

EC4060
Computer and Data Networks

ASSIGNMENT 1
INDEPENDENT LEARNING AND IMPLEMENTATION

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GROUP CG12

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01 Objective

To apply the principles of network design to create and simulate a functional network infrastructure for an institution with multiple branches.

02 Scenario

The Engineering Faculty consists of five academic departments (Civil, Mechanical, Electrical and Electronic Engineering (EEE), Computer Engineering, and Interdisciplinary Studies) along with an Administration Section, requiring a scalable and secure network. The design must accommodate unique subnet allocation, subnet information (subnet mask, usable host range, broadcast address), and scalability for at least 30% future growth.

03 Network Design Implementation

a) Subnet Calculation Table

The following table provides details of VLAN IDs, subnet allocations, required IPs, and 30% growth scalability considerations:

Department	Network Type	VLAN ID	Total Hosts Needed	Network Address/Prefix	Subnet Mask	Usable IP Range	Broadcast Address
COM	Student	10	325	192.168.1.0/23	255.255.254.0	192.168.1.1 - 192.168.2.254	192.168.2.255
COM	Staff	11	100	192.168.3.0/25	255.255.255.128	192.168.3.1 - 192.168.3.126	192.168.3.127
EE	Student	20	195	192.168.4.0/24	255.255.255.0	192.168.4.1 - 192.168.4.254	192.168.4.255
EE	Staff	21	87	192.168.5.0/25	255.255.255.128	192.168.5.1 - 192.168.5.126	192.168.5.127
Civil	Student	30	98	192.168.6.0/25	255.255.255.128	192.168.6.1 - 192.168.6.126	192.168.6.127
Civil	Staff	31	42	192.168.7.0/26	255.255.255.192	192.168.7.1 - 192.168.7.62	192.168.7.63
Mech	Student	40	98	192.168.8.0/25	255.255.255.128	192.168.8.1 - 192.168.8.126	192.168.8.127
Mech	Staff	41	48	192.168.9.0/26	255.255.255.192	192.168.9.1 - 192.168.9.62	192.168.9.63
IDS	Student	50	20	192.168.10.0/27	255.255.255.224	192.168.10.1 - 192.168.10.30	192.168.10.31
IDS	Staff	51	42	192.168.11.0/26	255.255.255.192	192.168.11.1 - 192.168.11.62	192.168.11.63
Admin	Staff	60	39	192.168.12.0/26	255.255.255.192	192.168.12.1 - 192.168.12.62	192.168.12.63
CCTV	Staff	70	65	192.168.13.0/26	255.255.255.192	192.168.13.1 - 192.168.13.62	192.168.13.63

Table 1: Subnet Allocation Table

b) VLAN Plan and Mapping Table

VLAN ID	VLAN Name	Subnet	Purpose
10	Computer_Students	192.168.1.0/23	Student computers in COM
11	Computer_Staff	192.168.3.0/25	Staff computers in COM
20	EEE_Students	192.168.4.0/24	Student computers in EE
21	EEE_Staff	192.168.5.0/25	Staff computers in EE
30	Civil_Students	192.168.6.0/25	Student computers in Civil
31	Civil_Staff	192.168.7.0/26	Staff computers in Civil
40	Mech_Students	192.168.8.0/25	Student computers in Mech
41	Mech_Staff	192.168.9.0/26	Staff computers in Mech
50	IDS_Students	192.168.10.0/27	Student computers in IDS
51	IDS_Staff	192.168.11.0/26	Staff computers in IDS
60	Administration	192.168.12.0/26	Administration staff
70	CCTV	192.168.13.0/26	CCTV devices (staff)

c) Network Design Diagram

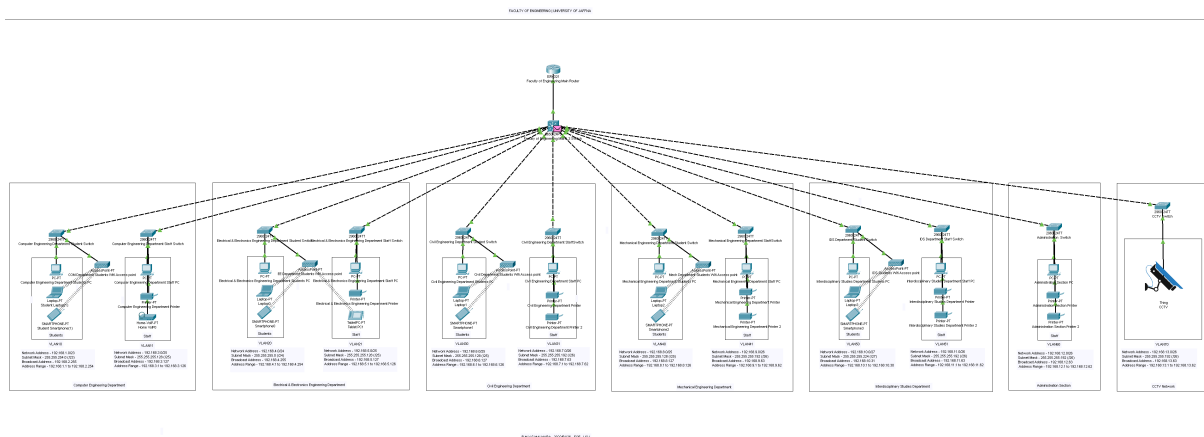


Figure 1: Network Design Diagram

d) Simulation and Configuration

• Network Simulation File

The network simulation for this project has been prepared using Cisco Packet Tracer. You can find the relevant simulation file here: [Download the .pkt file](#). As well as you can find the relevant simulation video file here: [Download the videot file](#).

• Core Router Configuration

You can find the relevant Configuration file here: [Download Cofiguration file](#).

```
enable
configure terminal

interface GigabitEthernet0/0/0
no shutdown

interface GigabitEthernet0/0/0.10
encapsulation dot1Q 10
ip address 192.168.1.1 255.255.254.0
exit

interface GigabitEthernet0/0/0.11
encapsulation dot1Q 11
ip address 192.168.3.1 255.255.255.128
exit

interface GigabitEthernet0/0/0.20
encapsulation dot1Q 20
ip address 192.168.4.1 255.255.255.0
exit

interface GigabitEthernet0/0/0.21
encapsulation dot1Q 21
ip address 192.168.5.1 255.255.255.128
exit

interface GigabitEthernet0/0/0.30
encapsulation dot1Q 30
ip address 192.168.6.1 255.255.255.128
exit

interface GigabitEthernet0/0/0.31
encapsulation dot1Q 31
```

```

ip address 192.168.7.1 255.255.255.192
exit

interface GigabitEthernet0/0/0.40
encapsulation dot1Q 40
ip address 192.168.8.1 255.255.255.128
exit

interface GigabitEthernet0/0/0.41
encapsulation dot1Q 41
ip address 192.168.9.1 255.255.255.192
exit

interface GigabitEthernet0/0/0.50
encapsulation dot1Q 50
ip address 192.168.10.1 255.255.255.224
exit

interface GigabitEthernet0/0/0.51
encapsulation dot1Q 51
ip address 192.168.11.1 255.255.255.192
exit

interface GigabitEthernet0/0/0.60
encapsulation dot1Q 60
ip address 192.168.12.1 255.255.255.192
exit

interface GigabitEthernet0/0/0.70
encapsulation dot1Q 70
ip address 192.168.13.1 255.255.255.192
exit

ip routing

ip dhcp excluded-address 192.168.1.1 192.168.1.10
ip dhcp excluded-address 192.168.3.1 192.168.3.10

ip dhcp pool COM_Students
network 192.168.1.0 255.255.254.0
default-router 192.168.1.1
dns-server 8.8.8.8
exit

ip dhcp pool COM_Staff
network 192.168.3.0 255.255.255.128
default-router 192.168.3.1
dns-server 8.8.8.8
exit

ip dhcp pool EE_Students
network 192.168.4.0 255.255.255.0
default-router 192.168.4.1
dns-server 8.8.8.8
exit

ip dhcp pool EE_Staff
network 192.168.5.0 255.255.255.128
default-router 192.168.5.1
dns-server 8.8.8.8
exit

ip dhcp pool Civil_Students
network 192.168.6.0 255.255.255.128
default-router 192.168.6.1
dns-server 8.8.8.8
exit

ip dhcp pool Civil_Staff
network 192.168.7.0 255.255.255.192
default-router 192.168.7.1
dns-server 8.8.8.8
exit

```

```

ip dhcp pool Mech_Students
network 192.168.8.0 255.255.255.128
default-router 192.168.8.1
dns-server 8.8.8.8
exit

ip dhcp pool Mech_Staff
network 192.168.9.0 255.255.255.192
default-router 192.168.9.1
dns-server 8.8.8.8
exit

ip dhcp pool IDS_Students
network 192.168.10.0 255.255.255.224
default-router 192.168.10.1
dns-server 8.8.8.8
exit

ip dhcp pool IDS_Staff
network 192.168.11.0 255.255.255.192
default-router 192.168.11.1
dns-server 8.8.8.8
exit

ip dhcp pool Admin
network 192.168.12.0 255.255.255.192
default-router 192.168.12.1
dns-server 8.8.8.8
exit

ip dhcp pool CCTV
network 192.168.13.0 255.255.255.192
default-router 192.168.13.1
dns-server 8.8.8.8
exit
exit

write memory

```

- Layer 3 Core Switch Configuration

You can find the relevant Configuration file here: [Download Cofiguration file.](#)

```

enable
configure terminal

vlan 11
name Computer_Staff
exit
vlan 10
name Computer_Students
exit
vlan 21
name EEE_Staff
exit
vlan 20
name EEE_Students
exit
vlan 31
name Civil_Staff
exit
vlan 30
name Civil_Students
exit
vlan 41
name Mech_Staff
exit
vlan 40
name Mech_Students
exit
vlan 51
name IDS_Staff

```

```

exit
vlan 50
name IDS_Students
exit
vlan 60
name Administration
exit
vlan 70
name CCTV
exit

interface GigabitEthernet1/0/1
description Trunk to Router
switchport mode trunk
switchport trunk allowed vlan 10,11,20,21,30,31,40,41,50,51,60,70
exit

interface GigabitEthernet1/0/2
description Trunk to Comp. Eng Student Switch
switchport mode trunk
switchport trunk allowed vlan 10
exit

interface GigabitEthernet1/0/3
description Trunk to Comp. Eng Staff Switch
switchport mode trunk
switchport trunk allowed vlan 11
exit

interface GigabitEthernet1/0/4
description Trunk to EEE Student Switch
switchport mode trunk
switchport trunk allowed vlan 20
exit

interface GigabitEthernet1/0/5
description Trunk to EEE Staff Switch
switchport mode trunk
switchport trunk allowed vlan 21
exit

interface GigabitEthernet1/0/6
description Trunk to Civil Eng Student Switch
switchport mode trunk
switchport trunk allowed vlan 30
exit

interface GigabitEthernet1/0/7
description Trunk to Civil Eng Staff Switch
switchport mode trunk
switchport trunk allowed vlan 31
exit

interface GigabitEthernet1/0/8
description Trunk to Mech Eng Student Switch
switchport mode trunk
switchport trunk allowed vlan 40
exit

interface GigabitEthernet1/0/9
description Trunk to Mech Eng Staff Switch
switchport mode trunk
switchport trunk allowed vlan 41
exit

interface GigabitEthernet1/0/10
description Trunk to IDS Student Switch
switchport mode trunk
switchport trunk allowed vlan 50
exit

interface GigabitEthernet1/0/11
description Trunk to IDS Staff Switch

```

```

switchport mode trunk
switchport trunk allowed vlan 51
exit

interface GigabitEthernet1/0/12
description Trunk to Admin Switch
switchport mode trunk
switchport trunk allowed vlan 60
exit

interface GigabitEthernet1/0/13
description Trunk to CCTV Switch
switchport mode trunk
switchport trunk allowed vlan 70
exit
exit

write memory

```

- Layer 2 Switch Configuration

You can find the relevant Configuration file here: [Download Cofiguration file.](#)

```

# Computer Department Student Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 10
exit

int range FastEthernet0/1 - 24
description CCTV
switchport mode access
switchport access vlan 10
exit

exit
write memory

# Computer Department Staff Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 11
exit

int range FastEthernet0/1 - 20
description Admin PC
switchport mode access
switchport access vlan 11
exit

int range FastEthernet0/1 - 24
description Admin Printer
switchport mode access
switchport access vlan 11
exit

exit
write memory

# Electrical Engineering Student Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 20
exit

```

```

int range FastEthernet0/1 - 24
description Student PCs
switchport mode access
switchport access vlan 20
exit

exit
write memory

# Electrical Engineering Staff Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 21
exit

int range FastEthernet0/1 - 20
description Staff PCs
switchport mode access
switchport access vlan 21
exit

int range FastEthernet0/1 - 24
description Staff Printer
switchport mode access
switchport access vlan 21
exit

exit
write memory

# Civil Engineering Student Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 30
exit

int range FastEthernet0/1 - 24
description Student PCs
switchport mode access
switchport access vlan 30
exit

exit
write memory

# Civil Engineering Staff Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 31
exit

int range FastEthernet0/1 - 20
description Staff PCs
switchport mode access
switchport access vlan 31
exit

int range FastEthernet0/1 - 24
description Staff Printer
switchport mode access
switchport access vlan 31
exit

```



```

exit
write memory

# Mechanical Engineering Student Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 40
exit

int range FastEthernet0/1 - 24
description Student PCs
switchport mode access
switchport access vlan 40
exit

exit
write memory

# Mechanical Engineering Staff Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 41
exit

int range FastEthernet0/1 - 20
description Staff PCs
switchport mode access
switchport access vlan 41
exit

int range FastEthernet0/1 - 24
description Staff Printer
switchport mode access
switchport access vlan 41
exit

exit
write memory

# IDS Student Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 50
exit

int range FastEthernet0/1 - 24
description Student PCs
switchport mode access
switchport access vlan 50
exit

exit
write memory

# IDS Staff Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 51
exit

int range FastEthernet0/1 - 20

```

```

description Staff PCs
switchport mode access
switchport access vlan 51
exit

int range FastEthernet0/1 - 24
description Staff Printer
switchport mode access
switchport access vlan 51
exit

exit
write memory

# Administration Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 60
exit

int range FastEthernet0/1 - 24
description Admin PCs
switchport mode access
switchport access vlan 60
exit

exit
write memory

# CCTV Switch
en
config t
interface GigabitEthernet0/1
description Trunk to Core Switch
switchport mode trunk
switchport trunk allowed vlan 70
exit

int range FastEthernet0/1 - 24
description CCTV Cameras
switchport mode access
switchport access vlan 70
exit

exit
write memory

```

e) Test Report

- Ping and traceroute results for device connectivity. You can find the relevant Video file here: [Download video file.](#)

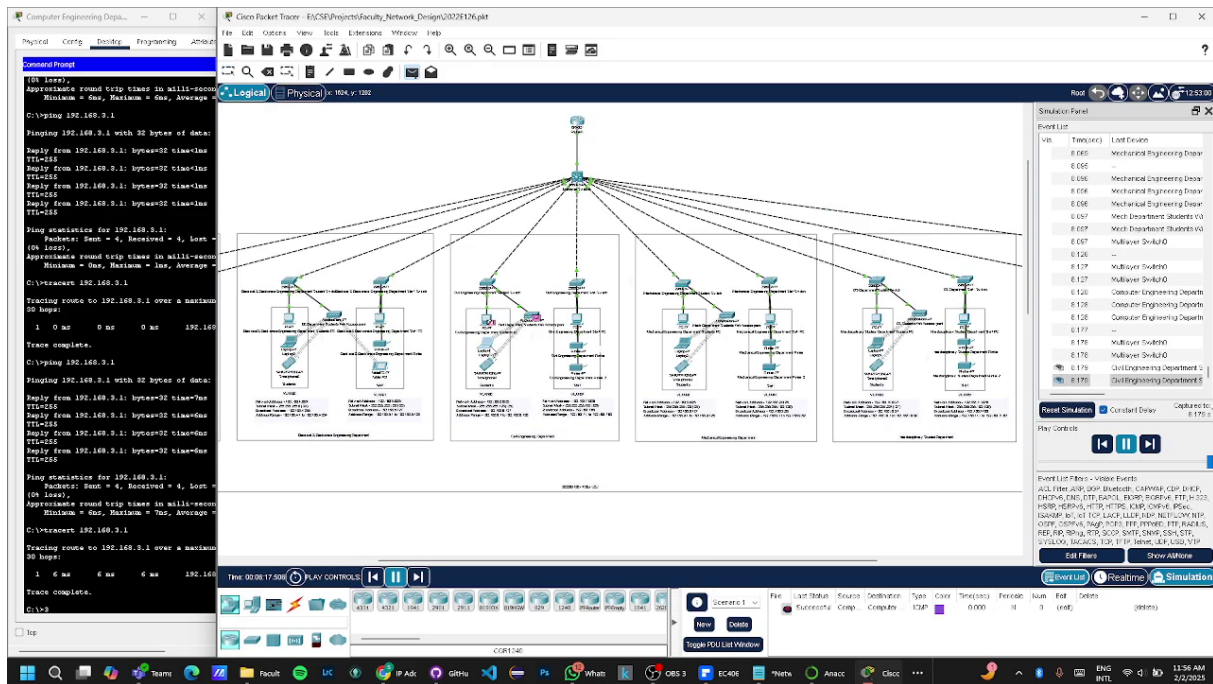


Figure 2: Between staff devices and printers ping and traceroute

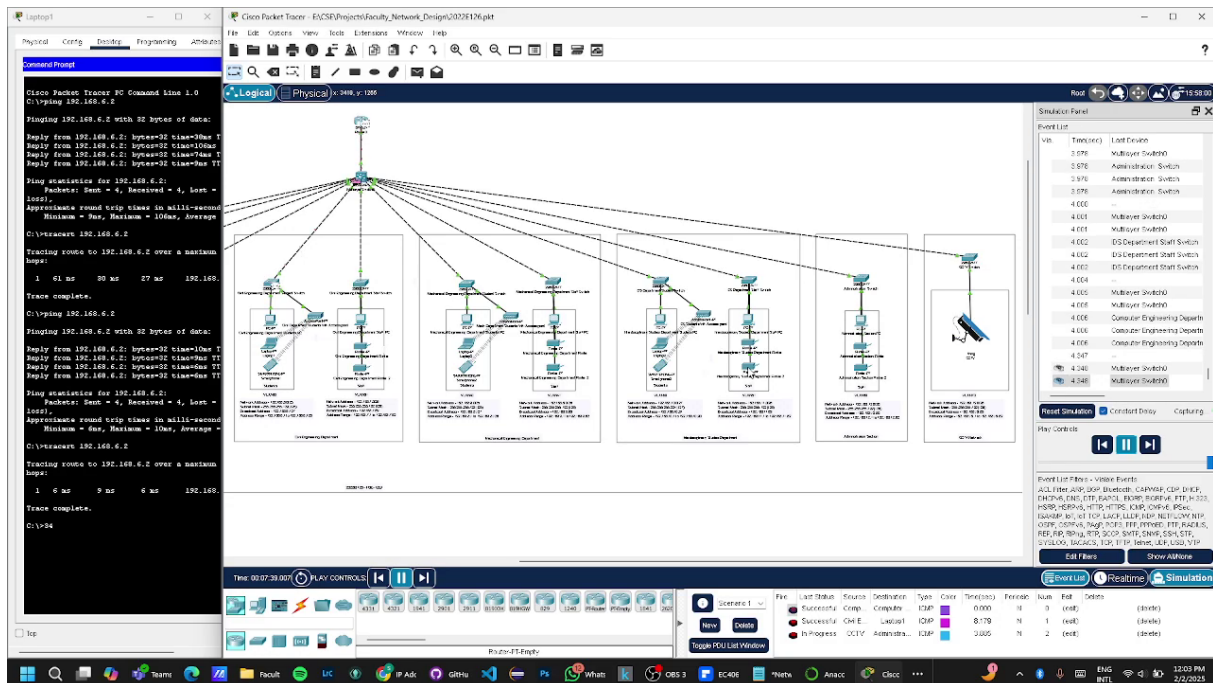


Figure 3: Between student devices within the same subnet ping and traceroute

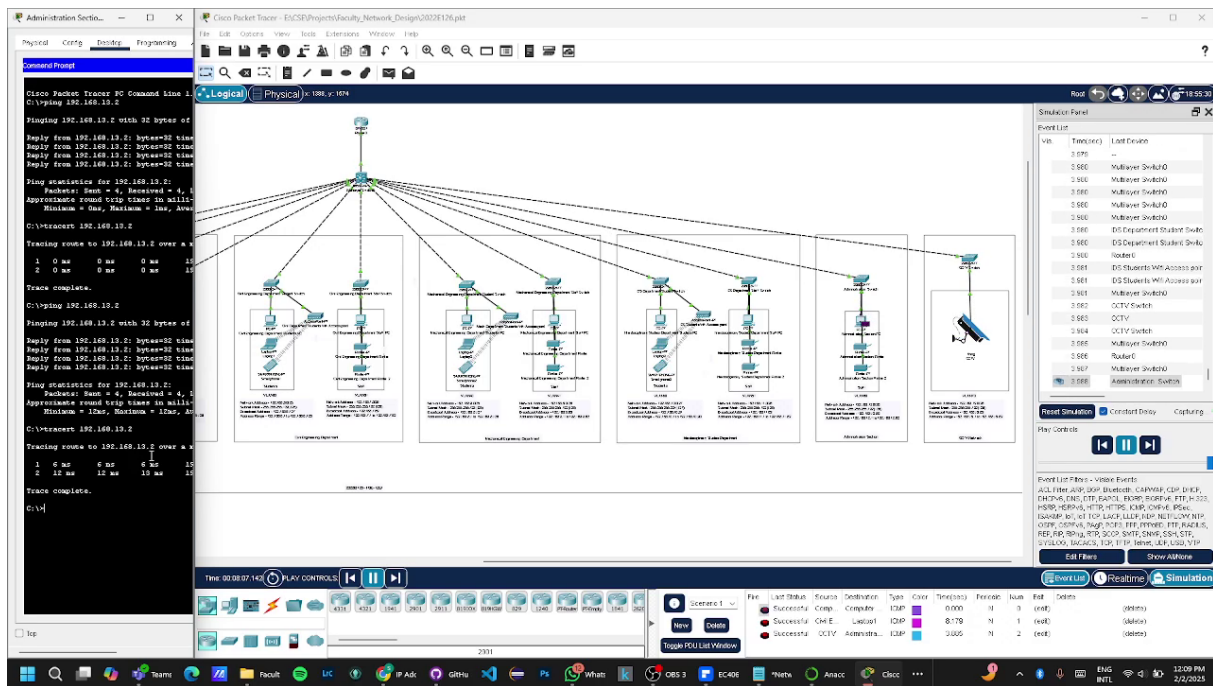


Figure 4: Between CCTV cameras and the administration computers ping and traceroute

- VLAN functionality tests for logical separation.

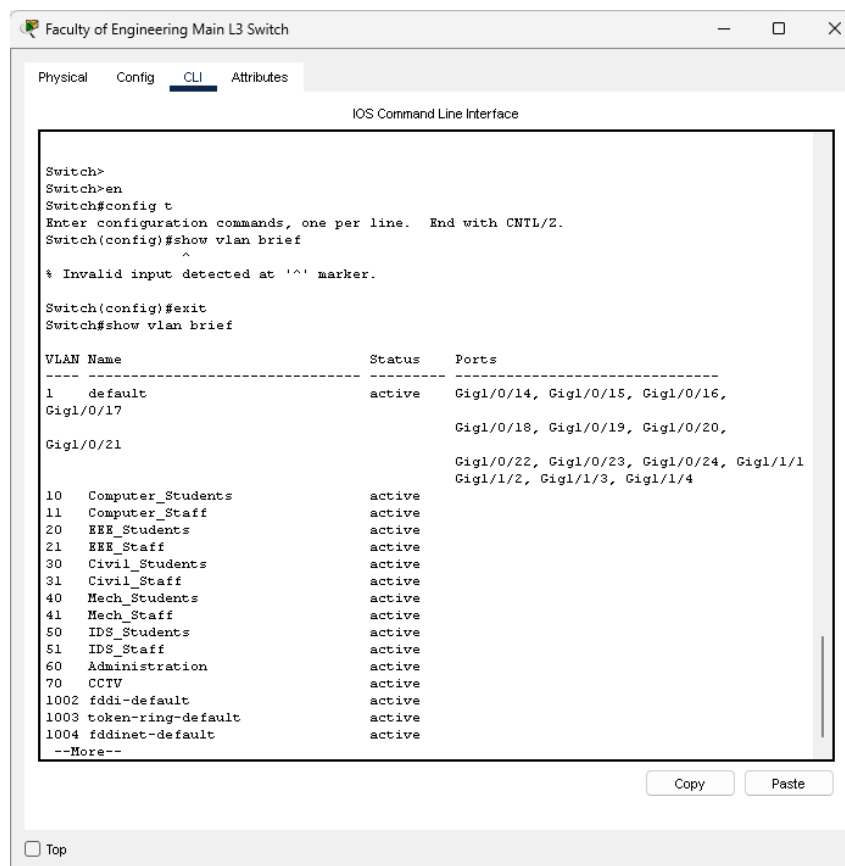


Figure 5: VLAN functionality test

- Scalability testing by adding extra devices and verifying network stability.

You can find the relevant Video file here: [Download video file.](#)

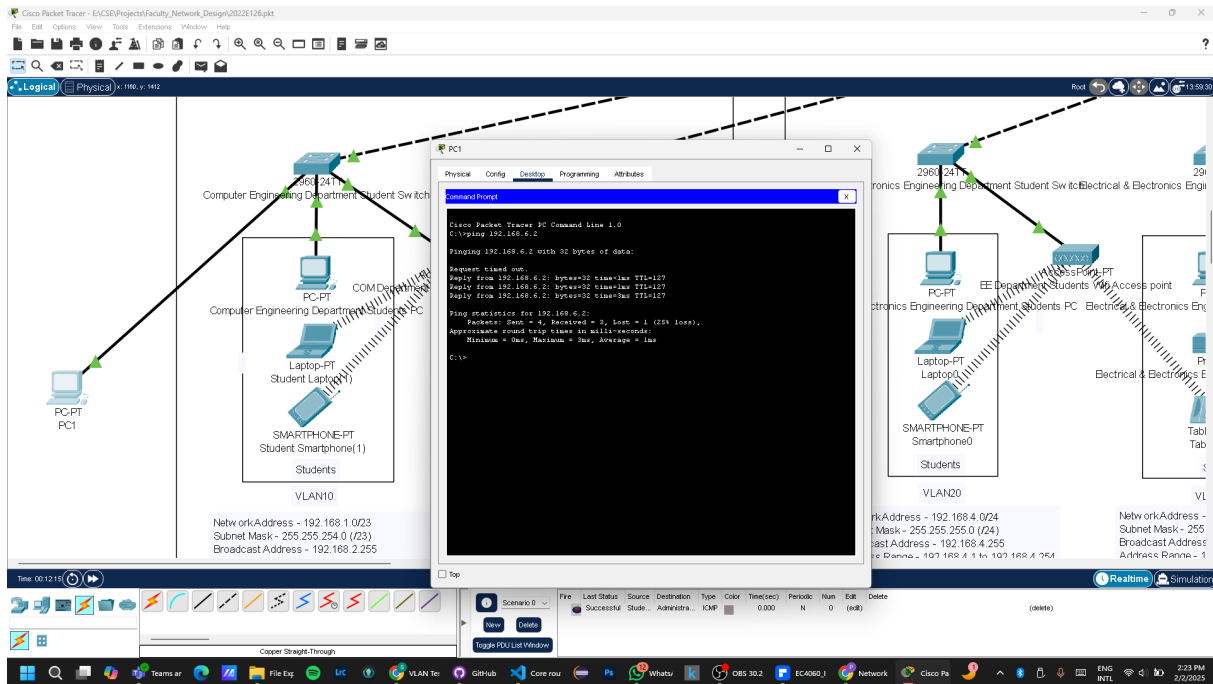


Figure 6: Scalability Validation

04 Conclusion

The designed network meets the given requirements, ensuring efficient segmentation, scalability, and security across the faculty departments and administration.

05 GitHub Repository

For the full project implementation, configuration files, and network simulation, refer to the GitHub repository: https://github.com/sasindumal/Faculty_Network_Design.git