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【实验题目】OSPF 配置实验

【实验目的】掌握 OSPF 协议单区域配置方法和网线制作方法。

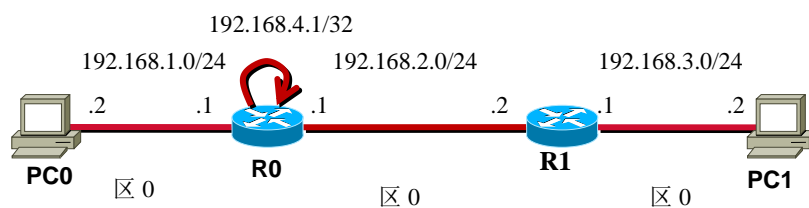
【实验内容】

**** 下面路由器均启动 OSPF 协议。实验结果和分析直接记录在下面每一个步骤后面。**

**** Loopback 网位于区 0。**

**** Loopback 接口的名: loopback num (num 为编号, 可以任意取)**

1、(ospf1.pkt)按下图配置两台路由器为 OSPF 协议。



* ping 通后先保存再重新打开 pkt 文件, 然后等 R0 和 R1 建立完全相邻关系, 再完成以下步骤

[1A、PC1 连通 PC0 和 192.168.4.1 后截屏结果。]

```
PC>ping 192.168.1.2
Pinging 192.168.1.2 with 32 bytes of data:
Reply from 192.168.1.2: bytes=32 time=0ms TTL=126
Reply from 192.168.1.2: bytes=32 time=1ms TTL=126
Reply from 192.168.1.2: bytes=32 time=0ms TTL=126
Reply from 192.168.1.2: bytes=32 time=0ms TTL=126

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>ping 192.168.4.1
Pinging 192.168.4.1 with 32 bytes of data:
Reply from 192.168.4.1: bytes=32 time=0ms TTL=254
Reply from 192.168.4.1: bytes=32 time=0ms TTL=254
Reply from 192.168.4.1: bytes=32 time=0ms TTL=254
Reply from 192.168.4.1: bytes=32 time=0ms TTL=254

Ping statistics for 192.168.4.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

[1B、显示并截屏 R0 和 R1 的路由表]

show ip route

```
Router#sh ip rou
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

C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/1
O    192.168.3.0/24 [110/2] via 192.168.2.2, 00:00:36, FastEthernet0/1
O    192.168.4.0/32 is subnetted, 1 subnets
C      192.168.4.1 is directly connected, Loopback0

Router#sh ip rou
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

O    192.168.1.0/24 [110/2] via 192.168.2.1, 00:00:29, FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/1
O    192.168.4.0/32 is subnetted, 1 subnets
O      192.168.4.1 [110/2] via 192.168.2.1, 00:00:29, FastEthernet0/0
```



[1C、显示 R0 和 R1 的 LS 数据库]

show ip ospf database

```
Router#sh ip ospf data
OSPF Router with ID (6.6.6.6) (Process ID 1)

    Router Link States (Area 0)

Link ID      ADV Router   Age         Seq#         Checksum Link count
6.6.6.6      6.6.6.6      29          0x80000005  0x000c40 3
7.7.7.7      7.7.7.7      29          0x80000004  0x002f92 2

    Net Link States (Area 0)

Link ID      ADV Router   Age         Seq#         Checksum
192.168.2.2  7.7.7.7      29          0x80000001  0x00f430

Router#sh ip ospf data
OSPF Router with ID (7.7.7.7) (Process ID 1)

    Router Link States (Area 0)

Link ID      ADV Router   Age         Seq#         Checksum Link count
7.7.7.7      7.7.7.7      15          0x80000004  0x002f92 2
6.6.6.6      6.6.6.6      15          0x80000005  0x000c40 3

    Net Link States (Area 0)

Link ID      ADV Router   Age         Seq#         Checksum
192.168.2.2  7.7.7.7      15          0x80000001  0x00f430
```

R0 的 RID 是 6.6.6.6， R1 的 RID 是 7.7.7.7。

R0 包含 2 个 Router LSA，它们是谁发出的？ R0 和 R1（R0 或 R1）

它们分别包含了几条链路 3、2。

R0 包含 1 个 Network LSA，其中 Network LSA 的 DR 是 R2。

[1D、显示 R0 的接口状态]

show ip ospf interface

！显示 OSPF 链路状态数据库信息。

```
Router#sh ip ospf int
Loopback0 is up, line protocol is up
Internet address is 192.168.4.1/32, Area 0
Process ID 1, Router ID 6.6.6.6, Network Type LOOPBACK, Cost: 1
Loopback interface is treated as a stub Host
FastEthernet0/0 is up, line protocol is up
Internet address is 192.168.1.1/24, Area 0
Process ID 1, Router ID 6.6.6.6, Network Type BROADCAST, Cost: 1
Transmit Delay is 1 sec, State DR, Priority 1
Designated Router (ID) 6.6.6.6, Interface address 192.168.1.1
No backup designated router on this network
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:01
Index 2/2, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 1
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)
FastEthernet0/1 is up, line protocol is up
Internet address is 192.168.2.1/24, Area 0
Process ID 1, Router ID 6.6.6.6, Network Type BROADCAST, Cost: 1
Transmit Delay is 1 sec, State BDR, Priority 1
Designated Router (ID) 7.7.7.7, Interface address 192.168.2.2
Backup Designated Router (ID) 6.6.6.6, Interface address 192.168.2.1
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
Hello due in 00:00:01
Index 3/3, flood queue length 0
Next 0x0(0)/0x0(0)
Last flood scan length is 1, maximum is 1
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 1, Adjacent neighbor count is 1
Adjacent with neighbor 7.7.7.7 (Designated Router)
Suppress hello for 0 neighbor(s)
```

Network LSA（看相应的接口）的 DR 和 BDR 分别是 R1 和 R0。

R0 的接口的链路开销是 1。

R0 的接口的优先权是 1。

[1E、显示并截屏 R0 的邻居状态]

show ip ospf neighbor

```
Neighbor ID    Pri  State      Dead Time   Address     Interface
7.7.7.7        1    FULL/DR    00:00:35   192.168.2.2 FastEthernet0/1
```

2、(ospf2.pkt)接步骤 1，通过加大另一台路由器的优先权使之成为 DR。

命令：**(config-if)#ip ospf priority 8** ！合法的范围是 0~255。缺省的优先级为 1。优先级为 0 不参与选举 DR

[2A、问题：在配置完毕重新打开后，R0 和 R1 之间的网络的 DR 是 R0，BDR 是 R1。]

[2B、在调试状态下，先断开 R1 和 R2 之间的连接，然后接通，看是否可以捕捉到指定路由器的选举过程和数据库同步的过程（多个步骤）。]



命令: #debug ip ospf events ! 进入调试状态

#no debug all ! 取消调试状态]

描述有关的发包情况:

R1->R0:打招呼

OSPF Hello

0		2		Bytes
VERSION NUM: 2		TYPE: 1		PACKET LEN: 48
ROUTER ID: 7.7.7.7				
AREA ID: 0.0.0.0				
CHECK SUM: 0		AUTH TYPE: 0		
AUTHENTICATION:				
NETWORK MASK: 255.255.255.0				
HELLO INTERVAL: 10		OPTIONS: 0		RP: 1
ROUTER DEAD INTERVAL: 40				
DESIGNATED ROUTER: 0.0.0.0				
BACKUP DESIGNATED ROUTER: 0.0.0.0				
NEIGHBOR COUNT: 1				

NEIGHBOR

0	2	Bytes
NEIGHBOR: 6.6.6.6		

R0->R1:打招呼

OSPF Hello

0		2		Bytes
VERSION NUM: 2		TYPE: 1		PACKET LEN: 48
ROUTER ID: 6.6.6.6				
AREA ID: 0.0.0.0				
CHECK SUM: 0		AUTH TYPE: 0		
AUTHENTICATION:				
NETWORK MASK: 255.255.255.0				
HELLO INTERVAL: 10		OPTIONS: 0		RP: 8
ROUTER DEAD INTERVAL: 40				
DESIGNATED ROUTER: 0.0.0.0				
BACKUP DESIGNATED ROUTER: 0.0.0.0				
NEIGHBOR COUNT: 1				

NEIGHBOR

0	2	Bytes
NEIGHBOR: 7.7.7.7		

R1->R0:选举包, DR 和 BDR 都为 192.168.2.1



OSPF Hello

0		2		Bytes
VERSION NUM: 2		TYPE: 1		PACKET LEN: 48
ROUTER ID: 7.7.7.7				
AREA ID: 0.0.0.0				
CHECK SUM: 0			AUTH TYPE: 0	
AUTHENTICATION:				
NETWORK MASK: 255.255.255.0				
HELLO INTERVAL: 10		OPTIONS: 0		RP: 1
ROUTER DEAD INTERVAL: 40				
DESIGNATED ROUTER: 192.168.2.1				
BACKUP DESIGNATED ROUTER: 192.168.2.1				
NEIGHBOR COUNT: 1				

NEIGHBOR

0	2	Bytes
NEIGHBOR: 6.6.6.6		

R0→R1:选举包，DR 为 192.168.2.1，BDR 为 192.168.2.2

OSPF Hello

0		2		Bytes
VERSION NUM: 2	TYPE: 1		PACKET LEN: 48	
ROUTER ID: 6.6.6.6				
AREA ID: 0.0.0.0				
CHECK SUM: 0		AUTH TYPE: 0		
AUTHENTICATION:				
NETWORK MASK: 255.255.255.0				
HELLO INTERVAL: 10		OPTIONS: 0	RP: 8	
ROUTER DEAD INTERVAL: 40				
DESIGNATED ROUTER: 192.168.2.1				
BACKUP DESIGNATED ROUTER: 192.168.2.2				
NEIGHBOR COUNT: 1				

NEIGHBOR

0	2	Bytes
NEIGHBOR: 7.7.7.7		

开始准备互传 LSA:

先互相共发了 3 个 Database Description, 之间还带了一个 LSA, 不太清楚这一步在干什么。



OSPF Database Description

0		2	Bytes
VERSION NUM: 2	TYPE: 2	PACKET LEN: 32	
ROUTER ID: 7.7.7.7			
AREA ID: 0.0.0.0			
CHECK SUM: 0		AUTH TYPE: 0	
AUTHENTICATION:			
INTERFACE MTU: 1500		OPTIONS: 0	I+M+MS
DD SEQUENCE NUM: 25919			

OSPF Database Description

0		2		Bytes
VERSION NUM: 2		TYPE: 2		PACKET LEN: 52
ROUTER ID: 7.7.7.7				
AREA ID: 0.0.0.0				
CHECK SUM: 0		AUTH TYPE: 0		
AUTHENTICATION:				
INTERFACE MTU: 1500		OPTIONS: 0		I+M+MS
DD SEQUENCE NUM: 25920				

OSPF LSA Header

0	2	Byte:
LSA AGE: 45	OPTIONS: 0	LS TYPE: 1
LINK STATE ID: 7.7.7.7		
ADVERTISING ROUTER: 7.7.7.7		
LS SEQUENCE NUM: 0x80000009		
LS CHECKSUM: 44413	LENGTH: 48	

OSPF Database Description

0		2		Bytes
VERSION NUM: 2	TYPE: 2	PACKET LEN: 32		
ROUTER ID: 7.7.7.7				
AREA ID: 0.0.0.0				
CHECK SUM: 0		AUTH TYPE: 0		
AUTHENTICATION:				
INTERFACE MTU: 1500		OPTIONS: 0		I+M+MS
DD SEQUENCE NUM: 25921				

确定链路状态:



OSPF Link State Request

0		2		Bytes
VERSION NUM: 2		TYPE: 3		PACKET LEN: 36
ROUTER ID: 7.7.7.7				
AREA ID: 0.0.0.0				
CHECK SUM: 0		AUTH TYPE: 0		
AUTHENTICATION:				

Request Header

0	2	Byte:
LINK STATE ID: 6.6.6.6		
LS TYPE: 1		
ADVERTISING ROUTER: 6.6.6.6		

开始互传 LSA:

OSPF Link State Update

0	2	Byte:
VERSION NUM: 2	TYPE: 4	PACKET LEN: 84
ROUTER ID: 6.6.6.6		
AREA ID: 0.0.0.0		
CHECK SUM: 0	AUTH TYPE: 0	
AUTHENTICATION:		
# LSAs: 1		

OSPF Router LSA

0	2	Bytes
LSA AGE: 0	OPTIONS: 0	LS TYPE: 1
LINK STATE ID: 6.6.6.6		
ADVERTISING ROUTER: 6.6.6.6		
LS SEQUENCE NUM: 0x8000000b		
CHECK SUM: 56681	LENGTH: 60	
0+V+E+B	0	LINKS COUNT: 3



OSPF Router Links

0	2	Bytes
LINK ID: 192.168.4.1		
LINK DATA: 255.255.255.255		
TYPE: 3	0	METRIC: 1

OSPF Router Links

0	2	Bytes
LINK ID: 192.168.1.0		
LINK DATA: 255.255.255.0		
TYPE: 3	0	METRIC: 1

OSPF Router Links

0	2	Bytes
LINK ID: 192.168.2.1		
LINK DATA: 192.168.2.1		
TYPE: 2	0	METRIC: 1

OSPF Link State Update

0	2	Byte:
VERSION NUM: 2	TYPE: 4	PACKET LEN: 72
ROUTER ID: 7.7.7.7		
AREA ID: 0.0.0.0		
CHECK SUM: 0	AUTH TYPE: 0	
AUTHENTICATION:		
# LSAs: 1		

OSPF Router LSA

0	2	Bytes
LSA AGE: 0	OPTIONS: 0	LS TYPE: 1
LINK STATE ID: 7.7.7.7		
ADVERTISING ROUTER: 7.7.7.7		
LS SEQUENCE NUM: 0x8000000a		
CHECK SUM: 11918	LENGTH: 48	
0+V+E+B	0	LINKS COUNT: 2

OSPF Router Links

0	2	Bytes
LINK ID: 192.168.3.0		
LINK DATA: 255.255.255.0		
TYPE: 3	0	METRIC: 1

OSPF Router Links

0	2	Bytes
LINK ID: 192.168.2.1		
LINK DATA: 192.168.2.2		
TYPE: 2	0	METRIC: 1



OSPF Link State Update

0	2	Byte:
VERSION NUM: 2	TYPE: 4	PACKET LEN: 56
ROUTER ID: 6.6.6.6		
AREA ID: 0.0.0.0		
CHECK SUM: 0	AUTH TYPE: 0	
AUTHENTICATION:		
# LSAs: 1		

OSPF Link State Acknowledgment

0	2	Byte:
VERSION NUM: 2	TYPE: 5	PACKET LEN: 84
ROUTER ID: 7.7.7.7		
AREA ID: 0.0.0.0		
CHECK SUM: 0	AUTH TYPE: 0	
AUTHENTICATION:		

OSPF LSA Header

0	2	Byte:
LSA AGE: 45	OPTIONS: 0	LS TYPE: 1
LINK STATE ID: 6.6.6.6		
ADVERTISING ROUTER: 6.6.6.6		
LS SEQUENCE NUM: 0x8000000a		
LS CHECKSUM: 25170	LENGTH: 60	

OSPF LSA Header

0	2	Byte:
LSA AGE: 0	OPTIONS: 0	LS TYPE: 1
LINK STATE ID: 6.6.6.6		
ADVERTISING ROUTER: 6.6.6.6		
LS SEQUENCE NUM: 0x8000000b		
LS CHECKSUM: 56681	LENGTH: 60	

OSPF LSA Header

0	2	Byte:
LSA AGE: 0	OPTIONS: 0	LS TYPE: 2
LINK STATE ID: 192.168.2.1		
ADVERTISING ROUTER: 6.6.6.6		
LS SEQUENCE NUM: 0x80000001		
LS CHECKSUM: 6161	LENGTH: 32	



OSPF Link State Acknowledgment

0		2		Byte:
VERSION NUM: 2		TYPE: 5	PACKET LEN: 64	
ROUTER ID: 6.6.6.6				
AREA ID: 0.0.0.0				
CHECK SUM: 0		AUTH TYPE: 0		
AUTHENTICATION:				

OSPF LSA Header

0	2	Byte:
LSA AGE: 45	OPTIONS: 0	LS TYPE: 1
LINK STATE ID: 7.7.7.7		
ADVERTISING ROUTER: 7.7.7.7		
LS SEQUENCE NUM: 0x80000009		
LS CHECKSUM: 44413	LENGTH: 48	

OSPF LSA Header

0	2	Byte:
LSA AGE: 0	OPTIONS: 0	LS TYPE: 1
LINK STATE ID: 7.7.7.7		
ADVERTISING ROUTER: 7.7.7.7		
LS SEQUENCE NUM: 0x8000000a		
LS CHECKSUM: 11918	LENGTH: 48	

3、(ospf3.pkt)接步骤 2，配置 vty 的用户密码和 MD5 的特权密码，PC0 和 PC1 同时在控制台窗口用命令 telnet 192.168.2.2 进入 R1，显示路由表并截屏（包含进入用户模式和特权模式）：

[3A、PC0 截屏]

```
PC>telnet 192.168.1.1
Trying 192.168.1.1 ...Open

User Access Verification

Password:
Route#ena
Route#
Route#sh ip rtr
Codes: C - connected, S - static, I - ISDP, S - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        NI - 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

C 192.168.1.0/24 is directly connected, FastEthernet0/0
C 192.168.2.0/24 is directly connected, FastEthernet0/1
O 192.168.3.0/24 (110/2) via 192.168.2.2, 00:19:39, FastEthernet0/1
O 192.168.4.0/24 is subnetted, 1 subnets
C 192.168.4.1 is directly connected, Loopback0
```

[3B、PC1 截屏]

```
PC>telnet 192.168.1.1
Trying 192.168.1.1 ...Open

User Access Verification

Password:
Route#ena
Route#
Route#sh ip rtr
Codes: C - connected, S - static, I - ISDP, S - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        NI - 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

C 192.168.1.0/24 is directly connected, FastEthernet0/0
C 192.168.2.0/24 is directly connected, FastEthernet0/1
O 192.168.3.0/24 (110/2) via 192.168.2.2, 00:21:29, FastEthernet0/1
O 192.168.4.0/24 is subnetted, 1 subnets
C 192.168.4.1 is directly connected, Loopback0
```

[3C、加入 PC2 用 console 接入 R1，显示 running-conf]

```
Route#sh running-config
Building configuration...

Current configuration:
!
enable
username cisco password cisco
!
interface FastEthernet0/0
ip address 192.168.1.1 255.255.255.0
!
interface FastEthernet0/1
ip address 192.168.2.2 255.255.255.0
!
interface Loopback0
ip address 192.168.4.1 255.255.255.0
!
router ospf 1
router-id 192.168.1.1
network 192.168.1.0 0.0.0.255 area 0
network 192.168.2.0 0.0.0.255 area 0
network 192.168.4.0 0.0.0.255 area 0
!
line vty 0 4
password cisco
login
!
end
```

【实验体会】

写出实验过程中的问题，思考及解决方法，简述实验体会（如果有的话）。

截包的过程中，大体可以看明白，但有些细节的信息还是不太能理解。

【交实验报告】



中山大學
SUN YAT-SEN UNIVERSITY

实验报告

实验报告上传地址: <http://103.26.79.35/netdisk/default.aspx?vm=18net>

截止日期(不迟于): 2020年7月21日(周二) 23:00

上传文件名: 学号_姓名_OSPF 协议.doc

学号_姓名_OSPF 协议.rar (包含.pkt 文件)