

**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, Broadcast Address and Usable IP Range:

You can find the relevant Network plan table file here: [Download Network plan table file.](#)

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

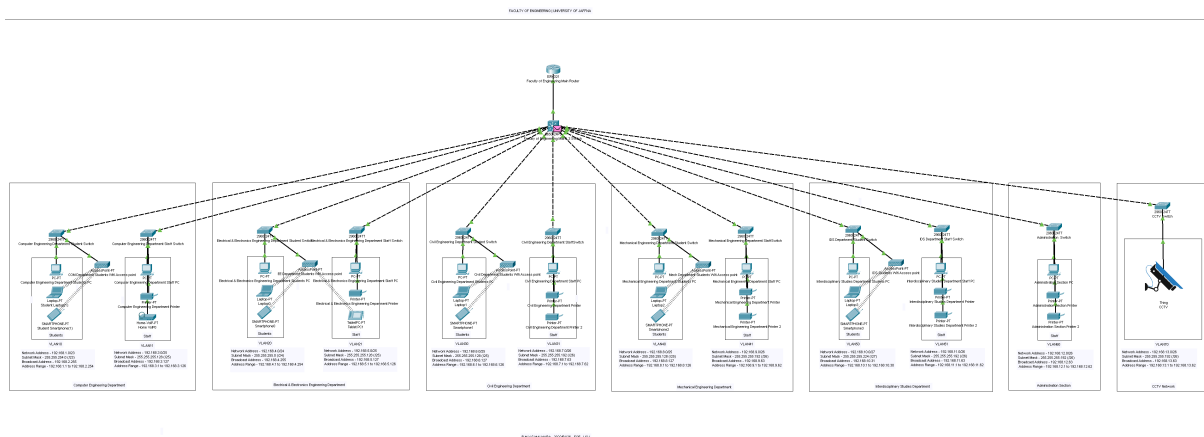


Figure 1: Network Design Diagram

### 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 simulation Cisco save file](#). As well as you can find the relevant simulation video file here: [Download the simulation video file](#).

- Core Router Configuration

You can find the relevant Configuration file here: [Download Core Router Configuration 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: [Core Switch 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 Layer 2 Switch Configuration 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

```

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

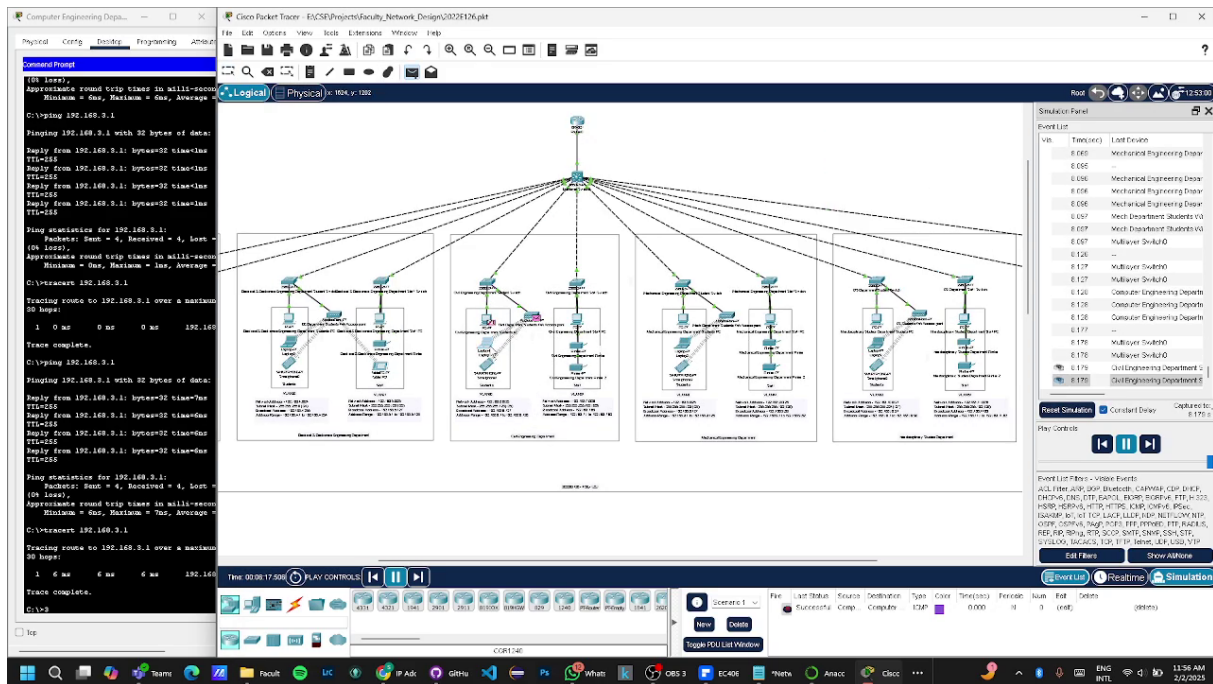


Figure 2: Between staff devices and printers ping and traceroute

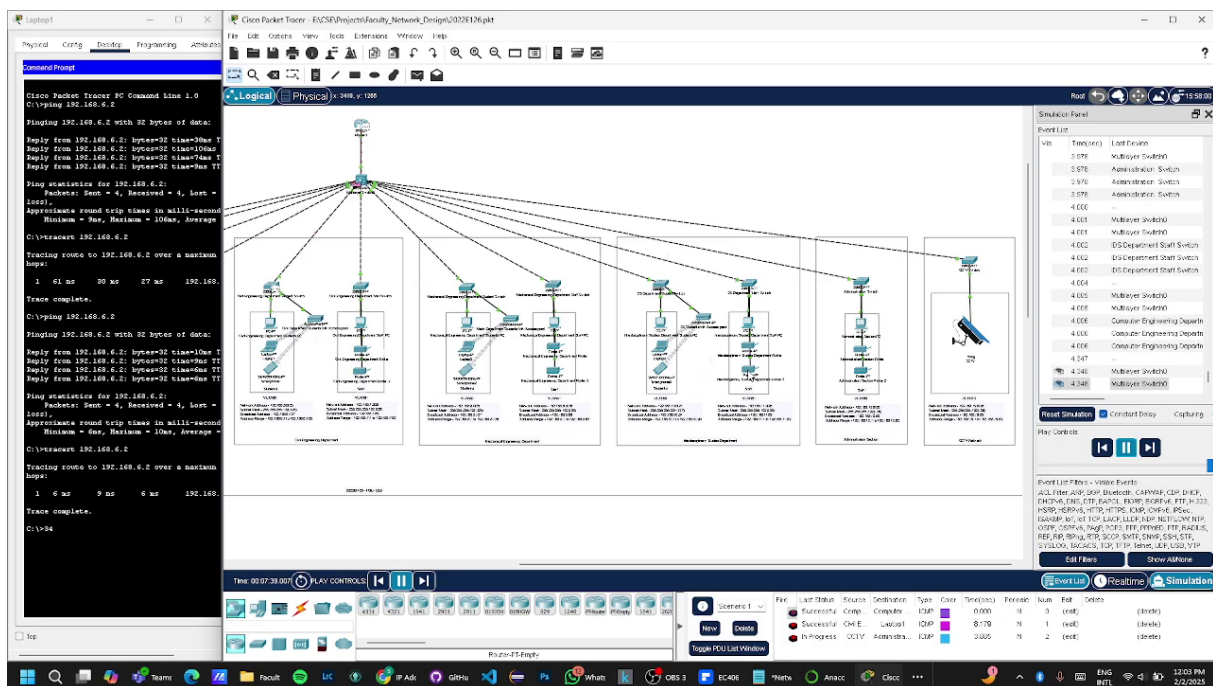


Figure 3: Between student devices within the same subne ping and traceroute

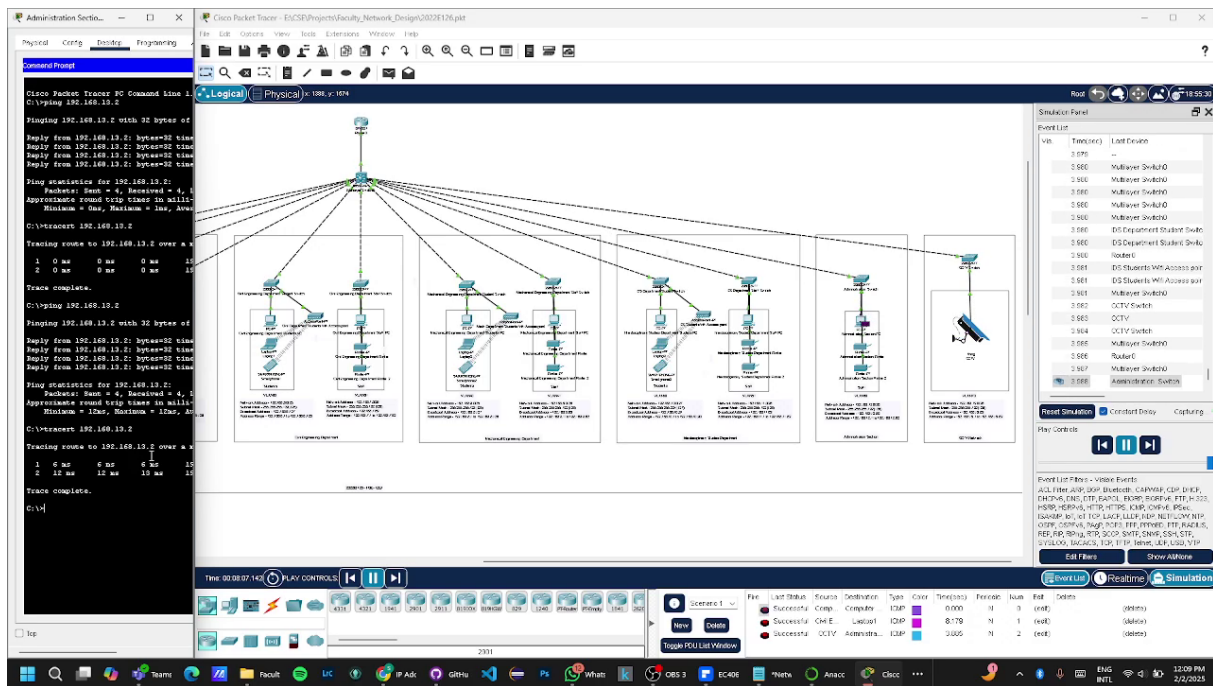


Figure 4: Between CCTV cameras and the administration computers ping and traceroute

- VLAN functionality tests for logical separation.

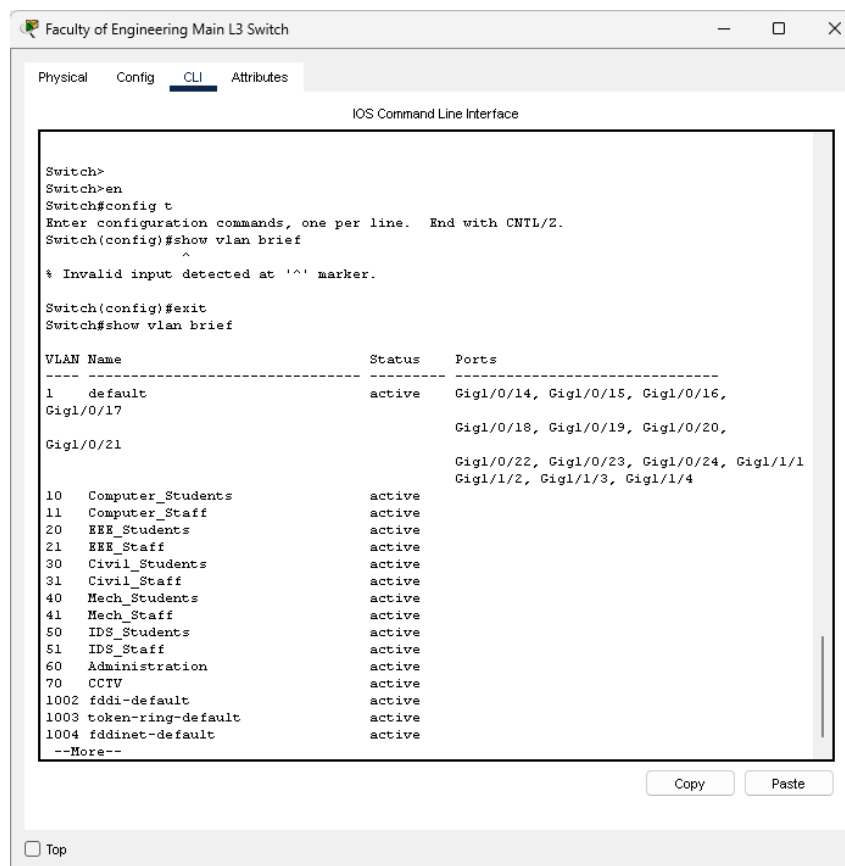


Figure 5: VLAN functionality test

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

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

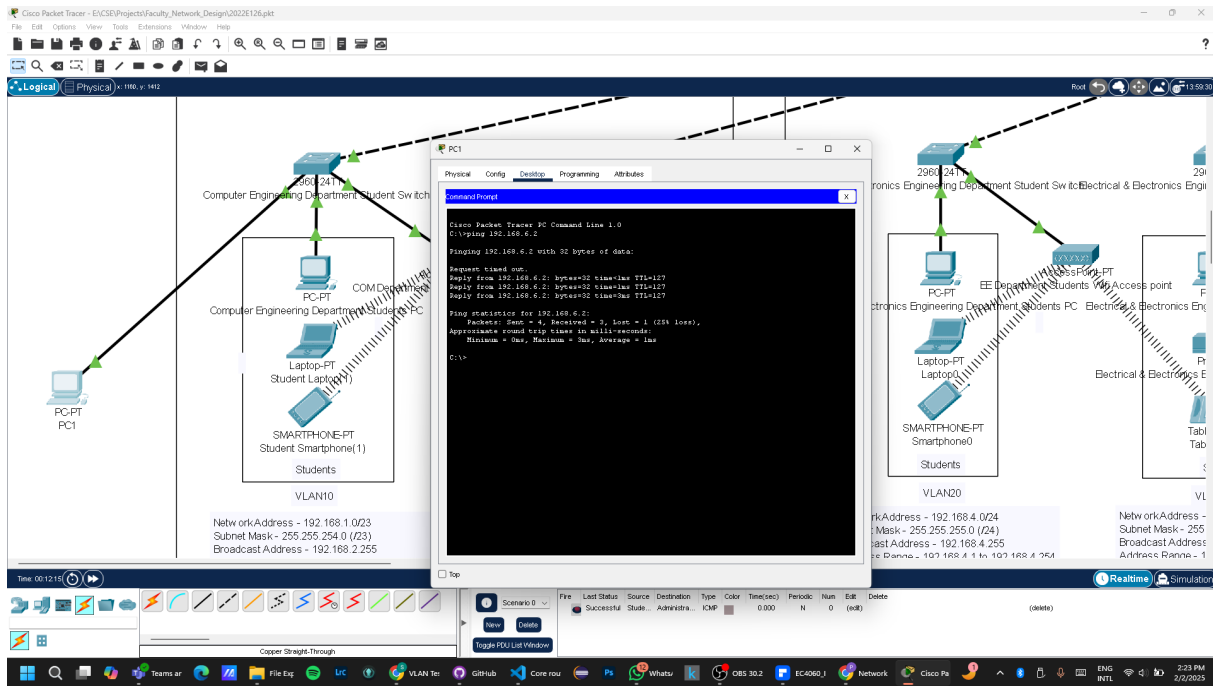


Figure 6: Scalability Validation

## 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](https://github.com/sasindumal/Faculty_Network_Design.git)