# Subnet Mask, Default Gateway and Static Routing

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# 1 Objectives

- Familiarization with network and subnet mask.
- Familiarization with default gateway and its configuration.
- Familiarization with Routing: Static Routing and its configuration.

# 2 Required Tools

## 2.1 Cisco Packet Tracer

Cisco Packet Tracer is a visual simulation software developed and distributed by Cisco Systems. Packet Tracer is a cross platform tool that allows simulated environment for modern computer network and network topologies.

# 3 Simulation Activities

The networks shown in Figure 1, 2 and 3 were created using packet tracer for the activities in the lab experiment. For sanity, the ping tests to and from group A (PC0, PC1 and PC2), group B (PC3, PC4 and PC5), and group C (PC6, PC7 and PC8) are represented by ping tests to and from PC0, PC3 and PC6 respectively. The observations for all the tests were conducted but only the selected ones are included in the report. The PCs are selected such that the observations represent the overall requirement of the activities.

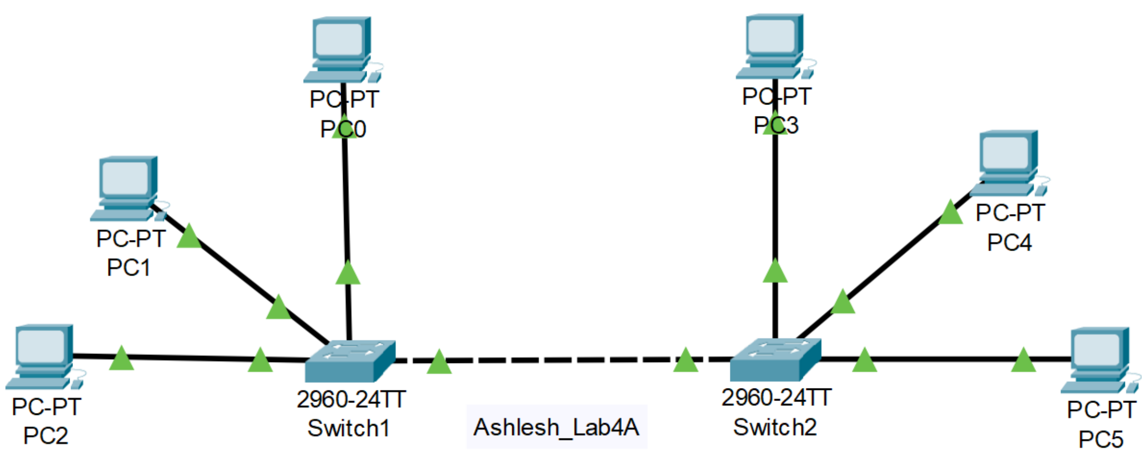


Figure 1: Simulated network for Activity A

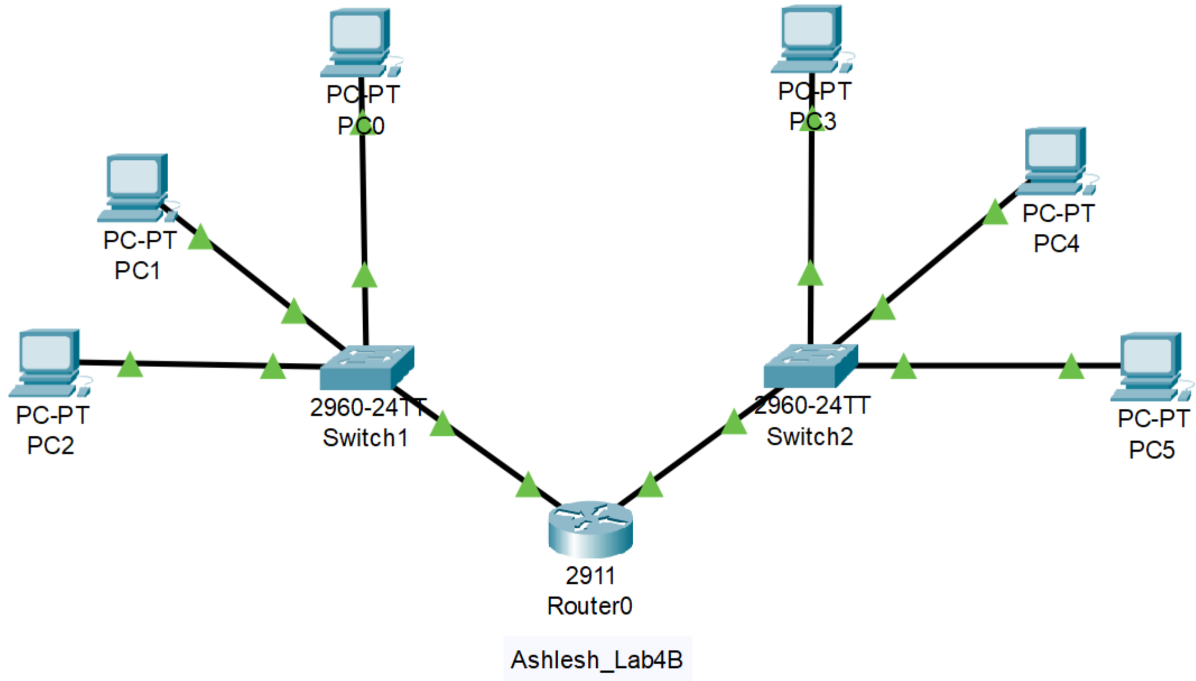


Figure 2: Simulated network for Activity B

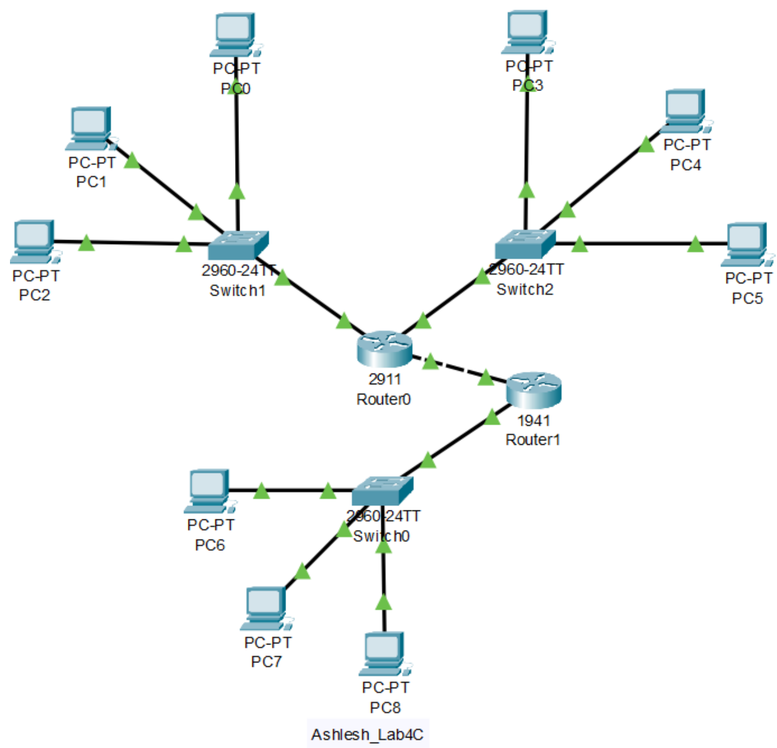


Figure 3: Simulated network for Activity C

# 4 Exercises

**Problem 1**
**What is a subnet mask? Why is it used? Explain with examples.**

A subnet mask is a four-octet or 32-bit number that is used in networks to identify the network and host IDs of a 32-bit IP address. The subnet mask is used to mask certain bits in the IP address using bitwise ANDing to determine the network and host IDs.

| IP address Class | Decimal notation | Binary notation | Classless Inter-Domain Routing (CIDR) notation |
|---|---|---|---|
| A | 255.0.0.0 | 11111111.00000000.00000000.00000000 | /8 |
| B | 255.255.0.0 | 11111111.11111111.00000000.00000000 | /16 |
| C | 255.255.255.0 | 11111111.11111111.11111111.00000000 | /24 |

Table 1: Default subnet masks for IP classes

| IP address Class | IP address | Network identifier | Host identifier |
|---|---|---|---|
| A | a.b.c.d | a.0.0.0 | 0.b.c.d |
| B | a.b.c.d | a.b.0.0 | 0.0.c.d |
| C | a.b.c.d | a.b.c.0 | 0.0.0.d |

Table 2: IP address class identifiers

While the default subnet masks shown in Table 1 are used in identifying the network and host IDs as in Table 2, the usage of subnet mask isn't limited to that. Subnet masks are used to segment larger networks into subnetworking by a process called subnetting. The default mask allows for over 16 million hosts per network for class A, over 16 thousand for class B and 254 for class C. But these numbers are useless since physical networks aren't located on a single network segment. The use of custom subnet masks allow the network to be split up into multiple unique routable networks. For instance, by changing the subnet mask from 255.255.0.0 to 255.255.255.0, we have 254 unique networks that each support 254 hosts.

| | | |
|---|---|---|
| IP address | 200.200.20.2 | 200.200.20.34 |
| | 11001000.11001000.00010100.00000010 | 11001000.11001000.00010100.00100010 |
| Default Subnet mask | 11111111.11111111.11111111.00000000 | |
| Network ID | 11001000.11001000.00010100.00000000 | 11001000.11001000.00010100.00000000 |
| | 200.200.20.0 | 200.200.20.0 |
| Custom Subnet mask | 11111111.11111111.11111111.11100000 | |
| Network ID | 11001000.11001000.00010100.00000000 | 11001000.11001000.00010100.00100000 |
| | 200.200.20.0 | 200.200.20.32 |

Table 3: Subnetting using custom subnet mask

Another example of a subnet mask's usage illustrated in Table 3can be figured out by taking two addresses, 200.200.20.2 and 200.200.20.34. For a subnet mask of 255.255.255.0, both of these IPs are on the same network, 200.200.20.0. But if we change the subnet mask to 255.255.255.224, the IP 200.200.20.2 is on the network 200.200.20.0 and IP 200.200.20.34 is on the network 200.200.20.32.

**Problem 2**

**How does a sending host know whether the destination computer is on the same network or on the different network? How data packet is forwarded in each case from the sending host? Explain.**

A sending host looking to communicate with a destination uses the subnet mask to determine whether the destination is in the same subnet as itself or in a different one. The bitwise ANDing of the IP address of the host and the subnet mask gives the network ID for the host. Similarly, the bitwise AND operation between the destination IP address and subnet mask identifies the network the destination is in. This is all performed by the sending host, based on which two of the following cases are possible,

### Host and destination in same subnet

If the destination is in the same subnet, i.e. is local to the host, the host uses the arp table to lookup the MAC address of the destination and directly communicates with the destination.

### Host and destination in different subnet

If the destination is in a different subnet, i.e. is rempte to the host, the host forwards the packet to the default gateway which then uses the route tables to communicate with the destination.

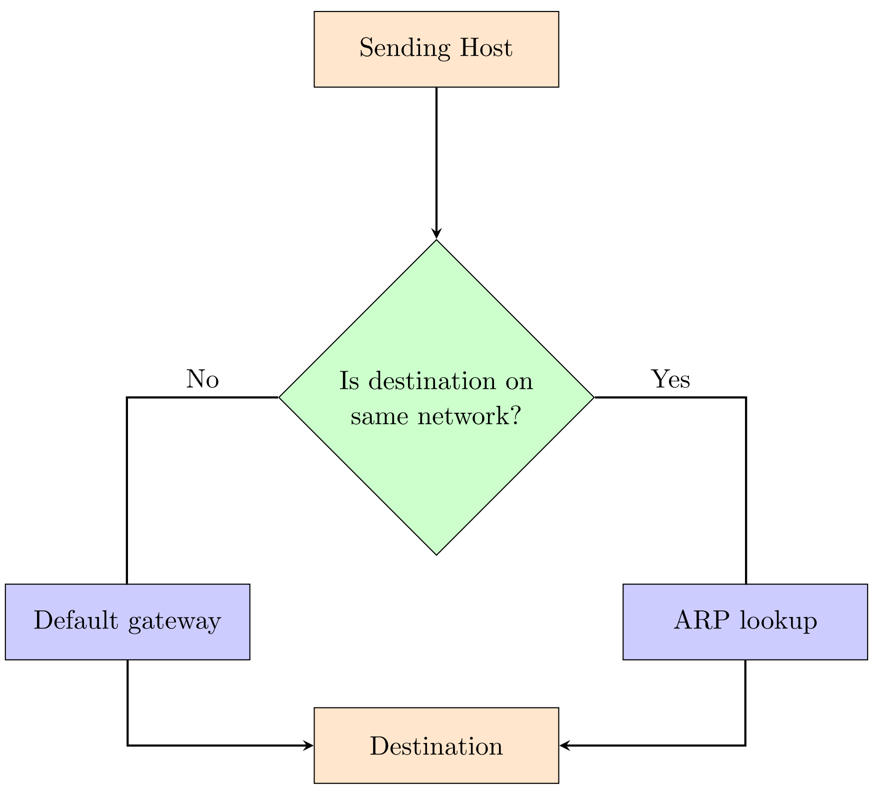


Figure 4: Data packet forwarding from host to destination

**Problem 3**

**What is a routing? Explain static routing and configuration of static routing in a router with its syntax and functions. Also mention how the routing table of a router can be observed.**

Routing is a process of determining the best way for a packet to move from one network to another. It is a process used by a router to route packets based on the packet header and routing table.
A router makes routing decisions based on which the packets are forwarded to the remote network. Static routing is one such method for routing. It is a technique where the network administrator adds non-adaptive routes manually into the routing table. The routes aren't to be modified or changed by the router based on network status. The use of static routing technique is useful for networks that require control over the routes that a packet takes, which ensures security during communication. The routes are manually added on the routing table using the syntax enlisted in Listing 1.

```
ip route Destination_Network Subnet_Mask [next-hop-address or
                                          outgoing interface]
where,
Destination_Network ==> Destination network address
Subnet_mask         ==> Subnet mask that reveals the network address
                        of destination
next-hop-address or ==> IP address of the nearest router in the
outgoing interface        path or the next interface
```

Listing 1: Syntax for configuring static route

The routing table of a router can be observed using the command *show ip route*.

**Problem 4**

**Note down the observation of each steps with necessary commands specified in activities A, B and C mentioned above and comment on it.**

**a. Activity A**

**Sub activity 1**

The network shown in Figure 1 is created using Packet Tracer with basic settings as,

| PC | IP address | Subnet mask |
|---|---|---|
| 0 | 200.200.20.2 | 255.255.255.0 |
| 1 | 200.200.20.3 | 255.255.255.0 |
| 2 | 200.200.20.4 | 255.255.255.0 |
| 3 | 200.200.20.34 | 255.255.255.0 |
| 4 | 200.200.20.35 | 255.255.255.0 |
| 5 | 200.200.20.36 | 255.255.255.0 |

Note: The ip addressess and subnet masks are set using the IP configuration application as shown in Figure 5

Table 4: IP address and subnet masks for the PCs in the network

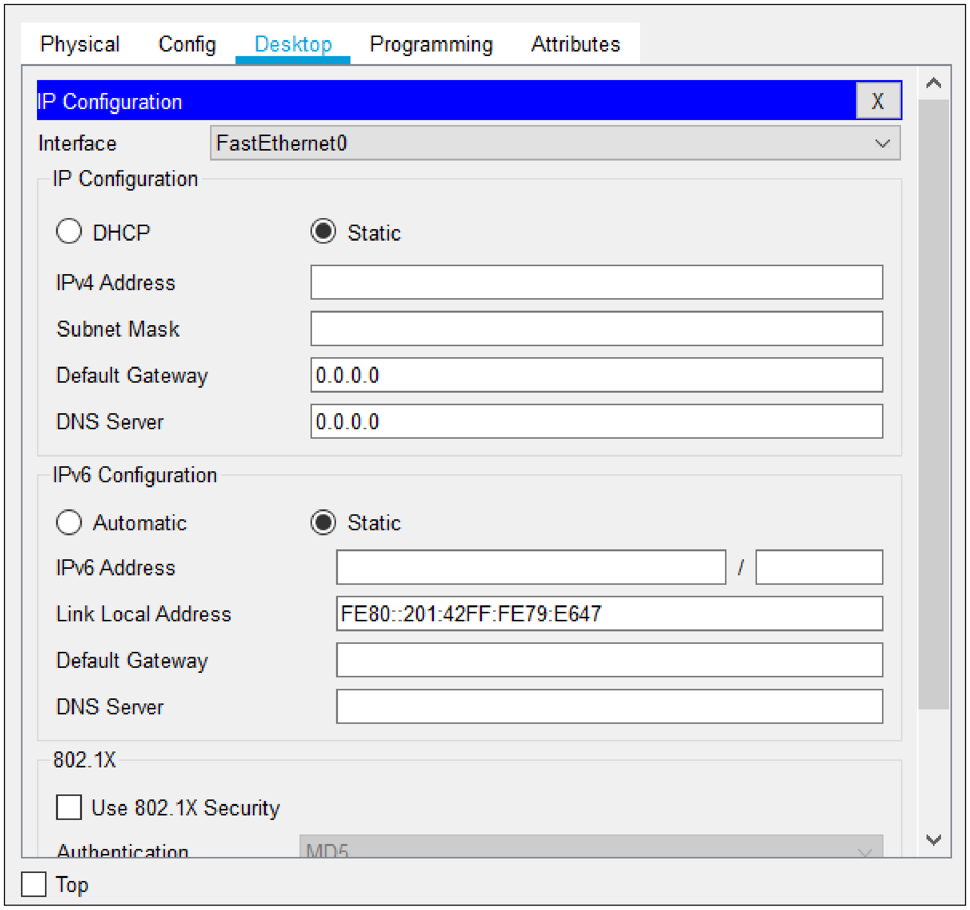


Figure 5: IP configuration application present in the desktop of individual PCs

### Sub activity 2

```
C:\>ping 200.200.20.3

Pinging 200.200.20.3 with 32 bytes of data:

Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time=1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time=11ms TTL=128

Ping statistics for 200.200.20.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms
```

Listing 2: Observation for ping test from PC0 to PC1

```
C:\>ping 200.200.20.34

Pinging 200.200.20.34 with 32 bytes of data:

Reply from 200.200.20.34: bytes=32 time=1ms TTL=128
Reply from 200.200.20.34: bytes=32 time<1ms TTL=128
Reply from 200.200.20.34: bytes=32 time<1ms TTL=128
Reply from 200.200.20.34: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.34:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 3: Observation for ping test from PC0 to PC3

| Sending Host | Destination | Ping status |
|---|---|---|
| PC0 | PC1<br>PC2<br>PC3<br>PC4<br>PC5 | Successful |

Table 5: Observation for ping tests from PC0 to other PCs

**Sub activity 3**

```
C:\>ping 200.200.20.2

Pinging 200.200.20.2 with 32 bytes of data:

Reply from 200.200.20.2: bytes=32 time=1ms TTL=128
Reply from 200.200.20.2: bytes=32 time<1ms TTL=128
Reply from 200.200.20.2: bytes=32 time<1ms TTL=128
Reply from 200.200.20.2: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 4: Observation for ping test from PC3 to PC0

```
C:\>ping 200.200.20.35
```

```
Pinging 200.200.20.35 with 32 bytes of data:

Reply from 200.200.20.35: bytes=32 time=1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 5: Observation for ping test from PC3 to PC4

| Sending Host | Destination | Ping status |
|---|---|---|
| PC3 | PC0<br>PC1<br>PC2<br>PC4<br>PC5 | Successful |

Table 6: Observation for ping tests from PC3 to other PCs

**Sub activity 4**

```
C:\>ping 200.200.20.3

Pinging 200.200.20.3 with 32 bytes of data:

Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.3:
    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 ping test from PC0 to PC1

```
C:\>ping 200.200.20.34

Pinging 200.200.20.34 with 32 bytes of data:

Request timed out.
```

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

Ping statistics for 200.200.20.34:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 7: Observation for ping test from PC0 to PC3

| Sending Host | Destination | Ping status |
|---|---|---|
| PC0 | PC1<br>PC2 | Successful |
| | PC3<br>PC4<br>PC5 | Request timed out |

Table 7: Observation for ping tests from PC0 to other PCs

The ping requests from PC0 to PC3 and PC0 to PC1 are successful for sub activity 2, but when the subnet mask of the PCs are changed from 255.255.255.0 to 255.255.255.224, the ping request from PC0 (200.200.20.2) to PC3 (200.200.20.34) fails with a request timed out error, whereas the ping to PC1 remains unchanged. This is beacuse the sending host, in this case, PC0 can't find the destination PC3 in it's subnet. The change in subnet mask causes the two PCs under consideration to be located in different subnets, hence the ping is unsuccessful.

**Sub activity 5**

```
C:\>ping 200.200.20.2

Pinging 200.200.20.2 with 32 bytes of data:

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

Ping statistics for 200.200.20.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 8: Observation for ping test from PC3 to PC0

```
C:\>ping 200.200.20.35

Pinging 200.200.20.35 with 32 bytes of data:

Reply from 200.200.20.35: bytes=32 time=1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
```

```
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 9: Observation for ping test from PC3 to PC4

| Sending Host | Destination | Ping status |
|---|---|---|
| PC3 | PC0<br>PC1<br>PC2 | Request timed out |
| | PC4<br>PC5 | Successful |

Table 8: Observation for ping tests from PC3 to other PCs

The ping requests from PC3 to PC0 and PC3 to PC4 are successful for sub activity 3, but when the subnet mask of the PCs are changed from 255.255.255.0 to 255.255.255.224, the ping request from PC3 (200.200.20.34) to PC0 (200.200.20.2) fails with a request timed out error, whereas the ping to PC4 remains unchanged. This is beacuse the sending host, in this case, PC3 can't find the destination PC0 in it's subnet. The change in subnet mask causes the two PCs under consideration to be located in different subnets, hence the ping is unsuccessful.

### b. Activity B

The network shown in Figure 2 is extended from the network for Activity A. The router is connected between the two switches using the gigbitethernet ports on the router and fast ethernet ports on the switches.

#### Sub activity 1

The gigabitethernet ports are configured as,

| Gigabitethernet | IP address | Subnet mask |
|---|---|---|
| 0/0 | 200.200.20.1 | 255.255.255.224 |
| 0/1 | 200.200.20.33 | 255.255.255.224 |

Note: The ip addressess and subnet masks are set using the configuration commands shown in Listing 10

Table 9: IP address and subnet masks for the gigabitethernet interfaces on Router0

```
Router(config)# interface gigabitethernet 0/0
Router(config-if)# ip address 200.200.20.1 255.255.255.224
Router(config-if)# no shutdown
```

```
Router(config)# interface gigabitethernet 0/1
Router(config-if)# ip address 200.200.20.33 255.255.255.224
Router(config-if)# no shutdown
```

Listing 10: Syntax for configuring interfaces on Router0

**Sub activity 2**

```
C:\>ping 200.200.20.3

Pinging 200.200.20.3 with 32 bytes of data:

Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time=1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time=11ms TTL=128

Ping statistics for 200.200.20.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms
```

Listing 11: Observation for ping test from PC0 to PC1

```
C:\>ping 200.200.20.34

Pinging 200.200.20.34 with 32 bytes of data:

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

Ping statistics for 200.200.20.34:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 12: Observation for ping test from PC0 to PC3

| Sending Host | Destination | Ping status |
|---|---|---|
| PC0 | PC1<br>PC2 | Successful |
| | PC3<br>PC4<br>PC5 | Request timed out |

Table 10: Observation for ping tests from PC0 to other PCs

**Sub activity 3**

```
C:\>ping 200.200.20.2

Pinging 200.200.20.2 with 32 bytes of data:

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

Ping statistics for 200.200.20.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 13: Observation for ping test from PC3 to PC0

```
C:\>ping 200.200.20.35

Pinging 200.200.20.35 with 32 bytes of data:

Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 14: Observation for ping test from PC3 to PC4

| Sending Host | Destination | Ping status |
|---|---|---|
| PC3 | PC0<br>PC1<br>PC2 | Request timed out |
| | PC4<br>PC5 | Successful |

Table 11: Observation for ping tests from PC3 to other PCs

**Sub activity 4**

```
C:\>ping 200.200.20.3

Pinging 200.200.20.3 with 32 bytes of data:
```

```
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.3:
    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 ping test from PC0 to PC1

```
C:\>ping 200.200.20.34

Pinging 200.200.20.34 with 32 bytes of data:

Reply from 200.200.20.34: bytes=32 time<1ms TTL=127
Reply from 200.200.20.34: bytes=32 time<1ms TTL=127
Reply from 200.200.20.34: bytes=32 time<1ms TTL=127
Reply from 200.200.20.34: bytes=32 time<1ms TTL=127

Ping statistics for 200.200.20.34:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 16: Observation for ping test from PC0 to PC3

| Sending Host | Destination | Ping status |
|---|---|---|
| PC0 | PC1<br>PC2<br>PC3<br>PC4<br>PC5 | Successful |

Table 12: Observation for ping tests from PC0 to other PCs

The ping request from PC0 to PC1 is successful and PC0 to PC3 failed with request timed out error for sub activity 2, but when the default gateway for PC0, PC1 and PC2 is set to 200.200.20.1 and that for PC3, PC4 and PC5 is set to 200.200.20.33, the ping request from PC0 (200.200.20.2) to PC3 (200.200.20.34) succeeds whereas the ping to PC1 remains unchanged. This is beacuse the sending host, at first couldn't locate PC3 in it's subnet but didn't know where to forward the packet. But once the default gateway is set correctly such that the router can receive the packet in case the sending host doesn't locate the destination itself, the router routes the packets correctly to other subnet. The default gateways for the two subnets are the IP addresses of the interfaces of the router that the switches are connected to.

**Sub activity 5**

```
C:\>ping 200.200.20.2

Pinging 200.200.20.2 with 32 bytes of data:

Reply from 200.200.20.2: bytes=32 time=1ms TTL=127
Reply from 200.200.20.2: bytes=32 time<1ms TTL=127
Reply from 200.200.20.2: bytes=32 time<1ms TTL=127
Reply from 200.200.20.2: bytes=32 time<1ms TTL=127

Ping statistics for 200.200.20.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 17: Observation for ping test from PC3 to PC0

```
C:\>ping 200.200.20.35

Pinging 200.200.20.35 with 32 bytes of data:

Reply from 200.200.20.35: bytes=32 time=1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 18: Observation for ping test from PC3 to PC4

| Sending Host | Destination | Ping status |
|---|---|---|
| PC3 | PC0<br>PC1<br>PC2<br>PC4<br>PC5 | Successful |

Table 13: Observation for ping tests from PC3 to other PCs

The ping request from PC3 to PC4 is successful and PC3 to PC0 failed with request timed out error for sub activity 3, but when the default gateway for PC0, PC1 and PC2 is set to 200.200.20.1 and that for PC3, PC4 and PC5 is set to 200.200.20.33, the ping request from PC3 (200.200.20.34) to PC0 (200.200.20.2) succeeds whereas the ping to PC4 remains unchanged. This is beacuse the sending host, at first couldn't locate PC0 in it's subnet but didn't know where to forward the packet. But once the default gateway is set correctly such that the router can receive the packet in case the sending host doesn't locate the destination itself, the router routes the packets correctly to other subnet.

### Sub activity 6

```
Router>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B -
   BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
   inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     200.200.20.0/24 is variably subnetted, 4 subnets, 2 masks
C       200.200.20.0/27 is directly connected, GigabitEthernet0/0
L       200.200.20.1/32 is directly connected, GigabitEthernet0/0
C       200.200.20.32/27 is directly connected, GigabitEthernet0/1
L       200.200.20.33/32 is directly connected, GigabitEthernet0/1
```

Listing 19: Observation for show ip route on Router0

Listing 19 shows the results for running the show ip route command on Router0. There are two interfaces connected in the network that are denoted by L (Local). Also, C (Connected) status indicates that the route was learned as a result of configuring the interface, which means that the two subnets connected on the two gigabitethernet interfaces are shown. There is no static route available as we haven't set one yet.

## c. Activity C

### Sub activity 1

The IP addressess and subnet masks for each PC added are configured as,

| PC | IP address | Subnet mask |
|---|---|---|
| 6 | 200.200.20.100 | 255.255.255.224 |
| 7 | 200.200.20.101 | 255.255.255.224 |
| 8 | 200.200.20.102 | 255.255.255.224 |

Note: The ip addressess and subnet masks are set using the IP configuration application as shown in Figure 5. The default gateway for these PCs is set to 200.200.20.99

Table 14: IP address and subnet masks for the PCs added in the network

### Sub activity 2

The IP addressess and subnet masks for the gigabitethernet interfaces on the routers are configured as,

| Gigabitethernet interface | IP address | Subnet mask |
|---|---|---|
| Router0 0/0 | 200.200.20.65 | 255.255.255.224 |
| Router1 0/0 | 200.200.20.66 | 255.255.255.224 |
| Router1 0/1 | 200.200.20.99 | 255.255.255.224 |

Note: The ip addressess and subnet masks are set using the configuration commands shown in Listing 20 and 21

Table 15: IP address and subnet masks for the gigabitethernet interfaces on Router0 and Router1

```
Router(config)# interface gigabitethernet 0/2
Router(config-if)# ip address 200.200.20.65 255.255.255.224
Router(config-if)# no shutdown
```

Listing 20: Syntax for configuring interfaces on Router0

```
Router(config)# interface gigabitethernet 0/0
Router(config-if)# ip address 200.200.20.66 255.255.255.224
Router(config-if)# no shutdown
Router(config-if)# exit

Router(config)# interface gigabitethernet 0/1
Router(config-if)# ip address 200.200.20.99 255.255.255.224
Router(config-if)# no shutdown
```

Listing 21: Syntax for configuring interfaces on Router1

**Sub activity 3**

The different parameters to be configured on Router0 and Router1 are,

| Router | hostname | console password | enable password | vty password |
|---|---|---|---|---|
| 0<br>1 | Ashlesh<br>Pandey | ashlesh | 407 | pandey |

Note: The ip parameters are set using the configuration commands shown in Listing 22 and 23

Table 16: Configuration parameters for Router0 and Router1

```
Router(config)#hostname Ashlesh

Ashlesh(config)#line console 0
Ashlesh(config-line)#password ashlesh
```

```
Ashlesh(config-line)#login
Ashlesh(config-line)#exit

Ashlesh(config)#enable password 407

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

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

Listing 22: Syntax for configuring mentioned parameters on Router0

```
Router(config)#hostname Pandey

Pandey(config)#line console 0
Pandey(config-line)#password ashlesh
Pandey(config-line)#login
Pandey(config-line)#exit

Pandey(config)#enable password 407

Pandey(config)#line vty 0 4
Pandey(config-line)#password pandey
Pandey(config-line)#login
Pandey(config-line)#exit

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

Listing 23: Syntax for configuring mentioned parameters on Router1

**Sub activity 4**

```
Ashlesh>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B -
   BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
   inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set
```

```
     200.200.20.0/24 is variably subnetted, 6 subnets, 2 masks
C       200.200.20.0/27 is directly connected, GigabitEthernet0/0
L       200.200.20.1/32 is directly connected, GigabitEthernet0/0
C       200.200.20.32/27 is directly connected, GigabitEthernet0/1
L       200.200.20.33/32 is directly connected, GigabitEthernet0/1
C       200.200.20.64/27 is directly connected, GigabitEthernet0/2
L       200.200.20.65/32 is directly connected, GigabitEthernet0/2
```

Listing 24: Observation for show ip route on Router0

```
Pandey>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B -
   BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
   inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     200.200.20.0/24 is variably subnetted, 4 subnets, 2 masks
C       200.200.20.64/27 is directly connected, GigabitEthernet0/0
L       200.200.20.66/32 is directly connected, GigabitEthernet0/0
C       200.200.20.96/27 is directly connected, GigabitEthernet0/1
L       200.200.20.99/32 is directly connected, GigabitEthernet0/1
```

Listing 25: Observation for show ip route on Router1

**Sub activity 5**

```
C:\>ping 200.200.20.3

Pinging 200.200.20.3 with 32 bytes of data:

Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128
Reply from 200.200.20.3: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 26: Observation for ping test from PC0 to PC1

```
C:\>ping 200.200.20.34

Pinging 200.200.20.34 with 32 bytes of data:

Reply from 200.200.20.34: bytes=32 time<1ms TTL=127
Reply from 200.200.20.34: bytes=32 time<1ms TTL=127
Reply from 200.200.20.34: bytes=32 time<1ms TTL=127
Reply from 200.200.20.34: bytes=32 time<1ms TTL=127

Ping statistics for 200.200.20.34:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 27: Observation for ping test from PC0 to PC3

```
C:\>ping 200.200.20.100

Pinging 200.200.20.100 with 32 bytes of data:

Reply from 200.200.20.1: Destination host unreachable.
Reply from 200.200.20.1: Destination host unreachable.
Reply from 200.200.20.1: Destination host unreachable.
Reply from 200.200.20.1: Destination host unreachable.

Ping statistics for 200.200.20.100:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 28: Observation for ping test from PC0 to PC6

```
C:\>ping 200.200.20.1

Pinging 200.200.20.1 with 32 bytes of data:

Reply from 200.200.20.1: bytes=32 time<1ms TTL=255
Reply from 200.200.20.1: bytes=32 time<1ms TTL=255
Reply from 200.200.20.1: bytes=32 time<1ms TTL=255
Reply from 200.200.20.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.1:
    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 ping test from PC0 to Router0 0/0

```
C:\>ping 200.200.20.33

Pinging 200.200.20.33 with 32 bytes of data:

Reply from 200.200.20.33: bytes=32 time=1ms TTL=255
Reply from 200.200.20.33: bytes=32 time<1ms TTL=255
Reply from 200.200.20.33: bytes=32 time<1ms TTL=255
Reply from 200.200.20.33: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 30: Observation for ping test from PC0 to Router0 0/1

```
C:\>ping 200.200.20.65

Pinging 200.200.20.65 with 32 bytes of data:

Reply from 200.200.20.65: bytes=32 time<1ms TTL=255
Reply from 200.200.20.65: bytes=32 time<1ms TTL=255
Reply from 200.200.20.65: bytes=32 time<1ms TTL=255
Reply from 200.200.20.65: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 31: Observation for ping test from PC0 to Router0 0/2

```
C:\>ping 200.200.20.66

Pinging 200.200.20.66 with 32 bytes of data:

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

Ping statistics for 200.200.20.66:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 32: Observation for ping test from PC0 to Router1 0/0

```
C:\>ping 200.200.20.99

Pinging 200.200.20.99 with 32 bytes of data:

Reply from 200.200.20.1: Destination host unreachable.
Reply from 200.200.20.1: Destination host unreachable.
Reply from 200.200.20.1: Destination host unreachable.
Reply from 200.200.20.1: Destination host unreachable.

Ping statistics for 200.200.20.99:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 33: Observation for ping test from PC0 to Router1 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| PC0 | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5 | Successful |
| | PC6<br>PC7<br>PC8 | Destination host unreachable |
| | Router0 0/0<br>Router0 0/1<br>Router0 0/2 | Successful |
| | Router1 0/0 | Request timed out |
| | Router1 0/1 | Destination host unreachable |

Table 17: Observation for ping tests from PC0 to other PCs and router interfaces

**Sub activity 6**

```
C:\>ping 200.200.20.2

Pinging 200.200.20.2 with 32 bytes of data:

Reply from 200.200.20.2: bytes=32 time<1ms TTL=127
Reply from 200.200.20.2: bytes=32 time<1ms TTL=127
Reply from 200.200.20.2: bytes=32 time<1ms TTL=127
Reply from 200.200.20.2: bytes=32 time<1ms TTL=127

Ping statistics for 200.200.20.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 34: Observation for ping test from PC3 to PC0

```
C:\>ping 200.200.20.35

Pinging 200.200.20.35 with 32 bytes of data:

Reply from 200.200.20.35: bytes=32 time=1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128
Reply from 200.200.20.35: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.35:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 35: Observation for ping test from PC3 to PC4

```
C:\>ping 200.200.20.100

Pinging 200.200.20.100 with 32 bytes of data:

Reply from 200.200.20.33: Destination host unreachable.
Reply from 200.200.20.33: Destination host unreachable.
Reply from 200.200.20.33: Destination host unreachable.
Reply from 200.200.20.33: Destination host unreachable.

Ping statistics for 200.200.20.100:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 36: Observation for ping test from PC3 to PC6

```
C:\>ping 200.200.20.1

Pinging 200.200.20.1 with 32 bytes of data:

Reply from 200.200.20.1: bytes=32 time<1ms TTL=255
Reply from 200.200.20.1: bytes=32 time<1ms TTL=255
Reply from 200.200.20.1: bytes=32 time<1ms TTL=255
Reply from 200.200.20.1: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 37: Observation for ping test from PC3 to Router0 0/0

```
C:\>ping 200.200.20.33

Pinging 200.200.20.33 with 32 bytes of data:

Reply from 200.200.20.33: bytes=32 time<1ms TTL=255
Reply from 200.200.20.33: bytes=32 time=2ms TTL=255
Reply from 200.200.20.33: bytes=32 time<1ms TTL=255
Reply from 200.200.20.33: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Listing 38: Observation for ping test from PC3 to Router0 0/1

```
C:\>ping 200.200.20.65

Pinging 200.200.20.65 with 32 bytes of data:

Reply from 200.200.20.65: bytes=32 time=1ms TTL=255
Reply from 200.200.20.65: bytes=32 time<1ms TTL=255
Reply from 200.200.20.65: bytes=32 time<1ms TTL=255
Reply from 200.200.20.65: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 39: Observation for ping test from PC3 to Router0 0/2

```
C:\>ping 200.200.20.66

Pinging 200.200.20.66 with 32 bytes of data:

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

Ping statistics for 200.200.20.66:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 40: Observation for ping test from PC3 to Router1 0/0

```
C:\>ping 200.200.20.99

Pinging 200.200.20.99 with 32 bytes of data:

Reply from 200.200.20.33: Destination host unreachable.
Reply from 200.200.20.33: Destination host unreachable.
Reply from 200.200.20.33: Destination host unreachable.
Request timed out.

Ping statistics for 200.200.20.99:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 41: Observation for ping test from PC3 to Router1 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| PC3 | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5 | Successful |
| | PC6<br>PC7<br>PC8 | Destination host unreachable |
| | Router0 0/0<br>Router0 0/1<br>Router0 0/2 | Successful |
| | Router1 0/0 | Request timed out |
| | Router1 0/1 | Destination host unreachable |

Table 18: Observation for ping tests from PC3 to other PCs and router interfaces

**Sub activity 7**

```
C:\>ping 200.200.20.2

Pinging 200.200.20.2 with 32 bytes of data:

Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.

Ping statistics for 200.200.20.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 42: Observation for ping test from PC6 to PC0

```
C:\>ping 200.200.20.34

Pinging 200.200.20.34 with 32 bytes of data:

Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.

Ping statistics for 200.200.20.34:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 43: Observation for ping test from PC6 to PC3

```
C:\>ping 200.200.20.101

Pinging 200.200.20.101 with 32 bytes of data:

Reply from 200.200.20.101: bytes=32 time<1ms TTL=128
Reply from 200.200.20.101: bytes=32 time<1ms TTL=128
Reply from 200.200.20.101: bytes=32 time<1ms TTL=128
Reply from 200.200.20.101: bytes=32 time<1ms TTL=128

Ping statistics for 200.200.20.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 44: Observation for ping test from PC6 to PC7

```
C:\>ping 200.200.20.1

Pinging 200.200.20.1 with 32 bytes of data:

Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.

Ping statistics for 200.200.20.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 45: Observation for ping test from PC6 to Router0 0/0

```
C:\>ping 200.200.20.33

Pinging 200.200.20.33 with 32 bytes of data:

Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.
Reply from 200.200.20.99: Destination host unreachable.

Ping statistics for 200.200.20.33:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 46: Observation for ping test from PC6 to Router0 0/1

```
C:\>ping 200.200.20.65

Pinging 200.200.20.65 with 32 bytes of data:

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

Ping statistics for 200.200.20.65:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

Listing 47: Observation for ping test from PC6 to Router0 0/2

```
C:\>ping 200.200.20.66

Pinging 200.200.20.66 with 32 bytes of data:

Reply from 200.200.20.66: bytes=32 time<1ms TTL=255
Reply from 200.200.20.66: bytes=32 time<1ms TTL=255
Reply from 200.200.20.66: bytes=32 time<1ms TTL=255
Reply from 200.200.20.66: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 48: Observation for ping test from PC6 to Router1 0/0

```
C:\>ping 200.200.20.99

Pinging 200.200.20.99 with 32 bytes of data:

Reply from 200.200.20.99: bytes=32 time=1ms TTL=255
Reply from 200.200.20.99: bytes=32 time<1ms TTL=255
Reply from 200.200.20.99: bytes=32 time<1ms TTL=255
Reply from 200.200.20.99: bytes=32 time<1ms TTL=255

Ping statistics for 200.200.20.99:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 49: Observation for ping test from PC6 to Router1 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| PC6 | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5 | Destination host unreachable |
| | PC6<br>PC7<br>PC8 | Successful |
| | Router0 0/0<br>Router0 0/1 | Destination host unreachable |
| | Router0 0/2 | Request timed out |
| | Router1 0/0<br>Router1 0/1 | Successful |

Table 19: Observation for ping tests from PC6 to other PCs and router interfaces

**Sub activity 8**

```
Ashlesh>ping 200.200.20.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 50: Observation for ping test from Router0 to PC0

```
Ashlesh>ping 200.200.20.34

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.34, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 51: Observation for ping test from Router0 to PC3

```
Ashlesh>ping 200.200.20.100

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.100, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Listing 52: Observation for ping test from Router0 to PC6

```
Ashlesh>ping 200.200.20.66

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.66, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

Listing 53: Observation for ping test from Router0 to Router1 0/0

```
Ashlesh>ping 200.200.20.99

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.99, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Listing 54: Observation for ping test from Router0 to Router1 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| Router0 (Ashlesh) | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5 | Successful |
| | PC6<br>PC7<br>PC8 | Failed |
| | Router1 0/0 | Successful |
| | Router1 0/1 | Failed |

Table 20: Observation for ping tests from Router0 to PCs and Router1 interfaces

**Sub activity 9**

```
Pandey>ping 200.200.20.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Listing 55: Observation for ping test from Router1 to PC0

```
Pandey>ping 200.200.20.34

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.34, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Listing 56: Observation for ping test from Router1 to PC3

```
Pandey>ping 200.200.20.100

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.100, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 57: Observation for ping test from Router1 to PC6

```
Pandey>ping 200.200.20.1
```

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5
```

Listing 58: Observation for ping test from Router1 to Router0 0/0

```
Pandey>ping 200.200.20.33

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.33, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Listing 59: Observation for ping test from Router1 to Router0 0/1

```
Pandey>ping 200.200.20.65

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.65, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 60: Observation for ping test from Router1 to Router0 0/2

| Sending Host | Destination | Ping status |
|---|---|---|
| Router1 (Pandey) | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5 | Failed |
| | PC6<br>PC7<br>PC8 | Successful |
| | Router0 0/0<br>Router0 0/1 | Failed |
| | Router0 0/2 | Successful |

Table 21: Observation for ping tests from Router1 to PCs and Router0 interfaces

**Sub activity 10**

The syntax to configure a static ip route is enlisted in Listing 1. For the network 3, the subnet mask is 255.255.255.224 and the next-hop-address is 200.200.20.66, but the destination network address needs to be calculated. To calculate the network address for network 3, we can perform bitwise AND operation between the subnet mask for the network and an IP address from the network, i.e. IP address of any of PC6, PC7 or PC8.

| | |
|---|---|
| IP address | 200.200.20.100 |
| | 11001000.11001000.00010100.01100100 |
| Subnet mask | 11111111.11111111.11111111.11100000 |
| Network ID | 11001000.11001000.00010100.01100000 |
| | 200.200.20.96 |

Table 22: Calculating network identifier for network 3

```
C:\>telnet 200.200.20.1
Trying 200.200.20.1 ...Open

User Access Verification

Password:
Ashlesh>enable
Password:
Ashlesh#config terminal
Ashlesh(config)#ip route 200.200.20.96 255.255.255.224 200.200.20.66
Ashlesh(config)#exit
```

Listing 61: Syntax for configuring static route for network 3 on Router0

**Sub activity 11**

The syntax to configure a static ip route is enlisted in Listing 1. For both network 1 and network 2, the subnet mask is 255.255.255.224 and the next-hop-address is 200.200.20.65, but the destination network addresses are different which have already been calculated in Table 3.

```
Ashlesh#telnet 200.200.20.66
Trying 200.200.20.66 ...Open
User Access Verification

Password:
Pandey>enable
Password:
Pandey#config terminal
Pandey(config)#ip route 200.200.20.0 255.255.255.224 200.200.20.65
Pandey(config)#ip route 200.200.20.32 255.255.255.224 200.200.20.65
Pandey(config)#exit
Pandey#exit
[Connection to 200.200.20.66 closed by foreign host]
Ashlesh#exit
[Connection to 200.200.20.1 closed by foreign host]
C:\>
```

Listing 62: Syntax for configuring static route for network 1 and network 2 on Router1

**Sub activity 12**

```
Ashlesh>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B -
   BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
   inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     200.200.20.0/24 is variably subnetted, 7 subnets, 2 masks
C       200.200.20.0/27 is directly connected, GigabitEthernet0/0
L       200.200.20.1/32 is directly connected, GigabitEthernet0/0
C       200.200.20.32/27 is directly connected, GigabitEthernet0/1
L       200.200.20.33/32 is directly connected, GigabitEthernet0/1
C       200.200.20.64/27 is directly connected, GigabitEthernet0/2
L       200.200.20.65/32 is directly connected, GigabitEthernet0/2
S       200.200.20.96/27 [1/0] via 200.200.20.66
```

Listing 63: Observation for show ip route on Router0

```
Pandey>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B -
   BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
   inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     200.200.20.0/24 is variably subnetted, 6 subnets, 2 masks
S       200.200.20.0/27 [1/0] via 200.200.20.65
S       200.200.20.32/27 [1/0] via 200.200.20.65
C       200.200.20.64/27 is directly connected, GigabitEthernet0/0
L       200.200.20.66/32 is directly connected, GigabitEthernet0/0
C       200.200.20.96/27 is directly connected, GigabitEthernet0/1
L       200.200.20.99/32 is directly connected, GigabitEthernet0/1
```

Listing 64: Observation for show ip route on Router1

On re-running *show ip config* on both the routers, changes in the list are observed. There are additional static routes on both the list. These static routes are key observations since they'll be responsible for routing the packets that were not going through in previous runs.

```
C:\>ping 200.200.20.100

Pinging 200.200.20.100 with 32 bytes of data:

Reply from 200.200.20.100: bytes=32 time=1ms TTL=126
Reply from 200.200.20.100: bytes=32 time<1ms TTL=126
Reply from 200.200.20.100: bytes=32 time<1ms TTL=126
Reply from 200.200.20.100: bytes=32 time<1ms TTL=126

Ping statistics for 200.200.20.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 65: Observation for ping test from PC0 to PC6

```
C:\>ping 200.200.20.66

Pinging 200.200.20.66 with 32 bytes of data:

Reply from 200.200.20.66: bytes=32 time<1ms TTL=254
Reply from 200.200.20.66: bytes=32 time<1ms TTL=254
Reply from 200.200.20.66: bytes=32 time<1ms TTL=254
Reply from 200.200.20.66: bytes=32 time<1ms TTL=254

Ping statistics for 200.200.20.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 66: Observation for ping test from PC0 to Router1 0/0

```
C:\>ping 200.200.20.99

Pinging 200.200.20.99 with 32 bytes of data:

Reply from 200.200.20.99: bytes=32 time<1ms TTL=254
Reply from 200.200.20.99: bytes=32 time<1ms TTL=254
Reply from 200.200.20.99: bytes=32 time<1ms TTL=254
Reply from 200.200.20.99: bytes=32 time<1ms TTL=254

Ping statistics for 200.200.20.99:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

```
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 67: Observation for ping test from PC0 to Router1 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| PC0 | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5<br>PC6<br>PC7<br>PC8<br>Router0 0/0<br>Router0 0/1<br>Router0 0/2<br>Router1 0/0<br>Router1 0/1 | Successful |

Table 23: Observation for ping tests from PC0 to other PCs and router interfaces

```
C:\>ping 200.200.20.100

Pinging 200.200.20.100 with 32 bytes of data:

Reply from 200.200.20.100: bytes=32 time=1ms TTL=126
Reply from 200.200.20.100: bytes=32 time<1ms TTL=126
Reply from 200.200.20.100: bytes=32 time=9ms TTL=126
Reply from 200.200.20.100: bytes=32 time=1ms TTL=126

Ping statistics for 200.200.20.100:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 9ms, Average = 2ms
```

Listing 68: Observation for ping test from PC3 to PC6

```
C:\>ping 200.200.20.66

Pinging 200.200.20.66 with 32 bytes of data:

Reply from 200.200.20.66: bytes=32 time=1ms TTL=254
Reply from 200.200.20.66: bytes=32 time=1ms TTL=254
Reply from 200.200.20.66: bytes=32 time<1ms TTL=254
```

```
Reply from 200.200.20.66: bytes=32 time<1ms TTL=254

Ping statistics for 200.200.20.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 69: Observation for ping test from PC3 to Router1 0/0

```
C:\>ping 200.200.20.99

Pinging 200.200.20.99 with 32 bytes of data:

Reply from 200.200.20.99: bytes=32 time<1ms TTL=254
Reply from 200.200.20.99: bytes=32 time<1ms TTL=254
Reply from 200.200.20.99: bytes=32 time<1ms TTL=254
Reply from 200.200.20.99: bytes=32 time<1ms TTL=254

Ping statistics for 200.200.20.99:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 70: Observation for ping test from PC3 to Router1 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| PC3 | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5<br>PC6<br>PC7<br>PC8<br>Router0 0/0<br>Router0 0/1<br>Router0 0/2<br>Router1 0/0<br>Router1 0/1 | Successful |

Table 24: Observation for ping tests from PC3 to other PCs and router interfaces

```
C:\>ping 200.200.20.2

Pinging 200.200.20.2 with 32 bytes of data:
```

```
Reply from 200.200.20.2: bytes=32 time<1ms TTL=126
Reply from 200.200.20.2: bytes=32 time<1ms TTL=126
Reply from 200.200.20.2: bytes=32 time<1ms TTL=126
Reply from 200.200.20.2: bytes=32 time<1ms TTL=126

Ping statistics for 200.200.20.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 71: Observation for ping test from PC6 to PC0

```
C:\>ping 200.200.20.34

Pinging 200.200.20.34 with 32 bytes of data:

Reply from 200.200.20.34: bytes=32 time<1ms TTL=126
Reply from 200.200.20.34: bytes=32 time=1ms TTL=126
Reply from 200.200.20.34: bytes=32 time<1ms TTL=126
Reply from 200.200.20.34: bytes=32 time<1ms TTL=126

Ping statistics for 200.200.20.34:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 72: Observation for ping test from PC6 to PC3

```
C:\>ping 200.200.20.1

Pinging 200.200.20.1 with 32 bytes of data:

Reply from 200.200.20.1: bytes=32 time<1ms TTL=254
Reply from 200.200.20.1: bytes=32 time<1ms TTL=254
Reply from 200.200.20.1: bytes=32 time<1ms TTL=254
Reply from 200.200.20.1: bytes=32 time<1ms TTL=254

Ping statistics for 200.200.20.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Listing 73: Observation for ping test from PC6 to Router0 0/0

```
C:\>ping 200.200.20.33

Pinging 200.200.20.33 with 32 bytes of data:

Reply from 200.200.20.33: bytes=32 time=1ms TTL=254
Reply from 200.200.20.33: bytes=32 time<1ms TTL=254
Reply from 200.200.20.33: bytes=32 time<1ms TTL=254
Reply from 200.200.20.33: bytes=32 time=2ms TTL=254

Ping statistics for 200.200.20.33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms
```

Listing 74: Observation for ping test from PC6 to Router0 0/1

```
C:\>ping 200.200.20.65

Pinging 200.200.20.65 with 32 bytes of data:

Reply from 200.200.20.65: bytes=32 time=1ms TTL=254
Reply from 200.200.20.65: bytes=32 time<1ms TTL=254
Reply from 200.200.20.65: bytes=32 time<1ms TTL=254
Reply from 200.200.20.65: bytes=32 time<1ms TTL=254

Ping statistics for 200.200.20.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Listing 75: Observation for ping test from PC6 to Router0 0/2

| Sending Host | Destination | Ping status |
|---|---|---|
| PC6 | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5<br>PC6<br>PC7<br>PC8<br>Router0 0/0<br>Router0 0/1<br>Router0 0/2<br>Router1 0/0<br>Router1 0/1 | Successful |

Table 25: Observation for ping tests from PC6 to other PCs and router interfaces

```
Ashlesh>ping 200.200.20.100

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.100, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 76: Observation for ping test from Router0 to PC6

```
Ashlesh>ping 200.200.20.99

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.99, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 77: Observation for ping test from Router0 to Router1 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| Router0 (Ashlesh) | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5<br>PC6<br>PC7<br>PC8<br>Router1 0/0<br>Router1 0/1 | Successful |

Table 26: Observation for ping tests from Router0 to PCs and Router1 interfaces

```
Pandey>ping 200.200.20.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 78: Observation for ping test from Router1 to PC0

```
Pandey>ping 200.200.20.34

Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 200.200.20.34, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 79: Observation for ping test from Router1 to PC3

```
Pandey>ping 200.200.20.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/1 ms
```

Listing 80: Observation for ping test from Router1 to Router0 0/0

```
Pandey>ping 200.200.20.33

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.200.20.33, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms
```

Listing 81: Observation for ping test from Router1 to Router0 0/1

| Sending Host | Destination | Ping status |
|---|---|---|
| Router1 (Pandey) | PC0<br>PC1<br>PC2<br>PC3<br>PC4<br>PC5<br>PC6<br>PC7<br>PC8<br>Router0 0/0<br>Router0 0/1<br>Router0 0/2 | Successful |

Table 27: Observation for ping tests from Router1 to PCs and Router0 interfaces

The ping tests that previously failed are now successful since the static route has been setup for inter-network communication. The network 1 and 2 can communicate with the default gateway properly set whereas the network 3 requires a proper static route to be accessible from network 1 and network 2 and vice versa.

# 5 Conclusion

The activities were performed sequentially which aided in the understanding of a network subnetting and the various steps that need to be followed to configure a proper network topology. While performing activity

A, the concepts of subnet masks and subnetting were understood once the change in the default subnet mask was made. The change divided the network into two subnets which resulted in the ping tests from one subnet to the other to fail. During activity B, the inital observations were quite similar to that of the latter half of activity A since the packets weren't leaving a subnet although we had a router configured. Once the proper default gateways (IP address of the interface connected to the subnet) for all the PCs in both the subnets were set, the two subnets could communicate with each other as seen in the observations. For activity C, two routers were connected and different ping tests were performed. The additional subnetwork 3 couldn't communicate with the existing networks 1 and 2. The ip route table for both the routers showed that the router had no idea of the route that it should forward the packets to, and this is true since the static route wasn't set till this point. This is where the two ways a data packet is sent from a sending host to a destination was observed. Since the host couldn't find the destination on it's subnet, it forwarded the packet to the default gateway, which should've routed the packets to the destination but couldn't since the route wasn't defined. Once the static routes for both the routers were set properly, all the ping tests succeeded. Hence, the completion of this lab experiment allowed us to observe and understand the concepts of subnet masks, default gateway and static routing along with their usage within a network.