



Department of Computer Science and Engineering

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Project

Course Code: CSE405

Course Title: Computer Networks

Section: 02

Project Title: Design a full-fledged network for an organization with multiple subnets.

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Introduction:

University of Scholars, is an enterprise like East West University, owns many computers, with a complex network infrastructure. Apart from wired internet access to all the classrooms, labs, employee PCs, library and other administrative and academic wings, the university also provides wireless internet access for every campus. On top of that the university runs a complex networked systems to support several of its business process like admissions, advising, results, eTender, library management, accounts and so on.

This complex network infrastructure is subnetted and switching/routing mechanisms are in practice.

Tools Used:

- Cisco Packet Tracer Software (version 5)
- PC (Generic)
- Laptop (Generic)
- Switches (2960)
- Routers (Generic)
- Access Point-PT (Wireless Device)
- Server-PT (Single Server for WEB, DHCP and DNS)
- Connectors (Copper straight through, Serial DCE)

Tasks Done:

- A single DNS server is installed to locate webserver - meaning people will browse University's web site with the following address: <http://www.scholars.edu.bd>
- Configure the whole network in such a way that IP for the hosts of different campuses will be automatically assigned by a single DHCP server.
- Among the hosts in a network make sure some wireless hosts are added in addition to wired hosts.

- University's full network has covered its seven campuses with seven routers exactly the given topology.
- Connectivity between all the hosts needs to be established.

Network Diagram:

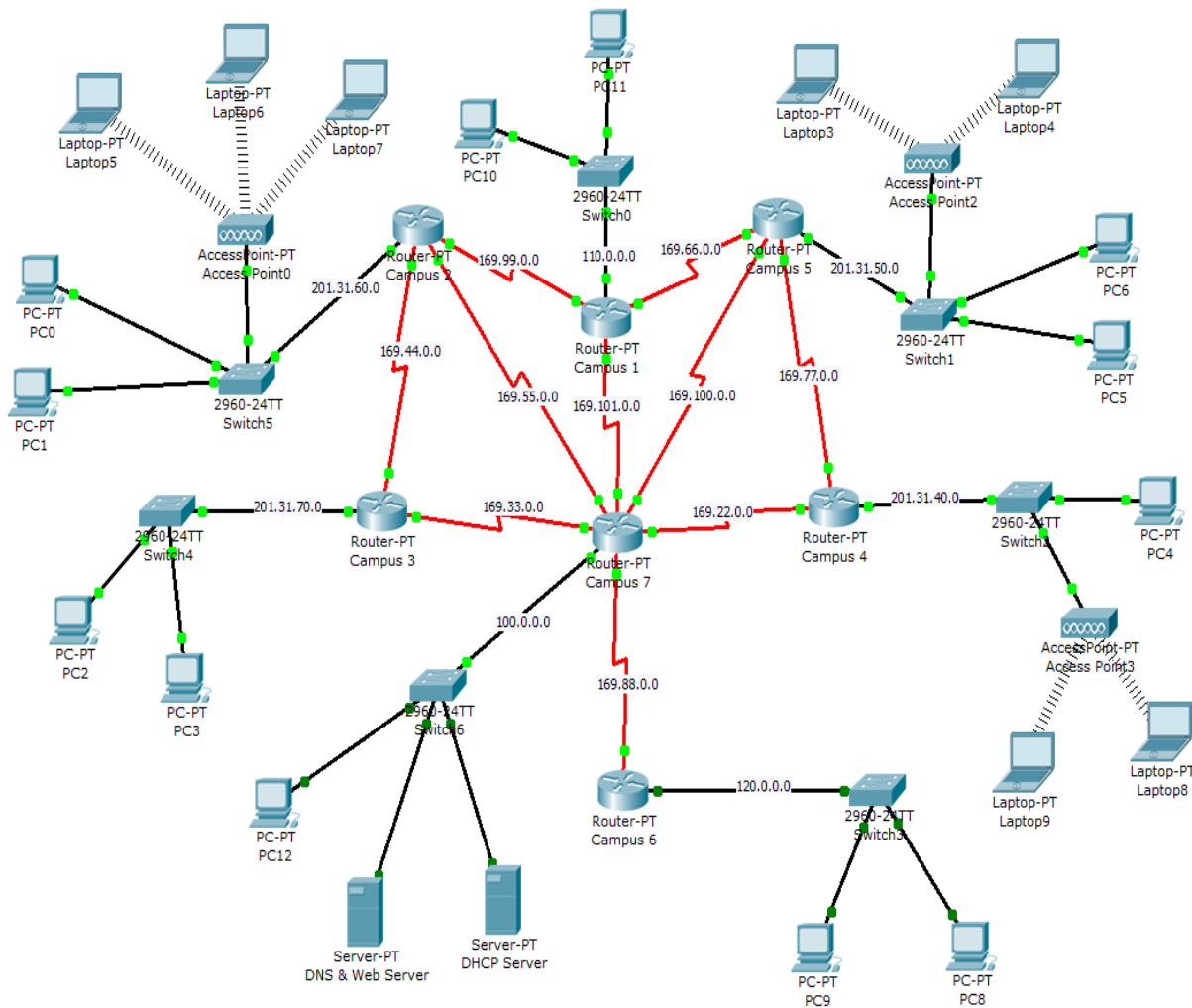


Figure 1: A Full Design a full-fledged network for an organization with multiple subnets.

Setup IP Addresses:

I have used the IP address of class B for the networks between the campuses (169.22.0.0, 169.33.0.0, 169.44.0.0, 169.55.0.0, 169.66.0.0, 169.77.0.0, 169.88.0.0, 169.99.0.0, 169.100.0.0, 169.101.0.0). And, I have used the IP address of class A for the subnetworks of campuses between switch (110.0.0.0, 120.0.0.0) and also used the IP address of class C for the networks between the switch (201.31.40.0, 201.31.50.0, 201.31.60.0, 201.31.70.0).

Router Configurations:

For The Router IP Setup, I have used a CLI code for each router,

For Campus 1:

```
interface fa0/0
```

```
ip address 110.0.0.254 255.0.0.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se6/0
```

```
ip address 169.99.0.2 255.255.0.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se3/0
```

```
ip address 169.66.0.2 255.255.0.0
```

```
clock rate 64000
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se2/0
ip address 169.101.0.2 255.255.0.0
no shut
do wr
exit
```

For Campus 2:

```
interface fa0/0
ip address 201.31.60.254 255.255.255.0
no shut
do wr
exit
```

```
interface se2/0
ip address 169.44.0.2 255.255.0.0
clock rate 64000
no shut
do wr
exit
```

```
interface se3/0
ip address 169.55.0.2 255.255.0.0
no shut
do wr
exit
```

```
interface se6/0
ip address 169.99.0.1 255.255.0.0
clock rate 64000
```

no shut

do wr

exit

For Campus 3:

interface fa0/0

ip address 201.31.70.254 255.255.255.0

no shut

do wr

exit

interface se2/0

ip address 169.44.0.1 255.255.0.0

no shut

do wr

exit

interface se3/0

ip address 169.33.0.2 255.255.0.0

clock rate 64000

no shut

do wr

exit

For Campus 4:

```
interface fa0/0
ip address 201.31.40.254 255.255.255.0
no shut
do wr
exit
```

```
interface se3/0
ip address 169.22.0.2 255.255.0.0
clock rate 64000
no shut
do wr
exit
```

```
interface se2/0
ip address 169.77.0.2 255.255.0.0
clock rate 64000
no shut
do wr
exit
```

For Campus 5:

```
interface fa0/0
ip address 201.31.50.254 255.255.255.0
no shut
do wr
exit
```

```
interface se3/0
```

```
ip address 169.66.0.1 255.255.0.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se2/0
```

```
ip address 169.100.0.1 255.255.0.0
```

```
no shut
```

```
do wr
```

```
exit
```

```
interface se6/0
```

```
ip address 169.77.0.1 255.255.0.0
```

```
no shut
```

```
do wr
```

```
exit
```

For Campus 6:

```
interface fa0/0
```

```
ip address 120.0.0.254 255.0.0.0
```

```
no shut
```

```
do wr
```

```
exit
```



```
interface se2/0
ip address 169.88.0.2 255.255.0.0
clock rate 64000
no shut
do wr
exit
```

For Campus 7:

```
interface fa0/0
Ip address 100.0.0.254 255.0.0.0
no shut
do wr
exit
```

```
interface se9/0
ip address 169.88.0.1 255.255.0.0
no shut
do wr
exit
```

```
interface se8/0
ip address 169.22.0.1 255.255.0.0
no shut
do wr
exit
```

```
interface se3/0
ip address 169.100.0.1 255.255.0.0
clock rate 64000
no shut
do wr
exit
```

```
interface se2/0
ip address 169.101.0.1 255.255.0.0
clock rate 64000
no shut
do wr
exit
```

```
interface se6/0
ip address 169.55.0.1 255.255.0.0
clock rate 64000
no shut
do wr
exit
```

```
interface se7/0
ip address 169.33.0.1 255.255.0.0
no shut
do wr
exit
```

OSPF Configuration:

Then, now inserting routing table for each campus;

For Campus 1:

```
router ospf 1
network 110.0.0.0 0.255.255.255 area 1
network 169.66.0.0 0.0.255.255 area 1
network 169.99.0.0 0.0.255.255 area 1
network 169.101.0.0 0.0.255.255 area 1
exit
```

For Campus 2:

```
router ospf 2
network 201.31.60.0 0.0.0.255 area 1
network 169.99.0.0 0.0.255.255 area 1
network 169.55.0.0 0.0.255.255 area 1
network 169.44.0.0 0.0.255.255 area 1
exit
```

For Campus 3:

```
router ospf 3
network 201.31.70.0 0.0.0.255 area 1
network 169.44.0.0 0.0.255.255 area 1
network 169.33.0.0 0.0.255.255 area 1
exit
```

For Campus 4:

```
router ospf 4
network 201.31.40.0 0.0.0.255 area 1
network 169.22.0.0 0.0.255.255 area 1
network 169.77.0.0 0.0.255.255 area 1
exit
```

For Campus 5:

```
router ospf 5
network 201.31.50.0 0.0.0.255 area 1
network 169.77.0.0 0.0.255.255 area 1
network 169.100.0.0 0.0.255.255 area 1
network 169.66.0.0 0.0.255.255 area 1
exit
```

For Campus 6:

```
router ospf 6
network 169.88.0.0 0.0.255.255 area 1
network 120.0.0.0 0.255.255.255 area 1
exit
```

For Campus 7:

```
router ospf 7
network 100.0.0.0 0.255.255.255 area 1
network 169.33.0.0 0.0.255.255 area 1
network 169.55.0.0 0.0.255.255 area 1
network 169.101.0.0 0.0.255.255 area 1
```

```
network 169.100.0.0 0.0.255.255 area 1
network 169.22.0.0 0.0.255.255 area 1
network 169.88.0.0 0.0.255.255 area 1
exit
```

I have used an IP helper address to connect the server to all networks. This is a remote DHCP service that allows the server to communicate with all networks. The IP address of the server is set to 125.0.0.5 and the helper address is configured on all interfaces using command line interface (CLI) code.

```
interface fa0/0
ip helper-address 100.0.0.110
do wr
no shut
exit
```

Server Setup:

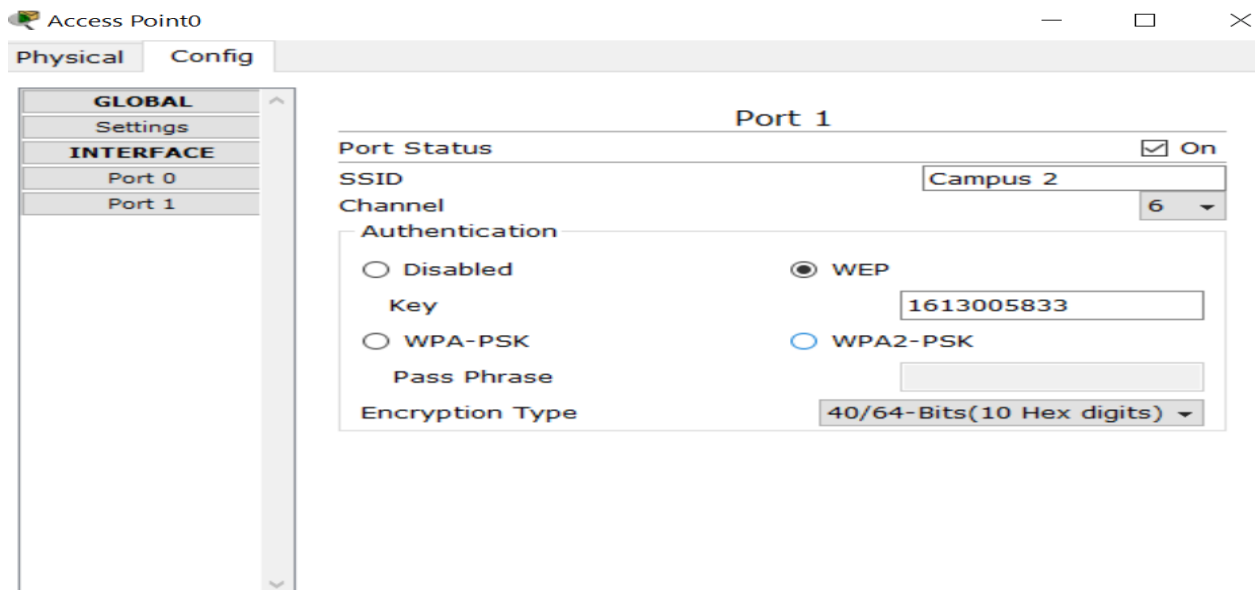


Figure 2: Wireless Router Configuration

Here we have created seven pools in the DHCP server to generate the IP range for different networks. These pools will be used to manage and assign IP addresses to devices in different networks.

DHCP

Service: ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 100.0.0.254

DNS Server: 0.0.0.0

Start IP Address: 100.0.0.100

Subnet Mask: 255.0.0.0

Maximum number of Users: 26022

TFTP Server: 0.0.0.0

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max Number	TFTP Server
serverPool	100.0.0.254	0.0.0.0	100.0.0.100	255.0.0.0	26022	0.0.0.0
Router 1	100.0.0.254	0.0.0.0	110.0.0.120	255.0.0.0	26022	0.0.0.0
Router 6	100.0.0.254	0.0.0.0	120.0.0.170	255.0.0.0	26022	0.0.0.0
Router 2	100.0.0.254	0.0.0.0	201.31.60.130	255.255.255.0	126	0.0.0.0
Router 3	100.0.0.254	0.0.0.0	201.31.70.140	255.255.255.0	116	0.0.0.0
Router 4	100.0.0.254	0.0.0.0	201.31.40.150	255.255.255.0	106	0.0.0.0
Router 5	100.0.0.254	0.0.0.0	201.31.50.160	255.255.255.0	96	0.0.0.0

Figure 3: DHCP Server Setup

DNS

DNS Service: ☒ On ☐ Off

Resource Records

Name: www.scholars.edu.bd Type: A Record

Address: 100.0.0.5

No.	Name	Type	Details
1	www.scholars.edu.bd	A Record	100.0.0.5

Figure 4: DNS Server Setup

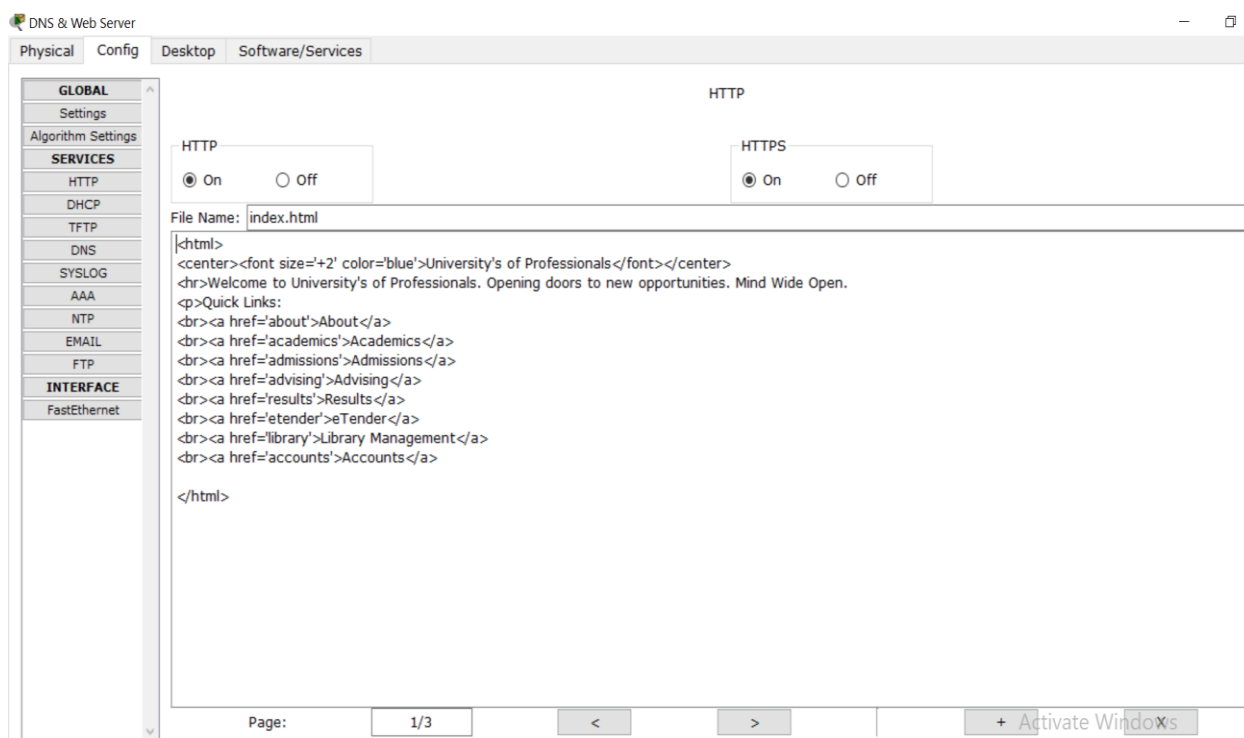


Figure 5: HTTP setup for webpage “index.html”

Accessing the webpage from a PC:

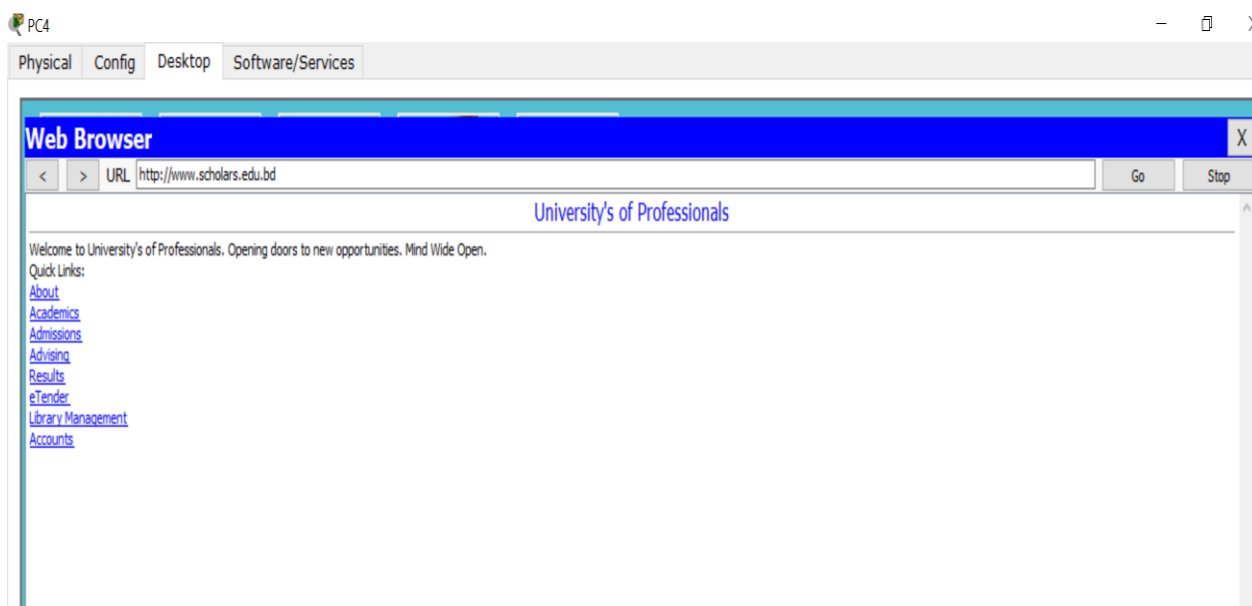
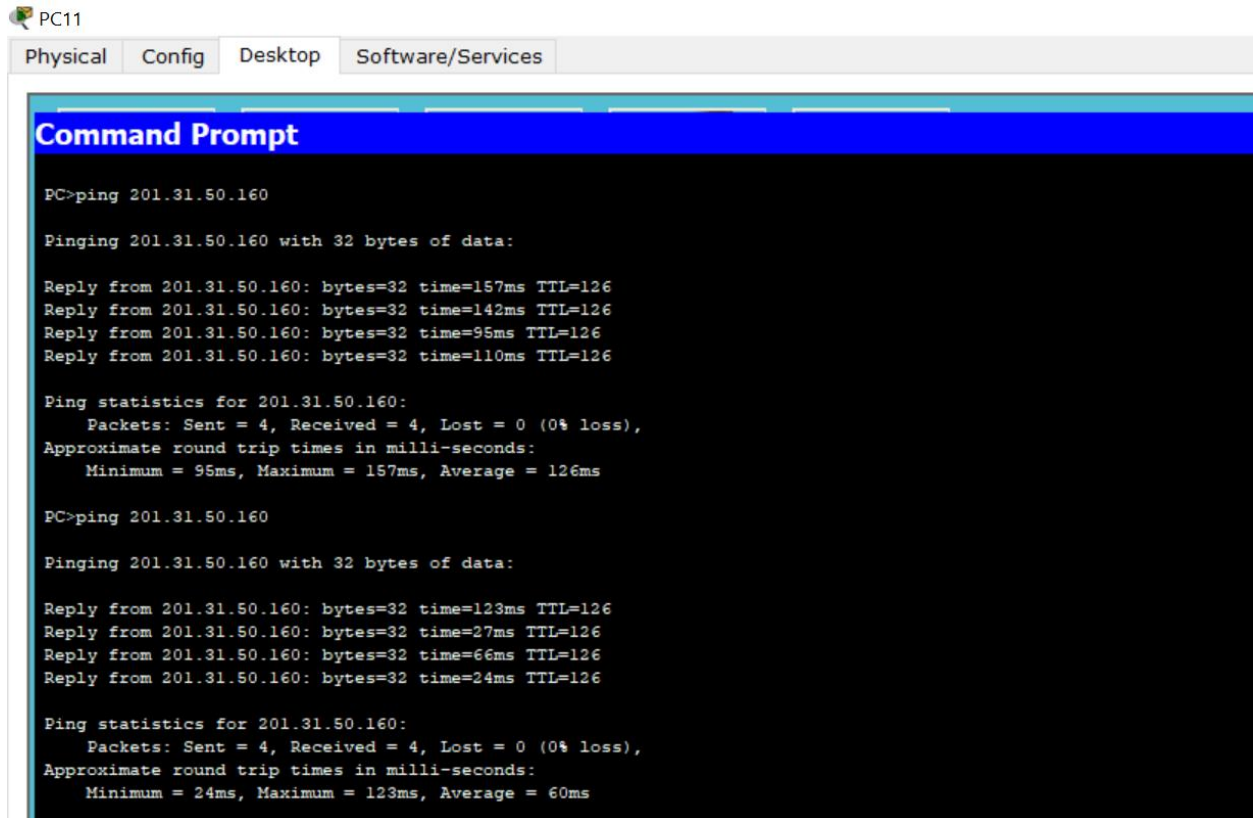


Figure 6: Browsing the University website site with the address <http://www.scholars.edu.bd>

Establishing the connection between hosts:

Here, pinging the PC 5 with IP address 201.31.50.160 of campus 5 from the PC 11 of campus 1 with IP address 110.0.0.121



The screenshot shows the Command Prompt interface of PC11. The window has tabs for Physical, Config, Desktop, and Software/Services. The Command Prompt title bar is blue with the text "Command Prompt". The background is black with white text. The user has entered the command "PC>ping 201.31.50.160" twice. The first execution shows four successful replies with round trip times of 157ms, 142ms, 95ms, and 110ms, and statistics showing 0% loss and an average of 126ms. The second execution shows four successful replies with round trip times of 123ms, 27ms, 66ms, and 24ms, and statistics showing 0% loss and an average of 60ms.

```
PC11
Physical Config Desktop Software/Services

Command Prompt

PC>ping 201.31.50.160

Pinging 201.31.50.160 with 32 bytes of data:

Reply from 201.31.50.160: bytes=32 time=157ms TTL=126
Reply from 201.31.50.160: bytes=32 time=142ms TTL=126
Reply from 201.31.50.160: bytes=32 time=95ms TTL=126
Reply from 201.31.50.160: bytes=32 time=110ms TTL=126

Ping statistics for 201.31.50.160:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 95ms, Maximum = 157ms, Average = 126ms

PC>ping 201.31.50.160

Pinging 201.31.50.160 with 32 bytes of data:

Reply from 201.31.50.160: bytes=32 time=123ms TTL=126
Reply from 201.31.50.160: bytes=32 time=27ms TTL=126
Reply from 201.31.50.160: bytes=32 time=66ms TTL=126
Reply from 201.31.50.160: bytes=32 time=24ms TTL=126

Ping statistics for 201.31.50.160:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 24ms, Maximum = 123ms, Average = 60ms
```

Figure 07: Establishing connection PC 5 between PC 11

Limitations:

During the design and implementation of this project, I encountered various software bugs, particularly when trying to establish wireless connections. Connecting hosts wirelessly was challenging and an access point caused issues by automatically connecting to another access point. Additionally, after the network was set up, there were initial failures in packet transfer but it eventually succeeded.

Conclusion:

In conclusion, I have designed a full-featured network for the University of Scholars, a complex enterprise with multiple subnets. The OSPF network architecture made it simple to set up the router configurations. The design takes into account the structure and facilities of the university and includes features such as a single DNS server, automatic IP assignment via a DHCP server, and both wireless and wired hosts. The network, which uses seven routers, covers seven campuses and is specifically designed for each subnet. The final design is reflected in the submitted packet tracer file and technical report.