CSE 4512 [Computer Networks Lab]

Lab # 05

1. Objectives:

- Define and describe the concept of static routing
- Explain practical static routing concepts used in cisco devices
- Configure static routing in a network topology following given specifications

2. Theory:

As with other labs, this lab will also build up on the concepts and techniques of previous labs. So, make sure you've properly understood the previous lab contents.

Static Routing:

By now, you all know that routers take the help of routing table to forward packets to the intended destinations. When a packet reaches the router, it looks up the routing table, finds the corresponding output interfaces for the destination network address and sends the packet through that interface. The question is how this routing table is formed in the first place. The answer is either manually configuring the routing entries or using routing protocols to configure the routes dynamically. The first approach is called static routing and this is what we'll talk about and learn in this lab. The second approach is the topic of next lab.

In static routing, the network administrator manually adds the routing entries to the routing table. The routing entries will not be changed automatically. All changes have to be done manually. If the network condition changes (for example, *some link goes down*), then the necessary changes in the routing table must be done manually whereas these info are updated automatically in dynamic routing.

In practical large networks, static routing is mostly used as a backup to dynamic routing. Unlike dynamic routing, static routing requires very less computational resource and bandwidth as no extra packet is required for routing table update process. But as the network administrator needs to know the whole network topology and network addresses to effectively configure the routing table, static routing is not used as the only routing mechanism in large scale networks.

There are some concepts related to static routing that you need to be familiar with before you get your hands dirty. You know that packets travel from one hop to the next to reach its final destination. In the routing table of a router, the next hop address is associated with a certain destination address. Its not realistic to assume that there would be next-hop entry for every possible destination network. That’s why a routing entry known as the **default route** is present in the routing table. It defines a default exit interface for the packets that don't have any corresponding route in the routing table.

When working with CISCO devices and specifically for this lab, you'll encounter two types of static default routes. One is **directly connected** static default route and another is **next-hop** static default route. You'll have to configure these two types of routes in this lab.

The general format of the command to specify static routes is:

```
ip route destination_network_prefix destination_prefix_mask (next-hop_address | interface) [distance_metric]
ipv6 route ipv6_destination_network_prefix(with CIDR) (ipv6_next-hop_address | interface) [distance_metric]
```

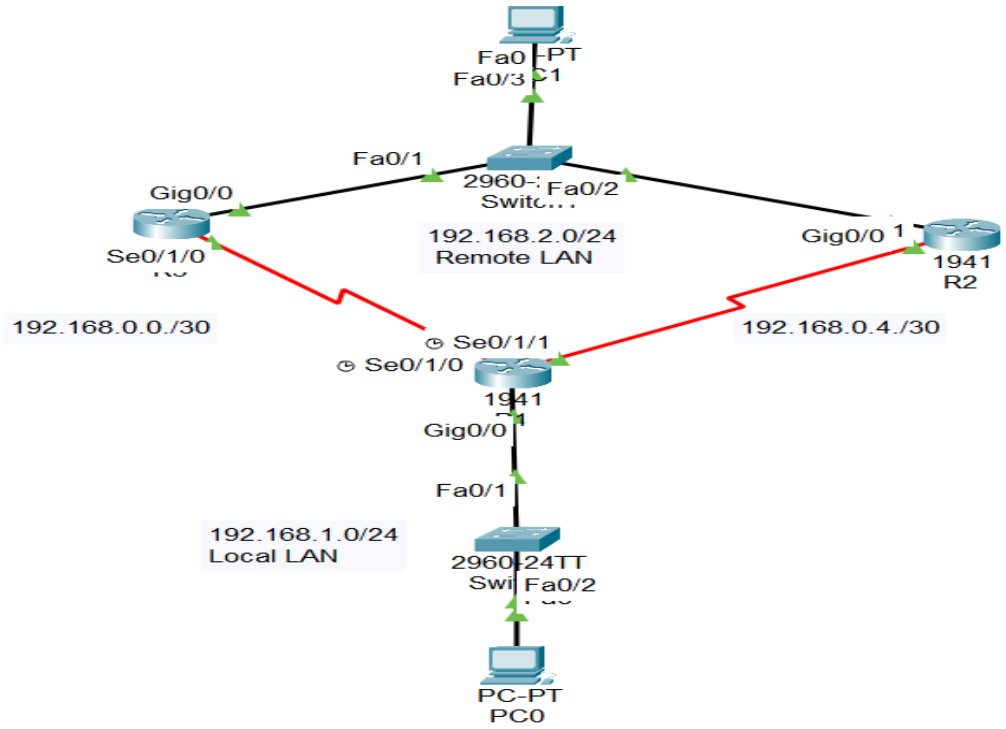
In case of directly connected static default routes, you'll specify the ***interface***. In case of next-hop static default routes, you'll specify the ***next_hop address***. One special use case of the above command is to configure a **primary static default route** where both the *destination_network_prefix* and *destination_prefix_mask* are *0.0.0.0*. The IPv4 and IPv6 command format for specifying primary static default route is given below:

```
ip route 0.0.0.0 0.0.0.0 (next-hop_address | interface) [distance_metric]
ipv6 route ::/0 (ipv6_next-hop_address | interface) [distance_metric]
```

The above commands basically mean that "*packets from any IP address with any subnet mask get sent to the specified next-hop address or interface*".

Another concept when configuring static routing is the **floating static route**. A floating route is nothing but the route that's used to forward a packet to a certain destination when main route is unavailable. The way floating routes are defined is by providing a higher ***distance_metric*** to a certain route. The default ***distance_metric*** when its not manually specified is **1**. The floating static routes are given higher numbers than 1. Routers always take the route with *lower* ***distance_metric*** when multiple routes to the same destination are available. That's why this floating static route will only be used when main route is down or unavailable.

3. Configure static routing:



I. Configure R1 Interfaces

```
R1(config)#int g0/0
R1(config-if)#ip add 192.168.1.1 255.255.255.0
R1(config-if)#desc connection-to-PC0
R1(config-if)#no shutdown
R1(config-if)#exit

R1(config)#int s0/1/0
R1(config-if)#ip add 192.168.0.2 255.255.255.252
R1(config-if)#desc connection-to-R3
R1(config-if)#clock rate 64000
R1(config-if)#no shutdown
R1(config-if)#exit

R1(config)#int s0/1/1
R1(config-if)#ip add 192.168.0.6 255.255.255.252
R1(config-if)#desc connection-to-R2
R1(config-if)#clock rate 64000
R1(config-if)#no shutdown
R1(config-if)#exit
```

II. Configure R2 Interfaces

```
R2(config)#int s0/1/1
R2(config-if)#ip add 192.168.0.5 255.255.255.252
R2(config-if)#desc connection-to-R1
R2(config-if)#no shutdown
R2(config-if)#exit

R2(config)#int g0/0
R2(config-if)#ip add 192.168.2.1 255.255.255.0
R2(config-if)#desc connection-to-RemoteLAN
R2(config-if)#no shutdown
R2(config-if)#exit
```

III. Configure R3 Interfaces

```
R3(config)#int s0/1/0
R3(config-if)#ip add 192.168.0.1 255.255.255.252
R3(config-if)#desc connection-to-R1
R3(config-if)#no shutdown
R3(config-if)#exit

R3(config)#int g0/0
R3(config-if)#ip add 192.168.2.2 255.255.255.0
R3(config-if)#desc connection-to-RemoteLAN
R3(config-if)#no shutdown
R3(config-if)#exit
```

IV. Configure PC0

```
IP: 192.168.1.10
Mask: 255.255.255.0
Gateway: 192.168.1.1
```

V. Configure PC1

```
IP: 192.168.2.10
Mask: 255.255.255.0
Gateway: 192.168.2.1
```

VI. Configure static routing to Remote LAN in R1

```
R1(config)#ip route 192.168.2.0 255.255.255.0 s0/1/1
```

It's a **directly connected** static default route.

```
R1(config)#ip route 192.168.2.0 255.255.255.0 192.168.0.1 5
```

It's a **next-hop floating** static default route.

VII. Configure static routing to Local LAN in R2

```
R2(config)#ip route 192.168.1.0 255.255.255.0 s0/1/1
```

It's a **directly connected** static default route.

```
R2(config)#ip route 192.168.1.0 255.255.255.0 192.168.0.6 5
```

It's a **next-hop floating** static default route

VIII. Configure static routing to Local LAN in R3

```
R2(config)#ip route 192.168.1.0 255.255.255.0 s0/1/0
```

It's a **directly connected** static default route.

```
R2(config)#ip route 192.168.1.0 255.255.255.0 192.168.0.2 5
```

It's a **next-hop floating** static default route

IX. Verify

```
Ping PC1 from PC0
```

4. Tasks:

I. You will implement **IPv4 and IPv6 static routing** following the address configurations in a given network topology in this task. The task description for this task is provided in the pdf ***Task-1_ipv4-and-ipv6-static-and-default-routes***. You're provided a .pka file for this task.

Packet Tracer - Configure IPv4 and IPv6 Static and Default Routes

Addressing Table

Device	Interface	IP Address / Prefix
Edge_Router	S0/0/0	10.10.10.2/30
		2001:db8:a:1::2/64
	S0/0/1	10.10.10.6/30
		2001:db8:a:2::2/64
	G0/0	192.168.10.17/28
		2001:db8:1:10::1/64
	G0/1	192.168.11.33/27
		2001:db8:1:11::1/64
ISP1	S0/0/0	10.10.10.1/30
		2001:db8:a:1::1/64
	G0/0	198.0.0.1/24
		2001:db8:f:f::1/64
ISP2	S0/0/1	10.10.10.5/30
		2001:db8:a:2::1/64
	G0/0	198.0.0.2/24
		2001:db8:f:f::2/64
PC-A	NIC	192.168.10.19/28
		2001:db8:1:10::19/64
PC-B	NIC	192.168.11.4/27
		2001:db8:1:11::45
Customer Server	NIC	198.0.0.10
		2001:db8:f:f::10

Packet Tracer - Configure IPv4 and IPv6 Static and Default Routes

Objectives

In this Packet Tracer summary activity, you will configure static, default, and floating static routes for both the IPv4 and IPv6 protocols.

- Configure IPv4 Static and Floating Static Default Routes.
- Configure IPv6 static and floating static default routes.
- Configure IPv4 static and floating static routes to internal LANs.
- Configure IPv6 static and floating static routes to the internal LANS.
- Configure IPv4 host routes.
- Configure IPv6 host routes.

Background / Scenario

In this activity, you will configure IPv4 and IPv6 default static and floating static routes.

Note: The static routing approach that is used in this lab is used to assess your ability to configure different types of static routes only. This approach may not reflect networking best practices.

Instructions

Part 1: Configure IPv4 Static and Floating Static Default Routes

The PT network requires static routes to provide internet access to the internal LAN users through the ISPs. In addition, the ISP routers require static routes to reach the internal LANs. In this part of the activity, you will configure an IPv4 static default route and a floating default route to add redundancy to the network.

Step 1: Configure an IPv4 static default route.

On Edge_Router, configure a **directly connected** IPv4 default static route. This primary default route should be through router **ISP1**.

Step 2: Configure an IPv4 floating static default route.

On Edge_Router, configure a **directly connected** IPv4 floating static default route. This default route should be through router **ISP2**. It should have an administrative distance of **5**.

Part 2: Configure IPv6 Static and Floating Static Default Routes

In this part of the activity, you will configure IPv6 static default and floating static default routes for IPv6.

Step 1: Configure an IPv6 static default route.

On Edge_Router, configure a **next hop** static default route. This primary default route should be through router **ISP1**.

Step 2: Configure an IPv6 floating static default route.

On Edge_Router, configure a **next hop** IPv6 floating static default route. The route should be via router **ISP2**. Use an administrative distance of **5**.

Part 3: Configure IPv4 Static and Floating Static Routes to the Internal LANs

In this part of the lab you will configure static and floating static routers from the ISP routers to the internal LANs.

Step 1: Configure IPv4 static routes to the internal LANs.

a. On ISP1, configure a **next hop** IPv4 static route to the **LAN 1** network through Edge_Router.

b. On ISP1, configure a **next hop** IPv4 static route to the **LAN 2** network through Edge_Router.

Step 2: Configure IPv4 floating static routes to the internal LANs.

a. On ISP1, configure a directly connected floating static route to LAN 1 through the ISP2 router. Use an administrative distance of **5**.

b. On ISP1, configure a directly connected floating static route to LAN 2 through the ISP2 router. Use an administrative distance of **5**.

Part 4: Configure IPv6 Static and Floating Static Routes to the Internal LANs.

Step 1: Configure IPv6 static routes to the internal LANs.

c. On ISP1, configure a next hop IPv6 static route to the **LAN 1** network through Edge_Router.

d. On ISP1, configure a next hop IPv6 static route to the **LAN 2** network through Edge_Router.

Step 2: Configure IPv6 floating static routes to the internal LANs.

a. On ISP1, configure a next hop IPv6 floating static route to LAN 1 through the ISP2 router. Use an administrative distance of **5**.

b. On ISP1, configure a next hop IPv6 floating static route to LAN 2 through the ISP2 router. Use an administrative distance of **5**.

If your configuration has been completed correctly, you should be able to ping the Web Server from the hosts on LAN 1 and LAN 2. In addition, if the primary route link is down, connectivity between the LAN hosts and the Web Server should still exist.

Part 5: Configure Host Routes

Users on the corporate network frequently access a server that is owned by an important customer. In this part of the activity, you will configure static host routes to the server. One route will be a floating static route to support the redundant ISP connections.

Step 1: Configure IPv4 host routes.

a. On Edge Router, configure an IPv4 **directly connected** host route to the customer server.

b. On Edger Router, configure an IPv4 directly connected floating host route to the customer sever. Use an administrative distance of **5**.

Step 2: Configure IPv6 host routes.

a. On Edge Router, configure an IPv6 next hop host route to the customer server through the ISP1 router.

b. On Edger Router, configure an IPv6 directly connected floating host route to the customer sever through the ISP2 router. Use an administrative distance of **5**.