Lab 4: Static Routing & Default Route

Objectives:

- To be familiar with Static Routing and its configuration
- To be familiar with default route and its configuration
- To be familiar with route aggregation

Requirements:

- Network simulation tool: Packet Tracer

Procedure:

Procedure for Static Routing Technique

To configure static routing, a network administrator manually enters route information into a router's routing table, specifying the path packets should take to reach specific networks. This is done using the ip route command in global configuration mode, where the administrator defines the destination network, subnet mask, and either the next-hop IP address or the outgoing interface. For example, to route packets destined for the 172.16.3.0 network via the adjacent router with the IP address 172.16.4.1, the command would be ip route 172.16.3.0 255.255.255.0 172.16.4.1, or alternatively, using the outgoing interface Serial 0/0, it would be ip route 172.16.3.0 255.255.255.0 Serial 0/0. Verification is done using commands such as show running-config and show ip route to ensure the routes are correctly configured and present in the routing table.

Procedure for Network Modification with Router

Default routing is used to direct packets with destinations that do not match any specific entries in a router's routing table, typically towards an Internet gateway. This is achieved by configuring a default route using the ip route command in global configuration mode, with the destination and subnet mask set to 0.0.0.0. For example, ip route 0.0.0.0 0.0.0.0 [next-hop-address or outgoing interface] will forward all unmatched traffic to the specified next-hop address or interface. This configuration ensures that any packet without a specific route will follow this default path, facilitating efficient network traffic

management and simplifying the routing table. Verification is performed using show running-config and show ip route commands to confirm the presence and correctness of the default route.

Observation:

A. Static Routing

4. The `show ip route` command displayed only C (connected) and L (local) routes for directly connected Ethernet interfaces, with no static or default routes configured.

5-12. The `ping` command succeeded only for devices within the same local network, as there were no static or default routes configured to facilitate communication with other networks.

16-17. After manually configuring static routes using the `ip route` command, `ping` and `tracert` commands were executed successfully, allowing packet transfer across different networks. This included communication between routers (router-to-router), between routers and PCs (router-to-PC), and between PCs (PC-to-PC).

18. When executing `tracert 2.2.2.2`, the response "Destination host unreachable" was observed, indicating no route to the specified destination.

B. Default Routing

2. By removing static routes and configuring a default route on one router, `ping` command packet tracing was successful for paths covered by the default route. When attempting to ping destinations outside the default route, a 0% failure rate was observed.

6. Tracing the route to `2.2.2.2` over a maximum of 30 hops using default routing resulted in "Destination host unreachable," as there was no specific route to the destination beyond the default path.

C. Subnet Masking and Static Routing

4. The `show ip route` command displayed only C (connected) and L (local) routes for directly connected Ethernet interfaces, with no static or default routes configured.

5-9. Within the same local network segment, `ping` commands succeeded, with packets being transferred successfully. However, attempts to ping IP addresses outside the local network resulted in "Request timed out" errors.

11. After configuring static routes on the routers, `ping` commands within the local network were successful, but attempts to reach external destinations showed "Destination host unreachable."

Configuring and Aggregating Routes

To configure static routes on Router1 using Telnet for Network 1 and Network 2:

```
Router1(config)# ip route 200.200.20.0 255.255.255.224 200.200.20.65
Router1(config)# ip route 200.200.20.32 255.255.255.224 200.200.20.65
```

The previously added routes on Router1 was removed:

```
Router1(config)# no ip route 200.200.20.0 255.255.255.224 200.200.20.65
Router1(config)# no ip route 200.200.20.32 255.255.255.224 200.200.20.65
```

Since Network 1 and Network 2 were in consecutive address ranges, they were aggregated into a single route entry:

```
Router1(config)# ip route 200.200.20.0 255.255.255.192 200.200.20.65
```

This aggregation reduced the number of route entries and simplifies the routing table, making network management more efficient.

Conclusion:

In this lab we configured static and default routing, that helped in understanding of how routers forward packets to destination networks. By manually setting static routes and default routes using the ip route command, we learned the importance of route configuration in maintaining network connectivity and

efficient traffic management. The exercises gives the concepts of routing tables, next-hop addresses, and route verification.

Exercises:

Question 1: How does a sending host know whether the destination computer is on the same network or on a different network? Explain.

A sending host determines whether the destination computer is on the same network or a different network by comparing its own IP address and subnet mask with the IP address of the destination computer. The process involves the following steps:

- The host performs a bitwise AND operation between its own IP address and subnet mask to determine its network address.
- It performs the same bitwise AND operation between the destination IP address and the same subnet mask to determine the destination network address.
- If the network addresses match, the destination is on the same network. If they do not match, the destination is on a different network.

Question 2: Explain how the data is forwarded from the sending host in each of the following cases:

a. When the destination computer is within the same network

- The sending host will directly send the packet to the destination computer using the local network infrastructure.
- It resolves the destination MAC address using ARP (Address Resolution Protocol) if it is not already in the ARP cache.
- The packet is then encapsulated in a frame with the destination MAC address and sent over the local network segment.

b. When the destination computer is on a different network

- The sending host forwards the packet to its default gateway (usually a router).

- It sends the packet to the router's MAC address, and the router then determines the best path to forward the packet based on its routing table.
- The router encapsulates the packet in a new frame with the next hop's MAC address (another router or the destination host if it's on an adjacent network) and forwards it accordingly.
- This process continues until the packet reaches its final destination.

Question 3: What is routing? Discuss static routing and configuration of static routing in a router with its syntax briefly.

Routing is the process by which routers forward packets toward their destination based on the destination IP address. Routing involves determining the best path from the source to the destination network.

Static Routing

- In static routing, routes are manually configured by the network administrator.
- These routes do not change unless the administrator updates them, making them suitable for small or stable networks.
- Static routing provides control over routing behavior but lacks scalability and adaptability.

Configuration of Static Routing

To configure a static route, use the `ip route` command in global configuration mode.

- Syntax: `ip route [destination network] [subnet mask] [next-hop IP address or outgoing interface]`
- Example:

```
Router(config)# ip route 192.168.2.0 255.255.255.0 192.168.1.2
Router(config)# ip route 192.168.2.0 255.255.255.0 Serial 0/0
```

Question 4: What information can we get from the routing table? How can we observe the routing table of a router? Explain.

The routing table provides essential information about how packets should be forwarded through the network. It includes:

- Destination network addresses and subnet masks.
- Next-hop IP addresses or outgoing interfaces.
- Route metrics and administrative distances.
- Route types (static, dynamic, directly connected, etc.).

To observe the routing table on a router, use the `show ip route` command in privileged EXEC mode. This command displays the current routing table, showing all known routes and their statuses.

Question 5: What is a default route? What is its importance? State the default route configuration command with its syntax.

A default route is a special type of static route that directs packets to a specific gateway when no other specific route matches the destination IP address in the routing table. It is essentially a catch-all route for packets destined for unknown networks.

Importance

- Simplifies routing configuration by reducing the number of static routes needed.
- Ensures connectivity to remote networks, such as the Internet, without requiring explicit routes for each possible destination.

Configuration Command

- Syntax: `ip route 0.0.0.0 0.0.0.0 [next-hop IP address or outgoing interface]`
- Example:

```
Router(config)# ip route 0.0.0.0 0.0.0.0 192.168.1.1
```