

Network Infrastructure Design Report

EC4060



**FERNANDO S.M.H.G
2022/E/145**

1. Introduction

A well-structured and efficient network infrastructure is important for any institution to effectively communicate and manage resources. Also, increased demands by the students, the faculty, and the staff in six different departments-Civil, Mechanical, Electrical and Electronic Engineering, Computer, Interdisciplinary Studies, and Administration-led the Faculty of Engineering at the University of Jaffna to go for an upgradation of the already available network.

This project details the design and implementation of a scalable, secure, high-performance network that addresses the needs of these departments. It provides for the integration of VLANs, inter-VLAN routing, DHCP services, and mechanisms for access control on the network for maximum connectivity, ensuring data security and efficient traffic management. The structured subnetting approach allows this design to provide for both present needs and future development. This will be achieved by making use of Layer 3 and Layer 2 switches in addition to a core routing framework that will provide device and department connectivity while logically segmenting and providing security policies.

2. Network Design Overview

2.1 Subnet Allocation

Each department and device category (students, staff, and other devices) was allocated unique subnets to optimize performance and security. Subnets were designed with scalability in mind, ensuring a 30% growth allowance

Table01: Subnet Table

Department	Device Type	Total Devices	Future Growth (30%)	Required Hosts	Subnet Mask	Network Address	Usable IP Range	Broadcast Address
Computer Eng	Students	250	325	512	255.255.254.0 (/23)	192.168.0.0	192.168.0.1 - 192.168.1.254	192.168.1.255
	Staff	50	65	128	255.255.255.128 (/25)	192.168.2.0	192.168.2.1 - 192.168.2.126	192.168.2.127
	Other Devices	27	35	64	255.255.255.192 (/26)	192.168.2.128	192.168.2.129 - 192.168.2.190	192.168.2.191
EEE Eng	Students	150	195	256	255.255.255.0 (/24)	192.168.3.0	192.168.3.1 - 192.168.3.254	192.168.3.255
	Staff	50	65	128	255.255.255.128 (/25)	192.168.4.0	192.168.4.1 - 192.168.4.126	192.168.4.127
	Other Devices	17	22	32	255.255.255.224 (/27)	192.168.4.128	192.168.4.129 - 192.168.4.158	192.168.4.159
Civil Eng	Students	75	98	128	255.255.255.128 (/25)	192.168.5.0	192.168.5.1 - 192.168.5.126	192.168.5.127
	Staff	25	33	64	255.255.255.192 (/26)	192.168.5.128	192.168.5.129 - 192.168.5.190	192.168.5.191
	Other Devices	7	10	16	255.255.255.240 (/28)	192.168.5.192	192.168.5.193 - 192.168.5.206	192.168.5.207
Mech Eng	Students	75	98	128	255.255.255.128 (/25)	192.168.6.0	192.168.6.1 - 192.168.6.126	192.168.6.127
	Staff	25	33	64	255.255.255.192 (/26)	192.168.6.128	192.168.6.129 - 192.168.6.190	192.168.6.191
	Other Devices	12	16	32	255.255.255.224 (/27)	192.168.6.192	192.168.6.193 - 192.168.6.222	192.168.6.223
IDS	Students	15	20	32	255.255.255.224 (/27)	192.168.7.0	192.168.7.1 - 192.168.7.30	192.168.7.31
	Staff	25	33	64	255.255.255.192 (/26)	192.168.7.32	192.168.7.33 - 192.168.7.94	192.168.7.95
	Other Devices	7	10	16	255.255.255.240 (/28)	192.168.7.96	192.168.7.97 - 192.168.7.110	192.168.7.111
Administration	Staff	25	33	64	255.255.255.192 (/26)	192.168.8.0	192.168.8.1 - 192.168.8.62	192.168.8.63
	Printers	5	7	16	255.255.255.240 (/28)	192.168.8.64	192.168.8.65 - 192.168.8.78	192.168.8.79
CCTV System	CCTV Cameras	50	65	128	255.255.255.128 (/25)	192.168.9.0	192.168.9.1 - 192.168.9.126	192.168.9.127

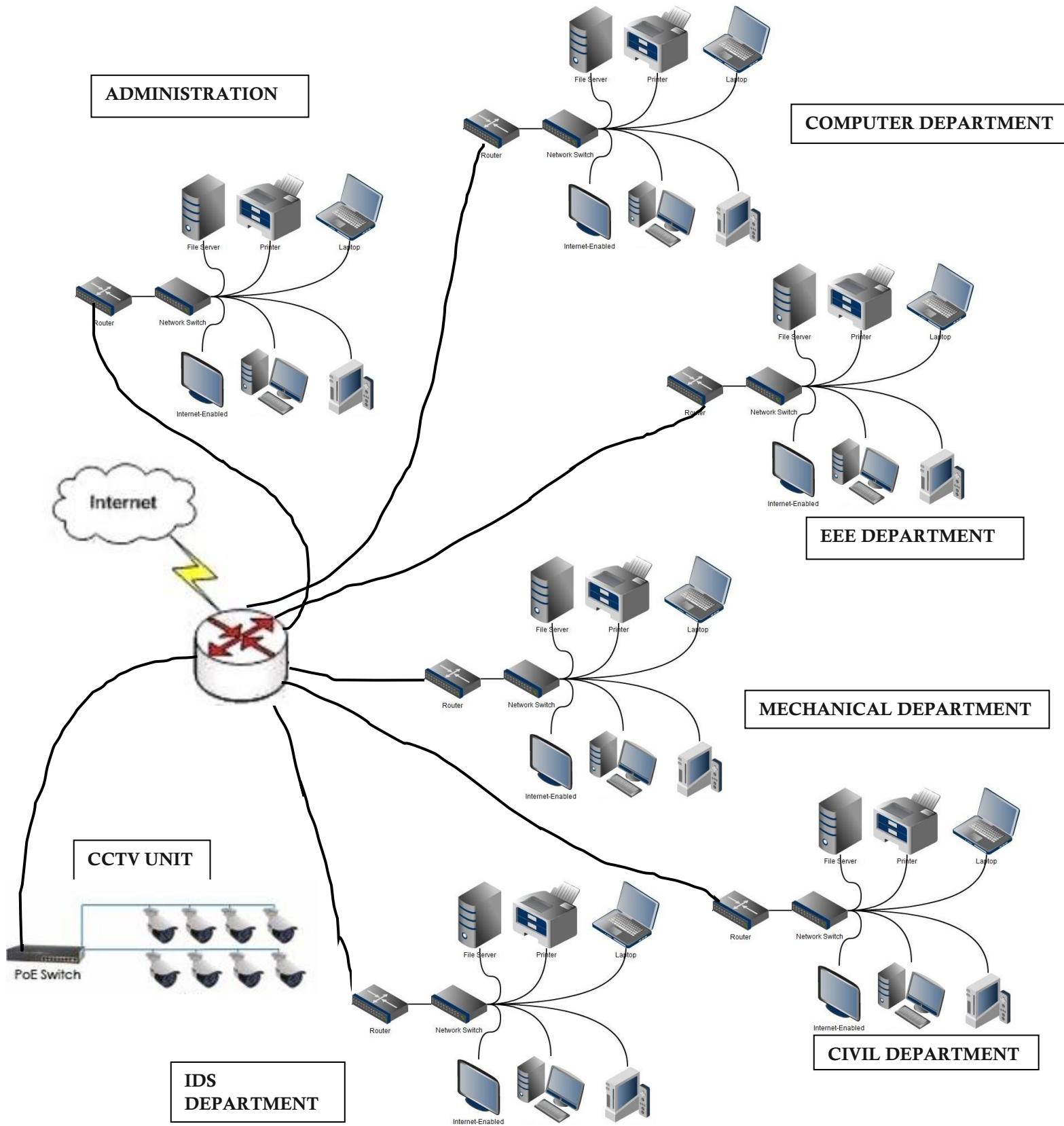
3. VLAN and Inter-VLAN Routing

VLANs were configured for logical separation of network traffic. Inter-VLAN routing was implemented on Layer 3 switches to ensure controlled communication between VLANs.

TABLE02: VLAN Plan and Mapping

Department	VLAN ID	Device Type	Subnet	Subnet Mask	Network Address
Computer Eng	10	Students	192.168.0.0/23	255.255.254.0	192.168.0.0
	20	Staff	192.168.2.0/25	255.255.255.128	192.168.2.0
	30	Other Devices	192.168.2.128/26	255.255.255.192	192.168.2.128
EEE	40	Students	192.168.3.0/24	255.255.255.0	192.168.3.0
	50	Staff	192.168.4.0/25	255.255.255.128	192.168.4.0
	60	Other Devices	192.168.4.128/27	255.255.255.224	192.168.4.128
Civil Eng	70	Students	192.168.5.0/25	255.255.255.128	192.168.5.0
	80	Staff	192.168.5.128/26	255.255.255.192	192.168.5.128
	90	Other Devices	192.168.5.192/28	255.255.255.240	192.168.5.192
Mech Eng	100	Students	192.168.6.0/25	255.255.255.128	192.168.6.0
	110	Staff	192.168.6.128/26	255.255.255.192	192.168.6.128
	120	Other Devices	192.168.6.192/27	255.255.255.224	192.168.6.192
IDS	130	Students	192.168.7.0/27	255.255.255.224	192.168.7.0
	140	Staff	192.168.7.32/26	255.255.255.192	192.168.7.32
	150	Other Devices	192.168.7.96/28	255.255.255.240	192.168.7.96
Admin	160	Staff	192.168.8.0/26	255.255.255.192	192.168.8.0
	170	Printers	192.168.8.64/28	255.255.255.240	192.168.8.64
CCTV	180	CCTV Cameras	192.168.9.0/25	255.255.255.128	192.168.9.0

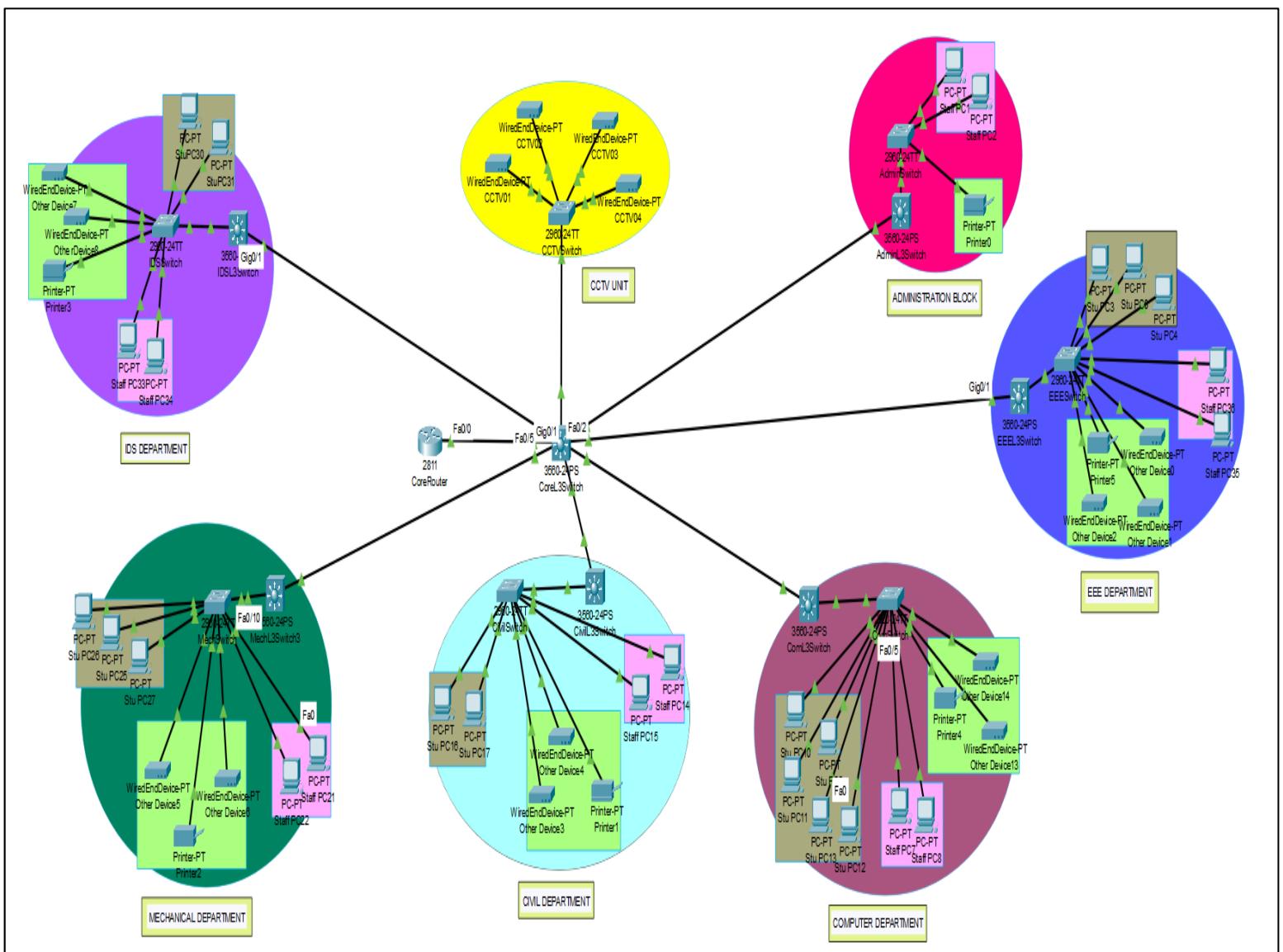
4. Network Topology



The network follows a **star topology**, ensuring a central connection point that enhances performance, scalability, and fault tolerance. This structure minimizes collision domains and optimizes data flow within departments.

The network topology consists of:

- Core Router: Connects all department L3 switches.
- Core L3 Switch: Provides VLAN routing and interconnectivity.
- Department L3 Switches: Handle inter-VLAN routing within each department.
- Department L2 Switches: Provide access-level switching for end devices



5. Implementation in Cisco Packet Tracer

5.1 Core Router Configuration

Commands for Core Router:

```
enable
configure terminal
interface FastEthernet0/0
ip address 192.168.255.1 255.255.255.0
no shutdown
exit
ip routing
ip route 192.168.0.0 255.255.254.0 192.168.255.2
ip route 192.168.2.0 255.255.255.0 192.168.255.2
ip route 192.168.3.0 255.255.255.0 192.168.255.2
ip route 192.168.4.0 255.255.255.0 192.168.255.2
ip route 192.168.5.0 255.255.255.0 192.168.255.2
ip route 192.168.6.0 255.255.255.0 192.168.255.2
ip route 192.168.7.0 255.255.255.0 192.168.255.2
ip route 192.168.8.0 255.255.255.0 192.168.255.2
ip route 192.168.9.0 255.255.255.128 192.168.255.2
copy running-config startup-config
exit
```

5.2 VLAN Configuration on Core L3 Switch

Core L3 Switch Configuration

```
enable                                         name IDS_Staff
configure terminal
vlan 10                                         name IDS_Other_Devices
name Computer_Eng_Students
vlan 20                                         name Admin_Staff
name Computer_Eng_Staff
vlan 30                                         name Admin_Printers
name Computer_Eng_Other_Devices
vlan 40                                         name CCTV_Cameras
name EEE_Students
exit
vlan 50                                         interface GigabitEthernet0/1
name EEE_Staff
description Link to Core Router
no switchport
ip address 192.168.255.2 255.255.255.0
no shutdown
exit
vlan 60                                         interface FastEthernet0/1
name EEE_Other_Devices
description Link to Computer Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
vlan 70                                         interface FastEthernet0/2
name Civil_Eng_Students
description Link to EE Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
vlan 80                                         interface FastEthernet0/3
name Civil_Eng_Staff
switchport mode trunk
no shutdown
exit
vlan 90                                         name Civil_Eng_Other_Devices
description Link to Computer Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
vlan 100                                         name Civil_Eng_Students
description Link to EE Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
name Mech_Eng_Students
description Link to EE Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
name Mech_Eng_Staff
switchport mode trunk
no shutdown
exit
name Mech_Eng_Other_Devices
description Link to EE Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
name IDS_Students
description Link to Core Router
switchport mode trunk
no shutdown
exit
name IDS_Staff
interface FastEthernet0/3
```

<i>description Link to Civil Eng L3 Switch</i>	<i>no shutdown</i>
<i>switchport trunk encapsulation dot1q</i>	<i>exit</i>
<i>switchport mode trunk</i>	<i>interface FastEthernet0/6</i>
<i>no shutdown</i>	<i>description Link to Admin L3 Switch</i>
<i>exit</i>	<i>switchport trunk encapsulation dot1q</i>
<i>interface FastEthernet0/4</i>	<i>switchport mode trunk</i>
<i>description Link to Mech Eng L3 Switch</i>	<i>no shutdown</i>
<i>switchport trunk encapsulation dot1q</i>	<i>exit</i>
<i>switchport mode trunk</i>	<i>interface FastEthernet0/7</i>
<i>no shutdown</i>	<i>description Link to CCTV L2 Switch</i>
<i>exit</i>	<i>switchport mode access</i>
<i>interface FastEthernet0/5</i>	<i>switchport access vlan 180</i>
<i>description Link to IDS L3 Switch</i>	<i>no shutdown</i>
<i>switchport trunk encapsulation dot1q</i>	<i>exit</i>
<i>switchport mode trunk</i>	<i>write memory</i>

5.3 Inter-VLAN Routing on Department L3 Switches

Com Eng L3 Switch Configuration

<i>enable</i>	<i>no shutdown</i>
<i>configure terminal</i>	<i>exit</i>
<i>vlan 10</i>	<i>Switch</i>
<i>name Com_Eng_Students</i>	<i>interface GigabitEthernet0/2</i>
<i>vlan 20</i>	<i>description Link to Com Eng L2 Switch</i>
<i>name Com_Eng_Staff</i>	<i>switchport trunk encapsulation dot1q</i>
<i>vlan 30</i>	<i>switchport mode trunk</i>
<i>name Com_Eng_Other_Devices</i>	<i>no shutdown</i>
<i>exit</i>	<i>exit</i>
<i>interface GigabitEthernet0/1</i>	<i>(VLAN 10)</i>
<i>description Link to Core L3 Switch</i>	<i>interface Vlan10</i>
<i>switchport trunk encapsulation dot1q</i>	<i>description Com Eng Students</i>
<i>switchport mode trunk</i>	<i>ip address 192.168.0.1 255.255.254.0</i>

<i>no shutdown</i>	<i>description Com Eng Other Devices</i>
<i>exit</i>	<i>ip address 192.168.2.129 255.255.255.192</i>
<i>interface Vlan20</i>	<i>no shutdown</i>
<i>description Com Eng Staff</i>	<i>exit</i>
<i>ip address 192.168.2.1 255.255.255.128</i>	<i>ip routing</i>
<i>no shutdown</i>	<i>ip default-gateway 192.168.255.2</i>
<i>exit</i>	<i>exit</i>
<i>interface Vlan30</i>	<i>write memory</i>

EEE L3 Switch Configuration

<i>enable</i>	<i>interface Vlan40</i>
<i>configure terminal</i>	<i>description EEE Students</i>
<i>vlan 40</i>	<i>ip address 192.168.3.1 255.255.255.0</i>
<i>name EEE_Students</i>	<i>no shutdown</i>
<i>vlan 50</i>	<i>exit</i>
<i>name EEE_Staff</i>	<i>interface Vlan50</i>
<i>vlan 60</i>	<i>description EEE Staff</i>
<i>name EEE_Other_Devices</i>	<i>ip address 192.168.4.1 255.255.255.128</i>
<i>exit</i>	<i>no shutdown</i>
<i>interface GigabitEthernet0/1</i>	<i>exit</i>
<i>description Link to Core L3 Switch</i>	<i>interface Vlan60</i>
<i>switchport trunk encapsulation dot1q</i>	<i>description EEE Other Devices</i>
<i>switchport mode trunk</i>	<i>ip address 192.168.4.129 255.255.255.224</i>
<i>no shutdown</i>	<i>no shutdown</i>
<i>exit</i>	<i>exit</i>
<i>interface GigabitEthernet0/2</i>	<i>ip routing</i>
<i>description Link to EEE L2 Switch</i>	<i>ip default-gateway 192.168.255.2</i>
<i>switchport trunk encapsulation dot1q</i>	<i>exit</i>
<i>switchport mode trunk</i>	<i>write memory</i>
<i>no shutdown</i>	
<i>exit</i>	

Civil L3 Switch Configuration

<i>enable</i>	<i>exit</i>
<i>configure terminal</i>	<i>interface Vlan70</i>
<i>vlan 70</i>	<i>description Civil Eng Students</i>
<i>name Civil_Eng_Students</i>	<i>ip address 192.168.5.1 255.255.255.128</i>
<i>vlan 80</i>	<i>no shutdown</i>
<i>name Civil_Eng_Staff</i>	<i>exit</i>
<i>vlan 90</i>	<i>interface Vlan80</i>
<i>name Civil_Eng_Other_Devices</i>	<i>description Civil Eng Staff</i>
<i>exit</i>	<i>ip address 192.168.5.129 255.255.255.192</i>
<i>interface GigabitEthernet0/1</i>	<i>no shutdown</i>
<i>description Link to Core L3 Switch</i>	<i>exit</i>
<i>switchport trunk encapsulation dot1q</i>	<i>interface Vlan90</i>
<i>switchport mode trunk</i>	<i>description Civil Eng Other Devices</i>
<i>no shutdown</i>	<i>ip address 192.168.5.193 255.255.255.240</i>
<i>exit</i>	<i>no shutdown</i>
<i>interface GigabitEthernet0/2</i>	<i>exit</i>
<i>description Link to Civil Eng L2 Switch</i>	<i>ip routing</i>
<i>switchport trunk encapsulation dot1q</i>	<i>ip default-gateway 192.168.255.2</i>
<i>switchport mode trunk</i>	<i>exit</i>
<i>no shutdown</i>	<i>write memory</i>

Mech L3 Switch Configuration

<i>enable</i>	<i>exit</i>
<i>configure terminal</i>	<i>interface GigabitEthernet0/1</i>
<i>vlan 100</i>	<i>description Link to Core L3 Switch</i>
<i>name Mech_Eng_Students</i>	<i>switchport trunk encapsulation dot1q</i>
<i>vlan 110</i>	<i>switchport mode trunk</i>
<i>name Mech_Eng_Staff</i>	<i>no shutdown</i>
<i>vlan 120</i>	<i>exit</i>
<i>name Mech_Eng_Other_Devices</i>	<i>interface GigabitEthernet0/2</i>

<i>description Link to Mech Eng L2 Switch</i>	<i>ip address 192.168.6.129 255.255.255.192</i>
<i>switchport trunk encapsulation dot1q</i>	<i>no shutdown</i>
<i>switchport mode trunk</i>	<i>exit</i>
<i>no shutdown</i>	<i>interface Vlan120</i>
<i>exit</i>	<i>description Mech Eng Other Devices</i>
<i>interface Vlan100</i>	<i>ip address 192.168.6.193 255.255.255.224</i>
<i>description Mech Eng Students</i>	<i>no shutdown</i>
<i>ip address 192.168.6.1 255.255.255.128</i>	<i>exit</i>
<i>no shutdown</i>	<i>ip routing</i>
<i>exit</i>	<i>ip default-gateway 192.168.255.2</i>
<i>interface Vlan110</i>	<i>exit</i>
<i>description Mech Eng Staff</i>	<i>write memory</i>

IDS L3 Switch Configuration

<i>enable</i>	<i>description Link to IDS L2 Switch</i>
<i>configure terminal</i>	<i>switchport trunk encapsulation dot1q</i>
<i>vlan 130</i>	<i>switchport mode trunk</i>
<i>name IDS_Students</i>	<i>no shutdown</i>
<i>vlan 140</i>	<i>exit</i>
<i>name IDS_Staff</i>	<i>interface Vlan130</i>
<i>vlan 150</i>	<i>description IDS Students</i>
<i>name IDS_Other_Devices</i>	<i>ip address 192.168.7.1 255.255.255.224</i>
<i>exit</i>	<i>no shutdown</i>
<i>interface GigabitEthernet0/1</i>	<i>exit</i>
<i>description Link to Core L3 Switch</i>	<i>interface Vlan140</i>
<i>switchport trunk encapsulation dot1q</i>	<i>description IDS Staff</i>
<i>switchport mode trunk</i>	<i>ip address 192.168.7.33 255.255.255.192</i>
<i>no shutdown</i>	<i>no shutdown</i>
<i>exit</i>	<i>exit</i>
<i>interface GigabitEthernet0/2</i>	<i>interface Vlan150</i>

<i>description IDS Other Devices</i>	<i>ip routing</i>
<i>ip address 192.168.7.97 255.255.255.240</i>	<i>ip default-gateway 192.168.255.2</i>
<i>no shutdown</i>	<i>exit</i>
<i>exit</i>	<i>write memory</i>

Admin L3 Switch Configuration

<i>enable</i>	<i>no shutdown</i>
<i>configure terminal</i>	<i>exit</i>
<i>vlan 160</i>	<i>interface Vlan160</i>
<i>name Admin_Staff</i>	<i>description Admin Staff</i>
<i>vlan 170</i>	<i>ip address 192.168.8.1 255.255.255.192</i>
<i>name Admin_Printers</i>	<i>no shutdown</i>
<i>exit</i>	<i>exit</i>
<i>interface GigabitEthernet0/1</i>	<i>interface Vlan170</i>
<i>description Link to Core L3 Switch</i>	<i>description Admin Printers</i>
<i>switchport trunk encapsulation dot1q</i>	<i>ip address 192.168.8.65 255.255.255.240</i>
<i>switchport mode trunk</i>	<i>no shutdown</i>
<i>no shutdown</i>	<i>exit</i>
<i>exit</i>	<i>ip routing</i>
<i>interface GigabitEthernet0/2</i>	<i>ip default-gateway 192.168.255.2</i>
<i>description Link to Admin L2 Switch</i>	<i>exit</i>
<i>switchport trunk encapsulation dot1q</i>	<i>write memory</i>
<i>switchport mode trunk</i>	

5.4 Inter-VLAN Routing on Department L2 Switches

Com Eng L2 Switch Configuration

```
enable                                         interface range FastEthernet0/10 - 11
configure terminal                           description Com Eng Staff PCs
vlan 10                                       switchport mode access
name Com_Eng_Students                         switchport access vlan 20
vlan 20                                       no shutdown
name Com_Eng_Staff                            exit
vlan 30                                       interface FastEthernet0/15
name Com_Eng_Other_Devices                   description Com Eng Printer
exit                                           switchport mode access
interface GigabitEthernet0/1                  switchport access vlan 30
description Link to Com Eng L3 Switch        no shutdown
switchport mode trunk                         exit
no shutdown                                    interface range FastEthernet0/16 - 17
exit                                           description Com Eng Other Devices
interface range FastEthernet0/1 - 5           switchport mode access
description Com Eng Student PCs              switchport access vlan 30
switchport mode access                       no shutdown
switchport access vlan 10                     exit
no shutdown                                    exit
exit                                           write memory
```

EEE L2 Switch Configuration

```
enable                                         name EEE_Other_Devices
configure terminal                           exit
vlan 40                                       interface GigabitEthernet0/1
name EEE_Students                            description Link to EEE L3 Switch
vlan 50                                       switchport mode trunk
name EEE_Staff                               no shutdown
vlan 60                                       exit
```

<i>interface range FastEthernet0/1 - 5</i>	<i>description EEE Printer</i>
<i>description EEE Student PCs</i>	<i>switchport mode access</i>
<i>switchport mode access</i>	<i>switchport access vlan 60</i>
<i>switchport access vlan 40</i>	<i>no shutdown</i>
<i>no shutdown</i>	<i>exit</i>
<i>exit</i>	<i>interface range FastEthernet0/16 - 17</i>
<i>interface range FastEthernet0/10 - 11</i>	<i>description EEE Other Devices</i>
<i>description EEE Staff PCs</i>	<i>switchport mode access</i>
<i>switchport mode access</i>	<i>switchport access vlan 60</i>
<i>switchport access vlan 50</i>	<i>no shutdown</i>
<i>no shutdown</i>	<i>exit</i>
<i>exit</i>	<i>exit</i>
<i>interface FastEthernet0/15</i>	<i>write memory</i>

Civil L2 Switch Configuration

<i>enable</i>	<i>switchport access vlan 70</i>
<i>configure terminal</i>	<i>no shutdown</i>
<i>vlan 70</i>	<i>exit</i>
<i>name Civil_Eng_Students</i>	<i>interface range FastEthernet0/10 - 11</i>
<i>vlan 80</i>	<i>description Civil Eng Staff PCs</i>
<i>name Civil_Eng_Staff</i>	<i>switchport mode access</i>
<i>vlan 90</i>	<i>switchport access vlan 80</i>
<i>name Civil_Eng_Other_Devices</i>	<i>no shutdown</i>
<i>interface GigabitEthernet0/1</i>	<i>exit</i>
<i>description Link to Civil Eng L3 Switch</i>	<i>interface FastEthernet0/15</i>
<i>switchport mode trunk</i>	<i>description Civil Eng Printer</i>
<i>no shutdown</i>	<i>switchport mode access</i>
<i>exit</i>	<i>switchport access vlan 90</i>
<i>interface range FastEthernet0/1 - 5</i>	<i>no shutdown</i>
<i>description Civil Eng Student PCs</i>	<i>exit</i>
<i>switchport mode access</i>	<i>interface range FastEthernet0/16 - 17</i>

<i>description Civil Eng Other Devices</i>	<i>exit</i>
<i>switchport mode access</i>	<i>exit</i>
<i>switchport access vlan 90</i>	<i>write memory</i>
<i>no shutdown</i>	

Mech L2 Switch Configuration

<i>enable</i>	<i>interface range FastEthernet0/10 - 11</i>
<i>configure terminal</i>	<i>description Mech Eng Staff PCs</i>
<i>vlan 100</i>	<i>switchport mode access</i>
<i>name Mech_Eng_Students</i>	<i>switchport access vlan 110</i>
<i>vlan 110</i>	<i>no shutdown</i>
<i>name Mech_Eng_Staff</i>	<i>exit</i>
<i>vlan 120</i>	<i>interface FastEthernet0/15</i>
<i>name Mech_Eng_Other_Devices</i>	<i>description Mech Eng Printer</i>
<i>exit</i>	<i>switchport mode access</i>
<i>interface GigabitEthernet0/1</i>	<i>switchport access vlan 120</i>
<i>description Link to Mech Eng L3 Switch</i>	<i>no shutdown</i>
<i>switchport mode trunk</i>	<i>exit</i>
<i>no shutdown</i>	<i>interface range FastEthernet0/16 - 17</i>
<i>exit</i>	<i>description Mech Eng Other Devices</i>
<i>interface range FastEthernet0/1 - 5</i>	<i>switchport mode access</i>
<i>description Mech Eng Student PCs</i>	<i>switchport access vlan 120</i>
<i>switchport mode access</i>	<i>no shutdown</i>
<i>switchport access vlan 100</i>	<i>exit</i>
<i>no shutdown</i>	<i>exit</i>
<i>exit</i>	<i>write memory</i>

IDS L2 Switch Configuration

<i>enable</i>	<i>vlan 140</i>
<i>configure terminal</i>	<i>name IDS_Staff</i>
<i>vlan 130</i>	<i>vlan 150</i>
<i>name IDS_Students</i>	<i>name IDS_Other_Devices</i>

<i>exit</i>	<i>no shutdown</i>
<i>interface GigabitEthernet0/1</i>	<i>exit</i>
<i>description Link to IDS L3 Switch</i>	<i>interface FastEthernet0/15</i>
<i>switchport mode trunk</i>	<i>description IDS Printer</i>
<i>no shutdown</i>	<i>switchport mode access</i>
<i>exit</i>	<i>switchport access vlan 150</i>
<i>interface range FastEthernet0/1 - 3</i>	<i>no shutdown</i>
<i>description IDS Student PCs</i>	<i>exit</i>
<i>switchport mode access</i>	<i>interface range FastEthernet0/16 - 17</i>
<i>switchport access vlan 130</i>	<i>description IDS Other Devices</i>
<i>no shutdown</i>	<i>switchport mode access</i>
<i>exit</i>	<i>switchport access vlan 150</i>
<i>interface range FastEthernet0/10 - 11</i>	<i>no shutdown</i>
<i>description IDS Staff PCs</i>	<i>exit</i>
<i>switchport mode access</i>	<i>exit</i>
<i>switchport access vlan 140</i>	<i>write memory</i>

Admin L2 Switch Configuration

<i>enable</i>	<i>description Admin Staff PCs</i>
<i>configure terminal</i>	<i>switchport mode access</i>
<i>vlan 160</i>	<i>switchport access vlan 160</i>
<i>name Admin_Staff</i>	<i>no shutdown</i>
<i>vlan 170</i>	<i>exit</i>
<i>name Admin_Printers</i>	<i>interface FastEthernet0/10</i>
<i>exit</i>	<i>description Admin Printer</i>
<i>interface GigabitEthernet0/1</i>	<i>switchport mode access</i>
<i>description Link to Admin L3 Switch</i>	<i>switchport access vlan 170</i>
<i>switchport mode trunk</i>	<i>no shutdown</i>
<i>no shutdown</i>	<i>exit</i>
<i>exit</i>	<i>exit</i>
<i>interface range FastEthernet0/1 - 2</i>	<i>write memory</i>

CCTV L2 Switch Configuration

<i>Step 1: Create VLAN for CCTV Cameras</i>	<i>exit</i>
<i>enable</i>	<i>interface range FastEthernet0/1 - 4</i>
<i>configure terminal</i>	<i>description CCTV Cameras</i>
<i>vlan 180</i>	<i>switchport mode access</i>
<i>name CCTV_Cameras</i>	<i>switchport access vlan 180</i>
<i>exit</i>	<i>no shutdown</i>
<i>interface GigabitEthernet0/1</i>	<i>exit</i>
<i>description Link to Core L3 Switch</i>	<i>exit</i>
<i>switchport mode trunk</i>	<i>write memory</i>
<i>no shutdown</i>	

5.5 DHCP Configuration for L3 and L2 Switches

Configure DHCP on the Core L3 Switch

<i>enable</i>	<i>default-router 192.168.2.129</i>
<i>configure terminal</i>	<i>dns-server 8.8.8.8</i>
<i>service dhcp</i>	<i>dns-server 8.8.4.4</i>
<i>ip dhcp pool Com_Eng_Students</i>	<i>exit</i>
<i>network 192.168.0.0 255.255.254.0</i>	<i>ip dhcp pool EEE_Students</i>
<i>default-router 192.168.0.1</i>	<i>network 192.168.3.0 255.255.255.0</i>
<i>dns-server 8.8.8.8</i>	<i>default-router 192.168.3.1</i>
<i>dns-server 8.8.4.4</i>	<i>dns-server 8.8.8.8</i>
<i>exit</i>	<i>dns-server 8.8.4.4</i>
<i>ip dhcp pool Com_Eng_Staff</i>	<i>exit</i>
<i>network 192.168.2.0 255.255.255.128</i>	<i>ip dhcp pool EEE_Staff</i>
<i>default-router 192.168.2.1</i>	<i>network 192.168.4.0 255.255.255.128</i>
<i>dns-server 8.8.8.8</i>	<i>default-router 192.168.4.1</i>
<i>dns-server 8.8.4.4</i>	<i>dns-server 8.8.8.8</i>
<i>exit</i>	<i>dns-server 8.8.4.4</i>
<i>ip dhcp pool Com_Eng_Other_Devices</i>	<i>exit</i>
<i>network 192.168.2.128 255.255.255.192</i>	<i>ip dhcp pool EEE_Other_Devices</i>

```

network 192.168.4.128 255.255.255.224
default-router 192.168.4.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Students
network 192.168.5.0 255.255.255.128
default-router 192.168.5.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Staff
network 192.168.5.128 255.255.255.192
default-router 192.168.5.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Other_Devices
network 192.168.5.192 255.255.255.240
default-router 192.168.5.193
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Students
network 192.168.6.0 255.255.255.128
default-router 192.168.6.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Staff
network 192.168.6.128 255.255.255.192
default-router 192.168.6.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Other_Devices
network 192.168.6.192 255.255.255.224
default-router 192.168.6.193
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Students
network 192.168.7.0 255.255.255.224
default-router 192.168.7.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Staff
network 192.168.7.32 255.255.255.192
default-router 192.168.7.33
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Other_Devices
network 192.168.7.96 255.255.255.240
default-router 192.168.7.97
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Admin_Staff
network 192.168.8.0 255.255.255.192
default-router 192.168.8.1
dns-server 8.8.8.8
dns-server 8.8.4.4

```

<i>exit</i>	<i>ip dhcp excluded-address 192.168.4.129 192.168.4.138</i>
<i>ip dhcp pool Admin_Printers</i>	<i>ip dhcp excluded-address 192.168.5.1 192.168.5.10</i>
<i>network 192.168.8.64 255.255.255.240</i>	<i>ip dhcp excluded-address 192.168.5.129 192.168.5.138</i>
<i>default-router 192.168.8.65</i>	<i>ip dhcp excluded-address 192.168.5.193 192.168.5.202</i>
<i>dns-server 8.8.8.8</i>	<i>ip dhcp excluded-address 192.168.6.1 192.168.6.10</i>
<i>dns-server 8.8.4.4</i>	<i>ip dhcp excluded-address 192.168.6.129 192.168.6.138</i>
<i>exit</i>	<i>ip dhcp excluded-address 192.168.6.193 192.168.6.202</i>
<i>ip dhcp pool CCTV_Cameras</i>	<i>ip dhcp excluded-address 192.168.7.1 192.168.7.10</i>
<i>network 192.168.9.0 255.255.255.128</i>	<i>ip dhcp excluded-address 192.168.7.33 192.168.7.42</i>
<i>default-router 192.168.9.1</i>	<i>ip dhcp excluded-address 192.168.7.97 192.168.7.106</i>
<i>dns-server 8.8.8.8</i>	<i>ip dhcp excluded-address 192.168.8.1 192.168.8.10</i>
<i>dns-server 8.8.4.4</i>	<i>ip dhcp excluded-address 192.168.8.65 192.168.8.74</i>
<i>exit</i>	<i>ip dhcp excluded-address 192.168.9.1 192.168.9.10</i>
<i>ip dhcp excluded-address 192.168.0.1 192.168.0.10</i>	<i>exit</i>
<i>ip dhcp excluded-address 192.168.2.1 192.168.2.10</i>	
<i>ip dhcp excluded-address 192.168.2.129 192.168.2.138</i>	
<i>ip dhcp excluded-address 192.168.3.1 192.168.3.10</i>	
<i>ip dhcp excluded-address 192.168.4.1 192.168.4.10</i>	<i>write memory</i>

DHCP Configuration for Com Eng L3 Switch

<i>enable</i>	<i>default-router 192.168.2.1</i>
<i>configure terminal</i>	<i>dns-server 8.8.8.8</i>
<i>service dhcp</i>	<i>dns-server 8.8.4.4</i>
<i>ip dhcp pool Com_Eng_Students</i>	<i>exit</i>
<i>network 192.168.0.0 255.255.254.0</i>	<i>ip dhcp pool Com_Eng_Other_Devices</i>
<i>default-router 192.168.0.1</i>	<i>network 192.168.2.128 255.255.255.192</i>
<i>dns-server 8.8.8.8</i>	<i>default-router 192.168.2.129</i>
<i>dns-server 8.8.4.4</i>	<i>dns-server 8.8.8.8</i>
<i>exit</i>	<i>dns-server 8.8.4.4</i>
<i>ip dhcp pool Com_Eng_Staff</i>	<i>exit</i>
<i>network 192.168.2.0 255.255.255.128</i>	<i>ip dhcp excluded-address 192.168.0.1 192.168.0.10</i>

<i>ip dhcp excluded-address 192.168.2.1 192.168.2.10</i>	<i>exit</i>
<i>ip dhcp excluded-address 192.168.2.129</i>	<i>write memory</i>
<i>192.168.2.138</i>	

DHCP configuration commands for the EEE L3 Switch:

<i>enable</i>	<i>dns-server 8.8.4.4</i>
<i>configure terminal</i>	<i>exit</i>
<i>service dhcp</i>	<i>ip dhcp excluded-address 192.168.3.1 192.168.3.10</i>
<i>ip dhcp pool EEE_Students</i>	<i>ip dhcp excluded-address 192.168.4.1 192.168.4.10</i>
<i>network 192.168.3.0 255.255.255.0</i>	<i>ip dhcp excluded-address 192.168.4.129</i>
<i>default-router 192.168.3.1</i>	<i>192.168.4.138</i>
<i>dns-server 8.8.8.8</i>	<i>exit</i>
<i>dns-server 8.8.4.4</i>	<i>write memory</i>
<i>exit</i>	<i>enable</i>
<i>ip dhcp pool EEE_Staff</i>	<i>configure terminal</i>
<i>network 192.168.4.0 255.255.255.128</i>	<i>interface Vlan40</i>
<i>default-router 192.168.4.1</i>	<i>ip helper-address 192.168.255.2</i>
<i>dns-server 8.8.8.8</i>	<i>exit</i>
<i>dns-server 8.8.4.4</i>	<i>interface Vlan50</i>
<i>exit</i>	<i>ip helper-address 192.168.255.2</i>
<i>ip dhcp pool EEE_Other_Devices</i>	<i>exit</i>
<i>network 192.168.4.128 255.255.255.224</i>	<i>interface Vlan60</i>
<i>default-router 192.168.4.129</i>	<i>ip helper-address 192.168.255.2</i>
<i>dns-server 8.8.8.8</i>	<i>exit</i>
	<i>write memory</i>

DHCP configuration commands for the Civil Eng L3 Switch:

<i>enable</i>	<i>default-router 192.168.5.1</i>
<i>configure terminal</i>	<i>dns-server 8.8.8.8</i>
<i>service dhcp</i>	<i>dns-server 8.8.4.4</i>
<i>ip dhcp pool Civil_Eng_Students</i>	<i>exit</i>
<i>network 192.168.5.0 255.255.255.128</i>	<i>ip dhcp pool Civil_Eng_Staff</i>

<i>network 192.168.5.128 255.255.255.192</i>	<i>exit</i>
<i>default-router 192.168.5.129</i>	<i>write memory</i>
<i>dns-server 8.8.8.8</i>	<i>enable</i>
<i>dns-server 8.8.4.4</i>	<i>configure terminal</i>
<i>exit</i>	<i>interface Vlan70</i>
<i>ip dhcp pool Civil_Eng_Other_Devices</i>	<i>ip helper-address 192.168.255.2</i>
<i>network 192.168.5.192 255.255.255.240</i>	<i>exit</i>
<i>default-router 192.168.5.193</i>	<i>interface Vlan80</i>
<i>dns-server 8.8.8.8</i>	<i>ip helper-address 192.168.255.2</i>
<i>dns-server 8.8.4.4</i>	<i>exit</i>
<i>exit</i>	<i>interface Vlan90</i>
<i>ip dhcp excluded-address 192.168.5.1 192.168.5.10</i>	<i>ip helper-address 192.168.255.2</i>
<i>ip dhcp excluded-address 192.168.5.129 192.168.5.138</i>	<i>exit</i>
<i>ip dhcp excluded-address 192.168.5.193 192.168.5.202</i>	<i>exit</i>
	<i>write memory</i>

DHCP configuration commands for the Mech Eng L3 Switch:

<i>enable</i>	<i>ip dhcp pool Mech_Eng_Other_Devices</i>
<i>configure terminal</i>	<i>network 192.168.6.192 255.255.255.224</i>
<i>service dhcp</i>	<i>default-router 192.168.6.193</i>
<i>ip dhcp pool Mech_Eng_Students</i>	<i>dns-server 8.8.8.8</i>
<i>network 192.168.6.0 255.255.255.128</i>	<i>dns-server 8.8.4.4</i>
<i>default-router 192.168.6.1</i>	<i>exit</i>
<i>dns-server 8.8.8.8</i>	<i>ip dhcp excluded-address 192.168.6.1 192.168.6.10</i>
<i>dns-server 8.8.4.4</i>	<i>ip dhcp excluded-address 192.168.6.129 192.168.6.138</i>
<i>exit</i>	<i>ip dhcp excluded-address 192.168.6.193 192.168.6.202</i>
<i>ip dhcp pool Mech_Eng_Staff</i>	<i>exit</i>
<i>network 192.168.6.128 255.255.255.192</i>	<i>write memory</i>
<i>default-router 192.168.6.129</i>	<i>enable</i>
<i>dns-server 8.8.8.8</i>	<i>configure terminal</i>
<i>dns-server 8.8.4.4</i>	<i>interface Vlan100</i>
<i>exit</i>	

<i>ip helper-address 192.168.255.2</i>	<i>interface Vlan120</i>
<i>exit</i>	<i>ip helper-address 192.168.255.2</i>
<i>interface Vlan110</i>	<i>exit</i>
<i>ip helper-address 192.168.255.2</i>	<i>exit</i>
<i>exit</i>	<i>write memory</i>

DHCP configuration commands for the IDS L3 Switch:

<i>enable</i>	<i>exit</i>
<i>configure terminal</i>	<i>ip dhcp excluded-address 192.168.7.1 192.168.7.10</i>
<i>service dhcp</i>	<i>ip dhcp excluded-address 192.168.7.33 192.168.7.42</i>
<i>ip dhcp pool IDS_Students</i>	<i>ip dhcp excluded-address 192.168.7.97</i>
<i>network 192.168.7.0 255.255.255.224</i>	<i>192.168.7.106</i>
<i>default-router 192.168.7.1</i>	<i>exit</i>
<i>dns-server 8.8.8.8</i>	<i>write memory</i>
<i>dns-server 8.8.4.4</i>	<i>enable</i>
<i>exit</i>	<i>configure terminal</i>
<i>ip dhcp pool IDS_Staff</i>	<i>interface Vlan130</i>
<i>network 192.168.7.32 255.255.255.192</i>	<i>ip helper-address 192.168.255.2</i>
<i>default-router 192.168.7.33</i>	<i>exit</i>
<i>dns-server 8.8.8.8</i>	<i>interface Vlan140</i>
<i>dns-server 8.8.4.4</i>	<i>ip helper-address 192.168.255.2</i>
<i>exit</i>	<i>exit</i>
<i>ip dhcp pool IDS_Other_Devices</i>	<i>interface Vlan150</i>
<i>network 192.168.7.96 255.255.255.240</i>	<i>ip helper-address 192.168.255.2</i>
<i>default-router 192.168.7.97</i>	<i>exit</i>
<i>dns-server 8.8.8.8</i>	<i>exit</i>
<i>dns-server 8.8.4.4</i>	<i>write memory</i>

DHCP configuration commands for the Admin L3 Switch:

<i>enable</i>	<i>network 192.168.8.0 255.255.255.192</i>
<i>configure terminal</i>	<i>default-router 192.168.8.1</i>
<i>service dhcp</i>	<i>dns-server 8.8.8.8</i>
<i>ip dhcp pool Admin_Staff</i>	<i>dns-server 8.8.4.4</i>

<i>exit</i>	<i>enable</i>
<i>ip dhcp pool Admin_Printers</i>	<i>configure terminal</i>
<i>network 192.168.8.64 255.255.255.240</i>	<i>interface Vlan160</i>
<i>default-router 192.168.8.65</i>	<i>ip helper-address 192.168.255.2</i>
<i>dns-server 8.8.8.8</i>	<i>exit</i>
<i>dns-server 8.8.4.4</i>	<i>interface Vlan170</i>
<i>exit</i>	<i>ip helper-address 192.168.255.2</i>
<i>ip dhcp excluded-address 192.168.8.1 192.168.8.10</i>	<i>exit</i>
<i>ip dhcp excluded-address 192.168.8.65 192.168.8.74</i>	<i>exit</i>
<i>exit</i>	<i>write memory</i>
<i>write memory</i>	

5.6 Steps to Block Students from Accessing Printers and Other Devices

Commands for Com Eng L3 Switch

<i>enable</i>
<i>configure terminal</i>
<i>ip access-list extended BLOCK_STUDENTS</i>
<i>deny ip 192.168.0.0 0.0.1.255 192.168.2.128 0.0.0.63</i>
<i>permit ip any any</i>
<i>exit</i>
<i>interface Vlan10</i>
<i>ip access-group BLOCK_STUDENTS in</i>
<i>exit</i>
<i>exit</i>
<i>write memory</i>

Commands for EEE L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.3.0 0.0.0.255 192.168.4.128 0.0.0.31
permit ip any any
exit
interface Vlan40
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

Commands for Civil Eng L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.5.0 0.0.0.127 192.168.5.192 0.0.0.15
permit ip any any
exit
interface Vlan70
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

Commands for Mech Eng L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.6.0 0.0.0.127 192.168.6.192 0.0.0.31
permit ip any any
exit
interface Vlan100
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

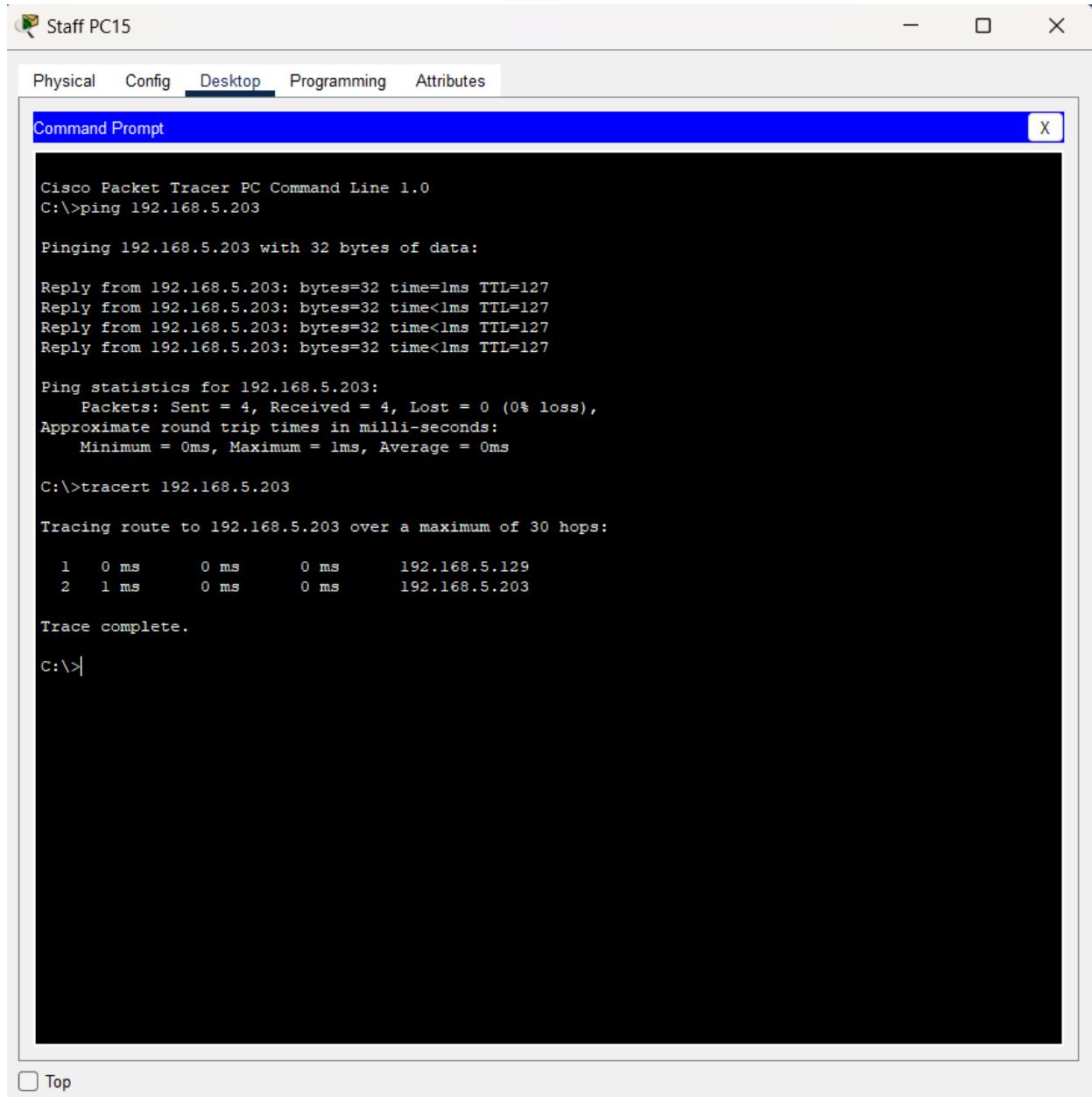
Commands for IDS L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.7.0 0.0.0.31 192.168.7.96 0.0.0.15
permit ip any any
exit
interface Vlan130
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

6. Testing and Validation

□ Ping Tests were conducted between:

1. Staff devices and printers.
2. Student devices within the same VLAN.
3. CCTV cameras and administration compute



The screenshot shows a window titled "Staff PC15" with a toolbar at the top containing "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". Below the toolbar is a "Command Prompt" window. The command prompt displays the following output:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.5.203

Pinging 192.168.5.203 with 32 bytes of data:

Reply from 192.168.5.203: bytes=32 time=1ms TTL=127
Reply from 192.168.5.203: bytes=32 time<1ms TTL=127
Reply from 192.168.5.203: bytes=32 time<1ms TTL=127
Reply from 192.168.5.203: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.5.203:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>tracert 192.168.5.203

Tracing route to 192.168.5.203 over a maximum of 30 hops:
  1  0 ms      0 ms      0 ms      192.168.5.129
  2  1 ms      0 ms      0 ms      192.168.5.203

Trace complete.

C:\>
```

Figure 01: Between Staff Devices and Printers

The screenshot shows a window titled "Stu PC27" with a tab bar containing "Physical", "Config", "Desktop" (which is selected), "Programming", and "Attributes". Below the tab bar is a title bar for a "Command Prompt" window. The command prompt window displays the following output:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.6.12

Pinging 192.168.6.12 with 32 bytes of data:

Reply from 192.168.6.12: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.6.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 192.168.6.12

Tracing route to 192.168.6.12 over a maximum of 30 hops:
  1  0 ms      0 ms      0 ms      192.168.6.12

Trace complete.

C:\>
```

Figure 02: Between Student Devices Within the Same Subnet

The screenshot shows a Cisco Packet Tracer Command Line window titled "Command Prompt". The window has tabs at the top: Physical, Config, Desktop (which is selected), Programming, and Attributes. The main area displays the following command-line session:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.9.14

Pinging 192.168.9.14 with 32 bytes of data:

Reply from 192.168.9.14: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.9.14:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 192.168.9.14

Tracing route to 192.168.9.14 over a maximum of 30 hops:
  1  0 ms      0 ms      0 ms      192.168.8.1
  2  0 ms      2 ms      0 ms      192.168.9.14

Trace complete.

C:\>
```

Figure 03: Between Admin Staff Devices and CCTV

7. Testing and Validation

The screenshot shows the EEEswitch software interface with the 'CLI' tab selected. The window title is 'EEEswitch'. The main area displays the output of several IOS Command Line Interface (CLI) commands related to VLAN configuration and interface status.

```
Switch>enable
Switch#show Vlan brief

VLAN Name          Status    Ports
----  -----
1    default        active   Fa0/6, Fa0/7, Fa0/8, Fa0/9
                           Fa0/12, Fa0/13, Fa0/14, Fa0/18
                           Fa0/19, Fa0/20, Fa0/21, Fa0/22
                           Fa0/23, Fa0/24, Gig0/2

10   Com_Eng_Students  active
20   Com_Eng_Staff     active
30   Com_Eng_Other_Devices  active
40   EEE_Students      active   Fa0/1, Fa0/2, Fa0/3, Fa0/4
                           Fa0/5
50   EEE_Staff         active   Fa0/10, Fa0/11
60   EEE_Other_Devices  active   Fa0/15, Fa0/16, Fa0/17
1002 fddi-default     active
1003 token-ring-default active
1004 fddinet-default   active
1005 trnet-default     active

Switch#show interface trunk
Port      Mode      Encapsulation  Status      Native vlan
Gig0/1    on       802.1q        trunking    1

Port      Vlans allowed on trunk
Gig0/1    1-1005

Port      Vlans allowed and active in management domain
Gig0/1    1,10,20,30,40,50,60

Port      Vlans in spanning tree forwarding state and not pruned
Gig0/1    1,10,20,30,40,50,60

Switch#
```

At the bottom right of the main window, there are 'Copy' and 'Paste' buttons. At the bottom left, there is a 'Top' button.

Figure 04: VLAN and routing functionality tested with
show VLAN brief and show interfaces trunk commands.

```

Switch#show ip route
Codes: C - connected, S - static, I - IGRP, 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, E - EGP
      i - IS-IS, 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

Gateway of last resort is not set

C    192.168.0.0/23 is directly connected, Vlan10
    192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C      192.168.2.0/25 is directly connected, Vlan20
C      192.168.2.128/26 is directly connected, Vlan30
C    192.168.3.0/24 is directly connected, Vlan40
    192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C      192.168.4.0/25 is directly connected, Vlan50
C      192.168.4.128/27 is directly connected, Vlan60
    192.168.5.0/24 is variably subnetted, 3 subnets, 3 masks
C      192.168.5.0/25 is directly connected, Vlan70
C      192.168.5.128/26 is directly connected, Vlan80
C      192.168.5.192/28 is directly connected, Vlan90
--More--

```

[Top](#)

Figure 05: VLAN and routing functionality tests using show Ip route command

8. Scalability Considerations

Subnet Expansion for Future Growth

To ensure that the network can support future expansion without the need for frequent restructuring, each subnet has been allocated an additional 30% capacity. This foresight ensures that when new devices are added to the network, the subnets will be able to handle the increased load without immediate reconfiguration.

Example Calculation for the Computer Engineering Department:

- Current Devices: 250
- Growth Factor (30%): $250 \times 1.3 = 325$ $250 + 325 = 575$
- Subnet Selection:
 - A /24 subnet (with 256 hosts) would not provide sufficient room for both current and future devices.

- As a result, a /23 subnet (which supports 512 hosts) has been chosen to ensure enough capacity for future growth.

This approach allows for a flexible and scalable network design that can grow in parallel with the institution's needs.

9. Conclusion

The network infrastructure design meets the objectives of security, scalability, and efficiency. The simulation results validate the configuration, ensuring optimal performance for the institution's multi-branch facility.