DEPLOYING IPV6 IN A CAMPUS NETWORK

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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DHAKA, BANGLADESH

DECEMBER 2019

APPROVAL

This Project/internship titled **"Deploying Ipv6 in a Campus Network"**, submitted by Abdullah Al Noman, ID No: 161-15-7427 and Arafat Chowdhury, ID No: 161-15-7522 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on December 2019.

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Narayan Ranjan Chakraborty, Assistant professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ACKNOWLEDGEMENT

First, we express our heartiest thanks and gratefulness to the almighty Allah for His divine blessing makes us possible to complete the final year project successfully.

We really grateful and wish our profound our indebtedness to **Narayan Ranjan Chakraborty**, **Assistant professor**, Department of CSE Daffodil International University, Dhaka. Deep Knowledge & keen interest of our supervisor in the field of "*Deploying ipv6 in a campus network*" to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project.

We would like to express our heartiest gratitude to **Dr. Syed Akhter Hossain,** Head**,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

We would like to thank our entire course mate in Daffodil International University, who took part in this discuss while completing the course work.

Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

With the rapid development of computer network, the construction of campus network is the inevitable choice of the development of information network. The campus network system is a very large and complicated system. It is not only for modern teaching, integrated information management and office automation series of applications to provide basic operating platform, but also to provide a variety of application services, so that information can be timely and accurate delivery. The campus network construction in the application of network technology is the important branch of LAN technology to build and management. This report shows the deployment of ipv6 in a campus network with network technology, network equipment selection and so on, and gives the concrete network topology diagram and implementation of the secure campus area network.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The Internet has experienced a phenomenal increase of devices accessing the Internet. Because of this increase, IPv4 addresses are running out. So, we want to deploy IPv6 in a campus network to accommodate this increased demand by providing a much larger address space, along with improved traffic routing and better security. We are currently on Internet Protocol version 4, or IPv4, but IPv6 will be the next generation protocol for Internet communication.

1.2 Motivation

We are moving toward the IPv6 gradually. So, we need to learn how it will be implemented in campus network. This project will help us to do that. This project will also be the standard guideline for those who wants to deploy IPv6 in their network in near future.

1.3 Objectives

- Study: Structure and Components of campus network.
- Case analysis.
- Case design.
- Sketch the design of our campus network.
- Create the network diagram in Packet Tracer and GNS3 with needed appliances.
- Ip planning for the designed campus network.
- Protocols choose.
- Implement the planned Ip addresses and protocols in campus network diagram.
- Test the network.

1.4 Expected Outcome

After completing the project, the campus network will be enabled. All devices will up and can share their information to each other. Data packets will be sent from one to another. Admin can create domain from DNS server. Hosts can browse via http server, can send Email via Email server, can create, save, download, read, write, edit or delete any file from Ftp server.

1.5 Report Layout

In this report, we will write about background, requirement specification, design specification, implementation with testing and conclusion with future scope. In background study, we will discuss about the related works like our project, scope of the problem and challenges for our project. In requirement specification, we will discuss about the requirement collection and analysis that where actually we learn about our project requirement to implement and design requirements. In design specification, we will discuss about front-end, back-end design for our project and requirements for implementing the project. In implementation and testing, we will discuss about how we implement ip, protocols in our project, will discuss the testing after implementation and will also discuss about the test result. After all of that we will discuss about our project future scope.

CHAPTER 2

BACKGROUND

2.1 Introduction

Web innovation started to spread in the grounds, the Internet and our grounds life has been firmly connected together. As a ground to develop the gifts of the century, to accomplish organize the executives, instructing is significant. So, the campus network is a very interactive and professional LAN. Multimedia teaching software development platform, multimedia presentation classrooms, teacher preparation system, library access system, test database, etc., can work through the network. If a university includes a number of professional disciplines, we can also form a number of local area networks, and through wired connection.

2.2 Related Works

As far as our study about deployment on ipv6 in a campus network, there is no such project done in campus network by using ipv6 address before but there are lots of studies, journals and research happens about it. What is to learn, how to plan for designing, what protocols should be used are discussed on those research and study [1-6].

Feasibility Study

The feasibility study of any system is mainly intended to study and analyzed the proposed system and to decide whether the system under consideration will viable or not after implementation. That is, it determines the usability of the project after deployment. Ipv4 ip addresses have shorter address space which is already running out. Nearly, incoming years we must switch to ipv6 ip address. So, we think this is an important project we choose which will impact the campus network future. Some question is being answered about the efficiency of our project. The questions came to our mind when we thought about our project was:

- Why choosing a campus network?
- What resources are available for the proposed system? Is it worth solving the problem?
- What will be the impact after completing the project? i.e. will it be fitted for the campus network?

Thus, since the practicability study could result in commitment of enormous resources, it becomes necessary that it ought to be conducted ably and no elementary errors of judgment square measure created.

2.3 Scope of the problem

Internet Protocol Version 4 (IPv4) ip addresses are being used everywhere but the biggest problem is its shorter ip addresses (32 bits only) are already running out. To find out the solution, Ipv6 ip addresses was invented but not yet implemented widely. So, we think it is a great scope to switch ipv6 and deploy the new address in campus area network.

2.4 Challenges

There are so many challenges for completing the project [7] [8]. The challenges are given below:

- Designing the campus network.
- Planning and implementing the correct ipv6 addresses for the campus.
- Connectivity of the network.
- Security of the campus.

CHAPTER 3
REQUIREMENT SPECIFICATION

3.1 Introduction

Requirement of a project is mainly the resources that is going to need for doing the project. If we want to make a project then after studying about the project sides we must need to look after the project requirements that is going to need for completing the project.

3.2 Requirement Collection and Analysis

To know about the requirements that our project going to need, we talked with Daffodil International University's IT control admin and visited the IT rooms. We gathered the knowledge we need from there and watched physically about the network device's placement and they worked. We are also studying CCNA (Cisco Certified Network Association) under an organization which almost completed. So, we gathered the basic knowledge and needy requirements from there first. For our campus network we need so many devices that's are router, switch, pc, laptop, printer, server and so many. So, it is important that how the devices act, need to configure and work. We learned about those devices that requires for our campus network and we have that confident to do that properly [9].

3.3 Design Requirements

For the design of our project, we use Cisco Packet Tracer and GNS3 where both are a simulator. We'll make a prototype by using those simulators. We need to download those simulators from their specific websites. Cisco Packet Tracer is an environment created by Cisco where all cisco appliances we can use and for free where GNS3 is also an environment that allows the combination of virtual and real devices, used to simulate complex network. But, in GNS3 not all Cisco appliances for free and those are not free

are expensive enough that we can't afford. So, most of our work will be shown in Packet Tracer [10] [11].

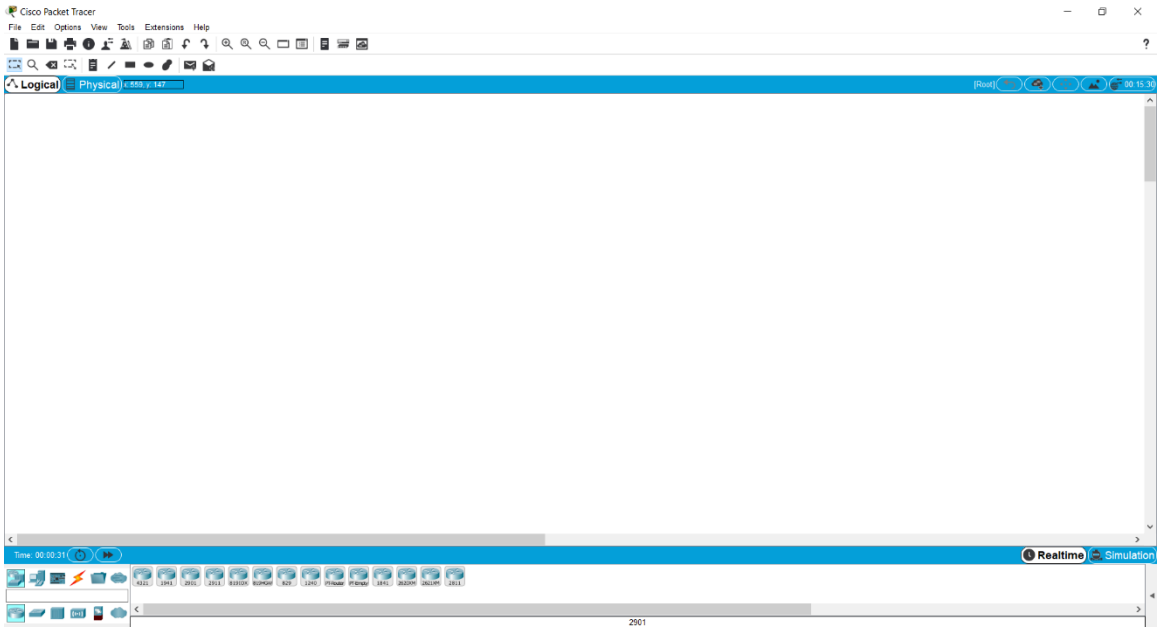

Figure 3.1: Cisco Packet Tracer Simulator

The figure 3.1 is the outlook of cisco packet tracer where we're going to make our campus network prototype.

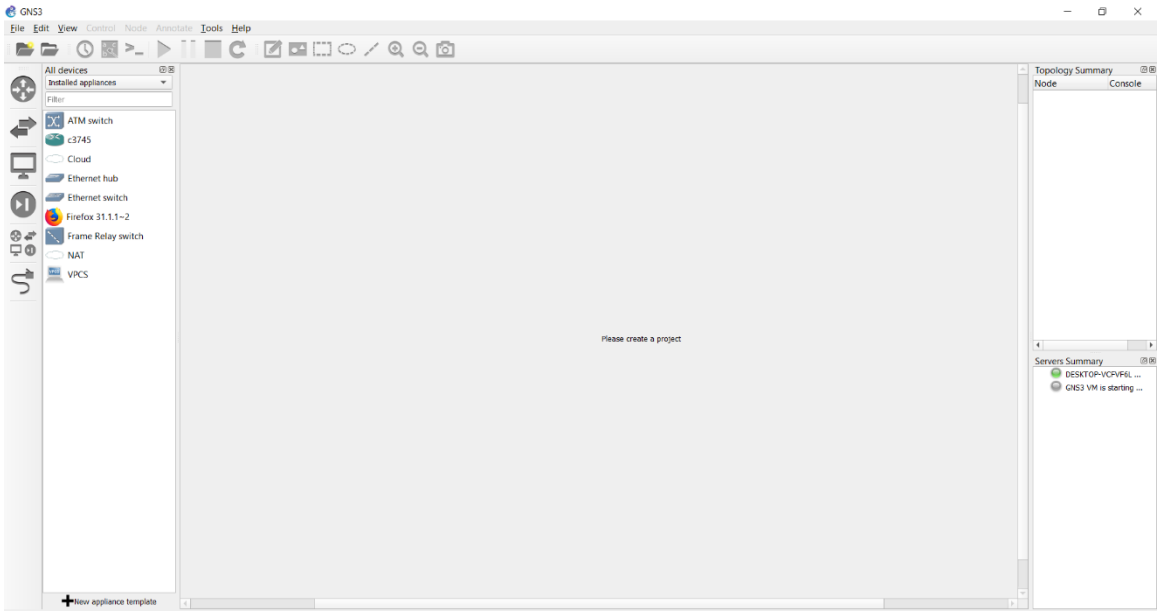

Figure 3.2: GNS3 Simulator

The figure 3.2 is the outlook of GNS3 simulator. We also make our campus network prototype besides cisco packet tracer.

CHAPTER 4
DESIGN SPECIFICATION

4.1 Introduction

In our campus network design, there is one Server building, one Administrative building, three Faculty Buildings (FSIT, FBE and FHSS), three Study buildings (CSE, BBA and English) department basis, one Library building, one Canteen Building and one Dormitory building. Total of five Cisco routers are connected between the buildings to establish the network inside the campus network. We use layer 2 switch in every building that's are connected with the router and the hosts of the buildings. We design serval server for our campus network which will provide http, https, dns, ftp, email service inside the campus. All devices are connected with different type of wires. We use serial interfaces from router to router, gigabit ethernet and fast ethernet interfaces from router to other devices. After configuring the network, the packet will pass from the source to destination via interfaces.

All buildings are in a single area network and internal network. We design an external network which is bounded with firewall for security from external attack and that is the internet or ISP.

4.2 Front-end Design

After studying and learning about ipv6, we design a small campus network diagram for our project with proper Ipv6 address plan.

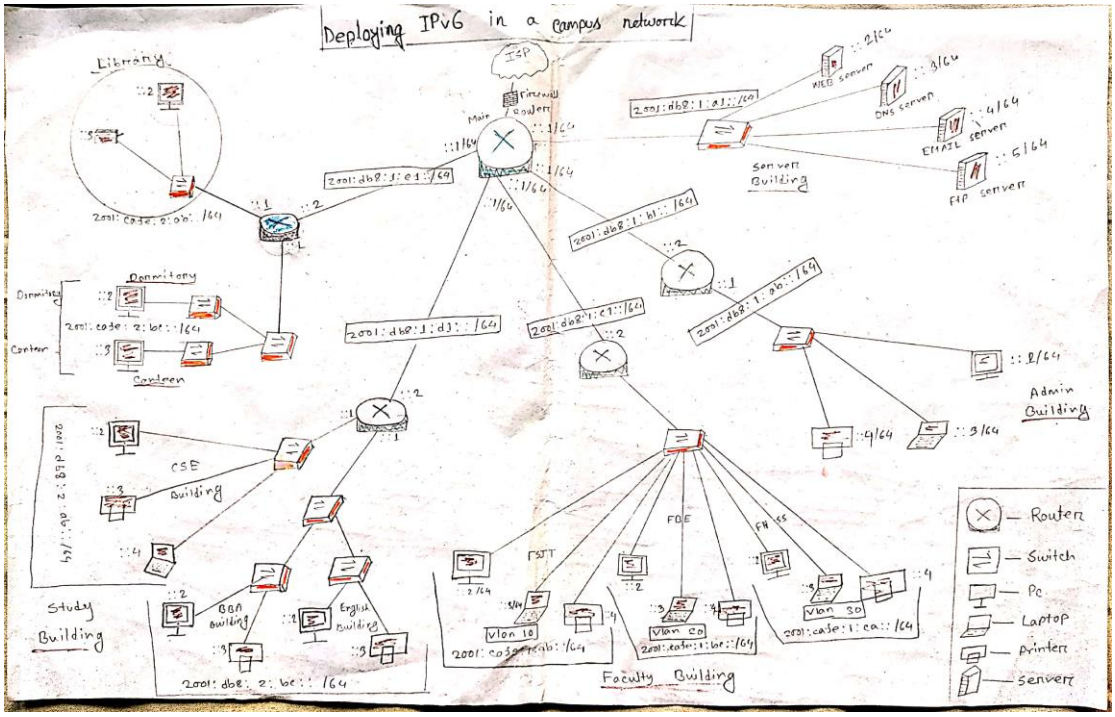

Figure 4.1: Sketch Design

The figure 4.1 is the sketch design of our campus network. This is the complete design of our campus where we're trying to show all the necessary components with proper ipv6 address plan.

We use router, switch, server, pc, laptop, camera, firewall and internet to design the campus network into simulator. The appliances are shown in the figure 4.2 below:

Figure 4.2: Appliances for Design

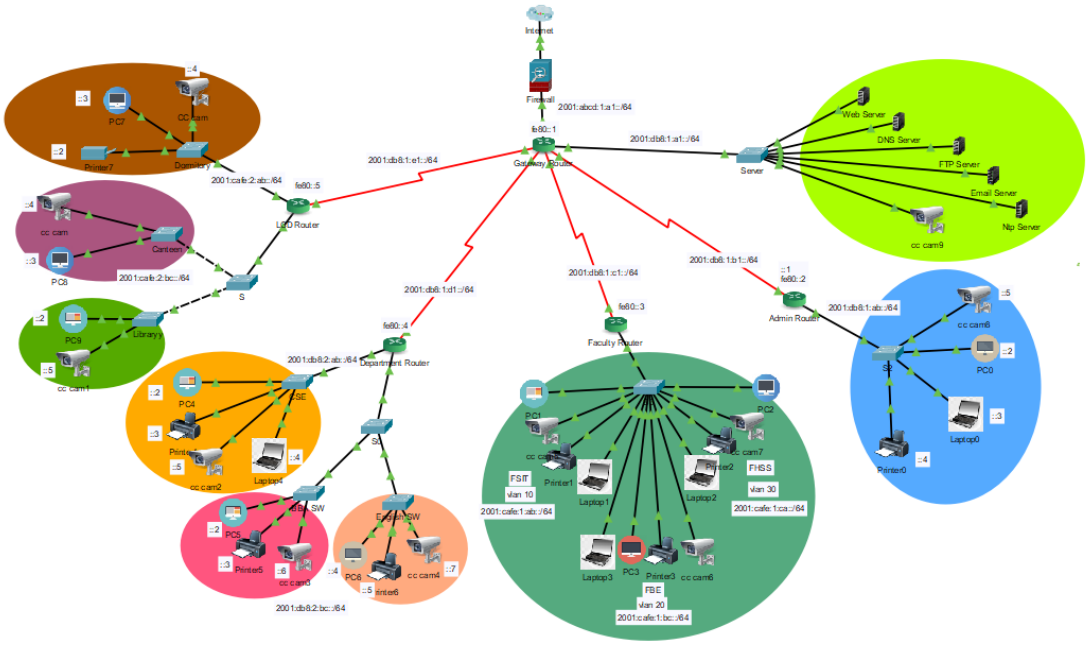

Figure 4.3: Campus Network Design in Packet Tracer

The figure 4.3 is the final and complete design of our campus network which we designed into packet tracer with needed components and ipv6 address.

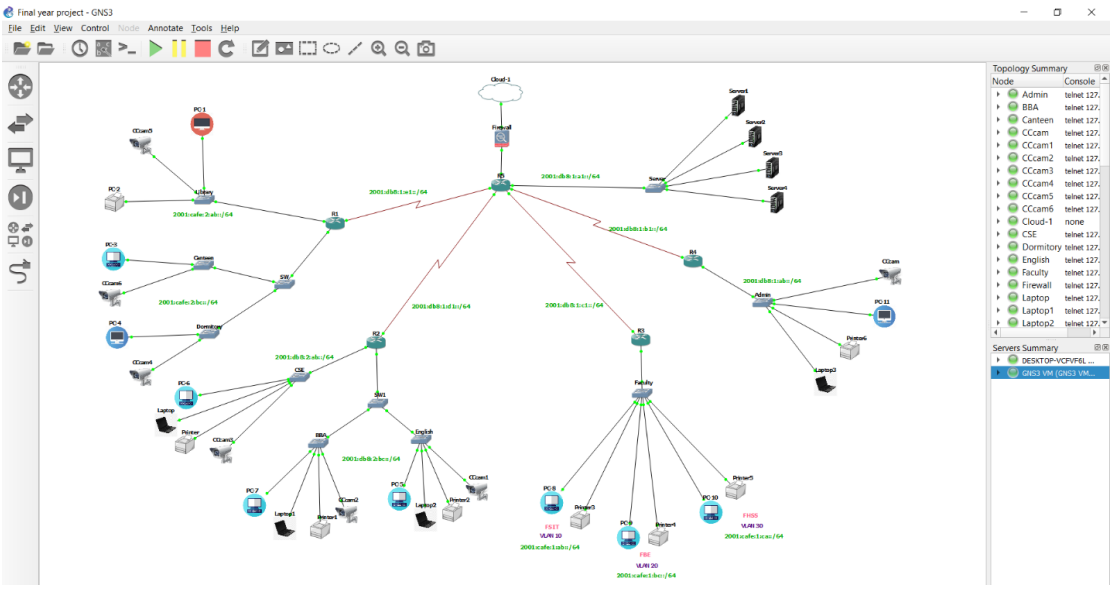

Figure 4.4: Campus Network Design in GNS3

The figure 4.4 is the final and complete design of our campus network which we designed into GNS3 simulator.

4.3 Back-end Design

Back-end design is the design where we will configure our commands and protocol. Next few figures will show the back-end design of different devices we use.

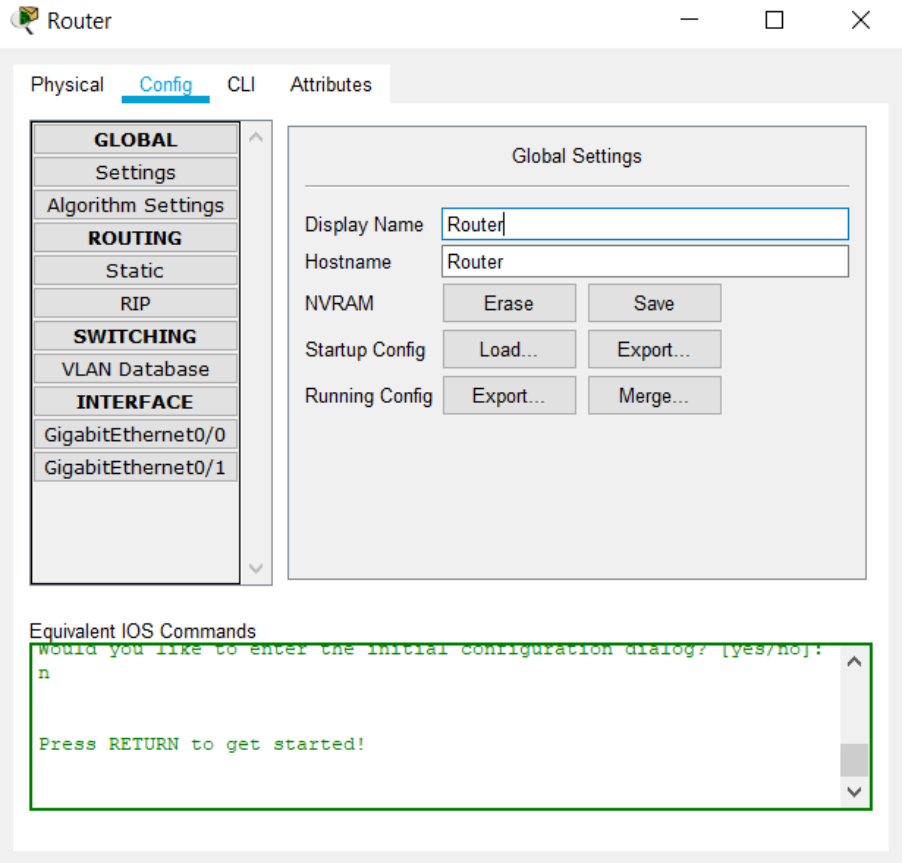

Figure 4.5: Back-end of a Router and Switch

The figure 4.5 is the back-end design of a router and switch. Here we can configure our router manually by giving commands.

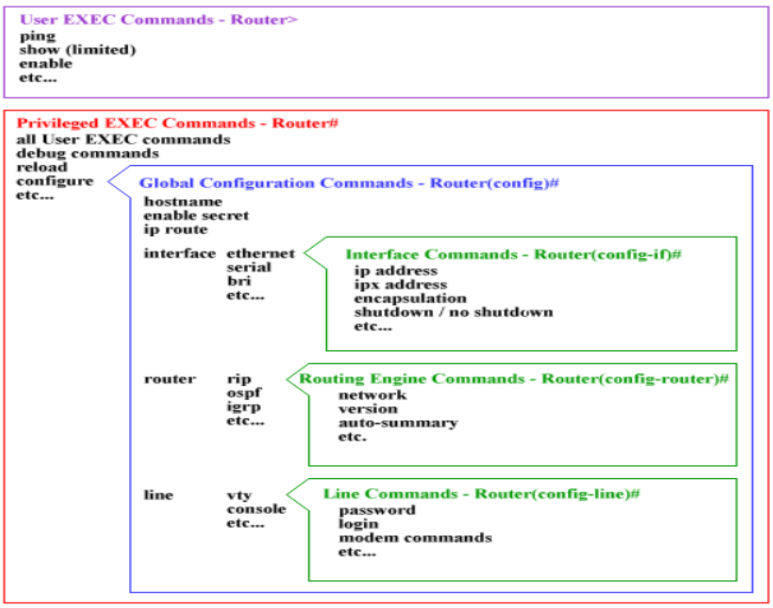

Figure 4.6: Cisco IOS Command Hierarchy [12]

The figure 4.6 is the figure of cisco ios command hierarchy. When we use command line in our router there are some mode of the command line we need to know.

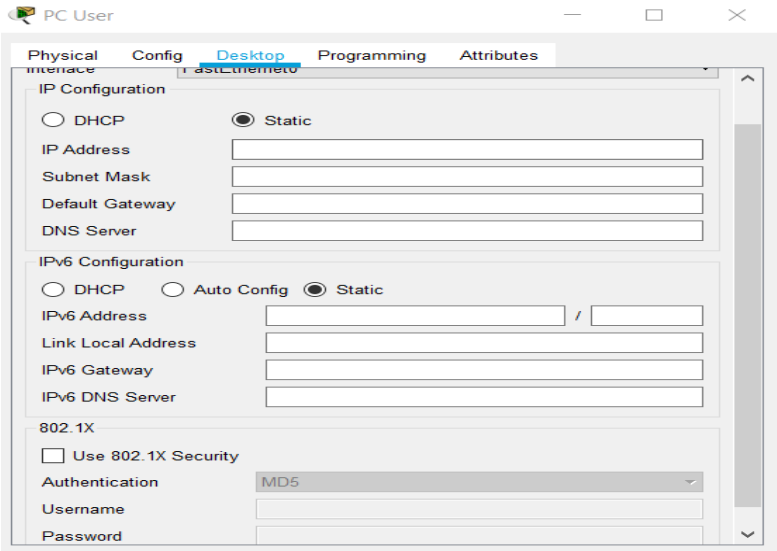

Figure 4.7: Pcs and Laptops Back-end

The figure 4.7 is the back-end design of pcs and laptops. Here we can configure the pcs and laptops by giving there ip address, gateway address and dns server address.

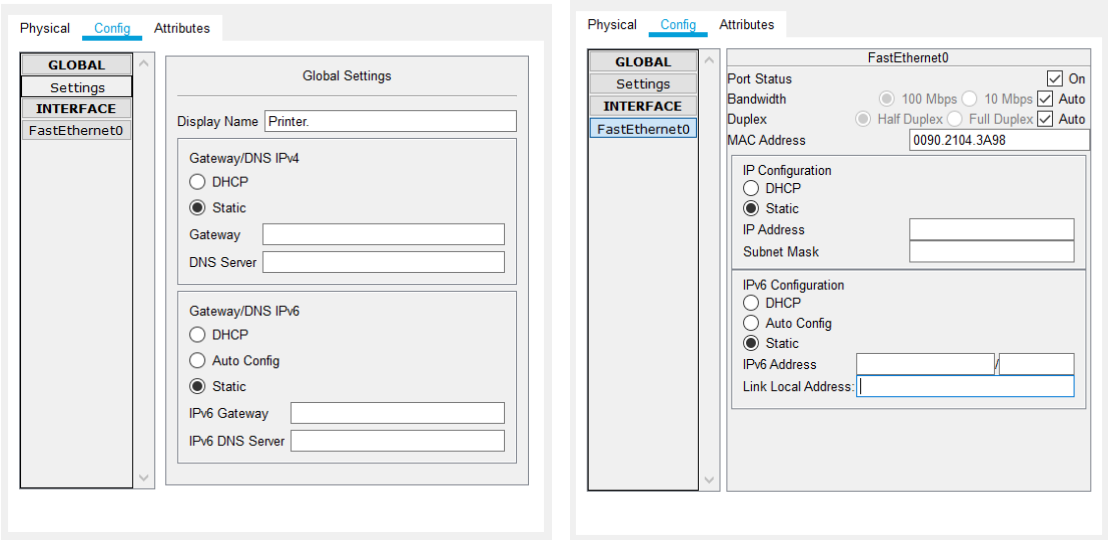

Figure 4.8: Printers Back-end

The figure 4.8 shows the back-end design of printers. Here we can configure our printer in the campus network by giving their ip address.

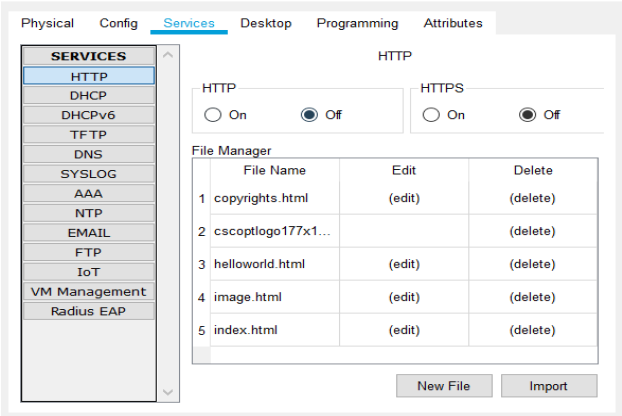

Figure 4.9: Servers Back-end

The figure 4.8 shows the back-end design of a server. Here we can configure the ip addresses and services of different servers.

Figure 4.10: Features of Back-end

The figure 4.10 is the back-end of packet tracer all features that we can use for our project.

4.4 Implementation Requirements

To implement the design, we also use packet tracer and gns3. We need to configure the ipv6 addresses, give the commands and use protocols for implementing.

CHAPTER 5
IMPLEMENTATION AND TESTING

5.1 Introduction

Implementation and testing are one of the most important part of our project. We have to configure all of the ipv6 addresses, protocols carefully and we need to verify and troubleshoot those after inserting. And after configuring, we have to test the whole campus network. If any error occurs then we must debug to solve the problem.

5.2 Implementation of Front-end Design

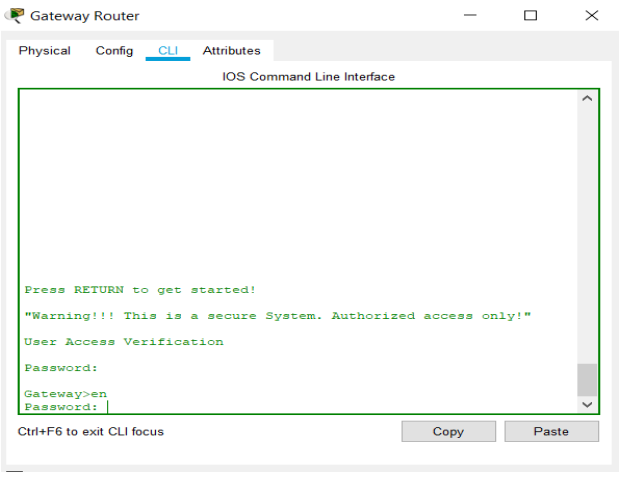

Figure 5.1: Enable password and banner to all routers

In figure 5.1, we configure the basic router settings. Set the router hostname, enable password for unauthorized access and set banner for a warning message.

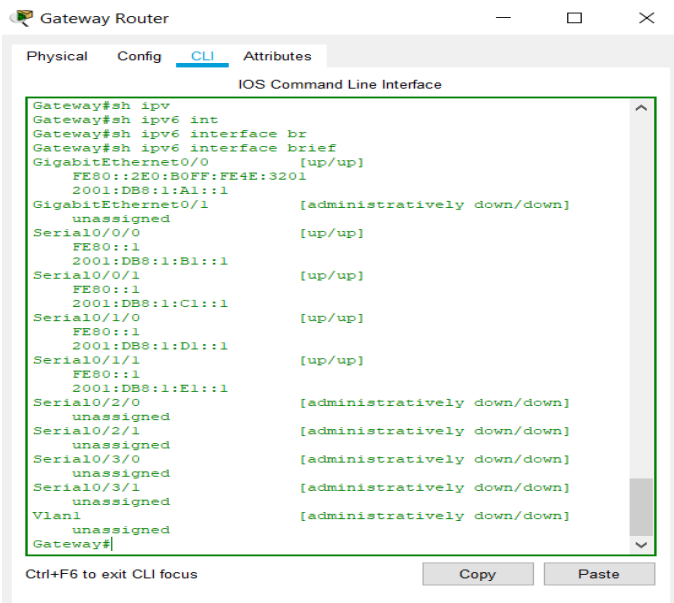

Figure 5.2: Ipv6 address to Gateway router

In figure 5.2, we already assigned the ipv6 address into all of the interfaces gateway router has and verifying the addresses with interfaces by using show ipv6 interface command.

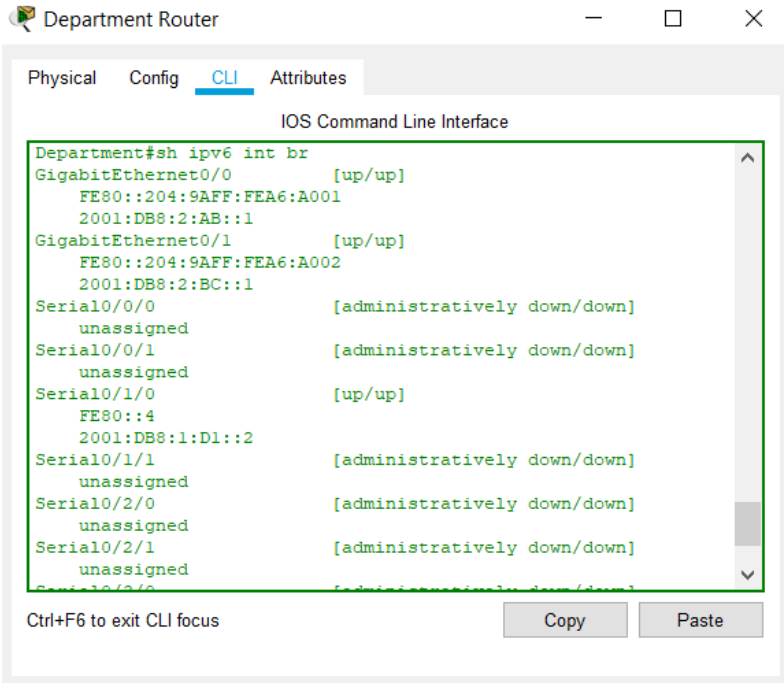

Figure 5.3: Ipv6 address to Study Building router

In figure 5.3, we already assigned the ipv6 address into all of the interfaces department router has and verifying the addresses with interfaces by using show ipv6 interface command

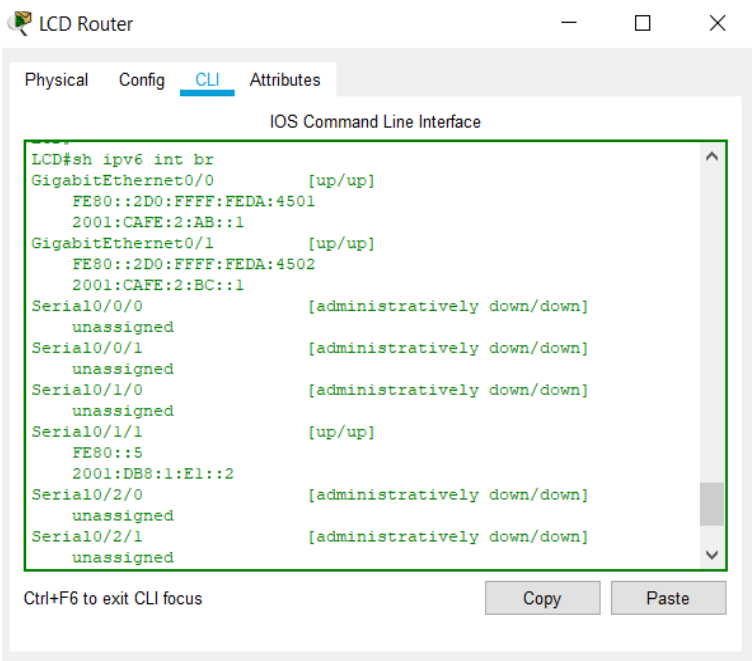

Figure 5.4: Ipv6 address to Library, Dormitory and Canteen Building router

In figure 5.4, we already assigned the ipv6 address into all of the interfaces LCD router has and verifying the addresses with interfaces by using show ipv6 interface command

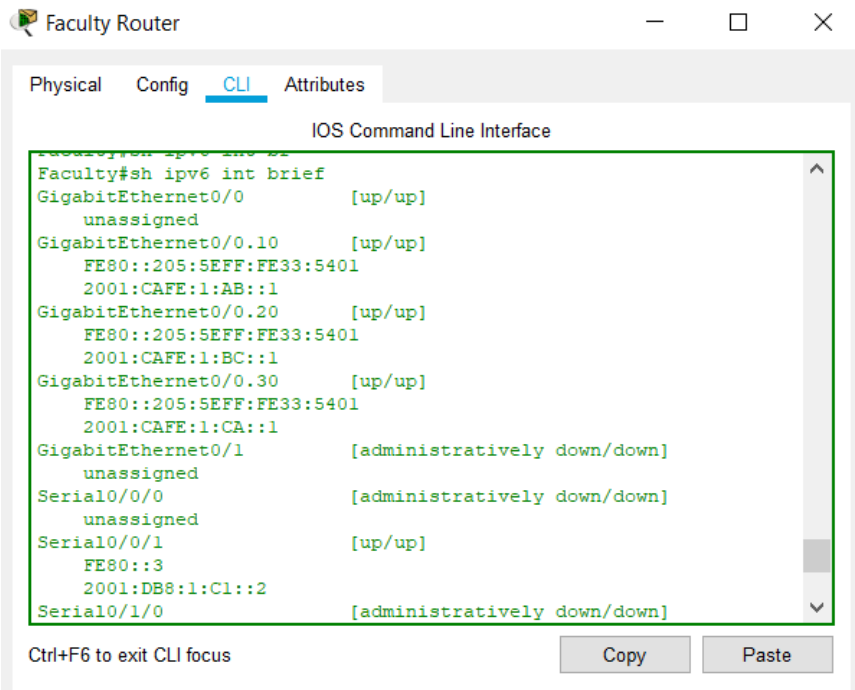

Figure 5.5: Ipv6 address to Faculty router with inter-vlan

In figure 5.5, we already assigned the ipv6 address into all of the interfaces faculty router has and verifying the addresses with interfaces by using show ipv6 interface command.

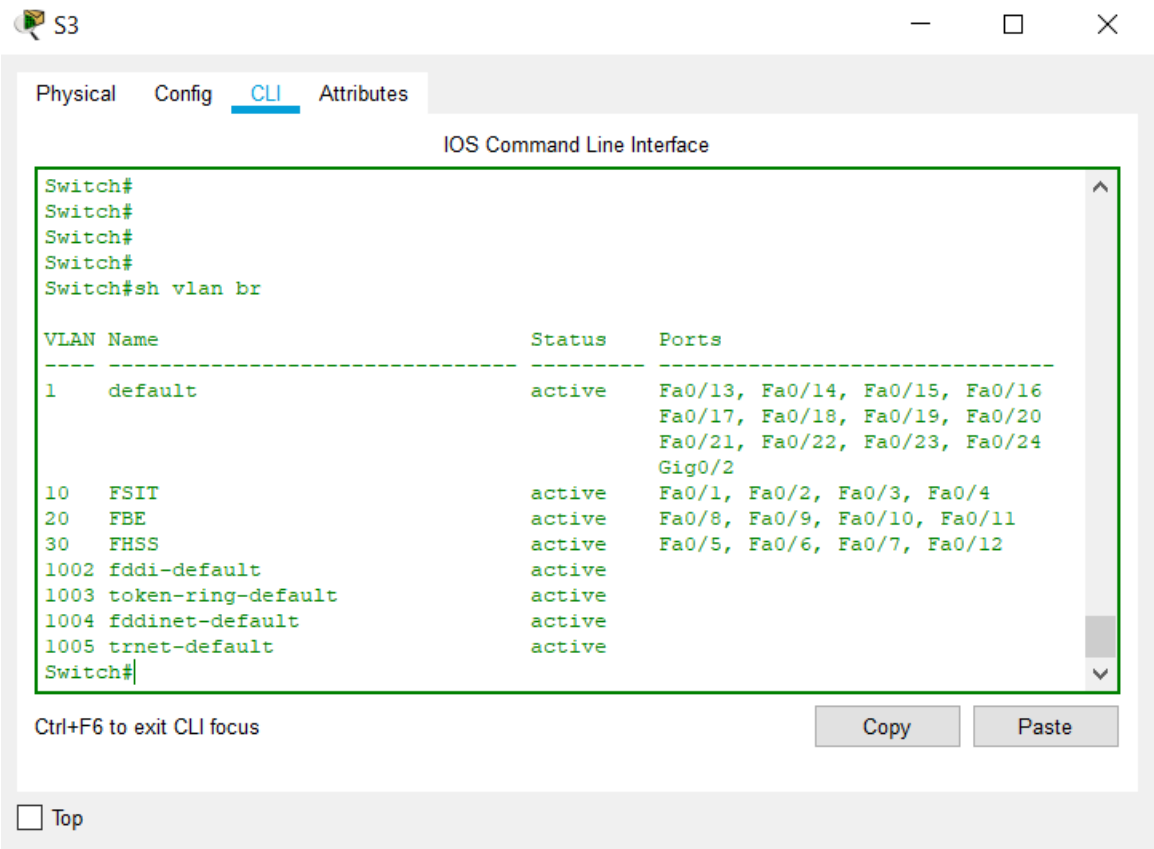

Figure 5.6: Create VLAN on Faculty Building switch

In figure 5.6, the vlan we created for inter-vlan routing and set the vlan into specific interfaces is shown.

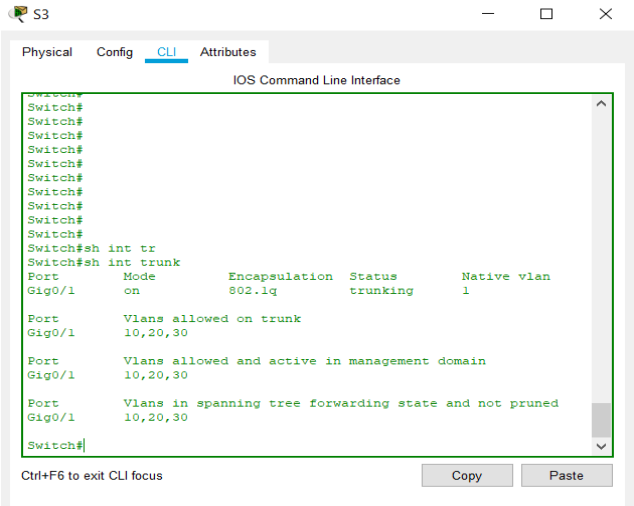

Figure 5.7: Trunk on Faculty Building VLAN switch

In figure 5.7, after activating the trunking mode we're verifying by using show interface trunk command.

Figure 5.8: Access VLAN to Faculty Building VLAN switch

The figure 5.8 shows that the separate vlans are assigned into specific interfaces.

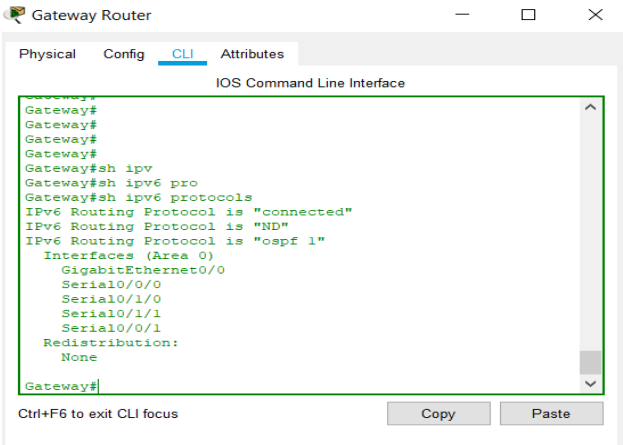

Figure 5.9: OSPF in Gateway router

In figure 5.9, we create OSPF in every router with OSPF ip 1 and considering the full campus area as area 0.

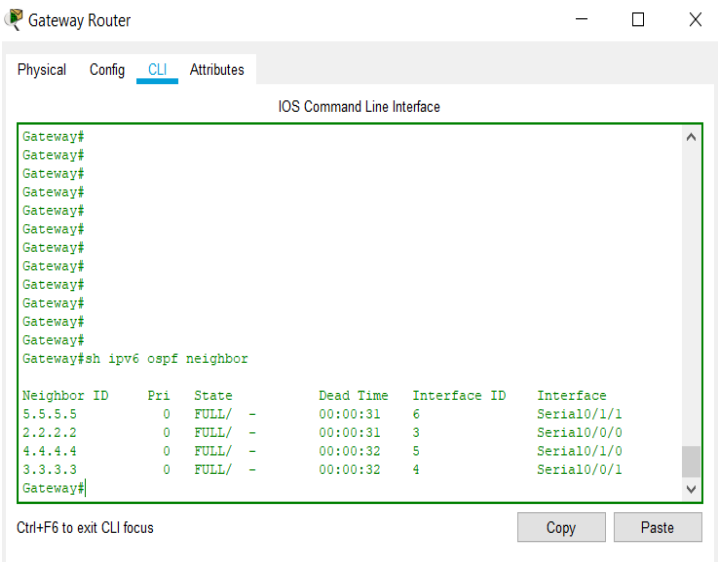

Figure 5.10: OSPF neighbors in Gateway router

By giving show ipv6 OSPF neighbor we can see the full neighbors which is configured manually by us in the router which is shown in figure 5.10.

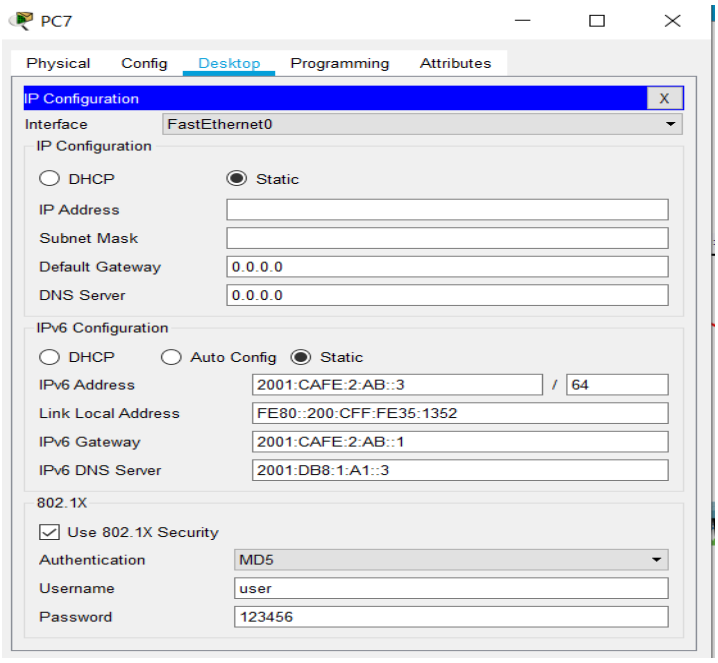

Figure 5.11: Ipv6 address to PC

In figure 5.11, this is the most likely configuration of all pcs and laptops. Here we need to assign the ipv6 address, gateway address and the DNS address. DNS server ip will be the same in every device. We also activate the MD5 authentication for security purpose.

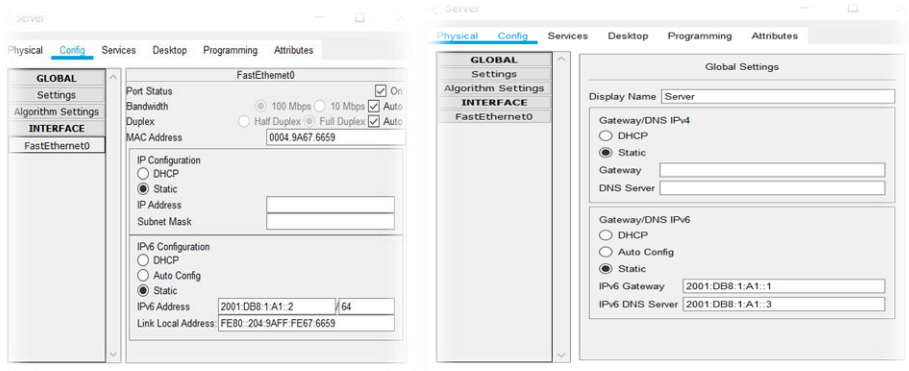

Figure 5.12: Ipv6 address to server

In figure 5.12, this is the most likely configuration of all servers. Here we need to assign the ipv6 address, gateway address and the DNS address. DNS server ip will be the same in every device.

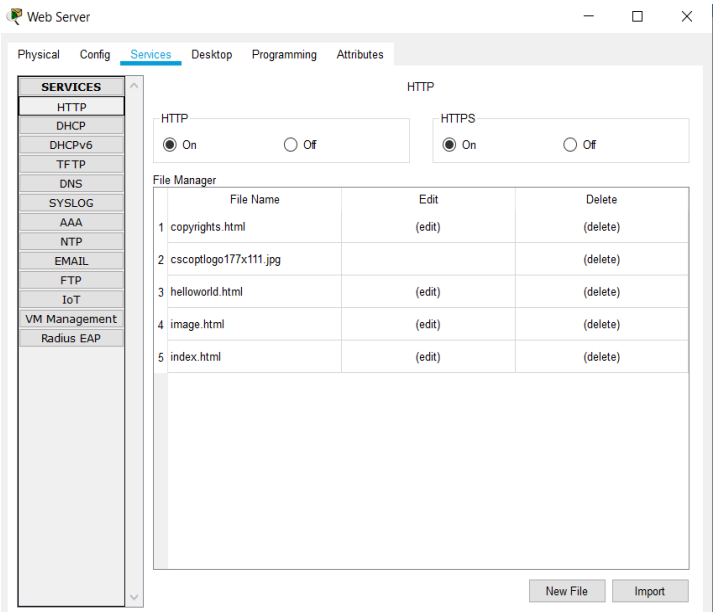

Figure 5.13: Web server setup

In figure 5.13, it is the figure of Web server where we need to turn on the http and https so that a host can tcp to web server. The files inside web server are html files. We can edit or delete those files when we need.

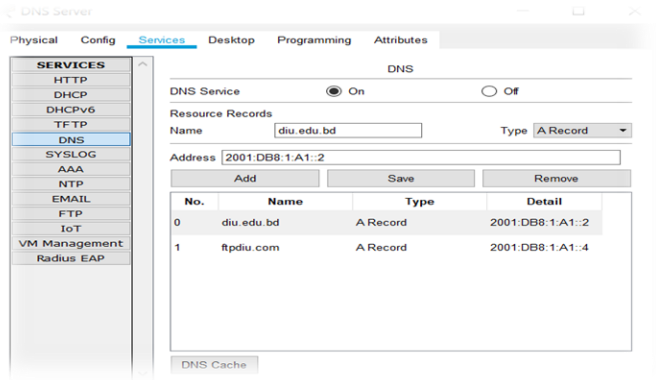

Figure 5.14: DNS server setup

In figure 5.14, it is the figure of DNS server where we need to turn on the DNS service. Here we can create a domain by giving the server address. All devices DNS address must be the same. Host can browse by using domain name instead of ip address.

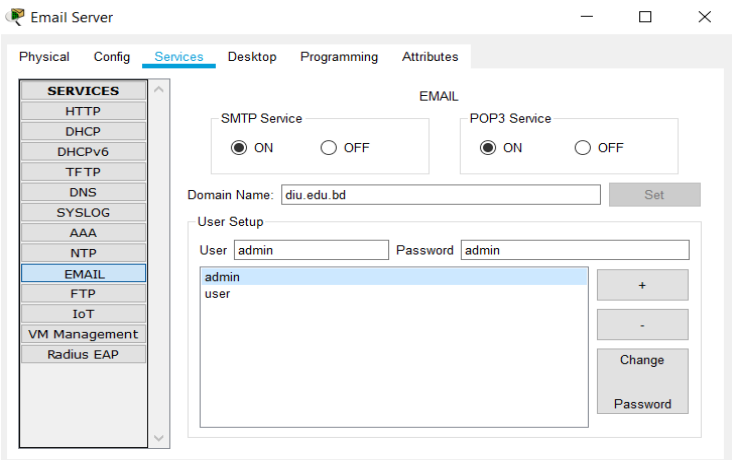

Figure 5.15: EMAIL server setup

In figure 5.14, it is the figure of Email server where we can set a domain and create user and password. User can easily maul each other by config the user id.

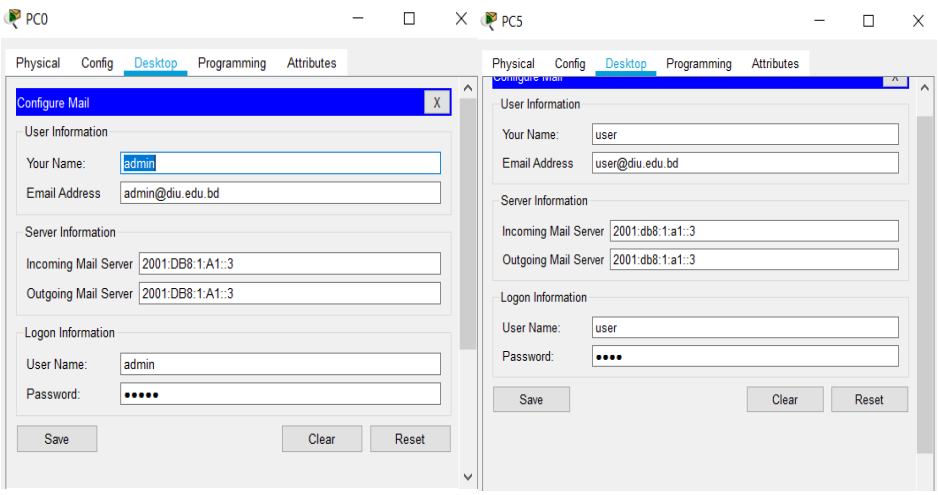

Figure 5.16: Configure EMAIL server in two hosts

This is the figure where admin building host pc0 and Study building host pc5 configuring mail address by using diu.edu.bd domain and user and password which are set into Email server previously. After configuring mail successfully both hosts can send mail to each other.

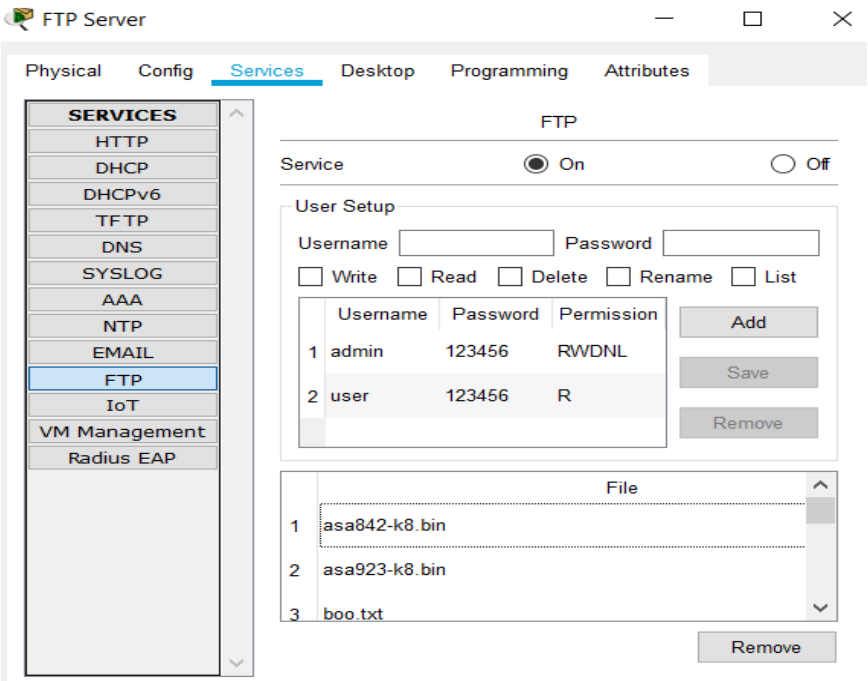

Figure 5.17: FTP server setup

This is the figure of Ftp server where we need to turn on the FTP then, create username and password and give access where the user can write, read, delete, rename, access or list the FTP files.

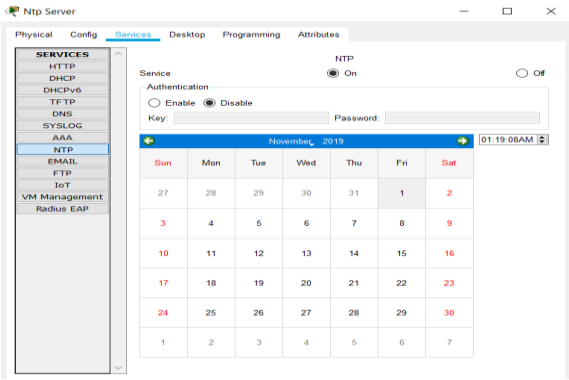

Figure 5.18: NTP server setup

The figure 5.18 is a NTP server. First we need enable it and then the other setup.

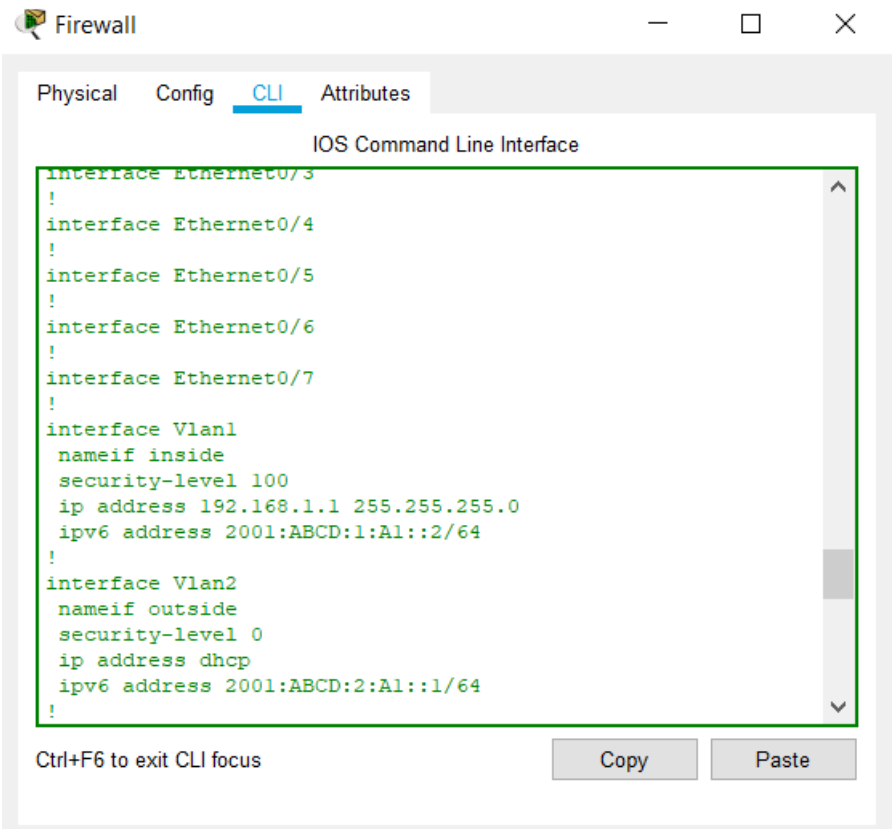

Figure 5.18.1: Firewall setup

The figure 5.19 is showing the configuration of cisco ASA firewall Firewall protects the inside network from any kind of attack or unauthorized access which can come from the outside network or the internet. For the inside network that is campus network, security level is 100 and we don't need to secure the outside network so its security level is 0.

5.3 Testing Implementation

Testing connectivity from one source host to another destination host

For testing the connectivity, we use ping and tracert.

Ping is test method of checking the computer is connected. It also determines the latency and or delay between two hosts. If the ping between two hosts are successful then we can easily understand that packet or data can transfer [13].

Ping command: ping 2001:db8:1:a1::1[destination host ip address]

Traceroute is also a method for testing the connectivity between two hosts. It shows several details about the path that a packet takes from the device we are on to whatever destination we specify [14].

Traceroute command: tracert 2001:db8:1:a1::1[destination host ip address]

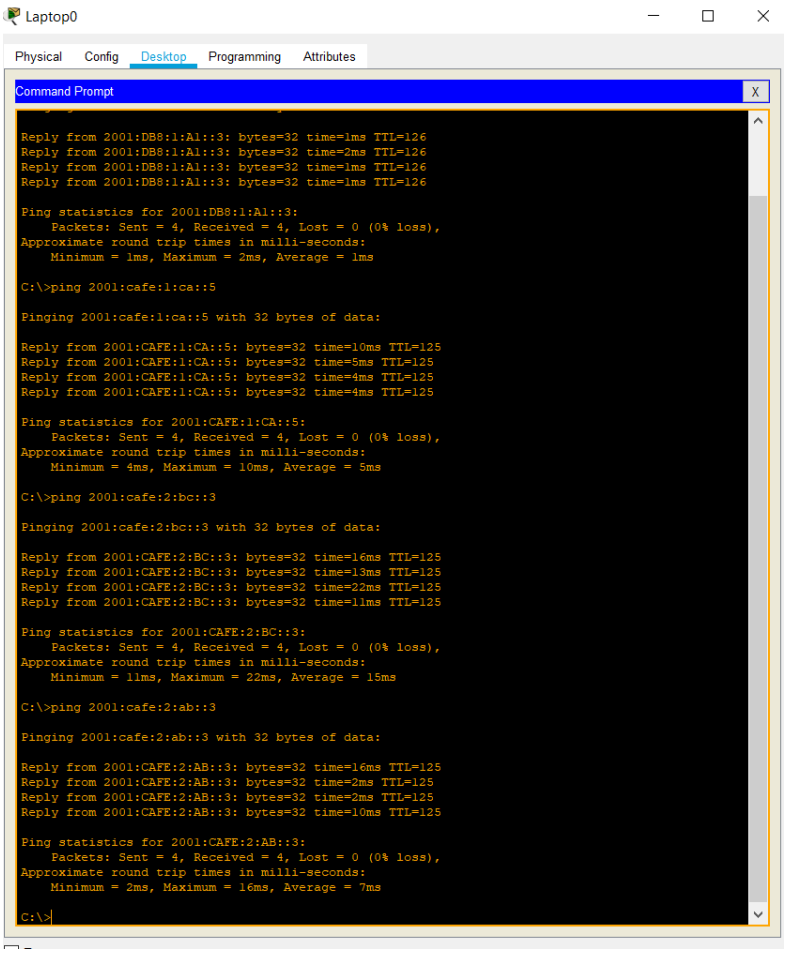

Figure 5.19: Ping test 1

This figure shows that this is a ping test from admin building host to other networks.

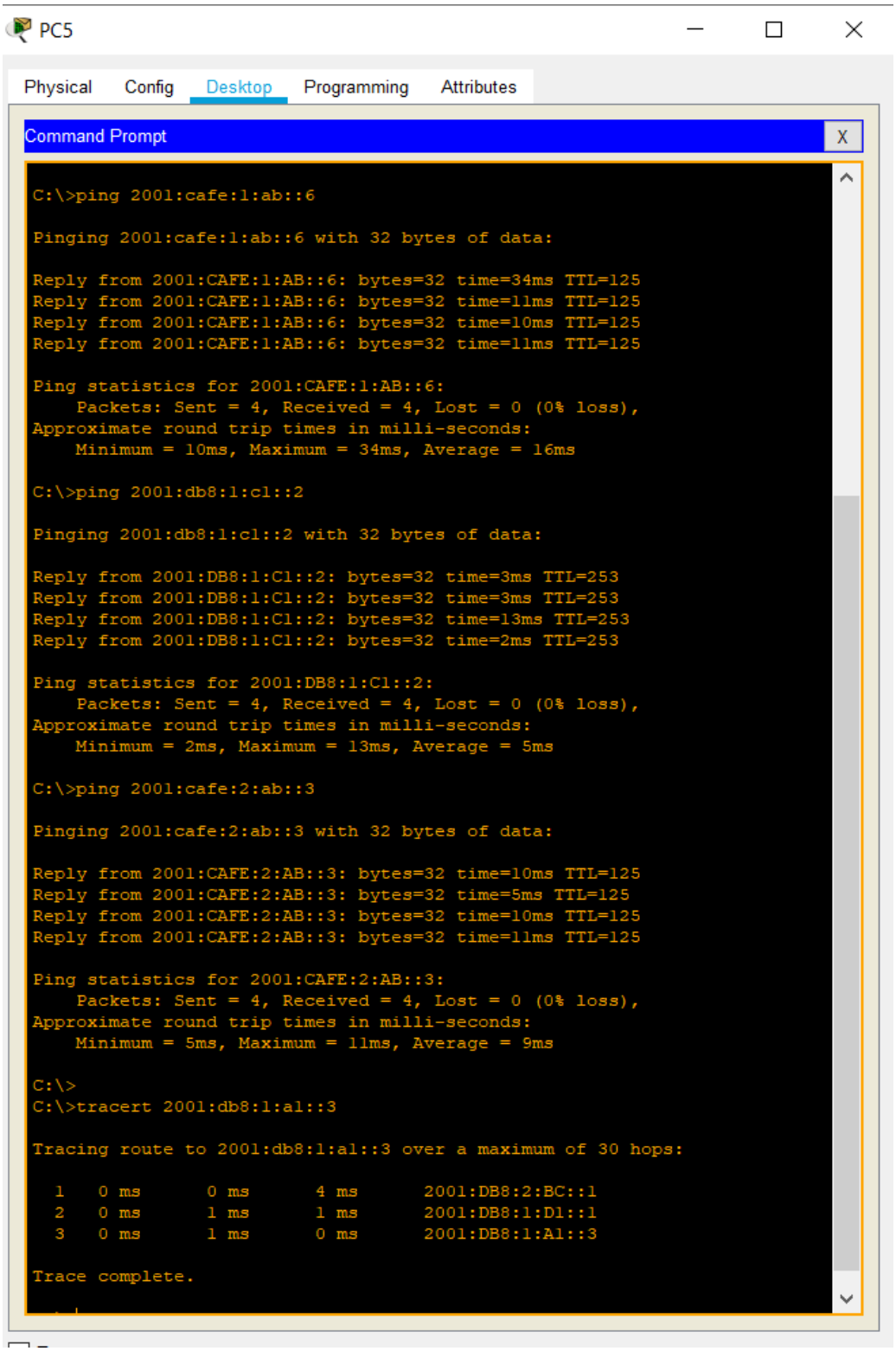

Figure 5.20: Ping test 2

This figure shows that this is a ping test from study building host to other networks.

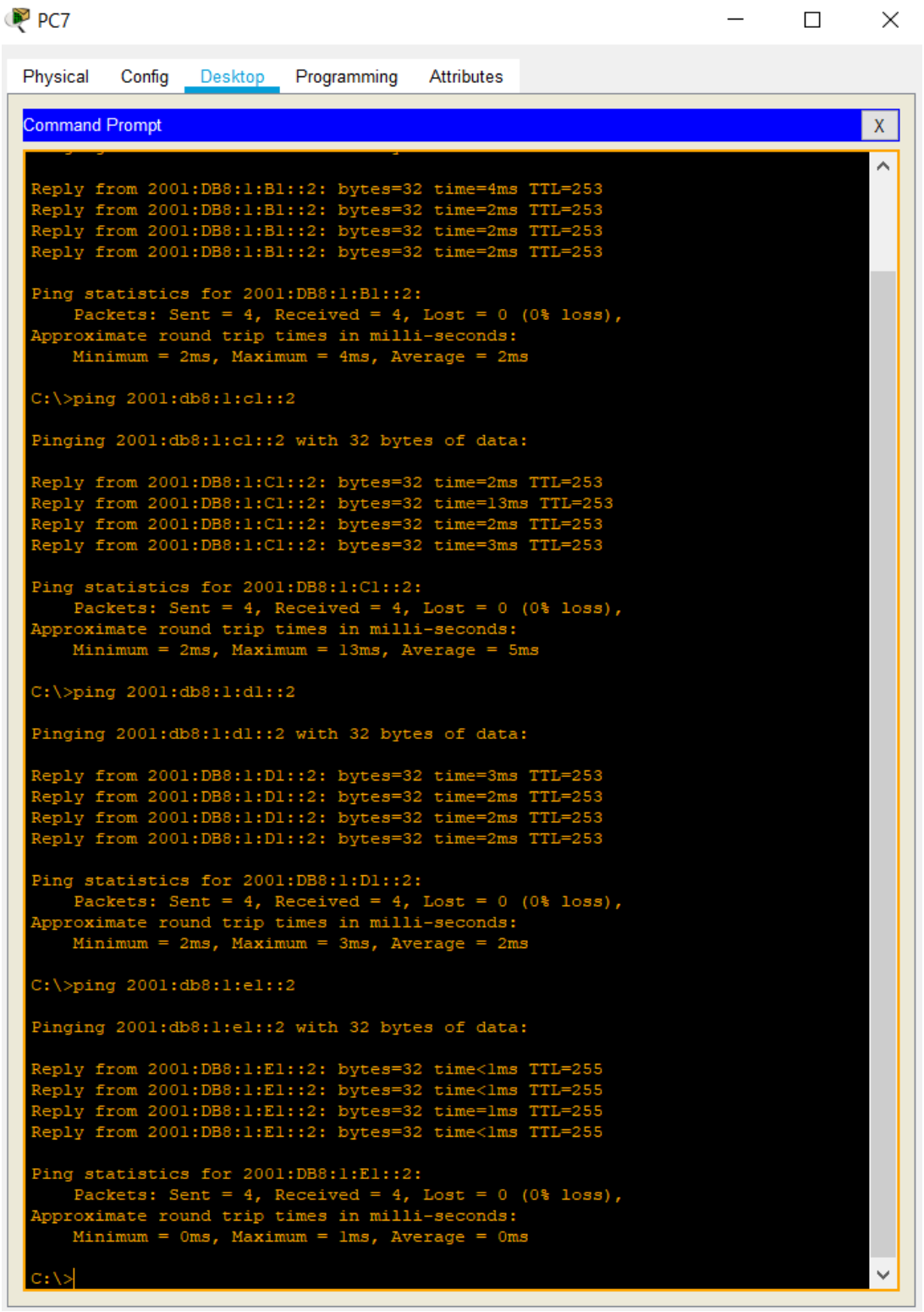

Figure 5.21: Ping test 3

This figure shows that this is a ping test from Dormitory building host to other networks.

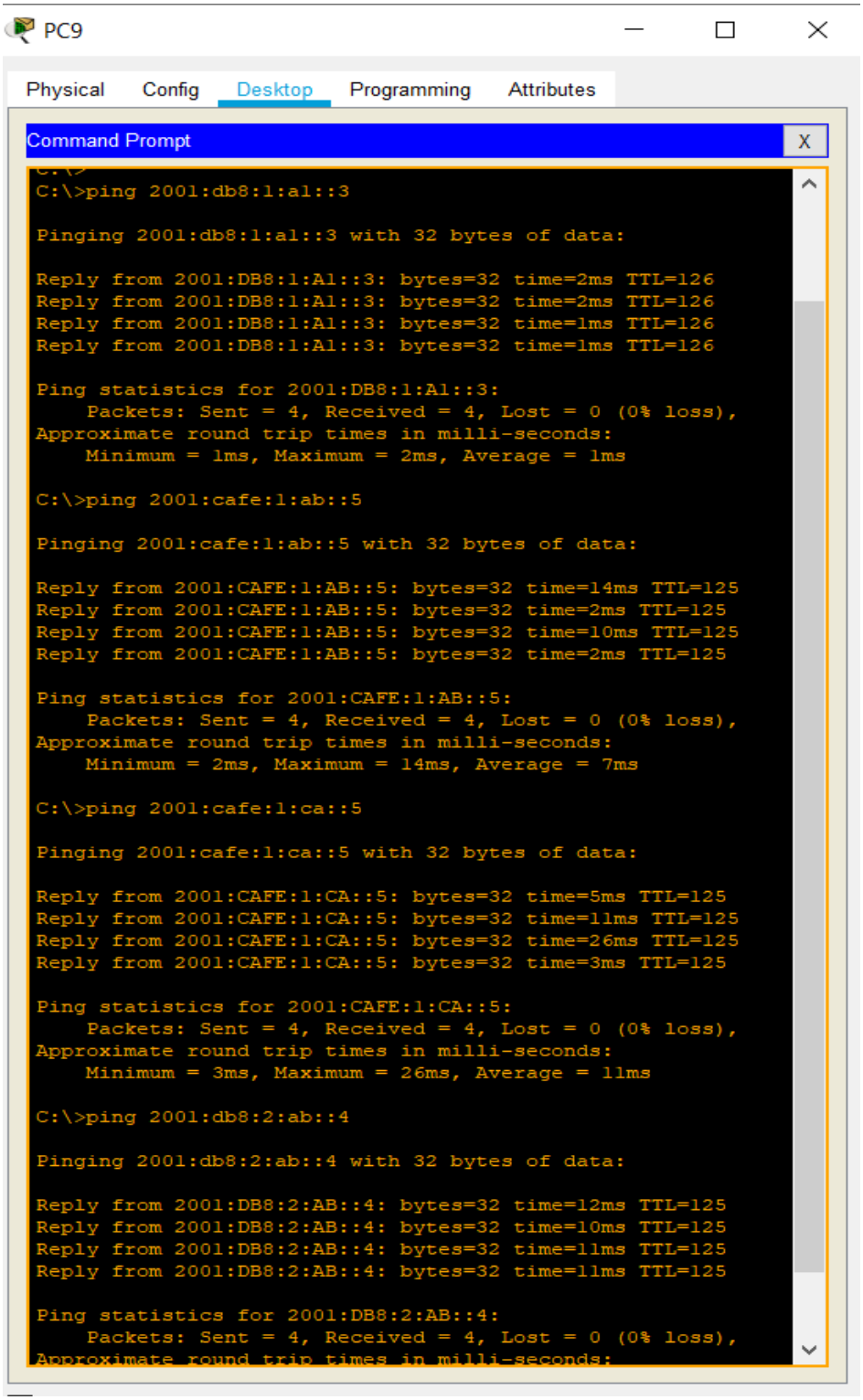

Figure 5.22: Ping test 4

This figure shows that this is a ping test from Library building host to other networks.

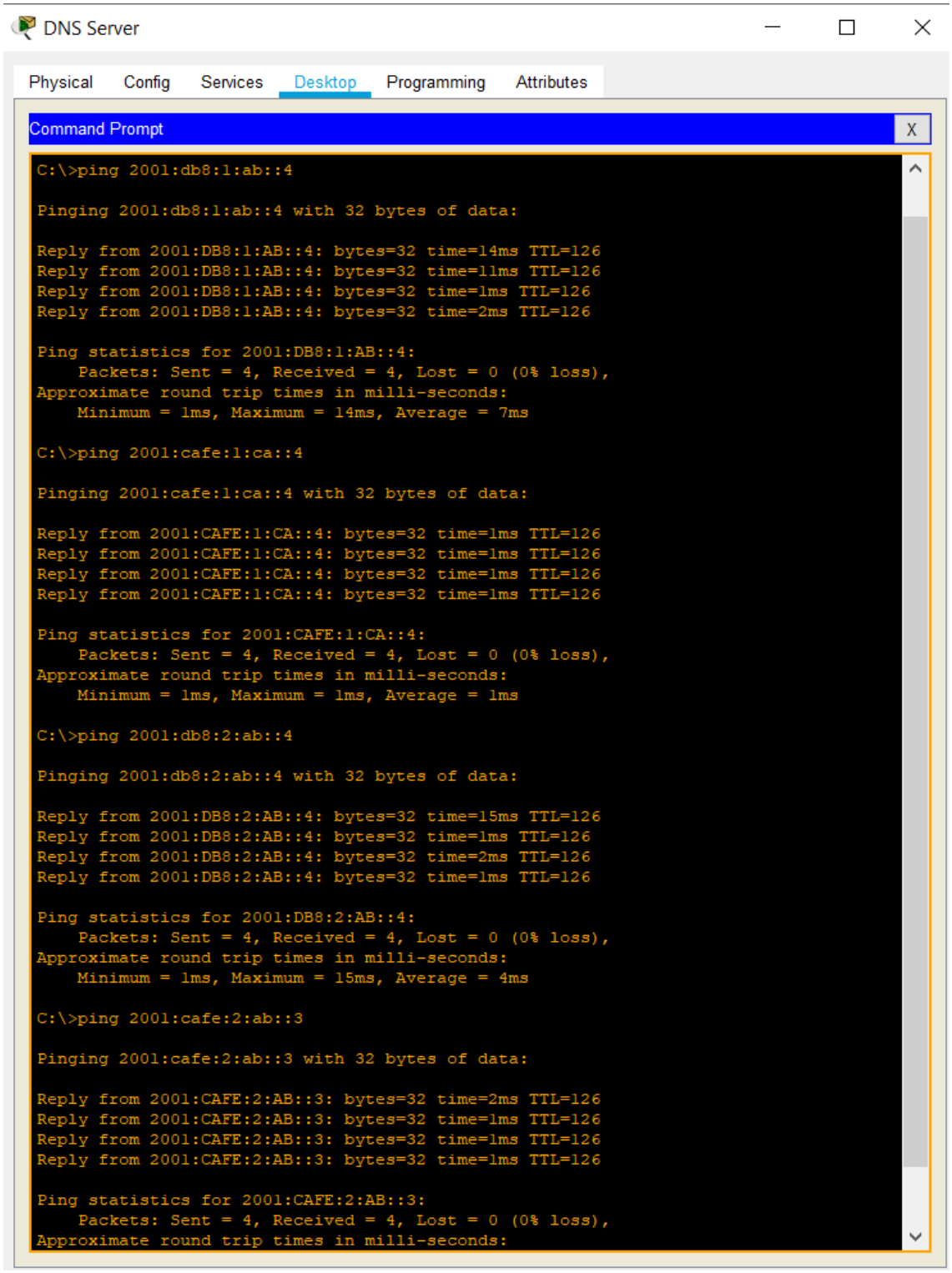

Figure 5.23: Ping test 5

This figure shows that this is a ping test from admin building host to other networks.

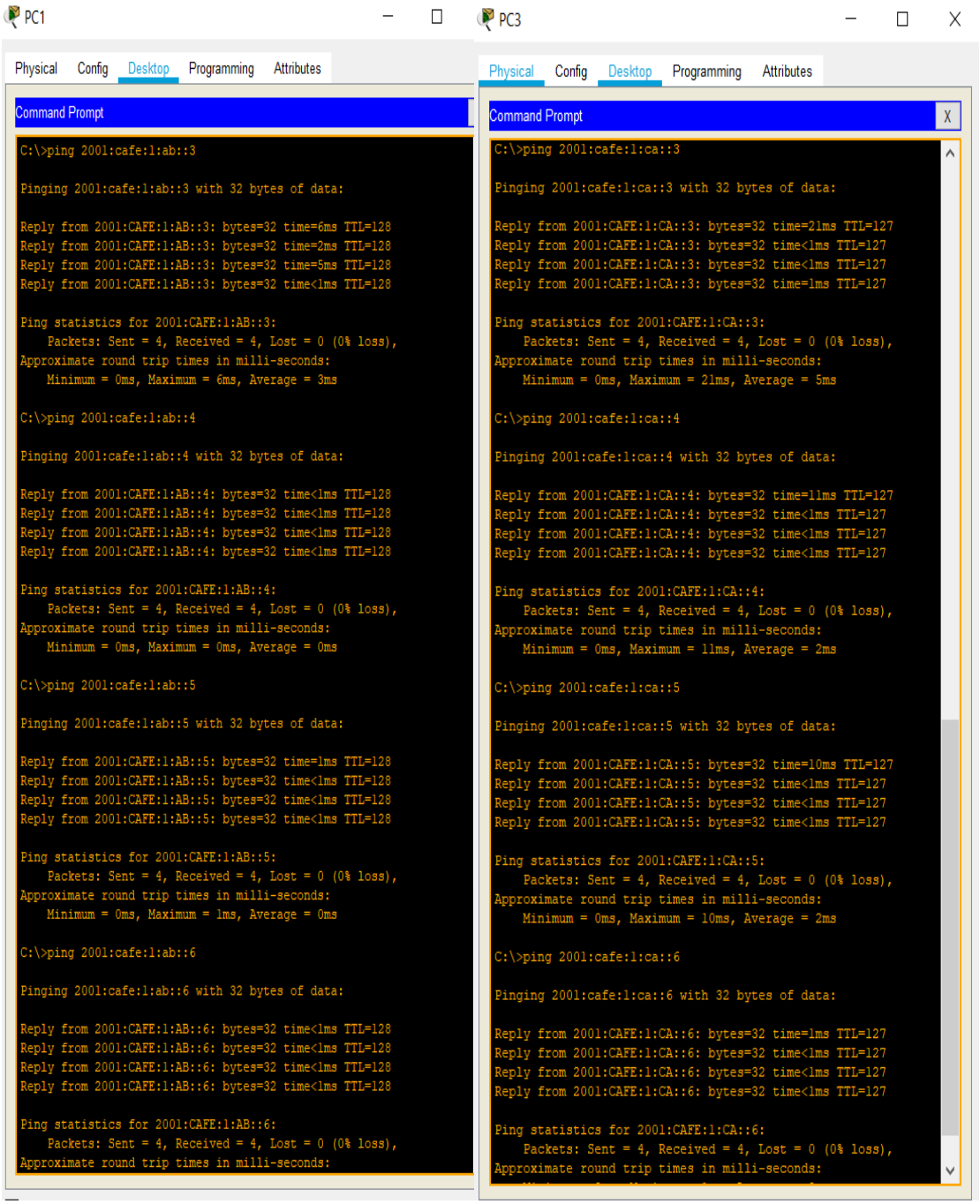

Figure 5.24: Inter-vlan ping test

This figure shows that this is an inter-vlan routing ping test to faculty building hosts network. First picture shows ping from vlan 10 to 20 and second picture shows ping from vlan 20 to vlan 30.

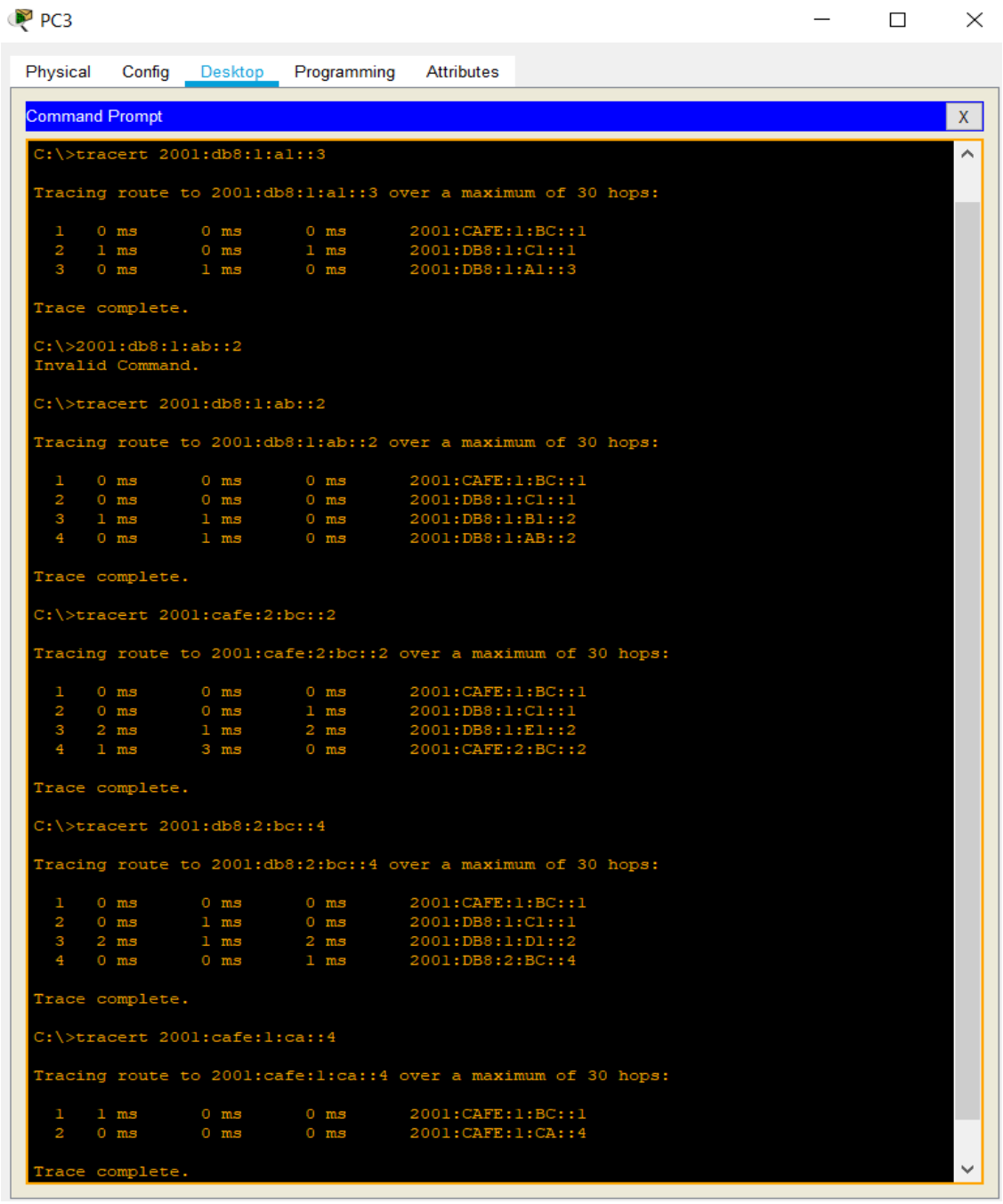

Figure 5.25: Traceroute test

This figure shows that traceroute test from faculty building host to other networks.

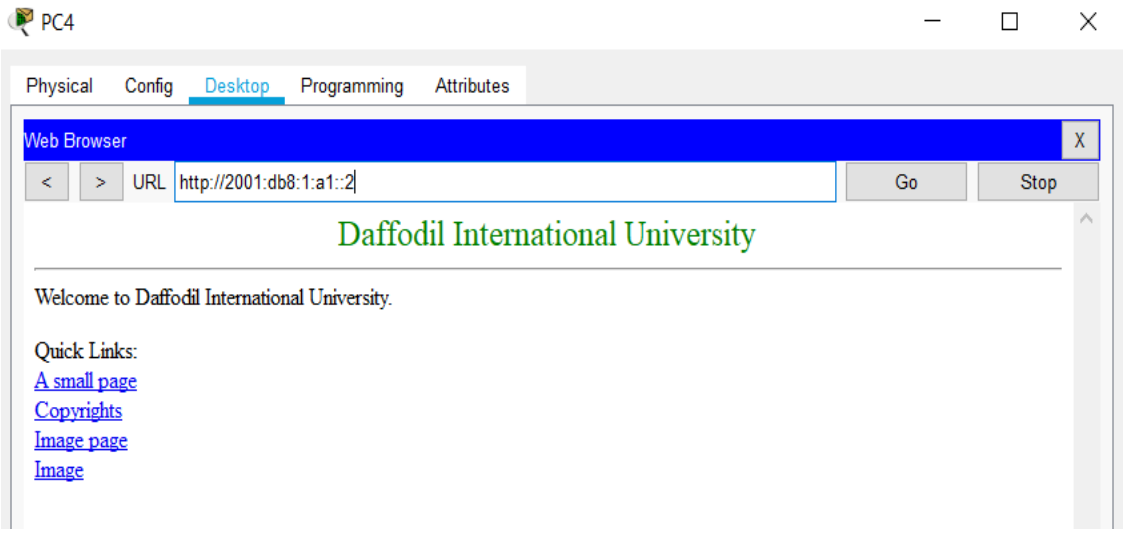

Figure 5.26: Web server test from host

The figure 5.26 shows that CSE building host pc4 can http to web server by entering the web server ipv6 address. Different hosts from different building can http to web server like this host does.

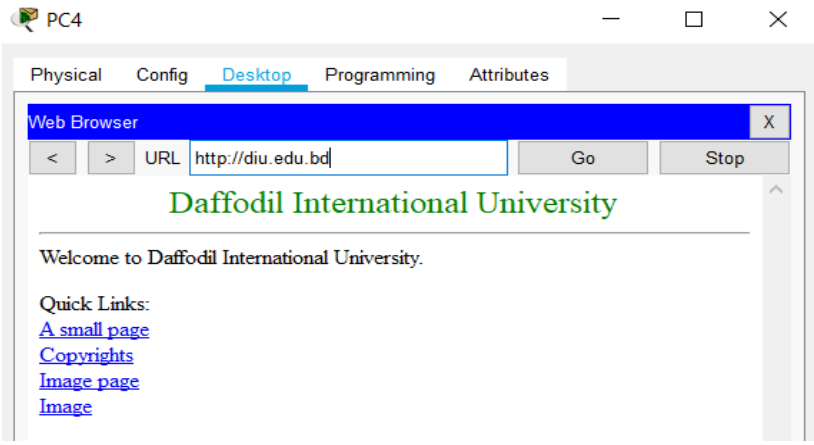

Figure 5.27: DNS server test from host

The figure 5.27 shows that CSE building host pc4 can http to web server by entering the domain name instead of web server ipv6 address. Different hosts from different building can http to web server by using the domain which is created by the DNS server.

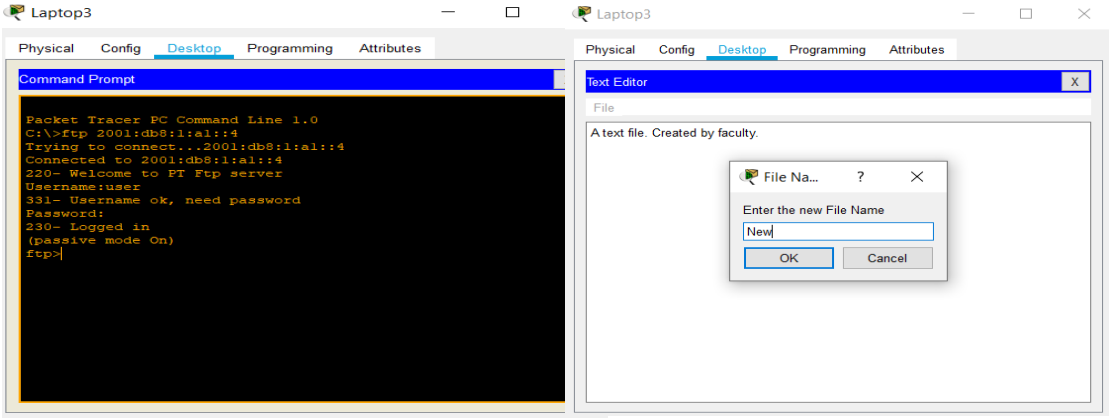

Figure 5.28: FTP server 1

In figure 5.28, logging to ftp server by using ftp server username and password which is created before in ftp server. Then create a text file from desktop text option.

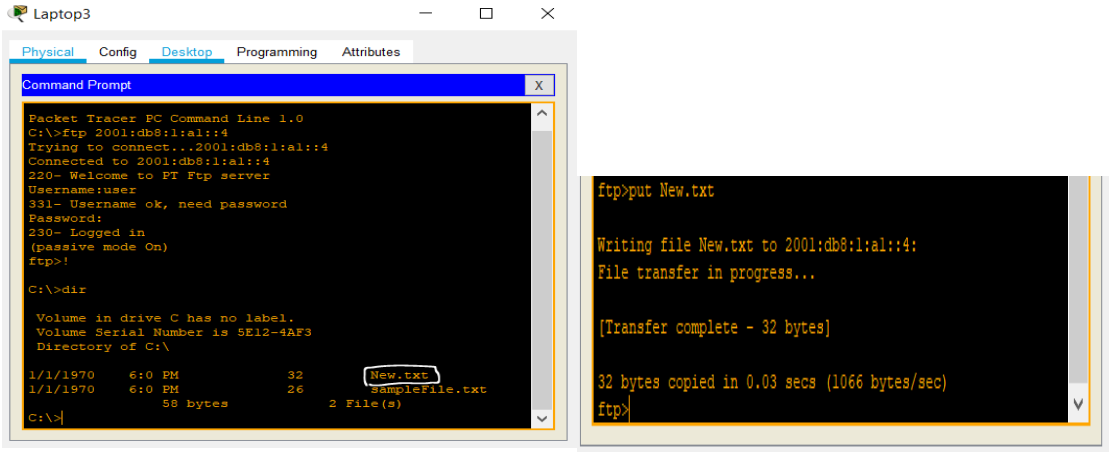

Figure 5.29: FTP server 2

In figure 5.29, the new created text file is in the c drive so, by using put command let's put the file on ftp server.

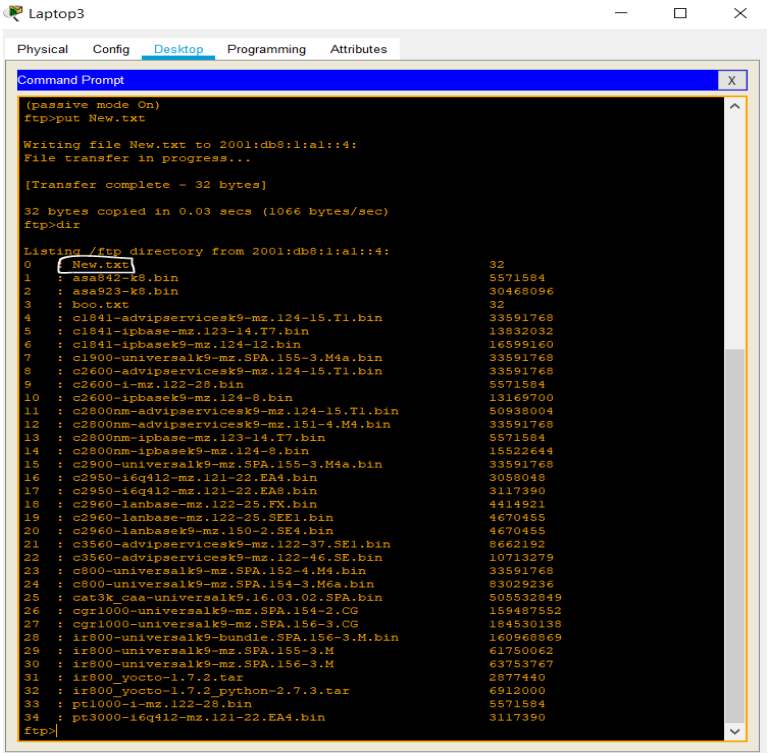

Figure 5.30: FTP server 3

In figure 5.30, after using put command the created text file is in the FTP server

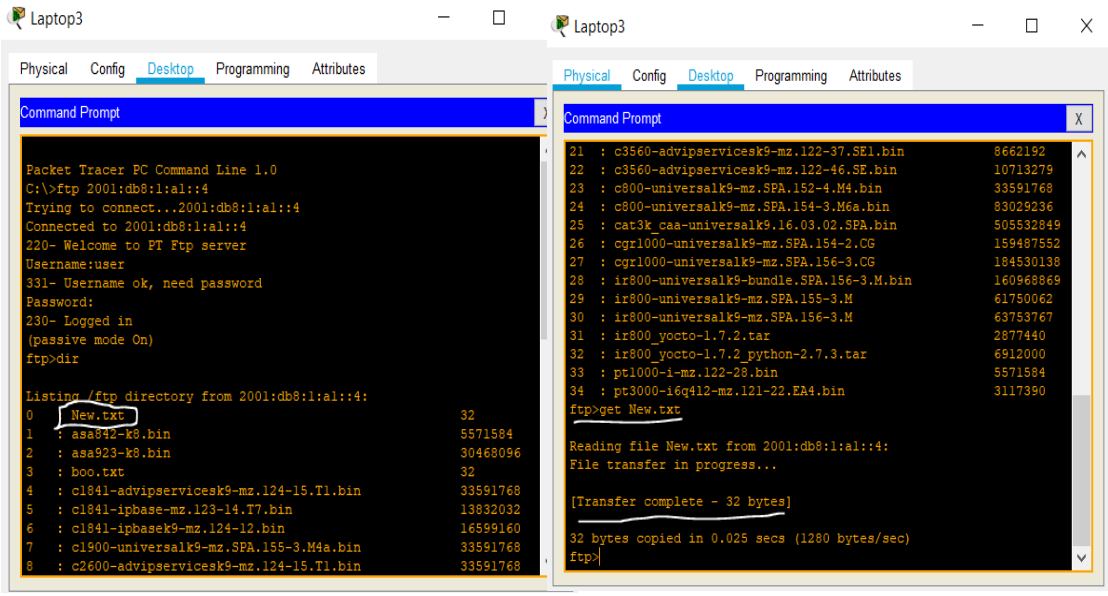

Figure 5.31: FTP server 4

In figure 5.31, logging to FTP server using another host and check the directory file that the New.txt file is there. Now use get command to download the FTP file.

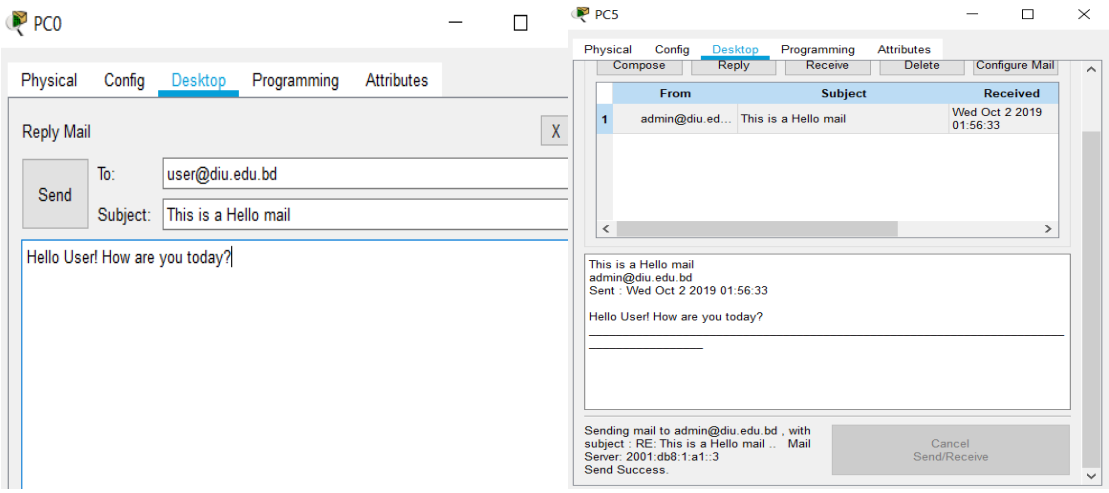

Figure 5.32: Sending mail from one host to another

The figure 5.32 shows that host PC0 sends a mail to another host pc5 and after sending the mail host pc5 has received the mail from pc0. Both hosts configured the mail before.

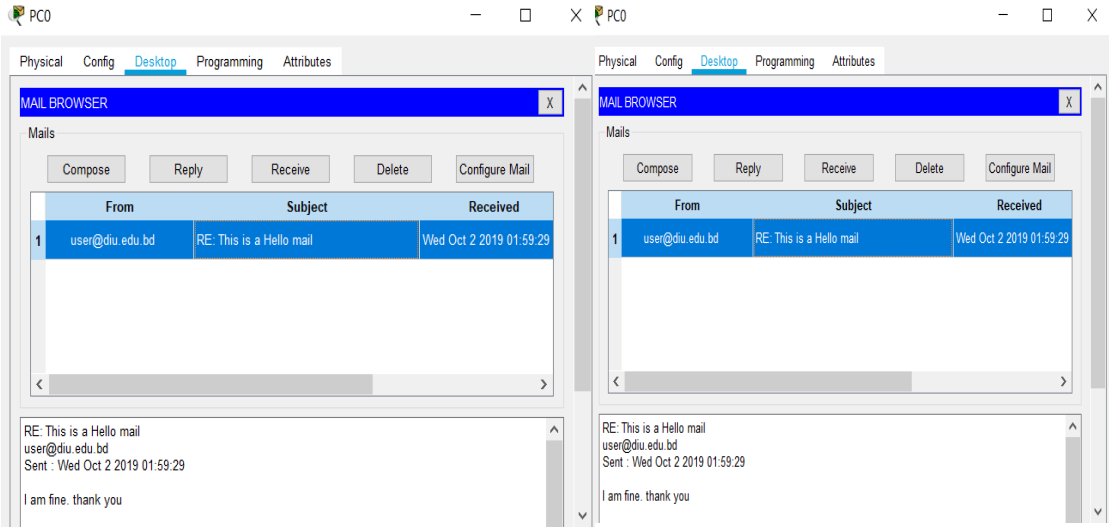

Figure 5.33: Replying mail from one host to another

The figure shows 5.33 that host PC5 reply the mail which it gets from host pc0. Host PC0 gets the reply mail from hosts pc5.

5.3 Test Results

After pinging and tracerouting from one host to another successfully and using the servers from hosts successfully we can say that, we are successfully deploy the ipv6 address in our campus network.

CHAPTER 6
CONCLUSION AND FUTURE SCOPE

6.1 Discussion and Conclusion

With the appearance of the web age, the impact of our education is new, and it additionally provides a fast leap for education opportunities, education ought to be destined towards modernization, facing the globe, facing the longer term, we tend to should 1st facing the network. Education will solely create a mixture with network so as to stay up with progress and development of times. The premise of network education is that the construction of the network, and because the construction of the field network isn't solely the development of the network exhausting setting, however additionally should embody the field network maintenance and security, field network resources and also the make love effective application of the field network and alternative 3 Link. solely the complete and make love effective application of the field network so as to create the whole teaching model and also the academic conception of an entire modification so as to use the new century to cultivate high-quality inventive and complicated skills wants for the field network construction, not applicable to any or all university program, even for a university, it's not possible to possess the simplest program, solely the higher program.

6.2 Scope for Further Development

Ipv6 is more secure than Ipv4 but the invention of Ipv6 was not so ago. Still it is working for better security and protocols. Though it is a new protocol so, there are lots of security issues happens and the newly attack possibility increases day by day. All protocols can be used in IPV4 still not come to IPV6. When it will come then we will use those protocols for making the campus more efficient and secure.

- Will Increase the campus area.
- Will add more protocols.
- Will increase more security.

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