

## 一、环境准备

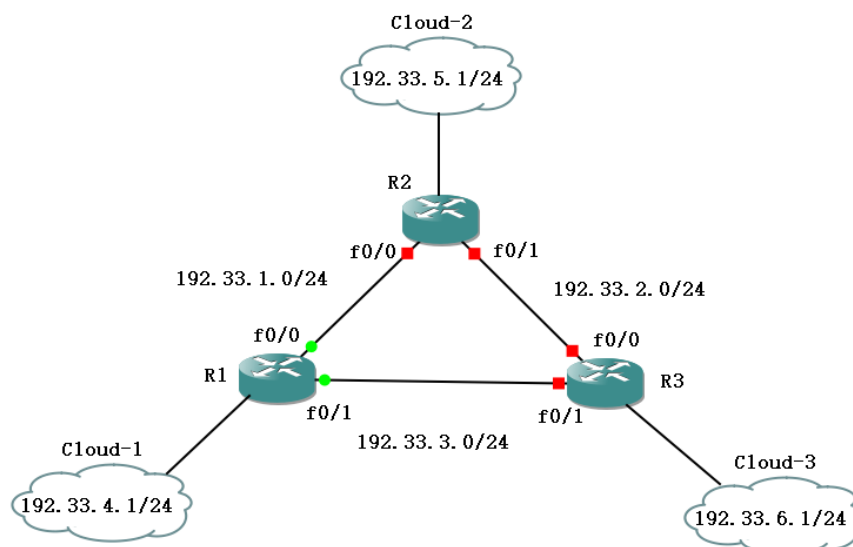
1. 软件：GNS3
2. 路由：c7200

## 二、实验操作

### 实验要求：

- 1、掌握 EIGRP 的不等价均衡的条件。
- 2、掌握 EIGRP 的 metric 值修改方法。
- 3、掌握 EIGRP 的 AD、FD、FC、Successor、FS 概念。
- 4、理解 EIGRP 的认证过程。
- 5、掌握 EIGRP 的认证的配置。

### 实验拓扑：



### 实验过程：

- 1、配置各台路由器的 IP 地址，并且使用 ping 命令确认各路由器的直连口的互通性  
参照作者 路由协议与交换技术~RIP 实验。
- 2、在每个路由器上配置 EIGRP 协议

参考命令：

R1 配置:

```
R1(config)#router eigrp 33

R1(config-router)#network 192.33.1.0

R1(config-router)# network 192.33.3.0

R1(config-router)# network 192.33.4.0
```

在 R2 和 R3 上做相同的配置, 注意 **network** 后面的网络地址不同。

问题 1: 在 R1 中查看路由表, 到达哪个网络的路由实现了负载均衡, 是等代价的还是不等代价的, 为什么?

R1 路由器:

```
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
D    192.33.5.0/24 [90/156160] via 192.33.1.2, 00:02:22, FastEthernet0/0
D    192.33.6.0/24 [90/156160] via 192.33.3.2, 00:02:17, FastEthernet0/1
C    192.33.1.0/24 is directly connected, FastEthernet0/0
D    192.33.2.0/24 [90/30720] via 192.33.3.2, 00:02:22, FastEthernet0/1
      [90/30720] via 192.33.1.2, 00:02:22, FastEthernet0/0
C    192.33.3.0/24 is directly connected, FastEthernet0/1
R1#
```

答: 到达 192.33.2.0 网络的路由实现了负载均衡。两条路由是等价的, 因为两条路由的 FD 值相同。

问题 2: 在 R1 中查看拓扑表, 看到达网络 192.168.6.0 的 AD 和 FD 是多少, 在 R2 中查看拓扑表, 到达网络 192.168.6.0 的 AD 和 FD 是多少?

R1 拓扑表:

```

R1#show ip eigrp topology
IP-EIGRP Topology Table for AS(33)/ID(192.33.4.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 192.33.1.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/0
P 192.33.3.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/1
P 192.33.2.0/24, 2 successors, FD is 30720
    via 192.33.1.2 (30720/28160), FastEthernet0/0
    via 192.33.3.2 (30720/28160), FastEthernet0/1
P 192.33.5.0/24, 1 successors, FD is 156160
    via 192.33.1.2 (156160/128256), FastEthernet0/0
P 192.33.4.0/24, 1 successors, FD is 128256
    via Connected, Loopback0
P 192.33.6.0/24, 1 successors, FD is 156160
    via 192.33.3.2 (156160/128256), FastEthernet0/1
R1#

```

答：R1 到达网络 192.168.6.0 的 AD：128256 、 FD：156160。

R2 拓扑表：

```

R2#show ip eigrp topology
IP-EIGRP Topology Table for AS(33)/ID(192.33.5.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 192.33.1.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/0
P 192.33.3.0/24, 2 successors, FD is 30720
    via 192.33.1.1 (30720/28160), FastEthernet0/0
    via 192.33.2.2 (30720/28160), FastEthernet0/1
P 192.33.2.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/1
P 192.33.5.0/24, 1 successors, FD is 128256
    via Connected, Loopback0
P 192.33.4.0/24, 1 successors, FD is 156160
    via 192.33.1.1 (156160/128256), FastEthernet0/0
P 192.33.6.0/24, 1 successors, FD is 156160
    via 192.33.2.2 (156160/128256), FastEthernet0/1
R2#

```

答：R2 到达网络 192.168.6.0 的 AD：128256 、 FD：156160。

3、为了实现负载均衡，修改 R2 的 f0/1 接口的带宽为 200Mbps，针对网络 192.168.6.0，让 R2 成为 R1 的可行后继路由。

参考命令：

```

R2(config)#int f0/1

R2(config-if)#bandwidth 200000

```

问题 3：在 R1 中查看拓扑表，看到达网络 192.168.6.0 的 AD 和 FD 是多少，在 R2 中查看拓扑表，到达网络 192.168.6.0 的 AD 和 FD 是多少？

R1 拓扑表:

```
R1#show ip eigrp topology
IP-EIGRP Topology Table for AS(33)/ID(192.33.4.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 192.33.1.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/0
P 192.33.3.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/1
P 192.33.2.0/24, 2 successors, FD is 30720
    via 192.33.1.2 (30720/15360), FastEthernet0/0
    via 192.33.3.2 (30720/28160), FastEthernet0/1
P 192.33.5.0/24, 1 successors, FD is 156160
    via 192.33.1.2 (156160/128256), FastEthernet0/0
P 192.33.4.0/24, 1 successors, FD is 128256
    via Connected, Loopback0
P 192.33.6.0/24, 1 successors, FD is 156160
    via 192.33.3.2 (156160/128256), FastEthernet0/1
    via 192.33.1.2 (158720/143360), FastEthernet0/0
R1#
```

答: R1 到达网络 192.168.6.0 的路径有两条。

- 1、后继中 AD: 128256 、FD: 156160
- 2、可行后继中 AD: 143360 、FD: 158720

R2 拓扑表:

```
R2#
*Mar 28 22:08:39.143: %SYS-5-CONFIG_I: Configured from console by console
R2#show ip eigrp topology
IP-EIGRP Topology Table for AS(33)/ID(192.33.5.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 192.33.1.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/0
P 192.33.3.0/24, 2 successors, FD is 30720
    via 192.33.1.1 (30720/28160), FastEthernet0/0
    via 192.33.2.2 (30720/28160), FastEthernet0/1
P 192.33.2.0/24, 1 successors, FD is 15360
    via Connected, FastEthernet0/1
P 192.33.5.0/24, 1 successors, FD is 128256
    via Connected, Loopback0
P 192.33.4.0/24, 1 successors, FD is 156160
    via 192.33.1.1 (156160/128256), FastEthernet0/0
P 192.33.6.0/24, 1 successors, FD is 143360
    via 192.33.2.2 (143360/128256), FastEthernet0/1
R2#
```

答: R2 到达网络 192.168.6.0 的后继中 AD: 128256 、FD: 143360

问题 4: 通过对问题 2 和问题 3 的对比, 哪些发生了变化。

答: R1 的拓扑表中多了一条到达 192.33.6.0 网络的可行后继路由, 因为 R2 上到达网络 192.33.6.0 网络的 FD 值小于 R1 上到达网络 192.33.6.0 网络的 FD 值。同时, R2 上到达网络 192.33.6.0 网络的 FD 值变小了。

问题 5: 在 R1 中查看拓扑表, 看到达网络 192.168.6.0 的路径有几条? 每条的 AD 和 FD 是多少?

R1 拓扑表:

```
R1#show ip eigrp topology
IP-EIGRP Topology Table for AS(33)/ID(192.33.4.1)

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status

P 192.33.1.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/0
P 192.33.3.0/24, 1 successors, FD is 28160
    via Connected, FastEthernet0/1
P 192.33.2.0/24, 2 successors, FD is 30720
    via 192.33.1.2 (30720/15360), FastEthernet0/0
    via 192.33.3.2 (30720/28160), FastEthernet0/1
P 192.33.5.0/24, 1 successors, FD is 156160
    via 192.33.1.2 (156160/128256), FastEthernet0/0
P 192.33.4.0/24, 1 successors, FD is 128256
    via Connected, Loopback0
P 192.33.6.0/24, 1 successors, FD is 156160
    via 192.33.3.2 (156160/128256), FastEthernet0/1
    via 192.33.1.2 (158720/143360), FastEthernet0/0
R1#
```

答: R1 到达网络 192.168.6.0 的路径有两条。

1、后继中 AD: 128256 、FD: 156160

2、可行后继中 AD: 143360 、FD: 158720

问题 6: 为了实现不等代价负载均衡, 应该在 R1 中修改 variance 值为多少?

答: variance=2

4、为了实现不等代价负载均衡, 在 R1 中修改 variance 值。

参考命令:

```
R1(config)#router eigrp 33
```

```
R1(config-router)#variance 2
```

注: 此参数修改为你在问题 6 中计算出来的值

问题 7: 查看路由表, 在路由条目 192.168.6.0 中有什么变化?

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

C    192.33.4.0/24 is directly connected, Loopback0
D    192.33.5.0/24 [90/156160] via 192.33.1.2, 00:00:23, FastEthernet0/0
D    192.33.6.0/24 [90/156160] via 192.33.3.2, 00:00:23, FastEthernet0/1
      [90/158720] via 192.33.1.2, 00:00:23, FastEthernet0/0
C    192.33.1.0/24 is directly connected, FastEthernet0/0
D    192.33.2.0/24 [90/30720] via 192.33.3.2, 00:00:23, FastEthernet0/1
      [90/30720] via 192.33.1.2, 00:00:23, FastEthernet0/0
C    192.33.3.0/24 is directly connected, FastEthernet0/1
R1#

```

答：R1 到达 192.168.6.0 网络的路由条目有两条，实现了不等价的负载均衡。

5、在 R1 和 R2 之间配置认证，和 RIP 的认证类似。

参考命令：

```

R1(config)#key chain xcu

R1(config-keychain)#key 1

R1(config-keychain-key)#key-string jiang

R1(config)#interface FastEthernet0/0

R1(config-if)#ip authentication mode eigrp 33 md5

R1(config-if)#ip authentication key-chain eigrp 33 xcu

R1(config-if)#shutdown

R1(config-if)#no shutdown

```

注：此处让重新生成路由表

问题 8：此时在 R1 中查看路由表到达网络 192.168.5.0 的下一条，是否还是 192.168.1.2？为什么？

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
D    192.33.5.0/24 [90/158720] via 192.33.3.2, 00:01:20, FastEthernet0/1
D    192.33.6.0/24 [90/156160] via 192.33.3.2, 00:08:32, FastEthernet0/1
C    192.33.1.0/24 is directly connected, FastEthernet0/0
D    192.33.2.0/24 [90/30720] via 192.33.3.2, 00:01:20, FastEthernet0/1
C    192.33.3.0/24 is directly connected, FastEthernet0/1
R1#

```

答：R1 到达网络 192.168.5.0 的下一条不是 192.168.1.2，而是 192.33.3.2，因为 R1 和 R2 在 192.33.2.0 网络之间的通信不可以通过认证。

6、参考步骤 5，在 R2 中做同样的配置，接口为 f0/0

问题 9：配置后再查看 R1 的路由表，到达目标网络 192.168.5.0 的下一条是多少？为什么？

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
D    192.33.5.0/24 [90/156160] via 192.33.1.2, 00:00:00, FastEthernet0/0
D    192.33.6.0/24 [90/156160] via 192.33.3.2, 00:00:00, FastEthernet0/1
        [90/158720] via 192.33.1.2, 00:00:00, FastEthernet0/0
C    192.33.1.0/24 is directly connected, FastEthernet0/0
D    192.33.2.0/24 [90/30720] via 192.33.3.2, 00:00:00, FastEthernet0/1
        [90/30720] via 192.33.1.2, 00:00:00, FastEthernet0/0
C    192.33.3.0/24 is directly connected, FastEthernet0/1
R1#

```

答：R1 到达网络 192.168.5.0 的下一条是 192.168.1.2，因为 R1 和 R2 在 192.33.2.0 网络之间的通信可以通过认证。

7、将路由器 R1 修改为 stub 网络

参考命令：

```

R1(config)#router eigrp 33

R1(config-router)#eigrp stub receive-only

```

问题 10：配置后，在 R2 和 R3 上还能否看到 192.168.4.0 网段的路由？为什么？

R2 路由表:

```
R2#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    192.33.5.0/24 is directly connected, Loopback0
D    192.33.6.0/24 [90/143360] via 192.33.2.2, 00:09:49, FastEthernet0/1
C    192.33.1.0/24 is directly connected, FastEthernet0/0
C    192.33.2.0/24 is directly connected, FastEthernet0/1
D    192.33.3.0/24 [90/30720] via 192.33.2.2, 00:01:17, FastEthernet0/1
R2#
```

R3 路由表:

```
R3#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

D    192.33.5.0/24 [90/156160] via 192.33.2.1, 00:01:26, FastEthernet0/0
C    192.33.6.0/24 is directly connected, Loopback0
D    192.33.1.0/24 [90/30720] via 192.33.2.1, 00:00:45, FastEthernet0/0
C    192.33.2.0/24 is directly connected, FastEthernet0/0
C    192.33.3.0/24 is directly connected, FastEthernet0/1
R3#
```

答: 在 R2 和 R3 上不能看到 192.168.4.0 网段的路由, 因为 R1 经过配置之后, 只能接收邻居发送过来路由信息, 而不能发送自己的路由信息。