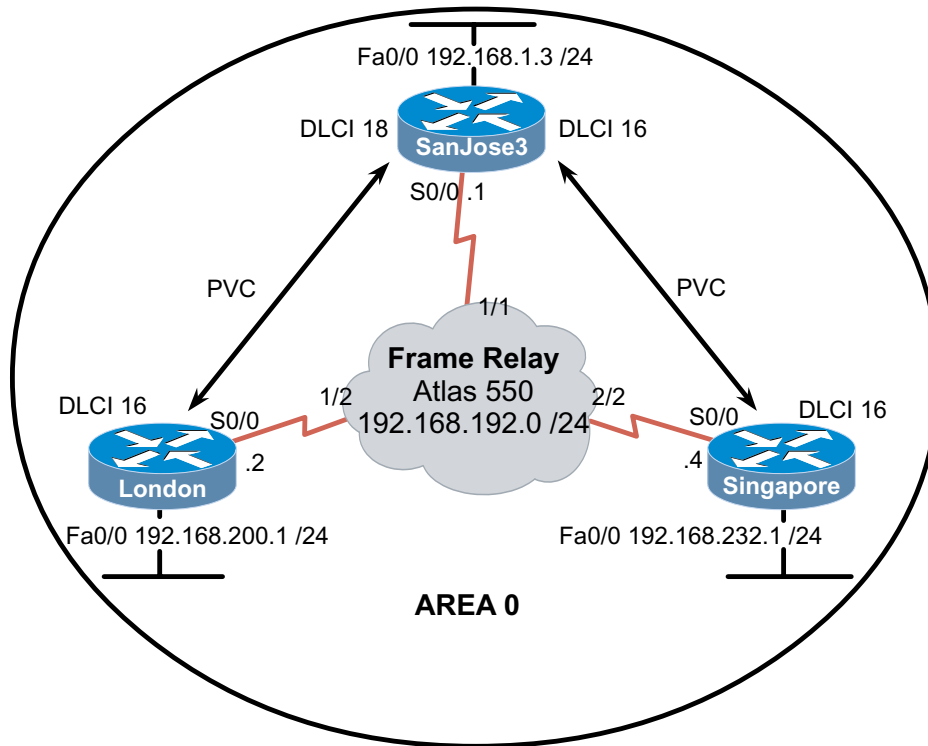
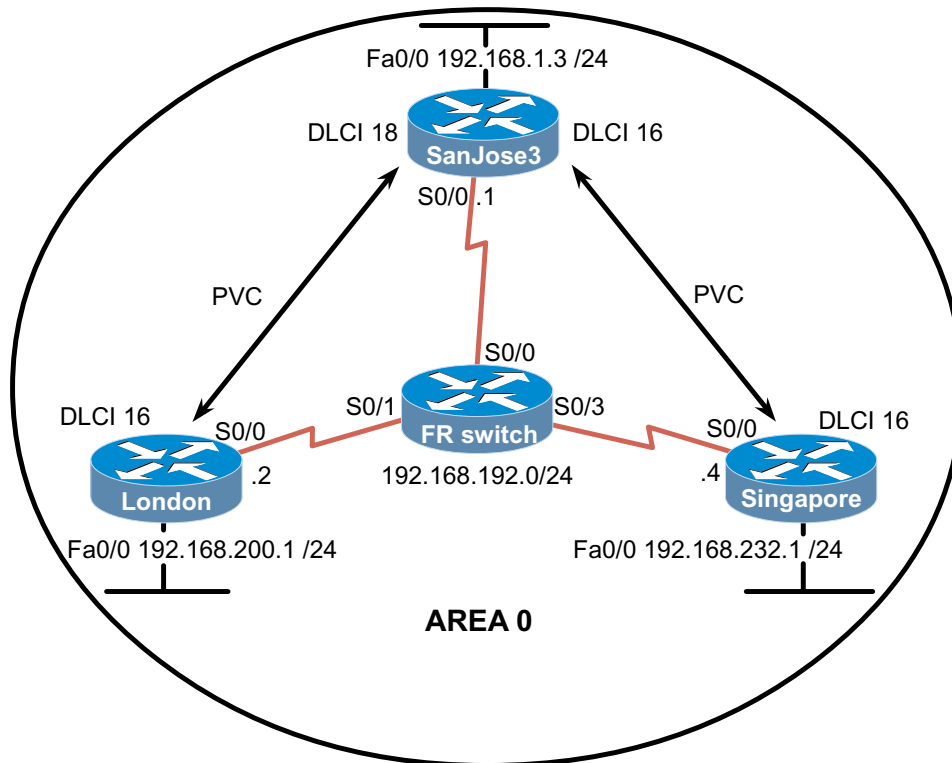


4.6.3: Configuring Point-to-Multipoint OSPF Over Frame Relay



Alternate:



Objective

In this lab, configure OSPF as a point-to-multipoint network type so that it operates efficiently over a hub-and-spoke Frame Relay topology.

Scenario

International Travel Agency has just connected two regional headquarters to San Jose using Frame Relay in a hub-and-spoke topology. You are asked to configure OSPF routing over this type of network, which is known for introducing complications into OSPF adjacency relationships. To avoid these complications, you must manually override the Non-Broadcast Multi-Access (NBMA) OSPF network type and configure OSPF to run as a point-to-multipoint network. In this environment, no DR or BDR is elected.

Step 1

Cable the network according to the diagram. (Note: This lab requires another router or device to act as a Frame Relay switch.) The first diagram assumes that you will use an Adtran Atlas 550, which is preconfigured. The second diagram assumes that you will configure a router with at least three serial interfaces as a Frame Relay switch. See the configuration at the end of this lab for an example of how to configure a router as a Frame Relay switch. If desired, you can copy the configuration to a 2600 router for use in this lab.

Configure each router's FastEthernet interface as shown, but leave the serial interfaces and OSPF routing unconfigured for now. Assign loopback interfaces to each router at your discretion (be sure they are unique within your network).

Until you configure Frame Relay, you will not be able to use ping to test connectivity.

Step 2

SanJose3 acts as the hub in this hub-and-spoke network. It reaches London and Singapore via two separate PVCs. Configure Frame Relay on SanJose3's serial interface as shown here:

```
SanJose3(config)#interface serial 0/0
SanJose3(config-if)#encapsulation frame-relay ietf
SanJose3(config-if)#ip address 192.168.192.1 255.255.255.0
SanJose3(config-if)#no shutdown
SanJose3(config-if)#frame-relay map ip 192.168.192.2 18 broadcast
SanJose3(config-if)#frame-relay map ip 192.168.192.4 16 broadcast
SanJose3(config-if)#ip ospf network point-to-multipoint
```

Note that this configuration includes **frame-relay map** commands, which are typically used with Frame Relay subinterfaces. These commands are needed here so that you can configure Frame Relay to handle broadcast traffic with the **broadcast** keyword. Without this configuration, OSPF multicast traffic will not be forwarded correctly over this Frame Relay topology.

Configure London's serial interface; use IETF encapsulation:

```
London(config)#interface serial 0/0
London(config-if)#encapsulation frame-relay ietf
London(config-if)#ip address 192.168.192.2 255.255.255.0
London(config-if)#no shutdown
London(config-if)#frame-relay map ip 192.168.192.1 17 broadcast
London(config-if)#frame-relay map ip 192.168.192.4 17 broadcast
London(config-if)#ip ospf network point-to-multipoint
```

Finally, configure Singapore's serial interface:

```
Singapore(config)#interface serial 0/0
Singapore(config-if)#encapsulation frame-relay IETF
Singapore(config-if)#ip address 192.168.192.4 255.255.255.0
Singapore(config-if)#no shutdown
Singapore(config-if)#frame-relay map ip 192.168.192.1 17 broadcast
Singapore(config-if)#frame-relay map ip 192.168.192.2 17 broadcast
Singapore(config-if)#ip ospf network point-to-multipoint
```

Verify Frame Relay operation with a ping from each router to the other two. Use **show frame-relay pvc** and **show frame-relay map** to troubleshoot connectivity problems. Rebooting the Frame Relay switch might also solve connectivity issues.

```
SanJose3#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 = 17, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0/0

input pkts 91	output pkts 76	in bytes 13322
out bytes 14796	dropped pkts 10	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 50	out bcast bytes 9808	
pvc create time 00:38:04, last time pvc status changed 00:01:18		

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

input pkts 61	output pkts 57	in bytes 10786
out bytes 14076	dropped pkts 4	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 30	out bcast bytes 8940	
pvc create time 00:48:17, last time pvc status changed 00:03:31		

```
SanJose3#show frame-relay map
```

```
Serial0/0 (up): ip 192.168.192.2 dlci 18(0x12,0x420), static,
                broadcast,
                IETF, status defined, active
Serial0/0 (up): ip 192.168.192.4 dlci 17(0x11,0x410), static,
                broadcast,
                IETF, status defined, active
```

Step 3

Configure OSPF to run over this point-to-multipoint network. Issue the following commands at the appropriate router:

```
London(config)#router ospf 1
London(config-router)#network 192.168.200.0 0.0.0.255 area 0
London(config-router)#network 192.168.192.0 0.0.0.255 area 0

SanJose3(config)#router ospf 1
SanJose3(config-router)#network 192.168.1.0 0.0.0.255 area 0
SanJose3(config-router)#network 192.168.192.0 0.0.0.255 area 0

Singapore(config)#router ospf 1
Singapore(config-router)#network 192.168.232.0 0.0.0.255 area 0
Singapore(config-router)#network 192.168.192.0 0.0.0.255 area 0
```

Verify your OSPF configuration by issuing the **show ip route** command at each of the routers:

```
London#show ip route

Gateway of last resort is not set

      192.168.192.0/24 is variably subnetted, 3 subnets, 2 masks
C       192.168.192.0/24 is directly connected, Serial0/0
O       192.168.192.1/32 [110/64] via 192.168.192.1, 00:06:49,
        Serial0/0
O       192.168.192.4/32 [110/128] via 192.168.192.1, 00:06:49,
        Serial0/0
C       192.168.200.0/24 is directly connected, FastEthernet0/0
O       192.168.232.0/24 [110/129] via 192.168.192.1, 00:06:49,
        Serial0/0
O       192.168.204.0/32 is subnetted, 1 subnets
C       192.168.204.1 is directly connected, Loopback0
O       192.168.1.0/24 [110/65] via 192.168.192.1, 00:06:50,
        Serial0/0
```

If each router has a complete table, including routes to 192.168.1.0 /24, 192.168.200.0 /24, and 192.168.232.0 /24, you have successfully configured OSPF to operate over Frame Relay.

Test these routes by pinging the FastEthernet interfaces of each router from London's console.

Finally, issue the **show ip ospf neighbor detail** command at any router's console:

```
SanJose3#show ip ospf neighbor

Neighbor ID    Pri   State       Dead Time   Address        Interface
192.168.200.1    1  FULL/  -    00:01:35    192.168.192.2  Serial0/0
192.168.232.1    1  FULL/  -    00:01:51    192.168.192.4  Serial0/0
```

```
SanJose3#show ip ospf neighbor detail
Neighbor 192.168.200.1, interface address 192.168.192.2
  In the area 0 via interface Serial0/0
  Neighbor priority is 1, State is FULL, 6 state changes
  DR is 0.0.0.0 BDR is 0.0.0.0
  Options 2
  Dead timer due in 00:01:41
  Index 2/2, retransmission queue length 0, number of
```

```

        retransmission 1
        First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
        Last retransmission scan length is 1, maximum is 1
        Last retransmission scan time is 0 msec, maximum is 0 msec
Neighbor 192.168.232.1, interface address 192.168.192.4
In the area 0 via interface Serial0/0
Neighbor priority is 1, State is FULL, 6 state changes
DR is 0.0.0.0 BDR is 0.0.0.0
Options 2
Dead timer due in 00:01:56
Index 1/1, retransmission queue length 0, number of
        retransmission 1
        First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
        Last retransmission scan length is 1, maximum is 1
        Last retransmission scan time is 0 msec, maximum is 0 msec

```

1. Is there a DR for this network? Why or why not?

There is no DR. Point-to-multipoint configuration creates a logical multiaccess network over physical point-to-point links. Because each router has only one physical neighbor, only one adjacency can be formed. No efficiency would be realized by electing a DR.

Router as Frame Relay Switch Configuration

The following example can be used to configure a router as the Frame Relay switch.

```

Frame-Switch#show run
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Frame-Switch
!
ip subnet-zero
no ip domain-lookup
!
ip audit notify log
ip audit po max-events 100
frame-relay switching
!
process-max-time 200
!
interface Serial0/0
no ip address
no ip directed-broadcast
encapsulation frame-relay
clockrate 56000
cdp enable
frame-relay intf-type dce
frame-relay route 17 interface Serial0/2 16
frame-relay route 18 interface Serial0/1 16
!
interface Serial0/1
no ip address
no ip directed-broadcast
encapsulation frame-relay
clockrate 56000
cdp enable
frame-relay intf-type dce
frame-relay route 16 interface Serial0/0 18

```

```
!  
interface Serial0/2  
  no ip address  
  no ip directed-broadcast  
  encapsulation frame-relay  
  clockrate 56000  
  cdp enable  
  frame-relay intf-type dce  
  frame-relay route 16 interface Serial0/0 17  
!  
interface Serial0/3  
  no ip address  
  no ip directed-broadcast  
  shutdown  
!  
ip classless  
no ip http server  
!  
line con 0  
  password cisco  
  login  
  transport input none  
line aux 0  
line vty 0 4  
  password cisco  
  login  
!  
no scheduler allocate  
end
```