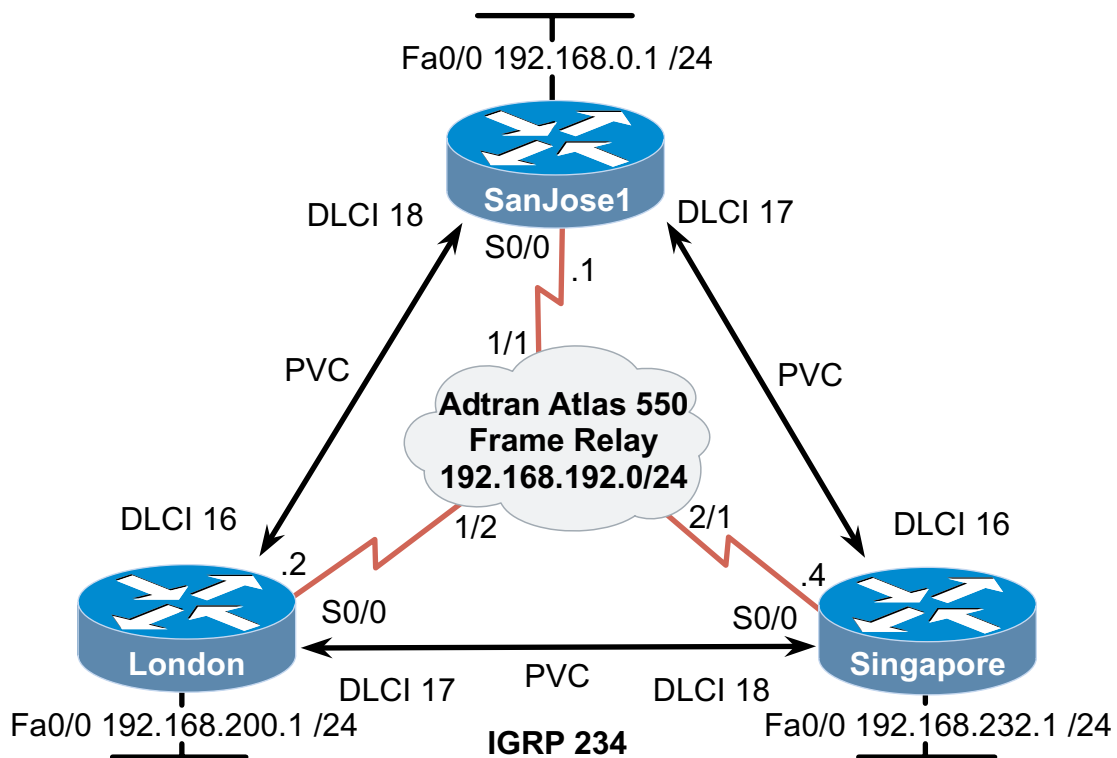


Configuring Full-Mesh Frame Relay



Objective

Configure three routers with Frame Relay in a full-mesh topology.

Scenario

Your ISP has provisioned Frame Relay PVCs for the International Travel Agency WAN. As the administrator, you are responsible for configuring Frame Relay among regional offices. You begin with North America, Asia, and Europe. The design calls for all three routers to be placed on the same logical IP network in a full-mesh topology. Also, use IGRP (AS 234) to dynamically exchange routes. The ISP Frame Relay switch uses the ANSI LMI-type, and is configured with the DLCIs shown in the diagram.

Step 1

Before beginning this lab, it is recommended that you reload each router after erasing its startup configuration. This will prevent you from having problems caused by residual configurations. After you prepare the equipment, proceed with Step 2. Cable the network according to the above diagram. This lab assumes use of an Adtran Atlas 550 for Frame Relay emulation. You can also use a router with three serial interfaces as a Frame Relay switch. If you are using the Atlas 550, be sure to connect the routers' serial interfaces to the correct port on the Atlas (labeled in the diagram) using a V.35 cable. Even if you have a WAN emulator, perform the lab both ways if possible. Being able to configure a router as a Frame Relay switch in a full-mesh topology is beneficial to understanding Frame Relay connectivity.

Step 2

On SanJose1, apply IP addressing to the interfaces, configure IGRP as the routing protocol, and encapsulate the Serial 0/0 WAN link as Frame Relay, as shown here:

```
SanJose1(config)#interface serial 0/0
SanJose1(config-if)#ip address 192.168.192.1 255.255.255.0
SanJose1(config-if)#encapsulation frame-relay
SanJose1(config-if)#interface fastethernet 0/0
SanJose1(config-if)#ip address 192.168.0.1 255.255.255.0
SanJose1(config-if)#exit
SanJose1(config)#router igrp 234
SanJose1(config-router)#network 192.168.0.0
SanJose1(config-router)#network 192.168.192.0
```

Configure Frame Relay on Singapore and London using the same command syntax.

Step 3

Verify complete configuration of full-mesh Frame Relay WAN.

Test with extended pings between each set of routers. Example: London to Singapore.

```
London#ping
Protocol [ip]:
Target IP address: 192.168.232.1
Repeat count [5]: 50
Datagram size [100]:
Timeout in seconds [2]:
Extended commands [n]: y
Source address or interface: 192.168.200.1
Type of service [0]:
Set DF bit in IP header? [no]:
Validate reply data? [no]:
Data pattern [0xABCD]:
Loose, Strict, Record, Timestamp, Verbose[none]:
Sweep range of sizes [n]:
Type escape sequence to abort.
Sending 50, 100-byte ICMP Echos to 192.168.232.1, timeout is 2
seconds:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Success rate is 100 percent (50/50), round-trip min/avg/max =
56/60/80 ms
```

All pings should be successful. With only one physical connection to the Frame Relay cloud, two different next-hop routers can be reached.

Issue the **show frame-relay lmi** on Singapore, as shown here:

```
Singapore#show frame-relay lmi

LMI Statistics for interface Serial0/0 (Frame Relay DTE) LMI TYPE
= ANSI
  Invalid Unnumbered info 0          Invalid Prot Disc 0
  Invalid dummy Call Ref 0          Invalid Msg Type 0
  Invalid Status Message 0          Invalid Lock Shift 0
  Invalid Information ID 0           Invalid Report IE Len 0
  Invalid Report Request 0          Invalid Keep IE Len 0
  Num Status Enq. Sent 2523         Num Status msgs Rcvd 2522
  Num Update Status Rcvd 0          Num Status Timeouts 7
```

The LMI type is ANSI.

1. The default LMI type is Cisco and you did not explicitly configure another type; why did the router select ANSI?

If a router is running Cisco IOS release 11.2 or later, it can autosense the LMI type as either Cisco, ANSI T1.617 Annex D (ANSI), or ITU-T Q.933 Annex A (q933a).

Issue the **show frame-relay pvc** command on Singapore.

```
Singapore#show frame-relay pvc

PVC Statistics for interface Serial0/0 (Frame Relay DTE)

          Active      Inactive      Deleted      Static
Local           2           0           0           0
Switched        0           0           0           0
Unused          0           0           0           0
DLCI = 16, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =
Serial0/0

input pkts 676          output pkts 470          in bytes 92211
out bytes 86466         dropped pkts 0           in FECN pkts 0
in BECN pkts 0         out FECN pkts 0        out BECN pkts
0
in DE pkts 0           out DE pkts 0
out bcast pkts 372     out bcast bytes 76274
pvc create time 03:32:04, last time pvc status changed 03:32:04

DLCI = 18, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =
Serial0/0

input pkts 433          output pkts 436          in bytes 81309
out bytes 82942         dropped pkts 0           in FECN pkts 0
in BECN pkts 0         out FECN pkts 0        out BECN pkts
0
in DE pkts 0           out DE pkts 0
out bcast pkts 371     out bcast bytes 76182
pvc create time 03:32:05, last time pvc status changed 03:32:05
```

Singapore S0/0 is using two DLCIs, 16 and 18, which you did not explicitly configure. The router learned about these dynamically from the Frame Relay switch. Recall that a DLCI identifies a PVC through the Frame Relay cloud.

Issue the **show frame-relay map** command on Singapore.

```
Singapore#show frame-relay map
Serial0/0 (up): ip 192.168.192.1 dlci 16(0x10,0x400), dynamic,
broadcast,, status defined, active
Serial0/0 (up): ip 192.168.192.2 dlci 18(0x11,0x410), dynamic,
broadcast,, status defined, active
```

Recall that mapping is the association between a DLCI and the next-hop DTE (router). The next hop is identified by its IP address.

2. Since mapping was not explicitly configured, how was this mapping achieved?
-

Once a router receives a list of DLCIs, it sends an Inverse ARP through every PVC requesting information regarding the DTE at the other end. The returned IP address and status information is displayed in the map table. Note that, according to the **show frame-relay map** output above, these maps were created dynamically. *Note:* Broadcasts and multicasts are supported on these PVCs, enabling routing protocols to exchange updates between regional sites.

Now issue the **show ip route** command on Singapore:

```
Singapore#show ip route

Gateway of last resort is not set

C    192.168.192.0/24 is directly connected, Serial0/0
I    192.168.200.0/24 [100/8486] via 192.168.192.2, 00:00:03,
     Serial0/0
C    192.168.232.0/24 is directly connected, FastEthernet0/0
I    192.168.0.0/24 [100/8486] via 192.168.192.1, 00:00:05,
     Serial0/0
```

Singapore should have a complete routing table, indicating that your full-mesh Frame Relay configuration is complete.

Step 4

Network engineers may not be comfortable with implicit configurations. The benefits of dynamic mapping are minor due to the static nature of most WANs. Once a link is established, there may not be a change for years. Also, if variables are not explicitly defined with configuration commands, the configuration file will not yield much information about the Frame Relay network.

You can explicitly configure the routers to define elements discussed previously. Here is an example of how SanJose1 might be configured:

```
SanJose1(config)#interface fastethernet 0/0
SanJose1(config-if)#ip address 192.168.0.1 255.255.255.0
SanJose1(config-if)#interface serial 0/0
SanJose1(config-if)#encapsulation frame-relay
SanJose1(config-if)#frame-relay map ip 192.168.192.2 18 broadcast
SanJose1(config-if)#frame-relay map ip 192.168.192.4 17 broadcast
SanJose1(config-if)#frame-relay lmi-type ansi
SanJose1(config-if)#exit
SanJose1(config)#router igrp 234
SanJose1(config-router)#network 192.168.192.0
SanJose1(config-router)#network 192.168.0.0
SanJose1(config-router)#passive-interface fastethernet 0/0
```

The **frame-relay map** command associates next-hop ip addresses with local a DLCI. The **broadcast** keyword allows multicasts and broadcasts to be propagated through that PVC. The **frame-relay lmi-type** command statically defines the DTE (router) LMI protocol, which must match the DCE (switch).

Note that, in this configuration, IGRP routing updates are blocked from exiting FastEthernet 0/0. This saves bandwidth on the LAN, as there are no IGRP neighbors on that network.