Switched Networks and Routing Fall 2024 | CASE STUDY

Pod number: 03

Date: 2024.09.30 and 2024.10.02

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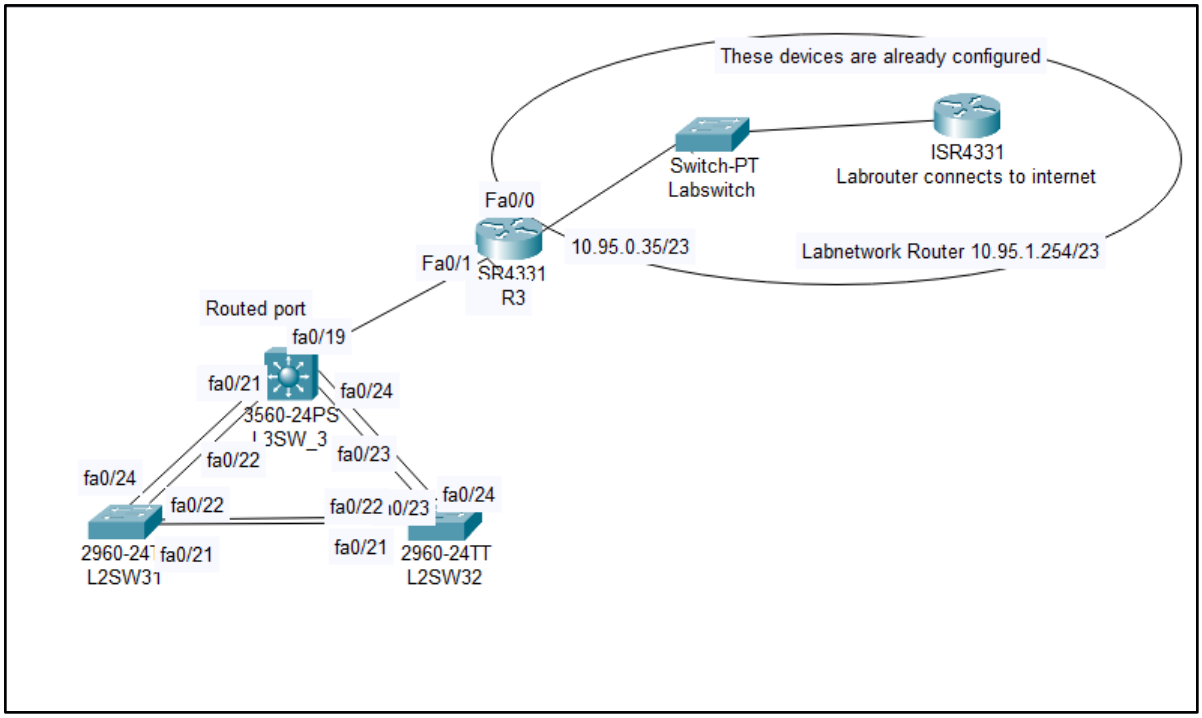
Introduction

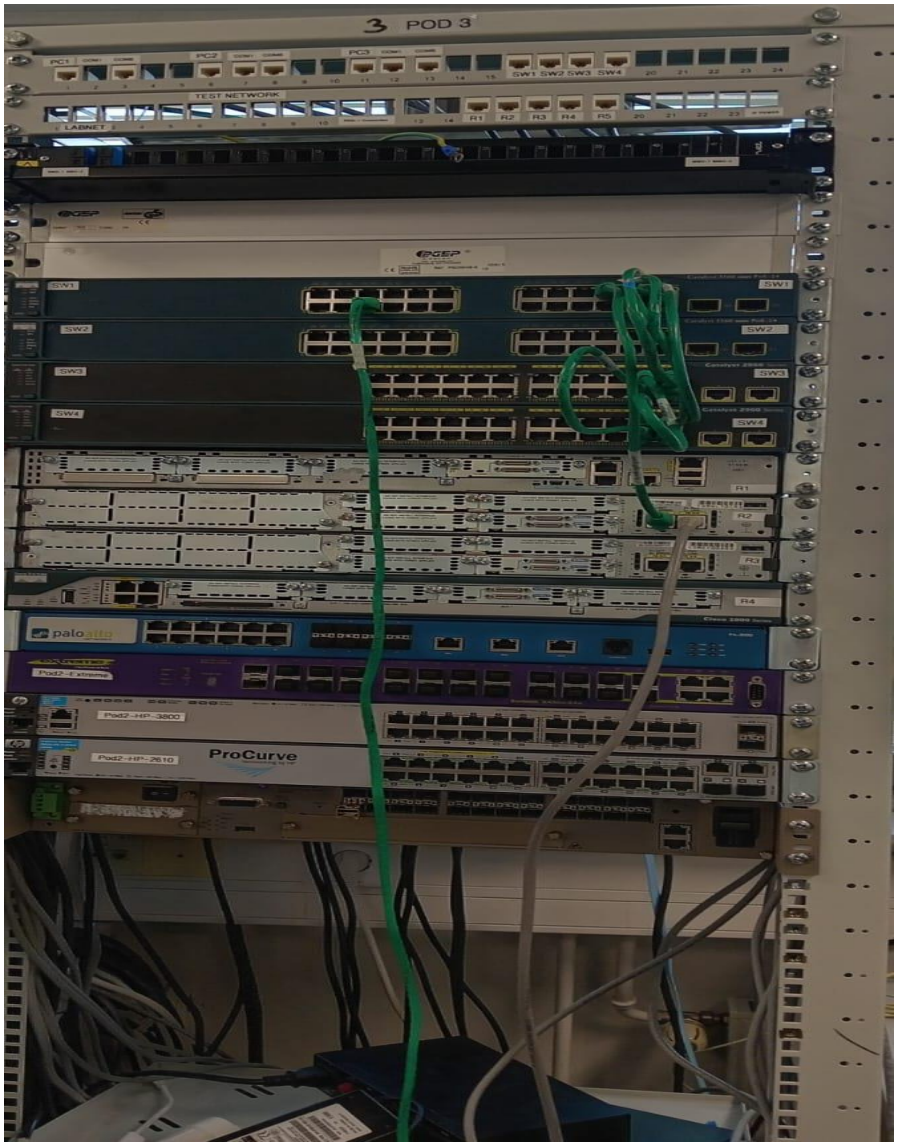
The network design and configure for Acme Ltd. as part of our CCNA2 Case Study for the Fall 2024. The objective was to design, configure, and test a LAN infrastructure tailored for various user group students, staff, and management. each segregated into their own VLANs. Additionally, the network was required to connect to an external Labnetwork.

Our team, designated as Pod 3, was allocated the IP range 10.95.30.0-10.95.39.255 and used real equipment in Lab KMD658 at Metropolia's Karamalmi campus. The configuration involved setting up Router R3 and switches (L3SW_3, L2SW_31, L2SW_32), with the Labrouter and Labswitch being pre-configured. This report provides a detailed account of the configuration steps, the commands used, testing procedures, and network performance analysis. Full configuration details are included in the appendix.

Network Diagram



Physical appearance



Network plan

The range we can use: 10.95.30.0-10.95.39.255

VLAN	network/CIDR	Network IP	Subnet mask
Student Vlan	10.95.32.0/22	10.95.32.0	255.255.252.0
Staff vlan	10.95.30.0/25	10.95.30.0	255.255.255.128
MGT vlan	10.95.31.0/26	10.95.31.0	255.255.255.192
RT to L3 switch	10.95.36.0/30	10.95.36.0	255.255.255.252

Method

Step 1: Configuring Router R3 (Rx) and Verifying Connectivity.

The fa0/0 interface of R3 was configured with the IP address 10.95.0.35. That interface was connected to the lab network (the socket labelled "labnetwork 10.95.0.0/23"). It was then verified that a ping could be successfully sent to the labrouter at 10.95.1.254.

Step 2: Configuring VLANs and IP Addressing Plan on L3SW_3

The next step was to set up three VLANs on L3SW_3, designated for students, staff, and management, each allocated specific IP address ranges. VLAN 31 was configured for students, VLAN 32 for staff, and VLAN 33 for management, with corresponding IP spaces. A point-to-point connection was also established between Router R3 and L3SW_3. To enable communication across the VLANs, EtherChannel was configured. Additionally, a default route was set up to handle traffic routing

Step 3: Configuring Static Routes and OSPF on Router R3

At this stage, static routes were configured on Router R3 to facilitate communication with the VLANs on L3SW_3. Additionally, OSPF routing was implemented to advertise these routes to the Labnetwork. The static routes ensured that traffic could move seamlessly between the router and the VLANs for students, staff, and management, while OSPF was responsible for distributing both static and connected routes across the network. This configuration enabled complete connectivity between Router R3, the VLANs, and the Labnetwork.

Step 4: Verifying Internet Connectivity

At this stage, a successful connection to the internet was confirmed by pinging Google's public DNS server (8.8.8.8) from Router R3. This test verified that the routing configurations, including OSPF and the default gateway, were correctly set up and functioning as intended.

Step 5: Configuring Static Default Route on L3SW_3 Towards R3

During this stage, a static default route was set up on L3SW_3 to forward all non-local traffic to Router R3. This configuration ensured efficient routing between L3SW_3 and Router R3, facilitating internet access. The setup was verified by inspecting the interfaces and the routing table, and connectivity was confirmed with successful communication to both Router R3 and the internet.

Step 6: Configuring Per VLAN Spanning Tree Plus (PVST+) on Switches

At this stage, the Per VLAN Spanning Tree Plus (PVST+) protocol was implemented on all switches to provide a separate spanning tree for each VLAN, improving traffic distribution and fault tolerance. PVST+ was configured on L3SW_3, L2SW_32, and L2SW_31, and the spanning tree settings were thoroughly checked to ensure proper functionality and effective loop prevention across all VLANs.

Step 7: Configuring L3SW_3 as the Spanning Tree Root for All VLANs

During this stage, L3SW_3 was set as the root bridge for VLANs 31, 32, and 33 to optimise spanning tree performance across these networks. By designating L3SW_3 as the primary root, network stability was enhanced, ensuring efficient traffic management for all VLANs.

Step 8: Configuring EtherChannel and Trunk Links on L3SW_3

At this stage, EtherChannel was configured on L3SW_3 to aggregate multiple links, enabling traffic flow for VLANs 31, 32, and 33. Load balancing was also set up, using source and destination IP addresses to distribute traffic more effectively. This setup ensures efficient utilisation of the bundled links for seamless VLAN communication.

Step 9: Configuring Access Ports for VLANs on L3SW_3, L2SW_31, and L2SW_32

In this step, we configured access ports on all three switches (L3SW_3, L2SW_31, and L2SW_32) to assign them to the appropriate VLANs. Ports were allocated for VLAN 31 (Students), VLAN 32 (Staff), and VLAN 33 (Management), ensuring that devices connected to these ports are correctly assigned to their respective VLANs.

Step 10: Configuring Port Security and Spanning Tree PortFast on Access Ports

During this stage, port security, spanning tree PortFast, and BPDU guard were set up on the access ports of all switches. The configuration permitted a maximum of two MAC addresses per port and enforced a shutdown if any security violations occurred. PortFast was enabled to speed up spanning tree convergence, while BPDU guard was activated to prevent potential BPDU attacks. These settings ensured both secure and efficient functionality of the access ports.

Step 11: Shutdown Unused Interfaces and Verify the Configuration

At this stage, security was strengthened by disabling all unused interfaces on the switches. This measure helps prevent unauthorised access while also optimising network performance. Once the interfaces were shut down, their status was checked to confirm that the configuration had been correctly implemented.

Step 12: Configure DHCP Servers for Each VLAN

During this phase, DHCP servers were set up for each VLAN (VLAN 31, VLAN 32, and VLAN 33) to provide dynamic IP address allocation, with 30 IP addresses reserved per VLAN for static devices. Additionally, Google's public DNS (8.8.8.8) was configured for use by DHCP clients. After completing the setup, the DHCP pools and IP address bindings were verified to confirm everything was functioning correctly.

Step 13: Configure NTP and Time Zones

At this stage, NTP servers were configured on both Layer 3 and Layer 2 switches to maintain synchronised clocks across the network. The appropriate time zone (EET) was applied, along with rules for transitioning to summertime (EEST). Once the setup was completed, the configurations were saved to memory.

Step 14: Configure SSH Version 2 and Disable Telnet

During this phase, SSH version 2 was set up on all switches (L3SW_3, L2SW31, and L2SW32), with Telnet being disabled for security reasons. A domain name was configured, and local login authentication was established, creating two user accounts: one with privilege level 1 and the other with privilege level 15.

Step 15: Configure DHCP Snooping for VLANs and Trust Trunk Ports.

At this stage, DHCP snooping was enabled for VLANs 31, 32, and 33 across all switches. Only the trunk ports were designated as trusted, enhancing network security by preventing unauthorised DHCP servers.

Step 16: Configure Dynamic ARP Inspection (DAI) for VLANs

During this phase, Dynamic ARP Inspection (DAI) was activated for VLANs 31, 32, and 33 on all switches. Trunk ports were designated as trusted to safeguard against ARP spoofing attacks.

Step 17: Configure Static IP for Management VLAN on L2 Switches

In this phase, static IP addresses were assigned to L2SW31 and L2SW32 within VLAN 33, along with a default gateway to facilitate time synchronisation.

Configuration

Router Configuration

This section highlights the commands of Router(R3) configurations according to the above steps.

Rx

```
en
erase startup-config
reload
en
conf t
hostname RX
router ospf 1
network 10.95.0.0 0.0.1.255 area 0
redistribute static metric 10 subnets
redistribute connected metric 10 subnets

int f0/1
ip address 10.95.36.1 255.255.255.252
no sh
exit

# Step 13
ntp server 10.94.1.3
ntp server 10.94.4.254
clock timezone EET 2
clock summer-time EEST recurring last Sun Mar 2:00 last Sun Oct 3:00

# Step 14
ip domain-name iotlab.metropolia.fi
crypto key generate rsa modulus 1024
ip ssh version 2
username cisco privilege 1 secret class
username admin privilege 15 secret ciscoeigrp
line vty 0 15
transport input ssh
login local
exit
exit
write memory

# trouble shooting
ip route 10.95.30.0 255.255.255.128 10.95.36.2
ip route 10.95.31.0 255.255.255.192 10.95.36.2
ip route 10.95.32.0 255.255.252.0 10.95.36.2
```

Layer 3 switch Configuration

This section highlights the commands of L3SW_3 configurations according to the above steps.

L3SW_X

```
en
erase startup-config
reload


en
conf t
hostname L3SW_X

int f0/19
no switchport
ip address 10.95.36.2 255.255.255.252
no sh
exit
ip route 0.0.0.0 0.0.0.0 10.95.36.1
int range f0/20-24
no sh
exit

vlan 31
name Student
exit
vlan 32
name Staff
exit
vlan 33
name MGT
exit

# Step 8
spanning-tree mode pvst
spanning-tree vlan 31 root primary
spanning-tree vlan 32 root primary
spanning-tree vlan 33 root primary

# Step 9
int range f0/21-22
channel-group 1 mode active
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk allowed vlan 31, 32, 33
exit
int range f0/23-24
channel-group 2 mode active
switchport trunk encapsulation dot1q
switchport mode trunk
switchport trunk allowed vlan 31, 32, 33
```

```
exit
port-channel load-balance src-dst-ip

# Step 9
interface range fa0/1 - 5
switchport mode access
switchport access vlan 31
no shutdown
exit
interface range fa0/6 - 10
switchport mode access
switchport access vlan 32
no shutdown
exit
interface range fa0/11 - 12
switchport mode access
switchport access vlan 33
no shutdown
exit

# Step 10
interface range fa0/1-12
switchport port-security
switchport port-security maximum 2
switchport port-security violation shutdown
spanning-tree portfast
spanning-tree bpduguard enable
exit
exit
write memory

# Step 11
conf t
interface range f0/13-18, f0/20
shutdown

# Step 12
ip dhcp excluded-address 10.95.30.1 10.95.30.30
ip dhcp excluded-address 10.95.31.1 10.95.31.30
ip dhcp excluded-address 10.95.32.1 10.95.32.30
ip dhcp pool Student
network 10.95.32.0 255.255.252.0
default-router 10.95.36.1
dns-server 8.8.8.8
exit
ip dhcp pool Staff
network 10.95.30.0 255.255.255.128
default-router 10.95.36.1
dns-server 8.8.8.8
exit
ip dhcp pool MGT
network 10.95.31.0 255.255.255.192
default-router 10.95.36.1
dns-server 8.8.8.8
```

```
exit

# Step 13
ntp server 10.94.1.3
ntp server 10.94.4.254
clock timezone EET 2
clock summer-time EEST recurring last Sun Mar 2:00 last Sun Oct 3:00

# Step 14
ip domain-name iotlab.metropolia.fi
crypto key generate rsa modulus 1024
ip ssh version 2
username cisco privilege 1 secret class
username admin privilege 15 secret ciscoeigrp
line vty 0 15
transport input ssh
login local
exit
exit
write memory

# Step 15
ip dhcp snooping
ip dhcp snooping vlan 31,32,33
interface range f0/21-24
ip dhcp snooping trust
exit

# Step 16
ip arp inspection vlan 31,32,33
interface range f0/21-24
ip arp inspection trust
exit
interface range f0/1-12
ip arp inspection limit rate 100
exit


# trouble shooting
int vlan 31
ip address 10.95.32.1 255.255.252.0
no shutdown
exit
ip dhcp pool Student
default-router 10.95.32.1
exit
int vlan 32
ip address 10.95.30.1 255.255.255.128
no shutdown
exit
ip dhcp pool Staff
default-router 10.95.30.1
exit
int vlan 33
```

```
ip address 10.95.31.1 255.255.255.192
no shutdown
exit
ip dhcp pool MGT
default-router 10.95.31.1
exit
```

Layer 2 switches Configuration

This section highlights the commands of L2SW_31 and L2SW_32 configurations according to the above steps.

L2SW_X1&2

```
en
erase startup-config
reload

# Step 9
en
conf t
interface range fa0/1 - 5
switchport mode access
switchport access vlan 31
no shutdown
exit
interface range fa0/6 - 10
switchport mode access
switchport access vlan 32
no shutdown
exit
interface range fa0/11 - 12
switchport mode access
switchport access vlan 33
no shutdown
exit

# Step 10
interface range fa0/1-12
switchport port-security
switchport port-security maximum 2
switchport port-security violation shutdown
spanning-tree portfast
spanning-tree bpduguard enable
exit
exit
write memory

# Step 11
conf t
interface range f0/13-20
shutdown
```

```
# Step 13
ntp server 10.94.1.3
ntp server 10.94.4.254
clock timezone EET 2
clock summer-time EEST recurring last Sun Mar 2:00 last Sun Oct 3:00

# Step 14
ip domain-name iotlab.metropolia.fi
crypto key generate rsa modulus 1024
ip ssh version 2
username cisco privilege 1 secret class
username admin privilege 15 secret ciscoeigrp
line vty 0 15
transport input ssh
login local
exit
exit
write memory

# Step 15
ip dhcp snooping
ip dhcp snooping vlan 31,32,33
interface range f0/21-24
ip dhcp snooping trust
exit

# Step 16
ip arp inspection vlan 31,32,33
interface range f0/21-24
ip arp inspection trust
exit
interface range f0/1-12
ip arp inspection limit rate 100
exit

# Step 17
# L2swX1
interface vlan 33
ip address 10.95.31.2 255.255.255.192
no shutdown
exit

# L2swX2
interface vlan 33
ip address 10.95.31.3 255.255.255.192
no shutdown
exit

no ip arp inspection vlan 31,32,33
ip dhcp snooping
ip dhcp snooping vlan 31,32,33
interface range FastEthernet0/21 - 24
ip dhcp snooping trust
```

```
exit
ip arp inspection vlan 31,32,33

# trouble shooting
# L2swX1
interface vlan 31
ip address 10.95.32.3 255.255.252.0
no shutdown
exit
interface vlan 32
ip address 10.95.30.3 255.255.255.128
no shutdown
exit

# L2swX2
interface vlan 31
ip address 10.95.32.2 255.255.252.0
no shutdown
exit
interface vlan 32
ip address 10.95.30.2 255.255.255.128
no shutdown
exit

# Both
no ip arp inspection vlan 31,32,33
ip dhcp snooping
ip dhcp snooping vlan 31,32,33
interface range FastEthernet0/21 - 24
ip dhcp snooping trust
exit
ip arp inspection vlan 31,32,33
```

Troubleshooting

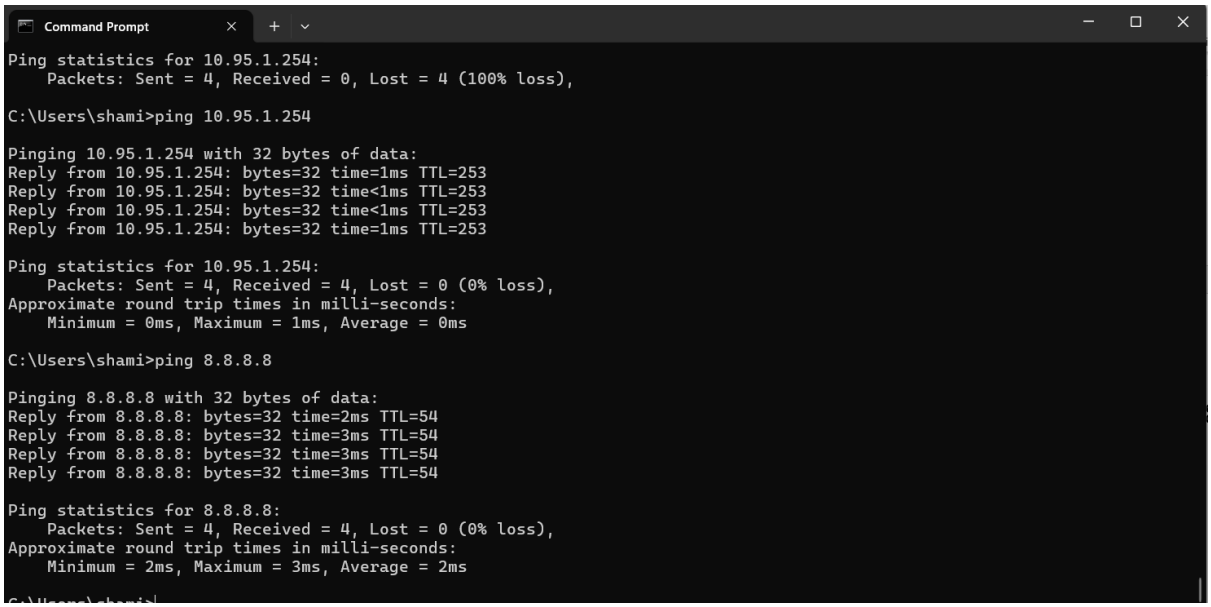
- Pings to external addresses, such as 8.8.8.8, were unsuccessful, with a 0% success rate. The issue stemmed from a missing or incorrect static route, which prevented the router from properly accessing external networks. After reviewing the routing table, the appropriate static route was added using the command: ip route 0.0.0.0 0.0.0.0 10.95.1.254. This adjustment restored external connectivity, and the pings were successful.

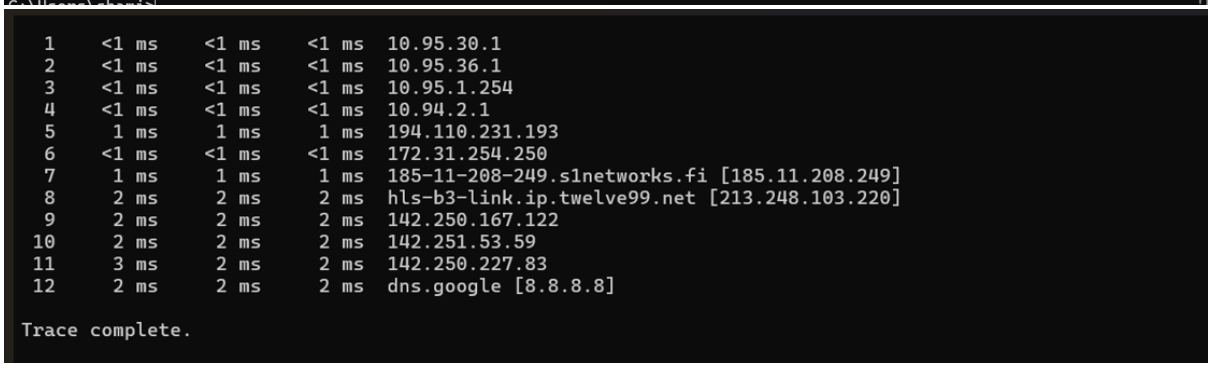
- While configuring OSPF, the message %OSPF-5-ADJCHG: Neighbor Down: Dead timer expired was repeatedly encountered. This issue usually occurs when OSPF neighbors fail to receive Hello packets within the specified Dead Interval, often due to network misconfigurations such as incorrect IP settings or mismatched timers. The problem was resolved by verifying and aligning the OSPF Hello and Dead intervals across all routers. Additionally, interface configurations were corrected, and static routes were adjusted as necessary to address underlying connectivity issues.

Verifying VLAN Connectivity and Internet Access

The final phase focused on testing internet connectivity by connecting a PC to each VLAN. To confirm proper access, the ping command was used to test connections to both 8.8.8.8 (Google's DNS) and google.com. The test results showed that all ping attempts were successful, with no packet loss, confirming that each VLAN was correctly configured for internet access.

The PC's IP configuration was verified using the **ipconfig** command to ensure it had received the correct IP address from the DHCP server. Additionally, a traceroute to facebook.com was conducted, which successfully traced the path through the network and the internet, as reflected in the results.



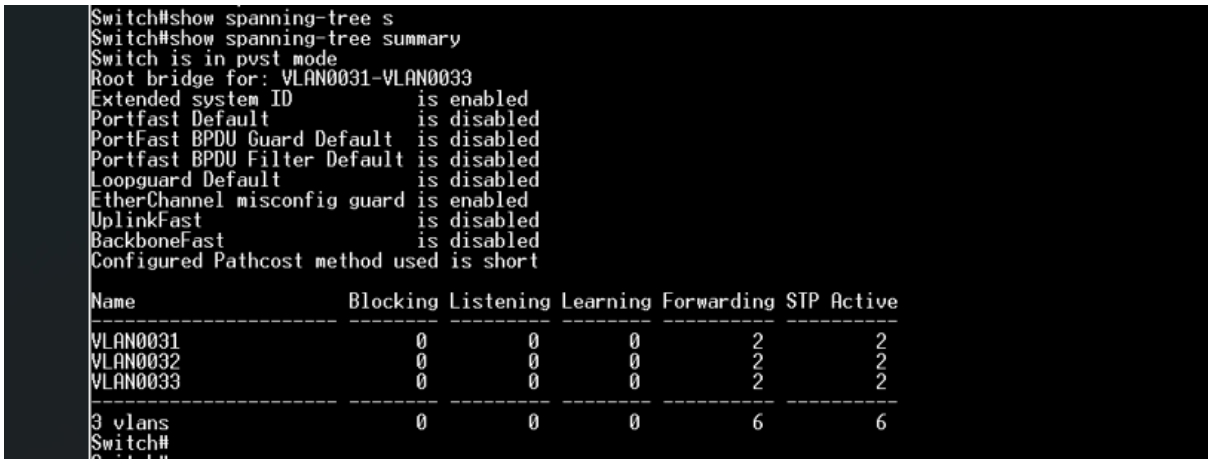


Questions

When you answer following questions, include the relevant IoS command with output of it:

1. How many links will L3Sw_x see in spanning-tree? There are 2 links for each VLAN. (6 total links from VLAN 31, 32, and 33)

Output



```
Switch#show spanning-tree s
Switch#show spanning-tree summary
Switch is in pvst mode
Root bridge for: VLAN0031-VLAN0033
Extended system ID           is enabled
Portfast Default             is disabled
PortFast BPDU Guard Default  is disabled
Portfast BPDU Filter Default is disabled
Loopguard Default            is disabled
EtherChannel misconfig guard is enabled
UplinkFast                   is disabled
BackboneFast                 is disabled
Configured Pathcost method used is short

Name                 Blocking Listening Learning Forwarding STP Active
-------------------- -------- --------- -------- ---------- ----------
VLAN0031                    0         0        0          2          2
VLAN0032                    0         0        0          2          2
VLAN0033                    0         0        0          2          2
-------------------- -------- --------- -------- ---------- ----------
3 vlans                     0         0        0          6          6
Switch#
```

2. What is the router ID of labrouter? 10.95.1.36

3. How many OSPF routes did the Rx receive? (show ip route ospf)

The Rx received 43 OSPF routes.

4. How many OSPF neighbors did Rx have? (show ip ospf neighbor)

The Rx has 10 OSPF neighbors.

5. Where there any requirements in this Case Study that you were unable to fulfill?

We could achieve all the requirements.

6. How you could improve security and performance of the network in your implementation of case study.

- Configure an access control list on the interface to allow only necessary traffic. This can restrict access to specific IP addresses or port numbers.
- Limit inter-VLAN routing to allow only necessary communication between VLANs. Set up ACLs to permit only specific traffic, thereby blocking unnecessary communications and enhancing security.

7. How much time did this Case Study take?

We spent 3 hours on 30th September + 5 hours on 2nd October, total 8 hours for this case study.

Conclusion

In conclusion, this case study gave us practical experience in setting up, configuring, and troubleshooting a complex network. Our team successfully built a working network for Acme Ltd. using real equipment and met all the project requirements. We configured static routes, OSPF, VLANs, DHCP servers, and security features, and ensured the network could connect to the internet. During the project, we faced some troubleshooting. This experience improved our understanding of network design, routing protocols, and security, and also helped us work better as a team. The skills we learned will be useful for future network projects.

Appendix (all configurations)

RX

```
RX#sh running-config
Building configuration...


Current configuration : 1850 bytes
!
! Last configuration change at 16:56:42 EEST Wed Oct 2 2024
! NVRAM config last updated at 15:12:07 EEST Wed Oct 2 2024
! NVRAM config last updated at 15:12:07 EEST Wed Oct 2 2024
version 15.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname RX
!
boot-start-marker
boot-end-marker
!
!
!
no aaa new-model
!
memory-size iomem 5
clock timezone EET 2 0
clock summer-time EEST recurring last Sun Mar 2:00 last Sun Oct 3:00
!
dot11 syslog
ip source-route
!
!
ip cef
!
!
!
```

```
ip domain name iotlab.metropolia.fi
no ipv6 cef
!
multilink bundle-name authenticated
!
!
!
!
!
!
!
!
!
!
!
voice-card 0
!
crypto pki token default removal timeout 0
!
!
!
!
license udi pid CISCO2811 sn FCZ1244720C
username cisco secret 5 $1$pHKC$SQGZxPF3mUCJjc8eENA9Z.
username admin privilege 15 secret 5 $1$LbMv$vEnkWpBEuIe4W2YkLVpjg1
!
redundancy
!
!
ip ssh version 2
!
!
!
!
!
!
!
!
!
interface FastEthernet0/0
 ip address dhcp
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 10.95.36.1 255.255.255.252
 duplex auto
 speed auto
!
interface Serial0/0/0
 no ip address
 shutdown
 no fair-queue
 clock rate 2000000
!
```

```
interface Serial0/0/1
 no ip address
 shutdown
 clock rate 2000000
!
router ospf 1
 redistribute connected metric 10 subnets
 redistribute static metric 10 subnets
 network 10.95.0.0 0.0.1.255 area 0
!
ip forward-protocol nd
no ip http server
no ip http secure-server
!
!
ip route 10.95.30.0 255.255.255.128 10.95.36.2
ip route 10.95.31.0 255.255.255.192 10.95.36.2
ip route 10.95.32.0 255.255.252.0 10.95.36.2
!
!
!
!
!
!
!
control-plane
!
!
!
!
mgcp profile default
!
!
!
!
!
!
line con 0
line aux 0
line vty 0 4
 login local
 transport input ssh
line vty 5 15
 login local
 transport input ssh
!
scheduler allocate 20000 1000
ntp server 10.94.1.3
ntp server 10.94.4.254
end
```

L3SW_X

```
Building configuration...

Current configuration : 5720 bytes
!
! Last configuration change at 17:53:13 EEST Wed Oct 2 2024
! NVRAM config last updated at 17:53:20 EEST Wed Oct 2 2024
!
version 12.2
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname L3SW_X
!
boot-start-marker
boot-end-marker
!
!
!
username cisco secret 5 $1$sm31$hAFf0W0RAJP2KEHzn8tP7/
username admin privilege 15 secret 5 $1$rRTq$TOxUQBvtdzazZ6ARDqCTT/
no aaa new-model
clock timezone EET 2 0
clock summer-time EEST recurring last Sun Mar 2:00 last Sun Oct 3:00
system mtu routing 1500
ip routing
ip arp inspection vlan 31-33
ip domain-name iotlab.metropolia.fi
!
ip dhcp excluded-address 10.95.32.1 10.95.32.30
ip dhcp excluded-address 10.95.30.1 10.95.30.30
ip dhcp excluded-address 10.95.31.1 10.95.31.30
!
ip dhcp pool Student
   network 10.95.32.0 255.255.252.0
   default-router 10.95.32.1
   dns-server 8.8.8.8
!
ip dhcp pool Staff
   network 10.95.30.0 255.255.255.128
   default-router 10.95.30.1
   dns-server 8.8.8.8
!
ip dhcp pool MGT
   network 10.95.31.0 255.255.255.192
   default-router 10.95.31.1
   dns-server 8.8.8.8
!
!
ip dhcp snooping vlan 31-33
```

```
ip dhcp snooping
!
!
!
!
!
!
port-channel load-balance src-dst-ip
!
spanning-tree mode pvst
spanning-tree extend system-id
spanning-tree vlan 31-33 priority 24576
!
vlan internal allocation policy ascending
!
ip ssh version 2
!
!
!
!
!
!
interface Port-channel1
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 31-33
 switchport mode trunk
!
interface Port-channel2
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 31-33
 switchport mode trunk
!
interface FastEthernet0/1
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/2
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/3
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
```

```
 spanning-tree bpduguard enable
!
interface FastEthernet0/4
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/5
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/6
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/7
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/8
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/9
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/10
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
```

```
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/11
 switchport access vlan 33
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/12
 switchport access vlan 33
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/13
 shutdown
!
interface FastEthernet0/14
 shutdown
!
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/16
 shutdown
!
interface FastEthernet0/17
 shutdown
!
interface FastEthernet0/18
 shutdown
!
interface FastEthernet0/19
 no switchport
 ip address 10.95.36.2 255.255.255.252
!
interface FastEthernet0/20
 shutdown
!
interface FastEthernet0/21
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 31-33
 switchport mode trunk
 ip arp inspection trust
 channel-group 1 mode active
 ip dhcp snooping trust
!
interface FastEthernet0/22
```

```
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 31-33
 switchport mode trunk
 ip arp inspection trust
 channel-group 1 mode active
 ip dhcp snooping trust
!
interface FastEthernet0/23
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 31-33
 switchport mode trunk
 ip arp inspection trust
 channel-group 2 mode active
 ip dhcp snooping trust
!
interface FastEthernet0/24
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 31-33
 switchport mode trunk
 ip arp inspection trust
 channel-group 2 mode active
 ip dhcp snooping trust
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 no ip address
!
interface Vlan31
 ip address 10.95.32.1 255.255.252.0
!
interface Vlan32
 ip address 10.95.30.1 255.255.255.128
!
interface Vlan33
 ip address 10.95.31.1 255.255.255.192
!
ip http server
ip http secure-server
!
!
ip route 0.0.0.0 0.0.0.0 10.95.36.1
!
logging esm config
!
!
!
line con 0
line vty 0 4
 login local
 transport input ssh
line vty 5 15
```

```
 login local
 transport input ssh
!
ntp server 10.94.1.3
ntp server 10.94.4.254
end
```

L2SW_X1

```
Building configuration...

Current configuration : 4244 bytes
!
! Last configuration change at 18:06:48 EEST Wed Oct 2 2024
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname L2swX1
!
boot-start-marker
boot-end-marker
!
!
username cisco secret 5 $1$k20P$tjTuOAzcCLKQ2PvMOnfko/
username admin privilege 15 secret 5 $1$izer$pptftR5M5.QQyFR0M.rG20
no aaa new-model
clock timezone EET 2 0
clock summer-time EEST recurring last Sun Mar 2:00 last Sun Oct 3:00
system mtu routing 1500
ip arp inspection vlan 31-33
!
!
ip dhcp snooping vlan 31-33
ip dhcp snooping
ip domain-name iotlab.metropolia.fi
!
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
```

```
ip ssh version 2
!
!
!
!
!
interface FastEthernet0/1
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/2
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/3
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/4
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/5
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/6
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
```

```
interface FastEthernet0/7
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/8
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/9
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/10
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/11
 switchport access vlan 33
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/12
 switchport access vlan 33
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/13
 shutdown
!
interface FastEthernet0/14
 shutdown
!
```

```
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/16
 shutdown
!
interface FastEthernet0/17
 shutdown
!
interface FastEthernet0/18
 shutdown
!
interface FastEthernet0/19
 shutdown
!
interface FastEthernet0/20
 shutdown
!
interface FastEthernet0/21
 ip arp inspection trust
 ip dhcp snooping trust
!
interface FastEthernet0/22
 ip arp inspection trust
 ip dhcp snooping trust
!
interface FastEthernet0/23
 ip arp inspection trust
 ip dhcp snooping trust
!
interface FastEthernet0/24
 ip arp inspection trust
 ip dhcp snooping trust
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan31
 ip address 10.95.32.3 255.255.252.0
!
interface Vlan32
 ip address 10.95.30.3 255.255.255.128
!
interface Vlan33
 ip address 10.95.31.3 255.255.255.192
!
ip http server
ip http secure-server
!
```

```
vstack
!
line con 0
line vty 0 4
 login local
 transport input ssh
line vty 5 15
 login local
 transport input ssh
!
ntp server 10.94.1.3
ntp server 10.94.4.254
end
```

L2SW_X2

```
Building configuration...

Current configuration : 4214 bytes
!
! Last configuration change at 17:57:02 EEST Wed Oct 2 2024
!
version 15.0
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname SW4
!
boot-start-marker
boot-end-marker
!
!
username cisco secret 5 $1$EZ2E$2wRD7um83X6nCxJKsjiO3.
username admin privilege 15 secret 5 $1$LKpl$W.1BYxCCfShG.aPmdeX830
no aaa new-model
clock timezone EET 2 0
clock summer-time EEST recurring last Sun Mar 2:00 last Sun Oct 3:00
system mtu routing 1500
ip arp inspection vlan 31-33
!
!
ip dhcp snooping vlan 31-33
ip domain-name iotlab.metropolia.fi
!
!
!
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
ip ssh version 2
!
!
!
!
!
interface FastEthernet0/1
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
```

```
 spanning-tree bpduguard enable
!
interface FastEthernet0/2
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/3
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/4
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/5
 switchport access vlan 31
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/6
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/7
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/8
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
```

```
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/9
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/10
 switchport access vlan 32
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/11
 switchport access vlan 33
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/12
 switchport access vlan 33
 switchport mode access
 switchport port-security maximum 2
 switchport port-security
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface FastEthernet0/13
 shutdown
!
interface FastEthernet0/14
 shutdown
!
interface FastEthernet0/15
 shutdown
!
interface FastEthernet0/16
 shutdown
!
interface FastEthernet0/17
 shutdown
!
interface FastEthernet0/18
 shutdown
!
```

```
interface FastEthernet0/19
 shutdown
!
interface FastEthernet0/20
 shutdown
!
interface FastEthernet0/21
 ip arp inspection trust
 ip dhcp snooping trust
!
interface FastEthernet0/22
 ip arp inspection trust
 ip dhcp snooping trust
!
interface FastEthernet0/23
 ip arp inspection trust
 ip dhcp snooping trust
!
interface FastEthernet0/24
 ip arp inspection trust
 ip dhcp snooping trust
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
 no ip address
!
interface Vlan31
 ip address 10.95.32.2 255.255.252.0
!
interface Vlan32
 ip address 10.95.30.2 255.255.255.128
!
interface Vlan33
 ip address 10.95.31.2 255.255.255.192
!
ip http server
ip http secure-server
!
vstack
!
line con 0
line vty 0 4
 login local
 transport input ssh
line vty 5 15
 login local
 transport input ssh
!
ntp server 10.94.1.3
ntp server 10.94.4.254
end
```