Basic Configuration of a Router

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1 Objectives

- Familiarization with network simulation tool: Cisco Packet Tracer.
- Familiarization with router, and its different components.
- Familiarization with commands for basic configuration of a router.

2 Required Tools

2.1 Cisco Packet Tracer

Cisco Packet Tracer, or sometimes simply referred to as the Packet Tracer is a visual simulation software developed and distributed by Cisco Systems, that expertises on manufacturing, developing and selling networking hardware and software tools. Packet Tracer is a cross platform tool that allows simulated environment for modern computer network and network topologies. With an easy to use drag and drop interface with simulated devices such as cisco routers, switches, end devices, cables and almost everthing needed for a network, the packet tracer is a complete tool for designing large networks for educational purposes which would be difficult physically.

3 Simulation Activity

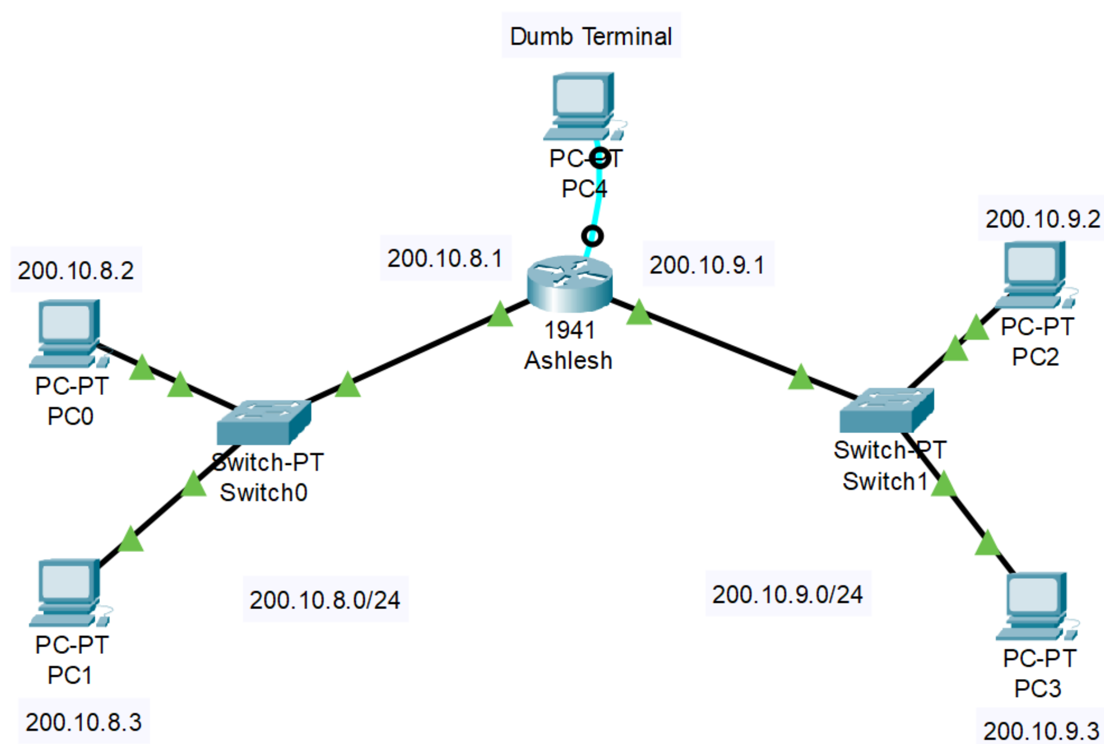

Figure 1: Simulated network with two switches and four computers

The connections as shown in Figure 1 were initially made on Packet Tracer. The router was connected to the switches using two gigabitethernet interfaces. A rollover cable was used to connect the console interface of the router with the RS232 interface of the PC4. Each of the two switches were connected with two separate PCs on the fastethernet interfaces. For basic configurations to be set on the router, the communication port on PC4 was configured with following settings,

- 9600 baud
- 8 data bits
- No parity
- 1 stop bit
- No flow control

Using the termial emulation software on PC4, the router was configured for various settings as needed. Firstly, the hostname of the router was set to *Ashlesh* using the appropriate command from the privileged EXEC mode. Passwords for console line, privileged EXEC mode and virtual terminal were set which were later encrypted too. The interface configuration mode was used to configure the two gigabitethernet interfaces on the router with the appropriate ip addresses and subnet masks. The interfaces were turned on and cross checked for status using the *show running-config* command on the privileged EXEC mode. Individual PCs, viz. PC0, PC1, PC2, PC3 were configured with the instructed ip addresses and subnet masks. Connectivity among the network devices was checked using the ping command as instructed and observations were noted. For further investigations, the default gateway for PC0 and PC1 was set to 200.10.8.1 and that of PC2 and PC3 was set to 200.10.9.1 and connectivity was checked once again.
The various commands used for the basic configuration of router along with their syntax and functions are discussed in Problem 2 and the observations for the simulation and connectivity tests are discussed in Problem 3 within the Exercises section.

4 Exercises

Problem 1
What is a router? Explain its role in computer networks.

A router is a networking device that is used in a network for receiving, analyzing and forwarding packets incoming into the router to another part of the network. Routers are termed as smart networking devices due to the fact that they can analyze the incoming packets and transfer the data over the network. A router uses the hardware and software combinations to route the packets all the way from the source to the destination. A router is more specifically important for combination of networks, meaning that it connects two or more networks having different network addresses. Large and complex networks are segmented into logical segments called subnets by the router based on the Layer 3 addressing system. The divison of larger networks into smaller logical units allows smaller broadcast domains that lead to a better performance of the overall network. A router is also essential for packet filtering purpose. The simplest form of a router configuration is visible in home routers where the local network is connected to the internet via the router. Here the router acts as a gateway to the vast internet and expands the local network.

Problem 2
List out the basic configuration commands of router (that you have used in this lab) with their syntax and functions.

The configuration commands are used in configuration mode. To access the various configuration modes we need to follow the following commands.

```
Router Modes              Displayed as          Command
User EXEC                 Router>               disable (from Privileged
(default mode)                                  EXEC mode)
Privileged EXEC           Router#               enable (from User EXEC mode)
Global configuration      Router(config)#       configure terminal (from
                                                Privileged EXEC)
Specific configuration    Router(config-...)#   interface interface_name
                                                interface_number
                                                line line_name line_number
```

Listing 1: Syntax for various router modes

Configure hostname

The hostname of the router can be changed from the command line terminal using *hostname* command. Configuring the hostname of a router aids in debugging and maintenance of the network.

```
Router(config)# hostname Ashlesh
Ashlesh(config)#
```

Listing 2: Syntax for configuring hostname

Configure passwords

Passwords for various accesses such as the console line login, privileged EXEC mode, virtual terminal can be set for security purposes. The passwords are stored in plain text format and can be revealed by the *show running-config* command. There is an option for encrypted password as well.

```
Ashlesh(config)# line console 0
Ashlesh(config-line)# password cnlab1
Ashlesh(config-line)# login

Ashlesh(config)# enable password cnlab1

Ashlesh(config)# line vty 0 4
Ashlesh(config-line)# password cnlab1
Ashlesh(config-line)# login

Ashlesh(config)# service password-encryption
```

Listing 3: Syntax for configuring router passwords

Configure interface

The two interfaces of the router that are connected to the switches must be configured with proper ip addresses and subnet masks. It is achieved by using the *interface* command in the global configuration mode. The *no shutdown* command enables the interface which can be verified from the *show interfaces* command.

```
Ashlesh(config)# interface gigabitethernet 0/0
Ashlesh(config-if)# ip address 200.10.8.1 255.255.255.0
Ashlesh(config-if)# no shutdown
```

```
Ashlesh(config)# interface gigabitethernet 0/1
Ashlesh(config-if)# ip address 200.10.9.1 255.255.255.0
Ashlesh(config-if)# no shutdown
```

Listing 4: Syntax for configuring interface

Problem 3
Note down the observation of each steps with necessary commands specified in activity D mentioned in the lab sheet and comment on it.

```
Router(config)# hostname Ashlesh
Ashlesh(config)#
```

Listing 5: Observation for configuring hostname

Changing the hostname of the router is essential for debugging and maintenance purposes. The hostname is displayed on every line of the CLI which aids in proper knowledge of multiple routers in a complex network.

Before setting default gateway

```
> ping 200.10.8.3

Pinging 200.10.8.3 with 32 bytes of data:

Reply from 200.10.8.3: bytes=32 time<1ms TTL=128
Reply from 200.10.8.3: bytes=32 time<1ms TTL=128
Reply from 200.10.8.3: bytes=32 time<1ms TTL=128
Reply from 200.10.8.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.10.8.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 6: Observation for pinging PC1 from PC0

Both PC0 and PC1 are in the same subnet, i.e. 200.10.8.0/24, so the ping goes through successfully without the need of a default gateway.

```
> ping 200.10.8.1

Pinging 200.10.8.1 with 32 bytes of data:

Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.10.8.1:
```

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

Listing 7: Observation for pinging interface of router in same subnet from PC0

Ping from the PC0 to the router interface 200.10.8.1 terminates successfully since they're in the same subnet.

```
> ping 200.10.9.1

Pinging 200.10.9.1 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 200.10.9.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
```

Listing 8: Observation for pinging interface of router in different subnet from PC0

Ping from the PC0 to the router interface 200.10.9.1 terminates with a request timed out error where none of the packets go through successfully. This is due to the fact that the ip address 200.10.9.1 isn't recognized by the subnet 200.10.8.0/24.

```
> ping 200.10.9.2

Pinging 200.10.9.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 200.10.9.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
```

Listing 9: Observation for pinging PC2 from PC0

Since PC0 and PC2 are in different subnets, i.e. 200.10.8.0/24 and 200.10.9.0/24, the ping from PC0 to PC2 fails without a single packet being transfered.

```
> ping 200.10.9.3

Pinging 200.10.9.3 with 32 bytes of data:

Request timed out.
Request timed out.
```

```
Request timed out.
Request timed out.

Ping statistics for 200.10.9.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
```

Listing 10: Observation for pinging PC3 from PC0

The ping from PC0 to PC3 fails for the same reason as that of ping to PC2. The difference in subnet causes the ping to fail since default gateways aren't set, so the packets aren't passed on to the appropriate destination.

```
> ping 200.10.8.2

Pinging 200.10.8.2 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 200.10.8.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
```

Listing 11: Observation for pinging PC0 from PC3

Since PC0 is in a different subnet than that of PC3, the ping fails. The packets aren't routed to the destination since the default gateway for the PCs isn't properly set.

```
> ping 200.10.8.3

Pinging 200.10.8.3 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 200.10.8.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
```

Listing 12: Observation for pinging PC1 from PC3

The ping fails with a request timed out error due to the same reason as mentioned for PC0. The packet can't go through the router since the source and destination PCs are in different subnets.

```
> ping 200.10.9.1

Pinging 200.10.9.1 with 32 bytes of data:
```

```
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255
Reply from 200.10.9.1: bytes=32 time=1ms TTL=255
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.10.9.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 13: Observation for pinging interface of router in same subnet from PC3

PC3 is in the same subnet as the router interface with ip 200.10.9.1, which is why the ping successfully terminates with no errors.

```
> ping 200.10.8.1

Pinging 200.10.8.1 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 200.10.8.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss)
```

Listing 14: Observation for pinging interface of router in different subnet from PC3

The ip address 200.10.8.1 is unknown to the subnet 200.10.9.0/24 which is why pinging the interface from PC3 fails with a request timed out error.

```
> ping 200.10.9.2

Pinging 200.10.9.2 with 32 bytes of data:

Reply from 200.10.9.2: bytes=32 time<1ms TTL=128
Reply from 200.10.9.2: bytes=32 time<1ms TTL=128
Reply from 200.10.9.2: bytes=32 time<1ms TTL=128
Reply from 200.10.9.2: bytes=32 time<1ms TTL=128

Ping statistics for 200.10.9.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 15: Observation for pinging PC2 from PC3

Since PC2 and PC3 are in the same subnet 200.10.9.0/24, the ping goes through successfully and hence we get a no loss result.

```
Ashlesh> ping 200.10.8.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.8.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 16: Observation for pinging PC0 from router

```
Ashlesh> ping 200.10.8.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.8.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 17: Observation for pinging PC1 from router

```
Ashlesh> ping 200.10.9.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.9.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 18: Observation for pinging PC2 from router

```
Ashlesh> ping 200.10.9.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.9.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

Listing 19: Observation for pinging PC3 from router

The router is connected to all the PCs which is why a ping from its terminal results in a successfully termination. The hostname of the router is also visible in the outputs which might be of use in complex networks with multiple routers.

After setting default gateway

The observations for ping tests between devices as shown in the section above leads us to a common conclusion that, for a properly set subnet, the ping test succeds no matter the default gateway configuration, but for devices or ip addresses on different subnets, the ping test fails without a single packet transfered. This is because the router has no idea of where the packets should go to reach the appropriate destination. This

issue is solved by setting default gateways on devices that match the ip adddresses of their router interface. For instance, the default gateway on PC0 and PC1 should be set to 200.10.8.1 and that of PC2 and PC3 should be set to 200.10.9.1 for the ping from either side to go through.
All the ping tests in this section succed since the gateways are properly set for each PC. The ICMP packets are handed over to the default gateway and the router then routes to the required address without any issue. In real life setup, the default gateway for various devices on our home networks are the ip addresses of the home router. The gateway is essentially the connection of a subnet to another subnet.

```
> ping 200.10.8.3

Pinging 200.10.8.3 with 32 bytes of data:

Reply from 200.10.8.3: bytes=32 time<1ms TTL=128
Reply from 200.10.8.3: bytes=32 time<1ms TTL=128
Reply from 200.10.8.3: bytes=32 time<1ms TTL=128
Reply from 200.10.8.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.10.8.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 20: Observation for pinging PC1 from PC0

```
> ping 200.10.8.1

Pinging 200.10.8.1 with 32 bytes of data:

Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.10.8.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 21: Observation for pinging interface of router in same subnet from PC0

```
> ping 200.10.9.1

Pinging 200.10.9.1 with 32 bytes of data:

Reply from 200.10.9.1: bytes=32 time=1ms TTL=255
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255
```

```
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.10.9.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 22: Observation for pinging interface of router in different subnet from PC0

```
> ping 200.10.9.2

Pinging 200.10.9.2 with 32 bytes of data:

Reply from 200.10.9.2: bytes=32 time=1ms TTL=127
Reply from 200.10.9.2: bytes=32 time=1ms TTL=127
Reply from 200.10.9.2: bytes=32 time<1ms TTL=127
Reply from 200.10.9.2: bytes=32 time<1ms TTL=127

Ping statistics for 200.10.9.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 23: Observation for pinging PC2 from PC0

```
> ping 200.10.9.3

Pinging 200.10.9.3 with 32 bytes of data:

Reply from 200.10.9.3: bytes=32 time<1ms TTL=127
Reply from 200.10.9.3: bytes=32 time<1ms TTL=127
Reply from 200.10.9.3: bytes=32 time=1ms TTL=127
Reply from 200.10.9.3: bytes=32 time<1ms TTL=127

Ping statistics for 200.10.9.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 24: Observation for pinging PC3 from PC0

```
> ping 200.10.8.2

Pinging 200.10.8.2 with 32 bytes of data:

Reply from 200.10.8.2: bytes=32 time<1ms TTL=127
Reply from 200.10.8.2: bytes=32 time<1ms TTL=127
```

```
Reply from 200.10.8.2: bytes=32 time<1ms TTL=127
Reply from 200.10.8.2: bytes=32 time<1ms TTL=127

Ping statistics for 200.10.8.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 25: Observation for pinging PC0 from PC3

```
> ping 200.10.8.3

Pinging 200.10.8.3 with 32 bytes of data:

Reply from 200.10.8.3: bytes=32 time=1ms TTL=127
Reply from 200.10.8.3: bytes=32 time<1ms TTL=127
Reply from 200.10.8.3: bytes=32 time<1ms TTL=127
Reply from 200.10.8.3: bytes=32 time<1ms TTL=127

Ping statistics for 200.10.8.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 26: Observation for pinging PC1 from PC3

```
> ping 200.10.9.1

Pinging 200.10.9.1 with 32 bytes of data:

Reply from 200.10.9.1: bytes=32 time<1ms TTL=255
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255
Reply from 200.10.9.1: bytes=32 time=1ms TTL=255
Reply from 200.10.9.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.10.9.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 27: Observation for pinging interface of router in same subnet from PC3

```
> ping 200.10.8.1

Pinging 200.10.8.1 with 32 bytes of data:

Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
```

```
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255
Reply from 200.10.8.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.10.8.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 28: Observation for pinging interface of router in different subnet from PC3

```
> ping 200.10.9.2

Pinging 200.10.9.2 with 32 bytes of data:

Reply from 200.10.9.2: bytes=32 time<1ms TTL=128
Reply from 200.10.9.2: bytes=32 time<1ms TTL=128
Reply from 200.10.9.2: bytes=32 time<1ms TTL=128
Reply from 200.10.9.2: bytes=32 time<1ms TTL=128

Ping statistics for 200.10.9.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 29: Observation for pinging PC2 from PC3

```
Ashlesh> ping 200.10.8.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.8.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 30: Observation for pinging PC0 from router

```
Ashlesh> ping 200.10.8.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.8.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 31: Observation for pinging PC1 from router

```
Ashlesh> ping 200.10.9.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.9.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 32: Observation for pinging PC2 from router

```
Ashlesh> ping 200.10.9.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.10.9.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

Listing 33: Observation for pinging PC3 from router

5 Conclusion

The use of cisco packet tracer allowed for a simulated network without the use of any physical devices which would've been difficult otherwise. The network configuration that we achieved during the lab experiment allowed us to learn about the router, its basic configurations, components and need within a network. The various commands for the configuration of a router along with their syntax and functions were also dealt with during the experiment. Connection among networks with different network addresses was performed by using basic setups on the router. The need of a proper default gateway was understood while connecting the two subnets. Logical separation of the two subnets allowed easy debugging for when the pings didn't succed. The report contains the different observations noted during the experiment with some necessary comments on the results.