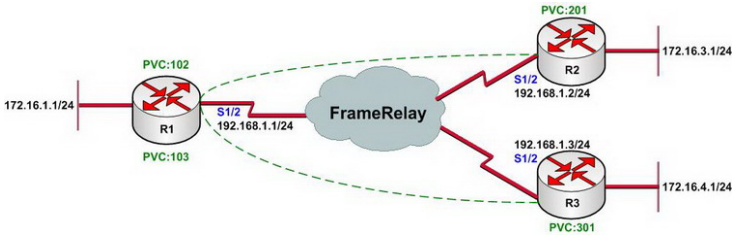
OSPF Lab1 - Configuring OSPF in NBMA

?Lab objectives?

1. Learn the two configuration method of manual and auto setup of OSPF neighbor relations in NBMA network

2. Learn how to specify OSPF interface priority, and how to avoid DR selection error by changing OSPF default interface network type.

?Lab Topology?



?Lab steps and requirements?

1. Configure IP addresses of every router, and use ping command to confirm the direct interface connectivity of every router.
2. The following shows configurations of R1, R2 and R3:

```
R1(config)#interface   loopback 0
R1(config-if)#ip   address 172.16.1.1 255.255.255.0
R1(config-if)#ip ospf network point-to-point
R1(config-if)#exit
R1(config)#
R1(config)#interface   serial 1/2
R1(config-if)#ip add   192.168.1.1 255.255.255.0
R1(config-if)#encapsulation   frame-relay
R1(config-if)#no frame-relay inverse-arp
R1(config-if)#frame-relay map ip 192.168.1.2   102 broadcast
R1(config-if)#frame-relay map ip 192.168.1.3   103 broadcast
R1(config-if)#exit
R1(config)#
R1(config)#router ospf   1
R1(config-router)#network   192.168.1.0 0.0.0.255 area 0
R1(config-router)#network   172.16.1.0 0.0.0.255 area 0
R1(config-router)#exit
R1(config)#
```

```
R2(config)#interface   loopback 0
R2(config-if)#ip   address 172.16.3.1 255.255.255.0
R2(config-if)#ip ospf   network point-to-point
R2(config-if)#exit
R2(config)#
R2(config)#interface   serial 1/2
R2(config-if)#encapsulation   frame-relay
R2(config-if)#ip address   192.168.1.2 255.255.255.0
R2(config-if)#no   frame-relay inverse-arp
R2(config-if)#frame-relay   map ip 192.168.1.1 201 broadcast
R2(config-if)#no   shutdown
R2(config-if)#exit
R2(config)#
R2(config)#router ospf   1
R2(config-router)#network   172.16.3.0 0.0.0.255 area 0
R2(config-router)#network   192.168.1.0 0.0.0.255 area 0
R2(config-router)#exit
R2(config)#
```

```
R3(config)#interface   loopback 0
R3(config-if)#ip   address 172.16.4.1 255.255.255.0
R3(config-if)#ip ospf   network point-to-point
R3(config-if)#exit
R3(config)#
R3(config)#interface   serial 1/2
R3(config-if)#ip   address 192.168.1.3 255.255.255.0
R3(config-if)#encapsulation   frame-relay
R3(config-if)#no   frame-relay inverse-arp
R3(config-if)#frame-relay   map ip 192.168.1.1 301 broadcast
R3(config-if)#no   shutdown
R3(config-if)#exit
R3(config)#
R3(config)#router ospf   1
R3(config-router)#network   172.16.4.0 0.0.0.255 area 0
R3(config-router)#network   192.168.1.0 0.0.0.255 area 0
R3(config-router)#exit
R3(config)#
```

3. After configuring OSPF, check OSPF neighbor table of R1, R2 and R3, and find that OSPF neighbor relation has not been set up.

R1#show ip ospf neighbor

R1#

4. Check OSPF information of Serial 1/2 on R1.

```
R1#show ip ospf interface serial 1/2
Serial1/2 is up, line protocol is up
 Internet Address 192.168.1.1/24, Area 0
 Process ID 1, Router ID 172.16.1.1, Network Type NON_BROADCAST, Cost: 64
 Transmit Delay is 1 sec, State DR, Priority 1
 Designated Router (ID) 172.16.1.1, Interface address 192.168.1.1
 No backup designated router on this network
 Timer intervals configured, Hello 30, Dead 120, Wait 120, Retransmit 5
 oob-resync timeout 120
 Hello due in 00:00:15
 Index 1/1, flood queue length 0
 Next 0x0(0)/0x0(0)
 Last flood scan length is 0, maximum is 0
 Last flood scan time is 0 msec, maximum is 0 msec
 Neighbor Count is 0, Adjacent neighbor count is 0
 Suppress hello for 0 neighbor(s)
R1#
```

5. From analysis, we know that: the reason that OSPF cannot form its own neighbor relations is OSPF think NBMA broadcast doesn't support broadcast and multi-cast, thus it will not actively send out HELLO data packet of OSPF.
6. Configure manually OSPF neighbor relations of R1:

```
R1(config)#router ospf 1
R1(config-router)#neighbor 192.168.1.2
```

R1(config-router)#neighbor 192.168.1.3

R2(config)#router ospf 1
R2(config-router)#neighbor 192.168.1.1

R3(config)#router ospf 1
R3(config-router)#neighbor 192.168.1.1

7. System IOS will prompt the following information after configuration:

*Jun 18 15:36:16.743: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.4.1 on Serial1/2 from LOADING to FULL, Loading Done
*Jun 18 15:36:16.747: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.3.1 on Serial1/2 from LOADING to FULL, Loading Don

8. Check R1 neighbor table:

R1#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface
172.16.3.1 1 FULL/DROTHER 00:01:31 192.168.1.2 Serial1/2
172.16.4.1 1 FULL/DR 00:01:57 192.168.1.3 Serial1/2
R1#

9. Apart from manual configuration, we may also change OSPF interface types, in this way router may automatically create OSPF neighbor relations. The configuration is very simple and error will not easily occur.

R1(config)#interface serial 1/2
R1(config-if)#ip ospf network broadcast
R1(config-if)#exit

10. Check interface information.

R1#show ip ospf interface serial 1/2
Serial1/2 is up, line protocol is up
Internet Address 192.168.1.1/24, Area 0
Process ID 1, Router ID 172.16.1.1, Network Type BROADCAST, Cost: 64
Transmit Delay is 1 sec, State DR, Priority 1
????
R1#

11. Check OSPF neighbor table of R1, R2 and R2.

R1#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface
172.16.3.1 1 FULL/DROTHER 00:00:32 192.168.1.2 Serial1/2
172.16.4.1 1 FULL/DR 00:00:33 192.168.1.3 Serial1/2
R1#

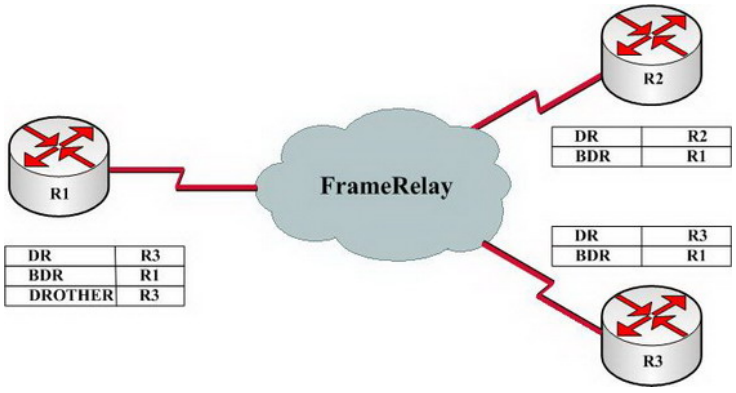
R2#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface
172.16.1.1 1 FULL/BDR 00:00:30 192.168.1.1 Serial1/2
R2#

R3#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface
172.16.1.1 1 FULL/BDR 00:00:39 192.168.1.1 Serial1/2
R3#

12. Observe OSPF neighbor table carefully, and you will find the following problems:
OSPF neighbor table of R1, indicate 172.16.4.1 is DR?172.16.3.1 being DROTHER, and itself being BDR.
OSPF neighbor table of R2, indicate 172.16.1.1 is BDR, and itself being DR.
OSPF neighbor table of R3, indicate 172.16.1.1 is BDR and itself being DR.
With the following graphic, we get a better idea of DR and BDR.



The reason that this problem occur is the network topology of Frame-Relay is not full meshed. When R3 is establishing neighbors with R1, R3 know not the existence of R2. And when R2 is establishing neighbor with R1, R2 know not R3. At this time, the network is running two different OSPF auto systems.
13. There are also other problems: when errors occur on subnet of R3 172.16.4.0/24, R3 will broadcast LSA to R1, and R1 will not transfer this LSA to R3, because R1 thinks that R3 will be broadcasted by DR. Moreover, if errors occur on 172.16.1.0/24 of R1, R1 will broadcast to DR by default, i.e. broadcast to R3, but not to R2. Because as BDR, R1 will only broadcast LSA to DR, and other DROTHER broadcast will be done by DR, but as a DR, R3 will not broadcast to R2 after receiving LSA from R1, because R3 do not know that R2 is in the network.

14. To solve this problem, we should manually specify DR of network, because OSPF priority will affect DR selection, OSPF with priority 0 will never become DR, and OSPF with higher priority will become DR easily. By default, OSPF priority is 1, thus configure R2 and R3 priority as 0:

```
R2(config)#interface   serial 1/2
R2(config-if)#ip ospf   priority 0
R2(config-if)#exit
R2(config)#
```

```
R3(config)#interface   serial 1/2
R3(config-if)#ip ospf   priority 0
R3(config-if)#exit
```

15. Check neighbor table of all routers; from neighbor table you may see every OSPF router has their own roles:

```
R1#show ip ospf   neighbor

Neighbor ID Pri State Dead Time Address Interface
172.16.3.1 0 FULL/DROTHER 00:00:38 192.168.1.2 Serial1/2
172.16.4.1 0 FULL/DROTHER 00:00:39 192.168.1.3 Serial1/2
R1#
```

```
R2#show ip ospf   neighbor
```

Neighbor ID Pri State Dead Time Address Interface
172.16.1.1 1 FULL/DR 00:00:31 192.168.1.1 Serial1/2
R2#

R3#show ip ospf neighbor

Neighbor ID Pri State Dead Time Address Interface
172.16.1.1 1 FULL/DR 00:00:38 192.168.1.1 Serial1/2
R3#

16. We may also change OSPF interface types to avoid DR and BDR selection, and thus reduce errors occurrence in DR selection. For example, change the R1 interface network to P2MP (point-to-multipoint), and change R2 and R3 interface network types to P2P (point-to-point), because in the various network types of OSPF, both P2MP and P2P need not to select DR and BDR.
17. Besides, when configuring interface network types, we also have to pay attention to HELLO death interval time of interfaces, because different types of network have different interval time. Different types of HELLO time interval will result in the failure of OSPF neighbor relations establishing.
18. The following is network type and DR selection of an OSPF, and HELLO time interval table for reference.

OSPF Mode	NBMA Preferred Topology	Subnet Address	Hello Timer	Adjacency	RFC or Cisco
Broadcast	Full or partial mesh	Same	10 sec	Automatic, DR/BDR elected	Cisco
Nonbroadcast (NBMA)	Full or partial mesh	Same	30 sec	Manual configuration, DR/BDR elected	RFC
Point-to-multipoint	Partial-mesh or star	Same	30 Sec	Automatic, no DR/BDR	RFC
Point-to-multipoint nonbroadcast	partial-mesh or star	Same	30 sec	Manual configuration, no/DR/BDR	Cisco
Point-to-point	Partial-mesh or star, using subinterface	Different for Each Subinterface	10 sec	Automatic, no DR/BDR	Cisco

19. Lab finished.
Hope to helpful for you!