

## 一、环境准备

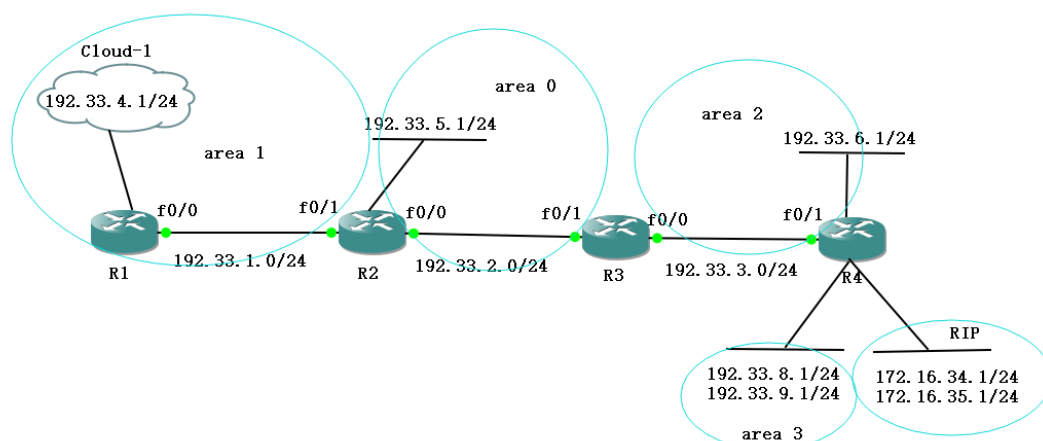
1. 软件：GNS3
2. 路由：c7200

## 二、实验操作

### 实验要求：

- 1、理解 OSPF 虚链路原理及何时需要使用虚链路。
- 2、掌握 OSPF 虚链路配置方法。
- 3、掌握 OSPF 的外部汇总路由类型及计算方法。
- 4、掌握 OSPF 外部路由汇总配置。
- 5、掌握 OSPF 末节（Stub）区域及完全末节区域特点。
- 6、掌握 OSPF Stub 区域及完全末节区域配置方法。
- 7、掌握 OSPF 中 LSA4 和 LSA5 的作用。
- 8、掌握在 OSPF 中配置默认路由的方法。
- 8、掌握配置区域认证的方法

### 实验拓扑：



### 实验过程：

- 1、根据实验拓扑，对路由器各接口配置 IP 地址。

## 2、在各路由器上配置 OSPF 协议。

### R1 上的配置清单：

```
R1(config)#router ospf 33

R1(config-router)#network 192.33.4.0 0.0.0.255 area 1

R1(config-router)#network 192.33.1.0 0.0.0.255 area 1
```

### R2 上的配置清单：

```
R2(config)#router ospf 33

R2(config-router)#network 192.33.1.0 0.0.0.255 area 1

R2(config-router)#network 192.33.5.0 0.0.0.255 area 0

R2(config-router)#network 192.33.2.0 0.0.0.255 area 0
```

### R3 上的配置清单：

```
R3(config)#router ospf 33

R3(config-router)#network 192.33.2.0 0.0.0.255 area 0

R3(config-router)#network 192.33.3.0 0.0.0.255 area 2
```

### R4 上的配置清单：

```
R4(config)#router ospf 33

R4(config-router)# network 192.33.6.0 0.0.0.255 area 2

R4(config-router)# network 192.33.3.0 0.0.0.255 area 2    注：这里没有添加 ar
ea3
```

## 3、在 R4 上配置

```
R4(config)#router ospf 33

R4(config-router)# network 192.33.8.0 0.0.0.255 area 3

R4(config-router)# network 192.33.9.0 0.0.0.255 area 3
```

问题 1: 配置后在 R1 中查看路由表, 能否看到 192.168.8.0 和 192.168.9.0 的路由, 原因是什么?

R1 路由表

```
R1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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    192.33.4.0/24 is directly connected, Loopback0
     192.33.5.0/32 is subnetted, 1 subnets
O IA  192.33.5.1 [110/2] via 192.33.1.2, 00:07:52, FastEthernet0/0
     192.33.6.0/32 is subnetted, 1 subnets
O IA  192.33.6.1 [110/4] via 192.33.1.2, 00:07:52, FastEthernet0/0
C    192.33.1.0/24 is directly connected, FastEthernet0/0
O IA  192.33.2.0/24 [110/2] via 192.33.1.2, 00:07:52, FastEthernet0/0
O IA  192.33.3.0/24 [110/3] via 192.33.1.2, 00:07:52, FastEthernet0/0
R1#
```

答: 在 R1 中查看路由表, 不能看到 192.168.8.0 和 192.168.9.0 的路由。因为不同域之间只能通过主干区域 area 0 进行交互, area 3 不能通过 area 0 和 area 1 进行交互。

问题 2: 在 R3 和 R4 中分别用 show ip ospf 来查看路由 ID, 这两个路由器的路由 ID 分别是什么?

答: R3 路由 ID: 192.33.3.1

```
R3#show ip ospf
Routing Process "ospf 33" with ID 192.33.3.1
Start time: 00:00:12.820, Time elapsed: 00:14:53.980
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
It is an area border router
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msecs
Minimum hold time between two consecutive SPFs 10000 msecs
Maximum wait time between two consecutive SPFs 10000 msecs
Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msecs
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msecs
```

答：R4 路由 ID：192.33.8.1

```
R4#show ip ospf
Routing Process "ospf 33" with ID 192.33.8.1
Start time: 00:00:12.992, Time elapsed: 00:15:28.452
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
Supports area transit capability
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msec
Minimum hold time between two consecutive SPF's 10000 msec
Maximum wait time between two consecutive SPF's 10000 msec
Incremental-SPF disabled
Minimum LSA interval 5 secs
Minimum LSA arrival 1000 msec
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
```

问题 3：在 R3 中查看 OSPF 数据库，看有几条类型 1（即路由链路状态）

```
Router Link States (Area 0)
Link ID      ADV Router   Age         Seq#         Checksum Link count
192.33.3.1   192.33.3.1   1127        0x80000002  0x00F5A4  1
192.33.5.1   192.33.5.1   1128        0x80000002  0x00405E  2

Net Link States (Area 0)
Link ID      ADV Router   Age         Seq#         Checksum
192.33.2.1   192.33.5.1   1128        0x80000001  0x00BDFD

Summary Net Link States (Area 0)
Link ID      ADV Router   Age         Seq#         Checksum
192.33.1.0   192.33.5.1   1163        0x80000001  0x003839
192.33.3.0   192.33.3.1   1163        0x80000001  0x003041
192.33.4.1   192.33.5.1   1123        0x80000001  0x001755
192.33.6.1   192.33.3.1   1122        0x80000001  0x000F5D

Router Link States (Area 2)
Link ID      ADV Router   Age         Seq#         Checksum Link count
192.33.3.1   192.33.3.1   1127        0x80000002  0x000890  1
192.33.8.1   192.33.8.1   1135        0x80000002  0x006E26  2

Net Link States (Area 2)
Link ID      ADV Router   Age         Seq#         Checksum
192.33.3.2   192.33.8.1   1135        0x80000001  0x00B0E6

Summary Net Link States (Area 2)
Link ID      ADV Router   Age         Seq#         Checksum
192.33.1.0   192.33.3.1   1130        0x80000001  0x005022
192.33.2.0   192.33.3.1   1170        0x80000001  0x003B37
```

答：有 2 条类型 1

3、配置在 R3 和 R4 上虚拟链路

```
R3(config)#router ospf 33
```

```
R3(config-router)#area 2 virtual-link 192.33.8.1
```

器 R4 的路由 ID

注，此处为路由

```
R4(config)#router ospf 33
```

```
R4(config-router)#area 2 virtual-link 192.33.3.1
```

器 R3 的路由 ID

注，此处为路由

问题 4：此时在 R1 中查看路由表，和原来有什么变化？

R1 路由表

```
R1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

      192.33.8.0/32 is subnetted, 1 subnets
O IA   192.33.8.1 [110/4] via 192.33.1.2, 00:01:31, FastEthernet0/0
O IA   192.33.9.0/24 [110/4] via 192.33.1.2, 00:01:31, FastEthernet0/0
C      192.33.4.0/24 is directly connected, Loopback0
C      192.33.5.0/32 is subnetted, 1 subnets
O IA   192.33.5.1 [110/2] via 192.33.1.2, 00:27:53, FastEthernet0/0
C      192.33.6.0/32 is subnetted, 1 subnets
O IA   192.33.6.1 [110/4] via 192.33.1.2, 00:27:53, FastEthernet0/0
C      192.33.1.0/24 is directly connected, FastEthernet0/0
O IA   192.33.2.0/24 [110/2] via 192.33.1.2, 00:27:53, FastEthernet0/0
O IA   192.33.3.0/24 [110/3] via 192.33.1.2, 00:27:53, FastEthernet0/0
R1#
```

答：在 R1 中查看路由表，能看到 192.168.8.0 和 192.168.9.0 的路由

4、在 R4 上配置 RIP 路由选择协议

参考命令如下：

```
R4(config)#router rip
```

```
R4(config-router)#version 2
```

```
R4(config-router)#network 172.16.0.0
```

```
R4(config-router)#no auto-summary
```

5、在 R4 上对 OSPF 和 RIP 做路由重分发

参考命令如下：

```
R4(config)#router ospf 33

R4(config-router)#redistribute rip metric 200 subnets

R4(config)#router rip

R4(config-router)#redistribute ospf 1 metric 10
```

问题 5：在路由器 R1 上查看路由表有什么变化？类型 E2 的路由有几条？

R1 路由表

```
R1#show ip route
Codes: C - connected, S - static, 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
        i - IS-IS, su - IS-IS summary, 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

    192.33.8.0/32 is subnetted, 1 subnets
O IA   192.33.8.1 [110/4] via 192.33.1.2, 00:07:18, FastEthernet0/0
O IA   192.33.9.0/24 [110/4] via 192.33.1.2, 00:07:18, FastEthernet0/0
    172.16.0.0/24 is subnetted, 2 subnets
O E2   172.16.34.0 [110/200] via 192.33.1.2, 00:00:44, FastEthernet0/0
O E2   172.16.35.0 [110/200] via 192.33.1.2, 00:00:44, FastEthernet0/0
C       192.33.4.0/24 is directly connected, Loopback0
    192.33.5.0/32 is subnetted, 1 subnets
O IA   192.33.5.1 [110/2] via 192.33.1.2, 00:33:40, FastEthernet0/0
    192.33.6.0/32 is subnetted, 1 subnets
O IA   192.33.6.1 [110/4] via 192.33.1.2, 00:33:40, FastEthernet0/0
C       192.33.1.0/24 is directly connected, FastEthernet0/0
O IA   192.33.2.0/24 [110/2] via 192.33.1.2, 00:33:40, FastEthernet0/0
O IA   192.33.3.0/24 [110/3] via 192.33.1.2, 00:33:41, FastEthernet0/0
R1#
```

答：新增两条路由条目：172.16.34.0、172.16.35.0。类型 E2 的路由有 2 条。

问题 6：在 R1 上查看 OSPF 数据库，类型 4 的链路有几条？链路 ID 是多少？

```

R1#show ip ospf database

        OSPF Router with ID (192.33.4.1) (Process ID 33)

          Router Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum Link count
192.33.4.1     192.33.4.1    221        0x80000003   0x002C76 2
192.33.5.1     192.33.5.1    250        0x80000003   0x00C3D2 1

          Net Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
192.33.1.2     192.33.5.1    250        0x80000002   0x00CBD1

          Summary Net Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
192.33.2.0     192.33.5.1    250        0x80000002   0x002B44
192.33.3.0     192.33.5.1    250        0x80000002   0x002A43
192.33.5.1     192.33.5.1    250        0x80000002   0x00FF6B
192.33.6.1     192.33.5.1    250        0x80000002   0x00095F
192.33.8.1     192.33.5.1    635        0x80000001   0x00F472
192.33.9.0     192.33.5.1    635        0x80000001   0x00F373

          Summary ASB Link States (Area 1)

Link ID        ADV Router    Age         Seq#          Checksum
192.33.8.1     192.33.5.1    246        0x80000001   0x00DC8A

          Type-5 AS External Link States

Link ID        ADV Router    Age         Seq#          Checksum Tag
172.16.34.0    192.33.8.1    254        0x80000001   0x00EB36 0
172.16.35.0    192.33.8.1    254        0x80000001   0x00E040 0
R1#

```

答：类型 4 的链路有 1 几条。链路 ID 是：192.33.8.1

问题 7：在 R1 上查看 OSPF 数据库，类型 5 的链路有几条？链路 ID 是多少？

```
R1#show ip ospf database

        OSPF Router with ID (192.33.4.1) (Process ID 33)

        Router Link States (Area 1)

Link ID        ADV Router    Age          Seq#           Checksum Link count
192.33.4.1     192.33.4.1     221          0x80000003    0x002C76 2
192.33.5.1     192.33.5.1     250          0x80000003    0x00C3D2 1

        Net Link States (Area 1)

Link ID        ADV Router    Age          Seq#           Checksum
192.33.1.2     192.33.5.1     250          0x80000002    0x00CBD1

        Summary Net Link States (Area 1)

Link ID        ADV Router    Age          Seq#           Checksum
192.33.2.0     192.33.5.1     250          0x80000002    0x002B44
192.33.3.0     192.33.5.1     250          0x80000002    0x002A43
192.33.5.1     192.33.5.1     250          0x80000002    0x00FF6B
192.33.6.1     192.33.5.1     250          0x80000002    0x00095F
192.33.8.1     192.33.5.1     635          0x80000001    0x00F472
192.33.9.0     192.33.5.1     635          0x80000001    0x00F373

        Summary ASB Link States (Area 1)

Link ID        ADV Router    Age          Seq#           Checksum
192.33.8.1     192.33.5.1     246          0x80000001    0x00DC8A

        Type-5 AS External Link States

Link ID        ADV Router    Age          Seq#           Checksum Tag
172.16.34.0    192.33.8.1     254          0x80000001    0x00EB36 0
172.16.35.0    192.33.8.1     254          0x80000001    0x00E040 0

R1#
```

答：类型 5 的链路有 2 几条？链路 ID 是：172.16.34.0、172.16.35.0

6、为了减少路由条目，在 R4 上进行自制系统外部路由汇总

参考命令为：

```
R4(config)#router ospf 33

R4(config-router)#summary-address 172.16.0.0 255.255.0.0      这里的网络地址
和子网掩码根据自己配置的 IP 地址修改为准确的汇总地址和子网掩码
```

问题 8：此时在 R1 上查看路由表，类型为 E2 的路由还有几条？

R1 路由表



```

R1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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

    192.33.8.0/32 is subnetted, 1 subnets
O IA   192.33.8.1 [110/4] via 192.33.1.2, 00:23:54, FastEthernet0/0
O IA   192.33.9.0/24 [110/4] via 192.33.1.2, 00:23:54, FastEthernet0/0
O E2   172.16.0.0/16 [110/200] via 192.33.1.2, 00:00:09, FastEthernet0/0
C       192.33.4.0/24 is directly connected, Loopback0
    192.33.5.0/32 is subnetted, 1 subnets
O IA   192.33.5.1 [110/2] via 192.33.1.2, 00:50:16, FastEthernet0/0
    192.33.6.0/32 is subnetted, 1 subnets
O IA   192.33.6.1 [110/4] via 192.33.1.2, 00:50:16, FastEthernet0/0
C       192.33.1.0/24 is directly connected, FastEthernet0/0
O IA   192.33.2.0/24 [110/2] via 192.33.1.2, 00:50:16, FastEthernet0/0
O IA   192.33.3.0/24 [110/3] via 192.33.1.2, 00:50:16, FastEthernet0/0
R1#

```

答：在 R1 上查看路由表，类型为 E2 的路由还有 1 条

7、为了让网络内的主机能够正常浏览 Internet，需要向内部路由器发布默认路由  
参考命令为：

在 R4 上配置静态默认路由

```
R4(config)#ip route 0.0.0.0 0.0.0.0 null 0
```

在 R4 上发布默认路由

```
R4(config)#router ospf 33
```

```
R4(config-router)# default-information originate
```

问题 9：配置后在路由器 R1 上能否看到默认路由，该默认路由的是由哪个类型的链路状态产生的？

R1 路由表

```

R1#show ip route
Codes: C - connected, S - static, 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
        i - IS-IS, su - IS-IS summary, 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 192.33.1.2 to network 0.0.0.0

    192.33.8.0/32 is subnetted, 1 subnets
O IA   192.33.8.1 [110/4] via 192.33.1.2, 00:31:01, FastEthernet0/0
O IA   192.33.9.0/24 [110/4] via 192.33.1.2, 00:31:01, FastEthernet0/0
O E2   172.16.0.0/16 [110/200] via 192.33.1.2, 00:07:16, FastEthernet0/0
C       192.33.4.0/24 is directly connected, Loopback0
    192.33.5.0/32 is subnetted, 1 subnets
O IA   192.33.5.1 [110/2] via 192.33.1.2, 00:57:23, FastEthernet0/0
    192.33.6.0/32 is subnetted, 1 subnets
O IA   192.33.6.1 [110/4] via 192.33.1.2, 00:57:23, FastEthernet0/0
C       192.33.1.0/24 is directly connected, FastEthernet0/0
O IA   192.33.2.0/24 [110/2] via 192.33.1.2, 00:57:23, FastEthernet0/0
O IA   192.33.3.0/24 [110/3] via 192.33.1.2, 00:57:23, FastEthernet0/0
O*E2   0.0.0.0/0 [110/1] via 192.33.1.2, 00:00:07, FastEthernet0/0
R1#

```

答：在路由器 R1 上能看到默认路由，该默认路由的是由类型 5 的链路状态产生的。

8、为了减少区域 1 的路由条目，把区域 1 设为存根网络，即不接受类型 4 和类型 5 的路由。

参考命令为：

```

R1(config)#router ospf 33

R1(config-router)#area 1 stub

R2(config)#router ospf 33

R2(config-router)#area 1 stub

```

问题 10：此时在 R1 上查看路由表，还能否看到 172.16.0.0 这条路由，增加了哪条路由？该路由是有哪个类型的链路状态产生的？

R1 路由表

```

R1#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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 192.33.1.2 to network 0.0.0.0

    192.33.8.0/32 is subnetted, 1 subnets
O IA   192.33.8.1 [110/4] via 192.33.1.2, 00:00:13, FastEthernet0/0
O IA   192.33.9.0/24 [110/4] via 192.33.1.2, 00:00:13, FastEthernet0/0
C       192.33.4.0/24 is directly connected, Loopback0
    192.33.5.0/32 is subnetted, 1 subnets
O IA   192.33.5.1 [110/2] via 192.33.1.2, 00:00:13, FastEthernet0/0
    192.33.6.0/32 is subnetted, 1 subnets
O IA   192.33.6.1 [110/4] via 192.33.1.2, 00:00:13, FastEthernet0/0
C       192.33.1.0/24 is directly connected, FastEthernet0/0
O IA   192.33.2.0/24 [110/2] via 192.33.1.2, 00:00:13, FastEthernet0/0
O IA   192.33.3.0/24 [110/3] via 192.33.1.2, 00:00:13, FastEthernet0/0
O*IA 0.0.0.0/0 [110/2] via 192.33.1.2, 00:00:13, FastEthernet0/0
R1#

```

答：在 R1 上查看路由表，不能看到 172.16.0.0 这条路由。增加了一条新的默认路由。该路由是有类型 3 的链路状态产生的。

问题 11：此时在 R1 上 ping 172.16.34.1 能否 ping 通？

```

R1#ping 172.16.34.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.34.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/61/68 ms
R1#

```

答：在 R1 上 ping 172.16.34.1 能 ping 通。

问题 12：此时查看 R1 的 OSPF 数据库，能否看到类型 4 和类型 5 的链路状态？

```

R1#show ip ospf database

        OSPF Router with ID (192.33.4.1) (Process ID 33)

        Router Link States (Area 1)

Link ID        ADV Router    Age          Seq#           Checksum Link count
192.33.4.1     192.33.4.1    158         0x80000006    0x00445D 2
192.33.5.1     192.33.5.1    158         0x80000006    0x00DBB9 1

        Net Link States (Area 1)

Link ID        ADV Router    Age          Seq#           Checksum
192.33.1.2     192.33.5.1    158         0x80000005    0x00E3B8

        Summary Net Link States (Area 1)

Link ID        ADV Router    Age          Seq#           Checksum
0.0.0.0        192.33.5.1    166         0x80000001    0x00B89D
192.33.2.0     192.33.5.1    166         0x80000004    0x00452A
192.33.3.0     192.33.5.1    166         0x80000004    0x004429
192.33.5.1     192.33.5.1    166         0x80000004    0x001A51
192.33.6.1     192.33.5.1    166         0x80000004    0x002345
192.33.8.1     192.33.5.1    166         0x80000003    0x000F58
192.33.9.0     192.33.5.1    166         0x80000003    0x000E59
R1#

```

答：查看 R1 的 OSPF 数据库，不能看到类型 4 和类型 5 的链路状态。

9、为了进一步简化 R1 的路由，将 area1 设为完全存根区域

参考配置命令：

```

R2(config)#router ospf 33

R2(config-router)#area 1 stub no-summary

```

注：只需在 ABR (即 R2) 上配置即可

问题 13：此时在 R1 上查看路由表，除了直连路由外，还剩下几条路由？

R1 路由表

```

R1#show ip route
Codes: C - connected, S - static, 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
        i - IS-IS, su - IS-IS summary, 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 192.33.1.2 to network 0.0.0.0

C    192.33.4.0/24 is directly connected, Loopback0
C    192.33.1.0/24 is directly connected, FastEthernet0/0
O*IA 0.0.0.0/0 [110/2] via 192.33.1.2, 00:00:06, FastEthernet0/0

```

答：在 R1 上查看路由表，除了直连路由外，还剩下 1 条路由。

问题 14：在 R1 上查看 OSPF 数据库，能看到集中链路类型？是否还有类型 3 的链路？如果有的话还剩下哪条链路？

R1 路由表

```
R1#show ip ospf database

      OSPF Router with ID (192.33.4.1) (Process ID 33)

      Router Link States (Area 1)

Link ID      ADV Router    Age      Seq#          Checksum Link count
192.33.4.1   192.33.4.1    322      0x80000006   0x00445D 2
192.33.5.1   192.33.5.1    323      0x80000006   0x00DBB9 1

      Net Link States (Area 1)

Link ID      ADV Router    Age      Seq#          Checksum
192.33.1.2   192.33.5.1    323      0x80000005   0x00E3B8

Summary Net Link States (Area 1)

Link ID      ADV Router    Age      Seq#          Checksum
0.0.0.0       192.33.5.1    17       0x80000002   0x00B69E

R1#
```

答：1、在 R1 上查看 OSPF 数据库，能看到集中链路类型。

2、有类型 3 的链路，还剩下 1 条链路。

10、在区域 1 配置明文认证，参考命令如下：

```
R1(config)#router ospf 33

R1(config-router)#area 1 authentication

R1(config)#int f0/0

R1(config-if)#ip ospf authentication-key ctj
```

问题 15：配置后查看 R1 和 R2 的邻居关系是否还存在，R1 的路由有什么变化？

邻居

```
R1#show ip ospf neighbor

R1#
```

R1 路由表

```

R1#show ip route
Codes: C - connected, S - static, 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
        i - IS-IS, su - IS-IS summary, 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    192.33.4.0/24 is directly connected, Loopback0
C    192.33.1.0/24 is directly connected, FastEthernet0/0
R1#

```

答：1、R1 和 R2 的邻居关系不存在。

2、R1 的路由只有直连路由条目。

参考 R1 的命令，在 R2 上做同样的配置。

问题 16：配置后 R1 的路由有什么变化？

R1 路由表

```

R1#show ip route
Codes: C - connected, S - static, 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
        i - IS-IS, su - IS-IS summary, 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 192.33.1.2 to network 0.0.0.0

C    192.33.4.0/24 is directly connected, Loopback0
C    192.33.1.0/24 is directly connected, FastEthernet0/0
O*IA 0.0.0.0/0 [110/2] via 192.33.1.2, 00:00:03, FastEthernet0/0
R1#

```

答：R1 的路由表中新增了一条默认路由。

11、在区域 1 配置密文认证，参考命令如下：

```

R1(config)#router ospf 33

R1(config-router)#area 1 authentication message-digest

R1(config)#int f0/0

R1(config-if)#ip ospf message-digest-key 1 md5 ctj

```

参考 R1 的配置在 R2 上做同样的配置。