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COMPUTER NETWORKING (BIC21303)

SECTION 04

GROUP PROJECT **(GROUP 01)**

TITLE: SMALL OFFICE HOME OFFICE (SOHO) NETWORK DESIGN WITH GUEST NETWORK & A CAMPUS NETWORK DESIGN FOR A COLLEGE

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PART 1

SMALL OFFICE HOME OFFICE (SOHO) NETWORK DESIGN WITH GUEST NETWORK

1.0 INTRODUCTION

1.1 Project Title

Small Office Home Office (SOHO) Network Design with Guest Network.

1.2 Project Scope

A small business network is to be designed for an organization in Parit Raja, Johor. The organization has a cyber security training center (Max 25 students) visiting the business premise. There are a total of 60 staff in the organization, each has been assigned a workstation. An email and FTP servers are required for all the 60 users to support daily workload.

2.0 PLANNING

2.1 Network Requirements

Within our modest business network, we have 85 PCs, 25 for guests and 60 for employees, all of which are linked to a DHCP server, an FTP server, and a DNS server. To establish connection, all PCs will connect to a single router via switches. The 60 worker PCs will be split over three switches, each supporting 20 PCs. In addition, we have one switch designated particularly for the 25 guest PCs. The router that we use is called Router ISR4331/K9 Black, and it's equipped with one Cisco GLC-T, 1000BASE-T SFP. It runs on normal Category 5 unshielded twisted-pair copper cable with connection lengths of up to 100 m, and the switches are Cisco 2960 WS-C2960-24LT-L.

Every switch will connect to the router, with the last switch connecting to the router, DHCP server, FTP server, and DNS server. To connect all of the devices, we utilize Copper Straight Through Cable CAT 6 Flat Patch Cord LAN Cable Gigabit Ethernet Cable 10G RJ45 UTP (5m) with improved bandwidth. Next, connect the switches using a Schneider CAT6 Crossover Patch Cord (10m). As a consequence, connecting all of the gadgets mentioned above needs around 93 cables. The router will be configured to meet the requirements of the guest and user PCs in order for it to operate.

NO.	ITEM	QUANTITY
1.	Cisco GLC-T, 1000BASE-T SFP transceiver module for Category 5 copper wire	1
2.	Copper Straight Through Cable CAT 6 Flat Patch Cord LAN Cable Gigabit Ethernet Cable 10G RJ45 UTP (5m)	91
3.	Dell Inspiron 27 All-in-One PC	85
4.	PowerEdge R250 Rack Server	3
5.	Router ISR4331/K9 Black	1
6.	Schneider CAT6 Crossover Patch Cord (10m)	2
7.	Switch WS-C2960-24TT-L	5

Table 2.1: List of Network Requirements.

2.2 Network Planning

The wiring diagram includes three subnets, each of which is linked to the router. The first subnet serves 60 staff network users with IP addresses ranging from 201.10.10.0 to 201.10.10.63. The broadcast address for all 60 users is 201.10.10.63. The second subnet address from the guest network is for the 25 guest users, with addresses ranging from 201.10.10.64 to 201.10.10.95. The broadcast address for all 25 guest users is 201.10.10.95. Finally, the third subnet is used to link the subnet servers to the DHCP, FTP, and DNS servers, with IP addresses spanning from 201.10.10.96 to 201.10.10.103. The broadcast address for this subnet is 201.10.10.103.

TASK	ASSIGN TO
Connects two or more networks, regulating traffic by forwarding data packets to the appropriate IP addresses and allowing several devices to share an Internet connection.	Router
Receives incoming data packets from a source and selects the proper port to send the packets to their destination.	Switch
Connect several sorts of devices, such as a computer to a switch or a router to a modem, to ensure effective data transfer over the network.	Copper Straight Cable
Offer services and functions to other computers.	Server
The 1000BASE-T SFP, a hot-swappable I/O device, connects to Gigabit Ethernet ports and provides full-duplex Gigabit Ethernet connection over existing copper networks, with a range of up to 100m on typical Category 5 cabling.	GLC-T
Connecting devices, such as two switches or two computers, allows for direct communication without the need for an intermediary device.	Copper Crossover Cable

Table 2.2: Network Task Assignment.

2.2.1 Group Member Task

Throughout this project, each group member will be allocated particular tasks to ensure the project's success. Members will work together to exchange ideas, encourage one another, and provide their unique abilities. Network Configurator, IP Network Designer, Network Tester, Accountant, Network Designer, Documentation, and Auditor are typical responsibilities. Each member's active engagement and responsibility are critical to attaining our joint objectives efficiently and effectively.

MEMBER	TASK
Nuralyana Maisara Binti Noorisham	• Leader • Network Configurator • IP Network Designer • Network Tester • Accountant
Nurul Nabilah Binti Suhud	• Network Designer • Documentation • Auditor • Network Tester • Accountant
Siti Nur Syuhadah Binti Arifin	• Network Designer • Documentation • Auditor • Network Tester • Accountant
Tuan Khalidah Syazwana Binti Tuan Mohd Kasmawi	• Network Designer • Network Configurator • Documentation • Network Tester • Accountant

Table 2.2.1: List of Group Member Tasks.

3.0 DESIGN

3.1 IP Network Design Table

The IP Network Design Table specifies the IP addressing strategy for a network. It contains crucial information including subnet address, subnet mask, number of hosts supported and needed, address range, broadcast address, default gateway, and assigned to which network. This table guarantees that IP addresses are allocated in an ordered and effective manner, hence enabling network administration, troubleshooting, and scalability. It is used as a reference by network managers and engineers to ensure consistent and optimal network performance.

Given IP	Subnet Address (SA)	Subnet Mask	No. of Host Supported (NHS)	No.of Host Needed (NHN)	Address Range (AR)	B/cast Address (BA)	Gateway	Assigned To (AT)
201.10.10.0	201.10.10.0 : 201.10.10.63	255.255.255.192 /26	62	60	201.10.10.1 : 201.10.10.62	201.10.10.63	201.10.10.1	Staff Network
	201.10.10.64 : 201.10.10.95	255.255.255.224 /27	30	25	201.10.10.65 : 201.10.10.94	201.10.10.95	201.10.10.65	Guest Network
	201.10.10.96 : 201.10.10.103	255.255.255.248 /29	6	2	201.10.10.97 : 201.10.10.102	201.10.10.103	201.10.10.97	Servers (Email Server and FTP Server)

Table 3.1.1: IP Network Design Table

We presume that a crossover cable was not utilized to link switches through their ports. As a result, with this setup, a single switch may link up to 25 PCs. This configuration simplifies network architecture and assures that each PC is directly linked to the switch, which improves network performance and administration.

According to Figure 3.1.2 below, the Network Configuration Table contains essential details for configuring and controlling network devices. It has columns labeled Device, Interface, IP Address, Subnet Mask, and Default Gateway. This table ensures that network settings are well documented and structured, making it easier to configure, debug, and maintain the network infrastructure.

Device	Interface	IP Address	Subnet Mask	Default Gateway
Router	G0/0/0	201.10.10.1 /26	255.255.255.192	N/A
	G0/0/1	201.10.10.97 /29	255.255.255.248	
	G0/0/2	201.10.10.65 /27	255.255.255.224	
STAFF NETWORK				
Switch-S1	VLAN1	201.10.10.2 /26	255.255.255.192	201.10.10.1
Switch-S2	VLAN1	201.10.10.3 /26	255.255.255.192	201.10.10.1
Switch-S3	VLAN1	201.10.10.4 /26	255.255.255.192	201.10.10.1
PC_Staff-1	F0/0/0	201.10.10.5 /26	255.255.255.192	201.10.10.1
PC_Staff-2	F0/0/0	201.10.10.20 /26	255.255.255.192	201.10.10.1
PC_Staff-3	F0/0/0	201.10.10.30 /26	255.255.255.192	201.10.10.1
PC_Staff-4	F0/0/0	201.10.10.40 /26	255.255.255.192	201.10.10.1
PC_Staff-5	F0/0/0	201.10.10.50 /26	255.255.255.192	201.10.10.1
PC_Staff-6	F0/0/0	201.10.10.60 /26	255.255.255.192	201.10.10.1
GUEST NETWORK				
Switch-G1	VLAN1	201.10.10.66 /27	255.255.255.224	201.10.10.65
PC_Guest-1	F0/0/0	201.10.10.73 /27	255.255.255.224	201.10.10.65
PC_Guest-2	F0/0/0	201.10.10.91 /27	255.255.255.224	201.10.10.65
SUBNET SERVER				
Switch	VLAN1	201.10.10.98 /29	255.255.255.248	201.10.10.97
Email Server	F0/0/0	201.10.10.99 /29	255.255.255.248	201.10.10.97
FTP Server	F0/0/0	201.10.10.100 /29	255.255.255.248	201.10.10.97
DNS Server	F0/0/0	201.10.10.101 /29	255.255.255.248	201.10.10.97

Table 3.1.2: Network Configuration Table

3.2 Physical Network Design

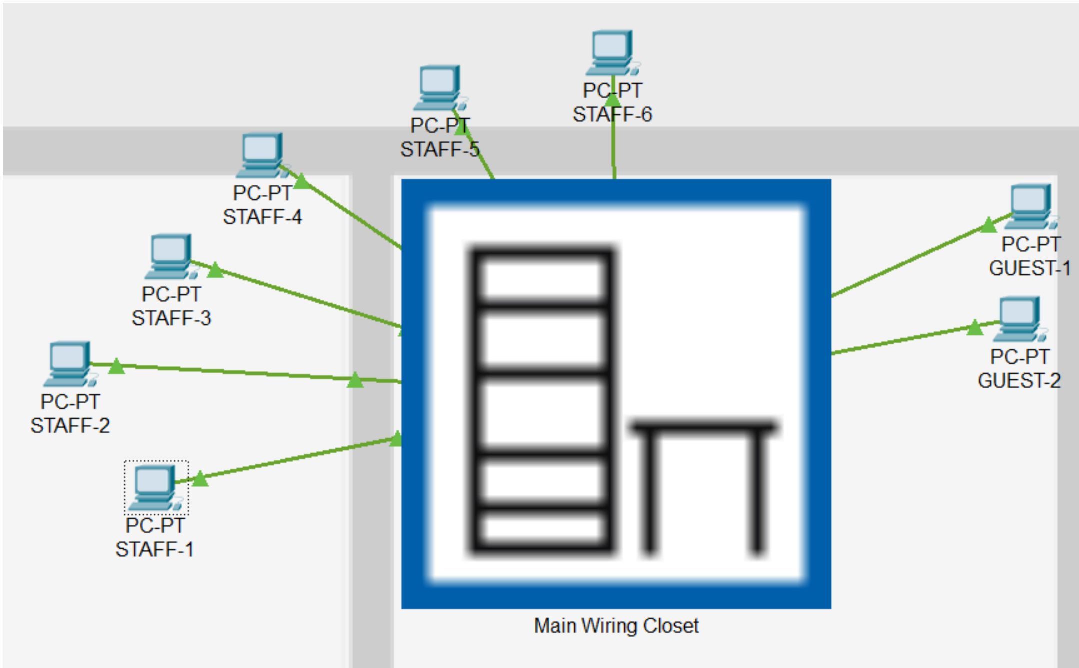


Figure 3.2: Physical Network Design

3.3 Logical Network Design

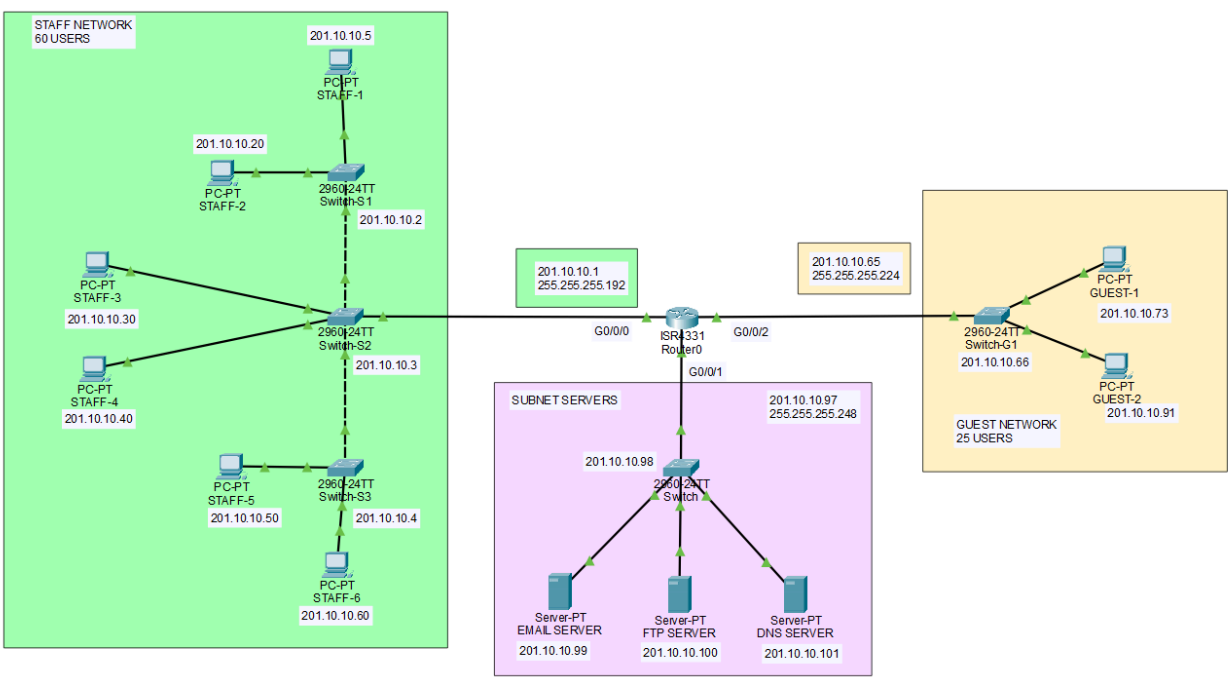


Figure 3.3: Logical Network Design

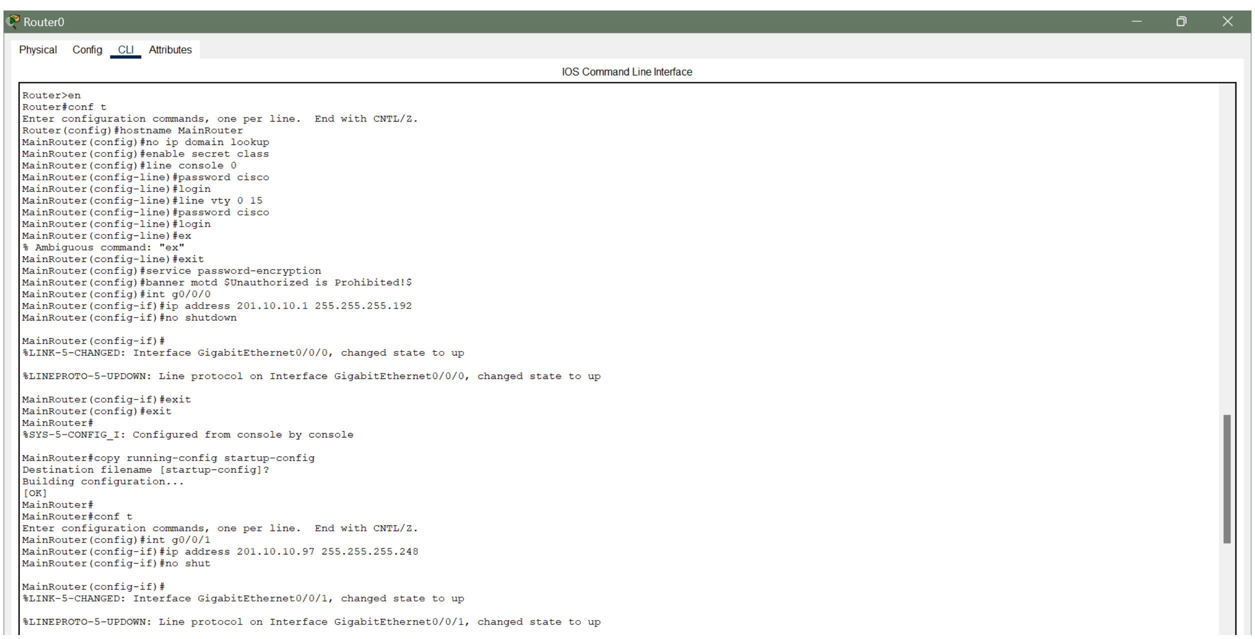
4.0 CONFIGURATION

4.1 Network Configuration

The router is an essential item in network architecture, positioned centrally to allow effective communication between devices. It supports the seamless flow of data and commands by giving IP addresses to each interface. This assignment enables for continuous connectivity and access across the network, allowing devices to interact effectively and complete activities without interruption. The router's function in controlling and directing traffic is critical to ensuring network stability and performance.

4.1.1 Main Router Configuration

The entered commands set the router's hostname, passwords, banner message, and interface IP address. It begins by entering privileged EXEC mode and global configuration mode. The hostname is changed to 'MainRouter', and DNS lookup is disabled. The password for privileged EXEC mode is set to 'class' and encrypted. The console and virtual terminal line passwords are set to 'cisco', and login authentication is enabled for both. Password encryption is enabled, and a message-of-the-day banner is configured. The GigabitEthernet 0/0/0 interface is allocated the IP address 201.10.10.1 and a subnet mask of 255.255.255.192. Finally, the setting gets saved into the starting configuration file.



```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname MainRouter
MainRouter(config)#no ip domain lookup
MainRouter(config)#enable secret class
MainRouter(config)#line console 0
MainRouter(config-line)#password cisco
MainRouter(config-line)#login
MainRouter(config-line)#line vty 0 15
MainRouter(config-line)#password cisco
MainRouter(config-line)#login
MainRouter(config-line)#ex
% Ambiguous command: "ex"
MainRouter(config-line)#exit
MainRouter(config)#service password-encryption
MainRouter(config)#banner motd $Unauthorized is Prohibited!$
MainRouter(config)#int g0/0/0
MainRouter(config-if)#ip address 201.10.10.1 255.255.255.192
MainRouter(config-if)#no shutdown

MainRouter(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/0, changed state to up

MainRouter(config-if)#exit
MainRouter(config)#exit
MainRouter#
%SYS-5-CONFIG_I: Configured from console by console

MainRouter#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
MainRouter#
MainRouter#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
MainRouter(config)#int g0/0/1
MainRouter(config-if)#ip address 201.10.10.97 255.255.255.248
MainRouter(config-if)#no shut

MainRouter(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed state to up
```

Figure 4.1.1.1: Main Router Configuration

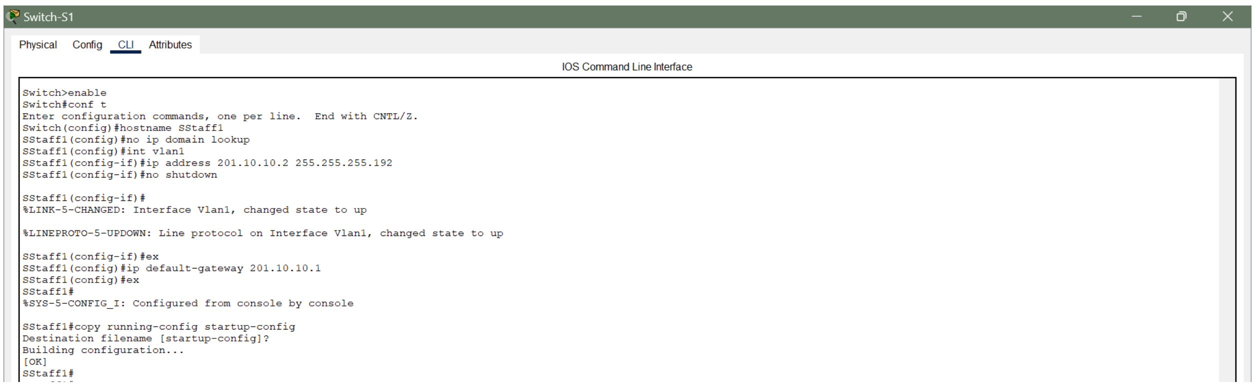
The following commands set up the MainRouter's GigabitEthernet 0/0/1 and GigabitEthernet 0/0/2 interfaces. The GigabitEthernet 0/0/1 interface is allocated the IP address 201.10.10.97 with a subnet mask of 255.255.255.248, while the GigabitEthernet 0/0/2 interface is assigned the IP address 201.10.10.65 with a subnet mask of 255.255.255.224. Both interfaces are active using the 'no shut' command. The configuration modifications are then saved to the startup configuration file to guarantee they remain following a reboot.

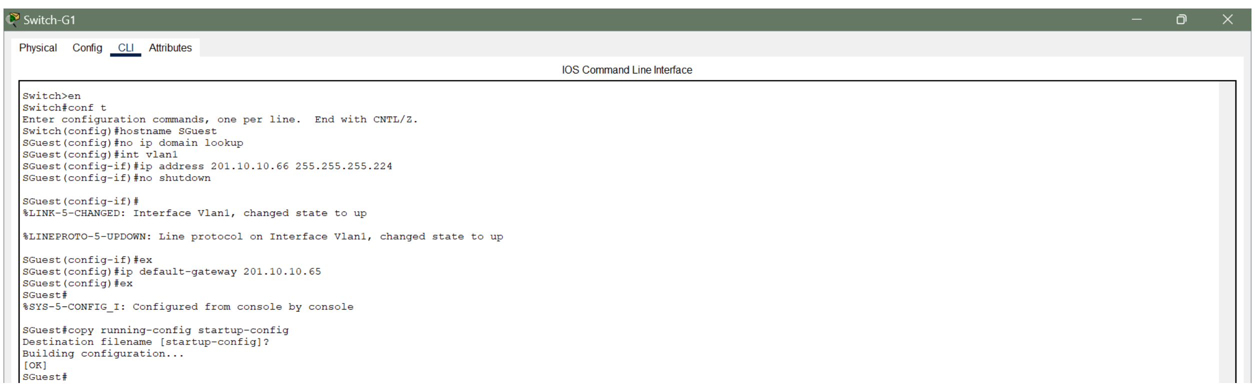
```
MainRouter(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/1, changed state to up

MainRouter(config-if)#ex
MainRouter(config)#ex
MainRouter#
%SYS-5-CONFIG_I: Configured from console by console

MainRouter#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
MainRouter#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
MainRouter(config)#int g0/0/2
MainRouter(config-if)#ip address 201.10.10.65 255.255.255.224
MainRouter(config-if)#no shut

MainRouter(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0/2, changed state to up

MainRouter(config-if)#ex
MainRouter(config)#ex
MainRouter#
%SYS-5-CONFIG_I: Configured from console by console

MainRouter#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
MainRouter#
```

Figure 4.1.1.2: Main Router Configuration

4.1.2 All Switches Configuration

The provided commands for configuring a switch in the staff network called SStaff1. They consist of entering privileged EXEC mode, global configuration mode, and interface configuration mode to configure the hostname, assign an IP address to the VLAN 1 interface, activate the interface, choose the default gateway, and save the configuration. These adjustments guarantee that the switch has sufficient network connectivity and operation.





All switches in the network are set up using the same set of commands, with just the hostname, IP address, subnet mask, and default gateway are different. This standard approach streamlines the configuration process while guaranteeing that each switch has its own network settings for reliable identification and communication within the network.

4.1.3 PC IP Configuration

The PC IP Configuration outlines the specific IP address, subnet mask, default gateway, and DNS settings assigned to each PC. This ensures that each computer is correctly networked, allowing for seamless communication, internet access, and resource sharing within the network. Proper IP configuration is essential for maintaining efficient and reliable network performance.

4.1.3.1 Staff Network

The PC IP Configuration for the Staff Network details the IP settings assigned to staff computers. This includes IP addresses, subnet masks, and default gateways, ensuring secure and efficient network connectivity. This configuration allows staff members to access network resources seamlessly and facilitates network management and troubleshooting.

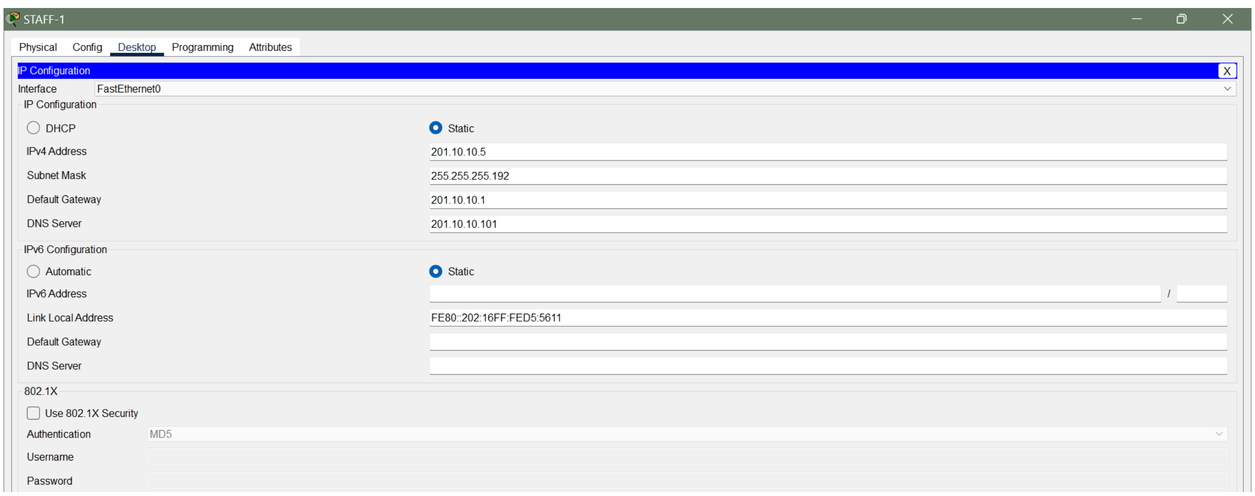


Figure 4.1.3.1: PC Staff Network Configuration

4.1.3.2 Guest Network

The following figure shows the IP setup information for PCs on the guest network, such as IP addresses, subnet masks, and default gateways. It guarantees that guest devices are properly configured for network access, resulting in secure and separated communication within the guest network.

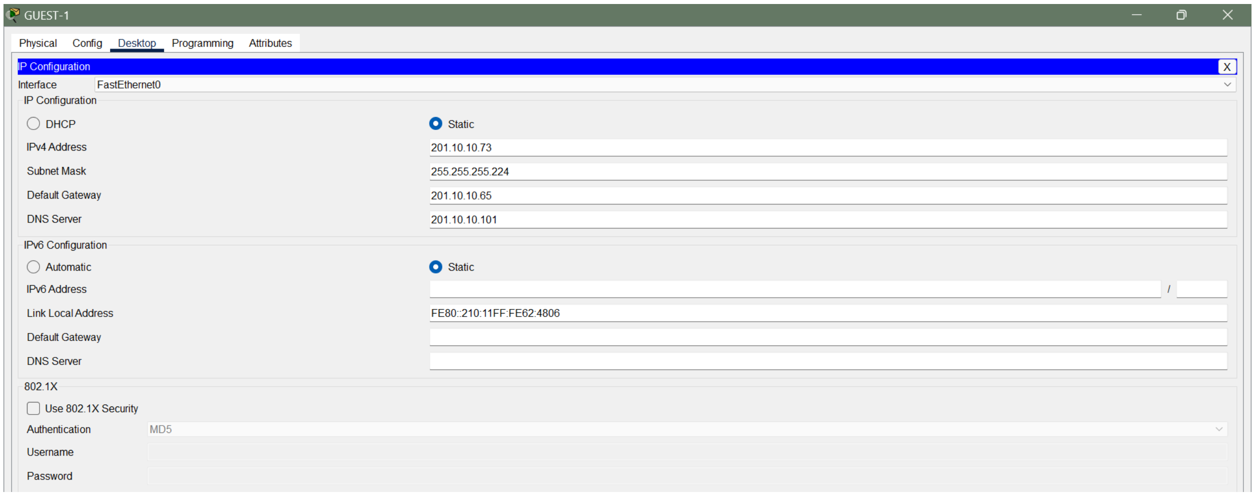


Figure 4.1.3.2: PC Guest Network Configuration

4.1.3.3 Server

It describes the IP setup for servers, including allocated IP addresses, subnet masks, and default Gateways. Proper configuration enables consistent server connectivity, effective network communication, and effortless management of the network architecture.

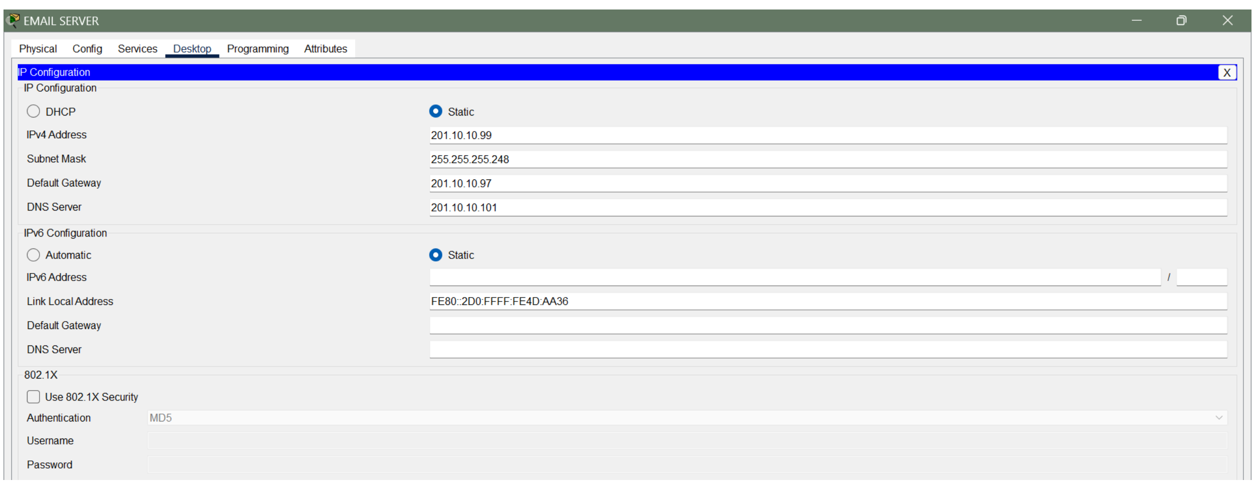


Figure 4.1.3.3.1: Email Server Configuration

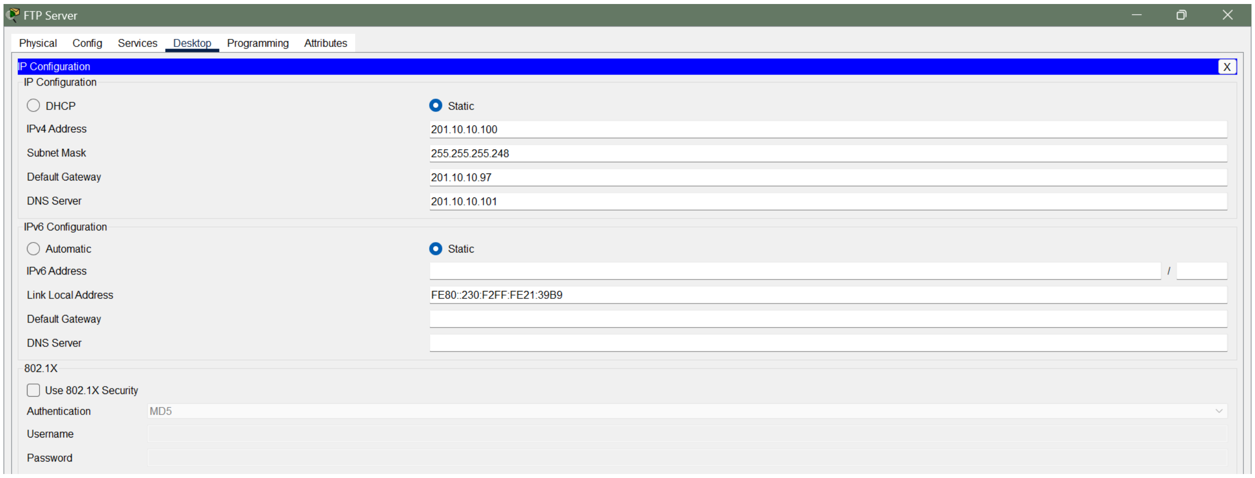


Figure 4.1.3.3.2: FTP Server Configuration

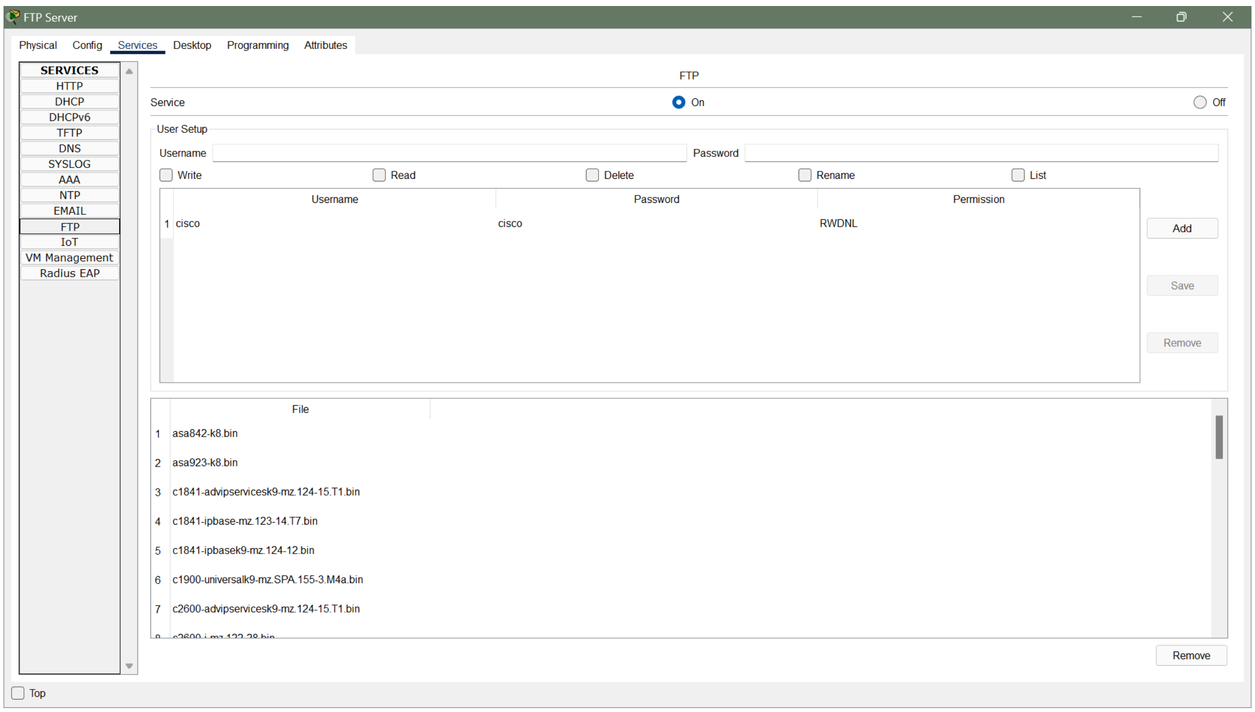


Figure 4.1.3.3.3: Setup on FTP Service

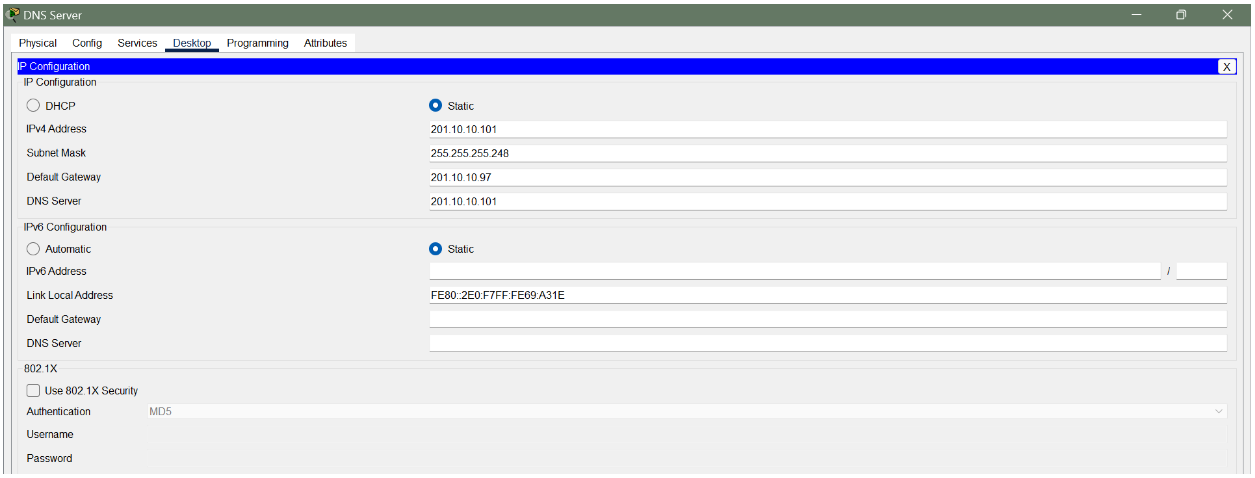


Figure 4.1.3.3.4: DNS Server Configuration

4.1.4 ACL Configuration

The provided commands for configuring a router called MainRouter. They enable the user to enter privileged EXEC mode, global configuration mode, and interface configuration mode. Assigning IP addresses, implementing access control lists (ACLs) for security, activating network interfaces, and configuring login credentials are all critical activities. These parameters guarantee that MainRouter has adequate network connectivity, improved security, and efficient administration capabilities.

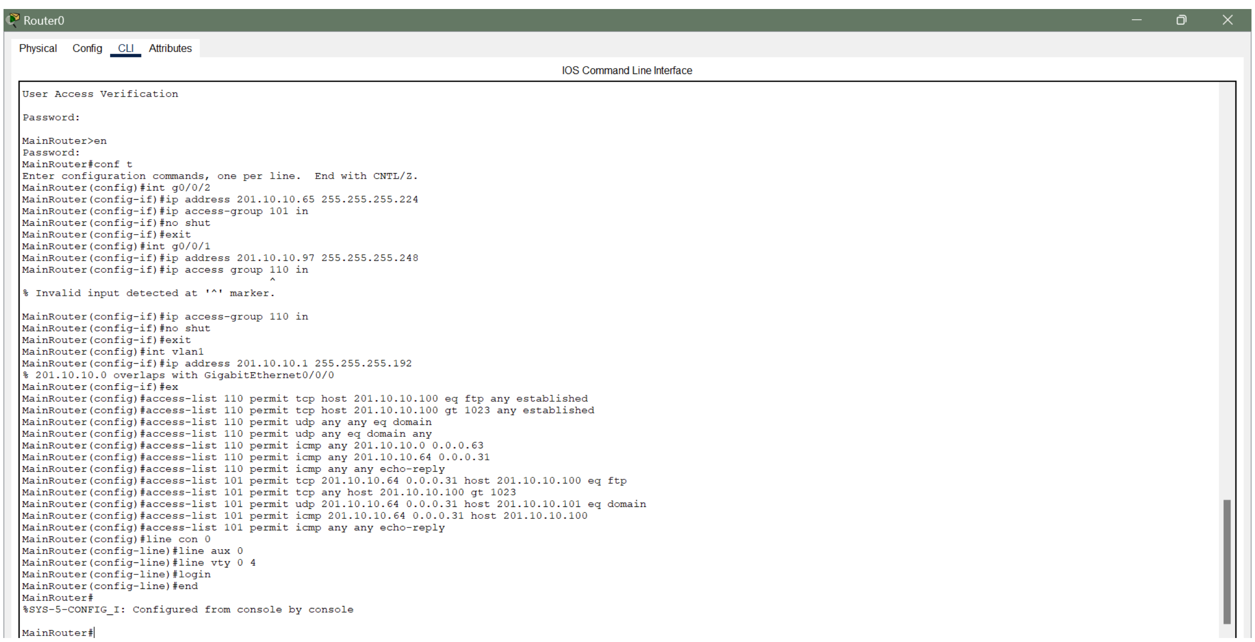


Figure 4.1.4: ACL Configuration

5.0 TESTING AND VERIFICATION

5.1 Network Testing and Verification Procedure

Develop the organization's network architecture by carefully examining its particular needs and doing extensive planning. The project team ran several network tests to confirm and establish the connections and configuration of the guest network within the network architecture. Figure 3.3 depicts three network designs: User Network, which can accommodate 60 users within the organization (IP address: 201.10.10.0 - 201.10.10.63), Guest Network, which can accommodate up to 25 guests who visit the office (IP address: 201.10.10.64 - 201.10.10.95), and Subnet Servers, which show the properties of three servers (IP address: 201.10.10.96 - 201.10.10.103) through a sequence of screenshots.

5.1.1 Via Staff Network

This phase entails testing the network using the Staff Network to guarantee consistent connectivity and performance. Tests involve validating IP address assignments, establishing device connection, evaluating access control list functioning, and assuring correct routing and switching operations. Successful testing demonstrates that the network is properly configured, secure, and operationally suitable for use by staff members.

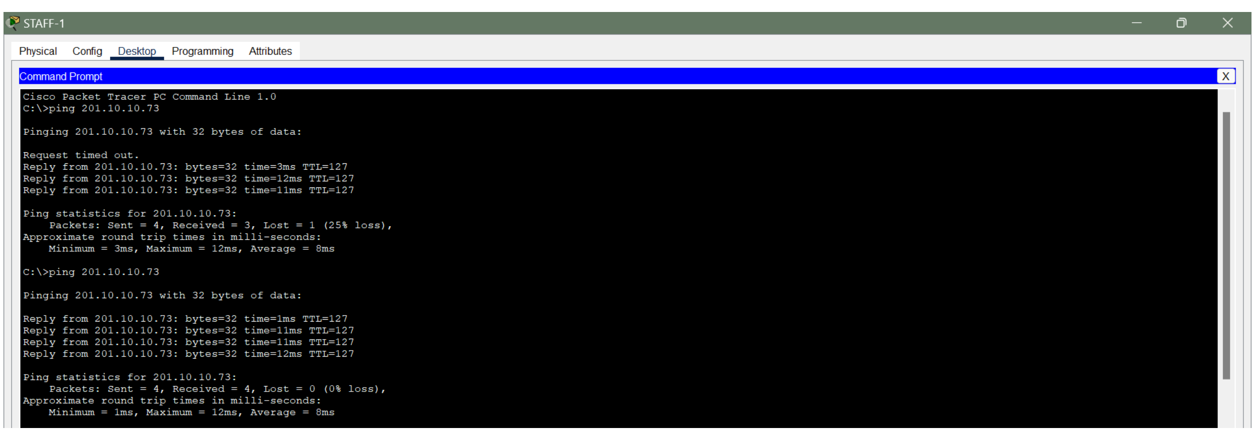


*Figure 5.1.1.1: Staff Network PC Ping to Guest Network PC (IP: 201.10.10.67) [**Successful**]*

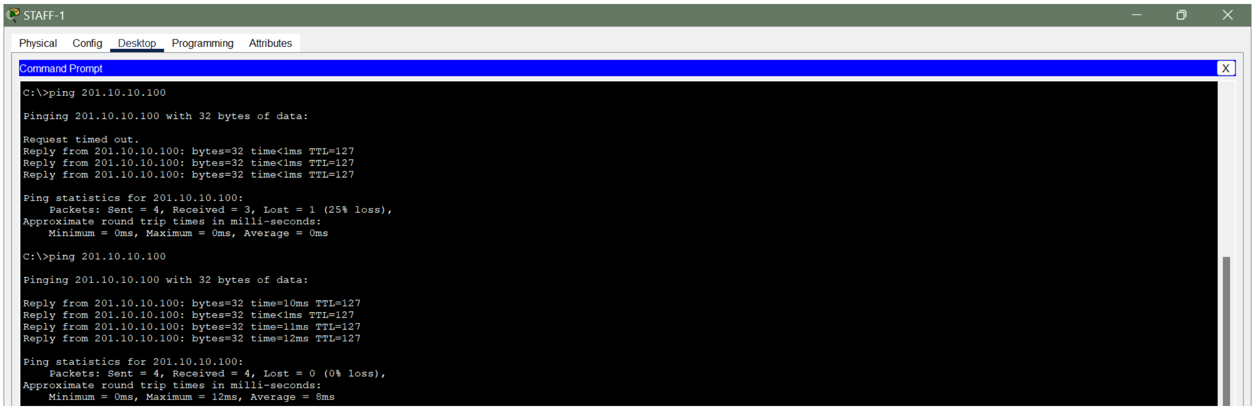


*Figure 5.1.1.2: Staff Network PC Ping to FTP Server(IP: 201.10.10.1) [**Successful**]*

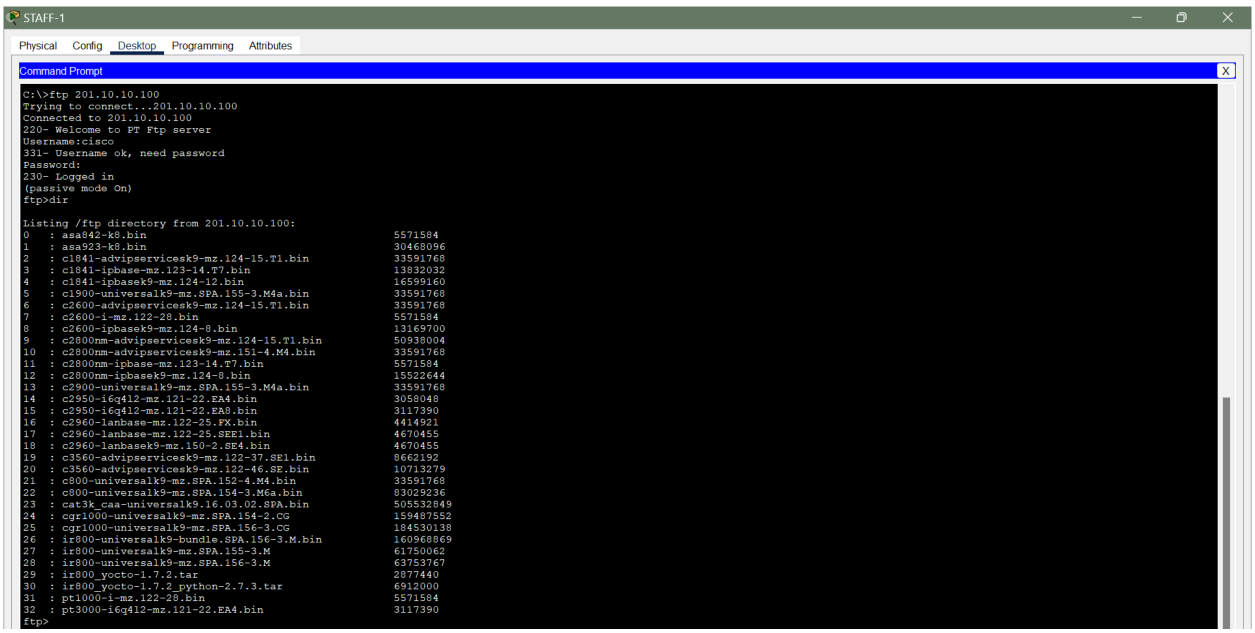


*Figure 5.1.1.3: Staff Network PC using FTP Service [**Successful**]*

5.1.2 Via Guest Network

The guest network testing includes examining the network's performance, accessibility, and security from the viewpoint of client access. This testing evaluates the reliability of guest network connections, the ease of access to shared resources such as internet access and particular services, and guarantees that guest users do not compromise the security of the main network. It aids in the identification of possible shortcomings or weaknesses and guarantees that the guest network runs smoothly while preserving the entire network infrastructure's integrity.

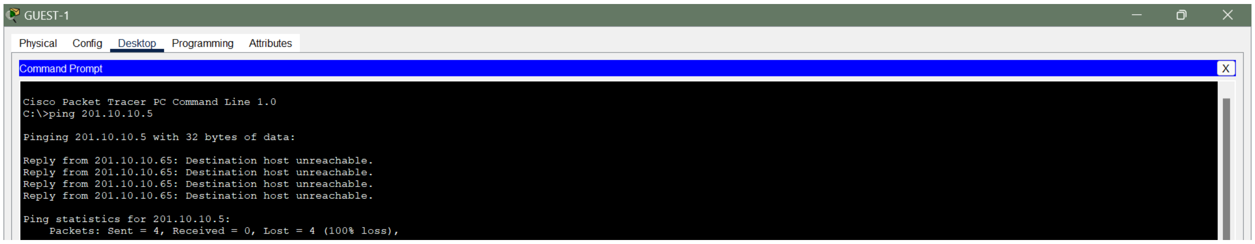


*Figure 5.1.2.1: Guest Network PC Ping to Staff Network PC-60(ACL Testing) [**Unsuccessful**]*

*Figure 5.1.2.2: Guest Network PC Ping to FTP Server [**Successful**].*

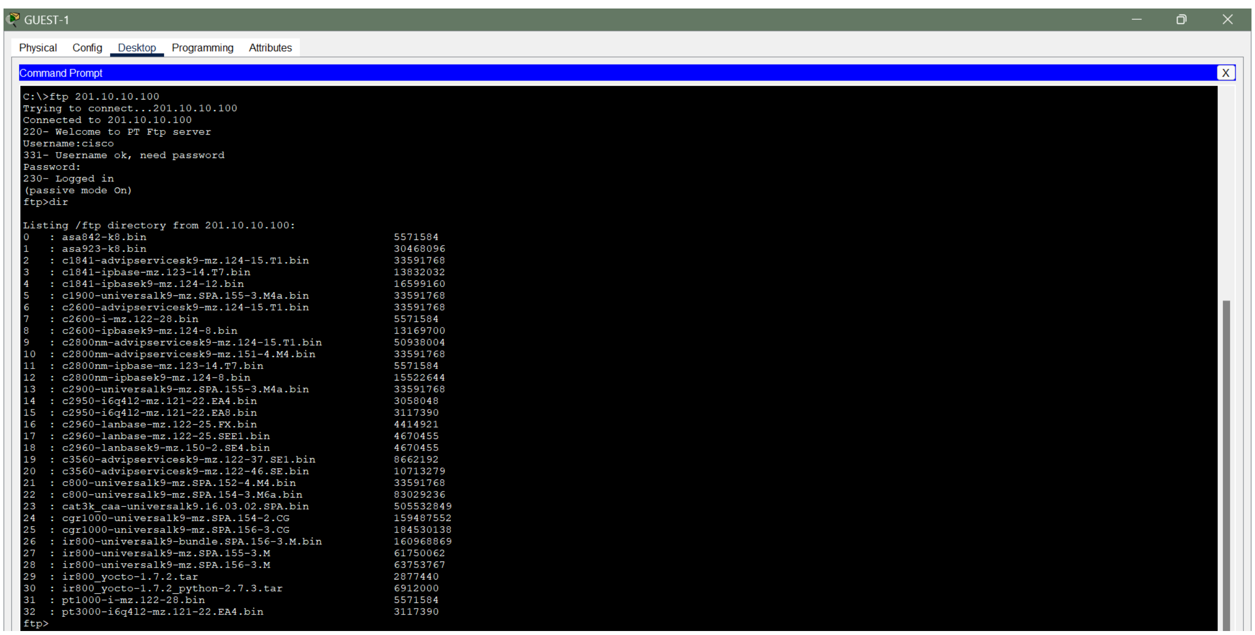


*Figure 5.1.2.3: Guest Network PC using FTP Service [**Successful**].*

5.1.3 Via Server Subnet (Email Server, FTP Server, DNS Server)

The testing procedure involves verifying the connection and functioning of critical servers inside a subnet. It entails reviewing the Email Server to guarantee smooth email communication, confirming the FTP Server for file transfer operations, and testing the DNS Server to assure domain name resolving capabilities. These tests verify that each server efficiently fulfills its assigned responsibilities, encouraging consistent network services and an ideal user experience throughout the network architecture.

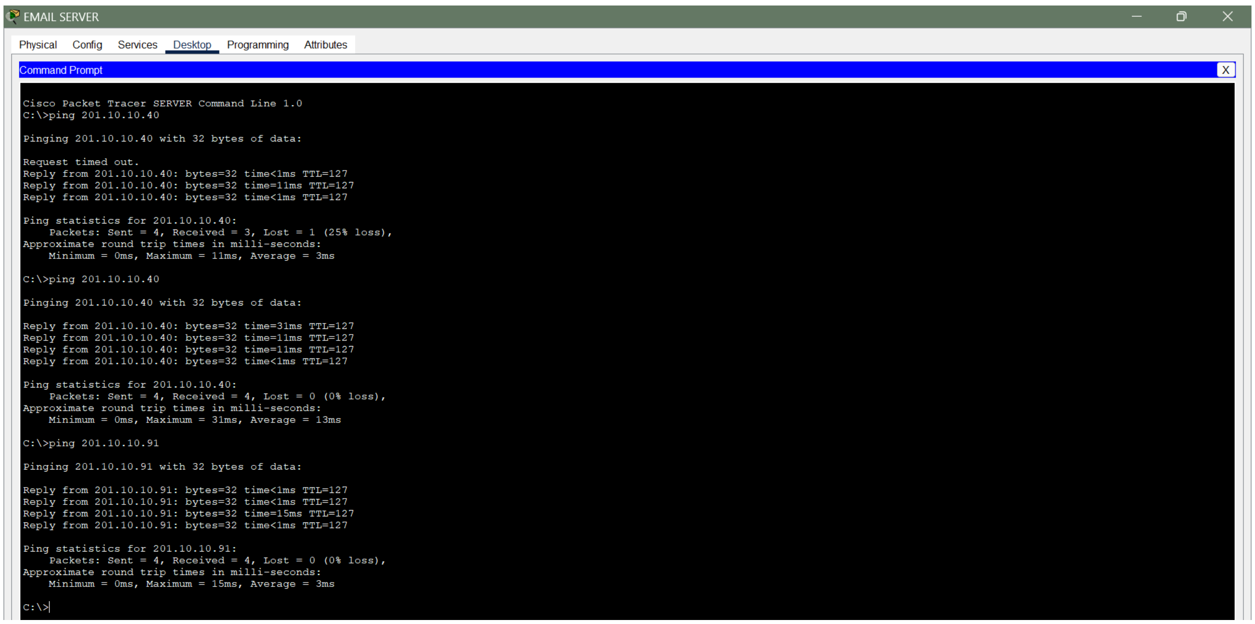


Figure 5.1.3.1: Email Server Ping to Staff Network PC and Guest Network PC.

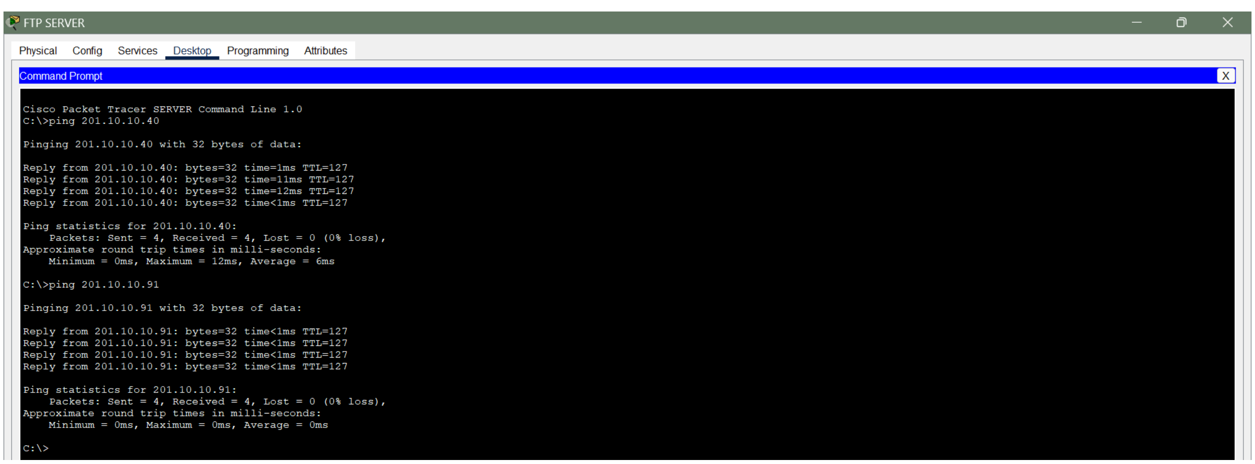


Figure 5.1.3.1: FTP Server Ping to Staff Network PC and Guest Network PC.

Figure 5.1.3.1: DNS Server Ping to Staff Network PC and Guest Network PC.

6.0 MATERIAL

6.1 Bill of Material

The Bill of Material (BOM) is a thorough inventory of all the components, parts, and raw materials needed to execute a project or manufacture a product. It contains item, unit price, quantity, and amount. The BOM supports precise inventory management, cost estimates, and procurement procedures, which allows for seamless project execution and effective resource allocation.

No.	Item	Unit Price (RM)	Quantity	Amount (RM)
1	Cisco GLC-T, 1000BASE-T SFP transceiver module for Category 5 copper wire	315.00	1	315.00
2	Copper Straight Through Cable CAT 6 Flat Patch Cord LAN Cable Gigabit Ethernet Cable 10G RJ45 UTP (5m)	5.45	91	495.95
3	Dell Inspiron 27 All-in-One PC	4 298.99	85	365 414.15
4	PowerEdge R250 Rack Server	14 069.08	3	42 207.24
5	Router ISR4331/K9 Black	6 932.23	1	6 932.23

6	Schneider CAT6 Crossover Patch Cord (10m)	39.00	2	78.00
7	Switch WS-C2960-24LT-L Cisco 2960	1 500.00	5	7 500.00
			Total	422 942.57

Table 6.1: Bill of Material

The overall cost of developing the small business network setup for this project is RM 422,942.57, excluding the 6% SST (Sales and Services Tax). Furthermore, the Cisco GLC-TE 1000BASE-T SFP transceiver module for Category 5 copper cable costs RM 315.00 per unit. Furthermore, the unit price for the Copper Straight Through Cable CAT 6 Flat Patch Cord LAN Cable Gigabit Ethernet Cable 10G RJ45 UTP (5m) is RM 5.45, and 91 units are required, totaling RM 495.95. This project's PCs are Dell Inspiron 27 All-in-One models. Each item costs RM 4,298.99. A total of 85 PCs were purchased, at a cost of RM 365,414.15. This project's servers are Dell PowerEdge R250 Rack Servers. Each server costs RM 14,069.08. Three servers were acquired, at a total cost of RM 42,207.24.The Router ISR4331/K9 Black costs RM 6,932.23 per unit. Following that, the Schneider CAT6 Crossover Patch Cord (10m) costs RM 39.00 each unit, with a total of two pieces costing RM 78.00. The switch WS-C2960-24LT-L Cisco 2960 costs RM 1,500.00. The total cost of five switches is RM 7,500.00.

REFERENCES

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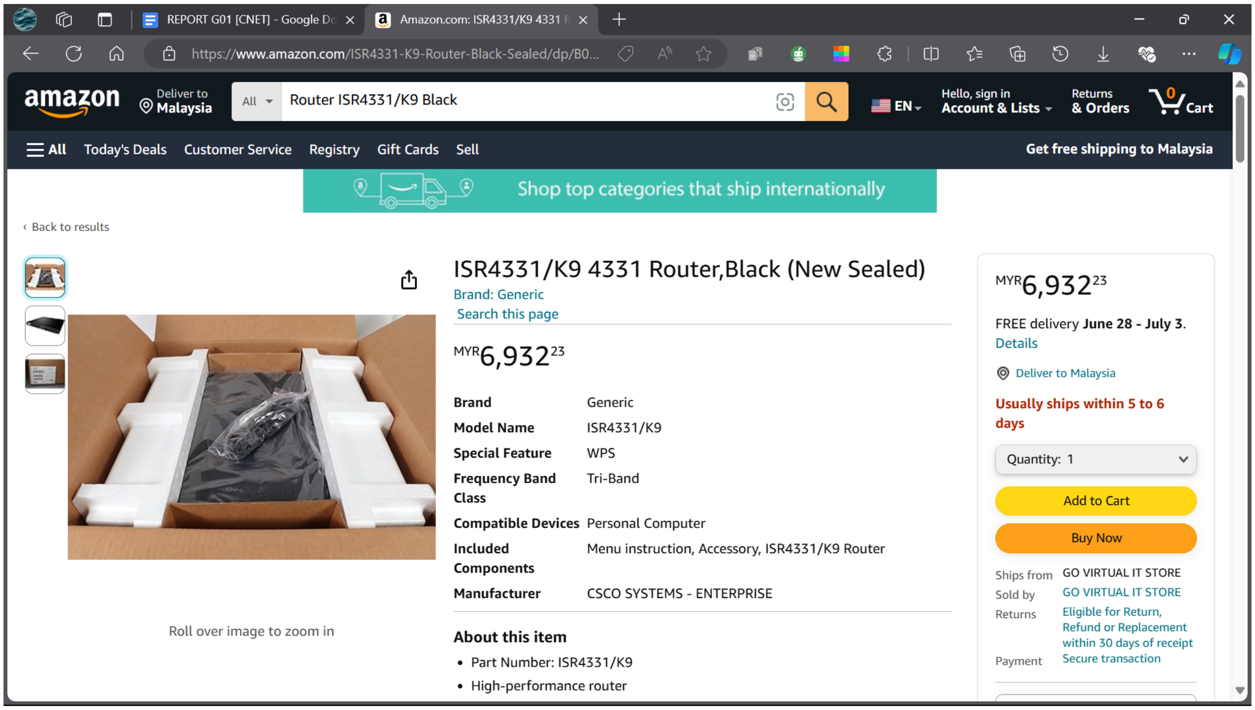
APPENDIX



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Amazon.com: ISR4331/K9 4331
https://www.amazon.com/ISR4331-K9-Router-Black-Sealed/dp/B0...
amazon
Deliver to Malaysia
Router ISR4331/K9 Black
Hello, sign in Account & Lists
Returns & Orders
Cart
All Today's Deals Customer Service Registry Gift Cards Sell
Get free shipping to Malaysia
Shop top categories that ship internationally
Back to results
ISR4331/K9 4331 Router,Black (New Sealed)
Brand: Generic
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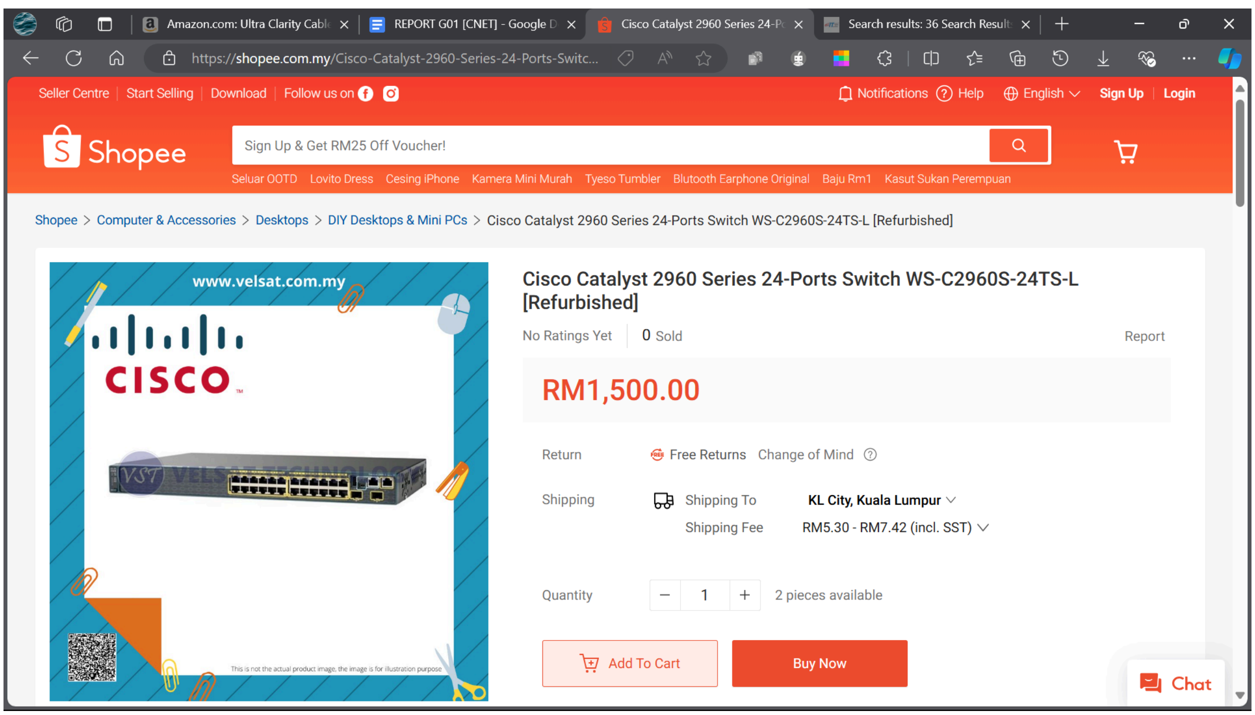
MYR6,932.23
Brand Generic
Model Name ISR4331/K9
Special Feature WPS
Frequency Band Class Tri-Band
Compatible Devices Personal Computer
Included Components Menu instruction, Accessory, ISR4331/K9 Router
Manufacturer CSCO SYSTEMS - ENTERPRISE
About this item
Part Number: ISR4331/K9
High-performance router
Roll over image to zoom in
FREE delivery June 28 - July 3. Details
Deliver to Malaysia
Usually ships within 5 to 6 days
Quantity: 1
Add to Cart
Buy Now
Ships from GO VIRTUAL IT STORE
Sold by GO VIRTUAL IT STORE
Returns Eligible for Return, Refund or Replacement within 30 days of receipt
Payment Secure transaction



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Cisco Catalyst 2960 Series 24-P
Search results: 36 Search Result
https://shopee.com.my/Cisco-Catalyst-2960-Series-24-Ports-Switc...
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Shopee > Computer & Accessories > Desktops > DIY Desktops & Mini PCs > Cisco Catalyst 2960 Series 24-Ports Switch WS-C2960S-24TS-L [Refurbished]
www.velsat.com.my
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Cisco Catalyst 2960 Series 24-Ports Switch WS-C2960S-24TS-L [Refurbished]
No Ratings Yet 0 Sold Report
RM1,500.00
Return Free Returns Change of Mind
Shipping Shipping To KL City, Kuala Lumpur
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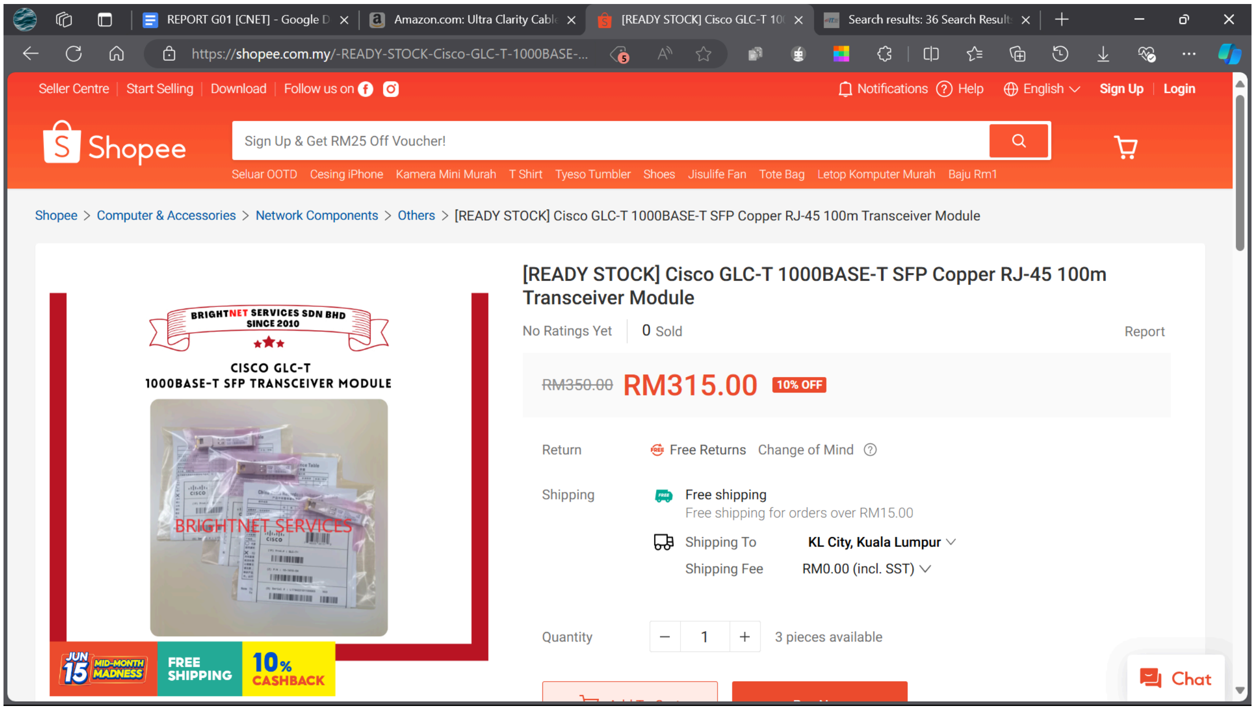
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Amazon.com: Ultra Clarity Cable
[READY STOCK] Cisco GLC-T 10
Search results: 36 Search Result
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Seluar OOTD Cesing iPhone Kamera Mini Murah T Shirt Tyeso Tumbler Shoes Jisulife Fan Tote Bag Letop Komputer Murah Baju Rm1
Shopee > Computer & Accessories > Network Components > Others > [READY STOCK] Cisco GLC-T 1000BASE-T SFP Copper RJ-45 100m Transceiver Module
BRIGHTNET SERVICES SDN BHD
SINCE 2010
CISCO GLC-T
1000BASE-T SFP TRANSCEIVER MODULE
BRIGHTNET SERVICES
JUN 15 MID-MONTH MADNESS
FREE SHIPPING
10% CASHBACK
[READY STOCK] Cisco GLC-T 1000BASE-T SFP Copper RJ-45 100m Transceiver Module
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0 Sold
Report
RM350.00 RM315.00 10% OFF
Return
Free Returns Change of Mind
Shipping
Free shipping
Free shipping for orders over RM15.00
Shipping To KL City, Kuala Lumpur
Shipping Fee RM0.00 (incl. SST)
Quantity
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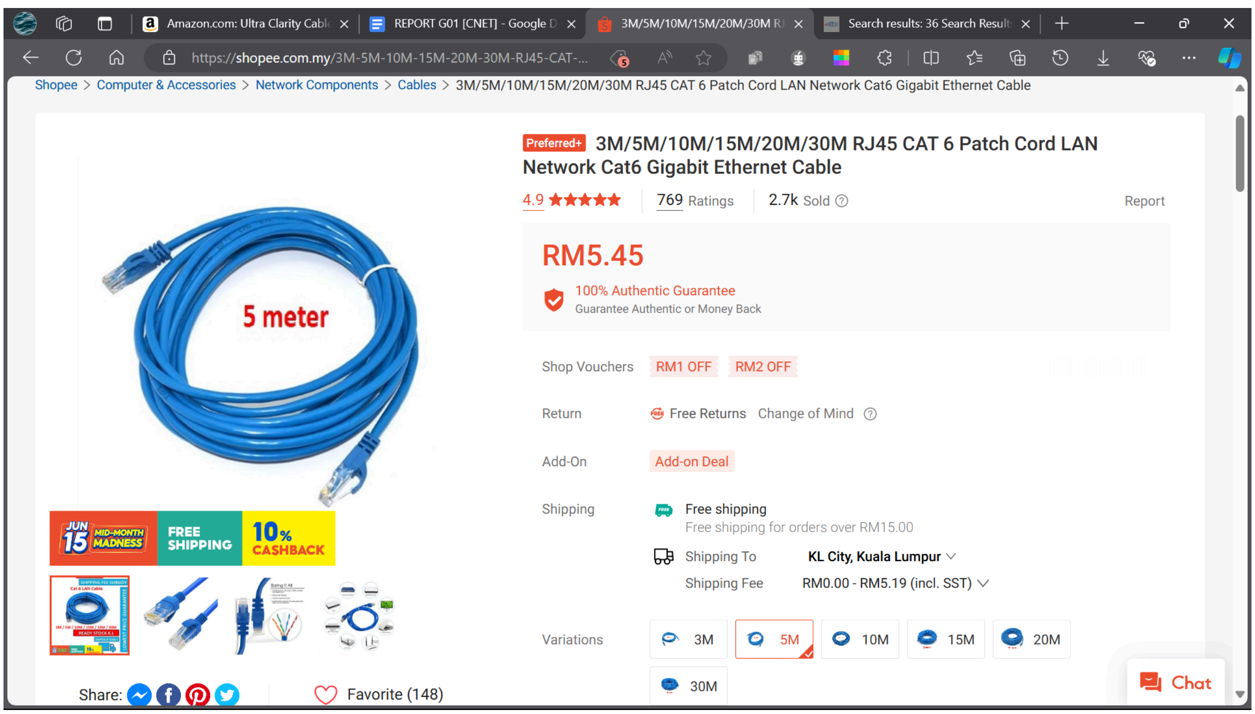
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https://shopee.com.my/3M-5M-10M-15M-20M-30M-RJ45-CAT-...
Shopee > Computer & Accessories > Network Components > Cables > 3M/5M/10M/15M/20M/30M RJ45 CAT 6 Patch Cord LAN Network Cat6 Gigabit Ethernet Cable
5 meter
JUN 15 MID-MONTH MADNESS
FREE SHIPPING
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Share:
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Preferred+ 3M/5M/10M/15M/20M/30M RJ45 CAT 6 Patch Cord LAN Network Cat6 Gigabit Ethernet Cable
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769 Ratings
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Report
RM5.45
100% Authentic Guarantee
Guarantee Authentic or Money Back
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Free shipping for orders over RM15.00
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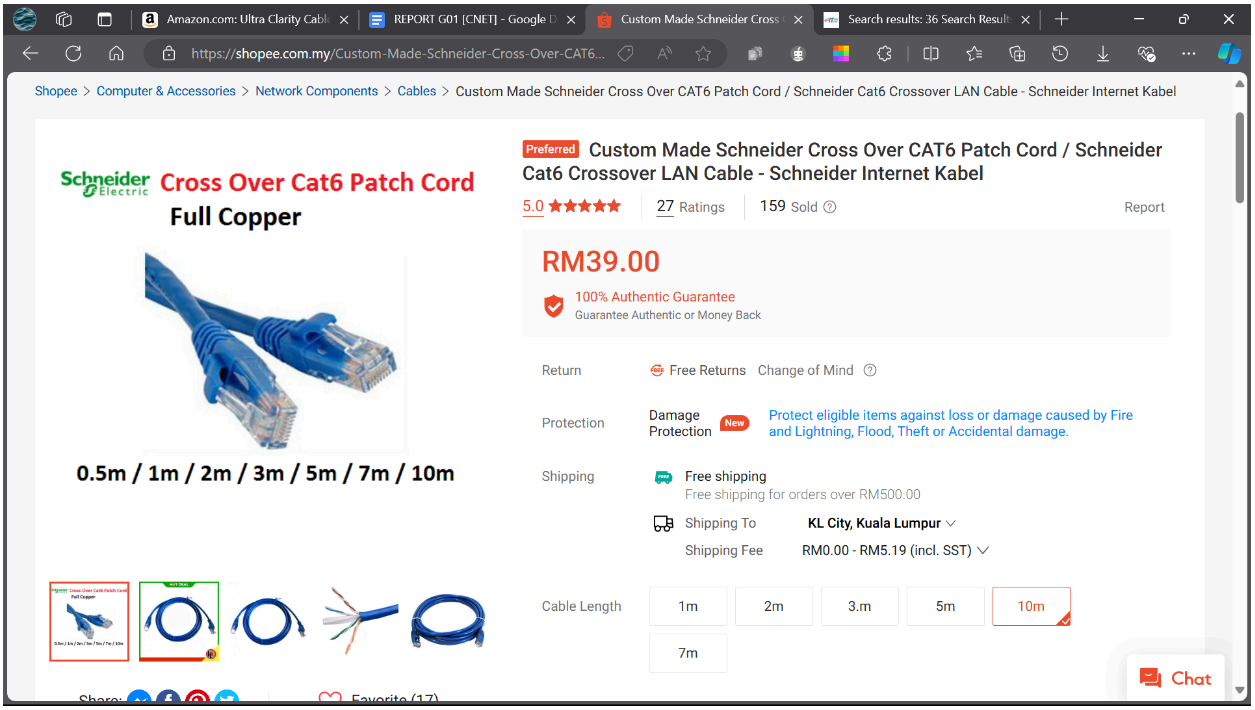
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Cross Over Cat6 Patch Cord
Full Copper
0.5m / 1m / 2m / 3m / 5m / 7m / 10m
Preferred
Custom Made Schneider Cross Over CAT6 Patch Cord / Schneider Cat6 Crossover LAN Cable - Schneider Internet Kabel
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27 Ratings
159 Sold
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RM39.00
100% Authentic Guarantee
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Protection
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Protect eligible items against loss or damage caused by Fire and Lightning, Flood, Theft or Accidental damage.
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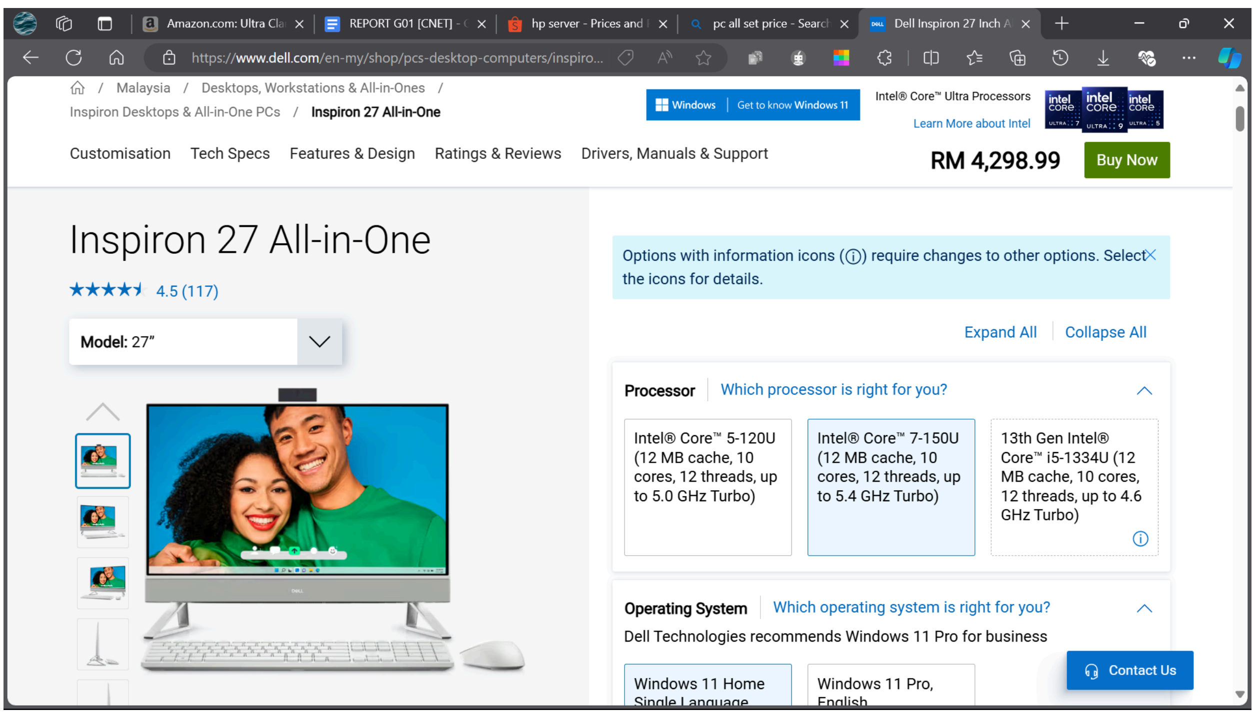
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4.5 (117)
Model: 27"
Options with information icons (ⓘ) require changes to other options. Select the icons for details.
Expand All
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Intel® Core™ 5-120U (12 MB cache, 10 cores, 12 threads, up to 5.0 GHz Turbo)
Intel® Core™ 7-150U (12 MB cache, 10 cores, 12 threads, up to 5.4 GHz Turbo)
13th Gen Intel® Core™ i5-1334U (12 MB cache, 10 cores, 12 threads, up to 4.6 GHz Turbo)
Operating System
Which operating system is right for you?
Dell Technologies recommends Windows 11 Pro for business
Windows 11 Home Single Language
Windows 11 Pro, English
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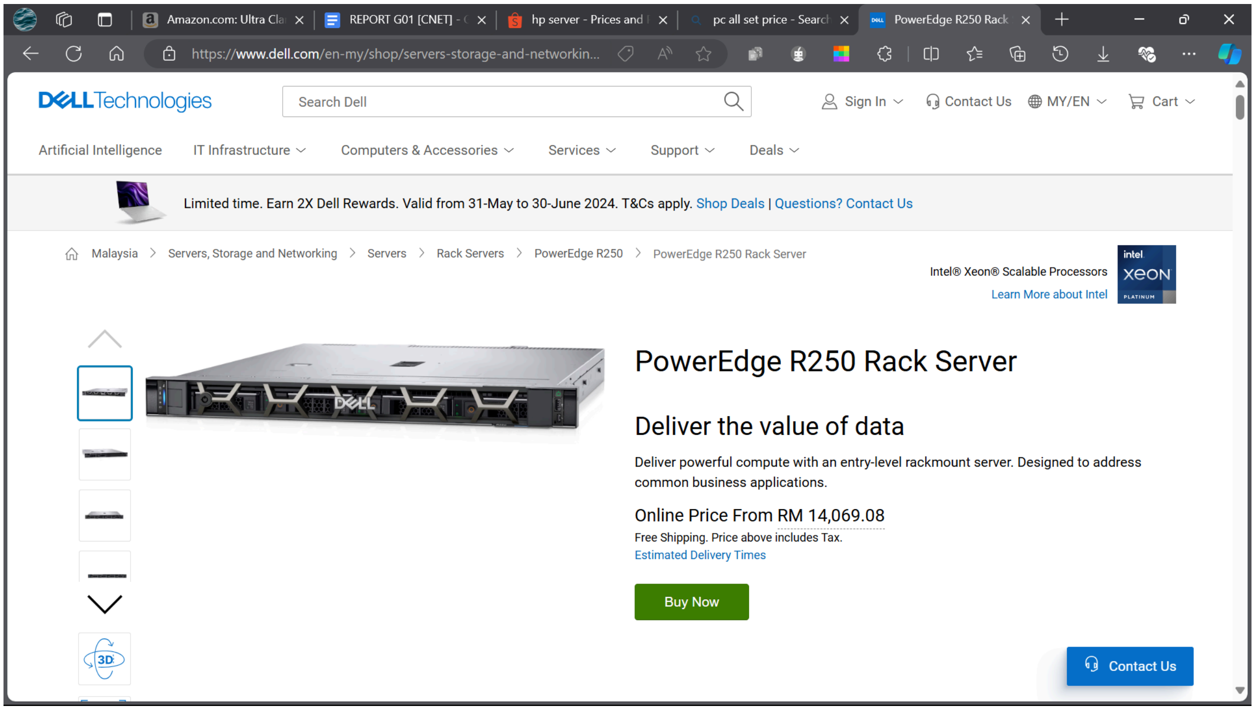
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PART 2

A CAMPUS NETWORK DESIGN FOR A COLLEGE

1.0 INTRODUCTION

1.1 Project Title

A Campus Network Design For A College

1.2 Project Scope

There are 630 users in the main campus of a private college. 260 users in the Main building, 90 users in Building 1, 60 users in Building 2 and the remaining equally distributed between R&D Building and CyberLab Building . Every building has a lobby which is 500 square feet open space, where wireless access to the network is required. Only registered students and guests have access to the wireless network.

The distance between Building 1 and the main building is 500 meters. The distance between Building 2 and the main building is 100 meters. The distance between Building 1 and Building 2 is 200 meters. R&D Building and CyberLab are situated in a remote area about 3 km from the main campus. A high speed cable internet connection is available in the main building which needs to be shared among all users.

A branch campus is located about 50 km from the main campus network. It has 100 users, all in the same building. There's a lobby where wifi access is available. Only registered students can access the wireless network.

A server farm consisting of a web server, email server, DNS server and DHCP server is to be created to support the business needs of the organization. A special secure subnet is to be allocated only for the server farm.

The necessary equipment and appropriate topology required for the campus network design along with the IP address schema, IP address management, secure wireless access, internet sharing, features and services should be worked out. A bill of material should be included with products from Microsoft, Cisco, D-LINK or Netgear with appropriate quantity which can be used for setting up of the campus infrastructure. Use at least 2 routers.

2.0 PLANNING

2.1 Network Requirements

We are serving 630 users in total across multiple buildings on the main campus of a private college, in addition to an additional 100 users at a branch campus. The main campus consists of the 260-user Main Building, Building 1 (which is 500 meters away from the Main Building) with 90 users, Building 2 (which is 100 meters away from the Main Building) with 60 users, and the R&D Building and CyberLab Building (which are each home to 110 users) which are about 3 kilometers away from the main campus. Situated 50 kilometers away, the branch campus has one building that can house 100 users. Every building on the main campus has a 500 square foot lobby that needs access to the wireless network, which is restricted to enrolled students only. The building is also divided into three parts, outside, inside and DMZ.

We will set up a shared high-speed cable internet connection in the Main Building for all users in order to provide connectivity throughout the main campus. The Main Building was divided into two departments, Department A and Department B. Each department will be supported with two Cisco Catalyst 2960X-48TS-L switches and the switches will be connected to a multilayer switch. Then, the Multilayer switch will be connected together to a Main Building Router which will be handled by a Cisco ISR 4331/K9 router.

Inside Building 1 which is radiated 500 meters from the Main Building will be connected with 2 Cisco Catalyst 2960X-24TT-L Switches (24 ports) via Cat6 Ethernet Cables to a Multilayer switch, WS-C3560-240S-S Cisco 3560 Switch. A similar hardware will be found in Building 2, which is located 100 meters from the Main

Building will be connected with 2 Cisco Catalyst 2960X-24TT-L Switches (24 ports) via Cat6 Ethernet Cables to a Multilayer switch, WS-C3560-240S-S Cisco 3560 Switch. Then, the multilayer that connects between Building 1 and Building 2 will connect to the Main Building Router via fiber optic links equipped with Cisco GLC-SX-MMD SFP modules.

Total of five Cisco Catalyst 2960X-48TS-L switches will be spread across the R&D and CyberLab buildings, which are located three kilometers from the main campus. A multilayer switch will connect between Cyberlab Building and R&D Building. Then, Cisco GLC-EX-SMD SFP modules will be used in long-distance fiber optic links that connect these buildings to the Main Building.

To support its 100 users, the branch campus will make use of one WS-C3560-240S-S Cisco 3560 Switch, multilayer switch and two Cisco Catalyst 2960X-24TT-L Switches . To ensure smooth integration and resource sharing, a Cisco ISR 4331/K9 router will establish a secure IP address to access the Branch Campus Building from the Main Building. A Cisco ASA 5506-X Firewall with FirePOWER Services will connect between Branch Campus Router and Main Building Router.

A server farm that consists of a web server, email server, DNS server, and DHCP server hosted on Dell PowerEdge R540 servers will have a secure subnet created that will be connected to the Main Building. A Cisco Catalyst 2960X-24TT-L Switches will control the server and connect to the Cisco ASA 5506-X Firewall with FirePOWER Services to access through the Campus Branch Building and Main Building.
An access control list (ACLs) and Network Address Translation (NAT) will be set up on this secure subnet to guarantee restricted access and improved security to allow internet sharing among all users. This ACL and NAT will be set up on the firewall to be accessible only through the permitted users and guests from Branch Campus and Main Building .

Ten Cisco GLC-SX-MMD fiber SFP modules, four Cisco GLC-EX-SMD long-range fiber SFP modules, thirty Cat6 Ethernet cables (5m), ten Cat6 crossover patch cords (10m), four WS-C3560-240S-S Cisco 3560 Switch, four Dell PowerEdge R540 servers, are included in the bill of materials.

The main and branch campuses' requirements are supported by this network design, which guarantees a stable, scalable, and secure infrastructure with dependable connectivity, secure wireless access, and effective IP address management.

NO.	ITEM	QUANTITY
1.	Cisco ISR 2991/K9 Routers	2
2.	WS-C3560-240S-S Cisco 3560 Switch (Multilayer Switch) (24 ports)	4
3.	Cisco Catalyst 2960X-24TT-L Switches (24 ports)	15
5.	Dell PowerEdge R540 (Web Server)	1
6.	Dell PowerEdge R540 (Email Server)	1
7.	Dell PowerEdge R540 (DNS Server)	1
8.	Dell PowerEdge R540 (DHCP Server)	1
9.	Cisco GLC-SX-MMD (Fiber SFP Modules)	10
10.	Cisco GLC-EX-SMD (Long-Range Fiber SFP Modules)	4
11.	Cat6 Ethernet Cables (5m)	210
12.	Cat6 Crossover Patch Cords (10m)	90

Table 2.1: List of Network Requirements.

2.2 Network Planning

Multiple subnets are included in this project, and they're all connected to the router. 130 users in the Main Building Department A are served by the first subnet, whose addresses range from 201.10.10.0 to 201.10.10.255. 201.10.10.255. is the broadcast address for these 130 users. Then, for Main Building Department B, another 130 users are served by the second subnet, from 201.10.11.0 to 201.10.11.255 and 201.10.11.255 is the broadcast address for this case. 110 users in Cyberlab Building 0 are covered by the third subnet, whose addresses range from 201.10.12.0 to 201.10.12.127. 201.10.12.127 is the broadcast address for these 110 users. With a broadcast address of 201.10.12.255, the third subnet also covers 110 users in the R & D Building and spans from 201.10.12.129 to 201.10.12.254.

Furthermore, Building 1 which consists of 90 users is the focus of the fourth subnet. With a broadcast address of 201.10.13.127, this subnet spans from 201.10.13.0 to 201.10.13.127. 60 users of Building 2 are served by the same subnet, which uses addresses ranging from 201.10.13.129 to 201.10.13.254 as well as 201.10.13.255 as the broadcast address.

Ranging from 201.10.14.0 to 201.10.14.127 has covered 100 users in Branch Campus using the fifth subnet and the broadcast address for this case is 210.10.14.127. The broadcast address for the server farm is 201.10. 15 01. Web server, email server, DNS server, and DHCP server are all part of the server farm. Two subnets were used specially for the connection between the router and the firewall for Main Building and Branch Campus Building. This configuration guarantees that every user and server group has a dedicated subnet, resulting in well-organized and effective network security and management.

TASK	ASSIGN TO
Connects two or more networks, regulating traffic by forwarding data packets to the appropriate IP addresses and allowing several devices to share an Internet connection.	Router
Receives incoming data packets from a source and selects the proper port to send the packets to their destination.	Switch
Connect several sorts of devices, such as a computer to a switch or a router to a modem, to ensure effective data transfer over the network.	Copper Straight Cable
Offer services and functions to other computers.	Server
The 1000BASE-T SFP, a hot-swappable I/O device, connects to Gigabit Ethernet ports and provides full-duplex Gigabit Ethernet connection over existing copper networks, with a range of up to 100m on typical Category 5 cabling.	GLC-T
Connecting devices, such as two switches or two computers, allows	Copper Crossover Cable

for direct communication without the need for an intermediary device.	
act as a gatekeeper for network communications examining and filtering network traffic to ensure only authorized and safe traffic passes through.	Firewall

Table 2.2: Network Task Assignment.

2.2.1 Group Member Task

In this task, each group member will be assigned specific responsibilities to ensure the successful completion of our project. Members will collaborate to share ideas, support one another, and contribute their unique skills. Tasks may include Network Configurator, IP Network Designer, Network Tester, Accountant, Network Designer, Documentation, and auditor. Each member's active participation and accountability are crucial for achieving our collective goals efficiently and effectively.

MEMBER	TASK
Nuralyana Maisara Binti Noorisham	• Leader • Network Configurator • IP Network Designer • Network Tester • Accountant
Nurul Nabilah Binti Suhud	• Network Designer • Documentation • Auditor • Network Tester • Accountant
Siti Nur Syuhadah Binti Arifin	• Network Designer • Documentation • Auditor

	• Network Tester • Accountant
Tuan Khalidah Syazwana Binti Tuan Mohd Kasmawi	• Network Designer • Documentation • Auditor • Network Tester • Accountant

Table 2.2.1: List of Group Member Tasks.

3.0 DESIGN

3.1 IP Network Design Table

The IP Network Design Table provides a detailed layout of the IP addressing scheme for a network. It includes critical information such as IP ranges, subnet masks, gateway addresses, VLAN IDs, and device assignments. This table ensures organized and efficient IP allocation, facilitating network management, troubleshooting, and scalability. It serves as a reference for network administrators and engineers to maintain consistent and optimal network performance.

Given IP	Subnet Address (SA)	Subnet Mask (SM)	No. of Host Supported (NHS)	No. of Host Needed (NHN)	Address Range (AR)	B/cast Address (BA)	Gateway Address (GA)	Assigned to (AT)
201.10.10.0	201.10.10.0	255.255.255.0	254	130	201.10.10.1 : 201.10.10.254	201.10.10.255	201.10.10.1	Main Building department A
201.10.11.0	201.10.11.0	255.255.255.0	254	130	201.10.11.1 : 201.10.11.254	201.10.11.255	201.10.11.1	Main Building department B
201.10.12.0	201.10.12.0	255.255.255.128	126	110	201.10.12.1 : 201.10.12.126	201.10.12.127	201.10.12.1	R&D Building
	201.10.12.129	255.255.255.128	126	110	201.10.12.129 : 201.10.12.254	201.10.12.255	201.10.12.129	CyberLab Building
201.10.13.0	201.10.13.0	255.255.255.128	126	90	201.10.13.1 : 201.10.13.126	201.10.13.127	201.10.13.1	Building 1
	201.10.13.129	255.255.255.128	126	60	201.10.13.129 : 201.10.13.254	201.10.13.255	201.10.13.129	Building 2
201.10.14.0	201.10.14.0	255.255.255.128	126	100	201.10.14.1 : 201.10.14.126	201.10.14.127	201.10.14.1	Branch campus

201.10.15.0	201.10.15.0	255.255.255.0	126	4	201.10.15.1 : 201.10.15.255	201.10.15.254	201.10.15.1	Server farm
201.10.16.0	201.10.16.0	255.255.255.252	2	2	201.10.16.1 201.10.16.2	201.10.16.3	201.10.16.1	Router to firewall (branch campus to firewall)
201.10.17.0	201.10.17.0	255.255.255.252	2	2	201.10.17.1 201.10.17.2	201.10.17.3	201.10.17.1	Router to firewall (main campus to firewall)

Table 3.1:IP Design Table

3.2 Physical Network Design

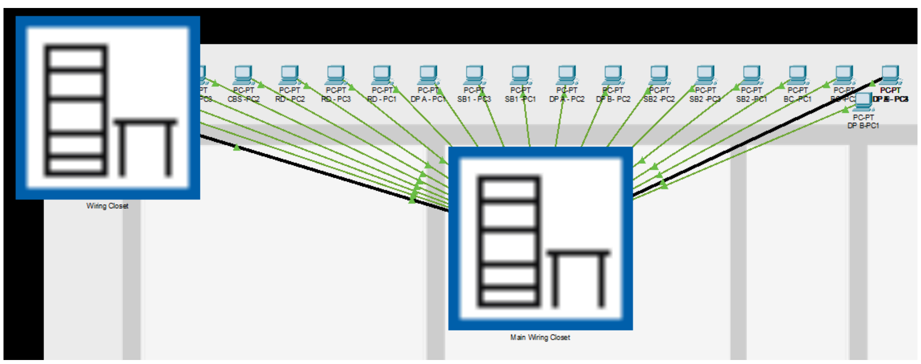


Figure 3.2: Physical Network Design

3.3 Logical Network Design

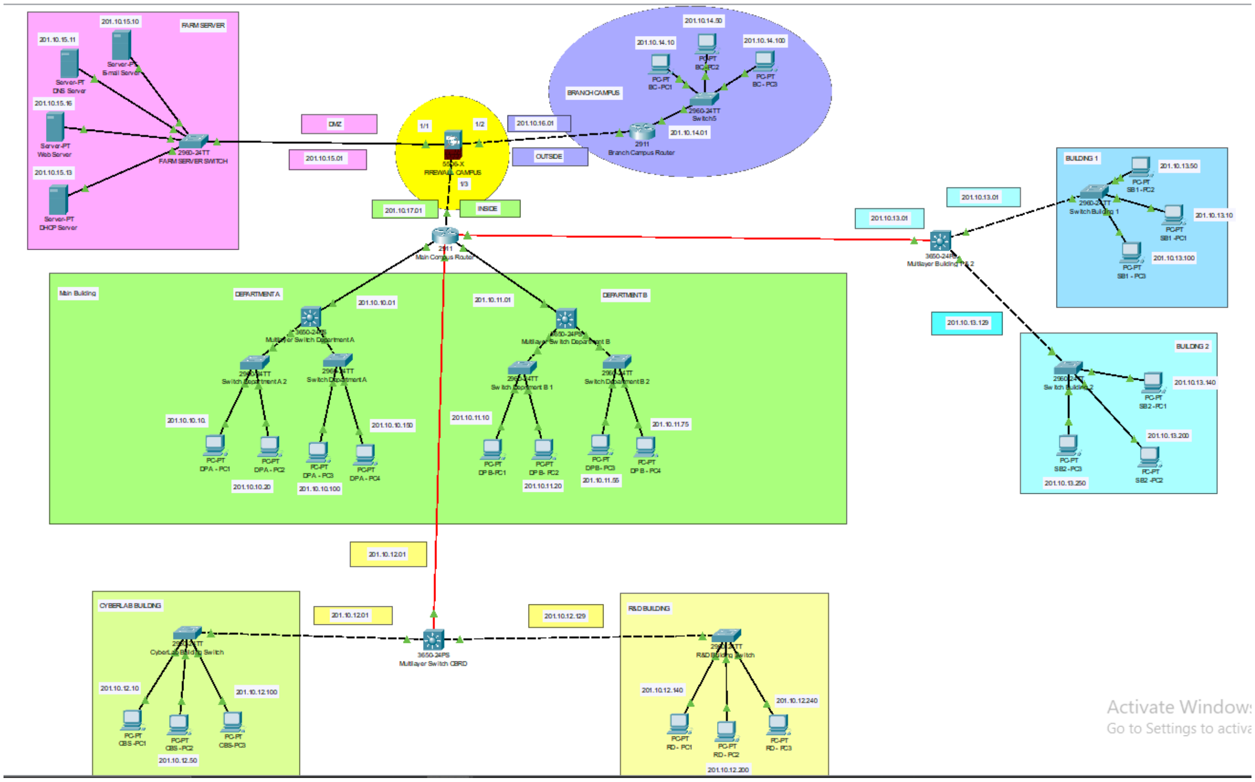


Figure 3.3: :Logical Network Design

3.4 Campus Diagram Design

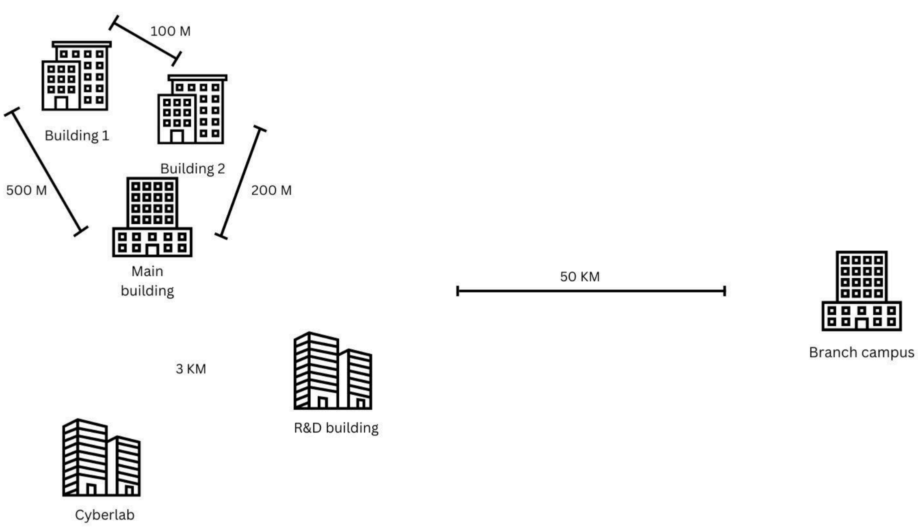


Figure 3.4: Campus Diagram

4.0 CONFIGURATION

4.1 Network Configuration

The firewall is an essential item in network architecture, positioned centrally to allow effective communication between devices. It supports the seamless flow of data and commands by giving IP addresses to each interface. The firewall is an important medium that connects the farm server (DMZ), main campus (INSIDE) and the branch campus (OUTSIDE) all together. This project enables for continuous connectivity and access across the network, allowing devices to interact effectively and complete activities without interruption. The firewall's function in controlling and directing traffic is critical to ensuring network stability and performance with the ACL andNAT configurations.

4.1.1 All Router Configuration

The router configuration holds the default-gateway for each main campus building, Main Building, Cyberlab Building, R&D Building, Building 1 and Building 2 all together under a main router. By enabling a password 'cisco' and 'class' for each connection Gigabits that connects with the routers which allows only authorized users into the router and the building that connects with the main campus router. A same concept applies on the branch campus router, by enabling passwords that connect through the campus branch router to access through the connection.

```
Router(config)#enable secret class
Router(config)#line console 0
Router(config-line)#password cisco
Router(config-line)#login
Router(config-line)#line vty 0 15
Router(config-line)#password cisco
Router(config-line)#login
Router(config-line)#ex
% Ambiguous command: "ex"
Router(config-line)#exit
Router(config)#service password-encryption
Router(config)#banner motd $Authorized User Only$
Router(config)#int g0/3/0
Router(config-if)#ip address 201.10.12.01 255.255.255.0
Router(config-if)#no sh
Router(config-if)#ex
```

Figure 4.1.1 All Router Configuration

4.1.2. All Switch Configuration

The switch configuration holds an ip address for each building, either from the multiswitch and the common switch that connects with the PCs inside each building. The connectivity between the switch and the PCs and the router are set in a ‘ trunk’ to allow a connection with all PCs from the branch campus and main building with the farm server.

```
FSS(config)#interface FastEthernet0/2
FSS(config-if)#no ip domain lookup
FSS(config)#interface vlan1
FSS(config-if)#ip address 201.10.15.03 255.255.255.0
FSS(config-if)#no sh
FSS(config-if)#ex
FSS(config)#ip default-gateway 201.10.15.01
FSS(config)#ex
FSS#
%SYS-5-CONFIG_I: Configured from console by console
copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

Figure 4.1.2 All Switch Configuration

4.1.3 Firewall and DMZ Configuration

A firewall configuration that holds a special Subnet Address and IP address to connect from farm server (201.10.15,01) , main building (201.10.17.01) and branch campus (201.10.16.01). By setting each building with the specific configuration, DMZ, INSIDE and OUTSIDE, to divide the connection from each of the main buildings to having its own connectivity and to connect through each other by the configuration in the ASA-FIRE firewall.

```
ciscoasa(config)#hostname ASA-FIRE
ASA-FIRE(config)#
ASA-FIRE(config)#
ASA-FIRE(config)#enable password cisco
ASA-FIRE(config)#username CISCO password cisco
ASA-FIRE(config)#int g1/3
ASA-FIRE(config-if)#no sh

ASA-FIRE(config-if)#nameif INSIDE
INFO: Security level for "INSIDE" set to 0 by default.
ASA-FIRE(config-if)#security-level 100
ASA-FIRE(config-if)#ip address 201.10.17.01 255.255.255.0
ASA-FIRE(config-if)#ex
ASA-FIRE(config)#int g1/1
ASA-FIRE(config-if)#no sh

ASA-FIRE(config-if)#nameif DMZ
INFO: Security level for "DMZ" set to 0 by default.
ASA-FIRE(config-if)#security-level 70
ASA-FIRE(config-if)#ip address 201.10.15.01 255.255.255.0
ASA-FIRE(config-if)#ex
ASA-FIRE(config)#int g1/2
ASA-FIRE(config-if)#no sh

ASA-FIRE(config-if)#nameif OUTSIDE
INFO: Security level for "OUTSIDE" set to 0 by default.
ASA-FIRE(config-if)#security-level 0
ASA-FIRE(config-if)#ip address 201.10.16.01 255.255.255.0
ASA-FIRE(config-if)#EX
ASA-FIRE(config)#DO WR
ASA-FIRE(config)#WR MEM
Building configuration...
Cryptochecksum: 55685c57 437947f2 43d54f77 1d25570a
```

Figure 4.1.3 Firewall and DMZ Configuration

4.1.4. All PC Configuration

The PC IP Configuration outlines the specific IP address, subnet mask, default gateway, and DNS settings assigned to each PC. This ensures that each computer is correctly networked, allowing for seamless communication, internet access, and resource sharing within the network. Proper IP configuration is essential for maintaining efficient and reliable network performance. The main building is divided into 2 departments with a total of 130 each department. Building 1 consists of 90 users and Building 2 consists of 60 users only. Cyberlab Building and R&D Building each consist of 110 users. The Branch campus holds 100 users inside. Each building connects with 3 PCs for each building that connects with a switch.

4.1.4.1 Main Building (Department A)

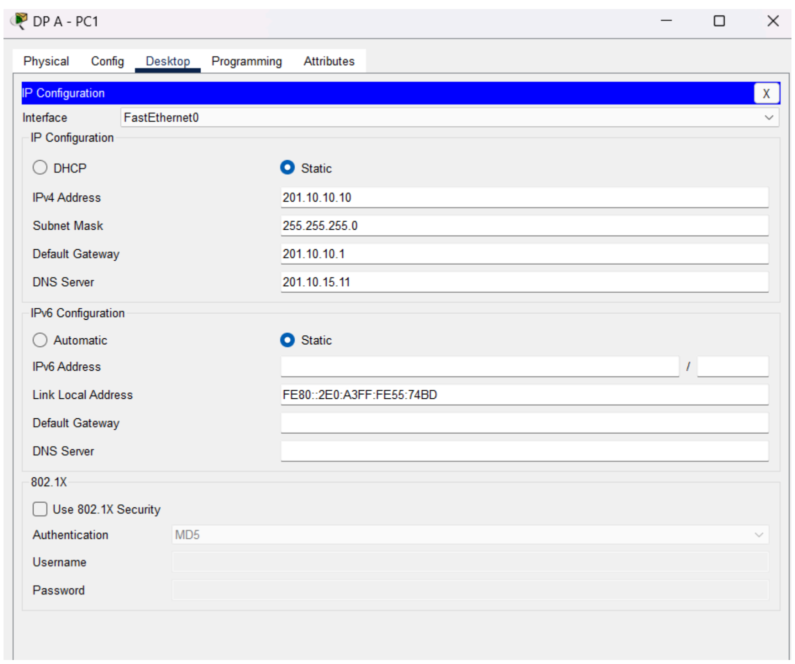


Figure 4.1.4.1.1: DPA-PC1 Main Building Configuration

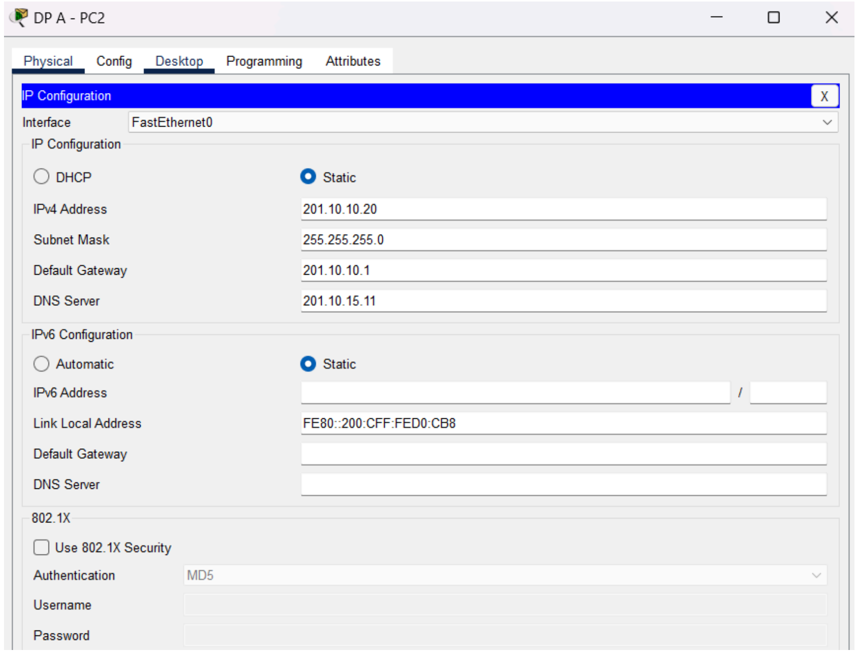


Figure 4.1.4.1.2: DPA-PC2 Main Building Configuration

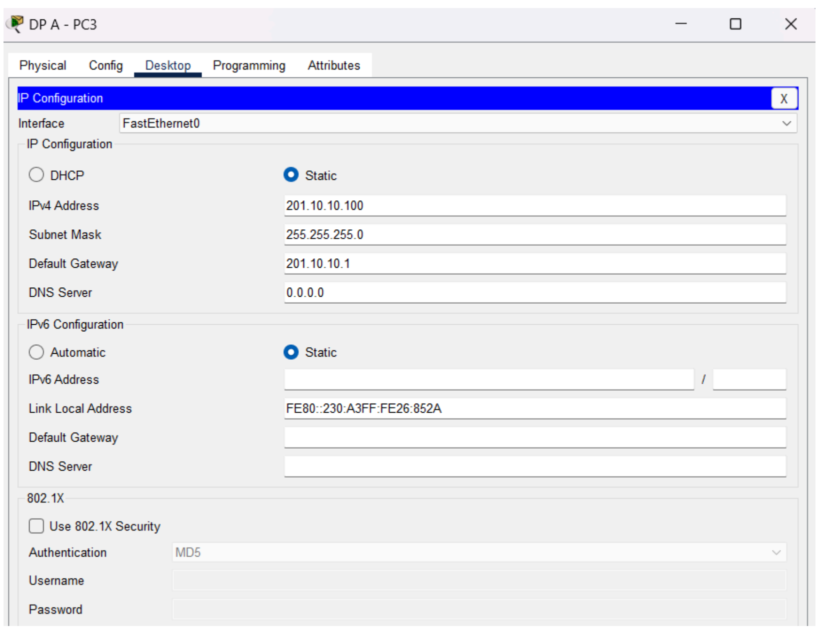


Figure 4.1.4.1.3: DPA-PC3 Main Building Configuration

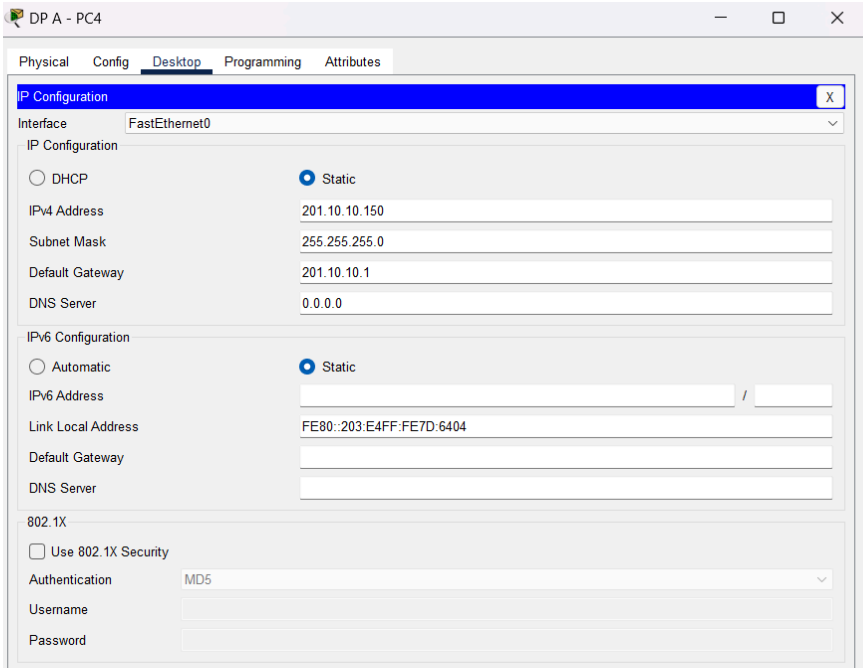


Figure 4.1.4.1.4: DPA-PC4 Main Building Configuration

4.1.4.2 Main Building (Department B)

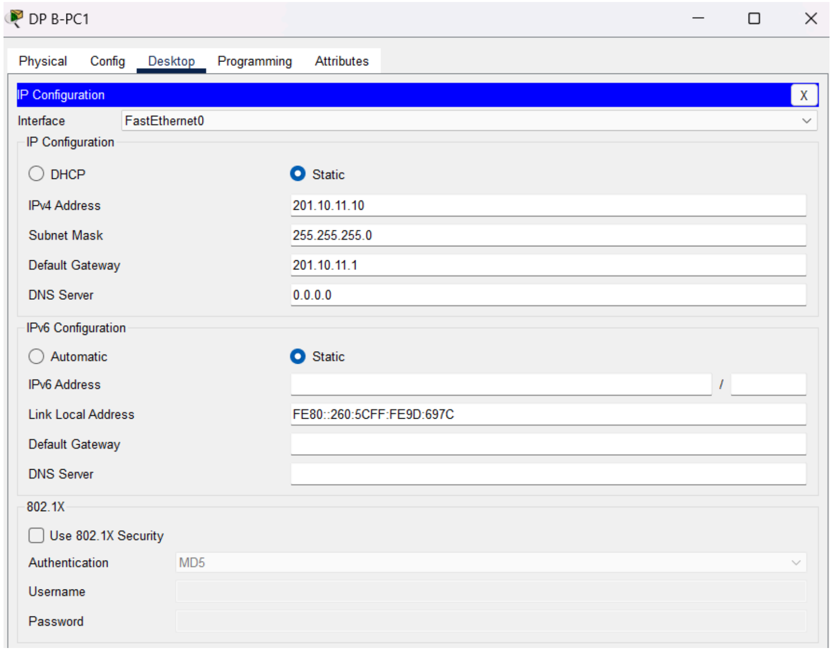


Figure 4.1.4.2.1: DPB-PC1 Main Building Configuration

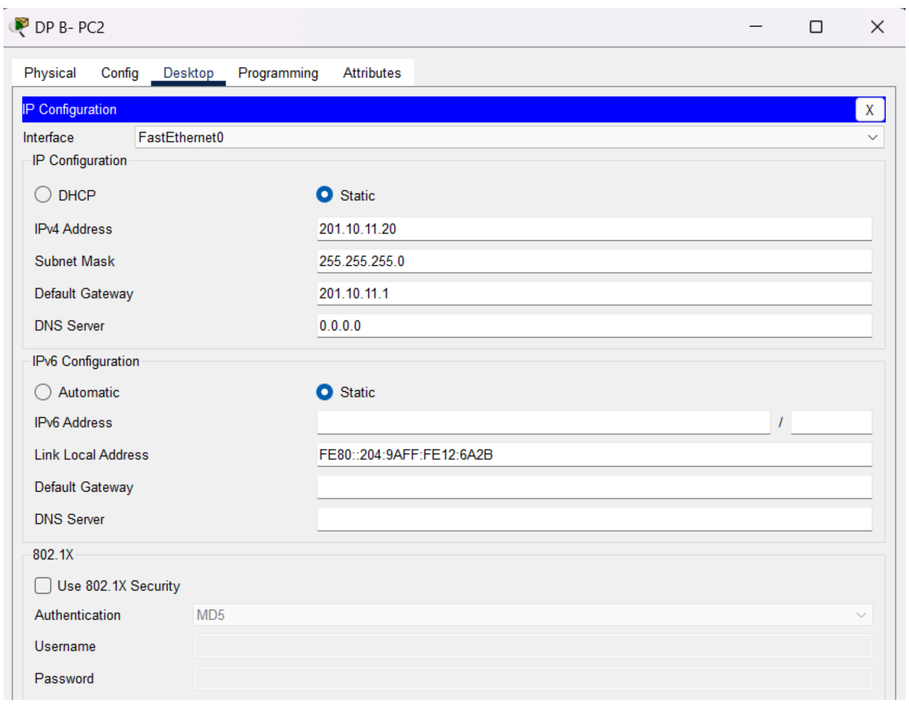


Figure 4.1.4.2.2: DPB-PC2 Main Building Configuration

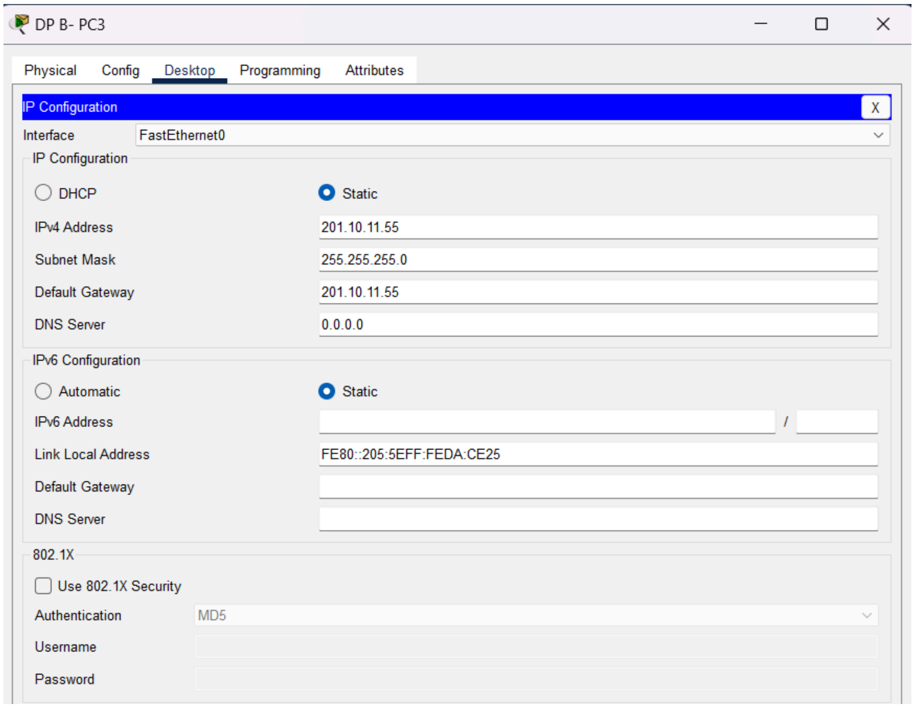


Figure 4.1.4.2.3: DPB-PC3 Main Building Configuration

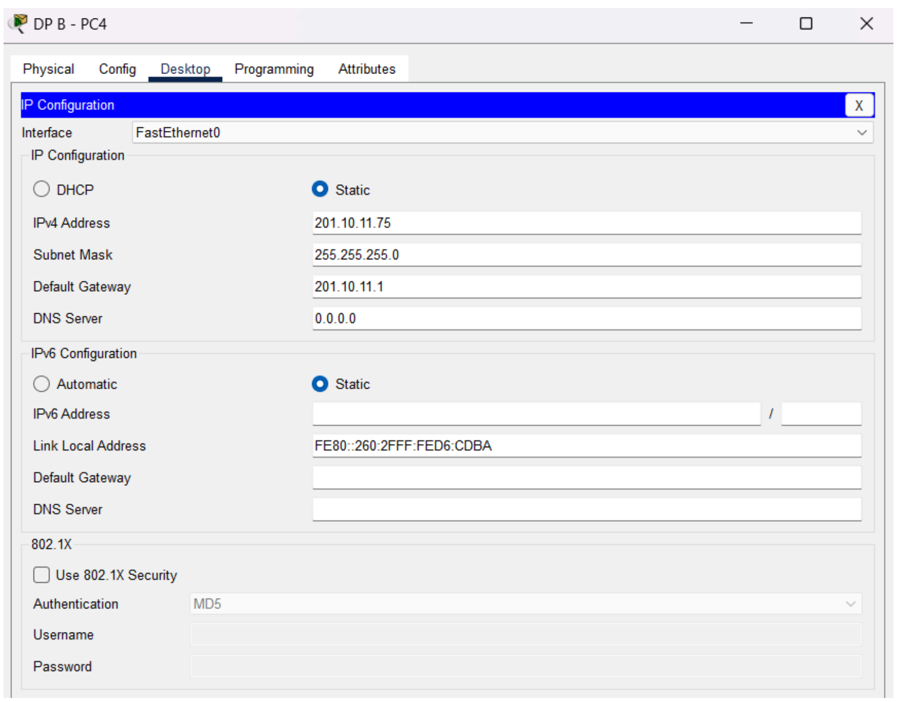


Figure 4.1.4.2.4: DPB-PC4 Main Building Configuration

4.1.4.3 R&D Building

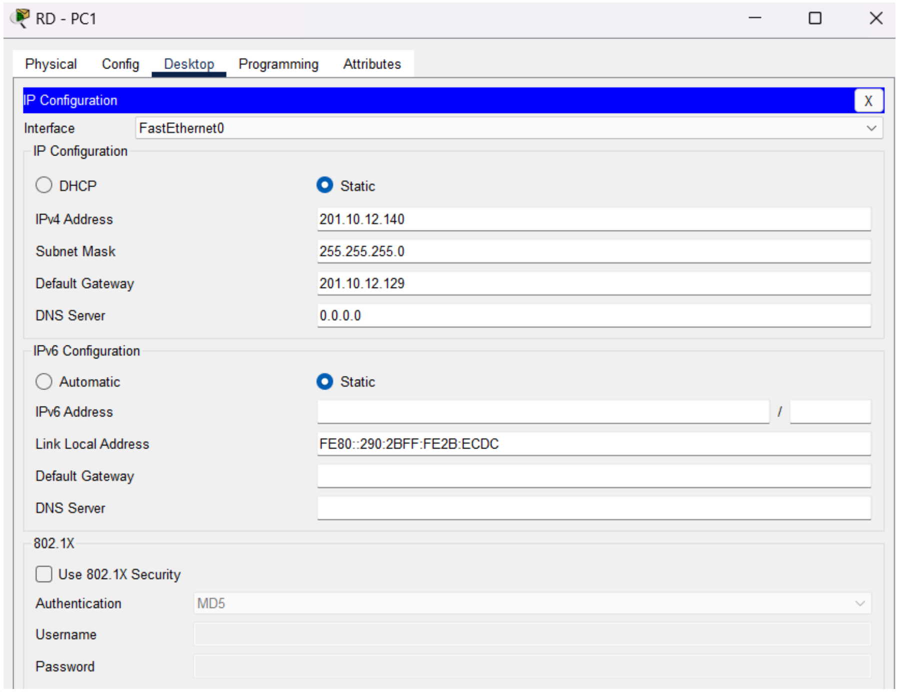


Figure 4.1.4.3.1: RD-PC1 R&D Building Configuration

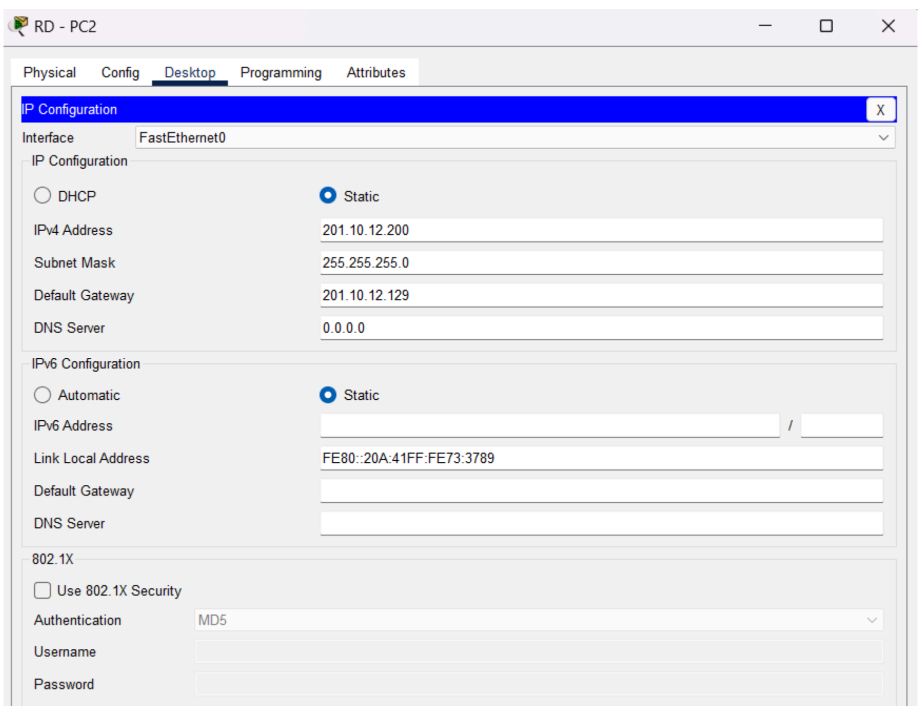


Figure 4.1.4.3.2: RD-PC2 R&D Building Configuration

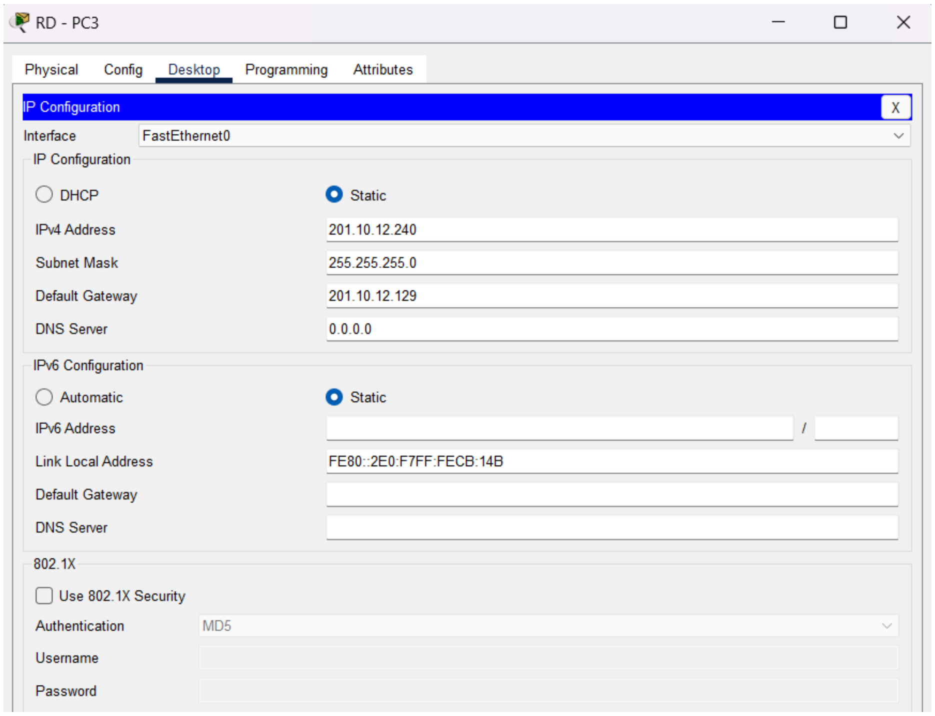


Figure 4.1.4.3.3: RD-PC3 R&D Building Configuration

4.1.4.4 Cyberlab Building

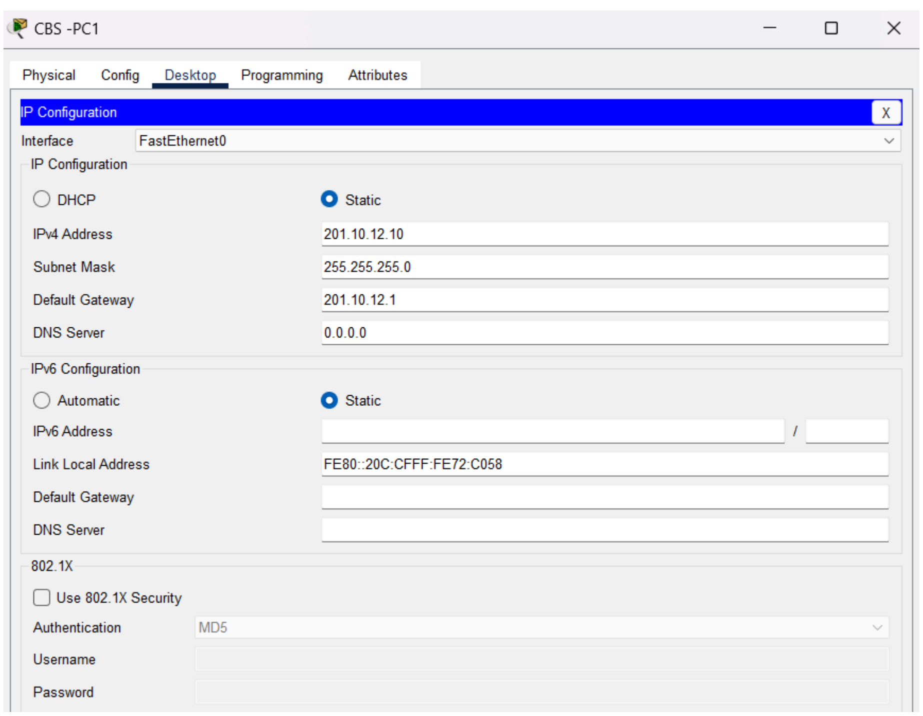


Figure 4.1.4.4.1: CBS-PC1 Cyberlab Building Configuration

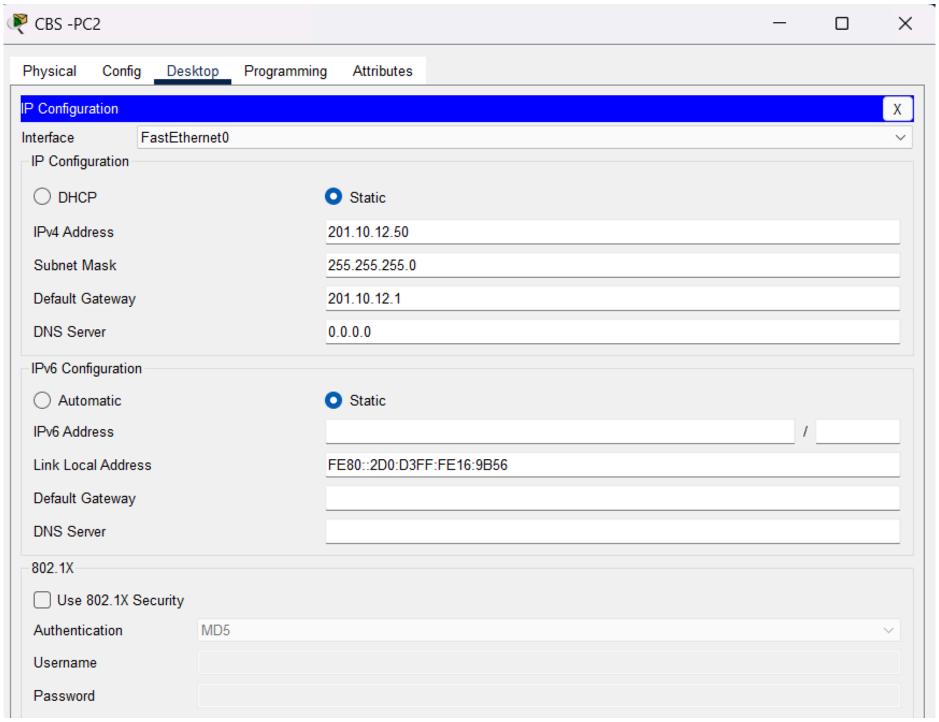


Figure 4.1.4.4.2: CBS-PC2 Cyberlab Building Configuration

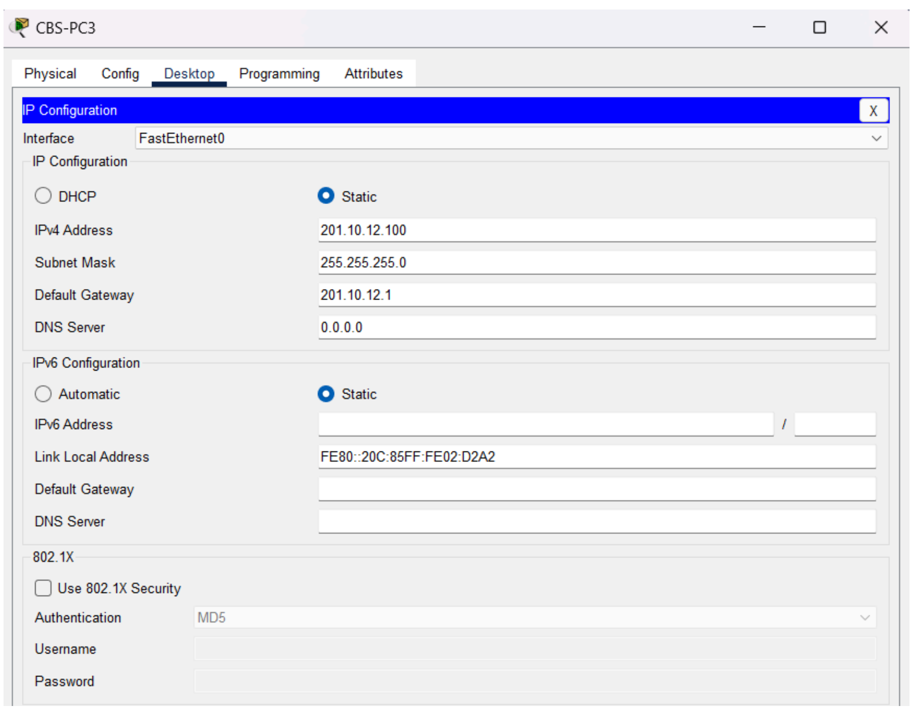


Figure 4.1.4.4.3: CBS-PC3 Cyberlab Building Configuration

4.1.4.5 Building 1

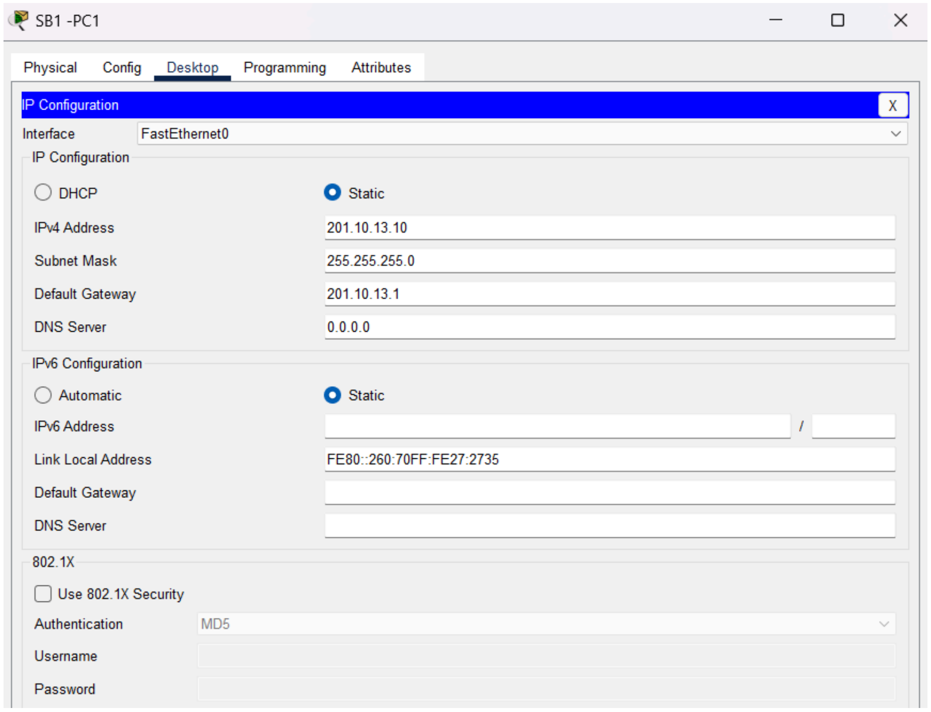


Figure 4.1.4.5.1: SB1-PC1 Building 1 Configuration

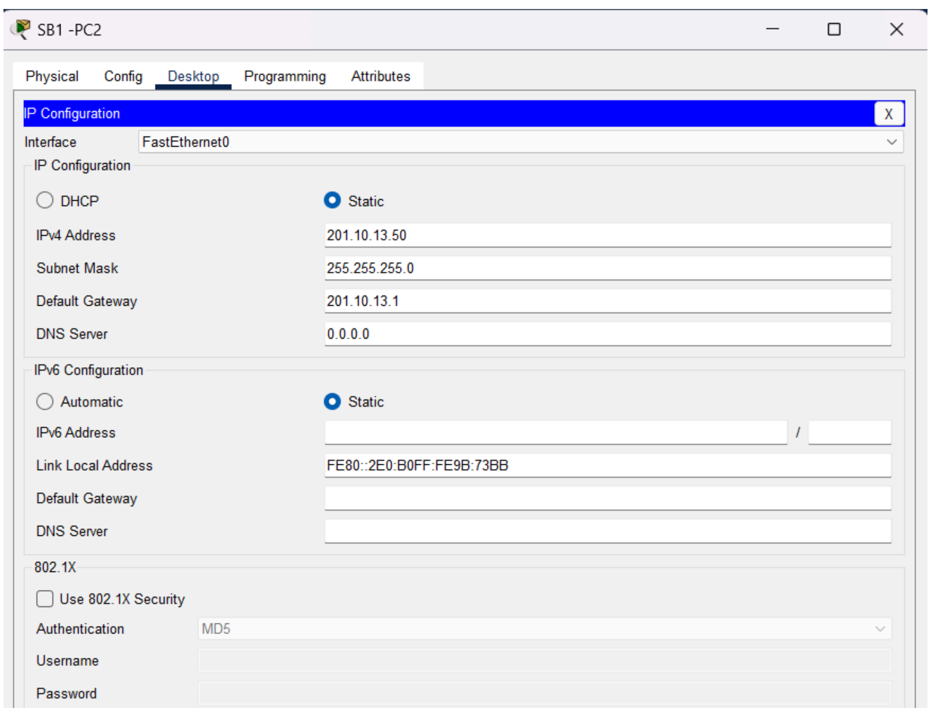


Figure 4.1.4.5.2: SB1-PC2 Building 1 Configuration

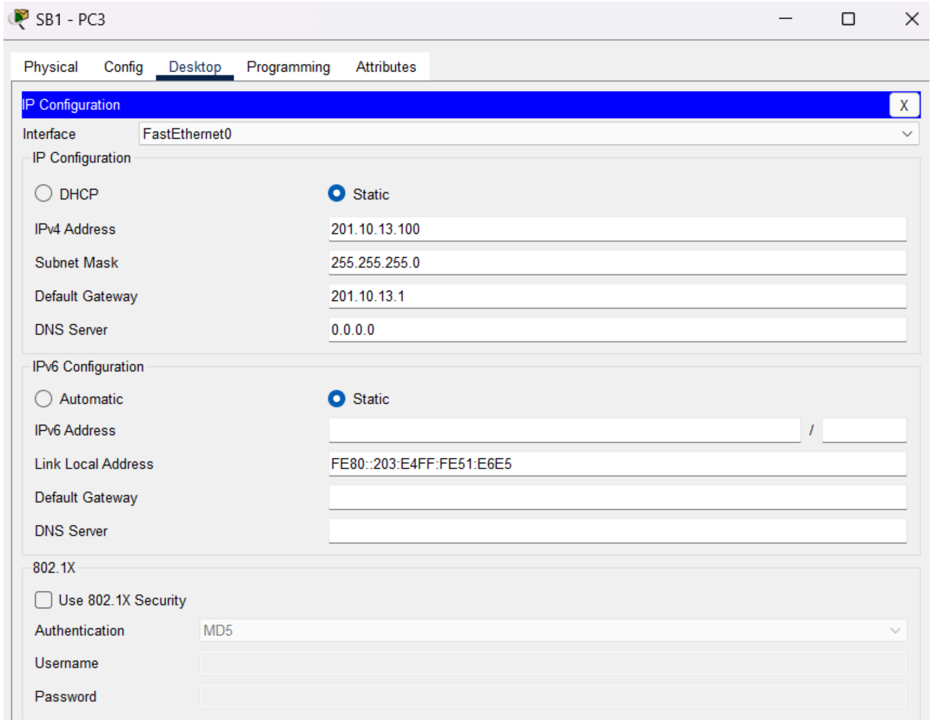


Figure 4.1.4.5.3: SB1-PC3 Building 1 Configuration

4.1.4.6 Building 2

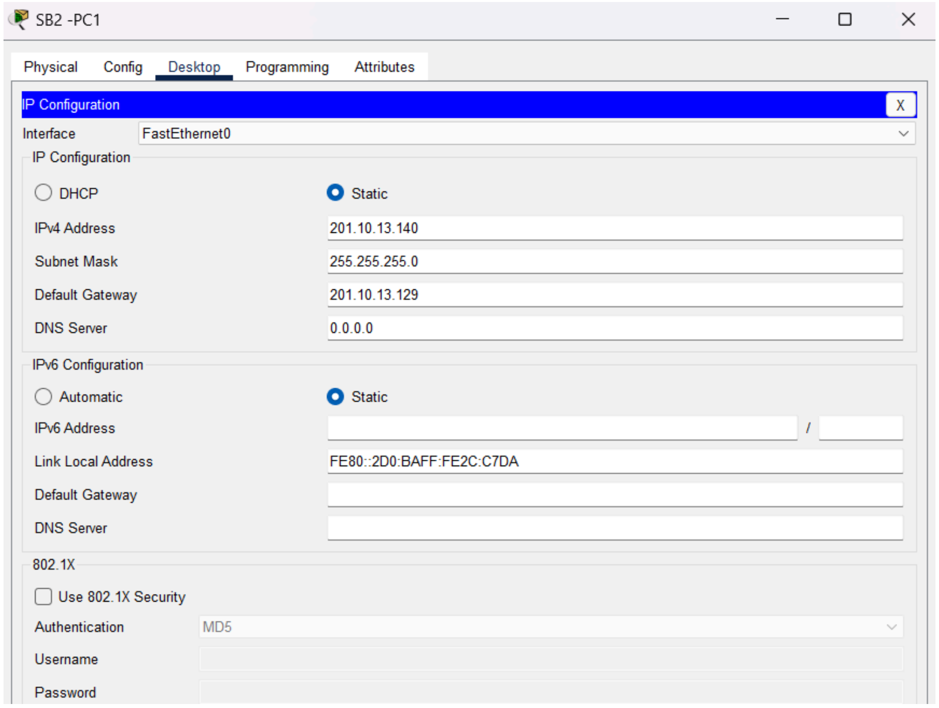


Figure 4.1.4.6.1: SB2-PC1 Building 2 Configuration

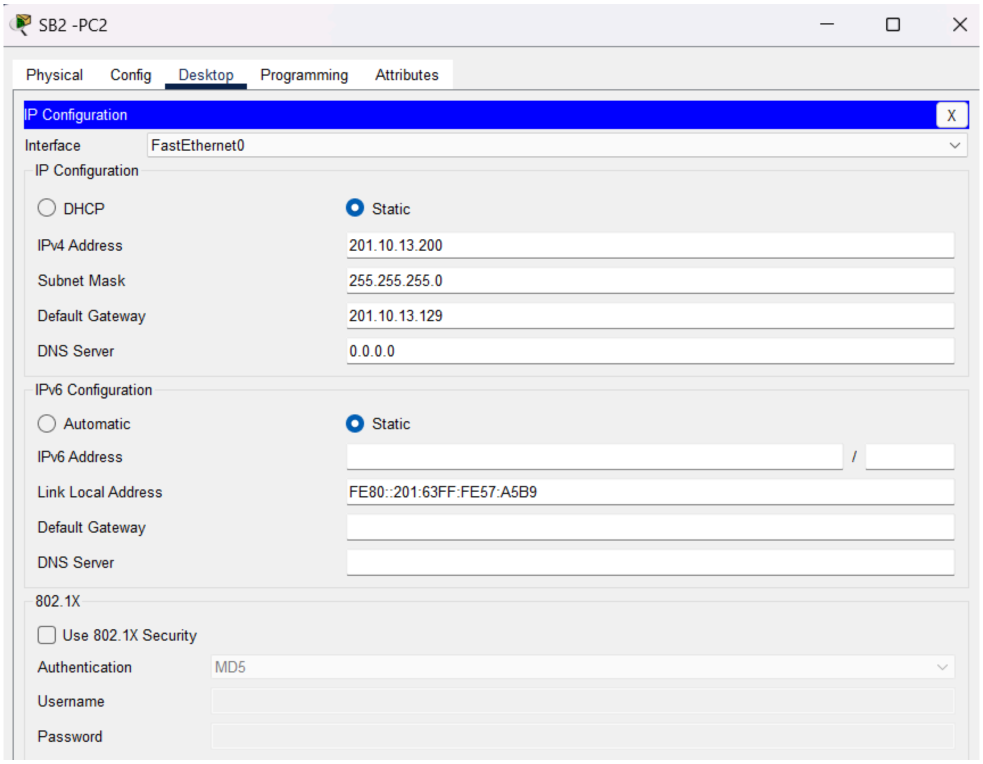


Figure 4.1.4.6.2: SB2-PC2 Building 2 Configuration

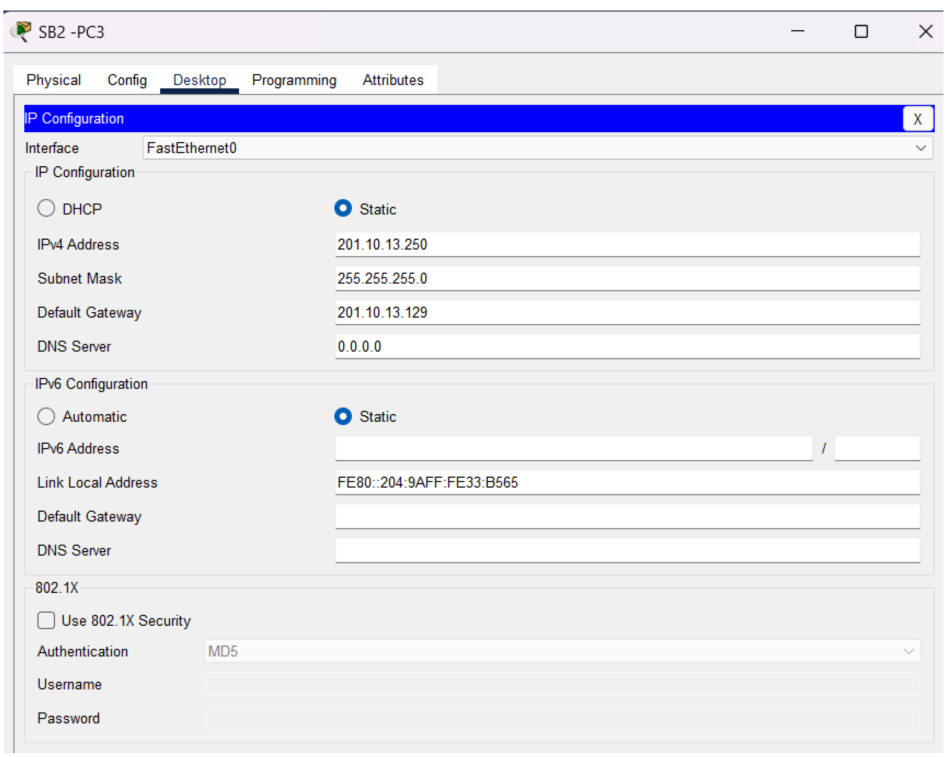


Figure 4.1.4.6.3: SB2-PC3 Building 2 Configuration

4.1.4.7 Branch Campus

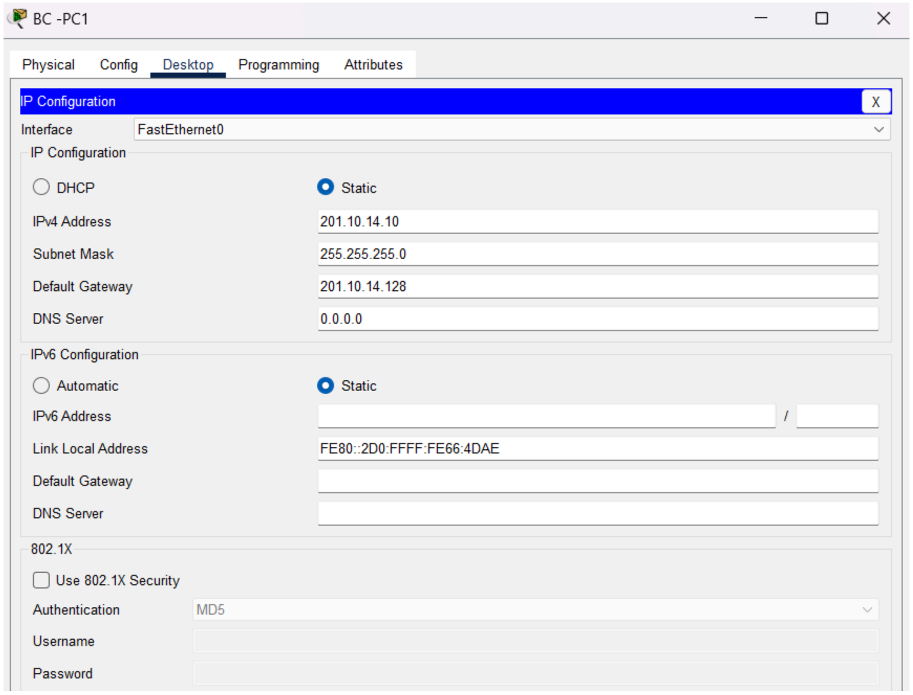


Figure 4.1.4.7.1: BC-PC1 Branch Campus Configuration

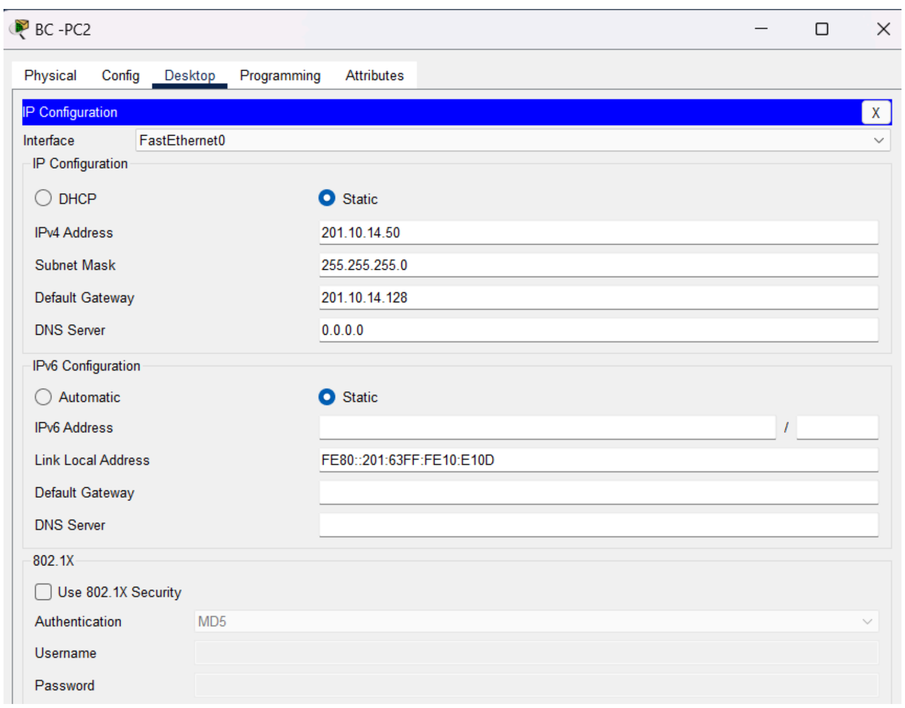


Figure 4.1.4.7.2: BC-PC2 Branch Campus Configuration

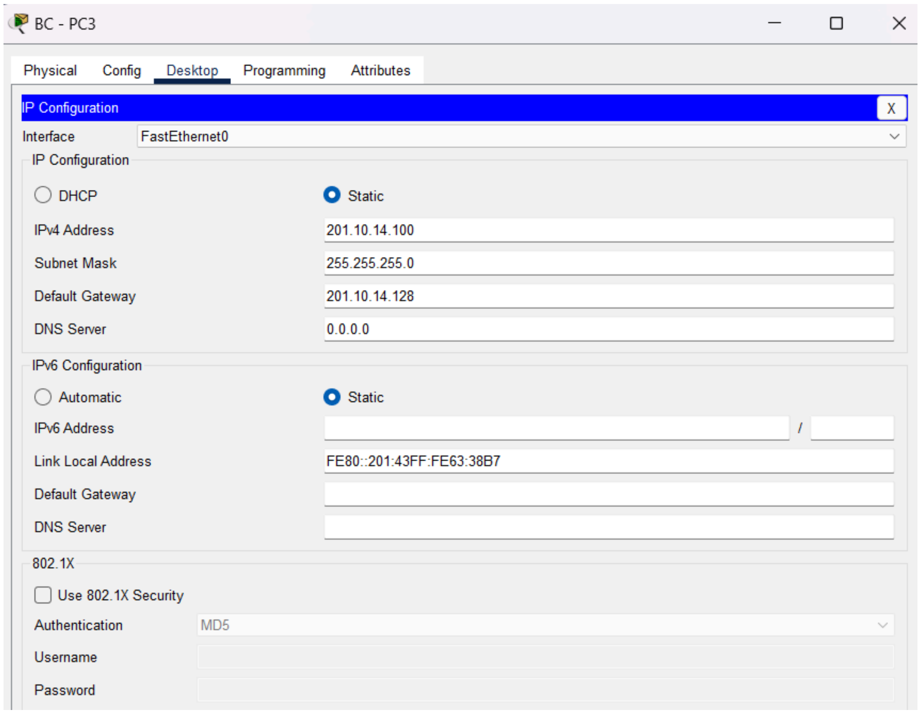


Figure 4.1.4.7.3: BC-PC3 Branch Campus Configuration

4.1.5 NAT and ACL Configuration on Firewall

The provided commands for configuring a firewall called ASA-FIRE. They enable the user to enter privileged EXEC mode, global configuration mode, and interface configuration mode. Assigning IP addresses, implementing access control lists (ACLs) for security, activating network interfaces, and configuring login credentials are all critical activities. These parameters guarantee that ASA-FIRE firewall has adequate network connectivity, improved security, and efficient administration capabilities. Besides, the Network Address Translation (NAT), gives access to the user to translate and allows access through main campus and branch campus.

```
ASA-FIRE(config-network-object)#nat (DMZ,OUTSIDE) DYNAMIC INTERFACE
ASA-FIRE(config-network-object)#do wr
ASA-FIRE(config)#wr mem
Building configuration...
Cryptochecksum: 55685c57 437947f2 43d54f77 1d25570a

1663  bytes copied in 2.767 secs (601 bytes/sec)
[OK]
ASA-FIRE(config)#
ASA-FIRE(config)#
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit icmp any any
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit icmp any any?

configure mode commands/options:
any
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 80
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 8080
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 53
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit udp  any any eq 53
ASA-FIRE(config)#
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit udp  any any eq 67
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit udp  any any eq 68
ASA-FIRE(config)#
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 25
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 587
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 465
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 110
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 143
ASA-FIRE(config)#access-list DMZ-ACCESS extended permit tcp  any any eq 993
ASA-FIRE(config)#
ASA-FIRE(config)#access-group DMZ-ACCESS in interface?

configure mode commands/options:
interface
ASA-FIRE(config)#access-group DMZ-ACCESS in interface DMZ
ASA-FIRE(config)#
```

Figure 4.1.5.1 NAT and ACL configuration

```
onfigure mode commands/options:
nterface
SA-FIRE(config)#access-group DMZ-ACCESS in interface DMZ
SA-FIRE(config)#
SA-FIRE(config)#
SA-FIRE(config)#
SA-FIRE(config)#
SA-FIRE(config)#access-list INTERNET-ACCESS extended permit icmp any
 Incomplete command.
SA-FIRE(config)#access-list INTERNET-ACCESS extended permit icmp any any
SA-FIRE(config)#
SA-FIRE(config)#access-list INTERNET-ACCESS extended permit tcp any any?

onfigure mode commands/options:
ny
SA-FIRE(config)#access-list INTERNET-ACCESS extended permit tcp any any eq 53
SA-FIRE(config)#access-list INTERNET-ACCESS extended permit udp any any eq 53
SA-FIRE(config)#
SA-FIRE(config)#access-list INTERNET-ACCESS extended permit tcp any any eq 80
SA-FIRE(config)#access-list INTERNET-ACCESS extended permit tcp any any eq 8080
SA-FIRE(config)#
SA-FIRE(config)#access-group INTERNET-ACCESS in interface?

onfigure mode commands/options:
nterface
SA-FIRE(config)#access-group INTERNET-ACCESS in interface OUTSIDE
```

Figure 4.1.5.2 NAT and ACL configuration

```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface GigabitEthernet0/2
Router(config-if)#ip address 201.10.15.1 255.255.255.0
Router(config-if)#ip address 201.10.17.10 255.255.255.0
Router(config-if)#EX
Router(config)#router ospf 50
Router(config-router)#router-id 1.2.1.2
Router(config-router)# network 201.10.10.01 255.255.255.0 area 0
Router(config-router)# network 201.10.11.01 255.255.255.0 area 0
Router(config-router)# network 201.10.12.01 255.255.255.0 area 0
Router(config-router)# network 201.10.13.01 255.255.255.0 area 0
Router(config-router)# network 201.10.17.01 255.255.255.0 area 0
Router(config-router)#do wr
Building configuration...
[OK]
```

Figure 4.1.5.3 NAT and ACL configuration

```
Router(config-if)#
Router(config-if)#exit
Router(config)#interface GigabitEthernet0/1
Router(config-if)#ip address 201.10.16.10 255.255.255.0
Router(config-if)#ip address 201.10.16.10 255.255.255.0
Router(config-if)#ex
Router(config)#router ospf 50
Router(config-router)#router-id 3.1.3.1
Router(config-router)#network 201.10.14.01 25.255.255.0 area 0
OSPF: Invalid address/mask combination (discontiguous mask)
Router(config-router)#network 201.10.14.01 255.255.255.0 area 0
Router(config-router)#network 201.10.16.01 255.255.255.0 area 0
Router(config-router)#ex
Router(config)#do wr
Building configuration...
[OK]
```

Figure 4.1.5.4 NAT and ACL configuration

```
ASA-FIRE#conf t
ASA-FIRE(config)#object network
% Incomplete command.
ASA-FIRE(config)#object network DMZ-OUT
ASA-FIRE(config-network-object)#host 201.10.15.01
ASA-FIRE(config-network-object)#nat (DMZ,OUTSIDE) DYNAMIC INTERFACE
ASA-FIRE(config-network-object)#
ASA-FIRE(config-network-object)#
ASA-FIRE(config-network-object)#DO WR
ASA-FIRE(config)#WR MEM
Building configuration...
Cryptochecksum: 14a62e3b 313b5d70 0be32f46 21183f22

1642  bytes copied in 2.014 secs (815 bytes/sec)
[OK]
ASA-FIRE(config)#
```

Figure 4.1.5.5 NAT and ACL configuration

5.0 TESTING AND VERIFICATION

5.1 Network Testing and Verification Procedure

The purpose of the network testing and verification procedure for this project is to ensure the designed and implemented network meets all functional and performance requirements, operates reliably and securely, and supports all intended users and services effectively. This involves systematically checking connectivity across all network segments, verifying the configuration of routers, switches, and access points, ensuring proper implementation of security protocols like VLANs, and testing the integration and performance of critical services such as DHCP, DNS, and internet access. By conducting thorough testing and verification, potential issues can be identified and resolved proactively, ensuring a robust and efficient network infrastructure that meets the college's operational needs and provides a seamless experience for users across both the main and branch campuses.

5.1.1 Via Main Building

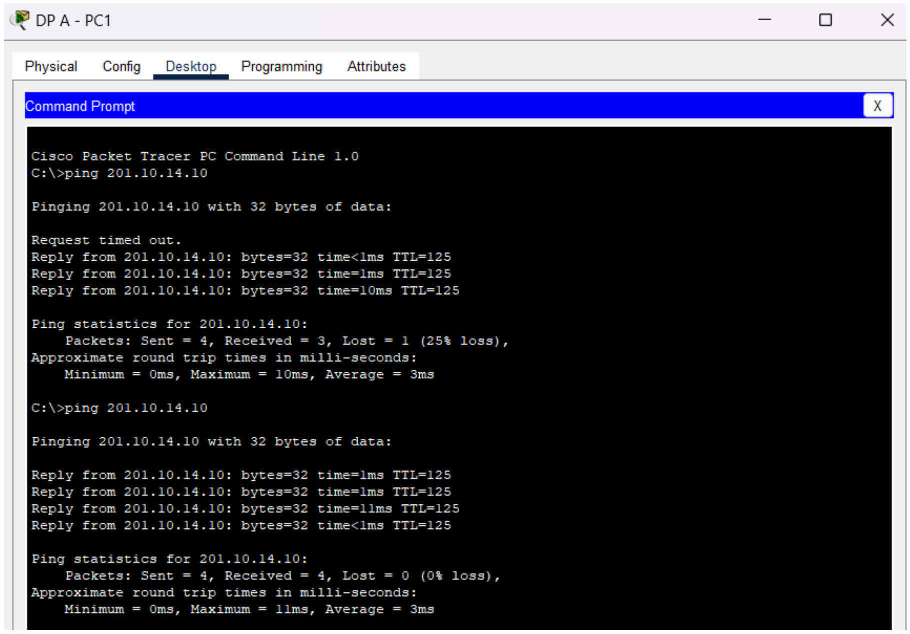


*Figure 5.1.1.1: Main Building PC Ping to Branch Campus PC [**Successful**]*

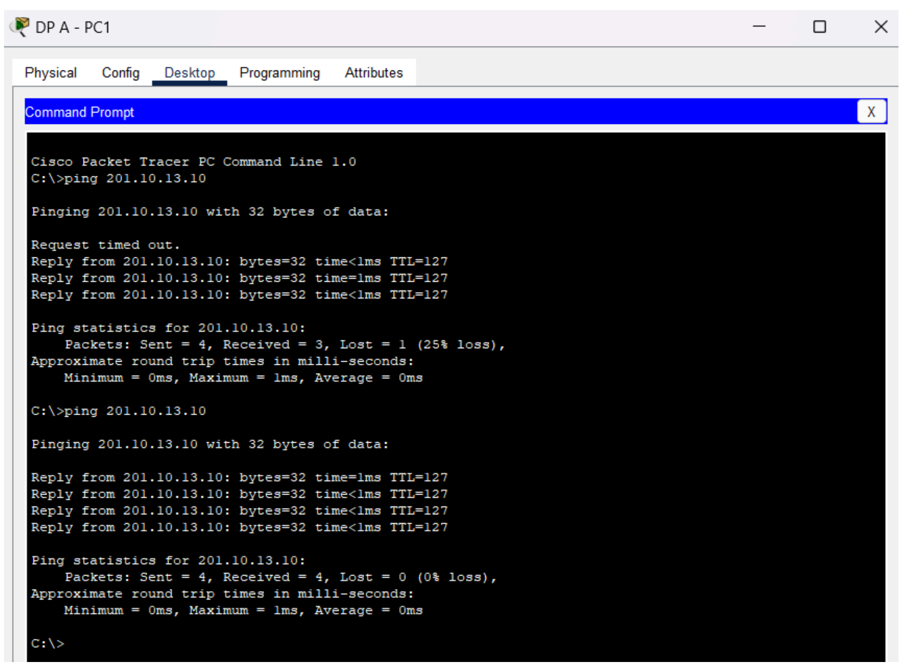


*Figure 5.1.1.2: Main Building PC Ping to Building 1 PC [**Successful**]*

```
C:\>ping 201.10.13.140

Pinging 201.10.13.140 with 32 bytes of data:

Reply from 201.10.13.140: bytes=32 time<1ms TTL=127
Reply from 201.10.13.140: bytes=32 time<1ms TTL=127
Reply from 201.10.13.140: bytes=32 time=10ms TTL=127
Reply from 201.10.13.140: bytes=32 time=1ms TTL=127

Ping statistics for 201.10.13.140:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

*Figure 5.1.1.3: Main Building PC Ping to Building 2 PC [**Successful**]*

```
C:\>ping 201.10.12.140

Pinging 201.10.12.140 with 32 bytes of data:

Request timed out.
Reply from 201.10.12.140: bytes=32 time=10ms TTL=127
Reply from 201.10.12.140: bytes=32 time=10ms TTL=127
Reply from 201.10.12.140: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.12.140:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 6ms

C:\>ping 201.10.12.140

Pinging 201.10.12.140 with 32 bytes of data:

Reply from 201.10.12.140: bytes=32 time<1ms TTL=127
Reply from 201.10.12.140: bytes=32 time<1ms TTL=127
Reply from 201.10.12.140: bytes=32 time<1ms TTL=127
Reply from 201.10.12.140: bytes=32 time=11ms TTL=127

Ping statistics for 201.10.12.140:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 2ms
```

*Figure 5.1.1.4: Main Building PC Ping to R&D Building PC [**Successful**]*

```
C:\>ping 201.10.12.10

Pinging 201.10.12.10 with 32 bytes of data:

Request timed out.
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127
Reply from 201.10.12.10: bytes=32 time=1ms TTL=127
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.12.10:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 201.10.12.10

Pinging 201.10.12.10 with 32 bytes of data:

Reply from 201.10.12.10: bytes=32 time<1ms TTL=127
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.12.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.1.5: Main Building PC Ping to Cyberlab Building PC [**Successful**]*

```
C:\>ping 201.10.15.10

Pinging 201.10.15.10 with 32 bytes of data:

Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time=10ms TTL=126
Reply from 201.10.15.10: bytes=32 time=10ms TTL=126
Reply from 201.10.15.10: bytes=32 time=1ms TTL=126

Ping statistics for 201.10.15.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 5ms
```

*Figure 5.1.1.6: Main Building PC Ping to Email Server [**Successful**]*

```
C:\>ping 201.10.15.11

Pinging 201.10.15.11 with 32 bytes of data:

Request timed out.
Reply from 201.10.15.11: bytes=32 time=11ms TTL=126
Reply from 201.10.15.11: bytes=32 time=14ms TTL=126
Reply from 201.10.15.11: bytes=32 time=10ms TTL=126

Ping statistics for 201.10.15.11:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 10ms, Maximum = 14ms, Average = 11ms

C:\>ping 201.10.15.11

Pinging 201.10.15.11 with 32 bytes of data:

Reply from 201.10.15.11: bytes=32 time=10ms TTL=126
Reply from 201.10.15.11: bytes=32 time=1ms TTL=126
Reply from 201.10.15.11: bytes=32 time=1ms TTL=126
Reply from 201.10.15.11: bytes=32 time=10ms TTL=126

Ping statistics for 201.10.15.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 5ms
```

*Figure 5.1.1.7: Main Building PC Ping to DNS Server[**Successful**]*

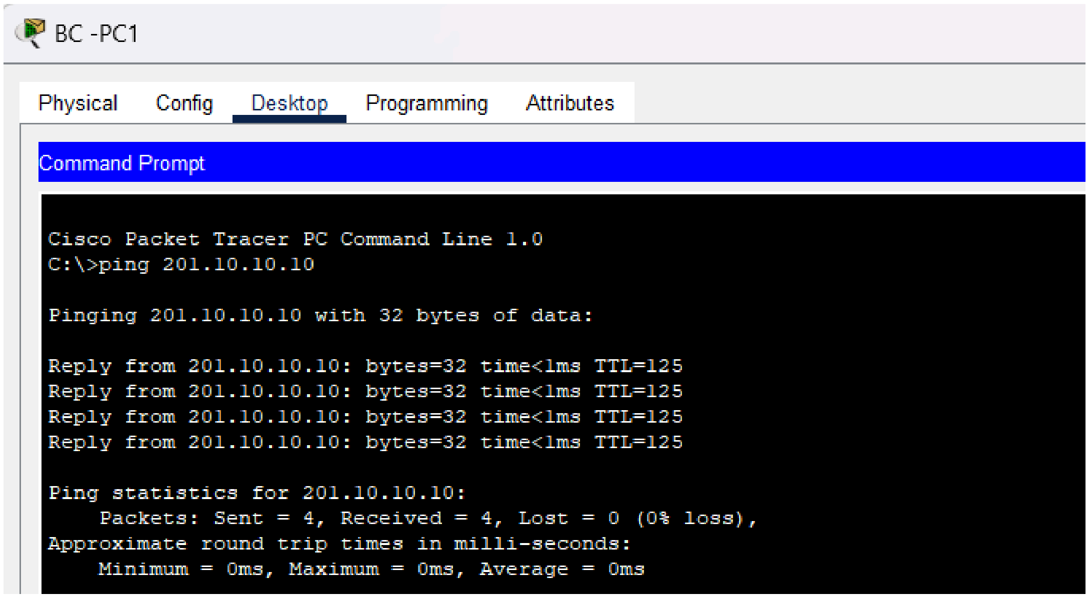
```
C:\>ping 201.10.15.16

Pinging 201.10.15.16 with 32 bytes of data:

Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time=7ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 7ms, Average = 1ms
```

*Figure 5.1.1.8: Main Building PC Ping to Web Server[**Successful**]*

```
C:\>ping 201.10.15.13

Pinging 201.10.15.13 with 32 bytes of data:

Request timed out.
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time=4ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.13:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 4ms, Average = 1ms

C:\>ping 201.10.15.13

Pinging 201.10.15.13 with 32 bytes of data:

Reply from 201.10.15.13: bytes=32 time=16ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time=1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 16ms, Average = 4ms
```

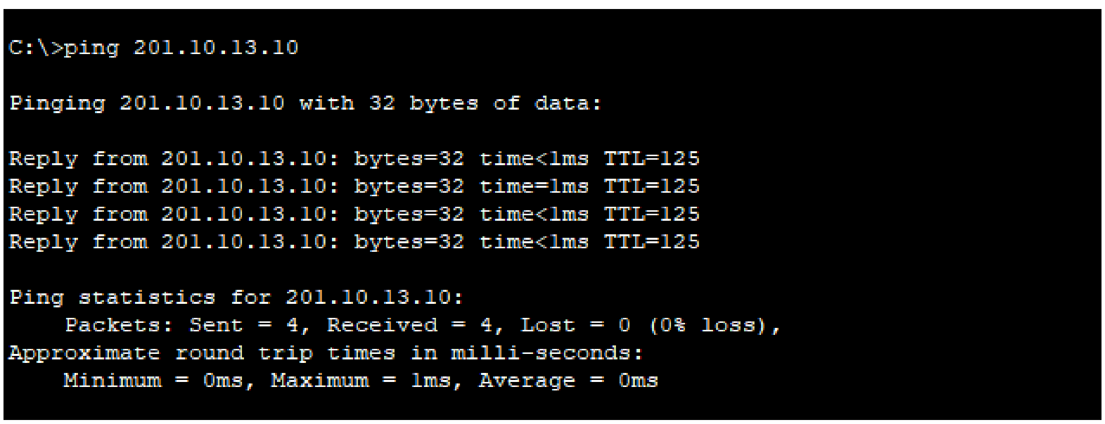
*Figure 5.1.1.9: Main Building PC Ping to DHCP Server[**Successful**]*

5.1.2 Via Branch Campus



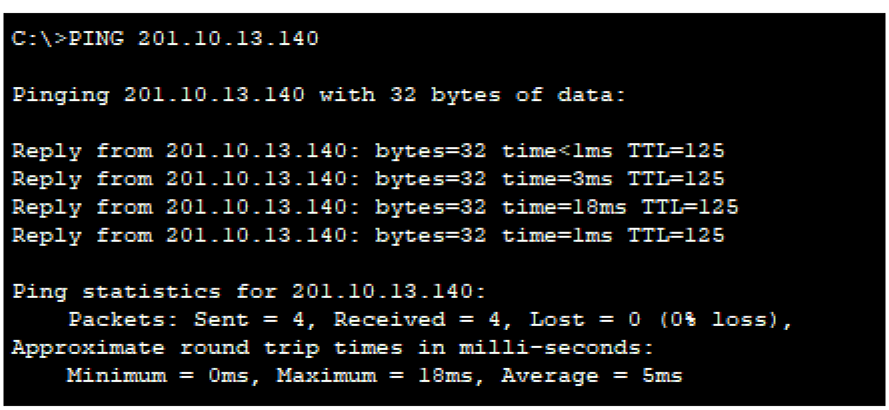

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 201.10.10.10

Pinging 201.10.10.10 with 32 bytes of data:

Reply from 201.10.10.10: bytes=32 time<1ms TTL=125
Reply from 201.10.10.10: bytes=32 time<1ms TTL=125
Reply from 201.10.10.10: bytes=32 time<1ms TTL=125
Reply from 201.10.10.10: bytes=32 time<1ms TTL=125

Ping statistics for 201.10.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.2.1: Branch Campus PC Ping to Main Building[**Successful**]*



```
C:\>ping 201.10.13.10

Pinging 201.10.13.10 with 32 bytes of data:

Reply from 201.10.13.10: bytes=32 time<1ms TTL=125
Reply from 201.10.13.10: bytes=32 time=1ms TTL=125
Reply from 201.10.13.10: bytes=32 time<1ms TTL=125
Reply from 201.10.13.10: bytes=32 time<1ms TTL=125

Ping statistics for 201.10.13.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.2.2: Branch Campus PC Ping to Building 1 PC[**Successful**]*



```
C:\>PING 201.10.13.140

Pinging 201.10.13.140 with 32 bytes of data:

Reply from 201.10.13.140: bytes=32 time<1ms TTL=125
Reply from 201.10.13.140: bytes=32 time=3ms TTL=125
Reply from 201.10.13.140: bytes=32 time=18ms TTL=125
Reply from 201.10.13.140: bytes=32 time=1ms TTL=125

Ping statistics for 201.10.13.140:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 18ms, Average = 5ms
```

*Figure 5.1.2.3: Branch Campus PC Ping to Building 2 PC[**Successful**]*

```
C:\>PING 201.10.12.200

Pinging 201.10.12.200 with 32 bytes of data:

Reply from 201.10.12.200: bytes=32 time<1ms TTL=125
Reply from 201.10.12.200: bytes=32 time=11ms TTL=125
Reply from 201.10.12.200: bytes=32 time=11ms TTL=125
Reply from 201.10.12.200: bytes=32 time<1ms TTL=125

Ping statistics for 201.10.12.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 5ms
```

*Figure 5.1.2.4: Branch Campus PC Ping to R&D Building PC[**Successful**]*

```
C:\>ping 201.10.12.10

Pinging 201.10.12.10 with 32 bytes of data:

Reply from 201.10.12.10: bytes=32 time<1ms TTL=125
Reply from 201.10.12.10: bytes=32 time<1ms TTL=125
Reply from 201.10.12.10: bytes=32 time<1ms TTL=125
Reply from 201.10.12.10: bytes=32 time<1ms TTL=125

Ping statistics for 201.10.12.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.2.5: Branch Campus PC Ping to Cyberlab PC[**Successful**]*

5.1.3 Via Building 1

SB1 -PC1

Physical | Config | Desktop | Programming | Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 201.10.10.10

Pinging 201.10.10.10 with 32 bytes of data:

Reply from 201.10.10.10: bytes=32 time<1ms TTL=127
Reply from 201.10.10.10: bytes=32 time<1ms TTL=127
Reply from 201.10.10.10: bytes=32 time=1ms TTL=127
Reply from 201.10.10.10: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.3.1: Building 1 PC Ping to Main Building PC[**Successful**]*

```
C:\>ping 201.10.14.10

Pinging 201.10.14.10 with 32 bytes of data:

Reply from 201.10.14.10: bytes=32 time<1ms TTL=125
Reply from 201.10.14.10: bytes=32 time=10ms TTL=125
Reply from 201.10.14.10: bytes=32 time<1ms TTL=125
Reply from 201.10.14.10: bytes=32 time<1ms TTL=125

Ping statistics for 201.10.14.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

*Figure 5.1.3.2: Building 1 PC Ping to Branch Campus PC[**Successful**]*

```
C:\>ping 201.10.13.140

Pinging 201.10.13.140 with 32 bytes of data:

Reply from 201.10.13.140: bytes=32 time<1ms TTL=128
Reply from 201.10.13.140: bytes=32 time<1ms TTL=128
Reply from 201.10.13.140: bytes=32 time<1ms TTL=128
Reply from 201.10.13.140: bytes=32 time<1ms TTL=128

Ping statistics for 201.10.13.140:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.3.3: Building 1 PC Ping to Building 2 PC[**Successful**]*

SB1 -PC2

Physical Config Desktop Programming Attributes

Command Prompt X

```
Cisco Packet Tracer PC Command Line 1.0
C:\>PING 201.10.12.140

Pinging 201.10.12.140 with 32 bytes of data:

Reply from 201.10.12.140: bytes=32 time<1ms TTL=127
Reply from 201.10.12.140: bytes=32 time=1ms TTL=127
Reply from 201.10.12.140: bytes=32 time<1ms TTL=127
Reply from 201.10.12.140: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.12.140:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.3.4: Building 1 PC Ping to R&D Building PC[**Successful**]*

```
C:\>ping 201.10.12.10

Pinging 201.10.12.10 with 32 bytes of data:

Reply from 201.10.12.10: bytes=32 time<1ms TTL=127
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127
Reply from 201.10.12.10: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.12.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.3.5: Building 1 PC Ping to Cyberlab Building PC[**Successful**]*

```
C:\>ping 201.10.15.10

Pinging 201.10.15.10 with 32 bytes of data:

Reply from 201.10.15.10: bytes=32 time=1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.3.6: Building 1 PC Ping to Email Server PC[**Successful**]*

```
C:\>ping 201.10.15.11

Pinging 201.10.15.11 with 32 bytes of data:

Request timed out.
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.11:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 201.10.15.11

Pinging 201.10.15.11 with 32 bytes of data:

Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time=1ms TTL=126
Reply from 201.10.15.11: bytes=32 time=1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.3.7: Building 1 PC Ping to DNS Server PC[**Successful**]*

```
C:\>ping 201.10.15.16

Pinging 201.10.15.16 with 32 bytes of data:

Request timed out.
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time=1ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.16:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 201.10.15.16

Pinging 201.10.15.16 with 32 bytes of data:

Reply from 201.10.15.16: bytes=32 time=1ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.3.8: Building 1 PC Ping to Web Server PC[**Successful**]*

```
C:\>ping 201.10.15.13

Pinging 201.10.15.13 with 32 bytes of data:

Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.3.9: Building 1 PC Ping to DHCP Server PC[**Successful**]*

5.1.4 Via Building 2

```
C:\>PING 201.10.10.10

Pinging 201.10.10.10 with 32 bytes of data:

Reply from 201.10.10.10: bytes=32 time<1ms TTL=127
Reply from 201.10.10.10: bytes=32 time=1ms TTL=127
Reply from 201.10.10.10: bytes=32 time<1ms TTL=127
Reply from 201.10.10.10: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.4.1: Building 2 PC Ping to Main Building PC[**Successful**]*

```
C:\>PING 201.10.14.10

Pinging 201.10.14.10 with 32 bytes of data:

Reply from 201.10.14.10: bytes=32 time<1ms TTL=125
Reply from 201.10.14.10: bytes=32 time=10ms TTL=125
Reply from 201.10.14.10: bytes=32 time=10ms TTL=125
Reply from 201.10.14.10: bytes=32 time<1ms TTL=125

Ping statistics for 201.10.14.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 5ms
```

*Figure 5.1.4.2: Building 2 PC Ping to Branch Campus PC[**Successful**]*

```
C:\>ping 201.10.13.50

Pinging 201.10.13.50 with 32 bytes of data:

Reply from 201.10.13.50: bytes=32 time<1ms TTL=128
Reply from 201.10.13.50: bytes=32 time=1ms TTL=128
Reply from 201.10.13.50: bytes=32 time<1ms TTL=128
Reply from 201.10.13.50: bytes=32 time=1ms TTL=128

Ping statistics for 201.10.13.50:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.4.3: Building 2 PC Ping to Building 1 PC[**Successful**]*

```
C:\>PING 201.10.12.140

Pinging 201.10.12.140 with 32 bytes of data:

Reply from 201.10.12.140: bytes=32 time<1ms TTL=127
Reply from 201.10.12.140: bytes=32 time=10ms TTL=127
Reply from 201.10.12.140: bytes=32 time<1ms TTL=127
Reply from 201.10.12.140: bytes=32 time=10ms TTL=127

Ping statistics for 201.10.12.140:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 5ms
```

*Figure 5.1.4.4: Building 2 PC Ping to R&D Building PC[**Successful**]*

```
C:\>PING 201.10.12.100

Pinging 201.10.12.100 with 32 bytes of data:

Reply from 201.10.12.100: bytes=32 time<1ms TTL=127
Reply from 201.10.12.100: bytes=32 time=1ms TTL=127
Reply from 201.10.12.100: bytes=32 time<1ms TTL=127
Reply from 201.10.12.100: bytes=32 time=1ms TTL=127

Ping statistics for 201.10.12.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.4.5: Building 2 PC Ping to Cyberlab Building PC[**Successful**]*

```
C:\>PING 201.10.15.10

Pinging 201.10.15.10 with 32 bytes of data:

Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time=10ms TTL=126
Reply from 201.10.15.10: bytes=32 time=10ms TTL=126
Reply from 201.10.15.10: bytes=32 time=1ms TTL=126

Ping statistics for 201.10.15.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 5ms
```

*Figure 5.1.4.6: Building 2 PC Ping to Email Server PC[**Successful**]*

```
C:\>PING 201.10.15.11

Pinging 201.10.15.11 with 32 bytes of data:

Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time=10ms TTL=126

Ping statistics for 201.10.15.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

*Figure 5.1.4.7: Building 2 PC Ping to DNS Server PC[**Successful**]*

```
C:\>PING 201.10.15.16

Pinging 201.10.15.16 with 32 bytes of data:

Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time=12ms TTL=126
Reply from 201.10.15.16: bytes=32 time=2ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 3ms
```

*Figure 5.1.4.8: Building 2 PC Ping to Web Server PC[**Successful**]*

```
C:\>PING 201.10.15.13

Pinging 201.10.15.13 with 32 bytes of data:

Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time=1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.4.9: Building 2 PC Ping to DHCP Server PC[**Successful**]*

5.1.5 Via R&D Building

```
C:\>PING 201.10.10.10

Pinging 201.10.10.10 with 32 bytes of data:

Reply from 201.10.10.10: bytes=32 time<1ms TTL=127
Reply from 201.10.10.10: bytes=32 time=2ms TTL=127
Reply from 201.10.10.10: bytes=32 time=1ms TTL=127
Reply from 201.10.10.10: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

*Figure 5.1.5.1: R&D Building PC Ping to Main Building PC[**Successful**]*

```
C:\>PING 201.10.14.10

Pinging 201.10.14.10 with 32 bytes of data:

Reply from 201.10.14.10: bytes=32 time<1ms TTL=125
Reply from 201.10.14.10: bytes=32 time=1ms TTL=125
Reply from 201.10.14.10: bytes=32 time=11ms TTL=125
Reply from 201.10.14.10: bytes=32 time=10ms TTL=125

Ping statistics for 201.10.14.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 5ms
```

*Figure 5.1.5.2: R&D Building PC Ping to Branch Campus PC[**Successful**]*

```
C:\>PING 201.10.13.100

Pinging 201.10.13.100 with 32 bytes of data:

Reply from 201.10.13.100: bytes=32 time<1ms TTL=127
Reply from 201.10.13.100: bytes=32 time<1ms TTL=127
Reply from 201.10.13.100: bytes=32 time=1ms TTL=127
Reply from 201.10.13.100: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.13.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.5.3: R&D Building PC Ping to Building 1 PC[**Successful**]*

```
C:\>PING 201.10.13.250

Pinging 201.10.13.250 with 32 bytes of data:

Reply from 201.10.13.250: bytes=32 time=1ms TTL=127
Reply from 201.10.13.250: bytes=32 time<1ms TTL=127
Reply from 201.10.13.250: bytes=32 time=10ms TTL=127
Reply from 201.10.13.250: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.13.250:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

*Figure 5.1.5.4: R&D Building PC Ping to Building 2 PC[**Successful**]*

```
C:\>ping 201.10.12.10

Pinging 201.10.12.10 with 32 bytes of data:

Reply from 201.10.12.10: bytes=32 time<1ms TTL=128
Reply from 201.10.12.10: bytes=32 time=3ms TTL=128
Reply from 201.10.12.10: bytes=32 time<1ms TTL=128
Reply from 201.10.12.10: bytes=32 time<1ms TTL=128

Ping statistics for 201.10.12.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 0ms
```

*Figure 5.1.5.5: R&D Building PC Ping to Cyberlab Building PC[**Successful**]*

```
C:\>ping 201.10.15.10

Pinging 201.10.15.10 with 32 bytes of data:

Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.5.6: R&D Building PC Ping to Email Server PC[**Successful**]*

```
C:\>ping 201.10.15.11

Pinging 201.10.15.11 with 32 bytes of data:

Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.5.7: R&D Building PC Ping to DNS Server PC[**Successful**]*

```
C:\>ping 201.10.15.16

Pinging 201.10.15.16 with 32 bytes of data:

Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time=26ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 26ms, Average = 6ms
```

*Figure 5.1.5.8: R&D Building PC Ping to Web Server PC[**Successful**]*

```
C:\>ping 201.10.15.13

Pinging 201.10.15.13 with 32 bytes of data:

Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time=10ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

*Figure 5.1.5.9: R&D Building PC Ping to DHCP Server PC[**Successful**]*

5.1.6 Via Cyberlab Building

```
Pinging 201.10.10.10 with 32 bytes of data:

Reply from 201.10.10.10: bytes=32 time=6ms TTL=127
Reply from 201.10.10.10: bytes=32 time<1ms TTL=127
Reply from 201.10.10.10: bytes=32 time=13ms TTL=127
Reply from 201.10.10.10: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 13ms, Average = 4ms
```

*Figure 5.1.6.1: Cyberlab Building PC Ping to Main Building PC[**Successful**]*

```
C:\>201.10.14.10
Invalid Command.

C:\>ping 201.10.14.10

Pinging 201.10.14.10 with 32 bytes of data:

Reply from 201.10.14.10: bytes=32 time<1ms TTL=125
Reply from 201.10.14.10: bytes=32 time<1ms TTL=125
Reply from 201.10.14.10: bytes=32 time<1ms TTL=125
Reply from 201.10.14.10: bytes=32 time<1ms TTL=125

Ping statistics for 201.10.14.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.6.2: Cyberlab Building PC Ping to Branch Campus PC[**Successful**]*

```
C:\>ping 201.10.13.10

Pinging 201.10.13.10 with 32 bytes of data:

Reply from 201.10.13.10: bytes=32 time<1ms TTL=127
Reply from 201.10.13.10: bytes=32 time=1ms TTL=127
Reply from 201.10.13.10: bytes=32 time=10ms TTL=127
Reply from 201.10.13.10: bytes=32 time=1ms TTL=127

Ping statistics for 201.10.13.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 3ms
```

*Figure 5.1.6.3: Cyberlab Building PC Ping to Building 1 PC[**Successful**]*

```
C:\>PING 201.10.13.250

Pinging 201.10.13.250 with 32 bytes of data:

Reply from 201.10.13.250: bytes=32 time<1ms TTL=127
Reply from 201.10.13.250: bytes=32 time<1ms TTL=127
Reply from 201.10.13.250: bytes=32 time<1ms TTL=127
Reply from 201.10.13.250: bytes=32 time<1ms TTL=127

Ping statistics for 201.10.13.250:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.6.4: Cyberlab Building PC Ping to Building 2 PC[**Successful**]*

```
C:\>ping 201.10.12.140

Pinging 201.10.12.140 with 32 bytes of data:

Reply from 201.10.12.140: bytes=32 time<1ms TTL=128
Reply from 201.10.12.140: bytes=32 time<1ms TTL=128
Reply from 201.10.12.140: bytes=32 time<1ms TTL=128
Reply from 201.10.12.140: bytes=32 time<1ms TTL=128

Ping statistics for 201.10.12.140:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.6.5: Cyberlab Building PC Ping to R&D Building PC[**Successful**]*

```
C:\>ping 201.10.15.10

Pinging 201.10.15.10 with 32 bytes of data:

Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126
Reply from 201.10.15.10: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.6.6: Cyberlab Building PC Ping to Email Server PC[**Successful**]*

```
C:\>ping 201.10.15.11

Pinging 201.10.15.11 with 32 bytes of data:

Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126
Reply from 201.10.15.11: bytes=32 time=1ms TTL=126
Reply from 201.10.15.11: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.6.7: Cyberlab Building PC Ping to DNS Server PC[**Successful**]*

```
C:\>ping 201.10.15.16

Pinging 201.10.15.16 with 32 bytes of data:

Reply from 201.10.15.16: bytes=32 time=1ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126
Reply from 201.10.15.16: bytes=32 time=16ms TTL=126
Reply from 201.10.15.16: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 16ms, Average = 4ms
```

*Figure 5.1.6.8: Cyberlab Building PC Ping to Web Server PC[**Successful**]*

```
C:\>ping 201.10.15.13

Pinging 201.10.15.13 with 32 bytes of data:

Reply from 201.10.15.13: bytes=32 time<1ms TTL=126
Reply from 201.10.15.13: bytes=32 time=1ms TTL=126
Reply from 201.10.15.13: bytes=32 time=1ms TTL=126
Reply from 201.10.15.13: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.15.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.6.9: Cyberlab Building PC Ping to DHCP Server PC[**Successful**]*

5.1.7 Via Farm Server

```
C:\>ping 201.10.10.10

Pinging 201.10.10.10 with 32 bytes of data:

Reply from 201.10.10.10: bytes=32 time=14ms TTL=126
Reply from 201.10.10.10: bytes=32 time<1ms TTL=126
Reply from 201.10.10.10: bytes=32 time<1ms TTL=126
Reply from 201.10.10.10: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.10.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 14ms, Average = 3ms
```

*Figure 5.1.7.1: Email Server PC Ping to Main Building PC[**Successful**]*

```
C:\>ping 201.10.14.10

Pinging 201.10.14.10 with 32 bytes of data:

Reply from 201.10.14.10: bytes=32 time<1ms TTL=126
Reply from 201.10.14.10: bytes=32 time<1ms TTL=126
Reply from 201.10.14.10: bytes=32 time<1ms TTL=126
Reply from 201.10.14.10: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.14.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.7.2: Email Server PC Ping to Branch Campus PC[**Successful**]*

```
C:\>ping 201.10.13.10

Pinging 201.10.13.10 with 32 bytes of data:

Reply from 201.10.13.10: bytes=32 time<1ms TTL=126
Reply from 201.10.13.10: bytes=32 time<1ms TTL=126
Reply from 201.10.13.10: bytes=32 time<1ms TTL=126
Reply from 201.10.13.10: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.13.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.7.3: Email Server PC Ping to Building 1 PC[**Successful**]*

```
C:\>ping 201.10.13.200

Pinging 201.10.13.200 with 32 bytes of data:

Reply from 201.10.13.200: bytes=32 time<1ms TTL=126
Reply from 201.10.13.200: bytes=32 time<1ms TTL=126
Reply from 201.10.13.200: bytes=32 time=1ms TTL=126
Reply from 201.10.13.200: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.13.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

*Figure 5.1.7.4: Email Server PC Ping to Building 2 PC[**Successful**]*

```
C:\>ping 201.10.12.200

Pinging 201.10.12.200 with 32 bytes of data:

Reply from 201.10.12.200: bytes=32 time<1ms TTL=126
Reply from 201.10.12.200: bytes=32 time<1ms TTL=126
Reply from 201.10.12.200: bytes=32 time=3ms TTL=126
Reply from 201.10.12.200: bytes=32 time=1ms TTL=126

Ping statistics for 201.10.12.200:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 3ms, Average = 1ms
```

*Figure 5.1.7.5:Email Server PC Ping to R&D Building PC[**Successful**]*

```
C:\>ping 201.10.12.10

Pinging 201.10.12.10 with 32 bytes of data:

Reply from 201.10.12.10: bytes=32 time<1ms TTL=126
Reply from 201.10.12.10: bytes=32 time<1ms TTL=126
Reply from 201.10.12.10: bytes=32 time<1ms TTL=126
Reply from 201.10.12.10: bytes=32 time<1ms TTL=126

Ping statistics for 201.10.12.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

*Figure 5.1.7.6: Email Server PC Ping to Cyberlab Building PC[**Successful**]*

6.0 MATERIAL

6.1 Bill of Material

The Bill of Material (BOM) is a thorough inventory of all the components, parts, and raw materials needed to execute a project or manufacture a product. It contains item, unit price, quantity, and amount. The BOM supports precise inventory management, cost estimates, and procurement procedures, which allows for seamless project execution and effective resource allocation. Table below shows the details of total cost for this project.

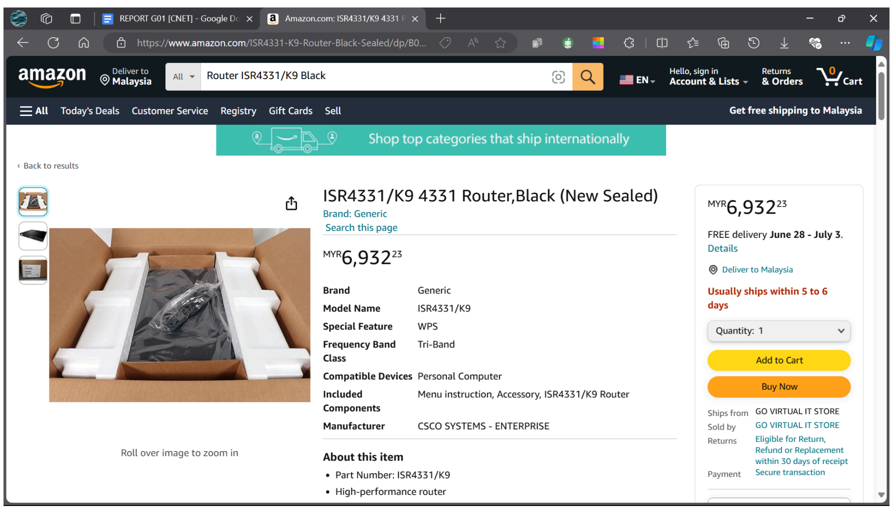
No.	**Item**	**Unit Price (RM)**	**Quantity**	**Amount (RM)**
1.	Cisco ISR 2991/K9 Routers	6 932.23	2	13.864.46
2.	WS-C3560-240S-S Cisco 3560 Switch (Multilayer Switch) (48 ports)	594.86	4	2379.44
3.	Cisco Catalyst 2960X-24TT-L Switches (24 ports)	1,500.00	15	22500.00
4.	Dell PowerEdge R540 (Server)	15,342.99	4	61,371.96
5.	Cisco GLC-SX-MMD (Fiber SFP Modules)	365.10	10	3651.00
6.	Cisco GLC-EX-SMD (Long-Range Fiber SFP Modules)	100.54	4	402.16
7.	Copper Straight Through Cable CAT 6 Flat Patch Cord LAN Cable Gigabit Ethernet Cable 10G RJ45 UTP (5m)	5.45	300	1635.00
			Subtotal :	**105,804.02**

Table 6.1 Bill Materials For This Project

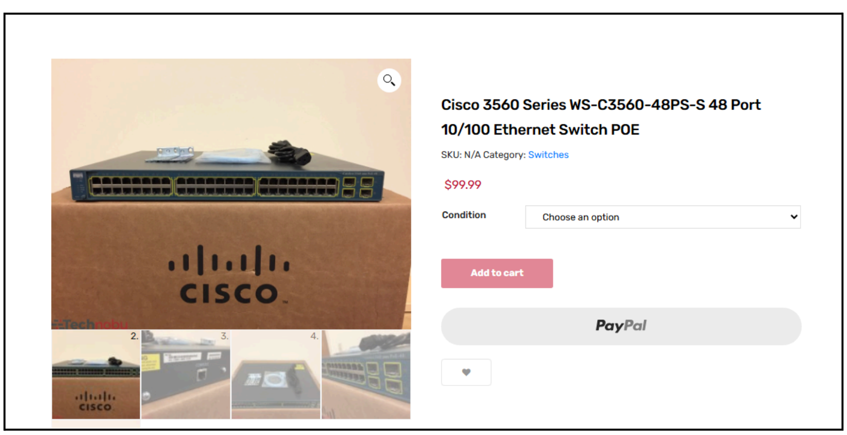
The total of this project is RM 105,804.02 that consists of the items needed for this project. The subtotal that shown in the bale are not included with the total of PCs that will be connected with the interfaces. An amount of 1,500,000.00 will be used to use the PC needed as the interfaces in this project. Total of 360 PCs from each building will be used as a budget for this project. The table 6.1 showed 2 Cisco ISR 2991/K9 Routers with a total RM 13.864.46 and each RM 6 932.23. The WS-C3560-240S-S Cisco 3560 Switch, a multilayer switch that consists of 48 ports with an amount of 4 and the total is RM 2379.44 with each of them is RM 594.86. Next, Cisco Catalyst 2960X-24TT-L Switches, a single switch with 24 ports on it and amount of 15 and the total price is RM 22500.00 with each of them is RM 1,500.00. The Dell PowerEdge R540, a server that will be used as a server farm in this project with an amount of 4 servers and total price of RM 61,371.96 and each of the servers cost RM 15,342.99. Furthermore, Cisco GLC-SX-MMD, a short fiber cable that will be used for Building 1 and Building 2 with 10 pieces of cables and total amount of this fiber is RM 3651.00. The long version of fiber cable, Cisco GLC-EX-SMD, with an amount of 4 and a total amount of RM 402.16. Lastly, a 5 meter long Copper Straight Through Cable CAT 6 Flat Patch Cord LAN Cable Gigabit Ethernet Cable 10G RJ45 UTP, that needs an amount of 300 pieces of it and the total amount of it is RM 1635.00.

Note : The price of the item listed might be different depending on the shop order and brand.

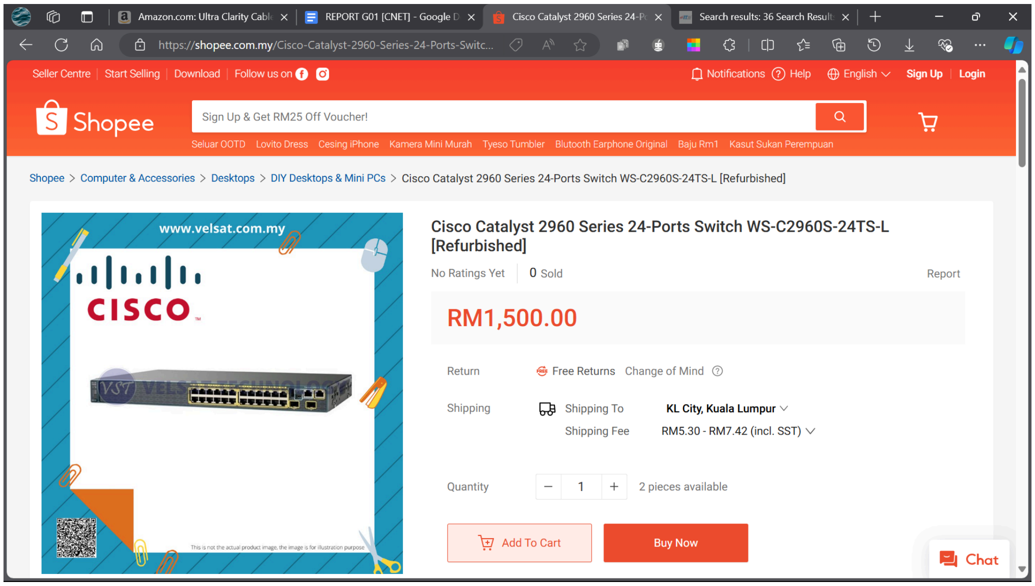
1. Cisco ISR 2991/K9 Routers



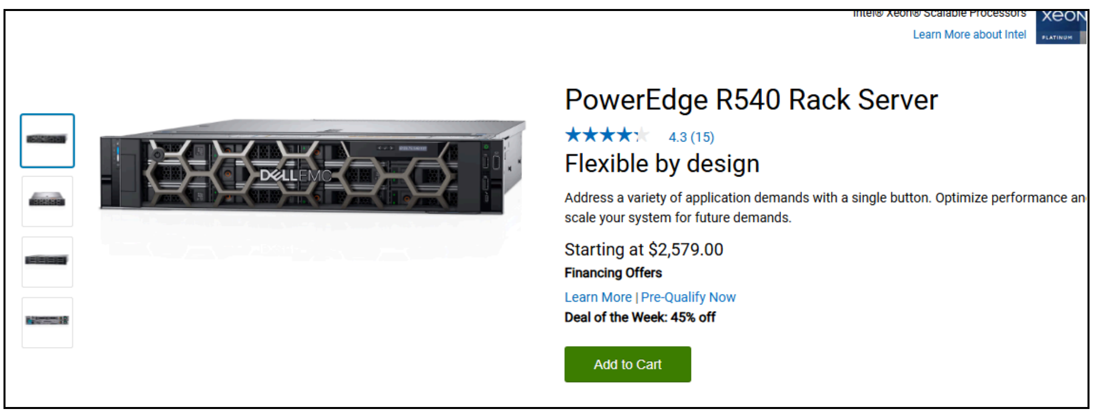
2. WS-C3560-240S-S Cisco 3560 Switch (Multilayer Switch) (48 ports)



3. Cisco Catalyst 2960X-24TT-L Switches (24 ports)



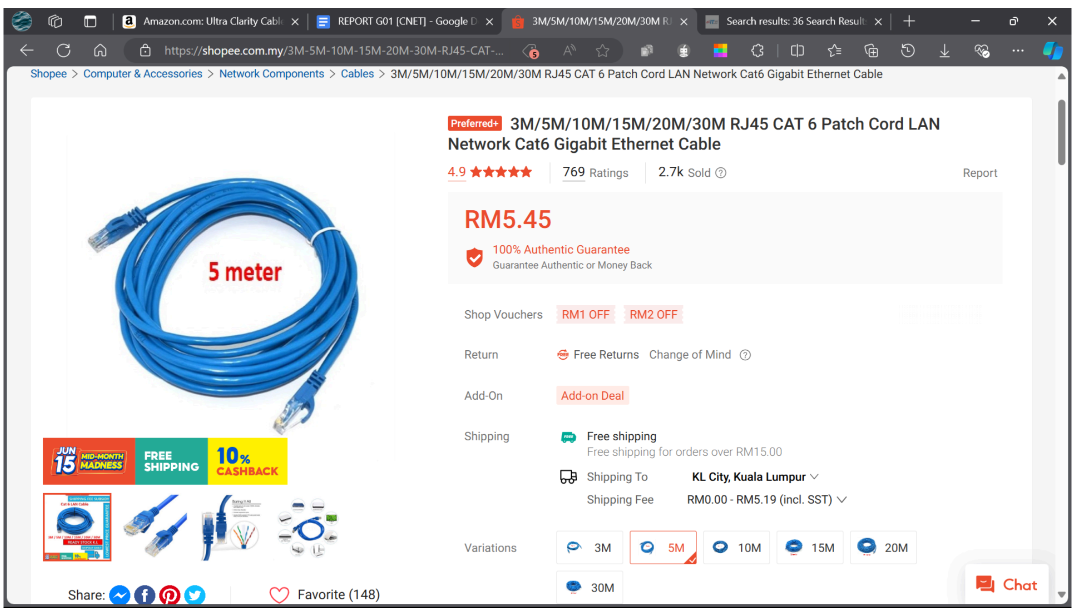
4. Dell PowerEdge R540 (Web Server)



5. Cisco GLC-SX-MMD (Fiber SFP Modules)

6. Cisco GLC-EX-SMD (Long-Range Fiber SFP Modules)

7. Copper Straight Through Cable CAT 6 Flat Patch Cord LAN Cable Gigabit Ethernet Cable 10G RJ45 UTP (5m)



7.0 REASONABLE BUDGET TO IMPLEMENT THE PROJECT

By using an optimum amount of items listed in the bill materials, the budget to implement this project is reasonable as the subtotal of the bill materials is only RM 105,804.02. The amount of the subtotal can be deducted by the cost for paying a professional person to plugin in and connect the interfaces. This energy can be obtained by the staff from the IT department with a professional guide and help from the outer staff, the total budget might be increased to almost RM 300,000. The outer staff will be paid with a range RM 3,000 TO RM 4,500 each of them.

An additional item that is reasonable to be added in the bill materials is the All-in-One PC that will be placed in each building. Totals of 360 PCs will be needed with a suitable amount of the PCs for each building according to the amount of the users. The subtotal will be around RM 1,050,000.00 after the implementation and the addition of the PCs in the bill materials. This amount of PCs will be used by the students time by time and everyday which is reasonable to be added as the items needed in the bill materials. However, as the time passed, eac student already had their own gadget such as phone, tablets and laptop instead of using the PCs provided. This is giving a bonus to saving the budget from the amount of budget needed to do a regular check up on the PCs. Therefore, in the future, the budget was reasonable as it would be used for a long time in a range of 3 to 6 years ahead.

REFERENCES

1. Cisco 3560 Series WS-C3560-48PS-S 48 Port 10/100 Ethernet Switch POE – Technobu. (n.d.). https://www.technobu.com/product/ws-c3560-48ps-s/

2. PowerEdge R540 Rack Server | Dell USA. (n.d.). Dell. https://www.dell.com/en-us/shop/dell-poweredge-servers/poweredge-r540-rack-server/spd/poweredge-r540/pe_r540_tm_vi_vpq1

APPENDIX

Address Range	Group #	Group Members
201.10.10.0, 201.10.11.0,	1	1. NURALYANA MAISARA BINTI NOORISHAM 2. NURUL NABILAH BINTI SUHUD 3. SITI NUR SYUHADAH BINTI ARIFIN 4. TUAN KHALIDAH SYAZWANA BINTI TUAN MOHD KASMAWI
201.20.20.0, 201.20.21.0	2	
201.30.30.0, 201.30.31.0	3	
201.40.40.0, 201.40.41.0	4	
201.50.50.0, 201.50.51.0	5	

201.60.60.0, 201.60.61.0	6	
201.70.70.0, 201.70.71.0	7	
201.80.80.0, 201.80.81.0	8	
201.90.90.0, 201.90.91.0	9	
201.100.100.0, 201.100.101.0	10	
201.110.110.0, 201.110.111.0	11	
201.120.120.0, 201.120.121.0	12	
201.130.130.0, 201.130.131.0	13	
201.140.140.0, 201.140.141.0	14	
201.150.150.0, 201.150.151.0	15	