

## Establishing Frame Relay Connections Using Packet Tracer

Shipra Suman

M. Tech Scholar, Department of ECE  
SHIATS  
Allahabad, India  
e-mail: shipra.suman92@gmail.com

Er. Aditi Agrawal

Assistant Professor, Department of ECE  
SHIATS  
Allahabad, India  
e-mail: aditi.agrawal@shiats.edu.in

**Abstract**— Frame Relay is a protocol used for connecting devices on a wide area network. It operates at the data link layer providing a connection-oriented network. A Data-Link Connection Identifier (DLCI) is used for finding a communication path between the source and destination nodes. Local Management Interface (LMI) message is used to check the status between Frame Relay DTE and DCE. The basic configuration of frame relay is simple, but the network administrator plans the Frame Relay configuration based on different factors. In this research work different configurations of establishing Frame Relay connections are analyzed using Cisco Packet Tracer.

**Keywords**- Frame Relay, DLCI, LMI, DTE, DCE, Cisco Packet Tracer.

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### I. INTRODUCTION

Frame Relay is a WAN protocol that works on frame-relay switches. It is used for reducing the cost of connecting remote connections. It does not involve error correction and flow control operations [1]. It is an example of packet-switched network that allow the end users to use the network medium dynamically with the available bandwidth. Frame Relay also supports windowing and retransmission of previous data

The Consultative Committee on International Telephone and Telegraph (CCITT) provided Frame Relay standards in the year 1984, but these standards were incomplete [2]. In 1990, CISCO, Digital Equipment Corporation (DEC), Northern Telecom and StrataCom together formed a group to bring development in the Frame Relay technology. They developed extensions in the protocol called Local Management Interface (LMI) to provide additional capabilities for complex networking [3]. The features of Frame Relay are as follows:

- Data transmission rate is high i.e., 44.3 Mbps
- Works only in physical and data link layers.
- Cheap alternative for WAN connections.
- More reliable data transmission.

In this paper different configuration methods for Frame Relay connections are analyzed and simulated using Cisco Packet Tracer.

### II. FRAME RELAY COMPONENTS

- Data Terminal Equipment (DTE):** Represents the devices that needs the Frame Relay service i.e, router.
- Data Communications Equipment (DCE):** Represents the Frame Relay switches.
- Access Link:** Represents the connection between DTE and DCE.
- Access Rate:** Represents the data transmission rate between DTE and DCE.
- Data Link Connection Identifier (DLCI):** Referred as the heart of Frame Relay network. It represents the logical circuit with its identification number between sender and receiver.

**f. Local Management Interface (LMI):** Checks the status between DCE and DTE. LMI messages types are ANSI, CISCO, Q933a.

**g. Committed Information Rate (CIR):** Represents the bandwidth purchased from ISP.

**h. Committed Burst (Bc):** Represents the total bandwidth available at ISP end.

**i. Excess Burst (Be):** Represents the extra bandwidth used by ISP to send data.

**j. Forward Explicit Congestion Notification (FECN):** Represents message sent to destination router due to congestion in a network.

**k. Backward Explicit Congestion Notification (BECN):** Represents message sent to source router due to congestion in a network.

**l. Discard Eligibility (DE) indicator:** During congestion Frame Relay switch drops the packets with DE bit set.

Figure 1 shows the physical connectivity of Frame Relay network and also displays the basic Frame Relay components such as Data Terminal Equipment (DTE), Data Communication Equipment (DCE), Access Link, Local Management Interface (LMI) messages [2].

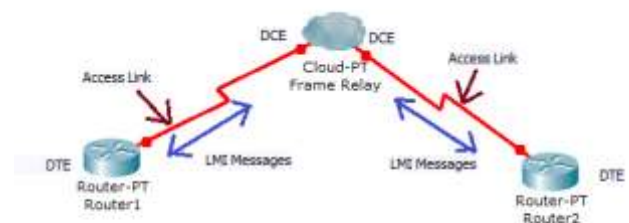


Figure 1. Physical connectivity of Frame Relay Network

Figure 2 shows the logical connectivity of the Frame Relay Network [2]. A Virtual Circuit is the logical communication path between a pair of DTE. The routers use DLCI as the Frame Relay address. This DLCI finds the

suitable virtual circuit over which the frame must travel [4].

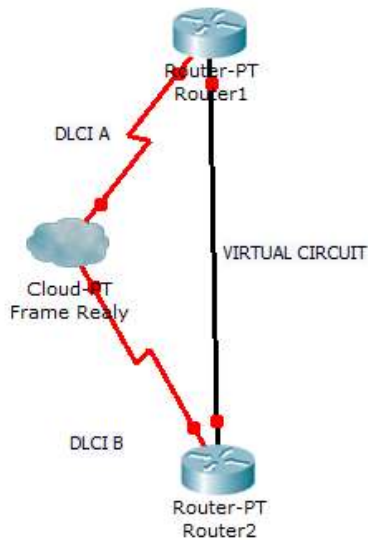


Figure 2. Logical Connectivity of Frame Relay Network

### III. FRAME RELAY CONFIGURATION COMMANDS

- a. **encapsulation frame-relay**: Defines the Frame Relay encapsulation.
- b. **frame-relay lmi-type (ansi/q933a/cisco)**: Defines the type of LMI messages that are sent to switch.
- c. **bandwidth num**: Enables to set the interface speed of the router.
- d. **interface serial number.sub (point-to-point / multipoint)**: Enables to configure a subinterface or reference a subinterface that is already created.
- e. **frame-relay interface-dlci dlci\_#**: Link the DLCI to the subinterface.

### IV. FRAME RELAY CONFIGURATION

The basic Frame Relay configuration is very simple. The steps followed to configure a Frame Relay are as follows [5]:

- The service provider states the type of LMI that will be used when the service is ordered.
- The administrator selects the endpoints of the virtual circuits.
- The IP addressing option is selected on every virtual circuits.
- The encapsulation type is selected such that the routers on both the ends must agree.

#### a. Configuring a basic Frame Relay network:

Figure 3 shows the basic Frame Relay network. The commands for configuring each routers are as follows:

#### Configuring Frame Relay on Router0:

```
Router>en
Router#config t
Enter configuration commands, one per line. End with
CNTL/Z.
Router(config)#int s2/0
Router(config-if)#ip add 2.2.2.1 255.0.0.0
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state
to up
Router(config-if)#encapsulation frame-relay
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to up
frame-relay lmi-type q933a
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to down
frame-relay interface-dlci 102
Router(config-if)#int f0/0
Router(config-if)#ip add 192.168.10.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up

Router(config-if)#router rip
Router(config-router)#network 2.0.0.0
Router(config-router)#network 192.168.10.0
Router(config-router)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to up
```

#### Configuring Frame Relay on Router1:

Similarly Router 1 is configured with serial connection IP address 2.2.2.2, fast Ethernet IP address 192.168.20.1 and DLCI number 201.



Figure 3. Basic Frame Relay Network

## b. Configuring a Frame Relay Point To Point

### Subinterfaces:

Figure 4 shows the Frame Relay point-to-point subinterfaces network. The interfaces s2/0.102 and s2/0.201 are the point-to-point subinterfaces that connect both the routers in the Frame Relay network. The DLCI value on subinterface serial 2/0.102 of Router0 is 102 and DLCI value on subinterface serial 2/0.201 of Router1 is 201.

### Configuring Frame Relay on Router0:

```
Router>en
Router#config t
Enter configuration commands, one per line. End with
CNTL/Z.
Router(config)#int s2/0
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state
to up
Router(config-if)#encapsulation frame-relay
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to up
exit
Router(config)#interface serial 2/0.102 point-to-point

%LINK-5-CHANGED: Interface Serial2/0.102, changed
state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0.102, changed state to up
Router(config-subif)#ip add 2.2.2.1 255.0.0.0

Router(config-subif)#frame-relay interface-dlci 102
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#int f0/0
Router(config-if)#ip add 192.168.10.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0,
changed state to up
Router(config-if)#router rip
Router(config-router)#network 2.0.0.0
Router(config-router)#network 192.168.10.0
Router(config-router)#exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0.102, changed state to down
```

### Configuring Frame Relay on Router1:

```
Router>en
Router#config t
Enter configuration commands, one per line. End with
CNTL/Z.
Router(config)#int s2/0
Router(config-if)#clock rate 64000
Router(config-if)#encapsulation frame-relay
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state
to up

Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to up
exit
Router(config)#interface serial 2/0.201 point-to-point

%LINK-5-CHANGED: Interface Serial2/0.201, changed
state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0.201, changed state to up
Router(config-subif)#ip add 2.2.2.2 255.0.0.0
Router(config-subif)#frame-relay interface-dlci 201
Router(config-subif)#exit
Router(config)#int f0/0
Router(config-if)#ip add 192.168.20.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0,
changed state to up
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#network 2.0.0.0
Router(config-router)#network 192.168.20.0
Router(config-router)#exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0.201, changed state to down
```



Figure 4. Frame Relay Point-to-Point Subinterfaces

**c. Configuring a Frame Relay Multipoint Subinterfaces:**



Figure 5. Frame Relay Multipoint Subinterfaces

**Configuring Frame Relay on Router0:**

```
Router>en
Router#config t
Enter configuration commands, one per line. End with
CNTL/Z.
Router(config)#int s2/0
Router(config-if)#exit
Router(config)#int f0/0
Router(config-if)#ip add 192.168.10.1 255.255.255.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed
state to up
exit
Router(config)#int s2/0
Router(config-if)#ip add 2.2.2.1 255.0.0.0
Router(config-if)#encapsulation frame-relay
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial2/0, changed state to
up

Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to up
frame-relay lmi-type q933a
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to down
frame-relay interface-dlci 102
Router(config-if)#frame-relay interface-dlci 103
Router(config-if)#exit
Router(config)#router rip
Router(config-router)#network 2.0.0.0
Router(config-router)#network 192.168.10.0
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up
```

**Configuring Frame Relay on Router1:**

```
Router>en
Router#config t
Enter configuration commands, one per line. End with
CNTL/Z.
Router(config)#int f0/0
Router(config-if)#ip add 192.168.20.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed
state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up

Router(config-if)#int s2/0
Router(config-if)#encapsulation frame-relay
Router(config-if)#frame-relay lmi-type q933a
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state to
up

Router(config-if)#interface serial 2/0.201 multipoint

%LINK-5-CHANGED: Interface Serial2/0.201, changed
state to up
Router(config-subif)#ip add 2.2.2.2 255.0.0.0
Router(config-subif)#frame-relay interface-dlci 201
Router(config-subif)#no shutdown
Router(config-subif)#router rip
Router(config-router)#network 2.0.0.0
Router(config-router)#network 192.168.20.0
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial2/0.201, changed state to up

Configuring Frame Relay on Router2:
Router>en
Router#config t
Enter configuration commands, one per line. End with
CNTL/Z.
Router(config)#int f0/0
Router(config-if)#ip add 192.168.30.1 255.255.255.0
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed
state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface
FastEthernet0/0, changed state to up
```

```
Router(config-if)#exit
Router(config)#int s2/0
Router(config-if)#encapsulation frame-relay
Router(config-if)#frame-relay lmi-type q933a
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
Router(config-if)#interface s2/0.301 multipoint
Router(config-subif)#
%LINK-5-CHANGED: Interface Serial2/0.301, changed state to up
ip add 2.2.2.3 255.0.0.0
Router(config-subif)#frame-relay interface-dlci 301
Router(config-subif)#no shutdown
Router(config-subif)#exit
Router(config)#router rip
Router(config-router)#network 2.0.0.0
Router(config-router)#network 192.168.30.0
Router(config-router)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console
write memory
Building configuration...
[OK]
Router#
```

Figure 6 shows the configuration of Frame Relay adding port and sublink.

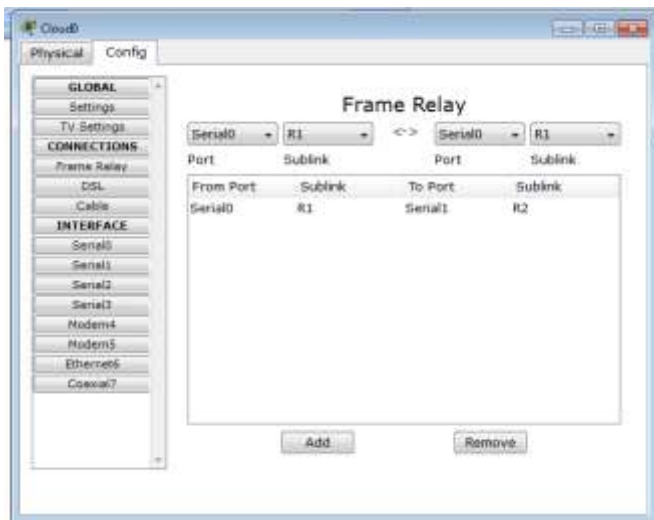


Figure 6. Adding port and sublink in Frame Relay

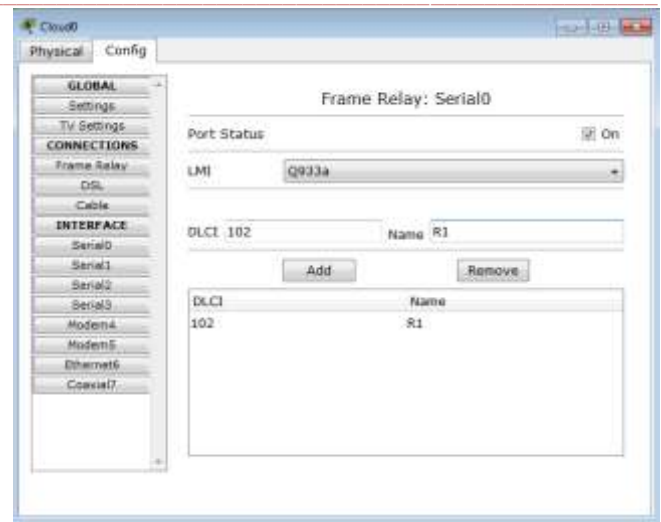


Figure 7. Adding of LMI message type and DLCI numbers to the serial interfaces

## V. CONCLUSION AND FUTURE SCOPE

This paper shows the different configuration methods for Frame Relay connections. The different configuration methods simulated are basic Frame Relay connection, Frame Relay point-to-point subinterfaces and Frame Relay multipoint subinterfaces. The Frame Relay subinterfaces are used to avoid the split horizon problem on the Frame Relay networks.

In future work, different Frame Relay topologies such as hub and spoke, dual hub and spoke, full mesh and partial mesh can be configured using CISCO packet tracer and get compared using different routing protocols.

## REFERENCES

- [1] A. Velte and T. Velte, "Cisco: A Beginner's Guide", McGraw-Hill Inc. 3rd edition (2004).
- [2] Cisco Systems Inc. <http://www.cisco.com>
- [3] Lammle, Todd. (2011). Cisco Certified Network Associate Study Guide, Wiley Publishing, Inc., Seventh Edition.
- [4] "Frame Relay Networks - a survey" by Viswanath Subramanian.
- [5] Cisco Frame Relay Solutions Guide 2nd edition" by Jonathan Chin.

Figure 7 shows the adding of LMI message type and DLCI numbers to the serial interfaces.