

# EE8203: DESIGN AND MANAGEMENT OF DATA NETWORKS

## ASSIGNMENT 01

NAME : DEMATAWAARACHCHI D.A.D.H.P.

REG NO : EG/2018/3304

DATE : 18/09/2023

FLOOR PLAN

MATLAB Lab			Server Room 2	Lecture Room 5		Lecture Room 6	
			Library		Lecture Room 7	Lecture Room 8	
	9	10	Lecture Offices			14	15

SECOND FLOOR

CAD Lab	Student Computer Lab		Server Room 1	Lecture Room 1		Lecture Room 2	
			Main Office	Lecture Room 3		Lecture Room 4	
	1	2	3	Lecture Offices		6	7

FIRST FLOOR

## PLANNING IPS

The network design is as follows.

1. Students are in a separate network. **(10.4.0.0/23)**
2. The staff, teaching assistants, lecture rooms, offices, and two server rooms are in a separate network. **(10.4.2.0/23)**

The basic IP plan can be summarized as follows.

Table 1: IP Plan

Group	Network IP	Subnet Mask	Gateway IPs	Current Capacity
MATLAB Lab (Students)	10.4.0.0	255.255.255.128	10.4.0.1 10.4.0.2 10.4.0.3	123
MATLAB Lab (Teaching Assistance + Server)	10.4.2.160	255.255.255.248	10.4.2.161 10.4.2.162 10.4.2.163	3
CAD Lab - (Students)	10.4.0.128	255.255.255.128	10.4.0.129 10.4.0.130 10.4.0.131	123
CAD Lab (Teaching Assistance + Server)	10.4.2.168	255.255.255.248	10.4.2.169 10.4.2.170 10.4.2.171	3
Computer Lab (Students)	10.4.1.0	255.255.255.192	10.4.1.1 10.4.1.2 10.4.1.3	59
Computer Lab (Server)	10.4.2.176	255.255.255.248	10.4.2.177 10.4.2.178 10.4.2.179	3
Access point (Students)	10.4.1.64	255.255.255.192	10.4.1.65 10.4.1.66 10.4.1.67	59
Library (Students)	10.4.1.128	255.255.255.192	10.4.1.129 10.4.1.130 10.4.1.131	59
Library (Staff)	10.4.2.128	255.255.255.240	10.4.2.129 10.4.2.130 10.4.2.131	11
Lecture Office	10.4.2.64	255.255.255.192	10.4.2.65 10.4.2.66 10.4.2.67	59

Main Office	10.4.2.32	255.255.255.224	10.4.2.33 10.4.2.34 10.4.2.35	27
Lecture Rooms	10.4.2.0	255.255.255.224	10.4.2.1 10.4.2.2 10.4.2.3	27
Sever Farm 01	10.4.2.192	255.255.255.240	10.4.2.193 10.4.2.197 10.4.2.201 10.4.2.205	8
Server Farm 02	10.4.2.208	255.255.255.240	10.4.2.209 10.4.2.213 10.4.2.217 10.4.2.221	8

- The network is set up to easily add more computers in the future if needed. (Scalability)

## NETWORK DESIGN

This network includes mainly Access layer, distribution layer and server farm.

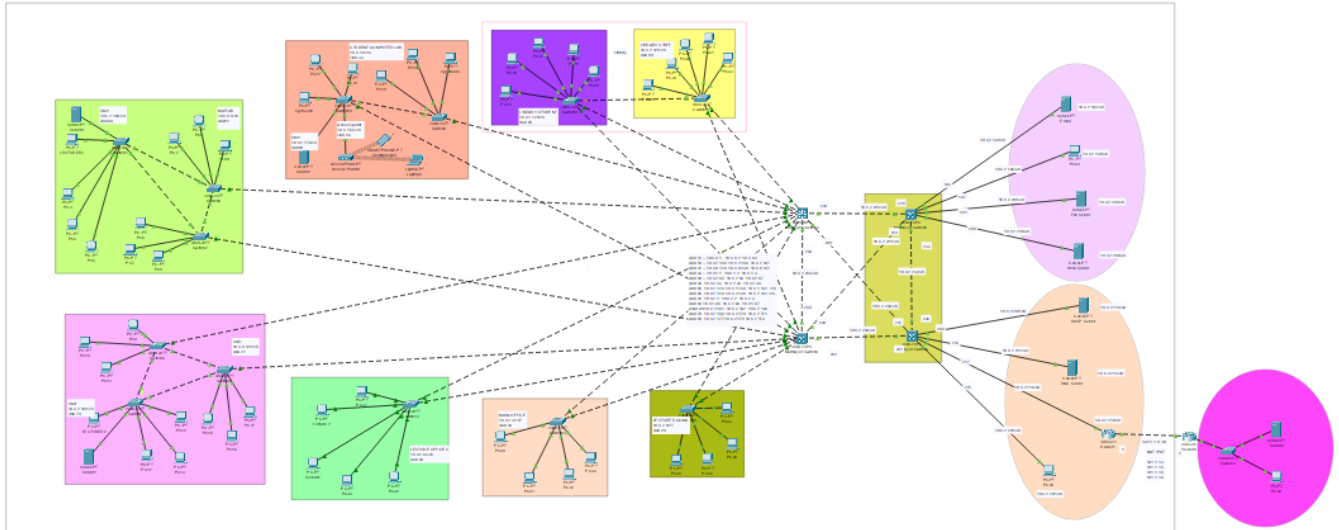


Figure 1: Complete Topology of the Network

For each and every section in the building, VLANs have been created for students as well as the teacher and staff.

## CAD Computer Lab

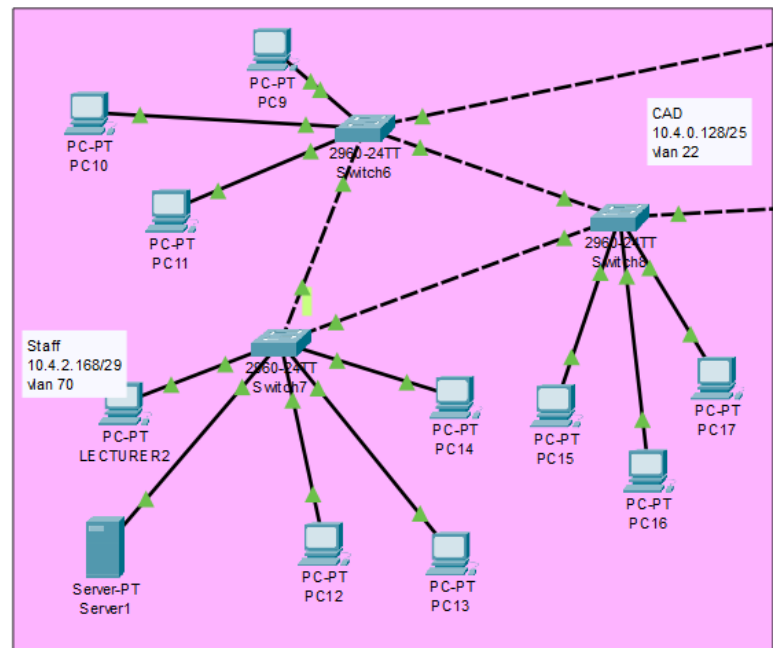


Figure 2: Network Diagram for CAD Computer Lab

## MATLAB Computer Lab

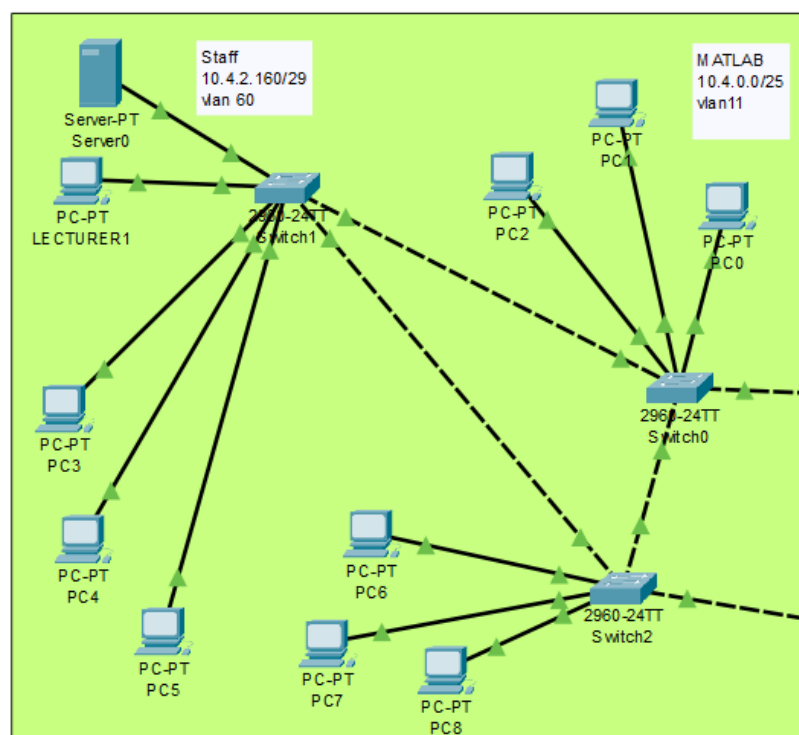


Figure 3: Network Diagram for MATLAB Computer Lab

## Student Computer Lab

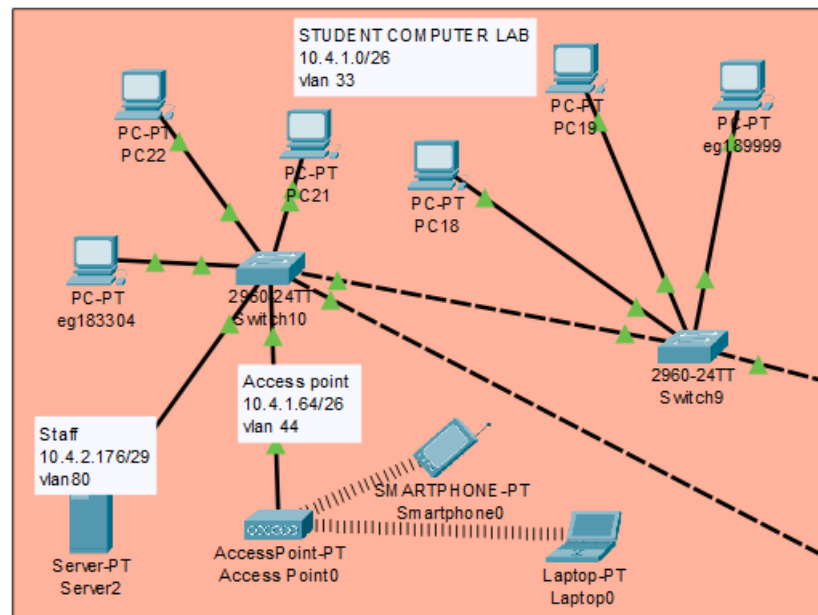


Figure 4 : Network Diagram for Student Computer Lab

## Library

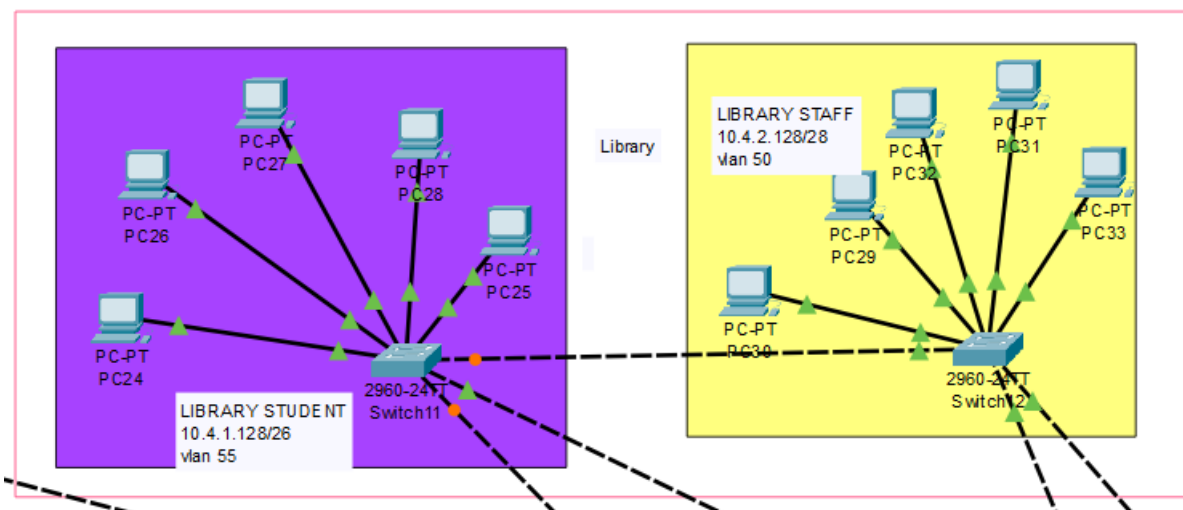


Figure 5: Network Diagram for Library

## Lecture Rooms

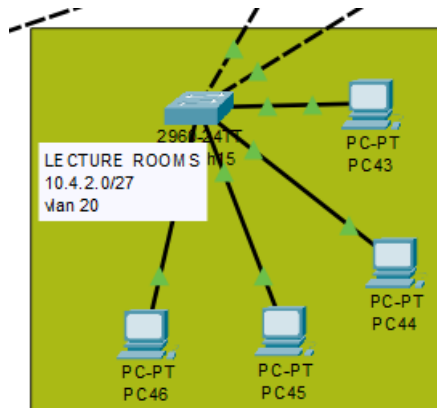


Figure 6: Network Diagram for Lecture Rooms

## Lecture Offices

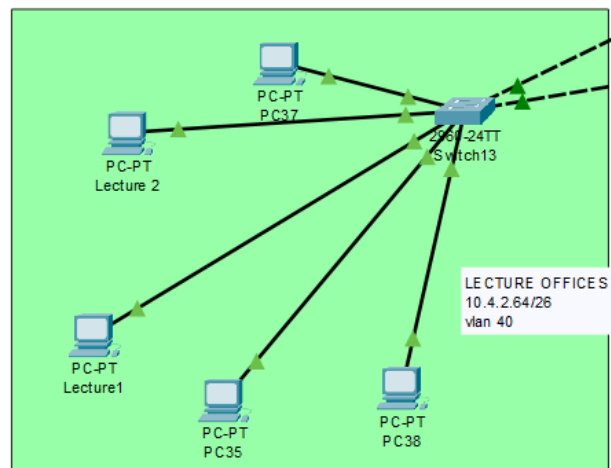


Figure 7: Network Diagram for Lecture Offices

## Main Office

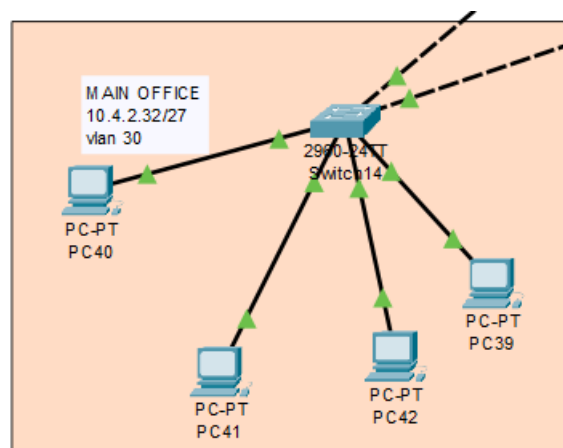


Figure 8: Network Diagram for Main Office

## Server Farm

There is one server room for each floor. It is clearly illustrated in the following Figure 9.

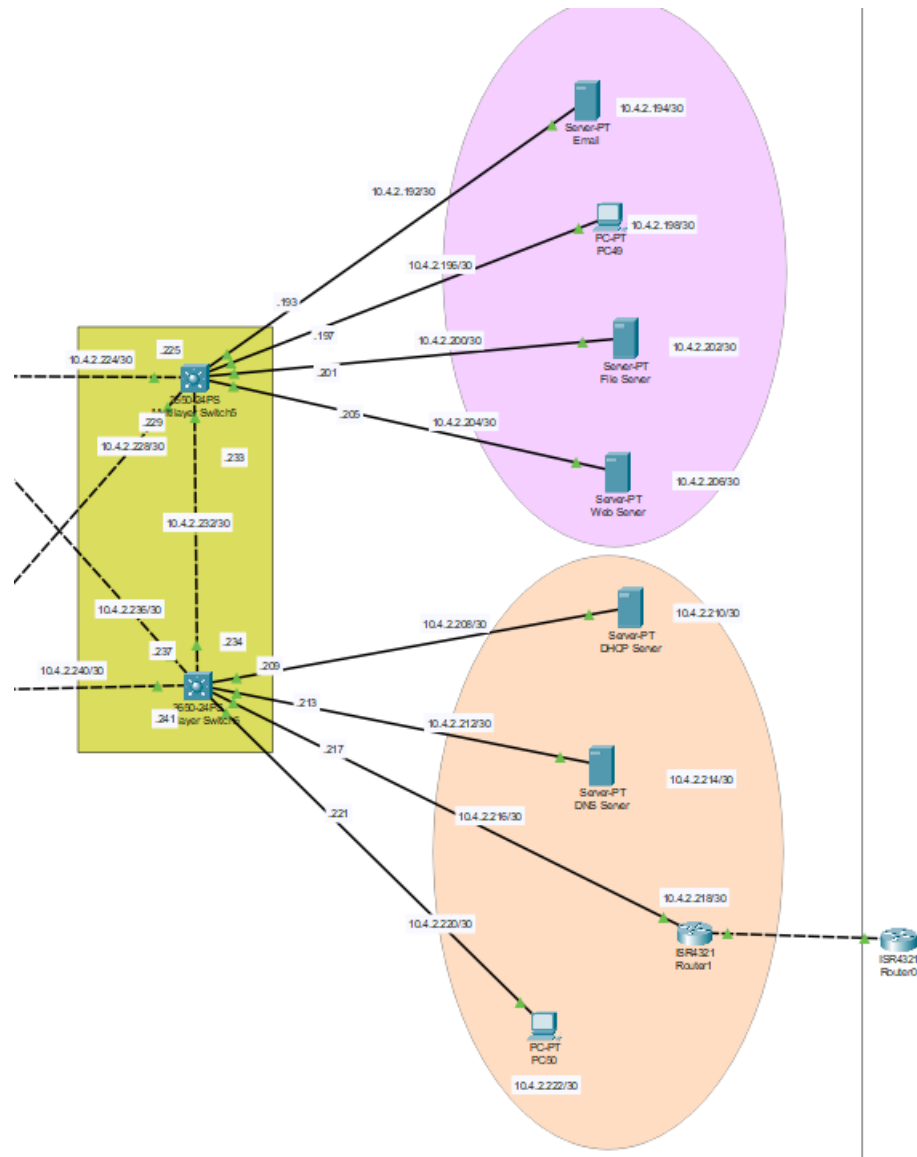


Figure 9: Network Diagram for Server Farm



## 1. DHCP Server

This DHCP Server in the server farm is responsible for assigning IPs for all the devices in this network. This allocation is done using the IP pools created in the DHCP server for each section of the building according to their VLANs.

The screenshot shows the 'DHCP Server' configuration window with the 'Desktop' tab selected. The 'IP Configuration' section is expanded, showing settings for the 'GigabitEthernet0' interface. The 'Static' radio button is selected for both IPv4 and IPv6 configurations. The IPv4 settings are: IP Address (10.4.2.210), Subnet Mask (255.255.255.252), Default Gateway (10.4.2.209), and DNS Server (0.0.0.0). The IPv6 settings are: Static (selected), Link Local Address (FE80::260:70FF:FEA9:ACC1), and Default Gateway (empty). The '802.1X' section is also visible, with 'Use 802.1X Security' unchecked and 'Authentication' set to 'MD5'.

Figure 10: IP Configuration of DHCP Server

The screenshot shows the 'DHCP Server' configuration window with the 'Services' tab selected. The 'DHCP' service is enabled. The 'IP Pools' table is displayed, showing the configuration for various VLANs and the 'serverPool'.

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
vlan 80	10.4.2.177	10.4.2.214	10.4.2.180	255.255.255.248	1	0.0.0.0	0.0.0.0
vlan 50	10.4.2.129	10.4.2.214	10.4.2.132	255.255.255.240	10	0.0.0.0	0.0.0.0
vlan 70	10.4.2.169	10.4.2.214	10.4.2.172	255.255.255.248	2	0.0.0.0	0.0.0.0
vlan 60	10.4.2.163	10.4.2.214	10.4.2.164	255.255.255.248	2	0.0.0.0	0.0.0.0
vlan 44	10.4.1.65	10.4.2.214	10.4.1.68	255.255.255.192	50	0.0.0.0	0.0.0.0
vlan 20	10.4.2.1	10.4.2.214	10.4.2.4	255.255.255.224	8	0.0.0.0	0.0.0.0
vlan 55	10.4.1.129	10.4.2.214	10.4.1.132	255.255.255.192	10	0.0.0.0	0.0.0.0
vlan 30	10.4.2.33	10.4.2.214	10.4.2.36	255.255.255.224	10	0.0.0.0	0.0.0.0
vlan 40	10.4.2.65	10.4.2.214	10.4.2.68	255.255.255.192	15	0.0.0.0	0.0.0.0
vlan 33	10.4.1.1	10.4.2.214	10.4.1.4	255.255.255.192	25	0.0.0.0	0.0.0.0
vlan 22	10.4.0.129	10.4.2.214	10.4.0.132	255.255.255.128	120	0.0.0.0	0.0.0.0
vlan 11	10.4.0.1	10.4.2.214	10.4.0.4	255.255.255.128	120	0.0.0.0	0.0.0.0
serverPool	0.0.0.0	0.0.0.0	10.4.2.208	255.255.255.252	512	0.0.0.0	0.0.0.0

Figure 11: IP Pools in the DHCP Server

## 2. DNS Server

The screenshot shows the 'DNS Server' configuration window with the 'IP Configuration' tab selected. The 'Interface' is set to 'GigabitEthernet0'. Under 'IP Configuration', 'Static' is selected. The fields are: IPv4 Address: 10.4.2.214, Subnet Mask: 255.255.255.252, Default Gateway: 10.4.2.213, and DNS Server: 0.0.0.0. Under 'IPv6 Configuration', 'Static' is selected. The fields are: IPv6 Address: (empty), Link Local Address: FE80::2E0:8FFF:FE23:EE28, Default Gateway: (empty), and DNS Server: (empty). Under '802.1X', 'Use 802.1X Security' is unchecked, and 'Authentication' is set to 'MD5'. There are fields for 'Username' and 'Password'. A 'Top' button is at the bottom left.

Figure 12: IP Configuration for the DNS Server

The screenshot shows the 'DNS Server' configuration window with the 'Services' tab selected. The 'DNS' service is turned 'On'. Under 'Resource Records', there is a table with 4 entries. Below the table are 'Add', 'Save', and 'Remove' buttons, and a 'DNS Cache' button. A 'Top' button is at the bottom left.

No.	Name	Type	Detail
0	eng.ruh.ac.lk	A Record	10.4.2.206
1	google.com	A Record	8.8.8.8
2	lms.eng.ruh.ac.lk	A Record	10.4.2.202
3	stm.eng.ruh.ac.lk	A Record	10.4.2.194

Figure 13: DNS Configurations

### 3. Email Server

The screenshot shows the 'Email' configuration window with the 'Desktop' tab selected. The 'IP Configuration' section is expanded, showing settings for the 'GigabitEthernet0' interface. The 'Static' radio button is selected under both 'IP Configuration' and 'IPv6 Configuration'. The IPv4 settings are: IP Address 10.4.2.194, Subnet Mask 255.255.255.252, Default Gateway 10.4.2.193, and DNS Server 0.0.0.0. The IPv6 settings are: Static selected, Link Local Address FE80::20A:F3FF:FEAE:57E1, and empty fields for Default Gateway and DNS Server. The '802.1X' section has 'Use 802.1X Security' unchecked, 'Authentication' set to 'MD5', and empty fields for 'Username' and 'Password'. A 'Top' button is at the bottom left.

Figure 14: IP Configurations of the Email Server

The screenshot shows the 'Email' configuration window with the 'Services' tab selected. The 'EMAIL' service is highlighted in the left sidebar. The 'SMTP Service' and 'POP3 Service' are both set to 'ON'. The 'Domain Name' is 'stm.eng.ruh.ac.lk'. The 'User Setup' section shows a list of users: 'eg183304' and 'eg189999'. There are buttons for '+', '-', 'Change', and 'Password' to manage the user list. A 'Top' button is at the bottom left.

Figure 15: Email Client Configurations of the Email Server

eg183304

Physical Config **Desktop** Programming Attributes

**Configure Mail** [X]

User Information

Your Name: Dematawaarachchi D.A.D.H.P.

Email Address: eg183304@stm.eng.ruh.ac.lk

Server Information

Incoming Mail Server: stm.eng.ruh.ac.lk

Outgoing Mail Server: stm.eng.ruh.ac.lk

Logon Information

User Name: eg183304

Password: ....

Save Remove Clear Reset

☐ Top

Figure 16: Email Client Configuration of User Device

eg189999

Physical Config **Desktop** Programming Attributes

**Message** [X]

Reply

From: eg183304@stm.eng.ruh.ac.lk Sent: Wed Sep 6 2023 17:29:08

To: eg189999@stm.eng.ruh.ac.lk

Subject: Testing Email Server

This is for test the email server

☐ Top

Figure 17: Email Service Testing

## 4. File Server

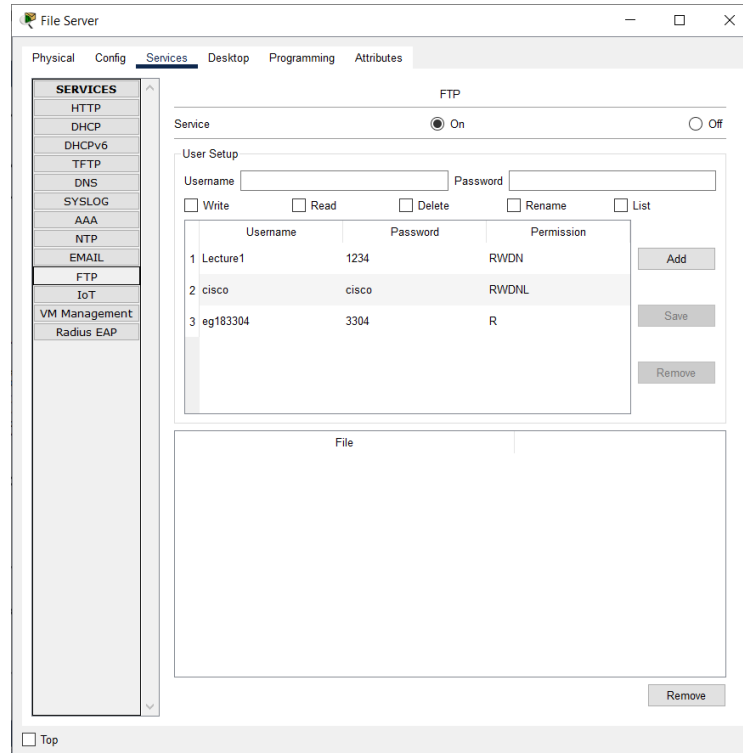


Figure 18: Client Configuration with Different Privileges in File Server

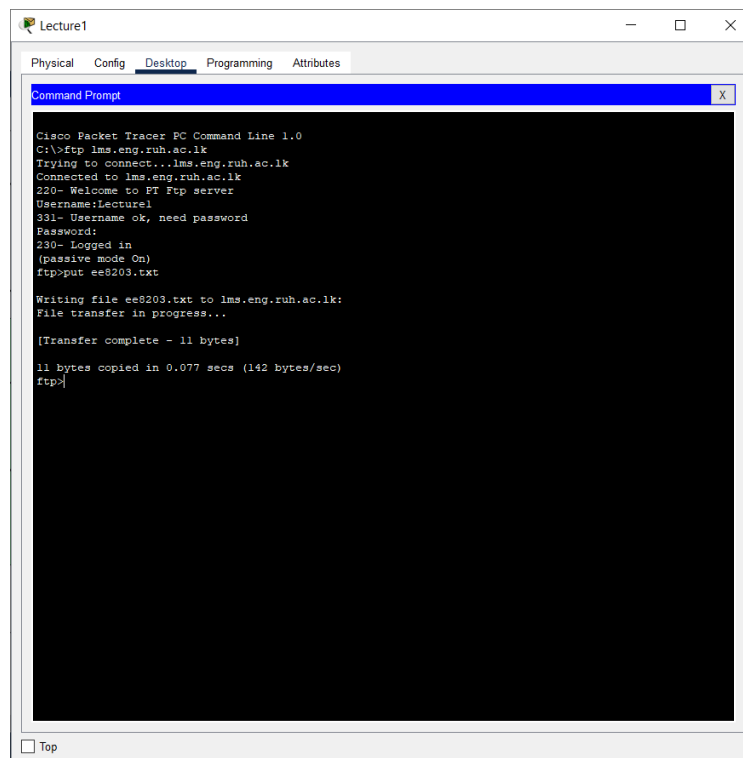


Figure 19: Lecturer uploads a File to Server

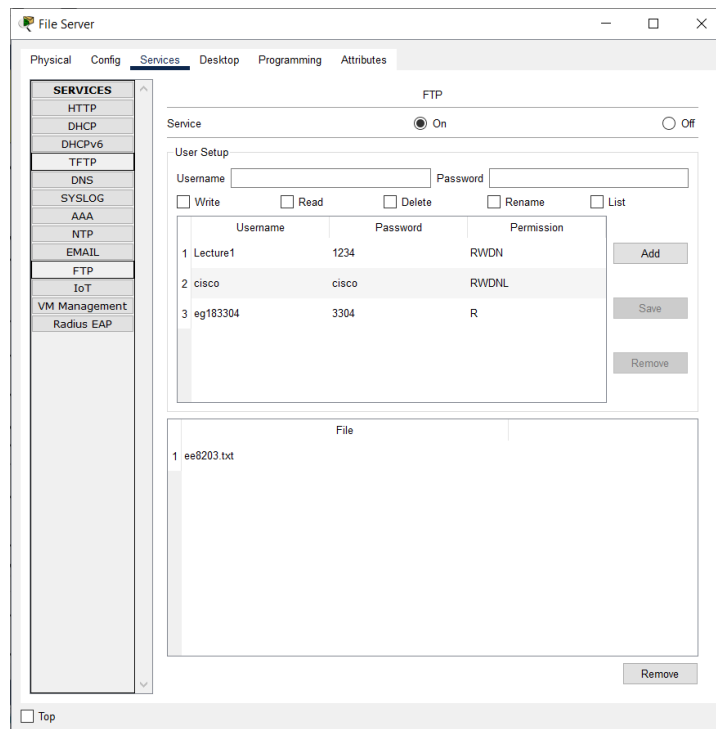


Figure 20: Verifying the File is Uploaded to the Server

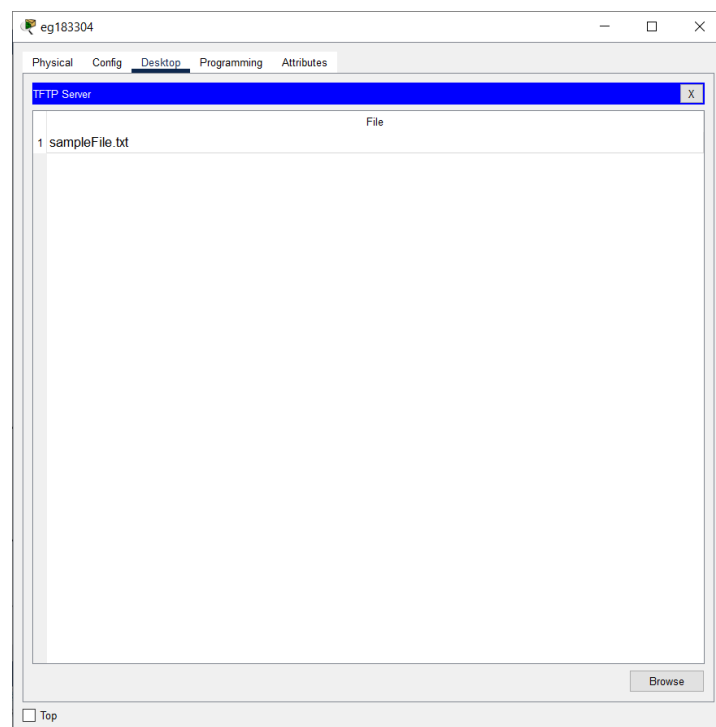


Figure 21: Student PC before Downloading the File

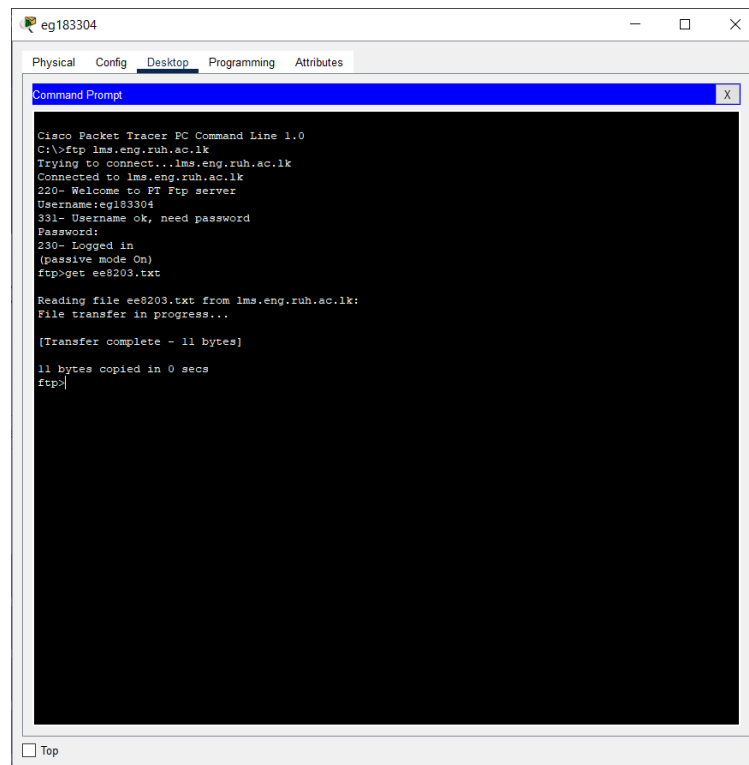


Figure 22: Student downloads the File from the Server

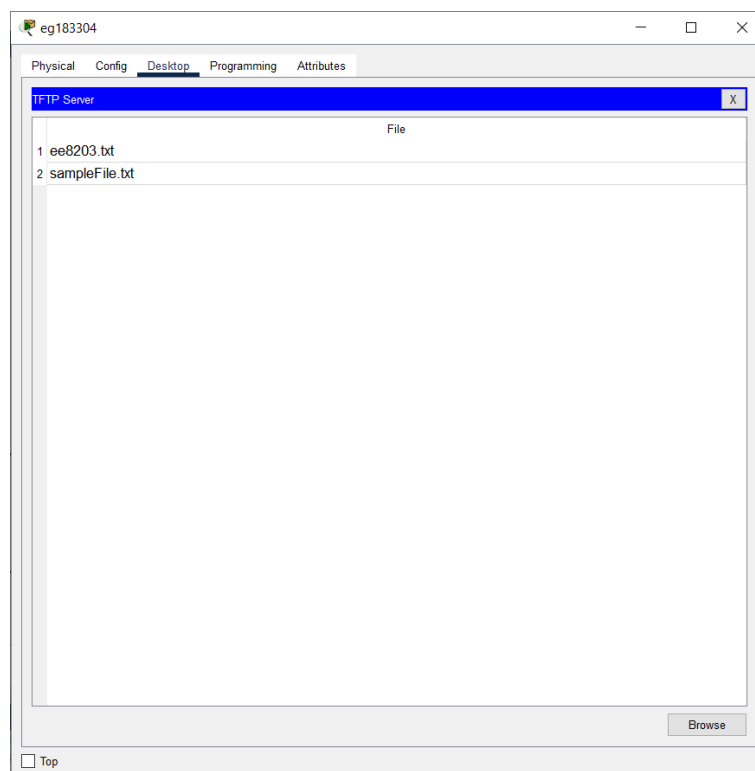
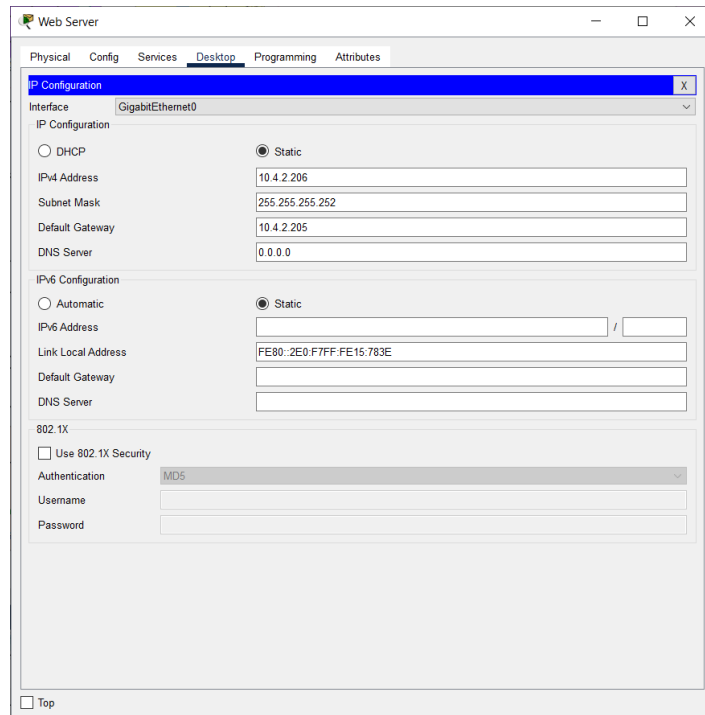


Figure 23: Student's PC After Downloading the File

## 5. Web Server



The screenshot shows the 'Web Server' configuration window with the 'Desktop' tab selected. The 'IP Configuration' section is active, showing settings for the 'GigabitEthernet0' interface. The 'IP Configuration' section has two sub-sections: 'IP Configuration' and 'IPv6 Configuration'. The 'IP Configuration' section has radio buttons for 'DHCP' and 'Static' (selected). Below these are text fields for 'IPv4 Address' (10.4.2.206), 'Subnet Mask' (255.255.255.252), 'Default Gateway' (10.4.2.205), and 'DNS Server' (0.0.0.0). The 'IPv6 Configuration' section has radio buttons for 'Automatic' and 'Static' (selected). Below these are text fields for 'IPv6 Address' (empty), 'Link Local Address' (FE80::2E0:F7FF:FE15:783E), 'Default Gateway' (empty), and 'DNS Server' (empty). At the bottom, there is a section for '802.1X' with a checkbox for 'Use 802.1X Security' (unchecked), a dropdown for 'Authentication' (MD5), and text fields for 'Username' and 'Password'.

Web Server

Physical Config Services Desktop Programming Attributes

IP Configuration

Interface GigabitEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 10.4.2.206

Subnet Mask 255.255.255.252

Default Gateway 10.4.2.205

DNS Server 0.0.0.0

IPv6 Configuration

☐ Automatic ☒ Static

IPv6 Address /

Link Local Address FE80::2E0:F7FF:FE15:783E

Default Gateway

DNS Server

802.1X

☐ Use 802.1X Security

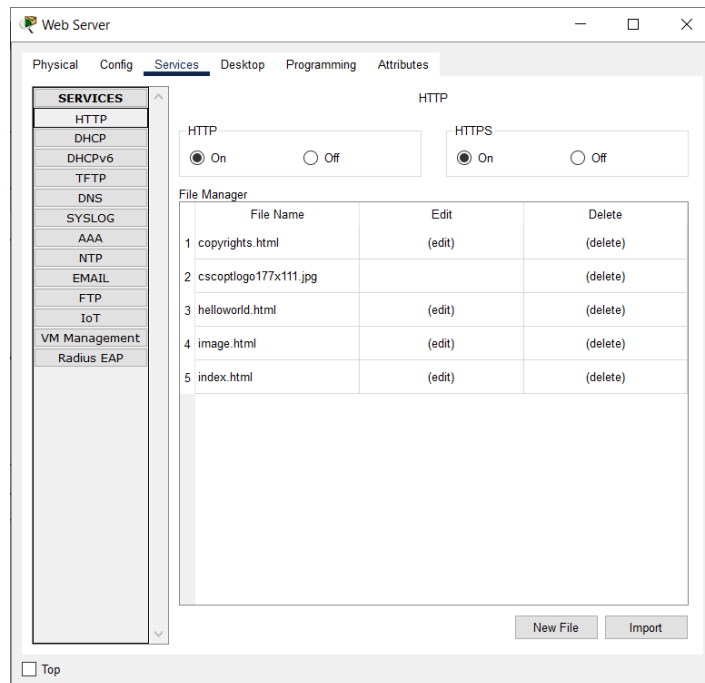
Authentication MD5

Username

Password

Top

Figure 24: IP Configuration of the Web Server



The screenshot shows the 'Web Server' configuration window with the 'Services' tab selected. The 'SERVICES' list on the left includes HTTP, DHCP, DHCPv6, TFTP, DNS, SYSLOG, AAA, NTP, EMAIL, FTP, IoT, VM Management, and Radius EAP. The 'HTTP' service is selected, showing 'HTTP' and 'HTTPS' status sections. Both 'HTTP' and 'HTTPS' have radio buttons for 'On' (selected) and 'Off'. Below these is a 'File Manager' table with columns for 'File Name', 'Edit', and 'Delete'. The table lists five files: 'copyrights.html', 'cscoptlogo177x111.jpg', 'helloworld.html', 'image.html', and 'index.html'. At the bottom right are 'New File' and 'Import' buttons.

Web Server

Physical Config Services Desktop Programming Attributes

SERVICES

HTTP

HTTP

☒ On ☐ Off

HTTPS

☒ On ☐ Off

File Manager

	File Name	Edit	Delete
1	copyrights.html	(edit)	(delete)
2	cscoptlogo177x111.jpg		(delete)
3	helloworld.html	(edit)	(delete)
4	image.html	(edit)	(delete)
5	index.html	(edit)	(delete)

New File Import

Top

Figure 25: Files in Web Server



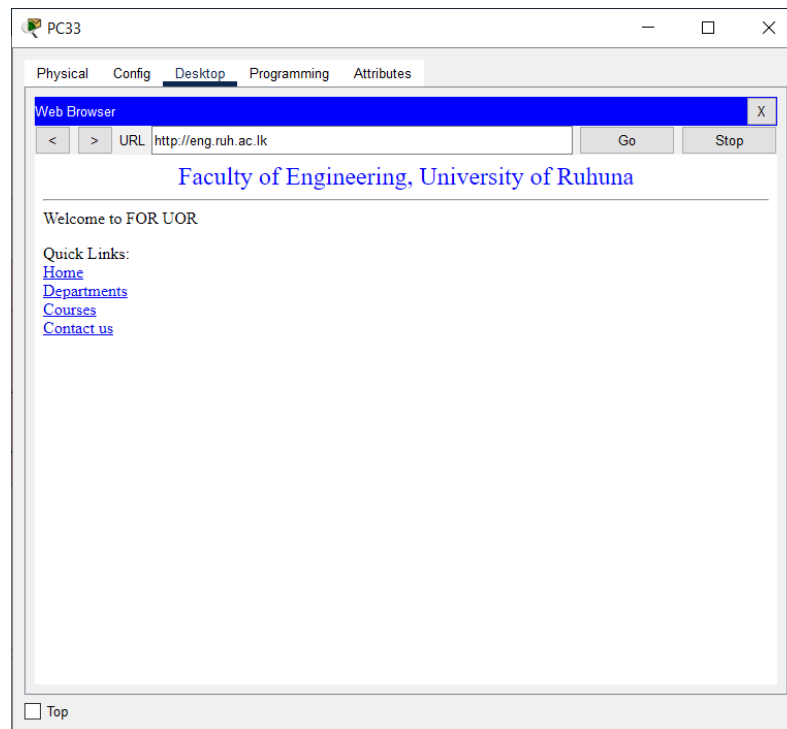


Figure 26: Verifying the Web Server is Running Accurately

## 6. WAN Link

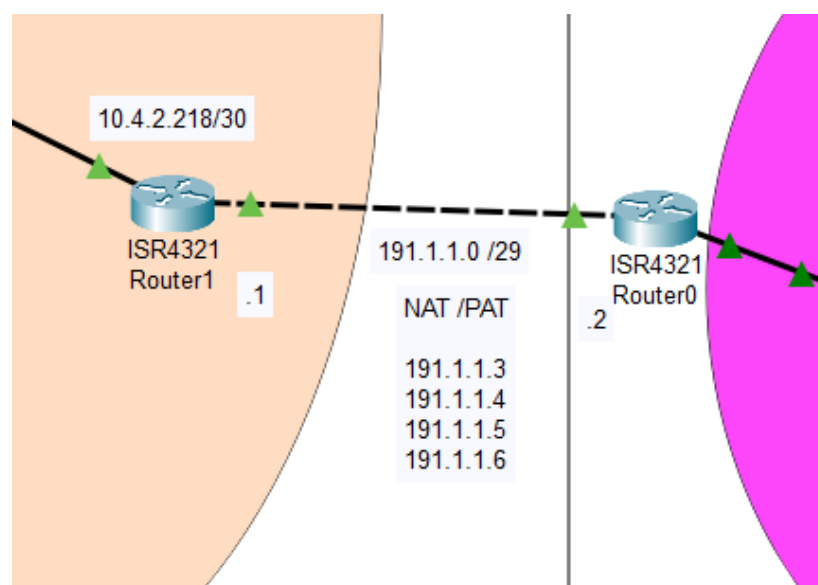


Figure 27: WAN Configuration of the Building

To translate local Ips to public Ips , NAT/PAT is used from 191.1.1.3 to 191.1.1.6 Ip range.

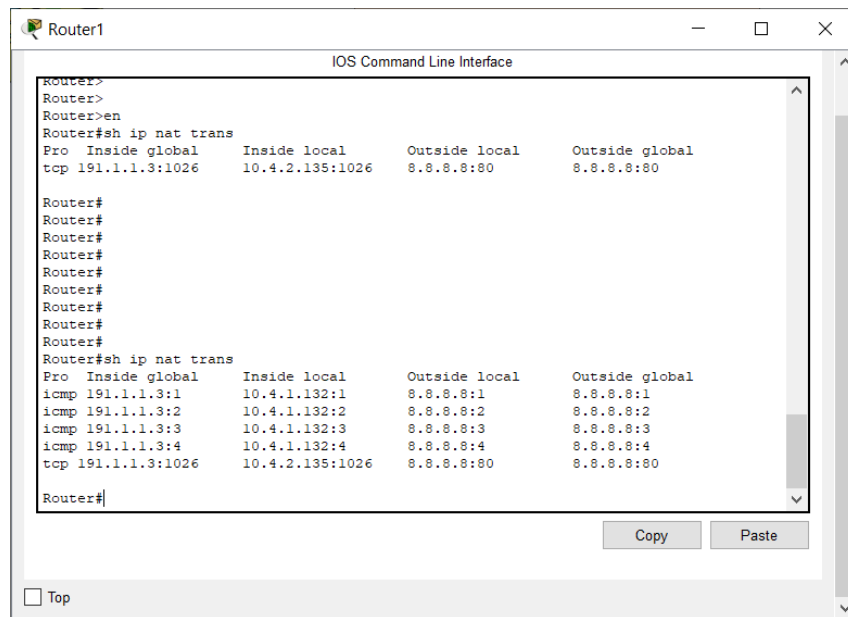


Figure 28: Verifying NAT/PAT Translation

## 7. Access Lists

Students in the computer lab cannot access the internet. Therefore, a standard access list is created in the multilayer switch to deny the access for internet to those students.

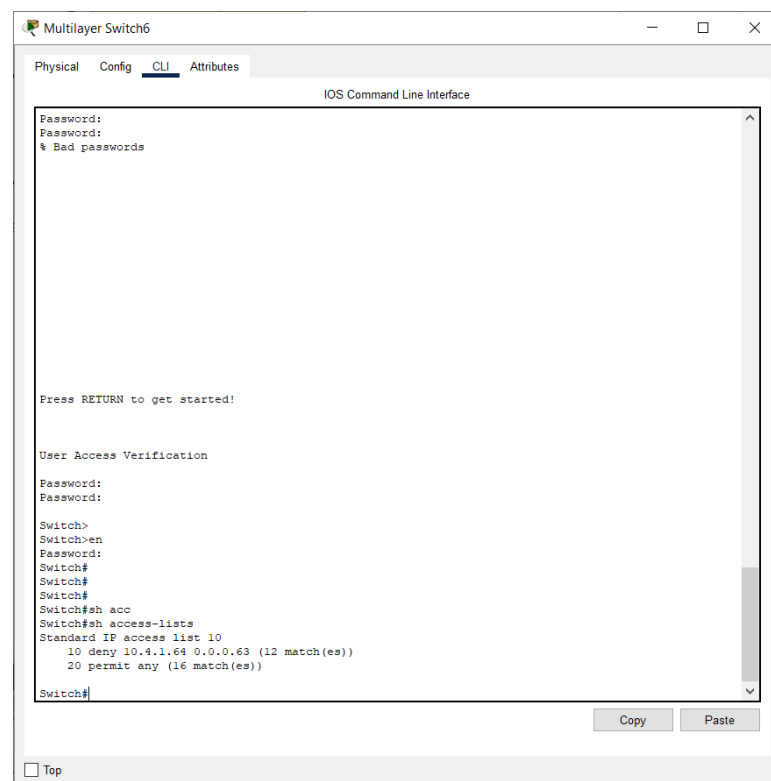


Figure 29: Configured Standard Access Lists

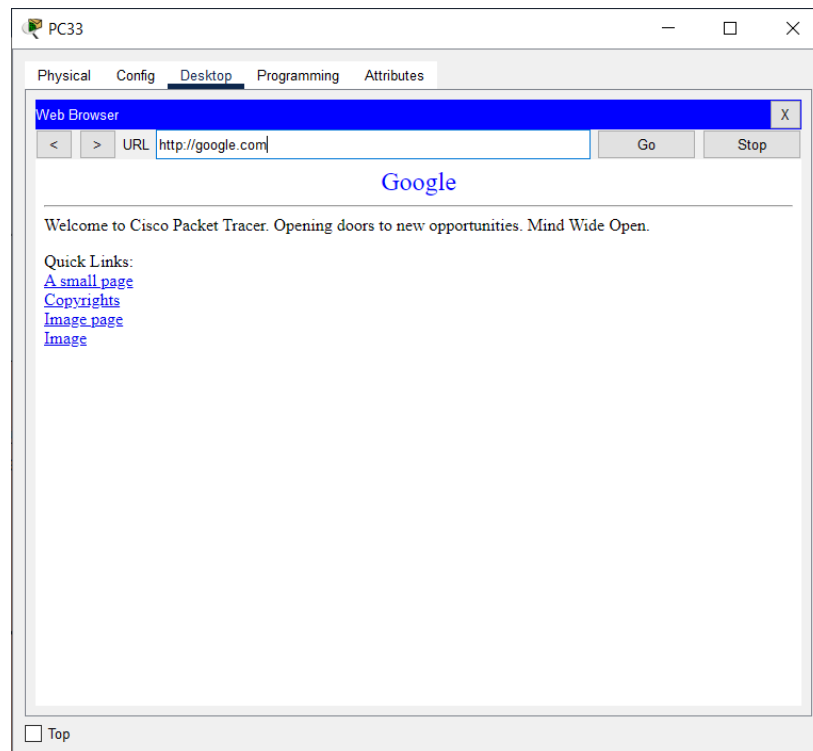


Figure 30: Verifying Access for Allowed Users

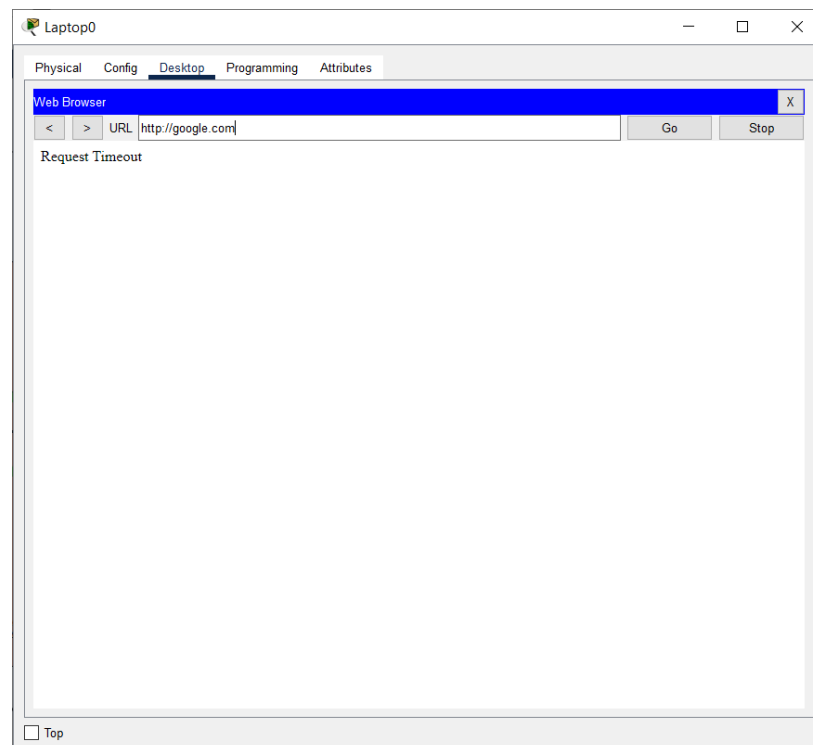


Figure 31: Verifying the Access Denied Users

## Access Point

The WLAN users in the computer lab obtain the IP s from the DHCP server.

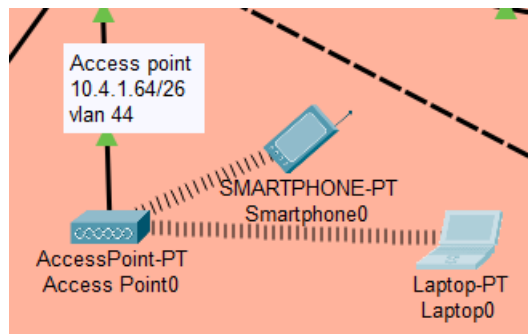


Figure 32: Network Diagram of the Access Point

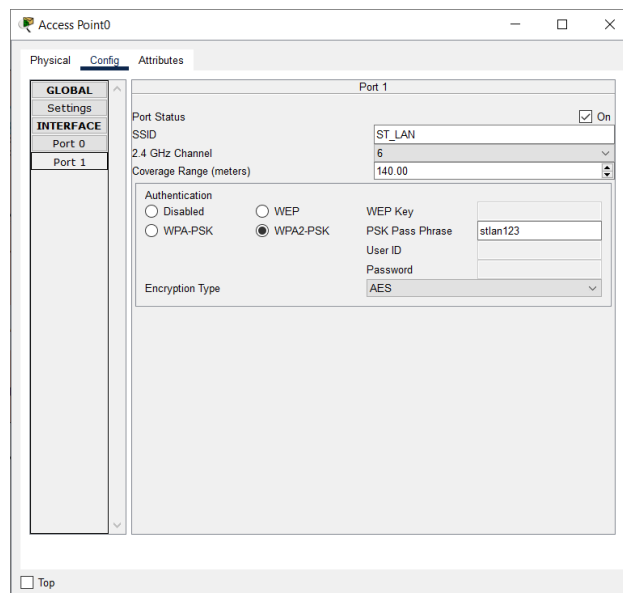


Figure 33: Access Point Configuration

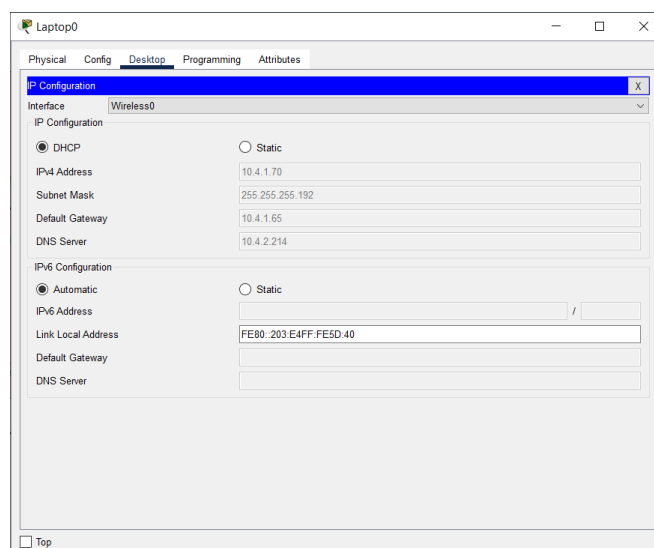


Figure 34: Verifying the IP Allocation of WLAN Users from DHCP Server

## Redundancy Implementations

According to Figure 35, it can be observed that redundant paths have been established between switches in the access layer to ensure reliable communication between each other. In this case, full mesh topology has been established between switches. Also, two links are implemented between the access layer and the distribution layer in each section. According to the Figure 36, in the distribution layer it has been implemented full mesh topology between the multilayer switches. Another special case is, for each floor there is an active multilayer switch and a standby multilayer switch. Active one is the switch located in the same floor and standby multilayer switch for each floor is the one located on the other floor. This is implemented using HSRP protocol.

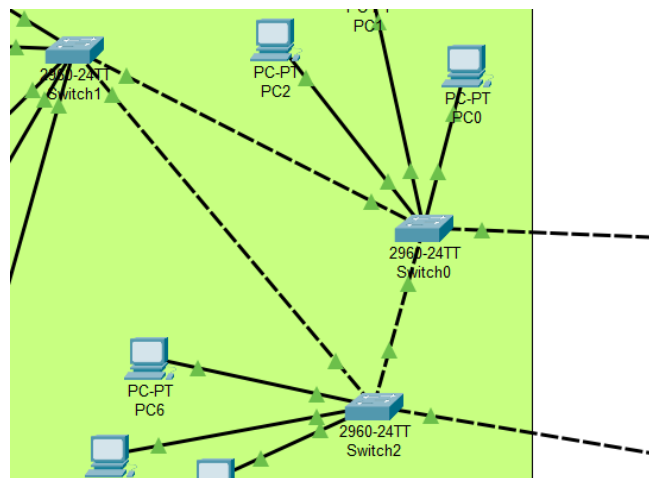


Figure 35: Redundancy in Access Layer

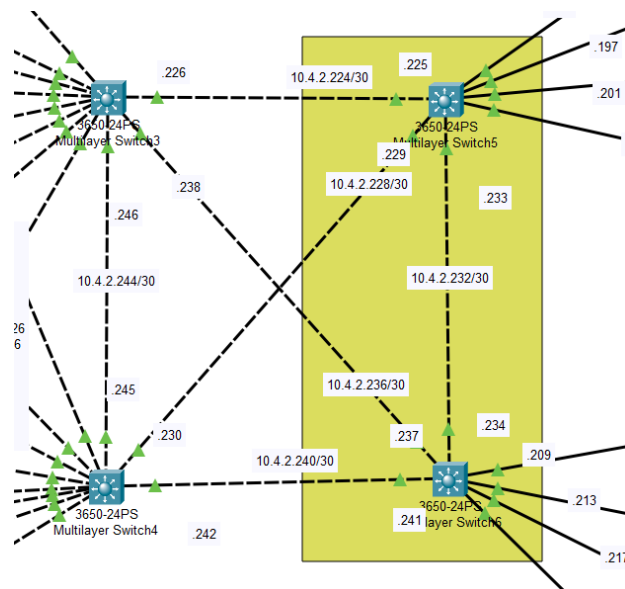


Figure 36: Redundancy in Distribution Layer

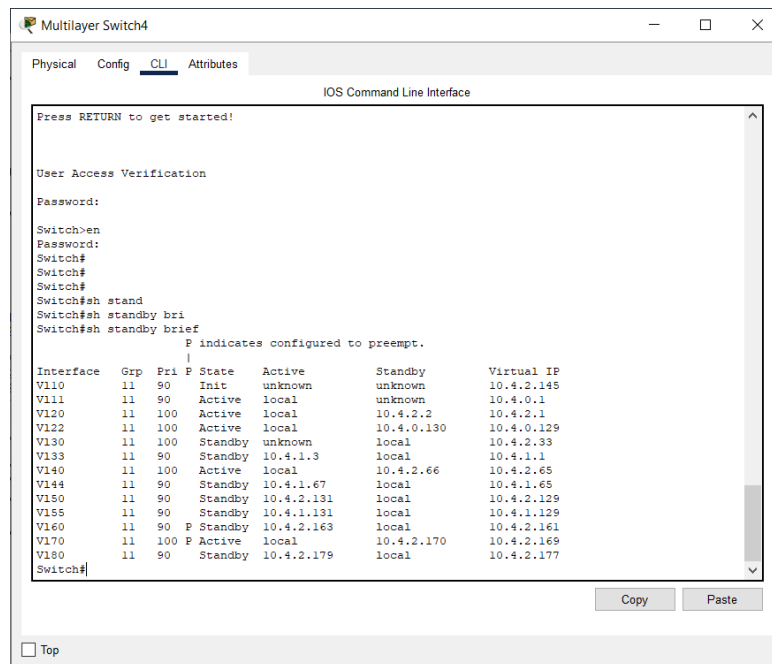


Figure 37: Implemented HSRP Protocol

## Security Implementations

For security purposes it has been added a console password and a telnet password to the switches, multilayer switches, and the routers in the entire network. Also, it has been added the enable secret password. Also, the passwords are encrypted for more security.

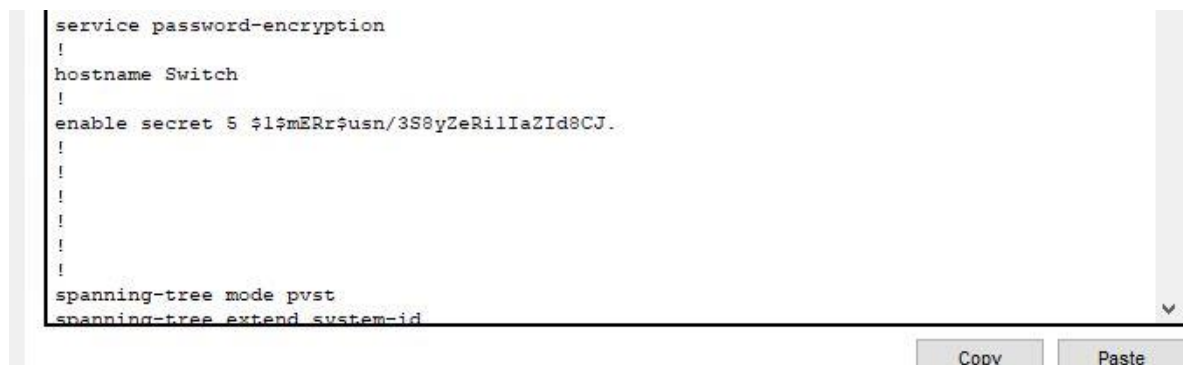


Figure 38: Enabled Secret Password in Switches

```

:
!
line con 0
 password 7 083649420A160812
 login
!
line vty 0 4
 password 7 080C4D5D1D1C17
 login
line vty 5 15
 login
!
!
!
!
end
Switch#

```

Copy Paste

Figure 39: Added Console and Telnet Passwords in Switch

```

User Access Verification

Password:
Password:
Password:

Switch>en
Password:
Switch#
Switch#
Switch#
Switch#

```

Copy Paste

☐ Top

Figure 40: User Access Verification

## Cable Implementations

Table 2: Cable Usage with the Network

Location	Cable Type	Speed/Model
PC - Switch	Copper (Twisted Pair) Straight through	Fast Ethernet
Switches – Switches	Copper (Twisted Pair) Cross over	Fast Ethernet
Switches – Multilayer switches	Copper (Twisted Pair) Cross over	Gigabit Ethernet
Multilayer switches – Multilayer switches	Copper (Twisted Pair) Cross over	Gigabit Ethernet
Multilayer switches – Servers (Within Server Farm)	Copper (Twisted Pair) Straight through	Gigabit Ethernet
Multilayer switches – Router	Copper (Twisted Pair) Straight through	Gigabit Ethernet
Router – Router	Copper (Twisted Pair) Cross over	Gigabit Ethernet