Understanding Frame-Relay

In this free CCNA lab we will use Packet Tracer to model several Frame-Relay scenarios to help us understand and configure Frame-Relay. These scenarios will include Full Mesh, Hub and Spoke, and Sub Interfaces. We will also explore the problems that may occur when using a Dynamic Routing protocol such as RIP, EIGRP, or OSPF.

## Learning Objectives:

* Review basic router configuration.
* Review Static Routing
* Review Dynamic Routing.
* Understand and configure a full mesh Frame-Relay.
* Understand and configure a hub and spoke Frame-Relay.
* Understand and configure a Point to Point Frame-Relay.
* Understand and configure a Point to Multi Point Frame-Relay.
* Understand and configure Sub Interfaces.
* Understand and configure the following Frame-Relay commands.
  + Encapsulation Frame-Relay.
  + Frame-Relay Interface.
  + Frame-Relay Map.
  + Frame-Relay LMI-Type.
  + split-horizon.

## Frame-Relay:

Frame-Relay is a standardized wide area network technology that specifies the physical and logical link layers of digital telecommunications channels using a packet switching methodology. Originally designed for transport across Integrated Services Digital Network (ISDN) infrastructure, it may be used today in the context of many other network interfaces.

There are two main types of Frame-Relay configurations Full Mesh and Hub and Spoke.

## Full Mesh:

The Full Mesh Frame-Relay has a dedicated connection from each connected device to all other devices. Therefore a network with four routers would require six dedicated connections. The advantages of this configuration is the reliability if a device or connection is lost the remainder of the network still functions and speed as each connection has full bandwidth. The disadvantages are cost and complexity.

## Hub and Spoke:

The Hub and Spoke Frame-Relay utilizes a single devise as the hub and has dedicated connections to all other connected devices the spokes. Communication between the spoke devices will be routed through the hub device. The main advantages to this configuration are cost and simplicity as the number of connection is far less. A network consisting of four routers would only require three dictated connections. The disadvantage of course are speed and reliability as the communication between spoke devices must be routed through the hub device and a failure of the hub device will result in a failure of the entire network.

## Lab Topology:

In this Activity we have provided two Packet Tracer topologies. The first is a for the Full Mesh Frame-Relay part of the lab and the second in for the Hub and Spoke part. The Hub and Spoke topology will be used for the Hub and Spoke, Sub Interfaces and Dynamic Routing labs.

The Frame-Relay cloud, ISP router, Web server and all PC’s have been configured and will require no additional configuration. The goal of these labs is to establish full connectivity between all end pc’s and the web server. The final configuration for each of these scenarios has been provided so you can compare your solution.

## Full Mesh Lab:

1. Perform basic configuration of al routers and switches.
2. Configure IP address and subnet on Fast Ethernet interfaces of all routers as shown in the network drawing.
3. Configure IP address and subnet on Serial interfaces of all routers as shown in the network drawing.
4. Enable Frame-Relay encapsulation on Serial interface S0/0/0 of R1, R2, R3, and R4 routers.
5. Using the Full Mesh Frame-Relay Table from the network drawing configure Frame-Relay mappings on R1, R2, R3, and R4 routers.
6. Configure the LMI type as ANSI on R1, R2, R3, and R4 routers.
7. Verify connectivity between Frame-Relay routers.
8. Configure static routes on R1, R2, R3, and R4 routers to allow communication between PC’s 1, 2, and 3.
9. Configure a default route on R1, R2, R3, and R4 to allow communication to the web server.
10. Verify connectivity between all PC’s and web server.

## Hub and Spoke Lab:

1. Perform basic configuration of al routers and switches.
2. Configure IP address and subnet on Fast Ethernet interfaces of all routers as shown in the network drawing.
3. Configure IP address and subnet on Serial interfaces of all routers as shown in the network drawing.
4. Enable Frame-Relay encapsulation on Serial interface S0/0/0 of R1, R2, R3, and R4 routers.
5. Using the Hub and Spoke Frame-Relay Table from the network drawing configure Frame-Relay mappings on R1, R2, R3, and R4 routers.
6. Configure the LMI type as ANSI on R1, R2, R3, and R4 routers.
7. Verify connectivity between Frame-Relay routers.
8. Configure static routes on R1, R2, R3, and R4 routers to allow communication between PC’s 1, 2, and 3.
9. Configure a default route on R1, R2, R3, and R4 to allow communication to the web server.
10. Save the configuration of R1, R2, R3, and R4.
11. Verify connectivity between all PC’s and web server.

## Hub and Spoke Using Sub Interfaces:

1. Using the previous saved configuration remove the Frame-Relay encapsulation and IP addressing on R1, R2, R3, and R4.
2. Enable Frame-Relay encapsulation of routers R1, R2, R3, and R4.
3. Create a point to multi point sub interface on serial interface S0/0/0 of R1.
4. Create a point to point sub interface on serial interface S0/0/0 of R2, R3, and R4.
5. Configure IP addresses and subnets on all previously created sub interfaces as shown in the network diagram.
6. Configure interface-dlci on all previously created sub interfaces as shown in the Hub and Spoke Frame-Relay table on the network drawing.
7. Verify Frame-Relay connectivity of all Frame routers.
8. Save the configuration of R1, R2, R3, and R4.
9. Verify connectivity between all PC’s and web server.

## Problems with Dynamic Routing Protocols:

The following exercise applies to all internal dynamic routing protocols, but in this scenario we will be using RIP as Packet Tracer only supports thesplit-horizon command with RIP.

1. Using the previously saved configuration remove all static routes except the default route on routers R1, R2, R3, and R4.
2. Enable RIP routing protocol on R1, R2, R3, and R4.
3. Advertise the 192.168.X.X network on R2, R3, and R4 routers.
4. Using ping verify connectivity between all PC’s and web server, (Note the pings fail).
5. Display the routing tables on R2, R3 and R4, (Note these router have not received RIP updates about each other).

R1 should forward information to the spoke routers, including routing advertisements. However, remember that distance vector routing protocols resist routing loops with the split horizon rule. This rule states that a router cannot advertise a route through the same physical interface it was received on. When an interface is configured with the encapsulation frame-relaycommand, split horizon is automatically disabled on the major interface (Serial0/0)but is enabled by default on Frame Relay sub interfaces.

Both of the PVCs are using the same multipoint sub interface on SanJose1. Therefore, routes learned from one spoke router cannot be sent back through the same sub interface to the other spoke router. Split horizon must be disabled in order for R1 to be able to send a route learned from one spoke to the other.

1. Apply the no ip split-horizon command to the sub interface of R1.
2. Verify the configuration of the sub interface of R1.
3. Using the ping command verify connectivity between PC1, PC2, and PC3.

This concludes the Packet Tracer Activity.