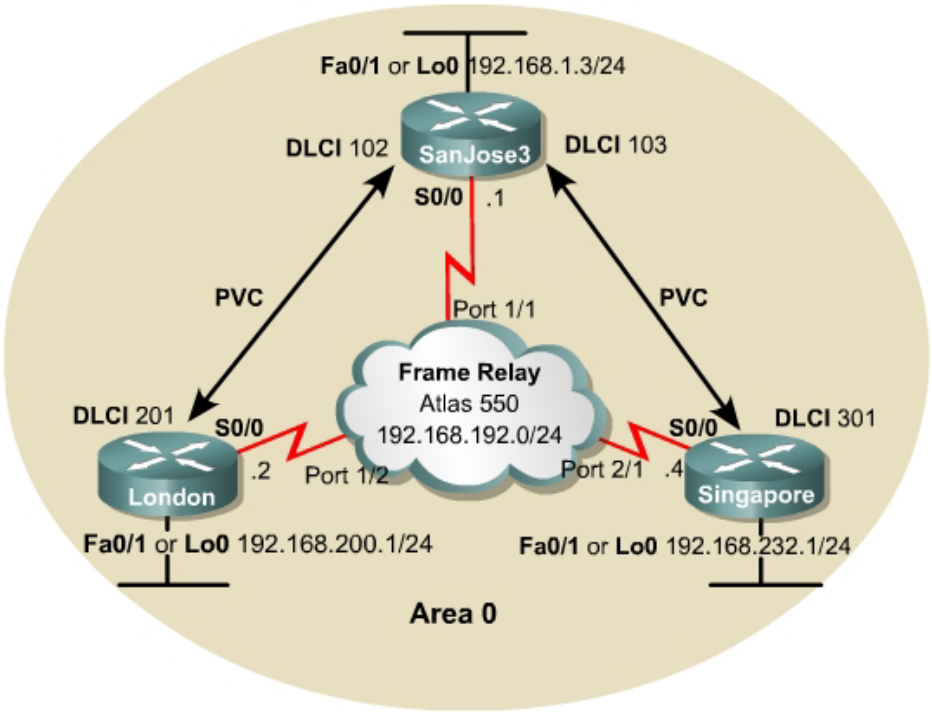
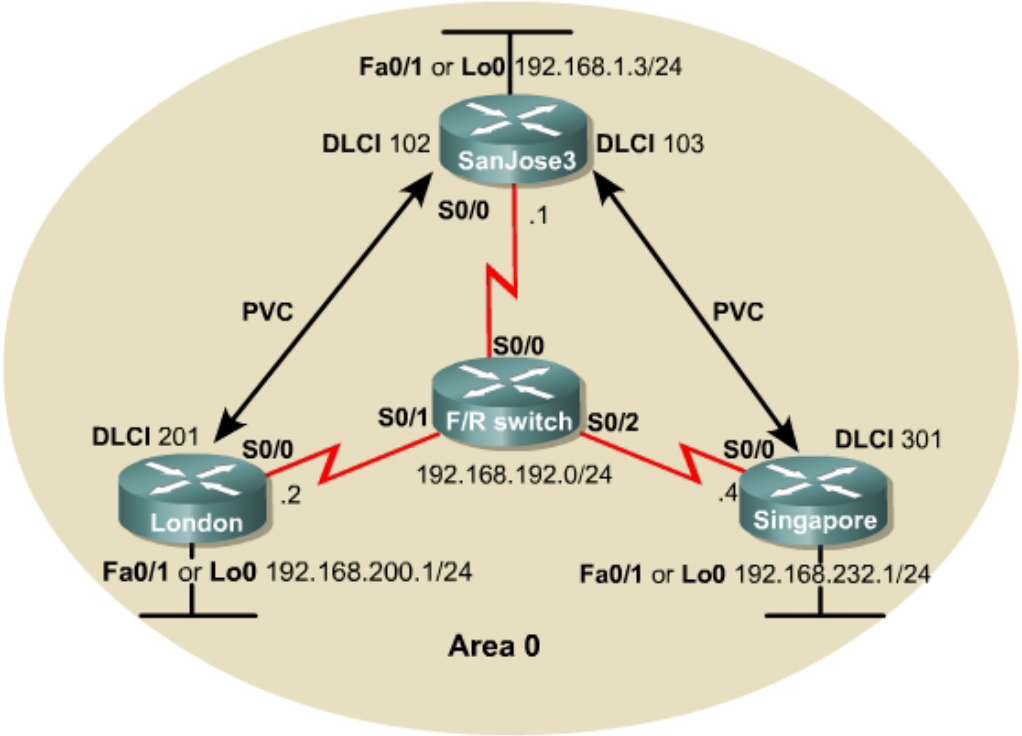
Lab 6.9.2b Configuring Point-to-Multipoint OSPF Over Frame Relay



Alternative



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. OSPF routing is to be configured over this type of network, which is known for introducing complications into OSPF adjacency relationships. To avoid these complications, 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. Configure the FastEthernet or Loopback interface for each router as shown, but leave the serial interfaces and OSPF routing unconfigured for now.

Until Frame Relay is configured, **`ping`** is not useful for testing connectivity.

> **Note:** This lab requires another router or device to act as a Frame Relay switch. The first diagram assumes that an Adtran Atlas 550 will be used, which is preconfigured. The second diagram assumes that a router will be configured 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, copy the configuration to a 2600 router for use in this lab.
>
> The Adtran Atlas 550 has a fixed internal configuration that is used for all CCNP 1-4 Version 3.0 labs. The Atlas Frame Relay configuration implements a full mesh topology. To implement a hub-and-spoke topology for this lab, both Frame Relay maps on London reference DLCI 201. Similarly, both Frame Relay maps on Singapore reference DLCI 301. DLCI 201 on London and DLCI 301 on Singapore cause the Atlas to switch frames to the hub router, SanJose3. Using Frame Relay maps on the spoke routers automatically disables Frame Relay inverse ARP on the serial interfaces, thus preventing inadvertent dynamic Frame Relay maps from being formed directly between the spoke routers (which would circumvent the hub router).

Step 2

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

```
SanJose3(config)#interface serial 0/0
SanJose3(config-if)#encapsulation frame-relay
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 192.168.192.2 102 broadcast
SanJose3(config-if)#frame-relay map ip 192.168.192.4 103 broadcast
SanJose3(config-if)#ip ospf network point-to-multipoint
```

Notice that this configuration includes **`frame-relay map`** commands, which are also used on multipoint Frame Relay subinterfaces. These commands are used here with the **`broadcast`** keyword so that Frame Relay can process broadcast traffic. Without this configuration, OSPF multicast traffic would not be forwarded correctly by the SanJose3 router.

Configure the serial interface for London as follows:

```
London(config)#interface serial 0/0
London(config-if)#encapsulation frame-relay
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 192.168.192.1 201 broadcast
London(config-if)#frame-relay map ip 192.168.192.4 201 broadcast
London(config-if)#ip ospf network point-to-multipoint
```

Finally, configure the serial interface for Singapore as follows:

```
Singapore(config)#interface serial 0/0
Singapore(config-if)#encapsulation frame-relay
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 192.168.192.1 301 broadcast
Singapore(config-if)#frame-relay map ip 192.168.192.2 301 broadcast
Singapore(config-if)#ip ospf network point-to-multipoint
```

Verify Frame Relay operation with a **ping** command 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            1            0            0

DLCI = 102, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0/0

  input pkts 111           output pkts 112          in bytes 10936
  out bytes 6259           dropped pkts 0           in pkts dropped 0
  out pkts dropped 0                out bytes dropped 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 19        out bcast bytes 1428
  pvc create time 00:10:58, last time pvc status changed 00:08:38

DLCI = 103, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0/0

  input pkts 65            output pkts 56           in bytes 5136
  out bytes 3752           dropped pkts 0           in pkts dropped 0
  out pkts dropped 0                out bytes dropped 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 19        out bcast bytes 1428
  pvc create time 00:11:01, last time pvc status changed 00:08:41

DLCI = 104, DLCI USAGE = UNUSED, PVC STATUS = INACTIVE, INTERFACE = Serial0/0

  input pkts 0             output pkts 0            in bytes 0
  out bytes 0              dropped pkts 0           in pkts dropped 0
  out pkts dropped 0                out bytes dropped 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 0         out bcast bytes 0
  switched pkts 0
  Detailed packet drop counters:
  no out intf 0            out intf down 0          no out PVC 0
  in PVC down 0            out PVC down 0           pkt too big 0
  shaping Q full 0         pkt above DE 0           policing drop 0
  pvc create time 00:10:22, last time pvc status changed 00:09:49


SanJose3#show frame-relay map
Serial0/0 (up): ip 192.168.192.2 dlci 102(0x66,0x1860), static,
              broadcast,
              CISCO, status defined, active
```



```
Serial0/0 (up): ip 192.168.192.4 dlci 103(0x67,0x1870), static,
             broadcast,
             CISCO, 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 0.0.0.255 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 the OSPF configuration by issuing the **show ip route** command at each of the routers:

```
London#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static 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 [110/781] via 192.168.192.1, 00:10:04, Serial0/0
O       192.168.192.4/32 [110/845] via 192.168.192.1, 00:10:04, Serial0/0
C    192.168.200.0/24 is directly connected, Loopback0
     192.168.232.0/32 is subnetted, 1 subnets
O       192.168.232.1 [110/846] via 192.168.192.1, 00:10:04, Serial0/0
     192.168.1.0/32 is subnetted, 1 subnets
O       192.168.1.3 [110/782] via 192.168.192.1, 00:10:04, 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, OSPF has been successfully configured 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 console:

```
SanJose3#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.200.1     1   FULL/  -        00:01:39    192.168.192.2   Serial0/0
192.168.232.1     1   FULL/  -        00:01:36    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 is 0x42
    Dead timer due in 00:01:49
    Neighbor is up for 00:12:25
    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 is 0x42
   Dead timer due in 00:01:46
   Neighbor is up for 00:12:25
   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. The configuration of OSPF point-to-multipoint network type on serial interfaces creates a logical multi-access network over physical point-to-point links. 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 103 interface Serial0/2 301
 frame-relay route 102 interface Serial0/1 201
!
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 201 interface Serial0/0 102
!
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 301 interface Serial0/0 103
!
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
```

