also remain in control when there is a flood.

Configurations

ALS1	int port-channel 1 storm-control broadcast level 50 storm-control action trap exit int port-channel 4 storm-control broadcast level 50 storm-control action trap exit
ALS2	int port-channel 3 storm-control broadcast level 50 storm-control action trap exit int port-channel 5 storm-control broadcast level 50 storm-control action trap exit

Additional Deliverables

1. A ping issued from any host in any VLAN will reach the CORE switches (1.1.1.1).

A host laptop was connected to an access port (G1/0/5) and was given an IP address to issue a ping towards 1.1.1.1. The output below shows proof that the ping was successful.

```
Pinging 1.1.1.1 with 32 bytes of data:
Reply from 1.1.1.1: bytes=32 time=2ms TTL=254
Reply from 1.1.1.1: bytes=32 time=2ms TTL=254
Reply from 1.1.1.1: bytes=32 time=2ms TTL=254
Reply from 1.1.1.1: bytes=32 time=2ms TTL=254

Ping statistics for 1.1.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 2ms, Average = 2ms
```

Assigned IP address: 10.7.0.50/24
Default gateway of VLAN 70: 10.7.0.1

```
C:\Users\Yash>ipconfig

Windows IP Configuration


Ethernet adapter Ethernet:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::68fd:ff8f:17b4:b5e6%9
   IPv4 Address. . . . . . . . . . . : 10.7.0.50
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 10.7.0.1

Ethernet adapter VirtualBox Host-Only Network #2:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::bddd:9074:1345:d32b%10
   IPv4 Address. . . . . . . . . . . : 192.168.56.1
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . :

Ethernet adapter Ethernet 2:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Ethernet adapter Ethernet 3:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Tunnel adapter Local Area Connection* 13:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :
```

2. A trace issued from any host in any VLAN will reach the CORE switches (1.1.1.1) using the active HSRP active router.

Using 10.7.0.2 active router, a trace was successfully completed to 1.1.1.1

```
C:\Users\Yash> tracert 1.1.1.1

Tracing route to 1.1.1.1 over a maximum of 30 hops

  1     2 ms     2 ms     2 ms  10.7.0.2
  2     3 ms     2 ms     2 ms  1.1.1.1

Trace complete.
```

3. When the active HSRP router fails, the passive router will switchover. Further, when the active HSRP router comes back up, preemption takes place and the desired active router regains the active role.

To see the change, shutdown vlan 72 on DLS2.

```
DLS2(config)#int vlan 72
DLS2(config-if)#shut
DLS2(config-if)#exit
DLS2(config)#
*Mar 15 00:21:10.197: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.7.2.3 (Vlan72) is down:
interface down
*Mar 15 00:21:12.190: %LINK-5-CHANGED: Interface Vlan72, changed state to administratively do
wn
*Mar 15 00:21:13.192: %LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan72, changed state t
o down
*Mar 15 00:21:13.192: %HSRP-5-STATECHANGE: Vlan72 Grp 7 state Active -> Init
DLS2(config)#do show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Vl70        7    100 P Standby 10.7.0.2        local           10.7.0.1
Vl71        7    100 P Standby 10.7.1.2        local           10.7.1.1
Vl72        7    110 P Init    unknown         unknown         10.7.2.1
Vl73        7    110 P Active  local           10.7.3.3        10.7.3.1
Vl79        7    110 P Active  local           10.7.9.3        10.7.9.1
```

Vlan 72 goes from active to Init and then on DLS 1, Vlan 72 goes into active state after being in standby.

```
DLS1(config)#do show standby brief
*Mar 15 00:18:46.422: %HSRP-5-STATECHANGE: Vlan72 Grp 7 state Standby -> Active
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State   Active          Standby         Virtual IP
Vl70        7    110 P Active  local           unknown         10.7.0.1
Vl71        7    110 P Active  local           10.7.1.3        10.7.1.1
Vl72        7    100 P Active  local           unknown         10.7.2.1
Vl73        7    100 P Standby 10.7.3.2        local           10.7.3.1
Vl79        7    100 P Standby 10.7.9.2        local           10.7.9.1
DLS1(config)#
*Mar 15 00:18:49.603: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.7.2.2 (Vlan
72) is down: holding time expired
*Mar 15 00:20:55.200: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.7.2.2 (Vlan
72) is up: new adjacency
*Mar 15 00:20:58.232: %HSRP-5-STATECHANGE: Vlan72 Grp 7 state Active -> Speak
*Mar 15 00:21:09.381: %HSRP-5-STATECHANGE: Vlan72 Grp 7 state Speak -> Standby
*Mar 15 00:21:17.303: %HSRP-5-STATECHANGE: Vlan72 Grp 7 state Standby -> Active
*Mar 15 00:21:21.671: %DUAL-5-NBRCHANGE: EIGRP-IPv4 100: Neighbor 10.7.2.2 (Vlan
72) is down: holding time expired
```

4. Port security violations will act as anticipated. i.e. The ports will shut down or transition to protect when a violation occurs as described above.

We first assigned a MAC address 70-88-6B-82-20-C7 then we inserted a new MAC address 70-88-6B-82-20-C1 to see of port security works. A message showed up saying that only one maximum MAC address can be assigned to this interface. This caused interface to transition into protect and then the interface went down.

```
ALS1(config)#int g1/0/5
ALS1(config-if)# switchport port-security mac-address 70-88-6B-82-20-C7
ALS1(config-if)#exit
ALS1(config)#int g1/0/5
ALS1(config-if)# switchport port-security mac-address 70-88-6B-82-20-C1
Total secure mac-addresses on interface GigabitEthernet1/0/5 has reached maximum limit.
```

```
ALS1(config)#int g1/0/6
ALS1(config-if)#switchport port-security mac-address 70-88-6B-82-55-70
Total secure mac-addresses on interface GigabitEthernet1/0/6 has reached maximum limit.
```

Interface G1/0/5 and G1/0/6 went down after port security violation

```
ALS1(config)#do show ip int brief | include down
FastEthernet0          unassigned      YES unset  administratively down down
GigabitEthernet1/0/5   unassigned      YES unset  down                  down
GigabitEthernet1/0/6   unassigned      YES unset  down                  down
```

Enterprise Network Design

1) A topology diagram, which must include the following functional areas of an Enterprise Campus Network (refer to Lecture 2 slides 9 & 10 for sample models):
    a) At least three campus modules (building access and building distribution), one of which is already defined in the topology above
    b) A core module (expand the existing one as needed)
    c) A data center module
    d) An Internet edge distribution module

VLANS

ALS1:

Name	VLAN	Subnet
Data1	x0	10.x.0.0/24
Voice1	x1	10.x.1.0/24
Management	x9	10.x.9.0/24

ALS2:

Name	VLAN	Subnet
Data2	x2	10.x.2.0/24
Voice2	x3	10.x.3.0/24
Management	x9	10.x.9.0/24

DLS1-to-DLS2 subnet: 10.99.x.0/24
DLS1-to-Core1 subnet: 10.100.x.0/25
DLS1-to-Core2 subnet: 10.200.x.0/25
DLS2-to-Core1 subnet: 10.100.x.128/25
DLS2-to-Core2 subnet: 10.200.x.128/25

Campus Module 2		
ALS3		
Name	**Vlan**	**Subnets**
Data1	80	10.8.0.0/24
Voice1	81	10.8.1.0/24
Management1	89	10.8.9.0/24
ALS4		
Data2	82	10.8.2.0/24
Voice2	83	10.8.3.0/24
Management2	89	10.8.9.0/24

Campus Module 3		
ALS5		
Name	**Vlan**	**Subnets**
Data1	90	10.9.0.0/24
Voice1	91	10.9.1.0/24
Management1	99	10.9.9.0/24
ALS6		
Data2	92	10.9.2.0/24
Voice2	93	10.9.3.0/24
Management2	99	10.9.9.0/24

Data Center Module		
ALS7		
Name	**Vlan**	**Subnets**
Data1	100	10.10.0.0/24
ALS8		
Voice1	101	10.10.1.0/24
ALS9		
Data2	102	10.10.2.0/24
ALS10		
Voice2	103	10.10.3.0/24
Management2	109	10.10.9.0/24

Internet Edge Module		
DLS9		
Name	**Vlan**	**Subnets**
Data1	110	10.10.0.0/24

Voice1	111	10.11.1.0/24
Management1	119	10.11.9.0/24
DLS10		
Data2	112	10.11.2.0/24
Voice2	113	10.11.3.0/24
Management2	119	10.11.9.0/24
Edge Router 1 and 2		
S0/0/0	10.11.10.0/24	
S0/1/0	10.11.11.0/24	
S0/1/1	10.11.12.0/24	

2) For each module in the diagram, show each device, each connection between the devices, and VLAN and subnet information. Be sure to specify which links are Layer 2 and which are Layer 3. Refer to the "Enterprise Campus 3.0 Architecture" document posted on Blackboard for guidance on proper design.

Campus Module 2 DLS3 and DLS4 SVI's		
VLAN SVI	IP address	Connection to Core
Vlan 80	10.8.0.1 255.255.255.0	DLS3 G1/0/23 -> Core 1 10.101.7.1/16 DLS3 G1/0/24 -> Core 2 10.201.7.1/16 DLS4 G1/0/24 -> Core 1 10.101.7.129/16 DLS4 G1/0/23 -> Core 2 10.201.7.129/16
Vlan 81	10.8.1.1 255.255.255.0	
Vlan 82	10.8.2.1 255.255.255.0	
Vlan 83	10.8.3.1 255.255.255.0	
Vlan 89	10.8.9.1 255.255.255.0 - 10.8.9.2 255.255.255.0	
Connection to ALS 5 and ALS 6		
DLS3 DLS3 G1/0/1-2 -> ALS3 G1/0/1-2 DLS3 G1/0/3 -> DLS4 G1/0/3 **Port-Channel IP Address: (10.99.8.1/24)** DLS3 G1/0/7 -> ALS4 G1/0/1		

DLS4
DLS4 G1/0/1 -> ALS3 G1/0/3
DLS4 G1/0/3 -> DLS3 G1/0/3 **Port-Channel IP Address: (10.99.8.2/24)**
DLS4 G1/0/7-8 -> ALS4 G1/0/7-8

ALS3
ALS3 G1/0/4 -> ALS4 G1/0/4

ALS4
ALS4 G1/0/4 -> ALS3 G1/0/4

Campus Module 3 DLS5 and DLS6 SVI's		
VLAN SVI	IP address	Connection to Core
Vlan 90	10.9.0.1 255.255.255.0	DLS5 G1/0/23 -> Core 1 10.102.7.1/16 DLS5 G1/0/24 -> Core 2 10.202.7.1/16 DLS6 G1/0/24 -> Core 1 10.102.7.129/16 DLS6 G1/0/23 -> Core 2 10.202.7.129/16
Vlan 91	10.9.1.1 255.255.255.0	
Vlan 92	10.9.2.1 255.255.255.0	
Vlan 93	10.9.3.1 255.255.255.0	
Vlan 99	10.9.9.1 255.255.255.0 - 10.8.9.2 255.255.255.0	
Connection to ALS 5 and ALS 6		

DLS5
DLS5 G1/0/1-2 -> ALS5 G1/0/1-2
DLS5 G1/0/3 -> DLS6 G1/0/3 **Port-Channel IP Address: (10.99.9.1/24)**
DLS5 G1/0/7-8 -> ALS6 G1/0/1-2

DLS6
DLS6 G1/0/1-2 -> ALS5 G1/0/3-4
DLS6 G1/0/3 -> DLS5 G1/0/3 **Port-Channel IP Address: (10.99.9.2/24)**
DLS6 G1/0/7 -> ALS6 G1/0/7

Data Center Module DLS7 and DLS8 SVI's		
VLAN SVI	IP address	Connection to Core
Vlan 100	10.10.0.1 255.255.255.0	DLS7 G1/0/11 -> Core 3

Vlan 101	10.10.1.1 255.255.255.0	10.103.7.1/16 DLS7 G1/0/12 -> Core 4 10.203.7.1/16 DLS8 G1/0/11 -> Core 3 10.103.7.129/16 DLS8 G1/0/12 -> Core 4 10.203.7.129/16
Vlan 102	10.10.2.1 255.255.255.0	
Vlan 103	10.10.3.1 255.255.255.0	
Vlan 109	10.10.9.1 255.255.255.0 - 10.10.9.2 255.255.255.0	
Connection to ALS7, ALS8, ALS9 and ALS10		
DLS7 DLS7 G1/0/1 -> ALS7 G1/0/1 DLS7 G1/0/2 -> ALS8 G1/0/2 DLS7 G1/0/3 -> ALS9 G1/0/3 DLS7 G1/0/4 -> ALS10 G1/0/4 DLS7 G1/0/9-10 -> DLS1 G1/0/9-10 **Port-Channel IP Address: (10.99.10.1/24)** **DLS8** DLS8 G1/0/5 -> ALS7 G1/0/5 DLS8 G1/0/6 -> ALS8 G1/0/6 DLS8 G1/0/7 -> ALS9 G1/0/7 DLS8 G1/0/8 -> ALS10 G1/0/8 DLS8 G1/0/9-10 -> DLS1 G1/0/9-10 **Port-Channel IP Address: (10.99.10.2/24)** **ALS7** ALS7 -> Application Server **ALS8** ALS8 -> Web Server **ALS9** ALS9 -> Database Server **ALS10** ALS10 -> Database Server		

Internet Edge Module		
Interface	IP address	Connection to Core
Vlan 110	10.11.0.1 255.255.255.0	DLS9 G1/0/11 -> Core 3 10.104.7.1/16 DLS9 G1/0/12 -> Core 4
Vlan 111	10.11.1.1 255.255.255.0	

Vlan 112	10.11.2.1 255.255.255.0	10.204.7.1/16 DLS10 G1/0/11 -> Core 3 10.104.7.129/16 DLS10 G1/0/12 -> Core 4 10.204.7.129/16
Vlan 113	10.11.3.1 255.255.255.0	
Vlan 119	10.11.9.1 255.255.255.0	
S0/0/0	10.11.10.1-2 255.255.255.0	
S0/1/0	10.11.11.1-2 255.255.255.0	
S0/1/1	10.11.12.1-2 255.255.255.0	
Connection to Edge Routers		
DLS9 DLS9 G1/0/1 -> Edge Router 1 S0/0/1 DLS9 G1/0/2 -> Edge Router 2 S0/0/0 DLS9 G1/0/9-10 -> DLS10 G1/0/9-10 **Port-Channel IP Address: (10.99.11.1/24)** **DLS10** DLS10 G1/0/1 -> Edge Router 2 S0/0/1 DLS10 G1/0/2 -> Edge Router 1 S0/0/0 DLS10 G1/0/9-10 -> DLS9 G1/0/9-10 **Port-Channel IP Address: (10.99.11.2/24)** **Edge Router 1** Edge Router 1 S0/1/1 -> Edge Router 2 S0/1/1 **Edge Router 2** Edge Router 2 S0/1/1 -> Edge Router 1 S0/1/1		

3) Using the best practices in the textbook and the "Campus Network for High Availability Design Guide" posted on Blackboard, explain exactly where in your network design you would include the following features and why:

a. Layer 3 Routing Protocols

i. Which ones would you implement and where

- Since campus module 1 already uses EIGRP from DLS1-to-DLS2 and DLS-to-Core, it is viable to use EIGRP in the remaining modules including the data center and the internet edge. EIGRP was chosen so there would only be one type of routing protocol. Furthermore, since EIGRP is scalable it can be used if the network ever expands. It will maintain its performance and also keep the convergence time as low as possible. Therefore, all connections between distribution and distribution to core level will use EIGRP for communication.

ii. Any special design notes regarding the implementation of the routing protocols

- Our campus topology is designed such that it follows a hierarchical model and therefore allow for easy tracking between links, in case of link error. Layer 3 links are used between DLS Switches and DLS-to-Core. The links are connected in a triangle topology for optimal path redundancy. DLS switches use VLAN SVI's so they have routing capability to the core switches. As for EIGRP, our addressing is done such that it can be easily summarized from the top down.

b. Layer 2 Redundancy

i. What type(s) of spanning tree would you use? Where? Why?

- For campus module 1we configured Rapid PVST+ as told, and as such we will configure it in other modules also. There are two main reasons why, one of which is rapid convergence. For example, convergence in a regular STP topology would take about a minute, however with Rapid PVST+, it takes 2 seconds by default. When there is a topology change, the network can converge as quick as 1 second compared to 1 minute. This type of convergence is necessary in a campus network where communication between devices (distribution and core) is needed uninterrupted. Another reason is interoperability. This feature allows RSTP to work with STP and does not cause an outage/downtime. Although, RSTP will lose its fast convergence benefit, it will still be a loop free topology as RSTP can run alongside STP. All switches whether it be access or distribution will use Rapid PVST+. Also, since all modules use vlans, for better performance it is viable to use Rapid PVST+.

ii. What enhancements would you implement? Where? Why?

- PortFast and BPDU Guard are some of the enhancements that would be implemented in the network. The ideal place for them to be implemented will be on access switches where end devices are likely to be connected to. It would be faster for the end devices to come from blocking state to forwarding state. BPDU Guard will also be used on access switches and protect the integrity of the PortFast enabled ports. Any PortFast enabled port that receives a DPBU will put into a err-disabled state, ultimately shutting down the port. It is also a good security measure as it prevents attackers from sending BPDUs and becoming the root bridge.

c. FHRPs

i. Which one(s) would you implement? Where? Why?

- We would implement VRRP and GLBP on different module of enterprise campus. Firstly, VRRP will be implemented on distribution layer of campus module 2 and 3. It has max groups of 255 which will be efficient in terms of scalability if the groups ever increase. Therefore, the need for different VLAN(s) will increase and with the option of 255 groups and the campus network will have an opportunity to add more groups. VRRP does not use standby routers, it only has one active and several backup routers. This method eliminates the election process for a standby router hence provides faster election process. Lastly, we would also implement GLBP on distribution layer of campus module 2 and 3 because, it provides load balancing between the routers which will allow multiple routers to forward traffic, instead of an active router that keeps forwarding all the traffic, and rest of the links unused.

ii. Where would the active switch(es) be in the topology? Why?

- Distribution layer switches will be active switches in the topology of campus module 2 and 3 because, they will be forwarding traffic towards core and from core to access layer. These layer 3 switches have the ability to act as a router and switch at the same time. Active switches could be any of the two switches in the distribution layer depending upon the election process.

d. Link Aggregation and Oversubscription

i. Describe the oversubscription ratios present in your network (based on the link bandwidths). Present this as a ratio reduced as much as possible (e.g. 8:1 rather than 16:2). Explain why this oversubscription exists in your network design and whether it will be problematic for your users.

- Let us first calculate oversubscription ratio for campus module. To calculate the oversubscription ratio, we decided to assume that each link operates as 1 Gbps also assuming that we have 20 hosts connected to each access layer switch. This will lead to 40 hosts in total which mean we will need 40 Gbps for each host and there are total 8 links between access layer and distribution layer, from there we have 4 more links towards core layer. Hence, in total, we have 12 links which will basically be required 12 Gbps since each link is assumed as 1 Gbps. Therefore, total oversubscription ratio for each campus module will be 40:12 (10:3). Now we will calculate oversubscription ratio for the data center. The Assumption for each link will be the same which is 1 Gbps but the amount of host will change from 40 to 4 hosts. Since we are using four servers in the data center, we have 4 hosts and the total number of links between access layer and distribution layer are 8 which means 8 Gbps from there we have 4 more links towards core layer. Hence, in total, we have 12 links, which means we need 12 Gbps since each link is 1 Gbps. Therefore, total oversubscription ratio for the data center will be 4:12 (1:3). This ratio tells us that there is no oversubscription in the data center as there are 3 links available for every host.

  Oversubscription is problematic in the campus modules because the ratio for each module is 10:3, which means for every 10 hosts they will have 3 links accommodated. This is oversubscription since the 10 hosts need to share the bandwidth of 3 links. If we assume we have 1gbps link then, 3 links equal to 3gbps. Therefore, 3000mbps/10 hosts equals to 300mbps per host. If more and more hosts join this module, then the link bandwidth per host will get smaller and smaller.

ii. Where would you implement link aggregation (EtherChannel) to help reduce oversubscription? How many links would you need to include in each bundle to meet your target ration, and what would be the total bandwidth?

- There are EtherChannels already in the access layer but they are only bundled with 2 links. To reduce oversubscription, we would add 6 more links to the EtherChannels making then a bundle of 8 links altogether. Since there are 4 EtherChannels that lead to the distribution layer, there will be 32 links in total with 8 links in each EtherChannel. Therefore, the new ratio will be 40:32 or 5:4. For every 5 hosts there will now be 4 links. Having 1 gbps per link gives 800mbps (4000mbps/5 hosts) per host. This certainly is better than having 300mbps per host.

e. Security

i. What Layer 2 security measures would you implement? Where? Why?

- The need of port security is essential on the access ports in the access switches. Port-Security limits the number of MAC addresses on a port. This prevents attacks that target the CAM table (CAM Table Overflow). Another security measure that can be implemented is manually configuring access ports and shutting down unused ports. This prevents attackers from spoofing a switch and using DTP negotiation to create a trunk link which would in return give access to any vlan. Lastly, we would implement storm control on access ports which would limit the traffic flow on specific ports. This will keep the bandwidth optimal across the network.

Design Notes On The Modules

Campus Modules

- Campus Modules (1, 2 and 3) consist of two ALS switches and two DLS switches. ALS switches connect with both DLS switches, but there is no connection between ALS switches to prevent any loops if connection ever fails between ALS switches.
- Links configured in a triangle topology.
- EtherChannels are implemented between all layer 2 and layer 3 switches except between ALS1 and ALS2. This method prevents overload of bandwidth usage when more switches are added to distribution layer or access layer, and prevents single point of failure.
- Layer 2 links are used between ALS switches and DLS switches for trunking purposes.
- Layer 3 links are used for the connections between distribution and core layer since they are using the EIGRP protocol. We needed to implement layer 3 links so they can become routed links and are able to communicate.

Data Center

- Data center consists of 2 DLS switches, 4 ALS switches and 4 servers. The DLS Switches connect to two core switches, ALS switches connect to DLS and 4 servers.
- The connections between the devices are done with keeping redundancy in mind. There are more than one paths for a device A to send data to device B.
- Links configured in a triangle topology.
- Trunking is enabled between all DLS and ALS switch connections with DTP turned off.
- Layer 2 links are between access switches and distribution switches.
- Layer 3 link (EtherChannel) is used between distribution switches. Distribution layer switches perform EIGRP to communicate with the core layer.

Internet Edge

- Internet Edge topology consist of two edge routers and two DLS switches.
- Edge router 1 and 2 has connection between DLS1 and DLS2 this improves redundancy in the topology as packets can take any path to reach DLS switches and vice versa. Even if any links fail in the topology the routers or switches will always have different paths to send packets/frames.

- Links configured in a triangle topology.
- These links can also be used for load balancing so all the links are in use rather than just using one specific link to reach the switches or routers.
- Since we are applying EIGRP protocol in Internet edge topology we decided to implement layer 3 links all over the network such that all links are routed links.
- Internet Edge has the ability to connect to the WAN network.

Overall Enterprise Network

- Hierarchy
    - Placed core layer in the center with distribution and access in the surrounding layers respectively. Core layer was expanded so network can scale without any complexity. In general, complexity is reduced when a hierarchical topology is designed. Also, isolating each layer, makes problems easy to find in the network.
- Modularity
    - Isolating each module within the network so problems can be dealt with effectively. Network changes can be done with simplicity allowing for flexibility in the maintenance and operation of the campus network. Campus network is based on the access-distribution block where each module consists of access and distribution layer. This is helpful when there needs to be a network change and so switches can be connected or disconnected easily.
- Resiliency
    - The ability of the network to remain available in in any condition. Our campus is resilient in many ways. For example, with the triangle topology implemented in the entire network there will always be more than one path for a device to send data to. Also with the use of port channels on distribution layer and core layer switches it provides redundancy. Core and distribution layer needs its services up and running at all times so it's good to use port channels in case of link failures. For further redundancy, port channels are also used in the access layer.
- Flexibility
    - Campus network is capable of being flexible with key features such as the allowance of migrating between different routing protocols, spanning tree, IPv6 capability, switching between different security measures, and more.

Conclusion

In conclusion, throughout this case study we learned how to configure access layer and distribution layer as well as how to design a network for different Campus Modules, Data Center, and Internet Edge. As a group, our responsibility was to plan, design and implement the UOIT Student Help Desk switched network. In first part, the instructions were given with the design for Campus module 1, and we had to configure Campus Module 1. However, in second part we were asked to design and plan an Enterprise Campus topology. Additionally, we had to provide reasoning behind our design choices, and also explain where and how we will implement certain protocols. Furthermore, we provided two securities which would be implemented in the campus network we designed. Overall, in the process of completing the case study we gained knowledge in regard to configuring a network and designing/planning a campus network efficiently.

SHOW-RUNNING CONFIGS

ALS1

```
hostname ALS1

vtp domain UOIT
vtp mode transparent

spanning-tree mode rapid-pvst
spanning-tree portfast default
spanning-tree portfast bpduguard default

vlan 70
 name Data1
exit

vlan 71
 name Voice1
exit

vlan 79
 name MANAGEMENT
exit

interface Port-channel1
int range g1/0/1-2
no shutdown
exit

interface Port-channel1
storm-control broadcast level 50
storm-control action trap
 switchport mode trunk
 switchport nonegotiate

no shutdown
exit

interface Port-channel4
int range g1/0/3-4
no shutdown
exit
```

```
interface Port-channel4
storm-control broadcast level 50
storm-control action trap
 switchport mode trunk
 switchport nonegotiate
no shutdown
exit

interface FastEthernet0
 no ip address
 shutdown
exit

interface GigabitEthernet1/0/1
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode active
no shutdown
exit

interface GigabitEthernet1/0/2
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode active
no shutdown
exit

interface GigabitEthernet1/0/3
 switchport mode trunk
 switchport nonegotiate
 channel-group 4 mode desirable
no shutdown
exit

interface GigabitEthernet1/0/4
 switchport mode trunk
 switchport nonegotiate
 channel-group 4 mode desirable
no shutdown
exit

interface GigabitEthernet1/0/5
 switchport access vlan 70
 switchport mode access
```

```
 switchport voice vlan 71
 switchport port-security
no shutdown
exit

interface GigabitEthernet1/0/6
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
 switchport port-security
no shutdown
exit

interface GigabitEthernet1/0/12
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/13
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/14
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/15
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/16
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
```

```
no shutdown
exit

interface GigabitEthernet1/0/17
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/18
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/19
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/20
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/21
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/22
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit
```

```
interface GigabitEthernet1/0/23
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit

interface GigabitEthernet1/0/24
 switchport access vlan 70
 switchport mode access
 switchport voice vlan 71
no shutdown
exit
```

ALS2

```
hostname ALS2

vtp domain UOIT
vtp mode transparent

spanning-tree mode rapid-pvst
spanning-tree portfast default
spanning-tree portfast bpduguard default

vlan 72
 name Data2
exit

vlan 73
 name Voice2
exit

vlan 79
 name MANAGEMENT
exit

interface Port-channel3
int range g1/0/7-8
no shutdown
exit
```

```
interface Port-channel3
storm-control broadcast level 50
storm-control action trap
switchport mode trunk
switchport nonegotiate
no shutdown
exit

interface port-channel5
int range g1/0/1-2
no shutdown
exit

interface Port-channel5
storm-control broadcast level 50
storm-control action trap
switchport mode trunk
switchport nonegotiate
no shutdown
exit

interface FastEthernet0
 no ip address
 shutdown
exit

interface GigabitEthernet1/0/1
 switchport mode trunk
 switchport nonegotiate
 channel-group 5 mode active
no shutdown
exit

interface GigabitEthernet1/0/2
 switchport mode trunk
 switchport nonegotiate
 channel-group 5 mode active
no shutdown
exit

interface GigabitEthernet1/0/5
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
```

```
 switchport port-security maximum 3
 switchport port-security
 switchport port-security violation protect
 spanning-tree portfast
 spanning-tree bpduguard enable
no shutdown
exit

interface GigabitEthernet1/0/6
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
 switchport port-security maximum 3
 switchport port-security
 switchport port-security violation protect
 spanning-tree portfast
 spanning-tree bpduguard enable
no shutdown
exit

interface GigabitEthernet1/0/7
 switchport mode trunk
 switchport nonegotiate
 channel-group 3 mode desirable
no shutdown
exit

interface GigabitEthernet1/0/8
 switchport mode trunk
 switchport nonegotiate
 channel-group 3 mode desirable
no shutdown
exit


interface GigabitEthernet1/0/12
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/13
 switchport access vlan 72
 switchport mode access
```

```
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/14
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/15
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/16
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/17
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/18
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/19
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit
```

```
interface GigabitEthernet1/0/20
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/21
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/22
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/23
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit

interface GigabitEthernet1/0/24
 switchport access vlan 72
 switchport mode access
 switchport voice vlan 73
no shutdown
exit
```

DLS 1

```
hostname DLS1

ip routing

no ip domain-lookup

vtp domain UOIT
vtp mode transparent

spanning-tree mode rapid-pvst
spanning-tree vlan 70,71 root primary

vlan 70
exit

vlan 71
exit

vlan 72
exit

vlan 73
exit

vlan 79
exit

interface Port-channel1
int range g1/0/1-2
no shut
exit

interface Port-channel1
 switchport mode trunk
 switchport nonegotiate
no shut
exit

interface Port-channel2
int range g1/0/3-4
no shut
```

```
exit

interface Port-channel2
 no switchport
 ip address 10.99.7.1 255.255.255.0
no shut
exit

interface Port-channel5
int range g1/0/7-8
no shut
exit

interface Port-channel5
 switchport mode trunk
 switchport nonegotiate
 spanning-tree vlan 79 cost 2


interface GigabitEthernet1/0/1
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode active
no shut
exit

interface GigabitEthernet1/0/2
 switchport mode trunk
 switchport nonegotiate
 channel-group 1 mode active
no shut
exit

interface GigabitEthernet1/0/3
 no switchport
 channel-group 2 mode active
no shut
exit

interface GigabitEthernet1/0/4
 no switchport
 channel-group 2 mode active
no shut
exit
```

```
interface GigabitEthernet1/0/5
shutdown
exit

interface GigabitEthernet1/0/6
shutdown
exit

interface GigabitEthernet1/0/7
 switchport mode trunk
 switchport nonegotiate
 channel-group 5 mode active
no shut
exit

interface GigabitEthernet1/0/8
 switchport mode trunk
 switchport nonegotiate
 channel-group 5 mode active
no shut
exit

interface GigabitEthernet1/0/9
shutdown
exit

interface GigabitEthernet1/0/10
shutdown
exit

interface GigabitEthernet1/0/11
shutdown
exit

interface GigabitEthernet1/0/12
shutdown
exit

interface GigabitEthernet1/0/13
shutdown
exit
interface GigabitEthernet1/0/14
shutdown
exit
```

```
interface GigabitEthernet1/0/15
shutdown
exit

interface GigabitEthernet1/0/16
shutdown
exit

interface GigabitEthernet1/0/17
shutdown
exit

interface GigabitEthernet1/0/18
shutdown
exit

interface GigabitEthernet1/0/19
shutdown
exit

interface GigabitEthernet1/0/20
shutdown
exit

interface GigabitEthernet1/0/21
shutdown
exit

interface GigabitEthernet1/0/22
shutdown
exit

interface GigabitEthernet1/0/23
 no switchport
 ip address 10.100.7.1 255.255.0.0
no shut
exit

interface GigabitEthernet1/0/24
 no switchport
 ip address 10.200.7.1 255.255.0.0
no shut
exit

interface GigabitEthernet1/1/1
```

```
shutdown
exit

interface GigabitEthernet1/1/2
shutdown
exit

interface GigabitEthernet1/1/3
shutdown
exit

interface GigabitEthernet1/1/4
shutdown
exit

interface Vlan70
 ip address 10.7.0.2 255.255.255.0
 standby 7 ip 10.7.0.1
 standby 7 priority 110
 standby 7 preempt
no shut
exit

interface Vlan71
 ip address 10.7.1.2 255.255.255.0
 standby 7 ip 10.7.1.1
 standby 7 priority 110
 standby 7 preempt
no shut
exit

interface Vlan72
 ip address 10.7.2.3 255.255.255.0
 standby 7 ip 10.7.2.1
 standby 7 preempt
no shut
exit

interface Vlan73
 ip address 10.7.3.3 255.255.255.0
 standby 7 ip 10.7.3.1
 standby 7 preempt
no shut
exit
```

```
interface Vlan79
 ip address 10.7.9.2 255.255.255.0
 standby 7 ip 10.7.9.1
 standby 7 preempt
no shut
exit

router eigrp 100
 network 10.0.0.0 0.255.255.255
 network 10.100.0.0 0.0.255.255
 network 10.200.0.0 0.0.255.255
exit
```

DLS 2

```
hostname DLS2

ip routing

no ip domain-lookup

vtp domain UOIT
vtp mode transparent

spanning-tree mode rapid-pvst

spanning-tree vlan 72-73,79 root primary

vlan 70
exit

vlan 71
exit

vlan 72
exit

vlan 73
exit

vlan 79
exit

interface Port-channel2
int range g1/0/3-4
```

```
no shut
exit

interface Port-channel2
 no switchport
 ip address 10.99.7.2 255.255.255.0
no shut
exit

interface Port-channel3
 switchport mode trunk
 switchport nonegotiate
no shut
exit

interface Port-channel3
int range g1/0/7-8
no shut
exit

interface Port-channel4
 switchport mode trunk
 switchport nonegotiate
no shut
exit

interface Port-channel4
 int range g1/0/1-2
no shut
exit

interface GigabitEthernet1/0/1
 switchport mode trunk
 switchport nonegotiate
 channel-group 4 mode desirable
no shut
exit

interface GigabitEthernet1/0/2
 switchport mode trunk
 switchport nonegotiate
 channel-group 4 mode desirable
no shut
exit
```

```
interface GigabitEthernet1/0/3
 no switchport
 no ip address
 channel-group 2 mode active
no shut
exit

interface GigabitEthernet1/0/4
 no switchport
 no ip address
 channel-group 2 mode active
no shut
exit

interface GigabitEthernet1/0/5
shutdown
exit

interface GigabitEthernet1/0/6
shutdown
exit

interface GigabitEthernet1/0/7
 switchport mode trunk
 switchport nonegotiate
 channel-group 3 mode desirable
no shut
exit

interface GigabitEthernet1/0/8
 switchport mode trunk
 switchport nonegotiate
 channel-group 3 mode desirable
no shut
exit

interface GigabitEthernet1/0/9
shutdown
exit

interface GigabitEthernet1/0/10
shutdown
exit

interface GigabitEthernet1/0/11
```

```
shutdown
exit

interface GigabitEthernet1/0/12
shutdown
exit

interface GigabitEthernet1/0/13
shutdown
exit

interface GigabitEthernet1/0/14
shutdown
exit

interface GigabitEthernet1/0/15
shutdown
exit

interface GigabitEthernet1/0/16
shutdown
exit

interface GigabitEthernet1/0/17
shutdown
exit

interface GigabitEthernet1/0/18
shutdown
exit

interface GigabitEthernet1/0/19
shutdown
exit

interface GigabitEthernet1/0/20
shutdown
exit

interface GigabitEthernet1/0/21
shutdown
exit

interface GigabitEthernet1/0/22
shutdown
```

```
exit

interface GigabitEthernet1/0/23
 no switchport
 ip address 10.200.7.129 255.255.0.0
no shut
exit

interface GigabitEthernet1/0/24
 no switchport
 ip address 10.100.7.129 255.255.0.0
no shut
exit

interface GigabitEthernet1/1/1
shutdown
exit

interface GigabitEthernet1/1/2
shutdown
exit

interface GigabitEthernet1/1/3
shutdown
exit

interface GigabitEthernet1/1/4
shutdown
exit

interface Vlan70
 ip address 10.7.0.3 255.255.255.0
 standby 7 ip 10.7.0.1
 standby 7 preempt
no shut
exit

interface Vlan71
 ip address 10.7.1.3 255.255.255.0
 standby 7 ip 10.7.1.1
 standby 7 preempt
no shut
exit

interface Vlan72
```

```
 ip address 10.7.2.2 255.255.255.0
 standby 7 ip 10.7.2.1
 standby 7 priority 110
 standby 7 preempt
no shut
exit

interface Vlan73
 ip address 10.7.3.2 255.255.255.0
 standby 7 ip 10.7.3.1
 standby 7 priority 110
 standby 7 preempt
no shut
exit

interface Vlan79
 ip address 10.7.9.3 255.255.255.0
 standby 7 ip 10.7.9.1
 standby 7 priority 110
 standby 7 preempt
no shut
exit

router eigrp 100
 network 10.0.0.0 0.255.255.255
 network 10.100.0.0 0.0.255.255
 network 10.200.0.0 0.0.255.255
exit
```

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IP Addresses

Campus Module 1

ALS 1:	Vlan	IP Addresses
Data 1	70	10.7.0.2/24
Voice 1	71	10.7.1.2/24
Management	79	10.7.9.2/24

ALS 2	Vlan	IP Addresses
Data 2	72	10.7.2.3/24
Voice 2	73	10.7.3.3/24
Management	79	10.7.9.3/24

DLS 1 - to - DLS 2 subnet 10.99.7.1 - 10.99.7.255/24

DLS 1- to - Core 1 subnet 10.100.7.1 - 10.100.7.255/16

DLS 1- to - Core 2 subnet 10.200.7.1 - 10.200.7.255/16

DLS 2 - to - Core 1 subnet 10.100.7.129-255/16

DLS 2 - to - Core 2 subnet 10.200.7.129-255/16

Campus Module 2

VLAN SVI	IP address	Connection to Core
Vlan 80	10.8.0.1 255.255.255.0	DLS1 G1/0/23 -> Core 1 10.101.7.1/16
Vlan 81	10.8.1.1 255.255.255.0	
Vlan 82	10.8.2.1 255.255.255.0	DLS1 G1/0/24 -> Core 2 10.201.7.1/16
Vlan 83	10.8.3.1 255.255.255.0	
		DLS2 G1/0/24 -> Core 1 10.101.7.129/16
Vlan 89	10.8.9.1 255.255.255.0 - 10.8.9.2 255.255.255.0	
		DLS2 G1/0/23 -> Core 2 10.201.7.129/16

DLS1 G1/0/3 -> DLS2 G1/0/3 Port-Channel IP: (10.99.8.1/24)

DLS2 G1/0/3 -> DLS1 G1/0/3 Port-Channel IP: (10.99.8.2/24)

Campus Module 3

VLAN SVI	IP address	Connection to Core
Vlan 90	10.9.0.1 255.255.255.0	DLS1 G1/0/23 -> Core 1 10.102.7.1/16
Vlan 91	10.9.1.1 255.255.255.0	
Vlan 92	10.9.2.1 255.255.255.0	DLS1 G1/0/24 -> Core 2 10.202.7.1/16
Vlan 93	10.9.3.1 255.255.255.0	
		DLS2 G1/0/24 -> Core 1 10.102.7.129/16
Vlan 99	10.9.9.1 255.255.255.0 - 10.8.9.2 255.255.255.0	
		DLS2 G1/0/23 -> Core 2 10.202.7.129/16

DLS1 G1/0/3 -> DLS2 G1/0/3 Port-Channel IP: (10.99.9.1/24)

DLS2 G1/0/3 -> DLS1 G1/0/3 Port-Channel IP: (10.99.9.2/24)

Data Center Module

VLAN SVI	IP address	Connection to Core
Vlan 100	10.10.0.1 255.255.255.0	DLS1 G1/0/11 -> Core 1 10.103.7.1/16
Vlan 101	10.10.1.1 255.255.255.0	
Vlan 102	10.10.2.1 255.255.255.0	DLS1 G1/0/12 -> Core 2 10.203.7.1/16
Vlan 103	10.10.3.1 255.255.255.0	
		DLS2 G1/0/11 -> Core 1 10.103.7.129/16
Vlan 109	10.10.9.1 255.255.255.0 - 10.10.9.2 255.255.255.0	
		DLS2 G1/0/12 -> Core 2 10.203.7.129/16

DLS1 G1/0/9-10 -> DLS1 G1/0/9-10 Port-Channel IP: (10.99.10.1/24)

DLS2 G1/0/9-10 -> DLS1 G1/0/9-10 Port-Channel IP: (10.99.10.2/24)

Internet Edge Module

Interface	IP address	Connection to Core
Vlan 110	10.11.0.1 255.255.255.0	DLS1 G1/0/11 -> Core 1 10.104.7.1/16
Vlan 111	10.11.1.1 255.255.255.0	
Vlan 112	10.11.2.1 255.255.255.0	DLS1 G1/0/12 -> Core 2 10.204.7.1/16
Vlan 113	10.11.3.1 255.255.255.0	
Vlan 119	10.11.9.1 255.255.255.0	DLS2 G1/0/11 -> Core 1 10.104.7.129/16
S0/0/0	10.11.10.1-2 255.255.255.0	
S0/1/0	10.11.11.1-2 255.255.255.0	DLS2 G1/0/12 -> Core 2 10.204.7.129/16
S0/1/1	10.11.12.1-2 255.255.255.0	

DLS1 G1/0/9-10 -> DLS2 G1/0/9-10 Port-Channel IP: (10.99.11.1/24)

DLS2 G1/0/9-10 -> DLS1 G1/0/9-10 Port-Channel IP: (10.99.11.2/24)

LEGEND

Port-channels

Layer 2 links

Layer 3 links

Data Center Module

ALS1

Name	Vlan	Subnets
Data1	100	10.10.0.0/24
Voice1	101	10.10.1.0/24
Management1	109	10.10.9.0/24

ALS2

Data2	102	10.10.2.0/24
Voice2	103	10.10.3.0/24
Management2	109	10.10.9.0/24

Internet Edge Module

DLS1

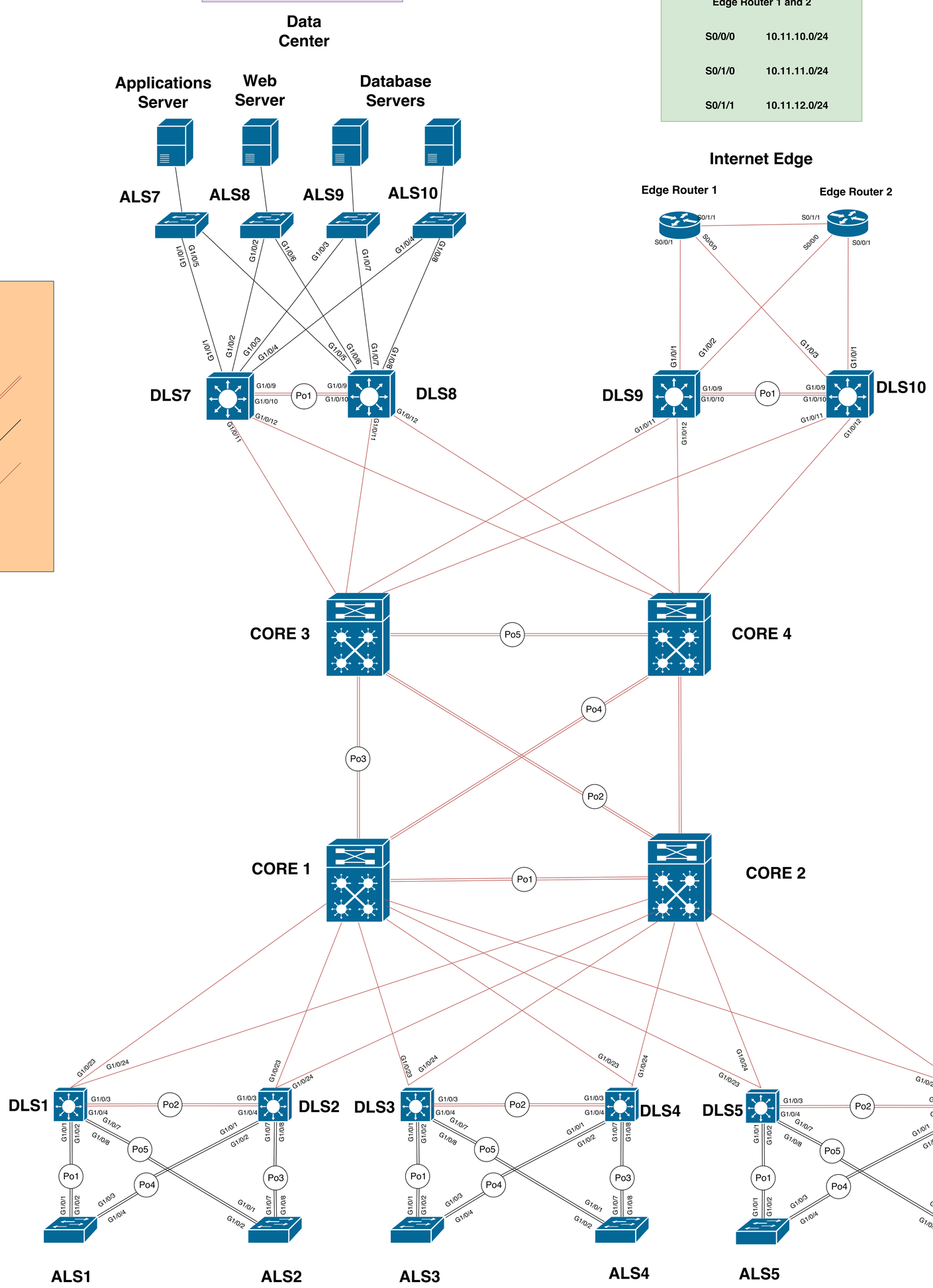
Name	Vlan	Subnets
Data1	110	10.10.0.0/24
Voice1	111	10.11.1.0/24
Management1	119	10.11.9.0/24

DLS2

Data2	112	10.11.2.0/24
Voice2	113	10.11.3.0/24
Management2	119	10.11.9.0/24

Edge Router 1 and 2

S0/0/0	10.11.10.0/24
S0/1/0	10.11.11.0/24
S0/1/1	10.11.12.0/24



Campus Module 2

VLANS

ALS1:

Name	VLAN	Subnet
Data1	70	10.7.0.0/24
Voice1	71	10.7.1.0/24
Management	79	10.7.9.0/24

ALS2:

Name VLAN Subnet
Data2 72 10.7.2.0/24
Voice2 73 10.7.3.0/24
Management 79 10.7.9.0/24

DLS1-to-DLS2 subnet: 10.99.7.0/24
DLS1-to-Core1 subnet: 10.100.7.0/25
DLS1-to-Core2 subnet: 10.200.7.0/25
DLS2-to-Core1 subnet: 10.100.7.128/25
DLS2-to-Core2 subnet: 10.200.7.128/25

Campus Module 2

ALS1

Name	Vlan	Subnets
Data1	80	10.8.0.0/24
Voice1	81	10.8.1.0/24
Management1	89	10.8.9.0/24

ALS2

Data2	82	10.8.2.0/24
Voice2	83	10.8.3.0/24
Management2	89	10.8.9.0/24

Campus Module 3

ALS1

Name	Vlan	Subnets
Data1	90	10.9.0.0/24
Voice1	91	10.9.1.0/24
Management1	99	10.9.9.0/24

ALS2

Data2	92	10.9.2.0/24
Voice2	93	10.9.3.0/24
Management2	99	10.9.9.0/24