

实验十九、OSPF 在 NBMA 网络的配置

一、 实验目的

1. 掌握 OSPF 协议在 NBMA（非广播多点可达）环境下的配置
2. 理解 NBMA 环境的特殊性

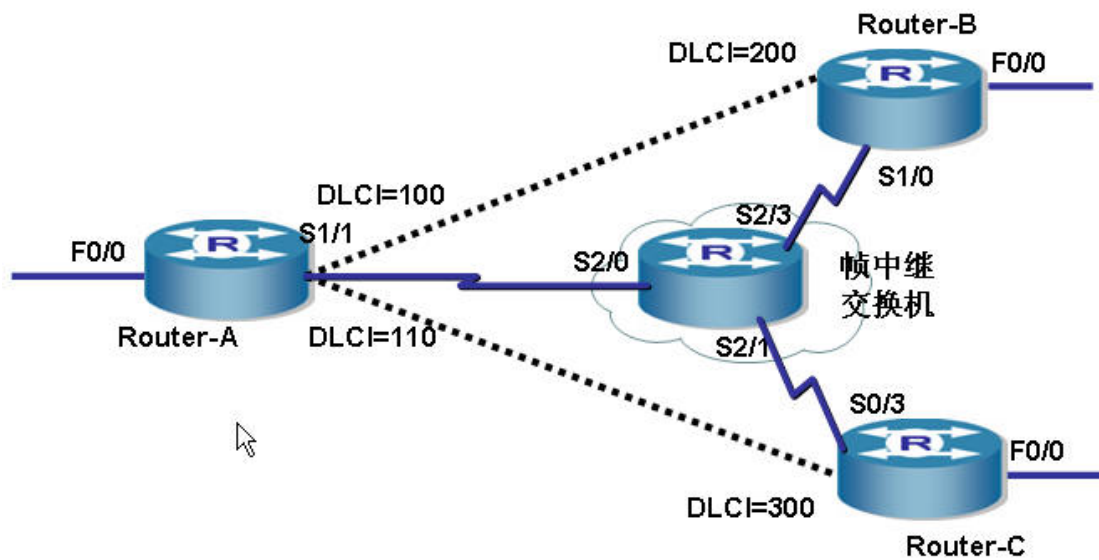
二、 应用环境

在帧中继的网络中，通常一个物理接口对应多条 PVC，DR 的选择非常重要，如在下图中，要保证 ROUTER-A 成为 DR，才能保证 OSPF 路由更新的正确

三、 实验设备

- | | |
|-----------------------------------|----|
| 1. DCR-1751 | 三台 |
| 2. DCR-2630（安装相应模块满足三个 serial 接口） | 一台 |
| 3. CR-V35FC | 三条 |
| 4. CR-V35MT | 三条 |

四、 实验拓扑



五、 实验要求

ROUTER-A

S1/1 192.168.1.1/24

F0/0 192.168.2.1/24

ROUTER-B

S1/0 192.168.1.2/24

F0/0 192.168.3.1/24

ROUTER-C

S03 192.168.1.3/24

F0/0 192.168.4.1/24

六、 实验步骤

第一步: 参照实验 15, 将帧中继网络配置好, 并测试连通性

第二步: 配置路由器 A、B、C 的 OSPF 协议

Router-A#**conf**

Router-A_config#**int f0/0**

Router-A_config_f0/0#**ip address 192.168.2.1 255.255.255.0**

Router-A_config_f0/0#**exit**

Router-A_config#**router ospf 1**

Router-A_config_ospf_1#**network 192.169.1.0 255.255.255.0 area 0**

Router-A_config_ospf_1#**network 192.169.2.0 255.255.255.0 area 0**

Router-B#**conf**

Router-B_config#**int f0/0**

Router-B_config_f0/0#**ip address 192.168.3.1 255.255.255.0**

Router-B_config_f0/0#**exit**

Router-B_config#**router ospf 1**

Router-B_config_ospf_1#**net 192.168.1.0 255.255.255.0 area 0**

Router-B_config_ospf_1#**net 192.168.3.0 255.255.255.0 area 0**

Router-C#**conf**

Router-C_config#**int f0/0**

Router-C_config_f0/0#**ip address 192.168.4.1 255.255.255.0**

Router-C_config_rip#**exit**

Router-C_config#**router ospf 1**

Router-C_config_ospf_1#**network 192.168.1.0 255.255.255.0 area 0**

Router-C_config_ospf_1#**network 192.168.4.0 255.255.255.0 area 0**

第三步: 查看各路由器的路由表

Router-A#**sh ip route**

Codes: C - connected, S - static, R - RIP, B - BGP, BC - BGP connected

D - DEIGRP, DEX - external DEIGRP, O - OSPF, OIA - OSPF inter area

ON1 - OSPF NSSA external type 1, ON2 - OSPF NSSA external type 2

OE1 - OSPF external type 1, OE2 - OSPF external type 2

DHCP - DHCP type

VRF ID: 0

C 192.168.2.0/24 is directly connected, FastEthernet0/0

C 192.168.1.0/24 is directly connected, Serial1/1

Router-B# **sh ip route**

Codes: C - connected, S - static, R - RIP, B - BGP, BC - BGP connected

D - DEIGRP, DEX - external DEIGRP, O - OSPF, OIA - OSPF inter area
ON1 - OSPF NSSA external type 1, ON2 - OSPF NSSA external type 2
OE1 - OSPF external type 1, OE2 - OSPF external type 2
DHCP - DHCP type

VRF ID: 0

C 192.168.1.0/24 is directly connected, Serial1/0
C 192.168.3.0/24 is directly connected, FastEthernet0/0

Router-C#sh ip route

Codes: C - connected, S - static, R - RIP, B - BGP, BC - BGP connected
D - DEIGRP, DEX - external DEIGRP, O - OSPF, OIA - OSPF inter area
ON1 - OSPF NSSA external type 1, ON2 - OSPF NSSA external type 2
OE1 - OSPF external type 1, OE2 - OSPF external type 2
DHCP - DHCP type

VRF ID: 0

C 192.168.1.0/24 is directly connected, Serial0/3
C 192.168.4.0/24 is directly connected, FastEthernet0/0

!都没有得到 OSPF 路由, 说明在 NBMA 环境下的需要做特定的配置

第四步: 查看 OSPF 状态

Router-A#sh ip ospf interface

Serial1/1 is up, line protocol is up

Internet Address: 192.168.1.1/24

Nettype: Non-Broadcast ! 网络类型为非广播

OSPF process is 1, AREA: 0, Router ID: 192.168.1.1

Cost: 1600, Transmit Delay is 1 sec, Priority 1

Hello interval is 30, Dead timer is 120, Retransmit is 5

OSPF INTF State is IWAITING

Neighbor Count is 0, Adjacent neighbor count is 0

Router-B#sh ip ospf interface

Serial1/0 is up, line protocol is up

Internet Address: 192.168.1.2/24

Nettype: Non-Broadcast ! 网络类型为非广播

OSPF process is 1, AREA: 0, Router ID: 192.168.2.1

Cost: 1600, Transmit Delay is 1 sec, Priority 1

Hello interval is 30, Dead timer is 120, Retransmit is 5

OSPF INTF State is IWAITING

Neighbor Count is 0, Adjacent neighbor count is 0

```
Router-C#sh ip ospf interface
Serial0/3 is up, line protocol is up
  Internet Address: 192.168.1.3/24
  Nettype: Non-Broadcast           ! 网络类型为非广播
  OSPF process is 1, AREA: 0, Router ID: 192.168.4.1
  Cost: 1600, Transmit Delay is 1 sec, Priority 1
  Hello interval is 30, Dead timer is 120, Retransmit is 5
  OSPF INTF State is IDrOTHER
  Neighbor Count is 0, Adjacent neighbor count is 0
```

第五步: NBMA 环境下的配置

```
Router-A#conf
Router-A_config#router ospf 1
Router-A_config_ospf_1#neighbor 192.168.1.2    ! 手工指定邻居
Router-A_config_ospf_1#neighbor 192.168.1.3

Router-B#conf
Router-B_config#int s1/0
Router-B_config_s1/0#ip ospf priority 0         ! 使 B 不参加 DR 选举
Router-B_config_s1/0#exit
Router-B_config#router ospf 1
Router-B_config_ospf_1#neighbor 192.168.1.1    ! 手工指定邻居
```

```
Router-C#conf
Router-C_config#int s0/3
Router-C_config_s0/3#ip ospf priority 0         ! 使 C 不参加 DR 选举
Router-C_config_s0/3#exit
Router-C_config#router ospf 1
Router-C_config_ospf_1#neighbor 192.168.1.1    ! 手工指定邻居
```

第六步: 再次查看各路由表

```
Router-A#sh ip route
Codes: C - connected, S - static, R - RIP, B - BGP, BC - BGP connected
       D - DEIGRP, DEX - external DEIGRP, O - OSPF, OIA - OSPF inter area
       ON1 - OSPF NSSA external type 1, ON2 - OSPF NSSA external type 2
       OE1 - OSPF external type 1, OE2 - OSPF external type 2
       DHCP - DHCP type
```

VRF ID: 0

C	192.168.1.0/24	is directly connected, Serial1/1
C	192.168.2.0/24	is directly connected, FastEthernet0/0
O	192.168.3.0/24	[110,1601] via 192.168.1.2(on Serial1/1)

O 192.168.4.0/24 [110,1601] via 192.168.1.3(on Serial1/1)

Router-B#**sh ip route**

Codes: C - connected, S - static, R - RIP, B - BGP, BC - BGP connected

D - DEIGRP, DEX - external DEIGRP, O - OSPF, OIA - OSPF inter area

ON1 - OSPF NSSA external type 1, ON2 - OSPF NSSA external type 2

OE1 - OSPF external type 1, OE2 - OSPF external type 2

DHCP - DHCP type

VRF ID: 0

C 192.168.1.0/24 is directly connected, Serial1/0

O 192.168.2.0/24 [110,1601] via 192.168.1.1(on Serial1/0)

C 192.168.3.0/24 is directly connected, FastEthernet0/0

O 192.168.4.0/24 [110,1601] via 192.168.1.3(on Serial1/0)

Router-C#**sh ip route**

Codes: C - connected, S - static, R - RIP, B - BGP, BC - BGP connected

D - DEIGRP, DEX - external DEIGRP, O - OSPF, OIA - OSPF inter area

ON1 - OSPF NSSA external type 1, ON2 - OSPF NSSA external type 2

OE1 - OSPF external type 1, OE2 - OSPF external type 2

DHCP - DHCP type

VRF ID: 0

C 192.168.1.0/24 is directly connected, Serial0/3

O 192.168.2.0/24 [110,1601] via 192.168.1.1(on Serial0/3)

O 192.168.3.0/24 [110,1601] via 192.168.1.2(on Serial0/3)

C 192.168.4.0/24 is directly connected, FastEthernet0/0

第七步: 查看 OSPF 状态

Router-A#**sh ip ospf interface**

! 查看 OSPF 接口状态

Serial1/1 is up, line protocol is up

Internet Address: 192.168.1.1/24

Nettype: Non-Broadcast

OSPF process is 1, AREA: 0, Router ID: 192.168.1.1

Cost: 1600, Transmit Delay is 1 sec, Priority 1

Hello interval is 30, Dead timer is 120, Retransmit is 5

OSPF INTF State is IDr

Designated Router ID: 192.168.1.1, Interface address 192.168.1.1

! A 成为 DR

Neighbor Count is 2, Adjacent neighbor count is 2

Adjacent with neighbor 192.168.2.1

! OSPF 邻居

Adjacent with neighbor 192.168.4.1

```
FastEthernet0/0 is up, line protocol is up
Internet Address: 192.168.2.1/24
Nettype: Broadcast
OSPF process is 1, AREA: 0, Router ID: 192.168.1.1
Cost: 1, Transmit Delay is 1 sec, Priority 1
Hello interval is 10, Dead timer is 40, Retransmit is 5
OSPF INTF State is IDr
Designated Router ID: 192.168.1.1, Interface address 192.168.2.1
Neighbor Count is 0, Adjacent neighbor count is 0
```

Router-A#**sh ip ospf neighbor** ! 查看邻居状态

```
-----
                        OSPF process: 1
                        AREA: 0
Neighbor ID      Pri   State           DeadTime   Neighbor Addr  Interface
192.168.2.1     0    FULL/DROTHER    109        192.168.1.2   Serial1/1
192.168.4.1     0    FULL/DROTHER    96         192.168.1.3   Serial1/1
-----
```

七、 注意事项和排错

1. 在 NBMA 环境下，通过优先级的设定，保证总部的路由器成为 DR
2. 需要手工指定邻居
3. 注意路由器的 ROUTER-ID 并不一定是邻居地址。

八、 配置序列

Router-A#**sh run**

Building configuration...

Current configuration:

```
!
!version 1.3.2E
service timestamps log date
service timestamps debug date
no service password-encryption
!
hostname Router-A
!
!
!
!
!
!
```

```
interface FastEthernet0/0
 ip address 192.168.2.1 255.255.255.0
 no ip directed-broadcast
!
interface Serial1/0
 no ip address
 no ip directed-broadcast
 physical-layer speed 64000
!
interface Serial1/1
 ip address 192.168.1.1 255.255.255.0
 no ip directed-broadcast
 encapsulation frame-relay
!
interface Async0/0
 no ip address
 no ip directed-broadcast
!
!
!
router ospf 1
 network 192.168.1.0 255.255.255.0 area 0
 network 192.168.2.0 255.255.255.0 area 0
 neighbor 192.168.1.2
 neighbor 192.168.1.3
!
!
!
!
!
```

九、 共同思考

1. 默认优先级是多少? 还有没有别的方法确保 A 成为 DR?
2. 为什么需要手工指定邻居?
3. OSPF 有哪些网络类型?

十、 课后练习

请将地址改为 10.10.10.0/24 重复以上实验



十一、 相关命令详解

neighbor

配置与非广播网络邻接的 OSPF 路由器。用 `no neighbor` 命令取消配置。

neighbor *ip-address* [*priority number*] [*poll-interval seconds*] [*cost number*]

no neighbor *ip-address* [*priority number*] [*poll-interval seconds*] [*cost number*]

参数

参数	参数说明
<i>ip-address</i>	邻接路由器的IP地址。
<i>priority number</i>	(任选项I) 8-位优先级。默认值为0，这个选项不能用在点到多点接口。
<i>poll-interval seconds</i>	(任选项I)表示查询间隔。在RFC 1247建议它必须大于hello时间间隔。这个选项不能用在点到多点接口。
<i>cost number</i>	(任选项I) 为相邻路由器指定花费（1 到 65535）如果未指定，采用ip ip ospf co 命令指定的花费。点到多点网络这是唯一一起作用的选项。这个选项不适用与 NBMA网络。

缺省

无缺省值

命令模式

路由配置态

使用说明

在 X. 25 和帧中继网络中，可以设定 OSPF 以广播方式工作。具体可参见

X25 map 与 frame-relay map 命令。

对于每个非广播网络邻居，必须在路由器中配置。且邻居地址必须是接口的主地址。

如果邻接路由器处于不活动器，仍有必要给它发送 hello 包。这些 hello 包按照 poll interval 间隔递减的方式发送。

当开启路由器时，它仅仅给具有非零优先级的路由器发送 hello 包。这个路由器有可能变成 DR 和 BDR 路由器。当 DR 和 BDR 路由器选定后，DR 和 BDR 路由器就发送 hello 包形成邻接表。

示例

下面的例子指定路由器 131.108.3.4 地址为非广播网络，优先值为 1，poll interval 间隔为 180 秒：


```
router ospf
```

```
neighbor 131.108.3.4 priority 1 poll-interval 180
```

下面的例子表示了点到多点的非广播网络的配置:

```
interface Serial0
```

```
ip address 10.0.1.1 255.255.255.0
```

```
ip ospf network point-to-multipoint non-broadcast
```

```
encapsulation frame-relay
```

```
no keepalive
```

```
frame-relay local-dlci 200
```

```
frame-relay map ip 10.0.1.3 202
```

```
frame-relay map ip 10.0.1.4 203
```

```
frame-relay map ip 10.0.1.5 204
```

```
no shut
```

```
!
```

```
router ospf 1
```

```
network 10.0.1.0 255.255.255.0 area 0
```

```
neighbor 10.0.1.3 cost 5
```

```
neighbor 10.0.1.4 cost 10
```

```
neighbor 10.0.1.5 cost 15
```

