

计算机网络

实验报告

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一、实验题目

OSPF 单区域实验

掌握在路由器上配置OSPF单区域

二、实验步骤

步骤1:

(1) 按照拓扑图配置PC1和PC2的IP地址、子网掩码、网关，并测试他们的连通性

配置PC1的ip地址为192.168.5.11

配置PC2的ip地址为192.168.3.22，接下来从PC1向PC2执行ping命令

```
管理员: C:\Windows\system32\cmd.exe
Microsoft Windows [版本 10.0.14393]
(c) 2016 Microsoft Corporation. 保留所有权利。

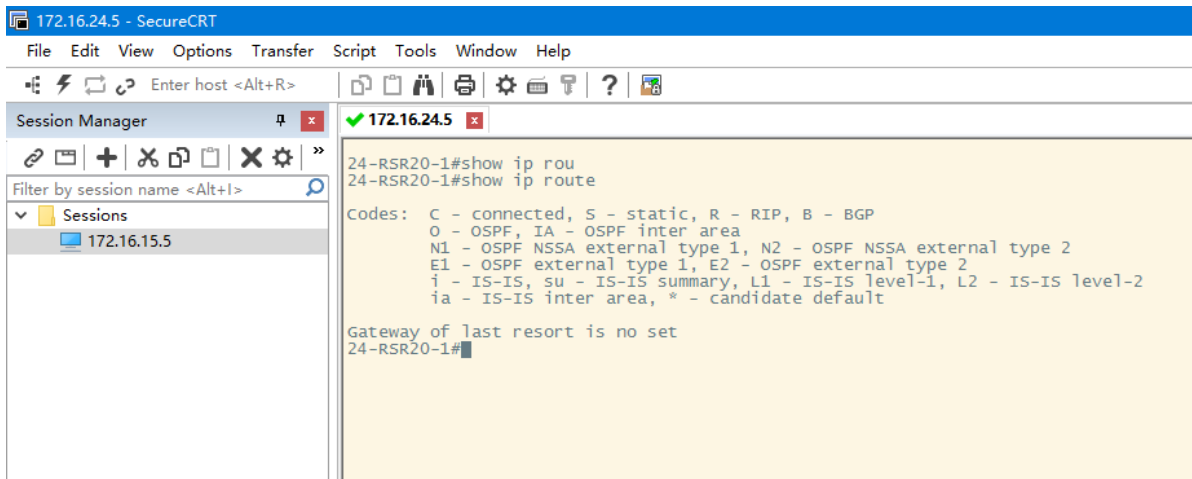
C:\Users\Administrator>ping 192.168.3.1

正在 Ping 192.168.3.1 具有 32 字节的数据:
来自 192.168.5.11 的回复: 无法访问目标主机。
来自 192.168.5.11 的回复: 无法访问目标主机。
请求超时。
请求超时。

192.168.3.1 的 Ping 统计信息:
    数据包: 已发送 = 4, 已接收 = 2, 丢失 = 2 (50% 丢失),
C:\Users\Administrator>
```

可以看到此时两个机器没有连通

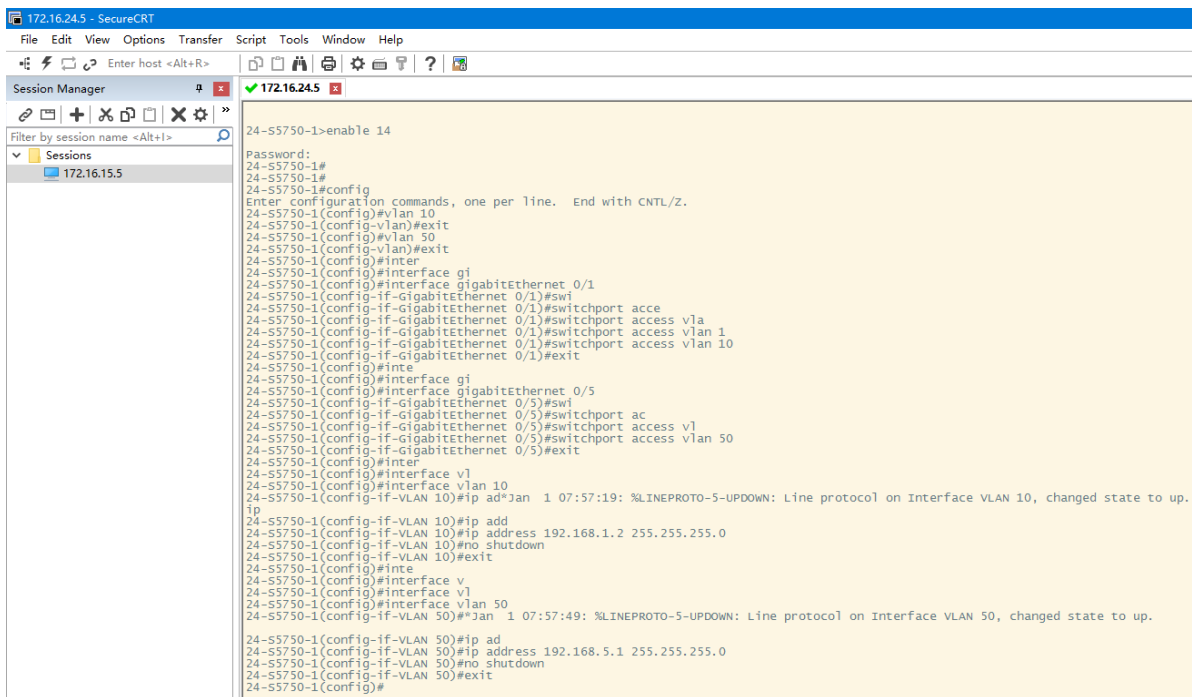
(2) 在路由器R1上执行show ip route 命令，记录路由表信息



此时路由表很干净，没有多余信息，可以直接开始配置

步骤2:

关于三层交换机的基本配置



配置完成

步骤3:

路由器R1的基本配置

172.16.24.5 - SecureCRT

File Edit View Options Transfer Script Tools Window Help

Enter host <Alt+R>

Session Manager

Filter by session name <Alt+I>

Sessions

172.16.15.5

172.16.24.5

```
24-RSR20-1#show ip rou
24-RSR20-1#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP
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
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set
24-RSR20-1#inter
24-RSR20-1#confi
24-RSR20-1#config
Enter configuration commands, one per line. End with CNTL/Z.
24-RSR20-1(config)#inter
24-RSR20-1(config)#interface gi
24-RSR20-1(config)#interface gigabitEthernet 0/1
24-RSR20-1(config-if-GigabitEthernet 0/1)#ip add
24-RSR20-1(config-if-GigabitEthernet 0/1)#2.168.1.1 255.255.255.0
24-RSR20-1(config-if-GigabitEthernet 0/1)#no shutdown
24-RSR20-1(config-if-GigabitEthernet 0/1)#exit
24-RSR20-1(config)#inter
24-RSR20-1(config)#interface gi
24-RSR20-1(config)#interface gigabitEthernet 0/3
24-RSR20-1(config-if-GigabitEthernet 0/3)#192.168.2.1 255.255.255.0
% Unknown command.

24-RSR20-1(config-if-GigabitEthernet 0/3)#ip ad
24-RSR20-1(config-if-GigabitEthernet 0/3)#2.168.2.1 255.255.255.0
24-RSR20-1(config-if-GigabitEthernet 0/3)#no shutdown
24-RSR20-1(config-if-GigabitEthernet 0/3)#exit
24-RSR20-1(config)#
```

因为我们的路由器没有串口，所以也是采用端口来进行配置，具体就是注意端口号即可

步骤4:

路由器R2的基本配置

172.16.24.5 - SecureCRT

File Edit View Options Transfer Script Tools Window Help

Enter host <Alt+R>

Session Manager

Filter by session name <Alt+I>

Sessions

172.16.15.5

172.16.24.5

```
24-RSR20-2#config
Enter configuration commands, one per line. End with CNTL/Z.
24-RSR20-2(Config)#inter
24-RSR20-2(config)#interface gig
24-RSR20-2(config)#interface gigabitEthernet 0/1
24-RSR20-2(config-if-GigabitEthernet 0/1)#ip ad
24-RSR20-2(config-if-GigabitEthernet 0/1)#2.168.3.1 255.255.255.0
24-RSR20-2(config-if-GigabitEthernet 0/1)#no shutdown
24-RSR20-2(config-if-GigabitEthernet 0/1)#exit
24-RSR20-2(config)#int
24-RSR20-2(config)#interface ig
24-RSR20-2(config)#interface gi
24-RSR20-2(config)#interface gigabitEthernet 0/3
24-RSR20-2(config-if-GigabitEthernet 0/3)#ip add
24-RSR20-2(config-if-GigabitEthernet 0/3)#2.168.2.2 255.255.255.0
24-RSR20-2(config-if-GigabitEthernet 0/3)#no shutdown
24-RSR20-2(config-if-GigabitEthernet 0/3)#exit
24-RSR20-2(config)#
```

步骤5:

配置OSPF路由协议，交换机S5750配置OSPF

```
172.16.24.5 - SecureCRT
File Edit View Options Transfer Script Tools Window Help
Enter host <Alt+R>
Session Manager
Filter by session name <Alt+I>
Sessions
172.16.15.5
24-S5750-1->enable 14
Password:
24-S5750-1#
24-S5750-1#
24-S5750-1#config
Enter configuration commands, one per line. End with CNTL/Z.
24-S5750-1(config)#vlan 10
24-S5750-1(config-vlan)#exit
24-S5750-1(config)#vlan 50
24-S5750-1(config-vlan)#exit
24-S5750-1(config)#inter
24-S5750-1(config)#interface gi
24-S5750-1(config)#interface gigabitEthernet 0/1
24-S5750-1(config-if-gigabitEthernet 0/1)#swi
24-S5750-1(config-if-gigabitEthernet 0/1)#switchport acce
24-S5750-1(config-if-gigabitEthernet 0/1)#switchport access vla
24-S5750-1(config-if-gigabitEthernet 0/1)#switchport access vlan 1
24-S5750-1(config-if-gigabitEthernet 0/1)#switchport access vlan 10
24-S5750-1(config-if-gigabitEthernet 0/1)#exit
24-S5750-1(config)#inte
24-S5750-1(config)#interface gi
24-S5750-1(config)#interface gigabitEthernet 0/5
24-S5750-1(config-if-gigabitEthernet 0/5)#swi
24-S5750-1(config-if-gigabitEthernet 0/5)#switchport ac
24-S5750-1(config-if-gigabitEthernet 0/5)#switchport access vl
24-S5750-1(config-if-gigabitEthernet 0/5)#switchport access vlan 50
24-S5750-1(config-if-gigabitEthernet 0/5)#exit
24-S5750-1(config)#inter
24-S5750-1(config)#interface vl
24-S5750-1(config)#interface vlan 10
24-S5750-1(config-if-VLAN 10)#ip ad#Jan 1 07:57:19: %LINEPROTO-5-UPDOWN: Line protocol on Interface VLAN 10, changed state to up.
ip
24-S5750-1(config-if-VLAN 10)#ip add
24-S5750-1(config-if-VLAN 10)#ip address 192.168.1.2 255.255.255.0
24-S5750-1(config-if-VLAN 10)#no shutdown
24-S5750-1(config-if-VLAN 10)#exit
24-S5750-1(config)#inte
24-S5750-1(config)#interface v
24-S5750-1(config)#interface vl
24-S5750-1(config)#interface vlan 50
24-S5750-1(config-if-VLAN 50)#Jan 1 07:57:49: %LINEPROTO-5-UPDOWN: Line protocol on Interface VLAN 50, changed state to up.
24-S5750-1(config-if-VLAN 50)#ip ad
24-S5750-1(config-if-VLAN 50)#ip address 192.168.5.1 255.255.255.0
24-S5750-1(config-if-VLAN 50)#no shutdown
24-S5750-1(config-if-VLAN 50)#exit
24-S5750-1(config)#rou
24-S5750-1(config)#route os
24-S5750-1(config)#route ospf 1
24-S5750-1(config-router)#netwo
24-S5750-1(config-router)#network 192.168.5.0 0.0.0.255 area 0
24-S5750-1(config-router)#netwo
24-S5750-1(config-router)#network 192.168.1.0 0.0.0.255 are
24-S5750-1(config-router)#network 192.168.1.0 0.0.0.255 area 0
24-S5750-1(config-router)#end
24-S5750-1#Jan 1 08:02:48: %SYS-5-CONFIG_I: Configured from console by console
```

步骤6:

路由器R1配置OSPF

```
24-RSR20-1(config)#route os
24-RSR20-1(config)#route ospf 1
24-RSR20-1(config-router)#net
24-RSR20-1(config-router)#network 192.168.1.0 0.0.0.255 ar
24-RSR20-1(config-router)#network 192.168.1.0 0.0.0.255 area 0
24-RSR20-1(config-router)#Dec 4 19:31:30: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.5.1-GigabitEthernet 0/1 from Down to Init, HelloReceived
*Dec 4 19:31:30: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.5.1-GigabitEthernet 0/1 from Loading to Full, Loadingdone.
24-RSR20-1(config-router)#netw
24-RSR20-1(config-router)#network 192.168.2.0 0.0.0.255 ar
24-RSR20-1(config-router)#network 192.168.2.0 0.0.0.255 area 0
24-RSR20-1(config-router)#end
24-RSR20-1#Dec 4 19:31:45: %SYS-5-CONFIG_I: Configured from console by console
```

步骤7:

路由器R2配置OSPF

```
24-RSR20-2(config)#netwo
24-RSR20-2(config)#network osp
24-RSR20-2(config)#network os
24-RSR20-2(config)#rou
24-RSR20-2(config)#route os
24-RSR20-2(config)#route ospf 1
24-RSR20-2(config-router)#net
24-RSR20-2(config-router)#network 192.168.2.0 0.0.0.255 ar
24-RSR20-2(config-router)#network 192.168.2.0 0.0.0.255 area 0
24-RSR20-2(config-router)#net
24-RSR20-2(config-router)#network 192.168.3.0 0/*Nov 13:43:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.1-GigabitEthernet 0/3 from down to Init, HelloReceived.
*Nov 4 13:43:45: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.2.1-GigabitEthernet 0/3 from Loading to Full, Loadingdone.
% Incomplete command.
24-RSR20-2(config-router)#network 192.168.3.0 0.0.0.255 area 0
24-RSR20-2(config-router)#end
24-RSR20-2#Nov 4 13:44:02: %SYS-5-CONFIG_I: Configured from console by console
```

步骤8:

查看验证3台路由设备的路由表是否自动学习了其他网段的路由信息，请注意路由条目O项

交换机

```
24-S5750-1#ip rou
24-S5750-1#show ip rou
24-S5750-1#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP
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
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set
C 192.168.1.0/24 is directly connected, VLAN 10
C 192.168.1.2/32 is local host.
O 192.168.2.0/24 [110/2] via 192.168.1.1, 00:01:45, VLAN 10
O 192.168.3.0/24 [110/3] via 192.168.1.1, 00:00:32, VLAN 10
C 192.168.5.0/24 is directly connected, VLAN 50
C 192.168.5.1/32 is local host.
24-S5750-1#
```

分析交换机S5750的路由表，表中有O条目吗？如果有，是怎样产生的

表中有O条目，两项分别表示192.168.2.0为目标地址的数据从192.168.1.1处进行，也就是我们最初配置的vlan10中的操作

后一项表示192.168.3.0为目标地址的数据也从192.168.1.1处进行，也是vlan中表示的操作，子网的选端口

主要是通过对于vlan10的配置，然后通过OSPF的自动学习网段的路由信息所生成的

R1

```
24-RSR20-1#show ip rou
24-RSR20-1#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP
        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
        i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
        ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set
C    192.168.1.0/24 is directly connected, GigabitEthernet 0/1
C    192.168.1.1/32 is local host.
C    192.168.2.0/24 is directly connected, GigabitEthernet 0/3
C    192.168.2.1/32 is local host.
O    192.168.3.0/24 [110/2] via 192.168.2.2, 00:01:11, GigabitEthernet 0/3
O    192.168.3.0/24 [110/2] via 192.168.1.2, 00:02:27, GigabitEthernet 0/1
24-RSR20-1#
```

分析交换机R1的路由表，表中有O条目吗？如果有，是怎样产生的

表中也存在O条目，主要是192.168.3.0为目标地址的数据从192.168.2.2处输出，以192.168.5.0为目标地址的数据从192.168.1.2处进行输出，主要规定了数据的输入以及输出端口的连接，也是我们所连接网线的几个端口，是由OSPF的自动学习网段的路由信息所生成的

R2

```
24-RSR20-2#show ip
24-RSR20-2#show ip r
24-RSR20-2#show ip rou
24-RSR20-2#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP
        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
        i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
        ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set
O    192.168.1.0/24 [110/2] via 192.168.2.1, 00:01:36, GigabitEthernet 0/3
C    192.168.2.0/24 is directly connected, GigabitEthernet 0/3
C    192.168.2.2/32 is local host.
C    192.168.3.0/24 is directly connected, GigabitEthernet 0/1
C    192.168.3.1/32 is local host.
O    192.168.5.0/24 [110/3] via 192.168.2.1, 00:01:36, GigabitEthernet 0/3
24-RSR20-2#
```

分析交换机R2的路由表，表中有O条目吗？如果有，是怎样产生的

表中也存在O条目，主要是192.168.2.0为目标地址的数据从192.168.2.1处输出，以192.168.5.0为目标地址的数据从192.168.2.1处进行输出，主要规定了数据的输入以及输出端口的连接，是由OSPF的自动学习网段的路由信息所生成的

步骤9：测试网络连通性

(1) 将此时的路由表与步骤0的路由表进行比较，有什么结论

此时的路由表R1

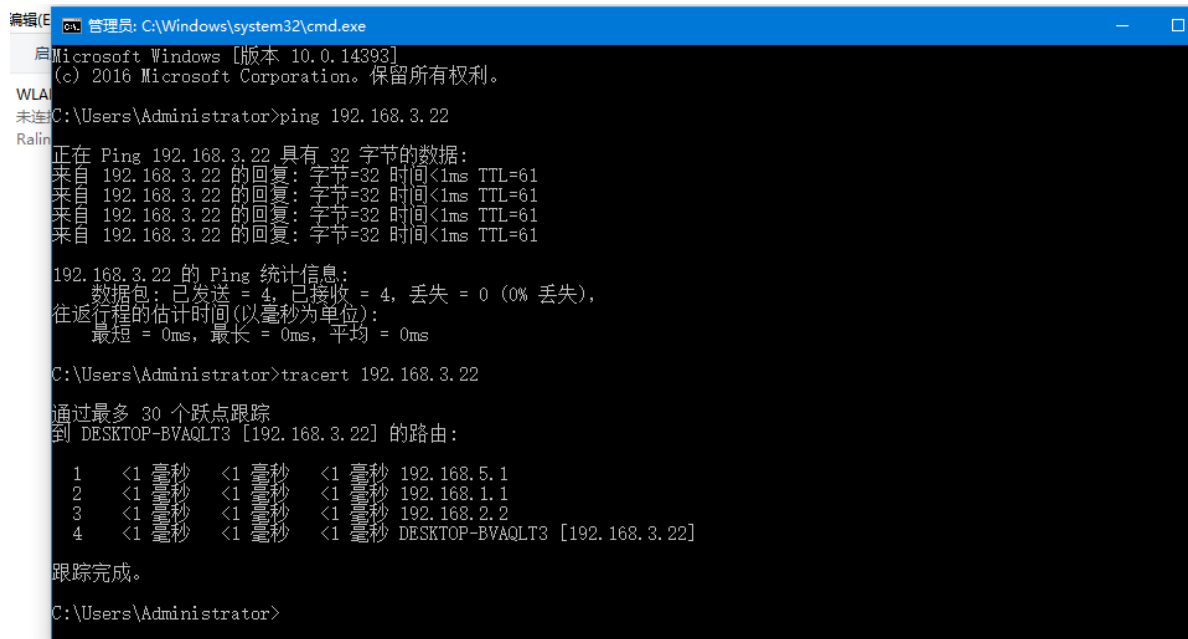
```
24-RSR20-1#show ip rou
24-RSR20-1#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP
        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
        i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
        ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set
C    192.168.1.0/24 is directly connected, GigabitEthernet 0/1
C    192.168.1.1/32 is local host.
C    192.168.2.0/24 is directly connected, GigabitEthernet 0/3
C    192.168.2.1/32 is local host.
O    192.168.3.0/24 [110/2] via 192.168.2.2, 00:01:11, GigabitEthernet 0/3
O    192.168.5.0/24 [110/2] via 192.168.1.2, 00:02:27, GigabitEthernet 0/1
24-RSR20-1#
```

之前的路由表是没有任何联系的，包括我们的接线也是不存在的，首先可以看到此时192.168.1.0/24和192.168.2.0/24都是直接通过网线连接，后面也输出了具体的连接端口，而192.168.3.0/24和192.168.5.0/24的信息都是通过OSPF自动学习网段的路由信息所产生具体的路径，说明此时R1已经产生了完整的本次OSPF单区域试验的路由表。

(2) 分析traceroute PC2的实验结果



```
管理员: C:\Windows\system32\cmd.exe
Microsoft Windows [版本 10.0.14393]
(c) 2016 Microsoft Corporation。保留所有权利。

C:\Users\Administrator>ping 192.168.3.22

正在 Ping 192.168.3.22 具有 32 字节的数据:
来自 192.168.3.22 的回复: 字节=32 时间<1ms TTL=61
来自 192.168.3.22 的回复: 字节=32 时间<1ms TTL=61
来自 192.168.3.22 的回复: 字节=32 时间<1ms TTL=61
来自 192.168.3.22 的回复: 字节=32 时间<1ms TTL=61

192.168.3.22 的 Ping 统计信息:
    数据包: 已发送 = 4, 已接收 = 4, 丢失 = 0 (0% 丢失),
    往返行程的估计时间 (以毫秒为单位):
        最短 = 0ms, 最长 = 0ms, 平均 = 0ms

C:\Users\Administrator>tracert 192.168.3.22

通过最多 30 个跃点跟踪
到 DESKTOP-BVAQLT3 [192.168.3.22] 的路由:

 1  <1 毫秒  <1 毫秒  <1 毫秒  192.168.5.1
 2  <1 毫秒  <1 毫秒  <1 毫秒  192.168.1.1
 3  <1 毫秒  <1 毫秒  <1 毫秒  192.168.2.2
 4  <1 毫秒  <1 毫秒  <1 毫秒  DESKTOP-BVAQLT3 [192.168.3.22]

跟踪完成。

C:\Users\Administrator>
```

我们首先是通过ping命令来进行跑不跑通的测试的，然后再具体进行traceroute命令

通过此时的traceroute命令可以看到，对于PC2（192.168.3.22），PC1所产生的数据包首先通过192.168.5.1也就是PC1在交换机上的输入端口，然后通过交换机到达192.168.1.1即路由器R1的输入端口，再通过R1到达R2的输入端口192.168.2.2，最后通过R2传输到目标地址192.168.3.22，说明整个单区域试验的连通性完好。

(3) 捕获数据包，分析OSPF头部结构。OSPF包在PC1上能捕获到吗？如果希望2台主机都能捕获到，请描述方法

```

v Internet Protocol Version 4, Src: 192.168.5.1, Dst: 224.0.0.5
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    Total Length: 64
    Identification: 0x0068 (104)
  > Flags: 0x00
    ...0 0000 0000 0000 = Fragment Offset: 0
    Time to Live: 1
    Protocol: OSPF IGP (89)
    Header Checksum: 0x128f [validation disabled]
    [Header checksum status: Unverified]
    Source Address: 192.168.5.1
    Destination Address: 224.0.0.5
v Open Shortest Path First
  v OSPF Header
    Version: 2
    Message Type: Hello Packet (1)
    Packet Length: 44
    Source OSPF Router: 192.168.5.1
    Area ID: 0.0.0.0 (Backbone)
    Checksum: 0x714b [correct]
    Auth Type: Null (0)
    Auth Data (none): 0000000000000000
  v OSPF Hello Packet
    Network Mask: 255.255.255.0
    Hello Interval [sec]: 10
    > Options: 0x02, (E) External Routing
    Router Priority: 1
    Router Dead Interval [sec]: 40
    Designated Router: 192.168.5.1
    Backup Designated Router: 0.0.0.0

```

首先是在pc1上捕获的OSPF报文，分析首部信息

version 2: 指版本为2

Message Type: Hello Packet(1): 代表消息类型为1类型，hello包，建立和维持邻居关系

Packet Length: 代表具体的包的大小为44

Source OSPF Router:192.168.5.1: 代表OSPF的路线来源，这里是交换机对应的端口地址

Area ID : 0.0.0.0 :代表此时的区域标志，我们的设置为单区域，area 0

checksum : 检验和

(4) 使用#debug ip ospf 命令显示上述OSPF协议的运行情况，观察并保存路由器R1发送和接受的update分组，注意其中LSA类型，观察有无224.0.0.5、224.0.0.6的ip地址，如有说明这两个地址的作用


```
24-RSR20-1#deb
24-RSR20-1#debug ip ospf
24-RSR20-1#Dec 4 19:39:29: %7: LSA[MaxAge]: Maxage walker finished (0.000000 sec)
*Dec 4 19:39:29: %7: IFSM[GigabitEthernet 0/1:192.168.1.1]: Hello timer expire
*Dec 4 19:39:29: %7: SEND[Hello]: To 224.0.0.5 via GigabitEthernet 0/1:192.168.1.1, length 48
*Dec 4 19:39:29: %7: -----
*Dec 4 19:39:29: %7: Header
*Dec 4 19:39:29: %7:   Version 2
*Dec 4 19:39:29: %7:   Type 1 (Hello)
*Dec 4 19:39:29: %7:   Packet Len 48
*Dec 4 19:39:29: %7:   Router ID 192.168.2.1
*Dec 4 19:39:29: %7:   Area ID 0.0.0.0
*Dec 4 19:39:29: %7:   Checksum 0xf0f2
*Dec 4 19:39:29: %7:   AuType 0
*Dec 4 19:39:29: %7:   Hello
*Dec 4 19:39:29: %7:   NetworkMask 255.255.255.0
*Dec 4 19:39:29: %7:   HelloInterval 10
*Dec 4 19:39:29: %7:   Options 0x2 (-|-|-|-|-|E|-)
*Dec 4 19:39:29: %7:   RtrPriority 1
*Dec 4 19:39:29: %7:   RtrDeadInterval 40
*Dec 4 19:39:29: %7:   DRouter 192.168.1.2
*Dec 4 19:39:29: %7:   BDRouter 192.168.1.1
*Dec 4 19:39:29: %7:   # Neighbors 1
*Dec 4 19:39:29: %7:     Neighbor 192.168.5.1
*Dec 4 19:39:31: %7: -----
*Dec 4 19:39:31: %7: RECV[Hello]: From 192.168.5.1 via GigabitEthernet 0/1:192.168.1.1 (192.168.1.2 -> 224.0.0.5), len = 48, cksum = 0xf0f2
*Dec 4 19:39:31: %7: -----
*Dec 4 19:39:31: %7: Header
*Dec 4 19:39:31: %7:   Version 2
*Dec 4 19:39:31: %7:   Type 1 (Hello)
*Dec 4 19:39:31: %7:   Packet Len 48
*Dec 4 19:39:31: %7:   Router ID 192.168.5.1
*Dec 4 19:39:31: %7:   Area ID 0.0.0.0
*Dec 4 19:39:31: %7:   Checksum 0xf0f2
*Dec 4 19:39:31: %7:   AuType 0
*Dec 4 19:39:31: %7:   Hello
*Dec 4 19:39:31: %7:   NetworkMask 255.255.255.0
*Dec 4 19:39:31: %7:   HelloInterval 10
*Dec 4 19:39:31: %7:   Options 0x2 (-|-|-|-|-|E|-)
*Dec 4 19:39:31: %7:   RtrPriority 1
*Dec 4 19:39:31: %7:   RtrDeadInterval 40
*Dec 4 19:39:31: %7:   DRouter 192.168.1.2
*Dec 4 19:39:31: %7:   BDRouter 192.168.1.1
*Dec 4 19:39:31: %7:   # Neighbors 1
*Dec 4 19:39:31: %7:     Neighbor 192.168.2.1
*Dec 4 19:39:31: %7: -----
*Dec 4 19:39:31: %7: NFSM[192.168.5.1-GigabitEthernet 0/1]: Full (HelloReceived)
*Dec 4 19:39:31: %7: NFSM[192.168.5.1-GigabitEthernet 0/1]: n fsm_ignore called
*Dec 4 19:39:31: %7: NFSM[192.168.5.1-GigabitEthernet 0/1]: Full (2-wayReceived)
*Dec 4 19:39:33: %7: IFSM[GigabitEthernet 0/3:192.168.2.1]: Hello timer expire
*Dec 4 19:39:33: %7: SEND[Hello]: To 224.0.0.5 via GigabitEthernet 0/3:192.168.2.1, length 48
*Dec 4 19:39:33: %7: -----
*Dec 4 19:39:33: %7: Header
*Dec 4 19:39:33: %7:   Version 2
*Dec 4 19:39:33: %7:   Type 1 (Hello)
*Dec 4 19:39:33: %7:   Packet Len 48
*Dec 4 19:39:33: %7:   Router ID 192.168.2.1
*Dec 4 19:39:33: %7:   Area ID 0.0.0.0
*Dec 4 19:39:33: %7:   Checksum 0xf0f2
*Dec 4 19:39:33: %7:   AuType 0
*Dec 4 19:39:33: %7:   Hello
*Dec 4 19:39:33: %7:   NetworkMask 255.255.255.0
*Dec 4 19:39:33: %7:   HelloInterval 10
*Dec 4 19:39:33: %7:   Options 0x2 (-|-|-|-|-|E|-)
*Dec 4 19:39:33: %7:   RtrPriority 1
*Dec 4 19:39:33: %7:   RtrDeadInterval 40
*Dec 4 19:39:33: %7:   DRouter 192.168.2.1
*Dec 4 19:39:33: %7:   BDRouter 192.168.2.2
```

存在224.0.0.5的地址，在send hello数据包时，会向此地址发送一个hello数据包，224.0.0.5指所有的路由器，在所有路由器开机后，路由器通过组播地址224.0.0.5发送HELLO 包，进行路由器的互相通信

没有224.0.0.6地址，因为本实验不存在DR/BDR，而只有在DR 和BDR确定后，BRouter才会通过组播地址224.0.0.6给DR和BDR发送消息

在我们通过将网线拔出后重新接入，得到了如下图所示的LSA数据包

```
*Dec 4 19:42:06: %7: RtrDeadInterval 40
*Dec 4 19:42:06: %7: DRouter 192.168.2.1
*Dec 4 19:42:06: %7: BRouter 192.168.2.2
*Dec 4 19:42:06: %7: # Neighbors 1
*Dec 4 19:42:06: %7:   Neighbor 192.168.2.1
*Dec 4 19:42:06: %7: -----
*Dec 4 19:42:06: %7: NFSM[192.168.3.1-GigabitEthernet 0/3]: Full (HelloReceived)
*Dec 4 19:42:06: %7: NFSM[192.168.3.1-GigabitEthernet 0/3]: n fsm_ignore called
*Dec 4 19:42:06: %7: NFSM[192.168.3.1-GigabitEthernet 0/3]: Full (2-wayReceived)
*Dec 4 19:42:08: %7: RECV[LS-Upd]: From 192.168.3.1 via GigabitEthernet 0/3:192.168.2.1 (192.168.2.2 -> 224.0.0.5), len = 64, cksum = 0xdc6d
*Dec 4 19:42:08: %7: -----
*Dec 4 19:42:08: %7: Header
*Dec 4 19:42:08: %7:   Version 2
*Dec 4 19:42:08: %7:   Type 4 (Link State Update)
*Dec 4 19:42:08: %7:   Packet Len 64
*Dec 4 19:42:08: %7:   Router ID 192.168.3.1
*Dec 4 19:42:08: %7:   Area ID 0.0.0.0
*Dec 4 19:42:08: %7:   Checksum 0xdc6d
*Dec 4 19:42:08: %7:   AuType 0
*Dec 4 19:42:08: %7:   Link State Update
*Dec 4 19:42:08: %7:     # LSAs 1
*Dec 4 19:42:08: %7:     LSA Header
*Dec 4 19:42:08: %7:       LS age 1
*Dec 4 19:42:08: %7:       Options 0x2
*Dec 4 19:42:08: %7:       LS type 1 (router-LSA)
*Dec 4 19:42:08: %7:       Link State ID 192.168.3.1
*Dec 4 19:42:08: %7:       Advertising Router 192.168.3.1
*Dec 4 19:42:08: %7:       LS sequence number 0x80000006
*Dec 4 19:42:08: %7:       LS checksum 0xcxxx
*Dec 4 19:42:08: %7:       length 36
*Dec 4 19:42:08: %7:     Router-LSA
*Dec 4 19:42:08: %7:       flags -|-|-
*Dec 4 19:42:08: %7:       # Links 1
*Dec 4 19:42:08: %7:       Link ID 192.168.2.1
*Dec 4 19:42:08: %7:       Link Data 192.168.2.2
*Dec 4 19:42:08: %7:       Type 2, #TOS 0, metric 1
*Dec 4 19:42:08: %7: -----
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Instance(0x35702c38) created with Link State Update
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Flood started
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Flooding via interface[GigabitEthernet 0/1:192.168.1.1]
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Flooding to neighbor[192.168.5.1]
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Added to neighbor[192.168.5.1]'s retransmit-list
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Sending update to interface[GigabitEthernet 0/1:192.168.1.1]
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Flooding via interface[GigabitEthernet 0/3:192.168.2.1]
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Flooding to neighbor[192.168.3.1]
*Dec 4 19:42:08: %7: SPF[0.0.0.0]: Calculation timer scheduled (delay 1.000000 secs)
*Dec 4 19:42:08: %7: LSA[0.0.0.0:Type1:192.168.3.1:192.168.3.1]: Install router-LSA
*Dec 4 19:42:08: %7: SEND[LS-Upd]: 1 LSAs to destination 224.0.0.5
*Dec 4 19:42:08: %7: SEND[LS-Upd]: To 224.0.0.5 via GigabitEthernet 0/1:192.168.1.1, length 64
*Dec 4 19:42:08: %7: -----
*Dec 4 19:42:08: %7: Header
*Dec 4 19:42:08: %7:   Version 2
*Dec 4 19:42:08: %7:   Type 4 (Link State Update)
*Dec 4 19:42:08: %7:   Packet Len 64
*Dec 4 19:42:08: %7:   Router ID 192.168.2.1
*Dec 4 19:42:08: %7:   Area ID 0.0.0.0
*Dec 4 19:42:08: %7:   Checksum 0xdd6c
*Dec 4 19:42:08: %7:   AuType 0
*Dec 4 19:42:08: %7:   Link State Update
*Dec 4 19:42:08: %7:     # LSAs 1
*Dec 4 19:42:08: %7:     LSA Header
*Dec 4 19:42:08: %7:       LS age 2
*Dec 4 19:42:08: %7:       Options 0x2
*Dec 4 19:42:08: %7:       LS type 1 (router-LSA)
*Dec 4 19:42:08: %7:       Link State ID 192.168.3.1
*Dec 4 19:42:08: %7:       Advertising Router 192.168.3.1
*Dec 4 19:42:08: %7:       LS sequence number 0x80000006
*Dec 4 19:42:08: %7:       LS checksum 0xcxxx
*Dec 4 19:42:08: %7:       length 36
```

此时的LSA是Router类型的，type1，用来生成这条LSA路由器的router id

(5) 本实验有没有DR/BDR?

无，因为本实验是点到点（串行链路），不需要DR、BDR的选举

三、 实验思考

(1) 如何查看OSPF协议发布的网段?

在路由器上使用show ip route命令查看其IP路由表，可以看到有2条行首标注为"O"的路由项，它们就是由OSPF协议学习到的路由。

在这些查看到了路由为起始地址，就为发布的网段

(3) 请问192.168.2.0/28的反掩码是多少?

255.255.255.255-192.168.2.0/28=63.87.253.240/28