Route V1.0试验分解指南

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EIGRP分解试验部分

1. EIGRP基本试验

拓扑图：

试验需求：

全网运行EIGRP路由协议，能够实现全网的互通，并且掌握主要几种show 命令的使用。

主要配置命令：

R1(config)#router eigrp 1
R1(config-route)#network 12.1.1.0 0.0.0.255
R1(config-route)#network 1.1.1.0 0.0.0.255

R2(config)#router eigrp 1
R2config-route)#network 12.1.1.0 0.0.0.255
R2config-route)#network 23.1.1.0 0.0.0.255

R3config)#router eigrp 1
R3onfig-route)#network 3.3.3.0 0.0.0.255
R3onfig-route)#network 23.1.1.0 0.0.0.255

查看路由表是否学习到路由

```
R1#show ip route
Gateway of last resort is not set
        1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C           1.1.1.0/24 is directly connected, Loopback0
D           1.0.0.0/8 is a summary, 00:00:29, Null0
D       23.0.0.0/8 [90/2681856] via 12.1.1.2, 00:00:16, Serial1/2
        12.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C           12.1.1.0/24 is directly connected, Serial1/2
D           12.0.0.0/8 is a summary, 00:00:29, Null0
```

EIGRP是无类路由协议，但是路由表中发现是**/8**位的主类路由，为什么呢？

答：EIGRP默认在网络边界进行自动汇总，我们需要关闭此特性。

R1/R2/R3

R1(config)#router eigrp 1

R1(config-route)#no auto-summary

Note:EIGRP配置注意事项

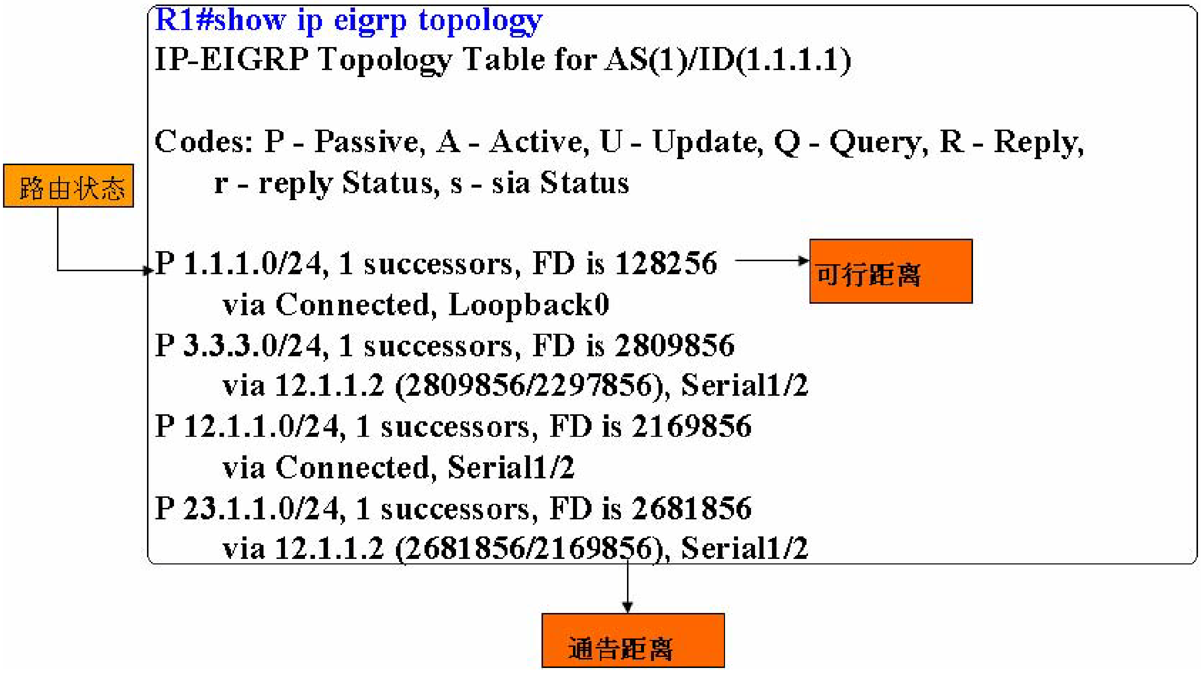
1.自治系统号要匹配

2.E IGRP可以直接宣告主类网络，但是最好我们通过通配符掩码进行精确匹配。使用通配符掩码，可以很好的控制哪些接口加入到EIGRP 的进程中工作。

3.关闭自动汇总。

EIGRP主要查看指令：

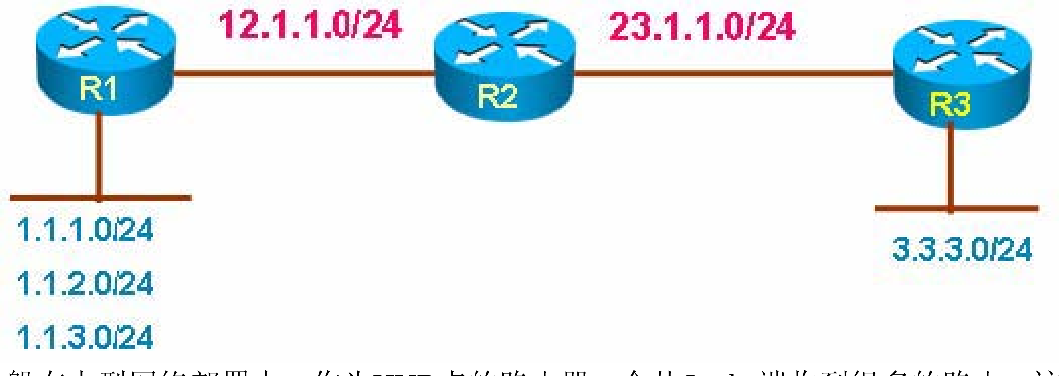
```
R1#show ip eigrp neighbors
IP-EIGRP neighbors for process 1
H   Address                 Interface       Hold Uptime   SRTT   RTO  Q  Seq
                                            (sec)         (ms)        Cnt Num
0   12.1.1.2                Se1/2             12 00:10:06  140   840  0  10
```



LAB2:EIGRP手工汇总

拓扑图：

实用场合：



一般在大型网络部署中，作为HUB点的路由器，会从Spoke端收到很多的路由。这样导致HUB点的路由表过大，查表缓慢，并且消耗路由器资源，为了减少路由表大小。加快收敛速度，我们需要设计良好的IP地址规划，便于做路由聚合技术。

主要配置指令：

在三台路由器上配置好EIGRP协议，参考上面试验配置。

R1配置路由聚合命令

interface Serial1/2

 ip address 12.1.1.1 255.255.255.0
 ip summary-address eigrp 1 1.1.0.0 255.255.252.0 5

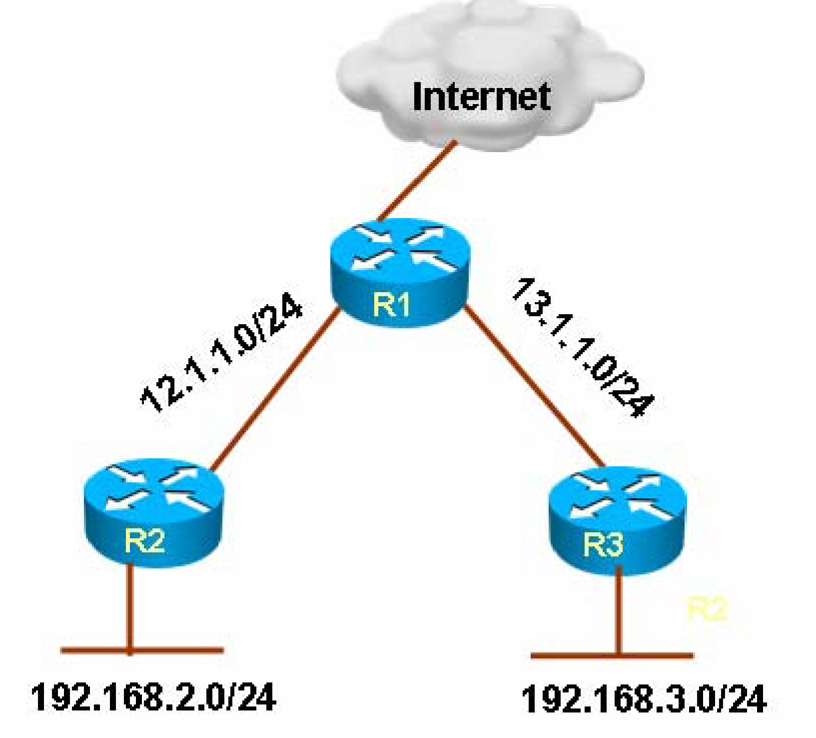
检验：

R2#show ip route
Gateway of last resort is not set
1.0.0.0/22 is subnetted, 1 subnets
D 1.1.0.0 [90/2297856] via 12.1.1.1, 00:00:39, Serial1/3
3.0.0.0/24 is subnetted, 1 subnets
D 3.3.3.0 [90/2297856] via 23.1.1.3, 00:39:34, Serial1/2
23.0.0.0/24 is subnetted, 1 subnets
C 23.1.1.0 is directly connected, Serial1/2
12.0.0.0/24 is subnetted, 1 subnets
C 12.1.1.0 is directly connected, Serial1/3

Lab3:注入默认路由

使用场合：

上图中，R1/R2/R3运行EIGRP，R1责接入互联网，正常情况下，R2/R3后的网络要访问互联网，必须要在R2/R3分别设置默认路由指向R1，但是这样配置如果下面路由器很多很明显比较麻烦，为了简化配置，我们只需要有R1负责向内部的路由器通过EIGRP发送默认路由，让R2/R3能够通过EIGRP收到一条默认。



初始化配置
R1配置两个loopback接口,其中一个192.168.1.0/24 网络。不宣告在EIGRP中，这个接口模拟互联网。另外一个loopback接口1.1.1.0/24宣告进EIGRP。

```
R1
router eigrp 1
 network 12.1.1.0 0.0.0.255
 network 13.1.1.0 0.0.0.255
 network 1.1.1.0 0.0.0.255
 no auto-summary
R2
router eigrp 1
 network 12.1.1.0 0.0.0.255
 network 192.168.2.0
 no auto-summary

R3
router eigrp 1
 network 13.1.1.0 0.0.0.255
 network 192.168.3.0
 no auto-summary
```

检验：
R2 ping R1的192.168.1.1 ,是不通的，很明显，R2没有到达R1身后192.168.1.1的路由

```
R2#ping 192.168.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

主要配置指令：
我们在R1配置EIGRP，向R2/R3发送缺省路由，以便能够让R2/R3访问过来。
R1(config)#ip default-network 1.0.0.0

配置完成后我们在R2查看路由表

```
R2#show ip route

Gateway of last resort is not set

     1.0.0.0/24 is subnetted, 1 subnets
D       1.1.1.0 [90/2297856] via 12.1.1.1, 00:01:45, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/3
     13.0.0.0/24 is subnetted, 1 subnets
D       13.1.1.0 [90/2681856] via 12.1.1.1, 00:01:45, Serial1/3
C    192.168.2.0/24 is directly connected, Loopback0
D    192.168.3.0/24 [90/2809856] via 12.1.1.1, 00:12:05, Serial1/3
```

并没发现R1注入过来的默认

解决：需要在R1上开启自动汇总
R1(config)#router eigrp 1
R1(config-router)#auto-summary

再次在R2查看路由表

```
R2#show ip route

Gateway of last resort is 12.1.1.1 to network 1.0.0.0

D*   1.0.0.0/8 [90/2297856] via 12.1.1.1, 00:00:29, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/3
D    13.0.0.0/8 [90/2681856] via 12.1.1.1, 00:00:29, Serial1/3
C    192.168.2.0/24 is directly connected, Loopback0
D    192.168.3.0/24 [90/2809856] via 12.1.1.1, 00:17:52, Serial1/3
```

在R2 ping 192.168.1.1,可以通

R2#ping 192.168.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/53/136 ms

Note: ip default-network注意事项：

ip default-network x.x.x.x(必须有类的输入）并且这条路由要能出现在本地路由表和整个网络中.

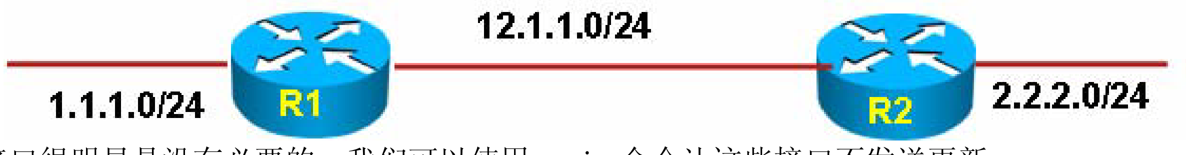
EIGRP不会产生0.0.0.0的默生路由，而是借用带有D*的路由的下一跳做为缺省下一跳。

需要作auto-summary　或者手工汇总

LAB4:EIGRP的passive-interface

使用场合：

R1/R2身后的网络1.1.1.0和2.2.2.0下面没有任何EIGRP邻居，这样让EIGRP发送各种更新到这些



接口很明显是没有必要的，我们可以使用passive命令让这些接口不发送更新。

验证没有使用**passive-interface**之前：

以下debug信息发现，会从loopack接口发送和接受hello消息

```
R1#debug eigrp packets
*Mar  1 04:08:02.758: EIGRP: Received HELLO on Serial1/2 nbr 12.1.1.2
*Mar  1 04:08:02.762:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 04:08:03.066: EIGRP: Sending HELLO on Loopback1
*Mar  1 04:08:03.066:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
*Mar  1 04:08:03.070: EIGRP: Received HELLO on Loopback1 nbr 1.1.1.1
*Mar  1 04:08:03.070:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0
*Mar  1 04:08:03.074: EIGRP: Packet from ourselves ignored
*Mar  1 04:08:03.986: EIGRP: Sending HELLO on Serial1/2
*Mar  1 04:08:03.986:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
*Mar  1 04:08:07.078: EIGRP: Received HELLO on Serial1/2 nbr 12.1.1.2
*Mar  1 04:08:07.082:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 04:08:07.802: EIGRP: Sending HELLO on Loopback1
*Mar  1 04:08:07.802:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
*Mar  1 04:08:07.806: EIGRP: Received HELLO on Loopback1 nbr 1.1.1.1
*Mar  1 04:08:07.806:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0
*Mar  1 04:08:07.810: EIGRP: Packet from ourselves ignored
*Mar  1 04:08:08.318: EIGRP: Sending HELLO on Serial1/2
*Mar  1 04:08:08.318:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
```

配置被动接口

R1

router eigrp 1

passive-interface Loopback0

或者：

router eigrp 1

passive-interface default

no passive-interface Serial1/2

验证开启被动接口后的**debug**信息

可以看到没有向**loopback**接口发送或者接受任何更新

```
R1#deb eigrp packets
*Mar  1 04:21:55.166: EIGRP: Received HELLO on Serial1/2 nbr 12.1.1.2
*Mar  1 04:21:55.170:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 04:21:56.290: EIGRP: Sending HELLO on Serial1/2
*Mar  1 04:21:56.290:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
*Mar  1 04:21:59.966: EIGRP: Received HELLO on Serial1/2 nbr 12.1.1.2
*Mar  1 04:21:59.970:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 04:22:00.846: EIGRP: Sending HELLO on Serial1/2
*Mar  1 04:22:00.846:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
*Mar  1 04:22:04.526: EIGRP: Received HELLO on Serial1/2 nbr 12.1.1.2
*Mar  1 04:22:04.530:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 04:22:05.714: EIGRP: Sending HELLO on Serial1/2
*Mar  1 04:22:05.714:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
*Mar  1 04:22:08.822: EIGRP: Received HELLO on Serial1/2 nbr 12.1.1.2
*Mar  1 04:22:08.822:   AS 1, Flags 0x0, Seq 0/0 idbQ 1/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 04:22:10.578: EIGRP: Sending HELLO on Serial1/2
*Mar  1 04:22:10.578:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
*Mar  1 04:22:13.190: EIGRP: Received HELLO on Serial1/2 nbr 12.1.1.2
*Mar  1 04:22:13.194:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 04:22:15.322: EIGRP: Sending HELLO on Serial1/2
*Mar  1 04:22:15.322:   AS 1, Flags 0x0, Seq 0/0 idbQ 0/0 iidbQ un/rely 0/0
```

LAB5：EIGRP认证

需求：

R1/R2使用**EIGRP**认证。保证路由的安全性，同时我们验证**EIGRP**认证的一些特点。注意：**EIGRP**只支持密文认证方式。

配置：

R1

R1(config)#key chain cisco 配置**key**密钥链名字为**cisco**

R1(config-keychain)#key 1 配置**key identifier** 为**1**

R1(config-keychain-key)#key-string cisco 密钥为**cisco**

接口下

```
interface Serial1/2
 ip address 12.1.1.1 255.255.255.0
 ip authentication mode eigrp 1 md5
 ip authentication key-chain eigrp 1 cisco
```

R2配置和**R1**相同，省略

测试**EIGRP**认证的特点：

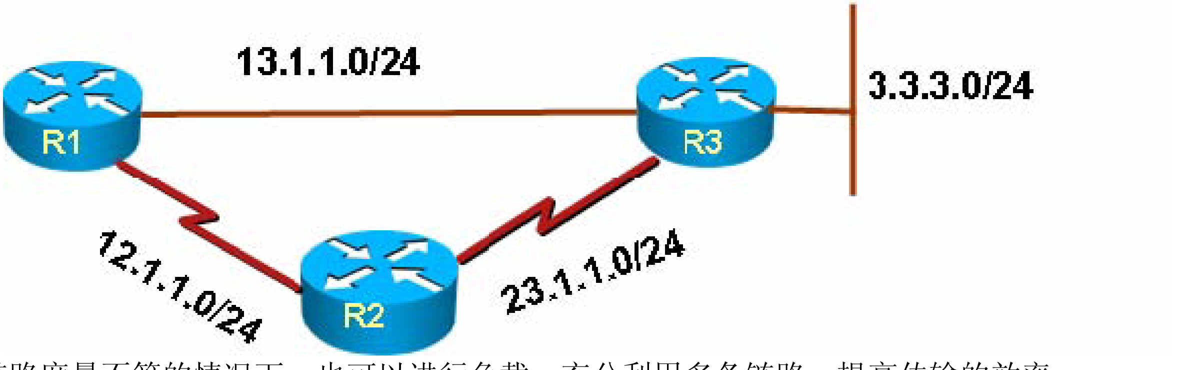
我们使用一下组合进行测试

R1的key chain	R2的key chain	可以形 居
key 1=cisco	key 2=cisco	不可
key 1=cisco key 2=cisco	key 2=cisco key 1=abcde	不可
key 1=cisco key 5=cisco	key 2=cisco	不可
key 1=cisco key 2=12345	key 1=cisco Key 2=abced	可

Note:EIGRP认证注意事项:
EGRP认证时，路由器发送最低ID的key，并且携带ID，只有 ID和key值完全相同才能成功认证。
key chain的名字都只是本地有效，key chain名字的不同不影响认证。

LAB6:EIGRP非等价负载均衡

使用场合:
每种路由协议都有等价负载均衡的功能，但是EIGRP协议还可以支持非等价负载均衡，当多条



链路度量不等的情况下，也可以进行负载，充分利用多条链路。提高传输的效率。
基本配置:

R1
interface Ethernet0/0
ip address 13.1.1.1 255.255.255.0

interface Serial1/2
ip address 12.1.1.1 255.255.255.0

router eigrp 1
network 12.1.1.0 0.0.0.255
network 13.1.1.0 0.0.0.255
no auto-summary

R2
interface Serial1/2
ip address 23.1.1.2 255.255.255.0

interface Serial1/3
ip address 12.1.1.2 255.255.255.0
serial restart-delay 0

```
router eigrp 1
 network 12.1.1.0 0.0.0.255
 network 23.1.1.0 0.0.0.255
 no auto-summary
```

```
R3
interface Loopback0
 ip address 3.3.3.3 255.255.255.0
!
interface Ethernet0/0
ip address 13.1.1.3 255.255.255.0
interface Serial1/3
 ip address 23.1.1.3 255.255.255.0
router eigrp 1
 network 3.3.3.0 0.0.0.255
 network 13.1.1.0 0.0.0.255
 network 23.1.1.0 0.0.0.255
 no auto-summary
```

在**R1**查看路由情况

```
R1#show ip route
Gateway of last resort is not set
     3.0.0.0/24 is subnetted, 1 subnets
D       3.3.3.0 [90/409600] via 13.1.1.3, 00:10:41, Ethernet0/0
     23.0.0.0/24 is subnetted, 1 subnets
D       23.1.1.0 [90/2195456] via 13.1.1.3, 00:15:41, Ethernet0/0
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
     13.0.0.0/24 is subnetted, 1 subnets
C       13.1.1.0 is directly connected, Ethernet0/0
```

查看**EIGRP**拓扑表，我们发现，**3.3.3.0**的网络并没有关于从**R2**走的这条路径。只有下一跳到**R3**的。为什么？

```
R1#show ip eigrp topology
IP-EIGRP Topology Table for AS(1)/ID(13.1.1.1)
P 3.3.3.0/24, 1 successors, FD is 179200
        via 13.1.1.3 (409600/128256), Ethernet0/0
P 12.1.1.0/24, 1 successors, FD is 2169856
        via Connected, Serial1/2
P 13.1.1.0/24, 1 successors, FD is 281600
        via Connected, Ethernet0/0
P 23.1.1.0/24, 1 successors, FD is 2195456
        via 13.1.1.3 (2195456/2169856), Ethernet0/0
```

via 12.1.1.2 (2681856/2169856), Serial1/2

我们通过这条命令看到，从**R2**走的路径的**AD>FD** （**2297856>409600**）也就是说要满足**FS**（可行后继）的条件不够，条件是**AD<FD**

R1#show ip eigrp topology all-links

```
IP-EIGRP Topology Table for AS(1)/ID(13.1.1.1)

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

P 3.3.3.0/24, 1 successors, FD is 179200, serno 9
        via 13.1.1.3 (409600/128256), Ethernet0/0
        via 12.1.1.2 (2809856/2297856), Serial1/2
P 12.1.1.0/24, 1 successors, FD is 2169856, serno 1
        via Connected, Serial1/2
P 13.1.1.0/24, 1 successors, FD is 281600, serno 8
        via Connected, Ethernet0/0
P 23.1.1.0/24, 1 successors, FD is 2195456, serno 5
        via 13.1.1.3 (2195456/2169856), Ethernet0/0
        via 12.1.1.2 (2681856/2169856), Serial1/2
```

我们可以通过更改**R2**的链路的带宽和延迟来影响，使之满足**AD<FD.**

R2

```
interface Serial1/2
 ip address 23.1.1.2 255.255.255.0
 bandwidth 100000
 delay 10
```

再次查看**R1**的拓扑表，出现了**2**个下一跳

```
R1#show ip eig topology
IP-EIGRP Topology Table for AS(1)/ID(13.1.1.1)

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

P 3.3.3.0/24, 1 successors, FD is 409600
        via 13.1.1.3 (409600/128256), Ethernet0/0
        via 12.1.1.2 (2300416/156160), Serial1/2
P 12.1.1.0/24, 1 successors, FD is 2169856
        via Connected, Serial1/2
P 13.1.1.0/24, 1 successors, FD is 281600
        via Connected, Ethernet0/0
P 23.1.1.0/24, 1 successors, FD is 2172416
        via 12.1.1.2 (2172416/28160), Serial1/2
```

via 13.1.1.3 (2195456/2169856), Ethernet0/0

配置R1 的EIGRP 的variance 值

非等价负载均衡：**VARIANCE**

非等价负载流量分配的方式：选择度量最小路径，选择负载均衡路径 **,**用后者的**metric** 除以前者的**metric,**有小数就进位**,**不可舍位**.**例如结果为**3.1.**那么配置的时候**variance 4.**

P 3.3.3.0/24, 1 successors, FD is 409600
via 13.1.1.3 (409600/128256), Ethernet0/0
via 12.1.1.2 (2300416/156160), Serial1/2
2300416/409600=5.61

VARIANCE配置为**6**
R1
router eigrp 1
variance 6

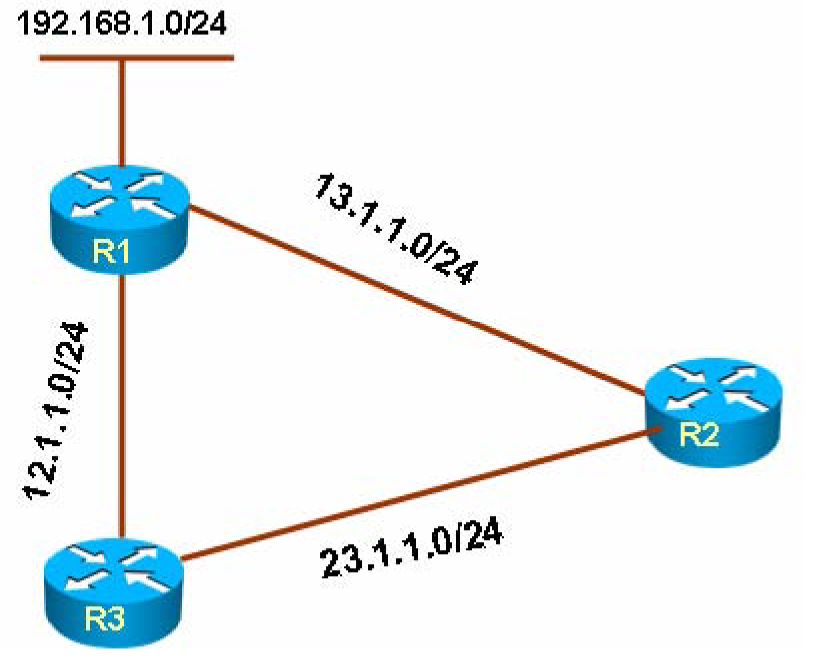
再次查看路由表是否出现**2**个下一跳

```
R1#show ip route
Gateway of last resort is not set
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     3.0.0.0/24 is subnetted, 1 subnets
D       3.3.3.0 [90/409600] via 13.1.1.3, 00:08:21, Ethernet0/0
                [90/2300416] via 12.1.1.2, 00:08:21, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
D       23.1.1.0 [90/2195456] via 13.1.1.3, 00:08:21, Ethernet0/0
                 [90/2172416] via 12.1.1.2, 00:08:21, Serial1/2
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.1.0 is directly connected, Loopback1
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
     13.0.0.0/24 is subnetted, 1 subnets
C       13.1.1.0 is directly connected, Ethernet0/0
```

LAB7:使用STUB限制query消息

拓扑：

使用场合：



当某条路由丢失，并且没有可行后继者（ feasible successor）时，EIGRP会发送Query.丢失的那条路由处于 active 状态.Query将被发向所有的邻居，除了原先的后继者（ successor）. 如果邻居也没有关于那条路由的信息， query将被发送到邻居的邻居. 当路由丢失时，在EIGRP重新计算新的successor之前，它必须获得所有邻居对query消息的reply.默认情况下，如果某个邻居在三分钟以内没有对query消息作出reply，那么这条路由将Stuck In Active (SIA)，并且路由器将重启（rest）与这个邻居的邻居关系.

如果EIGRP 的网络多达数十台及数百台路由，那么如果出现某个网络出错，则有可以引起整个网络产生大量的查询回复包。所以为了避免这样的问题，可以使用ip summary 命令或stub 参数来进行配置EIGRP，限制EIGRP 的查询范围。

把**R1**的**loopback**接口**down**掉，模拟故障

没有配置**STUB**之前的**debug**信息。

```
R2#debug eigrp packets query
*Mar  1 06:47:09.542: EIGRP: Received QUERY on Serial1/3 nbr 12.1.1.1
*Mar  1 06:47:09.546:   AS 1, Flags 0x0, Seq 74/55 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/0
*Mar  1 06:47:09.558: EIGRP: Enqueueing QUERY on Serial1/2 iidbQ un/rely 0/1 serno 30-30
*Mar  1 06:47:09.558: EIGRP: Enqueueing QUERY on Serial1/3 iidbQ un/rely 0/1 serno 30-30
*Mar  1 06:47:09.562: EIGRP: Enqueueing QUERY on Serial1/2 nbr 23.1.1.3 iidbQ un/rely 0/0 peerQ un/rely 0/0 serno 30-30
*Mar  1 06:47:09.566: EIGRP: Enqueueing QUERY on Serial1/3 nbr 12.1.1.1 iidbQ un/rely 0/0 peerQ un/rely 0/0 serno 30-30
*Mar  1 06:47:09.570: EIGRP: Sending QUERY on Serial1/2 nbr 23.1.1.3
*Mar  1 06:47:09.570:   AS 1, Flags 0x0, Seq 57/48 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/1 serno 30-30
*Mar  1 06:47:09.682: EIGRP: Received QUERY on Serial1/2 nbr 23.1.1.3
*Mar  1 06:47:09.682:   AS 1, Flags 0x0, Seq 51/56 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/1
```

在**R2**配置**STUB**，然后观察**debug**输出信息

R2(config-router)#router eig 1

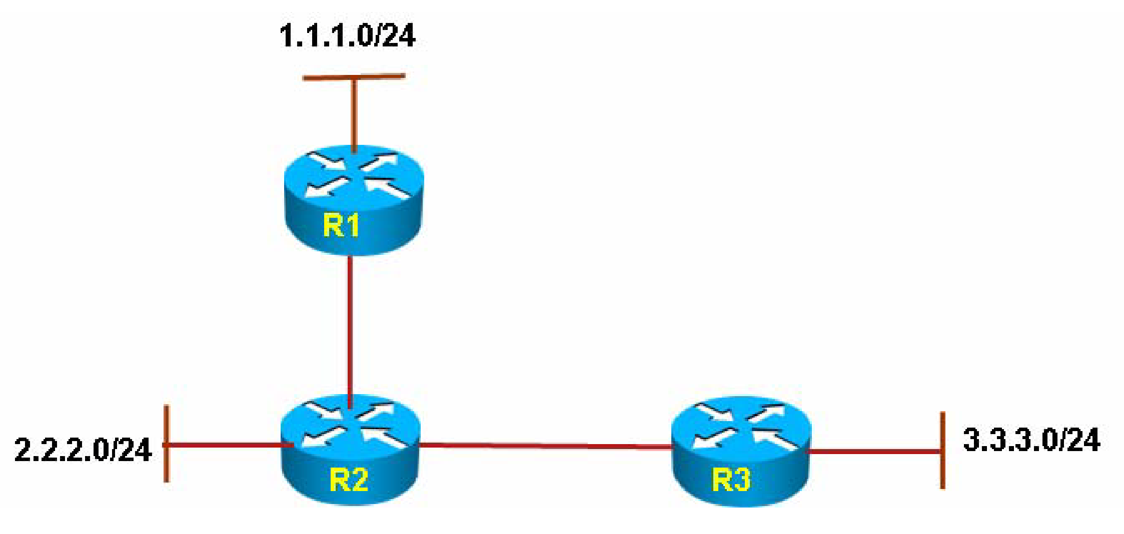
R2(config-router)#eigrp stub

注意观察R1/R3并没有对R2发送query

```
R2#debug eigrp packets query
*Mar  1 06:53:00.066: EIGRP: Enqueueing QUERY on Serial1/2 iidbQ un/rely 0/1 serno 39-39
*Mar  1 06:53:00.066: EIGRP: Enqueueing QUERY on Serial1/3 iidbQ un/rely 0/1 serno 39-39
*Mar  1 06:53:00.070: EIGRP: Enqueueing QUERY on Serial1/2 nbr 23.1.1.3 iidbQ un/rely 0/0 peerQ un/rely 0/0 serno 39-39
*Mar  1 06:53:00.070: EIGRP: Enqueueing QUERY on Serial1/3 nbr 12.1.1.1 iidbQ un/rely 0/0 peerQ un/rely 0/0 serno 39-39
*Mar  1 06:53:00.074: EIGRP: Sending QUERY on Serial1/2 nbr 23.1.1.3
*Mar  1 06:53:00.074:   AS 1, Flags 0x0, Seq 71/65 idbQ 0/0 iidbQ un/rely 0/0 peerQ un/rely 0/1 serno 39-39
*Mar  1 06:53:00.078: EIGRP: Sending QUERY on Serial1/3 nbr 12.1.1.1
```

LAB8：STUB命令参数测试

STUB Connect 命令测试



试验需求：

R1/R2运行**EIGRP**，**R2**做为**STUB**路由器，**R2**做静态路由指向**R3**的网络。同时**R2**对**R1**方向做汇总路由 **STUB**后面的参数只指定**eigrp stub connect .**测试有什么现象产生？

配置：

```
R2
interface Serial1/3
 ip address 12.1.1.2 255.255.255.0
 ip summary-address eigrp 1 2.2.0.0 255.255.248.0 5

router eigrp 1
 redistribute static metric 10000 100 255 1 1500  把静态路由重发布到EIGRP网络，以便EIGRP能够学习到路由
 network 2.2.2.0 0.0.0.255
 network 12.1.1.0 0.0.0.255
 no auto-summary
 eigrp stub connected
ip route 3.3.3.0 255.255.255.0 23.1.1.3
```

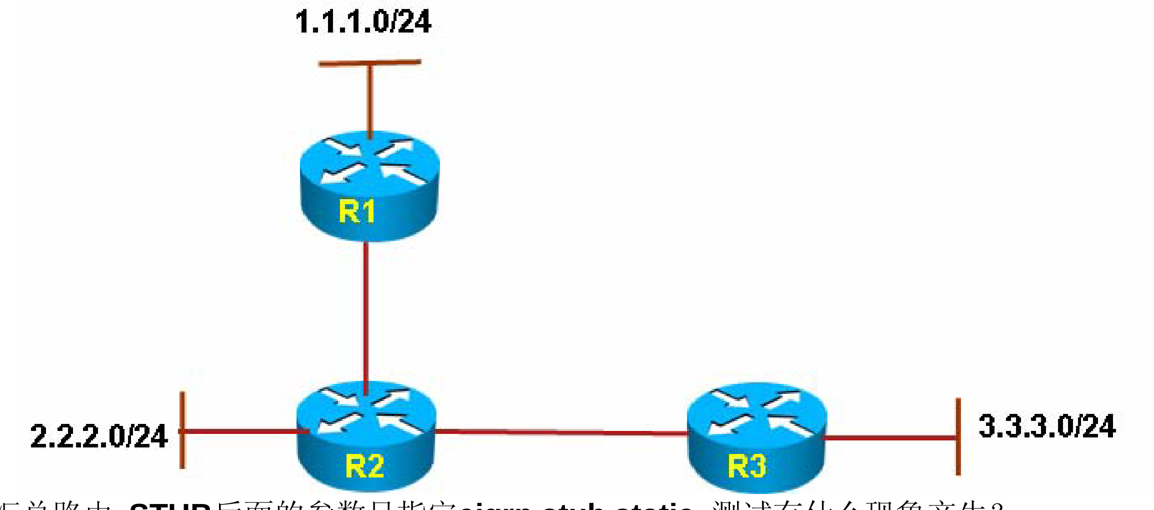
测试：**R1**并没有学习到关于**3.3.3.0**网络重发布到**EIGRP**的路由，**R2**只通告给**R1 2.2.2.0**的网络

```
R1#show ip route
Gateway of last resort is not set
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/24 is subnetted, 1 subnets
D       2.2.2.0 [90/2297856] via 12.1.1.2, 00:09:27, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

二：stub static 参数测试

试验需求：

R1/R2运行**EIGRP**，**R2**做为**STUB**路由器，**R2**做静态路由指向**R3**的网络。同时**R2**对**R1**方向做



汇总路由 **STUB**后面的参数只指定**eigrp stub static .**测试有什么现象产生？

配置：

R2

interface Serial1/3
ip address 12.1.1.2 255.255.255.0
ip summary-address eigrp 1 2.2.0.0 255.255.248.0 5

router eigrp 1
redistribute static metric 10000 100 255 1 1500
network 2.2.2.0 0.0.0.255
network 12.1.1.0 0.0.0.255
no auto-summary
eigrp stub static
ip route 3.3.3.0 255.255.255.0 23.1.1.3

检验：只收到R2重发布进来的路由

R1#show ip route
Gateway of last resort is not set
     1.0.0.0/24 is subnetted, 1 subnets
C   1.1.1.0 is directly connected, Loopback0
     3.0.0.0/24 is subnetted, 1 subnets
D EX   3.3.3.0 [170/2195456] via 12.1.1.2, 00:00:15, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C   12.1.1.0 is directly connected, Serial1/2

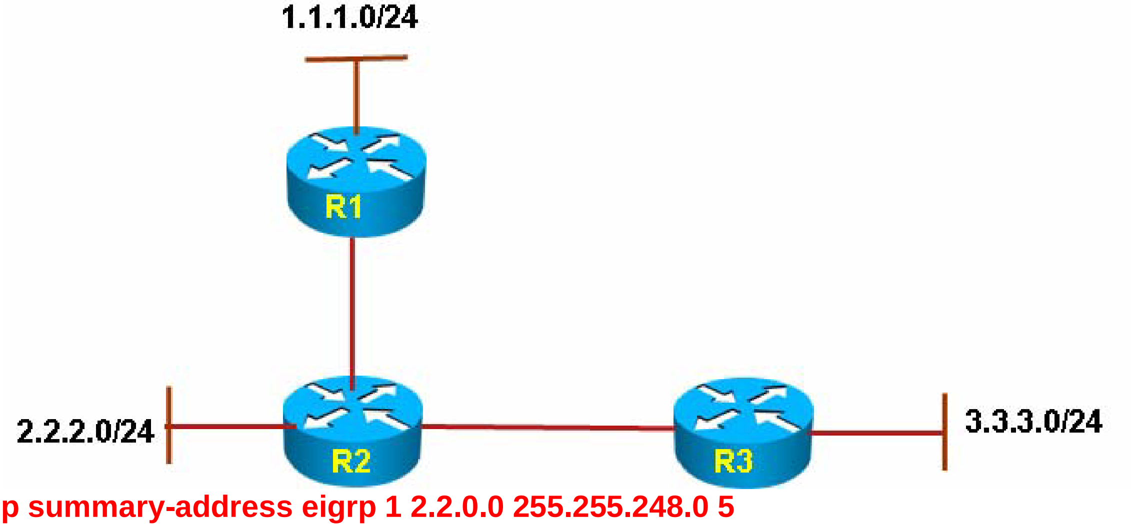
三：EIGRP receive-only参数测试

试验需求：

R1/R2运行EIGRP，R2做为STUB路由器，R2做静态路由指向R3的网络。同时R2对R1方向做汇总路由，STUB后面的参数只指定eigrp stub receive-only .测试有什么现象产生？

配置：

interface Serial1/3
 ip address 12.1.1.2 255.255.255.0



 ip summary-address eigrp 1 2.2.0.0 255.255.248.0 5

```
router eigrp 1
 redistribute static metric 10000 100 255 1 1500
 network 2.2.2.0 0.0.0.255
 network 12.1.1.0 0.0.0.255
 no auto-summary
 eigrp stub receive-only
ip route 3.3.3.0 255.255.255.0 23.1.1.3
```

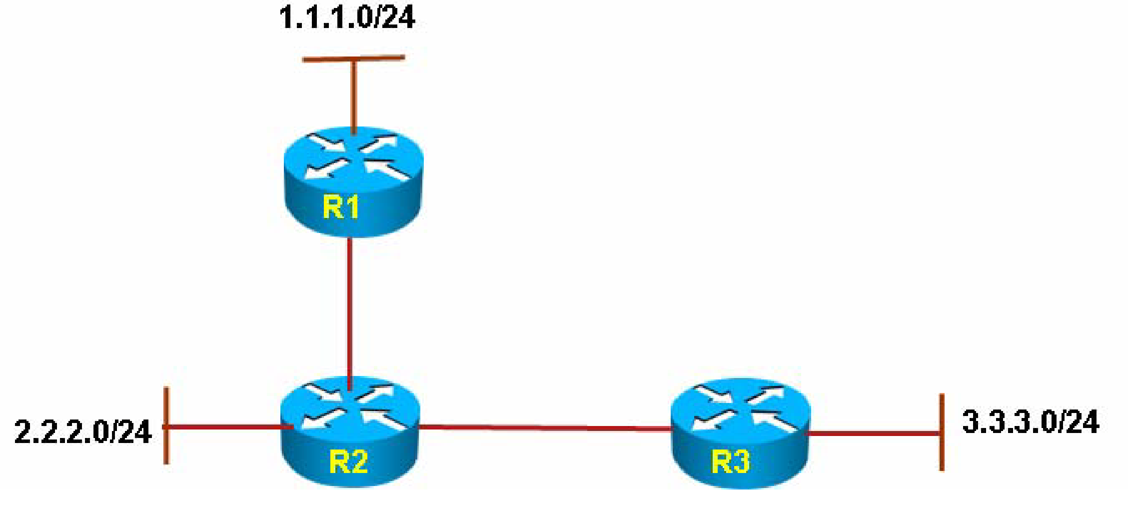
检验：**R1**没有收到任何关于**EIGRP**过来的路由

```
R1#show ip route
Gateway of last resort is not set
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

四EIGRP stub summary参数测试

试验需求：

R1/R2运行**EIGRP**，**R2**做为**STUB**路由器，**R2**做静态路由指向**R3**的网络。同时**R2**对**R1**方向做汇总路由，**STUB**后面的参数只指定**eigrp stub summary .**测试有什么现象产生？



配置：

R2

```
interface Serial1/3
 ip address 12.1.1.2 255.255.255.0
 ip summary-address eigrp 1 2.2.0.0 255.255.248.0 5
router eigrp 1
 redistribute static metric 10000 100 255 1 1500
 network 2.2.2.0 0.0.0.255
 network 12.1.1.0 0.0.0.255
 no auto-summary
 eigrp stub summary
ip route 3.3.3.0 255.255.255.0 23.1.1.3
```

检验：只收到**R2**发来的汇总

```
R1#show ip route
Gateway of last resort is not set
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/21 is subnetted, 1 subnets
D       2.2.0.0 [90/2297856] via 12.1.1.2, 00:00:03, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

总结：**STUB**选项

receive-only: 防止**STUB**路由器发送路由更新

connected: 允许**STUB**路由器发送直连路由信息

static : 允许**STUB**路由器发送重发布静态的路由
summary :允许**STUB**路由器发送汇总路由信息

通过以上测试我们发现，要让R1学习到R2发布过来的重发布路由，以及汇总路由。必须要加上如下参数

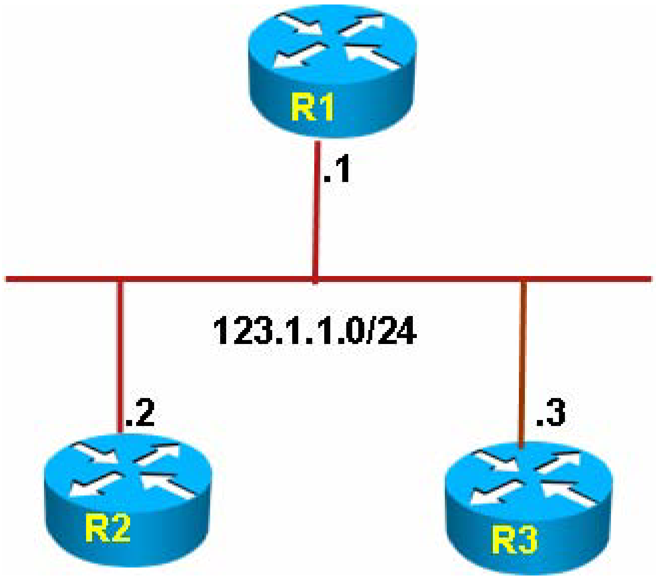
R2
eigrp stub connected static summary

Note:默认**STUB**选项后面是**connected** 和**summary**

OSPF分解试验部分

LAB1：OSPF DR选举测试试验

使用场合：



在以太网络中，如果OSPF路由器很多，那么他们更新LSA的次数要达到 $\frac{n(n-1)}{2}$ 次数，很明显，这样一个更新的次数浪费带宽，消耗路由器的开销，所以为了提高效率，我们要在整个ethernet网络中选择出一个DR，所有路由器向DR更新，提高效率。BDR作为DR备份的路由器。

试验需求：

测试**DR**选举，**DR**的选举规则如下：

Wait-time

优先级

Router-ID

基本配置：

```
R1
router ospf 1
 router-id 1.1.1.1
 log-adjacency-changes
 network 123.1.1.1 0.0.0.0 area 0
R2
router ospf 1
```

```
 router-id 2.2.2.2
 log-adjacency-changes
 network 123.1.1.2 0.0.0.0 area 0
```

R3

```
router ospf 1
 router-id 3.3.3.3
 log-adjacency-changes
 network 123.1.1.3 0.0.0.0 area 0
```

查看**DR,**从下面信息中我们看到**DR**是**R3**

```
R3#show ip os int e0/0
Ethernet0/0 is up, line protocol is up
  Internet Address 123.1.1.3/24, Area 0
  Process ID 1, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 3.3.3.3, Interface address 123.1.1.3
  Backup Designated router (ID) 2.2.2.2, Interface address 123.1.1.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:09
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 4 msec
  Neighbor Count is 2, Adjacent neighbor count is 2
    Adjacent with neighbor 1.1.1.1
    Adjacent with neighbor 2.2.2.2  (Backup Designated Router)
  Suppress hello for 0 neighbor(s)
```

那么我们测试是否是选择**Router-ID**最大的作为**DR**？

接下来我们清除**R3 OSPF**邻居，让它重新收敛。发现**DR**变为**R2**

R3＃clear ip ospf process

```
R3#show ip os int e0/0
Ethernet0/0 is up, line protocol is up
  Internet Address 123.1.1.3/24, Area 0
  Process ID 1, Router ID 3.3.3.3, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 2.2.2.2, Interface address 123.1.1.2
  Backup Designated router (ID) 3.3.3.3, Interface address 123.1.1.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
```

```
      oob-resync timeout 40
      Hello due in 00:00:06
    Supports Link-local Signaling (LLS)
    Index 1/1, flood queue length 0
    Next 0x0(0)/0x0(0)
    Last flood scan length is 0, maximum is 2
    Last flood scan time is 4 msec, maximum is 4 msec
    Neighbor Count is 2, Adjacent neighbor count is 2
      Adjacent with neighbor 1.1.1.1
      Adjacent with neighbor 2.2.2.2  (Designated Router)
    Suppress hello for 0 neighbor(s)
```

那么是否是先启动**OSPF**的路由器作为**DR**?

结论:

并不是先启动OSPF进程的路由器就是DR，而是有一个时间间隔让路由器来等待其他路由器，在这个时间间隔内，路由器相互监听Hello包中的DR和DBR字段中的信息，并且服从优先级原则。这个时间间隔和dead interval时间是相同的40S。

但是在实际的网络中，即使是40秒内同时起进程的情况也少见；实际情况下是率先启用ospf进程的路由器就很有可能成为DR，第二个启动的就很有可能成为BDR，所以这个地方可能很多人误解为先启动OSPF进程的路由器作为DR

总结:

如果**wait-time**时间内没有收到**HELLO**包，那么肯定是先配置的**OSPF**为**DR**，**DR**不抢占，所以不一定就是**router-id**大的是**DR**。

如果在**40S**时间内大家**OSPF**都起来了，那么一般就是**ROUTER-ID**大的是**DR**

接下来，更改优先级，**R1**为**255**，**R2**为**100**，**R3**默认**1**

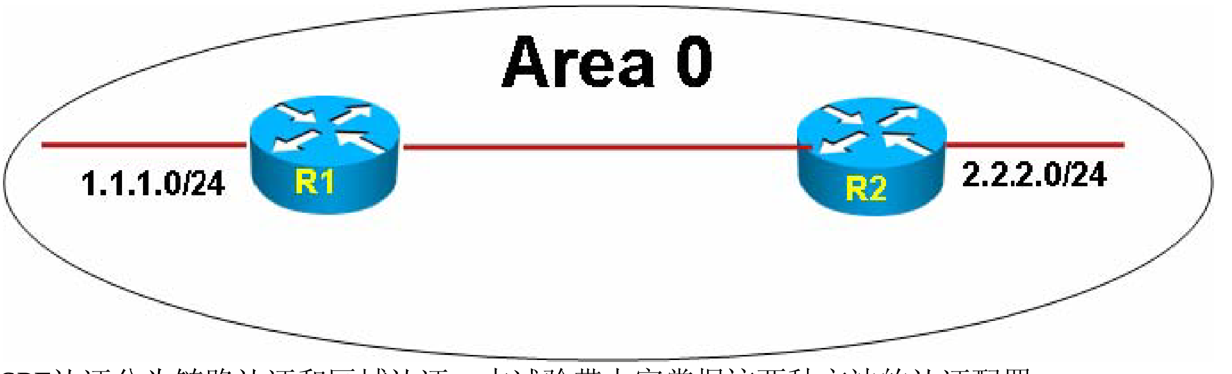
```
R1
interface Ethernet0/0
 ip address 123.1.1.1 255.255.255.0
 ip ospf priority 255
R2

R2(config-router)#int e0/0
R2(config-if)#ip os priority 100
```

查看**R1**现在是否为**DR**

```
R1#show ip os int e0/0
Ethernet0/0 is up, line protocol is up
  Internet Address 123.1.1.1/24, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State DR, Priority 255
  Designated Router (ID) 1.1.1.1, Interface address 123.1.1.1
  Backup Designated router (ID) 2.2.2.2, Interface address 123.1.1.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:02
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 2
  Last flood scan time is 0 msec, maximum is 4 msec
  Neighbor Count is 2, Adjacent neighbor count is 2
    Adjacent with neighbor 2.2.2.2  (Backup Designated Router)
    Adjacent with neighbor 3.3.3.3
  Suppress hello for 0 neighbor(s)
```

LAB2：OSPF认证

试验需求：



OSPF认证分为链路认证和区域认证，本试验带大家掌握这两种方法的认证配置。

1. 链路明文认证

配置

R1

interface Ethernet0/0

ip ospf authentication 启用**OSPF**认证

ip ospf authentication-key cisco 认证密钥**KEY**是**cisco**

R2同上

1. 链路密文认证

R1

interface Ethernet0/0

ip ospf authentication message-digest 启用基于**MD5**的认证

ip ospf message-digest-key 1 md5 cisco

R2同上

3．区域明文认证

R1

router ospf 1

router-id 1.1.1.1

area 0 authentication

network 123.1.1.1 0.0.0.0 area 0

interface Ethernet0/0

ip address 123.1.1.1 255.255.255.0
ip ospf authentication-key cisco

R2同上

4. 区域密文认证

R1
router ospf 1
router-id 1.1.1.1
area 0 authentication message-digest

interface Ethernet0/0
ip address 123.1.1.1 255.255.255.0
ip ospf message-digest-key 1 md5 cisco

密文认证比明文认证的优点：
密文认证在割接的时候可以很方便的不断网的情况下，平滑的替换密钥

测试：
R1/R2使用密文认证，替换密钥为**cisco123**

R1#show ip os in e0/0

```
Ethernet0/0 is up, line protocol is up
  Internet Address 123.1.1.1/24, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State DR, Priority 255
  Designated Router (ID) 1.1.1.1, Interface address 123.1.1.1
  Backup Designated router (ID) 2.2.2.2, Interface address 123.1.1.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:06
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 4
  Last flood scan time is 0 msec, maximum is 4 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 2.2.2.2  (Backup Designated Router)
  Suppress hello for 0 neighbor(s)
  Message digest authentication enabled
    Youngest key id is 1
```

目前使用的**key id**是**1**，那么密钥就是**cisco**

更改密钥

```
interface Ethernet0/0
 ip address 123.1.1.1 255.255.255.0
 ip ospf message-digest-key 1 md5 cisco
 ip ospf message-digest-key 2 md5 cisco123
```

查看现在认证情况

R1#show ip os int e0/0

```
Ethernet0/0 is up, line protocol is up
  Internet Address 123.1.1.1/24, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State DR, Priority 255
  Designated Router (ID) 1.1.1.1, Interface address 123.1.1.1
  Backup Designated router (ID) 2.2.2.2, Interface address 123.1.1.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:08
  Supports Link-local Signaling (LLS)
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 4
  Last flood scan time is 0 msec, maximum is 4 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 2.2.2.2  (Backup Designated Router)
  Suppress hello for 0 neighbor(s)
  Message digest authentication enabled
    Youngest key id is 2
```

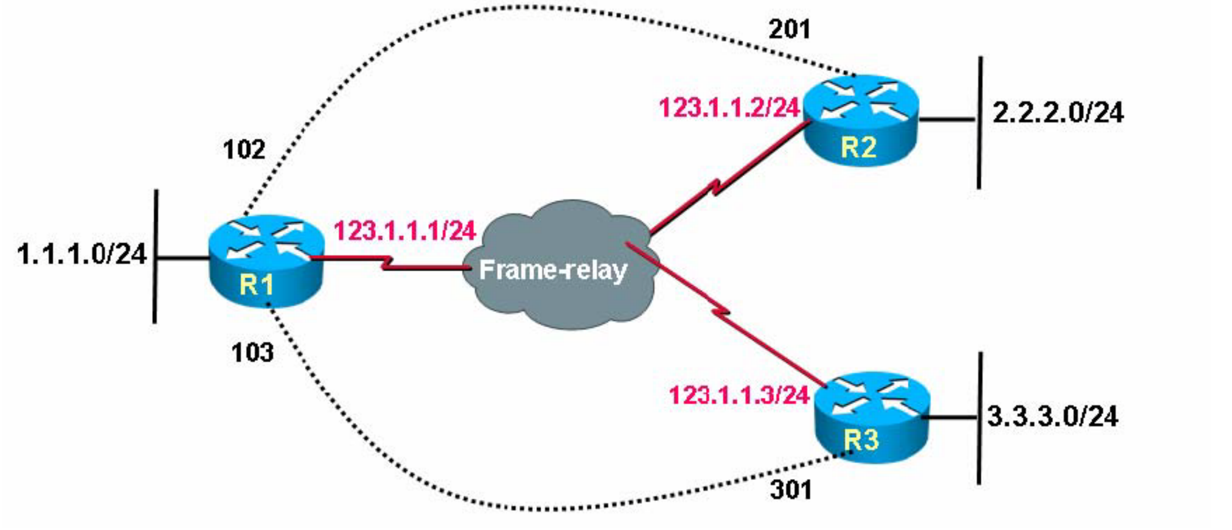
LAB3：OSPF各种网络类型试验

1．NBMA试验

网络类型	网络	Hello	邻居关系、是否选择DR和BDR
Broadcast	以太网	10s	自动建立邻居关系 有DR/BDR
Point-to-point	PPP、HDLC、帧中继p2p子接口	10s	自动建立邻居关系 无DR/BDR
NBMA	帧中继物理接口、mp子接口	30s	手工配置邻居关系 有DR/BDR
Point-to-multipoint	自定义	30s	自动建立邻居关系 无DR/BDR
Point-to-multipoint nonbroadcast	自定义	30s	手工配置邻居关系 无DR/BDR

试验需求：

Frame-relay使用物理接口，OSPF建立后，默认应该是NBMA网络类型。我们验证NBMA



中我们应该如何配置OSPF。

配置：

帧中继配置

R1

```
interface Serial1/0
 ip address 123.1.1.1 255.255.255.0
 encapsulation frame-relay
 serial restart-delay 0
 frame-relay map ip 123.1.1.3 103 broadcast        静态做DLCI和IP的映射
```

frame-relay map ip 123.1.1.2 102 broadcast
no frame-relay inverse-arp 关闭帧中继反向解析

R2
interface Serial1/0
ip address 123.1.1.2 255.255.255.0
encapsulation frame-relay
serial restart-delay 0
frame-relay map ip 123.1.1.1 201 broadcast
no frame-relay inverse-arp

R3
interface Serial1/0
ip address 123.1.1.3 255.255.255.0
encapsulation frame-relay
serial restart-delay 0
frame-relay map ip 123.1.1.1 301 broadcast
no frame-relay inverse-arp

OSPF配置部分
R1
router ospf 1
router-id 1.1.1.1
log-adjacency-changes
network 1.1.1.1 0.0.0.0 area 0
network 123.1.1.1 0.0.0.0 area 0

R2
router ospf 1
router-id 2.2.2.2
log-adjacency-changes
network 2.2.2.2 0.0.0.0 area 0
network 123.1.1.2 0.0.0.0 area 0

R3
router ospf 1
router-id 3.3.3.3
log-adjacency-changes
network 3.3.3.3 0.0.0.0 area 0
network 123.1.1.3 0.0.0.0 area 0

查看网络类型
R1#show ip ospf int serial 1/0

```
Serial1/0 is up, line protocol is up
  Internet Address 123.1.1.1/24, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type NON_BROADCAST, Cost: 64
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 3.3.3.3, Interface address 123.1.1.3
  Backup Designated router (ID) 1.1.1.1, Interface address 123.1.1.1
  Timer intervals configured, Hello 30, Dead 120, Wait 120, Retransmit 5
```

查看**OSPF**邻居，发现并没有看到邻居建立？为什么？

R1#show ip ospf neighbor

nbma中**2**层**FR**不支持广播能力，**HELLO**包无法发送。所以需要在**hub**端（**R8**）指定**neighbor**，发送单播**HELLO**给邻居。

配置

R1

router ospf 1

neighbor 123.1.1.2

neighbor 123.1.1.3

查看**R1/R2/R3**的邻居表

```
R1#show ip os neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
2.2.2.2           1   FULL/DROTHER    00:01:35    123.1.1.2       Serial1/0
3.3.3.3           1   FULL/DR         00:01:46    123.1.1.3       Serial1/0
```

```
R2#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1           1   FULL/BDR        00:01:57    123.1.1.1       Serial1/0
```

```
R3#show ip os neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
1.1.1.1           1   FULL/BDR        00:01:36    123.1.1.1       Serial1/0
```

仔细观察OSPF 的邻居表，会发现如下问题：

R1认为**R2**是**DRother , R3**是**DR**，自己是**BDR**

R2认为自己是**DR**，而**R1**是**BDR**

R3认为自己是**DR**，而**R1**是**DR**

现此问题的原因是因为Frame-Relay 的网络拓扑非全网状。R3 在与R1 在进行邻居创建时，R3 并不知道网络中还有R2 的存在。同时，R2 与R1 进行创建时，也不知道R3 的存在

进一步在观察路由表

```
R1#show ip route
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     3.0.0.0/32 is subnetted, 1 subnets
O       3.3.3.3 [110/65] via 123.1.1.3, 00:16:08, Serial1/0
     123.0.0.0/24 is subnetted, 1 subnets
C       123.1.1.0 is directly connected, Serial1/0
```

```
R2#show ip route
     2.0.0.0/24 is subnetted, 1 subnets
C       2.2.2.0 is directly connected, Loopback0
     123.0.0.0/24 is subnetted, 1 subnets
C       123.1.1.0 is directly connected, Serial1/0
```

```
R3#show ip route

    1.0.0.0/32 is subnetted, 1 subnets
O       1.1.1.1 [110/65] via 123.1.1.1, 00:17:04, Serial1/0
    3.0.0.0/24 is subnetted, 1 subnets
C       3.3.3.0 is directly connected, Loopback0
    123.0.0.0/24 is subnetted, 1 subnets
C       123.1.1.0 is directly connected, Serial1/0
```

以上我们发现，**DR**的认识在**R1/R2**之间并没有达成共识，但是**LSA**的通告必须遵守多路访问网络的更新规则，R1 默认会向DR 通告，所以R3肯定可以收到路由，但不会给R2通告，因为R1 作为BDR，只需要将LSA 通告给DR 即可，而做为DR 的R3 在收到R1 发送的LSA后，R3 实际上并没有向R2 通告，这是因为R3 并不知道网络中还有R2 的存在。

问题解决：

手工指定DR的角色，必须让HUB也就是R1做为DR，其他路由器作为DRother.

```
R1
interface Serial1/0
ip ospf priority 255


R2
interface Serial1/0
ip ospf priority 0

R3
interface Serial1/0
ip ospf priority 0
```

清除邻居关系，再次查看邻居关系和路由（省略）

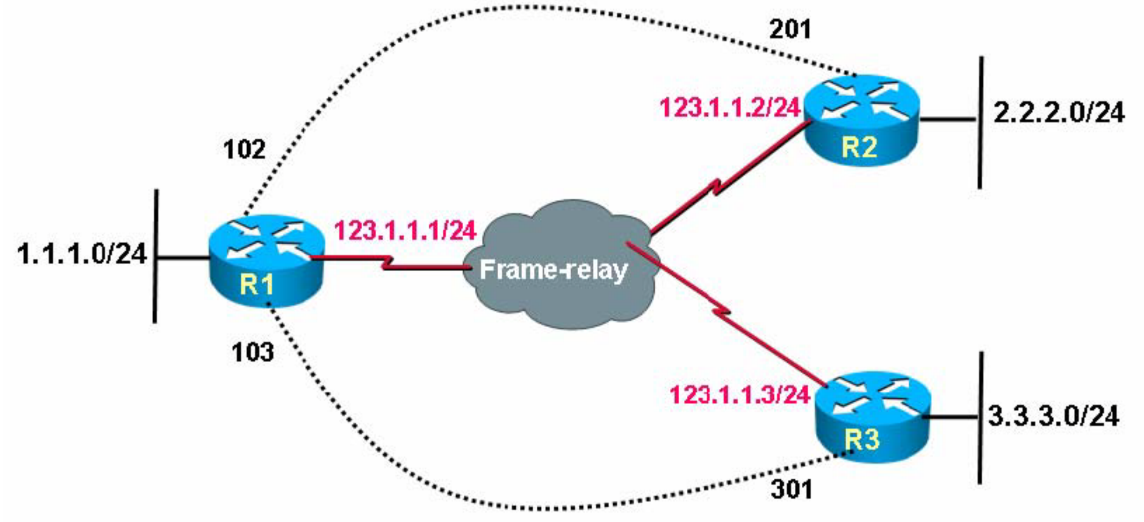
总结：

.

.

2．点对多点OSPF模式

使用场合：



上边的**NBMA**的配置方法，在实际工程中并不推荐使用，一是配置过于复杂，二是要选择**DR**，邻居建立慢，效率不高。建议使用点对多点模式。

配置：

R1/R2/R3

interface Serial1/0

ip ospf network point-to-multipoint

查看网络类型

查看路由表

```
R1#show ip os int s1/0
Serial1/0 is up, line protocol is up
  Internet Address 123.1.1.1/24, Area 0
  Process ID 1, Router ID 1.1.1.1, Network Type POINT_TO_MULTIPOINT, Cost: 64
  Transmit Delay is 1 sec, State POINT_TO_MULTIPOINT,
  Timer intervals configured, Hello 30, Dead 120, Wait 120, Retransmit 5
    oob-resync timeout 120
    Hello due in 00:00:03
```

```
R2#show ip route

     1.0.0.0/32 is subnetted, 1 subnets
O       1.1.1.1 [110/65] via 123.1.1.1, 00:01:54, Serial1/0
     2.0.0.0/24 is subnetted, 1 subnets
C       2.2.2.0 is directly connected, Loopback0
     3.0.0.0/32 is subnetted, 1 subnets
O       3.3.3.3 [110/129] via 123.1.1.1, 00:01:54, Serial1/0
     123.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
O       123.1.1.3/32 [110/128] via 123.1.1.1, 00:01:54, Serial1/0
O       123.1.1.1/32 [110/64] via 123.1.1.1, 00:01:54, Serial1/0
C       123.1.1.0/24 is directly connected, Serial1/0
```

LAB4：配置OSPF多区域

OSPF多区域是OSPF的精华部分之一，也是OSPF学习的难点之一，本试验带大家掌握多区域的概念，以及各种LSA类型的作用。

划分区域的优点：

1：减少路由表的大小

2：限制LSA的扩散

3:加快OSPF的收敛

4：增加OSPF的稳定性

多区域OSPF路由表类型

LSA类型表

Router Designator		Description
O	OSPF intra-area (router LSA) and network LSA	• Networks from within the area of the router • Advertised by way of router LSAs and network LSA
O IA	OSPF interarea (summary LSA)	• Networks from outside the area of the router, but within the OSPF autonomous system • Advertised by way of summary LSAs
O E1	Type 1 external routes	• Networks outside of the autonomous system of the router • Advertised by way of external LSAs
O E2	Type 2 external routes	

LSA Type	Description
1	Router LSAs
2	Network LSAs
3 or 4	Summary LSAs
5	Autonomous system external LSAs
6	Multicast OSPF LSA
7	Defined for not-so-stubby areas
8	External attributes LSA for Border Gateway Protocol (BGP)
9, 10, 11	Opaque LSAs

1. 查看类型一LSA，类型二LSA，和类型三LSA

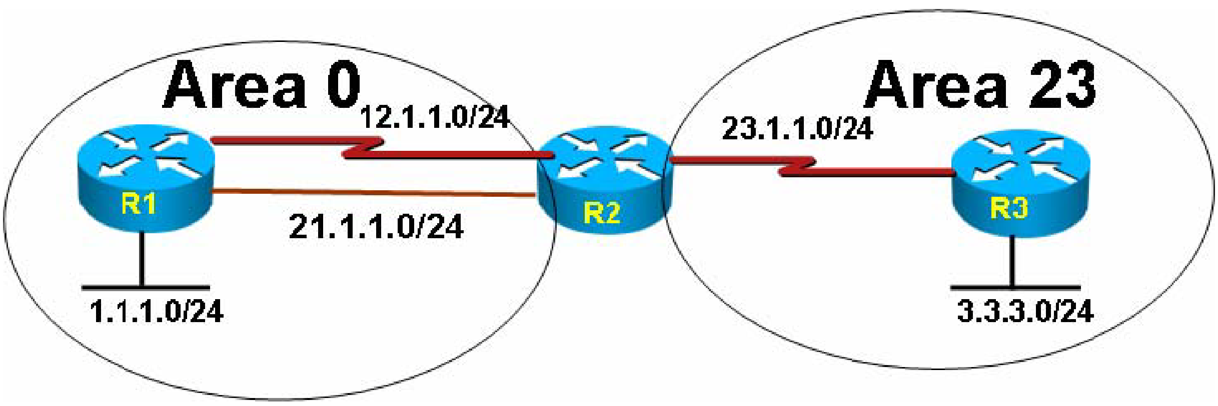
试验需求：

查看不同区域间的路由，以及掌握LSDB数据库的查看。

配置：

R1

```
router ospf 1
router-id 1.1.1.1
log-adjacency-changes
network 1.1.1.1 0.0.0.0 area 0
network 12.1.1.1 0.0.0.0 area 0
```



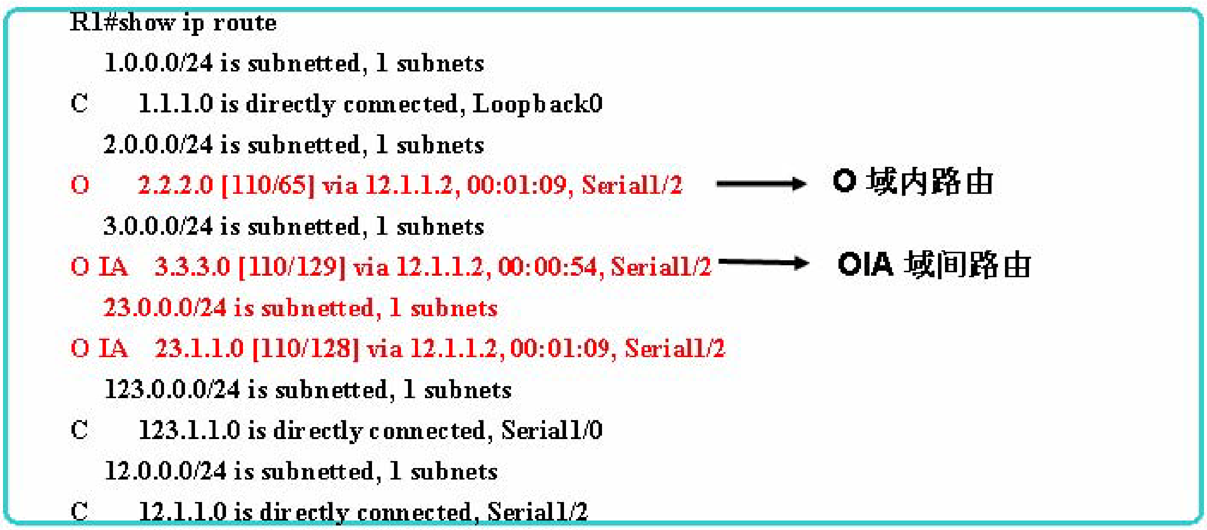
```
 network 21.1.1.1 0.0.0.0 area 0
```

```
R2
router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
 network 2.2.2.2 0.0.0.0 area 0
 network 12.1.1.2 0.0.0.0 area 0
 network 23.1.1.2 0.0.0.0 area 23
 network 21.1.1.1 0.0.0.0 area 0
```

```
R3
router ospf 1
 router-id 3.3.3.3
 log-adjacency-changes
 network 3.3.3.3 0.0.0.0 area 23
 network 23.1.1.3 0.0.0.0 area 23
```

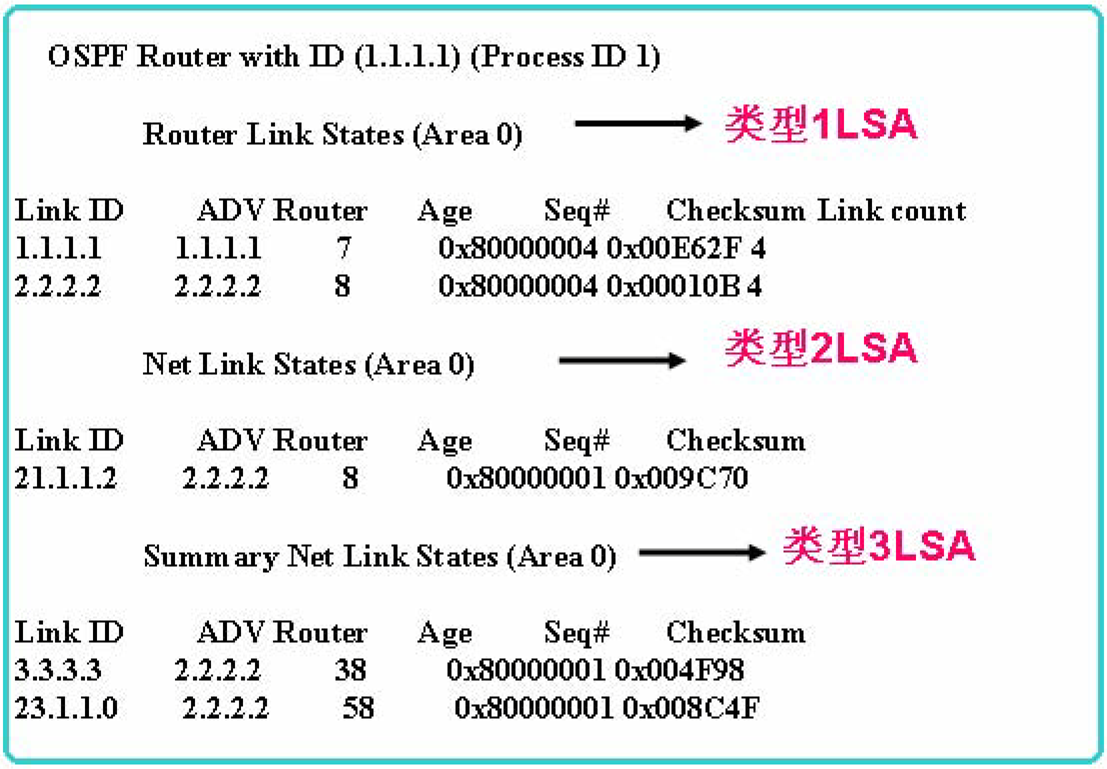
验证：

查看路由表



```
R1#show ip route
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/24 is subnetted, 1 subnets
O       2.2.2.0 [110/65] via 12.1.1.2, 00:01:09, Serial1/2
     3.0.0.0/24 is subnetted, 1 subnets
O IA    3.3.3.0 [110/129] via 12.1.1.2, 00:00:54, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 12.1.1.2, 00:01:09, Serial1/2
     123.0.0.0/24 is subnetted, 1 subnets
C       123.1.1.0 is directly connected, Serial1/0
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```


查看OSPF的链路状态数据库



类型一 LSA：

由每个区域内的每台路由器产生
包含了直连链路的列表以及其cost
每条链路由链路的IP前缀（网络号＋子网掩码）来标识
发送者标识：router ID
仅在该区域内部泛洪，不会穿越ABR

类型二LSA：

由络广播型多点访问网或NBMA网络中的DR产生
包含了连接到该链路的一组路由器的列表
包含了链路的子网掩码
仅在该区域内部泛洪，不会穿越ABR

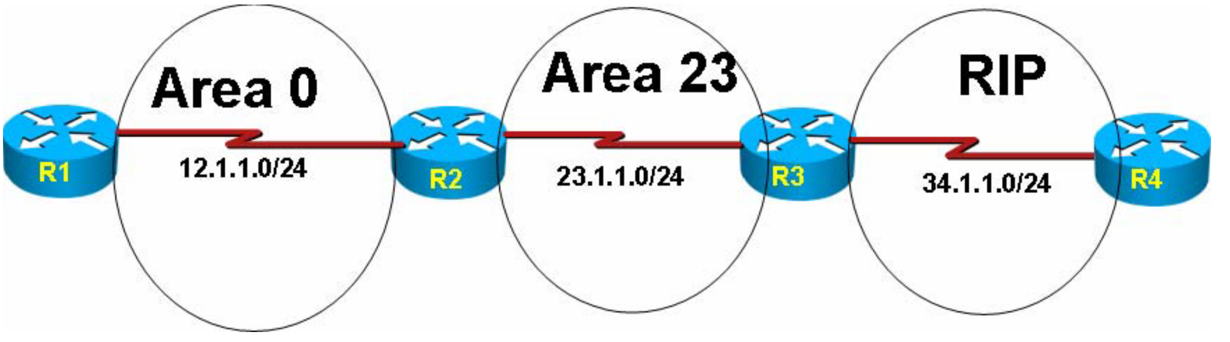
类型三LSA：

用于将本地区域的信息扩散到其他区域
描述链路的网络号和子网掩码

由ABR产生
类型3 LSA被泛洪到整个AS

查看类型四和类型五LSA

主要配置：

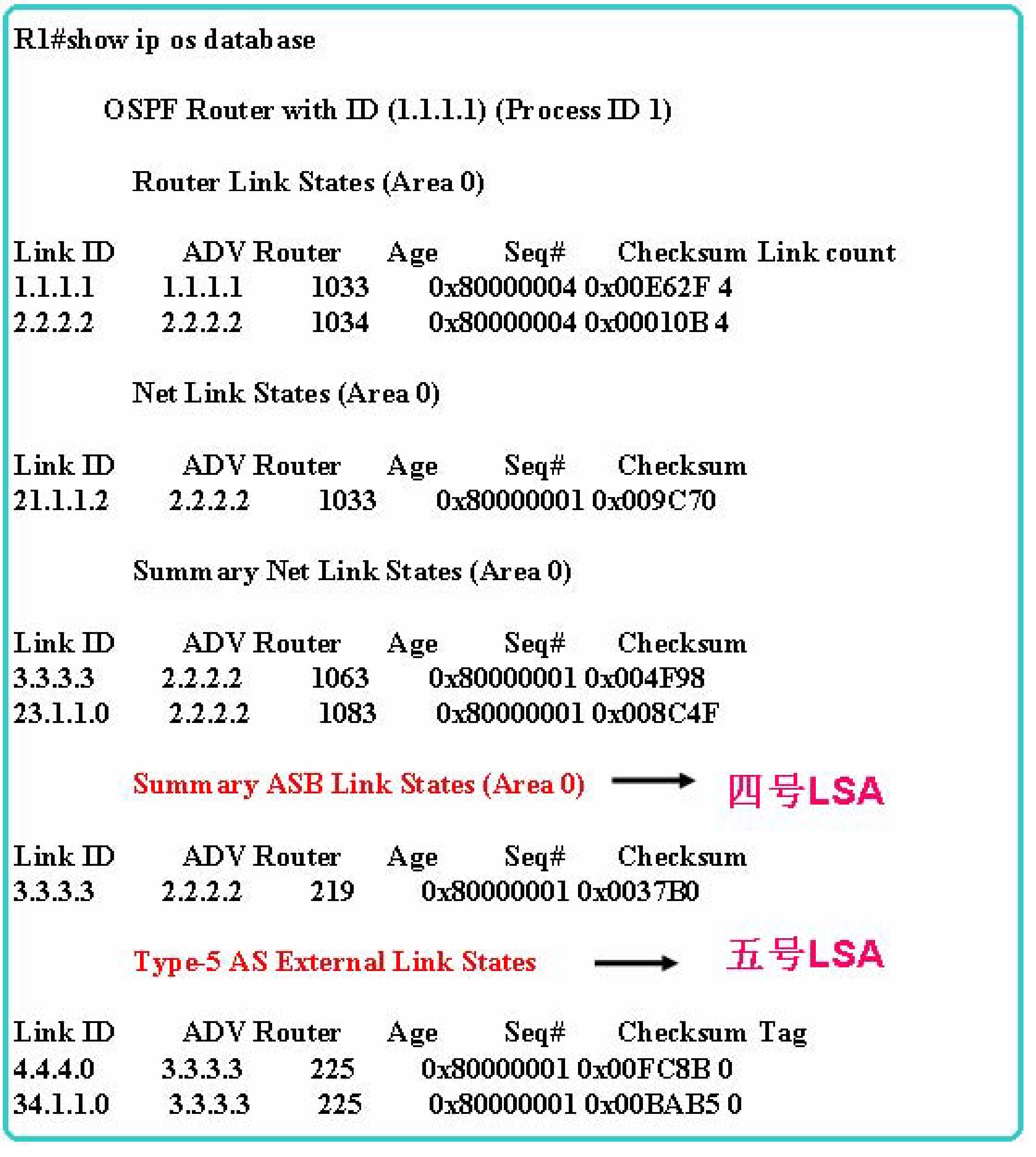


R3

```
router ospf 1
 router-id 3.3.3.3
 redistribute rip subnets  把RIP重发布到OSPF，以便OSPF能够学习到外部路由
 network 3.3.3.3 0.0.0.0 area 23
 network 23.1.1.3 0.0.0.0 area 23
!
router rip
 version 2
 passive-interface default
 no passive-interface Serial1/2
 network 34.0.0.0
 no auto-summary
```

验证：

```
R1#show ip route

     34.0.0.0/24 is subnetted, 1 subnets
O E2    34.1.1.0 [110/20] via 21.1.1.2, 00:02:50, Ethernet0/0
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/24 is subnetted, 1 subnets
O       2.2.2.0 [110/11] via 21.1.1.2, 00:16:24, Ethernet0/0
     3.0.0.0/32 is subnetted, 1 subnets
O IA    3.3.3.3 [110/75] via 21.1.1.2, 00:16:24, Ethernet0/0
     4.0.0.0/24 is subnetted, 1 subnets
O E2    4.4.4.0 [110/20] via 21.1.1.2, 00:02:50, Ethernet0/0
     21.0.0.0/24 is subnetted, 1 subnets
C       21.1.1.0 is directly connected, Ethernet0/0
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/74] via 21.1.1.2, 00:16:25, Ethernet0/0
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```



```
R1#show ip os database

          OSPF Router with ID (1.1.1.1) (Process ID 1)

             Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
1.1.1.1         1.1.1.1         1033        0x80000004 0x00E62F 4
2.2.2.2         2.2.2.2         1034        0x80000004 0x00010B 4

             Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
21.1.1.2        2.2.2.2         1033        0x80000001 0x009C70

             Summary Net Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum
3.3.3.3         2.2.2.2         1063        0x80000001 0x004F98
23.1.1.0        2.2.2.2         1083        0x80000001 0x008C4F

             Summary ASB Link States (Area 0)   ——>   四号LSA

Link ID         ADV Router      Age         Seq#       Checksum
3.3.3.3         2.2.2.2         219         0x80000001 0x0037B0

             Type-5 AS External Link States     ——>   五号LSA

Link ID         ADV Router      Age         Seq#       Checksum Tag
4.4.4.0         3.3.3.3         225         0x80000001 0x00FC8B 0
34.1.1.0        3.3.3.3         225         0x80000001 0x00BAB5 0
```

四号LSA：

类型4 LSA用于向其他区域描述某个ASBR
由每个区域的ABR产生
类型4 LSA被泛洪到整个AS
类型4 LSA中仅包含ASBR的router ID

五号LSA：

类型5 LSA用于描述到自治系统外部网络的路由
由ASBR产生
类型5 LSA被泛洪到整个AS
在AS内泛洪时，通告者（ASBR）的router ID一直保持不变
类型4 LSA被用来查找ASBR

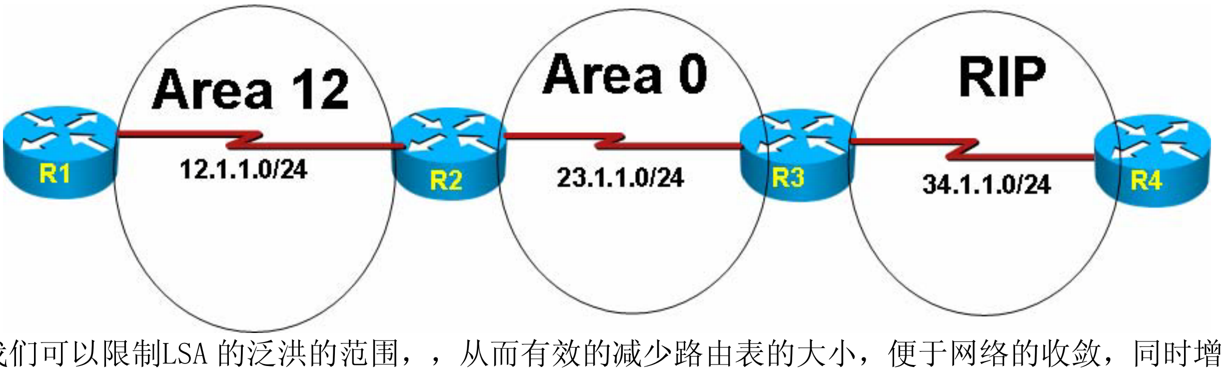
LAB5:OSPF STUB区域

试验需求：

AREA 12配置STUB区域，查看STUB区域的特点

适用场合：

在实际网络应用中，area 12并不需要学习到整个网络路由。过多的路由条目会导致路由器变大，不利用路由查询，同时也不利于网络的收敛。OSPF 网络路由是通过LSA 来进行通告。



我们可以限制LSA 的泛洪的范围，，从而有效的减少路由表的大小，便于网络的收敛，同时增强网络稳定性。

配置：

R1

```
router ospf 1
 router-id 1.1.1.1
 log-adjacency-changes
 network 1.1.1.1 0.0.0.0 area 12
 network 12.1.1.1 0.0.0.0 area 12
```

R2

```
router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
 network 2.2.2.2 0.0.0.0 area 0
 network 12.1.1.2 0.0.0.0 area 12
 network 23.1.1.2 0.0.0.0 area 0
```

R3

```
router ospf 1
 log-adjacency-changes
 redistribute rip subnets  重发布RIP进入OSPF
 network 3.3.3.3 0.0.0.0 area 0
 network 23.1.1.0 0.0.0.255 area 0
router rip
 passive-interface default
 no passive-interface Serial1/2
 network 34.0.0.0
```

R4

```
router rip
 version 2
 network 4.0.0.0
 network 34.0.0.0
 no auto-summary
```

查看路由表

```
R1#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
O E2    34.1.1.0 [110/20] via 12.1.1.2, 00:00:45, Serial1/2
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/24 is subnetted, 1 subnets
O IA    2.2.2.0 [110/65] via 12.1.1.2, 00:01:05, Serial1/2
     3.0.0.0/32 is subnetted, 1 subnets
O IA    3.3.3.3 [110/129] via 12.1.1.2, 00:01:02, Serial1/2
     4.0.0.0/24 is subnetted, 1 subnets
O E2    4.4.4.0 [110/20] via 12.1.1.2, 00:00:45, Serial1/2
     21.0.0.0/24 is subnetted, 1 subnets
C       21.1.1.0 is directly connected, Ethernet0/0
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 12.1.1.2, 00:01:06, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

查看OSPF 数据库

```
R1#show ip ospf database

        OSPF Router with ID (1.1.1.1) (Process ID 1)

          Router Link States (Area 12)  ———→  类型一LSA

Link ID       ADV Router     Age        Seq#       Checksum Link count
1.1.1.1       1.1.1.1        121        0x80000002 0x00144E 3
2.2.2.2       2.2.2.2        117        0x80000002 0x0098D7 2

          Summary Net Link States (Area 12)  ———→  类型三LSA

Link ID       ADV Router     Age        Seq#       Checksum
2.2.2.0       2.2.2.2        123        0x80000001 0x000F1F
3.3.3.3       2.2.2.2        108        0x80000001 0x004F98
23.1.1.0      2.2.2.2        118        0x80000001 0x008C4F

          Summary ASB Link States (Area 12)  ———→  类型四LSA

Link ID       ADV Router     Age        Seq#       Checksum
3.3.3.3       2.2.2.2        98         0x80000001 0x0037B0

          Type-5 AS External Link States  ———→  类型五LSA

Link ID       ADV Router     Age        Seq#       Checksum Tag
4.4.4.0       3.3.3.3        107        0x80000001 0x00FC8B 0
34.1.1.0      3.3.3.3        108        0x80000001 0x00BAB5 0
```

R1/R2 AREA 23配置为stub

router ospf 1

area 12 stub

配置area 12 区域为末节区域。同时需要注意的是：只要是从属于area 12 区域的OSPF 路由器，都需要配置此命令。

再次查看链路状态数据库

```
R1#show ip ospf database

          OSPF Router with ID (1.1.1.1) (Process ID 1)

             Router Link States (Area 12)

Link ID         ADV Router      Age         Seq#       Checksum Link count
1.1.1.1         1.1.1.1         11          0x80000004 0x002E34 3
2.2.2.2         2.2.2.2         10          0x80000004 0x00B2BD 2

             Summary Net Link States (Area 12)

Link ID         ADV Router      Age         Seq#       Checksum
0.0.0.0         2.2.2.2         14          0x80000001 0x0075C0
2.2.2.0         2.2.2.2         14          0x80000002 0x002B04
3.3.3.3         2.2.2.2         14          0x80000002 0x006B7D
23.1.1.0        2.2.2.2         14          0x80000002 0x00A834
```

我们发现LSA 4 5类型的LSA全部消失，那么没有这些LSA，R1如何访问外部网络？答案就是ABR路由器会向区域内部路由器发放默认路由。

```
R1#show ip route

Gateway of last resort is 12.1.1.2 to network 0.0.0.0

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/24 is subnetted, 1 subnets
O IA    2.2.2.0 [110/65] via 12.1.1.2, 00:00:00, Serial1/2
     3.0.0.0/32 is subnetted, 1 subnets
O IA    3.3.3.3 [110/129] via 12.1.1.2, 00:00:00, Serial1/2
     21.0.0.0/24 is subnetted, 1 subnets
C       21.1.1.0 is directly connected, Ethernet0/0
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 12.1.1.2, 00:00:00, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
O*IA 0.0.0.0/0 [110/65] via 12.1.1.2, 00:00:00, Serial1/2
```


STUB区域总结：

1.

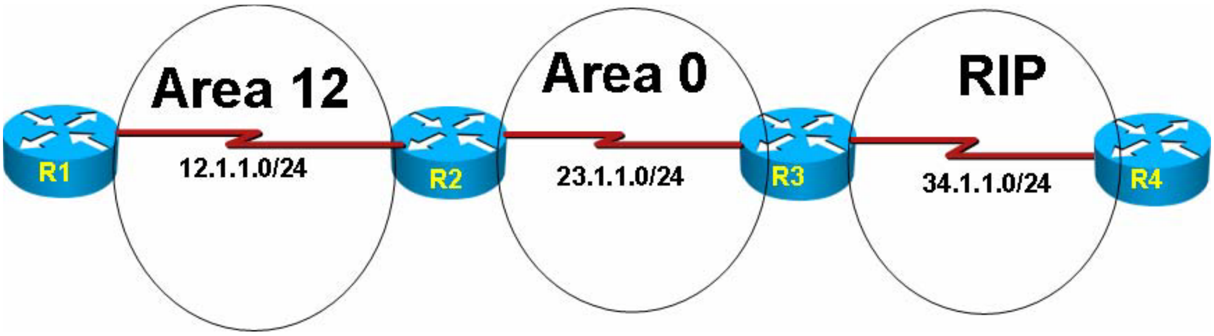
受**LSA 1 2 3** 拒绝**LSA 4 5 .**同时产生一条**LSA 3**的默认路由，即不知到的路由交给ABR。用于到达AS外部的区域

末梢区域内的所有路由器都要配置**STUB**

虚链路不能在一个**STUB**区域配置

STUB区域不能是**ASBR**路由器

LAB6:OSPF T-STUB区域



试验需求：

AREA 12配置T-STUB区域，查看T-STUB区域的特点

主要配置：

基本配置参照上一个试验

```
R2
router ospf 1
 router-id 2.2.2.2
```

area 12 stub no-summary 在**ABR**路由器上配置**T-STUB**

```
R1#sh ip route

Gateway of last resort is 12.1.1.2 to network 0.0.0.0

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     21.0.0.0/24 is subnetted, 1 subnets
C       21.1.1.0 is directly connected, Ethernet0/0
     20.0.0.0/24 is subnetted, 1 subnets
O       20.1.1.0 [110/65] via 12.1.1.2, 00:00:00, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
O*IA 0.0.0.0/0 [110/65] via 12.1.1.2, 00:00:00, Serial1/2
```

路由表可以看到**OIA**路由消失

查看链路状态数据库

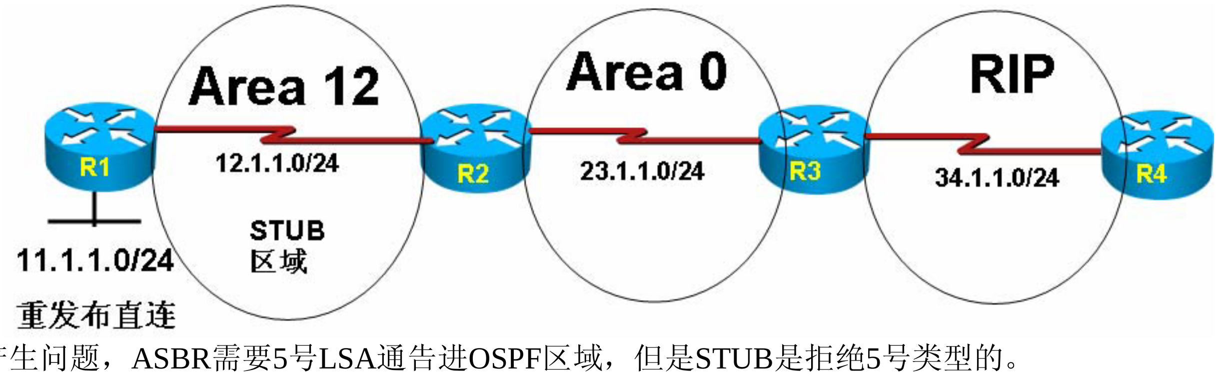
3号类型的具体LSA消失，取而代之的是ABR路由器向内部路由器发送了一条3号类型的LSA默认

```
R1#sh ip os da

         OSPF Router with ID (1.1.1.1) (Process ID 1)

            Router Link States (Area 12)

Link ID      ADV Router     Age       Seq#      Checksum Link count
1.1.1.1      1.1.1.1        702       0x80000004 0x002E34 3
2.2.2.2      2.2.2.2        92        0x80000005 0x007BCC 3

            Summary Net Link States (Area 12)

Link ID      ADV Router     Age       Seq#      Checksum
0.0.0.0      2.2.2.2        146       0x80000002 0x0073C1
```

LAB7 NSSA区域

使用场合：

R1身后有重发布进OSPF的外部网络，也就是说R1作为ASBR，同时也是STUB路由器，这样会



产生问题，ASBR需要5号LSA通告进OSPF区域，但是STUB是拒绝5号类型的。

所以我们需要把area 12改为NSSA区域，NSSA区域会把外部重发布进来的路由以7号类型通告进NSSA区域，同时在ABR路由器在进行7转5号类型通告到其他区域。

配置：

R1

route-map conn permit 10   用**Route-map**匹配需要重发布直连的接口

match interface Loopback1

router ospf 1

router-id 1.1.1.1

area 12 nssa

redistribute connected subnets route-map conn   重发布**R1**路由器的直连接口

R2

router ospf 1

router-id 2.2.2.2

area 12 nssa default-information-originate   **area 12**更改为**NSSA**，同时对内部区域发放默认

验证：

查看**R3**路由表

```
R3#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/2
     1.0.0.0/24 is subnetted, 1 subnets
O IA    1.1.1.0 [110/129] via 23.1.1.2, 00:04:20, Serial1/3
     2.0.0.0/24 is subnetted, 1 subnets
O       2.2.2.0 [110/65] via 23.1.1.2, 00:04:30, Serial1/3
     3.0.0.0/24 is subnetted, 1 subnets
C       3.3.3.0 is directly connected, Loopback0
     4.0.0.0/24 is subnetted, 1 subnets
R       4.4.4.0 [120/1] via 34.1.1.4, 00:00:15, Serial1/2
     20.0.0.0/24 is subnetted, 1 subnets
O IA    20.1.1.0 [110/65] via 23.1.1.2, 00:04:30, Serial1/3
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
     11.0.0.0/24 is subnetted, 1 subnets
O E2    11.1.1.0 [110/20] via 23.1.1.2, 00:02:37, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
O IA    12.1.1.0 [110/128] via 23.1.1.2, 00:04:30, Serial1/3
```

查看**R1**链路状态数据库

```
R1#show ip ospf database

        OSPF Router with ID (1.1.1.1) (Process ID 1)

            Router Link States (Area 12)

Link ID      ADV Router     Age      Seq#       Checksum Link count
1.1.1.1      1.1.1.1        421      0x8000000B 0x00ADA3 3
2.2.2.2      2.2.2.2        424      0x8000000A 0x00FE3A 3

            Summary Net Link States (Area 12)

Link ID      ADV Router     Age      Seq#       Checksum
2.2.2.0      2.2.2.2        434      0x80000002 0x00B274
3.3.3.3      2.2.2.2        434      0x80000002 0x00F2ED
23.1.1.0     2.2.2.2        434      0x80000002 0x0030A4

            Type-7 AS External Link States (Area 12)

Link ID      ADV Router     Age      Seq#       Checksum Tag
0.0.0.0      2.2.2.2        434      0x80000001 0x00D0D8 0
11.1.1.0     1.1.1.1        314      0x80000001 0x00C0C0 0
```

→ 重发布进来的路由OSPF以LSA7进来

同时我们注意到，**R1**做为**NSSA**区域的路由器，拒绝了**4**，**5**类**LSA**

查看**R2**的链路状态数据库

```
R2#show ip os da

        OSPF Router with ID (2.2.2.2) (Process ID 1)

            Router Link States (Area 0)

Link ID      ADV Router     Age       Seq#        Checksum
Link count
2.2.2.2      2.2.2.2        597       0x80000008 0x00A092 3
3.3.3.3      3.3.3.3        1240      0x80000004 0x000C21 3

            Summary Net Link States (Area 0)

Link ID      ADV Router     Age       Seq#        Checksum
1.1.1.0      2.2.2.2        582       0x80000001 0x00B53B
12.1.1.0     2.2.2.2        1197      0x80000003 0x0018CC
20.1.1.0     2.2.2.2        1949      0x80000002 0x0039E3

            Router Link States (Area 12)

Link ID      ADV Router     Age       Seq#        Checksum
Link count
1.1.1.1      1.1.1.1        587       0x8000000B 0x00ADA3 3
2.2.2.2      2.2.2.2        587       0x8000000A 0x00FE3A 3

            Summary Net Link States (Area 12)

Link ID      ADV Router     Age       Seq#        Checksum
2.2.2.0      2.2.2.2        597       0x80000002 0x00B274
3.3.3.3      2.2.2.2        598       0x80000002 0x00F2ED
23.1.1.0     2.2.2.2        598       0x80000002 0x0030A4

            Type-7 AS External Link States (Area 12)

Link ID      ADV Router     Age       Seq#        Checksum
Tag
0.0.0.0      2.2.2.2        598       0x80000001 0x00D0D8 0
11.1.1.0     1.1.1.1        480       0x80000001 0x00C0C0 0

            Type-5 AS External Link States

Link ID      ADV Router     Age       Seq#        Checksum
Tag
4.4.4.0      3.3.3.3        1241      0x80000003 0x00F88D 0
11.1.1.0     2.2.2.2        479       0x80000001 0x003750 0
34.1.1.0     3.3.3.3        1241      0x80000003 0x00B6B7 0
```

我们可以看到，**R2**做为**ABR**路由器执行了**LSA7**转**5**的操作。

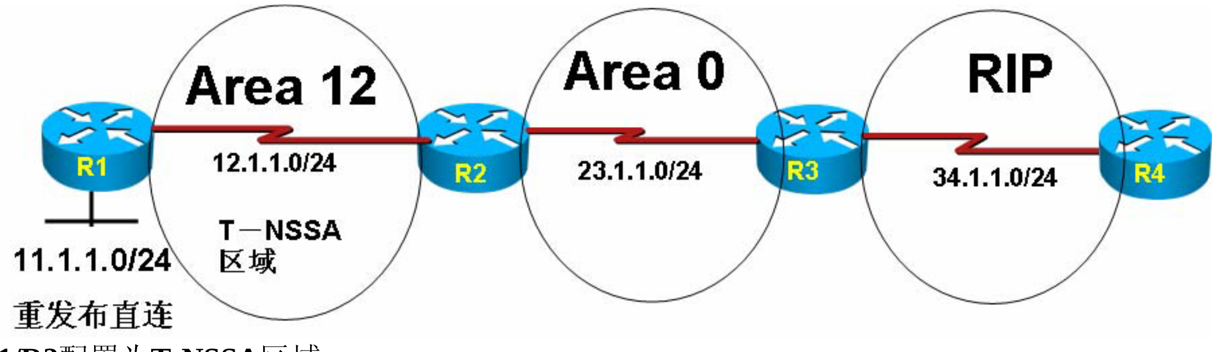
总结：

1.NSSA区域拒绝**LSA 4，5**类型，允许**LSA 1,2,3,7**类型

2. 必须要在**ABR**上配置**default-information-originate**参数，以便内部区域能够访问外部网络

LAB8：Total NSSA区域

需求：



R1/R2配置为**T-NSSA**区域

配置：

R2

router ospf 1
router-id 2.2.2.2
area 12 nssa no-summary

R1

router ospf 1
router-id 1.1.1.1
area 12 nssa

R3

router ospf 1
router-id 3.3.3.3
redistribute rip subnets
router rip
version 2
network 34.0.0.0
no auto-summary

验证：

路由表中只有**O**路由和**OIA**默认，没有**OIA**域间路由和**OE2**的外部路由。

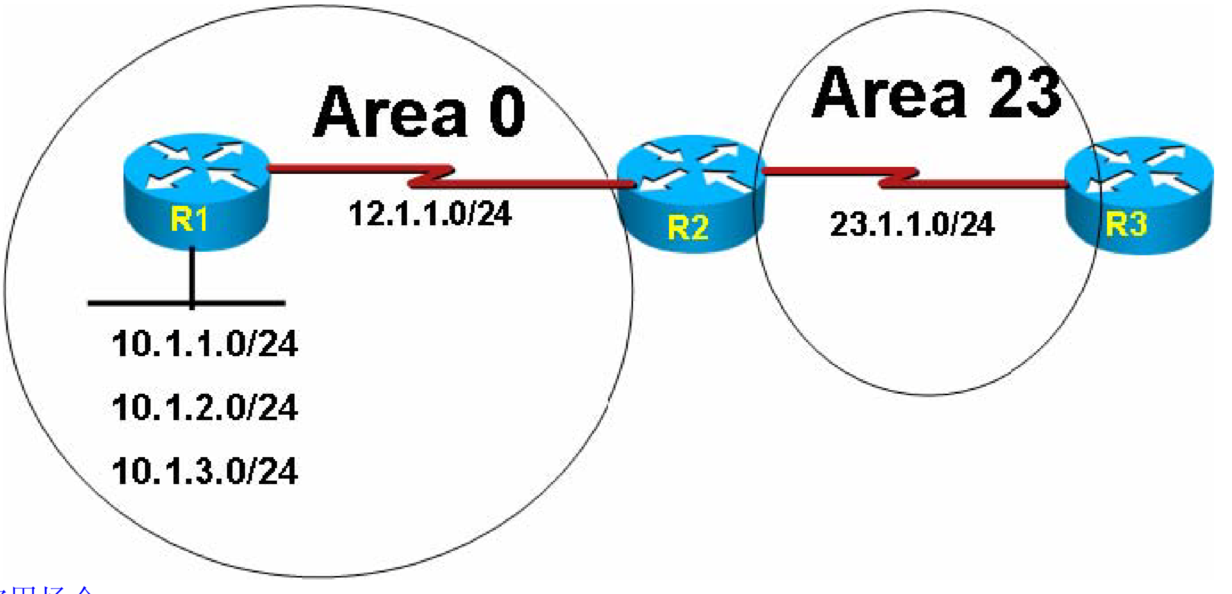
```
R1#show ip route

Gateway of last resort is 12.1.1.2 to network 0.0.0.0

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     21.0.0.0/24 is subnetted, 1 subnets
C       21.1.1.0 is directly connected, Ethernet0/0
     20.0.0.0/24 is subnetted, 1 subnets
O       20.1.1.0 [110/65] via 12.1.1.2, 00:21:14, Serial1/2
     11.0.0.0/24 is subnetted, 1 subnets
C       11.1.1.0 is directly connected, Loopback1
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
O*IA 0.0.0.0/0 [110/65] via 12.1.1.2, 00:00:05, Serial1/2
```

查看**R1**的链路状态数据库

```
R1#show ip ospf database

            OSPF Router with ID (1.1.1.1) (Process ID 1)

                Router Link States (Area 12)

Link ID         ADV Router      Age         Seq#       Checksum Link count
1.1.1.1         1.1.1.1         174         0x80000005 0x00FE5A 3
2.2.2.2         2.2.2.2         76          0x80000005 0x000935 3

                Summary Net Link States (Area 12)

Link ID         ADV Router      Age         Seq#       Checksum
0.0.0.0         2.2.2.2         187         0x80000001 0x00FC31
```

总结：**T-NSSA**拒绝**LSA 3,4,5** 允许**LSA 1,2,7**

LAB9：OSPF域间路由汇总



实用场合：

一般在大型网络部署中，作为HUB点的路由器，会从Spoke端收到很多的路由。这样导致HUB点的路由表过大，查表缓慢，并且消耗路由器资源，为了减少路由表大小。加快收敛速度，我们需要设计良好的IP地址规划，便于做路由聚合技术。

需求：

Area 0的路由要求进行汇总，在R3路由器上看到只有一条关于area 0路由的汇总。

基本配置：

R1

```
router ospf 1
 router-id 1.1.1.1
network 10.1.1.0 0.0.0.255 area 0
 network 10.1.2.0 0.0.0.255 area 0
 network 10.1.3.0 0.0.0.255 area 0
 network 12.1.1.1 0.0.0.0 area 0
```

R2

```
router ospf 1
 router-id 2.2.2.2
network 12.1.1.2 0.0.0.0 area 0
```

```
 network 23.1.1.2 0.0.0.0 area 23
R3
router ospf 1
 router-id 3.3.3.3
 log-adjacency-changes
 network 23.1.1.3 0.0.0.0 area 23
```

查看路由表

在**ABR**上进行路由汇总：

R2

```
router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
```

```
R3#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/2
     3.0.0.0/24 is subnetted, 1 subnets
C       3.3.3.0 is directly connected, Loopback0
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
     10.0.0.0/24 is subnetted, 3 subnets
O IA    10.1.3.0 [110/129] via 23.1.1.2, 00:03:55, Serial1/3
O IA    10.1.2.0 [110/129] via 23.1.1.2, 00:03:55, Serial1/3
O IA    10.1.1.0 [110/129] via 23.1.1.2, 00:03:55, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
O IA    12.1.1.0 [110/128] via 23.1.1.2, 00:03:55, Serial1/3
```

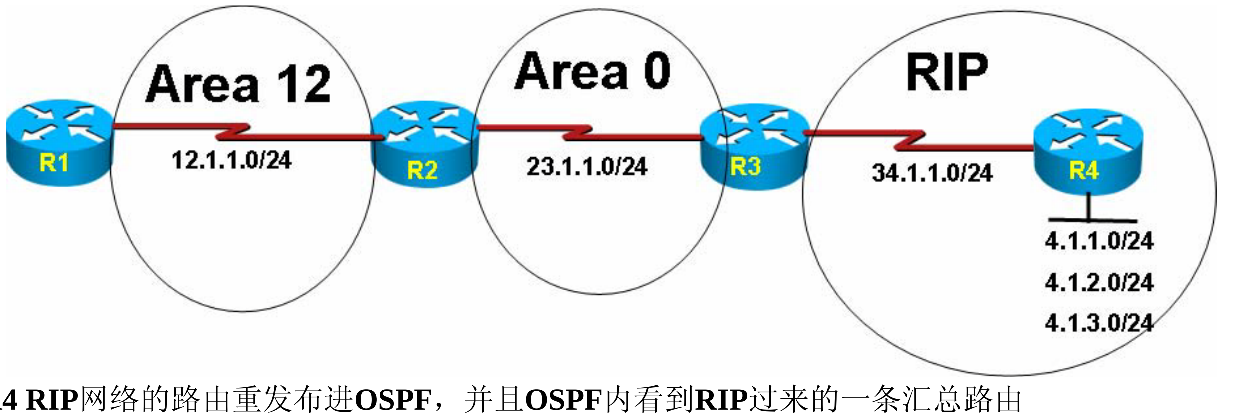
```
 area 0 range 10.1.0.0 255.255.252.0
```

在**R3**再次查看路由表

```
R3#show ip route

Gateway of last resort is not set

    34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/2
    3.0.0.0/24 is subnetted, 1 subnets
C       3.3.3.0 is directly connected, Loopback0
    23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
    10.0.0.0/22 is subnetted, 1 subnets
O IA    10.1.0.0 [110/129] via 23.1.1.2, 00:00:45, Serial1/3
    12.0.0.0/24 is subnetted, 1 subnets
O IA    12.1.1.0 [110/128] via 23.1.1.2, 00:06:16, Serial1/3
```

LAB10：OSPF外部路由汇总

需求：



R4 RIP网络的路由重发布进**OSPF**，并且**OSPF**内看到**RIP**过来的一条汇总路由

主要配置：

R3

router ospf 1
router-id 3.3.3.3
log-adjacency-changes
redistribute rip subnets
network 23.1.1.3 0.0.0.0 area 23

```
!
router rip
 version 2
 network 34.0.0.0
 no auto-summary
```

查看路由表

在**ASBR**路由器进行外部路由汇总

R3

```
router ospf 1
```

```
R1#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
O E2    34.1.1.0 [110/20] via 12.1.1.2, 00:00:56, Serial1/2
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     4.0.0.0/24 is subnetted, 4 subnets
O E2    4.4.4.0 [110/20] via 12.1.1.2, 00:00:56, Serial1/2
O E2    4.1.1.0 [110/20] via 12.1.1.2, 00:00:56, Serial1/2
O E2    4.1.3.0 [110/20] via 12.1.1.2, 00:00:56, Serial1/2
O E2    4.1.2.0 [110/20] via 12.1.1.2, 00:00:56, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 12.1.1.2, 00:17:30, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

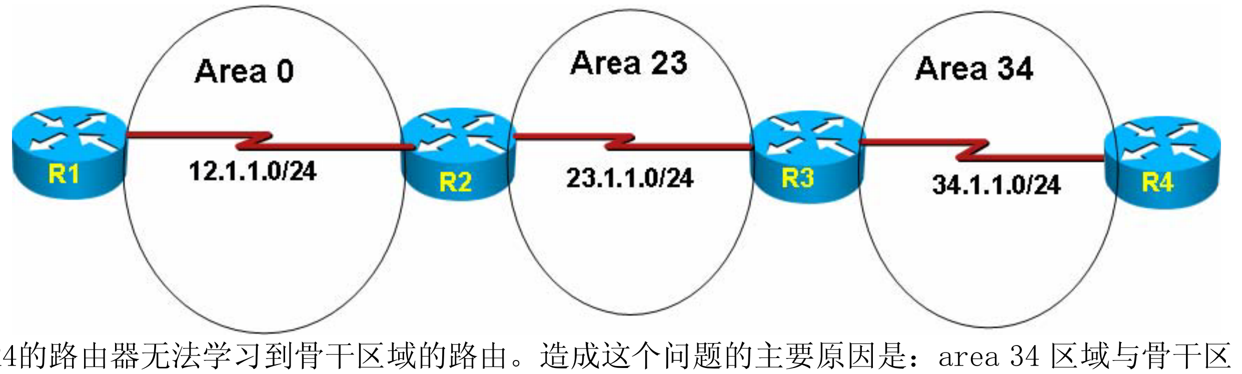
```
 router-id 3.3.3.3
 log-adjacency-changes
 summary-address 4.1.0.0 255.255.252.0
 redistribute rip subnets
 network 23.1.1.3 0.0.0.0 area 23
```

再次确认路由表

```
R1#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
O E2    34.1.1.0 [110/20] via 12.1.1.2, 00:03:10, Serial1/2
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     4.0.0.0/22 is subnetted, 1 subnets
O E2    4.1.0.0 [110/20] via 12.1.1.2, 00:01:06, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 12.1.1.2, 00:19:45, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

LAB11：OSPF virtual-link

使用场合：



R4的路由器无法学习到骨干区域的路由。造成这个问题的主要原因是：area 34 区域与骨干区域area 0 被分割。OSPF 的区域配置规则是：普通区域必须与骨干区域直连。当有这种问题出现时，可以使用虚链路的配置方案解决。使用虚链路可以确保非直连区域能够逻辑认为自己与骨干区域直连。但是我们要注意。此类问题一般都是由于网络迁移或是本身设计问题所造成的。OSPF 的虚链路仅仅是一种网络过渡的解决方案。

基本配置：

R1

```
router ospf 1
 router-id 1.1.1.1
 log-adjacency-changes
 network 1.1.1.1 0.0.0.0 area 0
 network 12.1.1.1 0.0.0.0 area 0
```

R2

```
router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
 network 2.2.2.2 0.0.0.0 area 0
 network 12.1.1.2 0.0.0.0 area 0
 network 23.1.1.2 0.0.0.0 area 23
```

R3

```
router ospf 1
 router-id 3.3.3.3
 log-adjacency-changes
 network 3.3.3.3 0.0.0.0 area 23
 network 23.1.1.3 0.0.0.0 area 23
 network 34.1.1.3 0.0.0.0 area 34
```

R4

```
router ospf 1
 router-id 4.4.4.4
 log-adjacency-changes
 network 4.4.4.4 0.0.0.0 area 34
 network 34.1.1.4 0.0.0.0 area 34
```

查看路由表

```
R1#show ip route

Gateway of last resort is not set

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/32 is subnetted, 1 subnets
O       2.2.2.2 [110/65] via 12.1.1.2, 00:03:30, Serial1/2
     3.0.0.0/24 is subnetted, 1 subnets
O IA    3.3.3.0 [110/129] via 12.1.1.2, 00:03:12, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 12.1.1.2, 00:03:30, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

```
R4#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/3
     4.0.0.0/24 is subnetted, 1 subnets
C       4.4.4.0 is directly connected, Loopback0
```

R1R4都没有关于对方的路由。

配置virtual-link

R2

```
router ospf 1
 router-id 2.2.2.2
area 23 virtual-link 3.3.3.3    IP地址为对方的router-id
```

```
R3
router ospf 1
 router-id 3.3.3.3
area 23 virtual-link 2.2.2.2    IP地址为对方的router-id
```

检查virtual-link是否起来

检查R1/R4路由表

```
R2#show ip os virtual-links
Virtual Link OSPF_VL0 to router 3.3.3.3 is up
  Run as demand circuit
  DoNotAge LSA allowed.
  Transit area 23, via interface Serial1/2, Cost of using 64
  Transmit Delay is 1 sec, State POINT_TO_POINT,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit
5
    Hello due in 00:00:05
    Adjacency State FULL (Hello suppressed)
    Index 2/3, retransmission queue length 0, number of
retransmission 0
    First 0x0(0)/0x0(0) Next 0x0(0)/0x0(0)
    Last retransmission scan length is 0, maximum is 0
    Last retransmission scan time is 0 msec, maximum is 0 msec
```

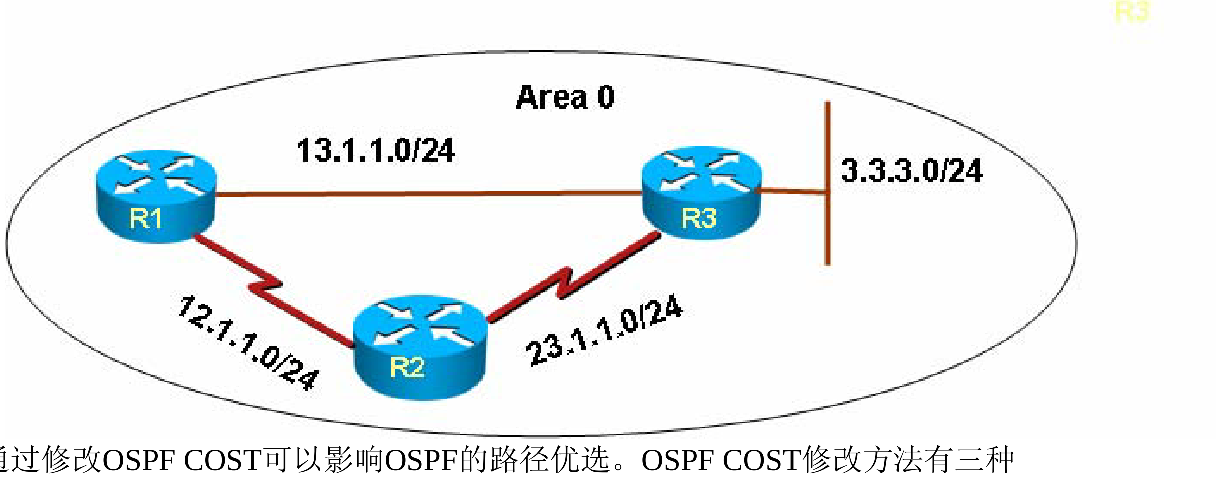
```
R1#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
O IA    34.1.1.0 [110/192] via 12.1.1.2, 00:02:24, Serial1/2
     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     2.0.0.0/32 is subnetted, 1 subnets
O       2.2.2.2 [110/65] via 12.1.1.2, 00:02:24, Serial1/2
     3.0.0.0/24 is subnetted, 1 subnets
O IA    3.3.3.0 [110/129] via 12.1.1.2, 00:02:24, Serial1/2
     4.0.0.0/24 is subnetted, 1 subnets
O IA    4.4.4.0 [110/193] via 12.1.1.2, 00:02:24, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 12.1.1.2, 00:02:24, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

R1已经学习到区域34的路由

```
R4#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/3
     1.0.0.0/24 is subnetted, 1 subnets
O IA    1.1.1.0 [110/193] via 34.1.1.3, 00:03:17, Serial1/3
     2.0.0.0/32 is subnetted, 1 subnets
O IA    2.2.2.2 [110/129] via 34.1.1.3, 00:03:17, Serial1/3
     3.0.0.0/24 is subnetted, 1 subnets
O IA    3.3.3.0 [110/65] via 34.1.1.3, 00:03:27, Serial1/3
     4.0.0.0/24 is subnetted, 1 subnets
C       4.4.4.0 is directly connected, Loopback0
     23.0.0.0/24 is subnetted, 1 subnets
O IA    23.1.1.0 [110/128] via 34.1.1.3, 00:03:27, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
O IA    12.1.1.0 [110/192] via 34.1.1.3, 00:03:17, Serial1/3
```

LAB12：OSPF cost修改

使用场合：



通过修改OSPF COST可以影响OSPF的路径优选。OSPF COST修改方法有三种
1.

修改接口带宽

接口下ip ospf cost 命令

参考带宽 **auto-cost reference-bandwidth *ref-bw***

需求：

让R1到达3.3.3.0网络优选R2到达。

配置：

配置OSPF全部网络宣告好，步骤省略

检验：

R1选择以太接口直接到达**R3**，很明显这条路径的**COST**最低。

如果选择**R2**到达**R3**，**COST**是**129**（**64+64+1**）

O 3.3.3.0 [110/129] via 12.1.1.2, 00:00:00, Serial1/2

```
R1#sh ip route

Gateway of last resort is not set

    1.0.0.0/24 is subnetted, 1 subnets
C      1.1.1.0 is directly connected, Loopback0
    3.0.0.0/24 is subnetted, 1 subnets
O      3.3.3.0 [110/11] via 13.1.1.3, 00:00:09, Ethernet0/0
    23.0.0.0/24 is subnetted, 1 subnets
O      23.1.1.0 [110/66] via 12.1.1.2, 00:00:09, Serial1/2
    12.0.0.0/24 is subnetted, 1 subnets
C      12.1.1.0 is directly connected, Serial1/2
    13.0.0.0/24 is subnetted, 1 subnets
C      13.1.1.0 is directly connected, Ethernet0/0
```

修改COST

R1

```
interface Serial1/2
 ip address 12.1.1.1 255.255.255.0
 ip ospf cost 1
```

R2

```
interface Serial1/2
```

```
 ip address 23.1.1.2 255.255.255.0
 ip ospf cost 1
```

再次查看R1路由表

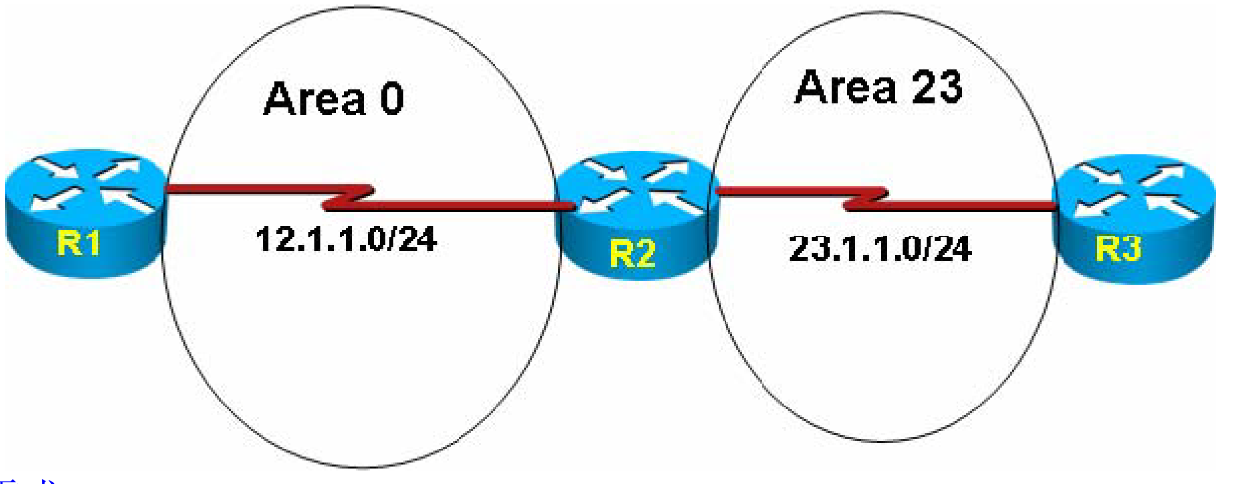
已经选择经过R2到达3.3.3.0,cost为3

在使用traceroute确认是否是按照我们希望的路径走的

```
R1#show ip route

Gateway of last resort is not set

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     3.0.0.0/24 is subnetted, 1 subnets
O       3.3.3.0 [110/3] via 12.1.1.2, 00:01:36, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O       23.1.1.0 [110/2] via 12.1.1.2, 00:01:36, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
     13.0.0.0/24 is subnetted, 1 subnets
O       13.1.1.0 [110/12] via 12.1.1.2, 00:01:36, Serial1/2
```

```
R1#traceroute 3.3.3.3
Type escape sequence to abort.
Tracing the route to 3.3.3.3
  1 12.1.1.2 108 msec 64 msec 104 msec
  2 23.1.1.3 136 msec 76 msec *
```

LAB13：OSPF 注入默认路由



需求：

R2 ABR路由器向R3路由器发放默认路由

配置：

第一种方法：

R2

router ospf 1
router-id 2.2.2.2
default-information originate
ip route 0.0.0.0 0.0.0.0 Null0

第二种方法：

router ospf 1
router-id 2.2.2.2
default-information originate always

注意**:**加入**always**关键词之后，就不需要在手工书写默认路由

检验：

```
R3#sh ip route

Gateway of last resort is 23.1.1.2 to network 0.0.0.0

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/2
     1.0.0.0/24 is subnetted, 1 subnets
O       1.1.1.0 [110/129] via 23.1.1.2, 00:03:48, Serial1/3
     3.0.0.0/24 is subnetted, 1 subnets
C       3.3.3.0 is directly connected, Loopback0
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
O       12.1.1.0 [110/128] via 23.1.1.2, 00:03:48, Serial1/3
     13.0.0.0/24 is subnetted, 1 subnets
C       13.1.1.0 is directly connected, Ethernet0/0
O*E2 0.0.0.0/0 [110/1] via 23.1.1.2, 00:00:00, Serial1/3
```

重发布和路由过滤部分

对重发布影响最大的协议特征是度量、和管理距离。

重新分配的时候必须为重分配的路由指定METRIC。如果分配了不正确的METRIC重发布将失败。

看上图：

RIP 和EIGRP协议重发布的时候一定要明确指定metric，如果不指定metric那么重发布将会失

Table 11-7 *Default Metrics and Route Metric Types in IGP Route Redistribution*

KEY POINT

IGP into Which Routes Are Redistributed	Default Metric	Default (and Possible) Metric Types
RIP	None	RIP has no concept of external routes
EIGRP	None	External
OSPF	20/1*	E2 (E1 or E2)
IS-IS	0	L1 (L1, L2, L1/L2, or external)

* OSPF uses cost 20 when redistributing from an IGP, and cost 1 when redistributing from BGP.

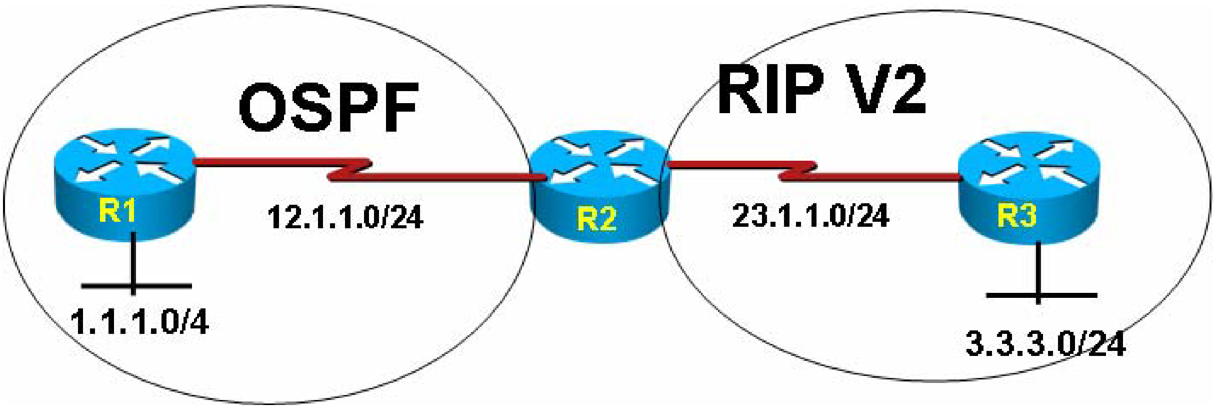
败。

例如：

```
Router eigrp 1
 Redistribute rip  ---此重发布失败
Router eigrp 1
 Redistribute rip metric 10000 100 255 1 1500 要明确指定metric
```

LAB1:rip 和eigrp重发布

需求:



Rip 和OSPF之间在R2做双向重发布，能够互相学习到对方路由。

配置:

```
R2
router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
 redistribute rip subnets
 network 12.1.1.2 0.0.0.0 area 0
router rip
 version 2
 redistribute ospf 1 metric 1
 network 23.0.0.0
 no auto-summary
```

命令解释:

redistribute rip subnets

将rip网络的路由重发布到OSPF 的网络中。Subnets 命令可以确保RIP网络中的无类子网路由能够正确的被发布。

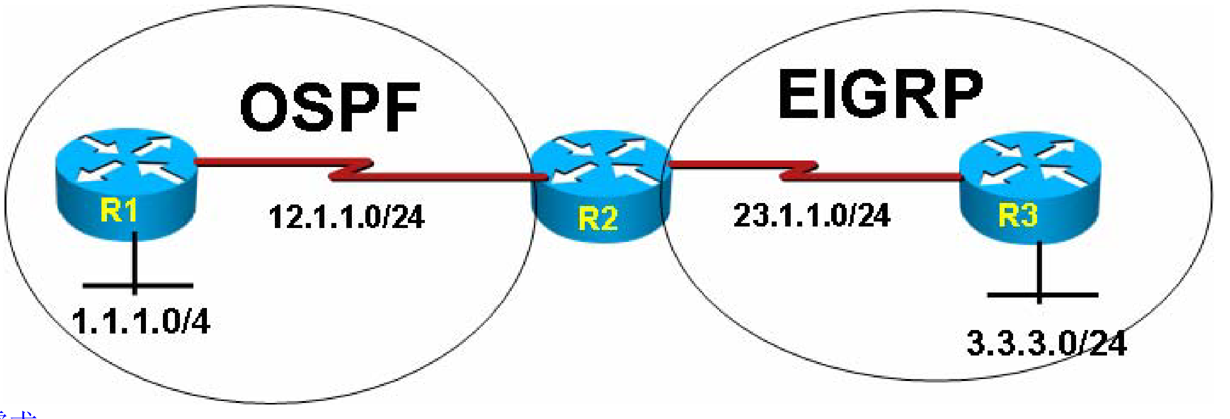
检验：

仔细观察：重发布到OSPF的路由metric默认是20

```
R1#show ip route

Gateway of last resort is not set

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     3.0.0.0/24 is subnetted, 1 subnets
O E2    3.3.3.0 [110/20] via 12.1.1.2, 00:08:44, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O E2    23.1.1.0 [110/20] via 12.1.1.2, 00:08:44, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

```
R3#show ip route

Gateway of last resort is not set

     1.0.0.0/24 is subnetted, 1 subnets
R       1.1.1.0 [120/1] via 23.1.1.2, 00:00:04, Serial1/3
     3.0.0.0/24 is subnetted, 1 subnets
C       3.3.3.0 is directly connected, Loopback0
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
R       12.1.1.0 [120/1] via 23.1.1.2, 00:00:04, Serial1/3
```

LAB2：eigrp和OSPF重发布



需求：

EIGRP 和OSPF之间在R2做双向重发布，能够互相学习到对方路由。

配置：

R2

```
router eigrp 1
 redistribute ospf 1 metric 10000 100 255 1 1500
 network 23.1.1.0 0.0.0.255
 no auto-summary

router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
 redistribute eigrp 1 subnets
 network 12.1.1.2 0.0.0.0 area 0
```

检验：

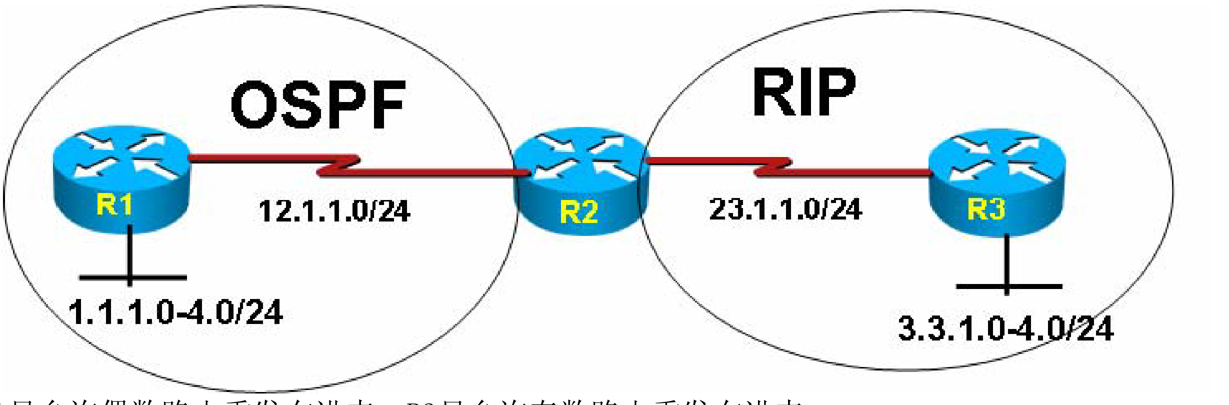
```
R1#show ip route

Gateway of last resort is not set

     1.0.0.0/24 is subnetted, 1 subnets
C       1.1.1.0 is directly connected, Loopback0
     3.0.0.0/24 is subnetted, 1 subnets
O E2    3.3.3.0 [110/20] via 12.1.1.2, 00:08:44, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O E2    23.1.1.0 [110/20] via 12.1.1.2, 00:08:44, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

```
R3#show ip route

     1.0.0.0/24 is subnetted, 1 subnets
D EX    1.1.1.0 [170/2195456] via 23.1.1.2, 00:01:13, Serial1/3
     3.0.0.0/24 is subnetted, 1 subnets
C       3.3.3.0 is directly connected, Loopback0
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
D EX    12.1.1.0 [170/2195456] via 23.1.1.2, 00:01:13, Serial1/3
```

注意观察：EIGRP从外部学习的路由以DEX显示，并且默认管理距离是170。

LAB3：重发布过滤路由－使用distribute-list

需求：



R1只允许偶数路由重发布进来。R3只允许奇数路由重发布进来。

配置：

R2

```
router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
 redistribute rip subnets
 network 12.1.1.2 0.0.0.0 area 0
router rip
 redistribute ospf 1 metric 1
 network 23.0.0.0
```

首先确保所有路由器都收到路由。

过滤配置：

R2

```
access-list 1 permit 3.3.0.0 0.0.254.0
access-list 2 permit 1.1.1.0 0.0.254.0
router ospf 1
distribute-list 1 out rip
```

```
router rip
distribute-list 2 out Serial1/2
```

检验:

R1只收到RIP过来的偶数路由。

```
R1#show ip route

     1.0.0.0/24 is subnetted, 4 subnets
C       1.1.1.0 is directly connected, Loopback0
C       1.1.2.0 is directly connected, Loopback1
C       1.1.3.0 is directly connected, Loopback3
C       1.1.4.0 is directly connected, Loopback4
     3.0.0.0/24 is subnetted, 2 subnets
O E2    3.3.2.0 [110/20] via 12.1.1.2, 00:11:39, Serial1/2
O E2    3.3.4.0 [110/20] via 12.1.1.2, 00:11:39, Serial1/2
     12.0.0.0/24 is subnetted, 1 subnets
C       12.1.1.0 is directly connected, Serial1/2
```

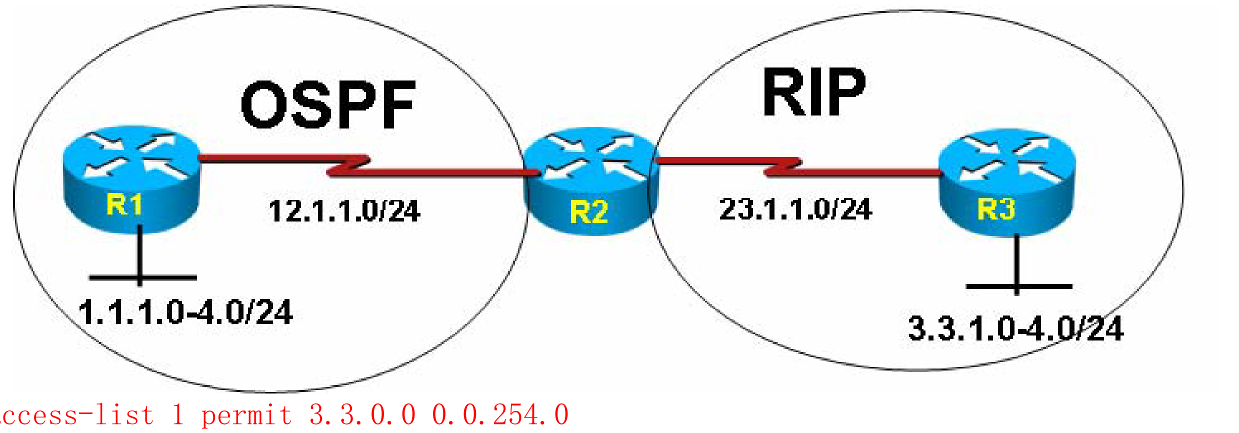
```
R3#show ip route

     1.0.0.0/24 is subnetted, 2 subnets
R       1.1.1.0 [120/1] via 23.1.1.2, 00:00:01, Serial1/3
R       1.1.3.0 [120/1] via 23.1.1.2, 00:00:01, Serial1/3
     3.0.0.0/24 is subnetted, 4 subnets
C       3.3.1.0 is directly connected, Loopback2
C       3.3.2.0 is directly connected, Loopback1
C       3.3.3.0 is directly connected, Loopback0
C       3.3.4.0 is directly connected, Loopback3
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
```

R3只收到OSPF过来的奇数路由

注意：**distribute-list access-list-name out (interface)----**该命令在链路状态的协议（**OSPF,ISIS**）是不起作用的，因为它不能阻止**LSA**的向外发送。链路状态协议out方向只能跟协议来进行过滤。

LAB4：重发布过滤路由－使用route-map

需求：
R1只允许偶数路由重发布进来。R3只允许奇数路由重发布进来。
配置：
配置中使用了2中不同的方法。一种是使用route-map做拒绝操作，另外一个是使用ACL做拒绝操作，route-map是permit.




```
access-list 1 permit 3.3.0.0 0.0.254.0
route-map A deny 10
 match ip address 1
route-map A permit 20
router ospf 1
redistribute rip subnets route-map A

access-list 2 deny   1.1.0.0 0.0.254.0
access-list 2 permit any
```

```
route-map B permit 10
 match ip address 2
router rip
redistribute ospf 1 metric 1 route-map B
```

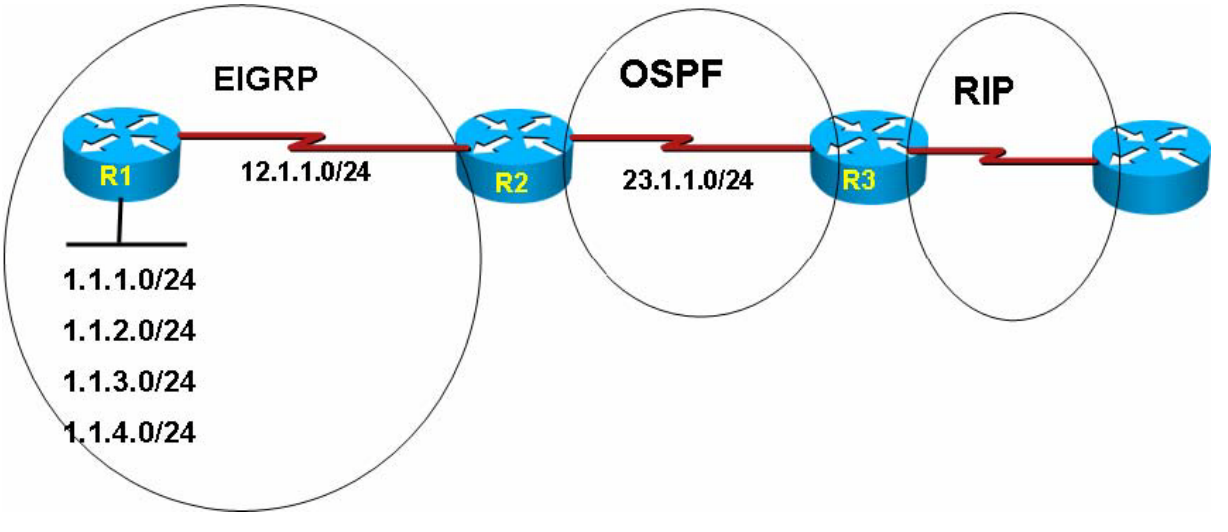
注意事项：
1.
默认也有deny any的隐含条件，所以看上面例子我们加入了一条route-map A permit 20，里面无任何match。意思就是permit any的含义。

LAB5: 重发布过滤路由-使用tag

支持TAG的协议：RIPv2,EIGRP,IS-IS,OSPF,BGP 不支持**TAG**的协议： RIPV1,IGRP

试验需求：
在R2/R3上做双向重发布，R2给1.1.1.0和2.0路由打上TAG 10，在R3对基于TAG 10的路由进行过滤。

基本配置：
R2



```
router eigrp 1
 redistribute ospf 1 metric 10000 100 255 1 1500

router ospf 1
redistribute eigrp 1 subnets
```

R3

```
router ospf 1
redistribute rip subnets
router rip
redistribute ospf 1 metric 1
```

确认R4是否学习到重发布过来的路由

在R2给路由打TAG

```
access-list 1 permit 1.1.1.0 0.0.0.255
access-list 1 permit 1.1.2.0 0.0.0.255

route-map TAG permit 10
```

```
R4#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/3
     1.0.0.0/24 is subnetted, 4 subnets
R       1.1.1.0 [120/1] via 34.1.1.3, 00:00:20, Serial1/3
R       1.1.2.0 [120/1] via 34.1.1.3, 00:00:20, Serial1/3
R       1.1.3.0 [120/1] via 34.1.1.3, 00:00:20, Serial1/3
R       1.1.4.0 [120/1] via 34.1.1.3, 00:00:20, Serial1/3
     23.0.0.0/24 is subnetted, 1 subnets
R       23.1.1.0 [120/1] via 34.1.1.3, 00:00:20, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
R       12.1.1.0 [120/1] via 34.1.1.3, 00:00:21, Serial1/3
```

```
 match ip address 1
 set tag 100
route-map TAG permit 20
router ospf 1
redistribute eigrp 1 subnets route-map TAG
```

R3确认是否收到打TAG的信息

R3基于TAG进行过滤

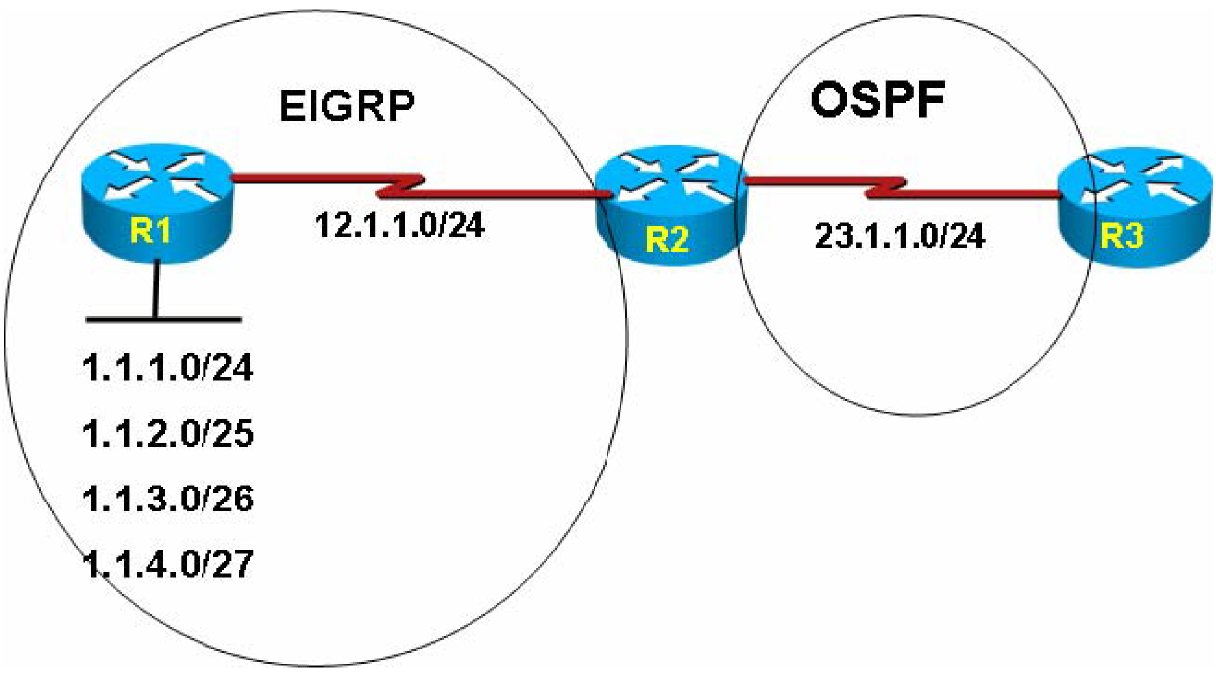
```
R3# show ip route 1.1.1.0
Routing entry for 1.1.1.0/24
  Known via "ospf 1", distance 110, metric 20
  Tag 100, type extern 2, forward metric 64
  Redistributing via rip
  Advertised by rip metric 1
  Last update from 23.1.1.2 on Serial1/3, 00:13:11 ago
  Routing Descriptor Blocks:
  * 23.1.1.2, from 2.2.2.2, 00:13:11 ago, via Serial1/3
      Route metric is 20, traffic share count is 1
      Route tag 100
```

```
router rip
redistribute ospf 1 metric 1 route-map TAG
route-map TAG deny 10
 match tag 100
route-map TAG permit 20
```

确认R4的路由被过滤：

```
R4#show ip route
Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/3
     1.0.0.0/24 is subnetted, 2 subnets
R       1.1.3.0 [120/1] via 34.1.1.3, 00:00:04, Serial1/3
R       1.1.4.0 [120/1] via 34.1.1.3, 00:00:04, Serial1/3
     23.0.0.0/24 is subnetted, 1 subnets
R       23.1.1.0 [120/1] via 34.1.1.3, 00:00:04, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
R       12.1.1.0 [120/1] via 34.1.1.3, 00:00:04, Serial1/3
```

LAB6: 重发布过滤路由—使用prefix-list(前缀列表)



使用场合:

前缀列表对于抓路由比传统的ACL要精确很多，所以建议一般做路由过滤的时候推荐大家使用前缀列表，但是要注意前缀列表抓路由必须要连续，比如抓奇偶数就不行，因为不连续。

需求：

匹配从/22位开始到<=25位结束的路由

配置：

R2

```
ip prefix-list cisco permit 1.1.1.0/22 le 25
```

le的含义是<=的意思

ge的含义是>=的意思

```
router ospf 1
redistribute eigrp 1 subnets route-map prefix
route-map prefix permit 10
 match ip address prefix-list cisco
```

检验：

R3确认路由

```
R3#
R3#show ip route

Gateway of last resort is not set

     34.0.0.0/24 is subnetted, 1 subnets
C       34.1.1.0 is directly connected, Serial1/2
     1.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
O E2    1.1.1.0/24 [110/20] via 23.1.1.2, 00:00:13, Serial1/3
O E2    1.1.2.0/25 [110/20] via 23.1.1.2, 00:00:13, Serial1/3
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
```

LAB7：修改管理距离

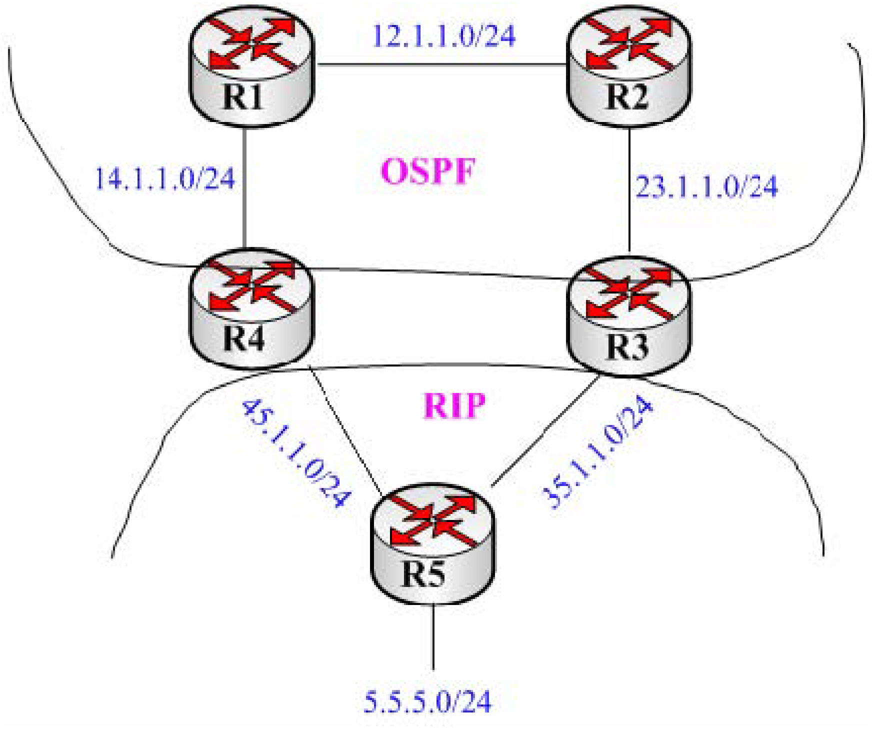
什么是管理距离？

所谓管理距离就是不同路由协议之间的一个信任值，当有多条路径并且协议不同的时候用于路由器优选路径使用的一个参数。

在重发布中如果是双点双向的重发布容易产生环路，或者次优路径的问题，这些问题我们可以通过调整管理距离或者使用路由过滤来消除。

各种不同协议的AD值如下：

Route Source	Default Distance
Connected interface	0
Static route	1
EIGRP summary route	5
External BGP	20
Internal EIGRP	90
IGRP	100
OSPF	110
IS-IS	115
RIPv1, RIPv2	120
External EIGRP	170
Internal BGP	200
Unknown	255



需求：

R3 R4做双向重发布。调整管理距离，解决重发布后次优路径的问题。

配置：

R4(config)#router rip
R4(config-router)#redistribute ospf 1 metric 1
R4(config-router)#router ospf 1
R4(config-router)#redistribute rip subnets

R3(config)#router rip
R3(config-router)#redistribute ospf 1 metric 1

R3(config-router)#router ospf 1
R3(config-router)#redistribute rip subnets

检验：

R4路由表发现，35.1.1.0和5.5.5.0网络选择了一条次优路径。

```
R4#show ip route

     35.0.0.0/24 is subnetted, 1 subnets
O E2    35.1.1.0 [110/20] via 14.1.1.1, 00:26:41, Serial1/0
     5.0.0.0/24 is subnetted, 1 subnets
O E2    5.5.5.0 [110/20] via 14.1.1.1, 00:26:41, Serial1/0
     23.0.0.0/24 is subnetted, 1 subnets
O       23.1.1.0 [110/192] via 14.1.1.1, 00:26:41, Serial1/0
     12.0.0.0/24 is subnetted, 1 subnets
O       12.1.1.0 [110/128] via 14.1.1.1, 00:26:41, Serial1/0
     14.0.0.0/24 is subnetted, 1 subnets
C       14.1.1.0 is directly connected, Serial1/0
     45.0.0.0/24 is subnetted, 1 subnets
C       45.1.1.0 is directly connected, Serial1/1
```

解决方法：修改AD，本例子中修改OSPF的AD为125，大于RIP AD

R3

access-list 1 permit 5.5.5.0
access-list 1 permit 45.1.1.0

router ospf 1

distance 125 0.0.0.0 255.255.255.255 1

R4

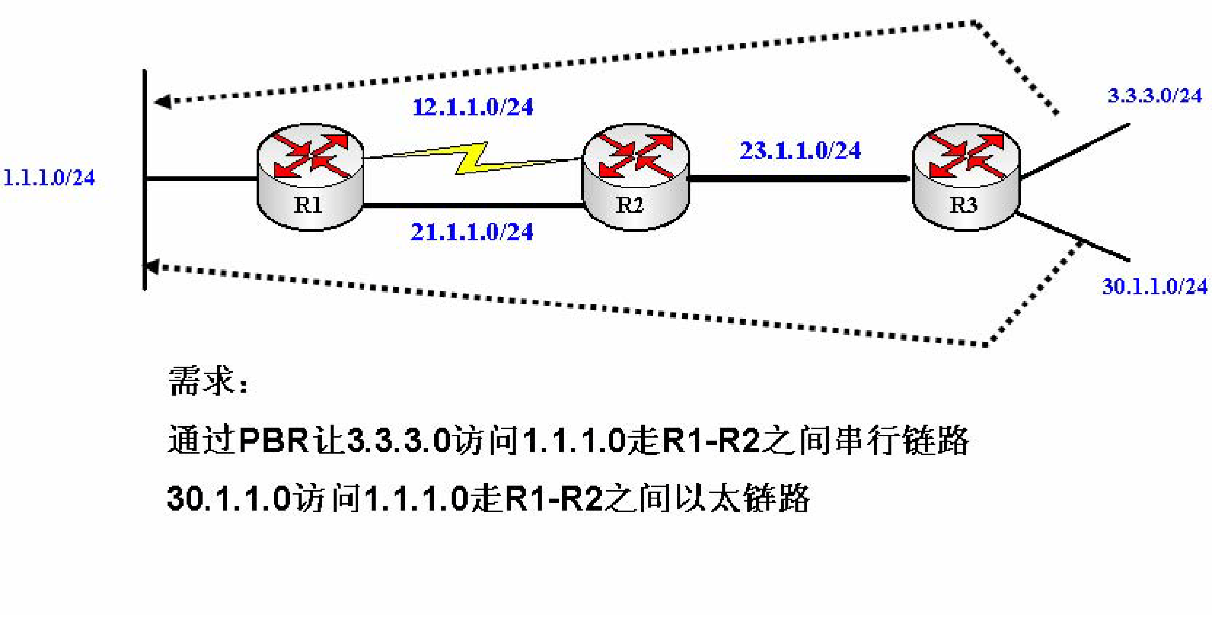
access-list 1 permit 5.5.5.0
access-list 1 permit 35.1.1.0
router ospf 1
distance 125 0.0.0.0 255.255.255.255 1

再次查看R3/R4的路由表是否选择RIP到达目标网络

```
R3#show ip route

Gateway of last resort is not set

     35.0.0.0/24 is subnetted, 1 subnets
C       35.1.1.0 is directly connected, Serial1/0
     5.0.0.0/24 is subnetted, 1 subnets
R       5.5.5.0 [120/1] via 35.1.1.5, 00:00:10, Serial1/0
     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
     12.0.0.0/24 is subnetted, 1 subnets
O       12.1.1.0 [110/128] via 23.1.1.2, 00:05:51, Serial1/3
     14.0.0.0/24 is subnetted, 1 subnets
O       14.1.1.0 [110/192] via 23.1.1.2, 00:05:51, Serial1/3
     45.0.0.0/24 is subnetted, 1 subnets
R       45.1.1.0 [120/1] via 35.1.1.5, 00:00:10, Serial1/0
```

```
R4#show ip route

Gateway of last resort is not set

     35.0.0.0/24 is subnetted, 1 subnets
R       35.1.1.0 [120/1] via 45.1.1.5, 00:00:10, Serial1/2
     5.0.0.0/24 is subnetted, 1 subnets
R       5.5.5.0 [120/1] via 45.1.1.5, 00:00:10, Serial1/2
     23.0.0.0/24 is subnetted, 1 subnets
O       23.1.1.0 [110/192] via 14.1.1.1, 00:05:47, Serial1/0
     12.0.0.0/24 is subnetted, 1 subnets
O       12.1.1.0 [110/128] via 14.1.1.1, 00:05:47, Serial1/0
     14.0.0.0/24 is subnetted, 1 subnets
C       14.1.1.0 is directly connected, Serial1/0
     45.0.0.0/24 is subnetted, 1 subnets
C       45.1.1.0 is directly connected, Serial1/2
```

LAB8:PBR（策略路由）



基本配置：

每台路由器运行某个IGP协议，为了测试方便注意以太口网段不宣告进IGP。
首先通过tracerroute看看经过的路径，全部都走串口（12.1.1.0）

```
R3#traceroute 1.1.1.1 source 3.3.3.3

Type escape sequence to abort.
Tracing the route to 1.1.1.1

 1 23.1.1.2 96 msec 80 msec 112 msec
 2 12.1.1.1 92 msec 128 msec *
```

R2做PBR实现上述需求

```
access-list 100 permit ip 3.3.3.0 0.0.0.255 1.1.1.0 0.0.0.255
access-list 101 permit ip 30.1.1.0 0.0.0.255 1.1.1.0 0.0.0.255
```

```
route-map A permit 10
 match ip address 100
 set ip next-hop 12.1.1.1
route-map A permit 20
 match ip address 101
 set ip next-hop 21.1.1.1
interface Serial1/2
 ip address 23.1.1.2 255.255.255.0
 ip policy route-map A
```

验证：
再次确认，我们发现源于30.1.1.3访问1.1.1.1的路径已经走以太口（21.1.1.0）到达

相关debug和show命令查看

```
R3#traceroute 1.1.1.1 source 30.1.1.3

Type escape sequence to abort.
Tracing the route to 1.1.1.1

  1 23.1.1.2 80 msec 68 msec 88 msec
  2 21.1.1.1 24 msec 108 msec *

R3#traceroute 1.1.1.1 source 3.3.3.3

Type escape sequence to abort.
Tracing the route to 1.1.1.1

  1 23.1.1.2 64 msec 84 msec 76 msec
  2 12.1.1.1 68 msec 124 msec *
```

```
R2#debug ip policy
Policy routing debugging is on
R2#
*Mar  1 00:30:29.107: IP: s=3.3.3.3 (Serial1/2), d=1.1.1.1, len 100, FIB policy
match
*Mar  1 00:30:29.107: IP: s=3.3.3.3 (Serial1/2), d=1.1.1.1, g=12.1.1.1, len 100,
FIB policy routed
*Mar  1 00:30:29.247: IP: s=3.3.3.3 (Serial1/2), d=1.1.1.1, len 100, FIB policy
R2#
R2#
*Mar  1 00:30:36.795: IP: s=30.1.1.3 (Serial1/2), d=1.1.1.1, len 100, FIB policy
match
*Mar  1 00:30:36.795: IP: s=30.1.1.3 (Serial1/2), d=1.1.1.1, g=21.1.1.1, len 100,
FIB policy routed
 100, FIB policy match
*Mar  1 00:30:37.215: IP: s=30.1.1.3 (Serial1/2), d=1.1.1.1, g=21.1.1.1, len 100,
FIB policy routed
```

```
R2#show route-map
route-map A, permit, sequence 10
  Match clauses:
    ip address (access-lists): 100
  Set clauses:
    ip next-hop 12.1.1.1
  Policy routing matches: 8 packets, 616 bytes
route-map A, permit, sequence 20
  Match clauses:
    ip address (access-lists): 101
  Set clauses:
    ip next-hop 21.1.1.1
  Policy routing matches: 8 packets, 616 bytes
```

LAB9:IP SLA应用试验

使用场合：

上图中全网运行静态路由，R1正常情况下访问R3，如果R1和R2之间直连链路DOWN掉是可以切换的。但问题是如果是非直连的DOWN，例如R3接口DOWN了。R1这边是不会知道的。所以要真正实现上述需求我们可以使用IP SLA技术实现。

配置：

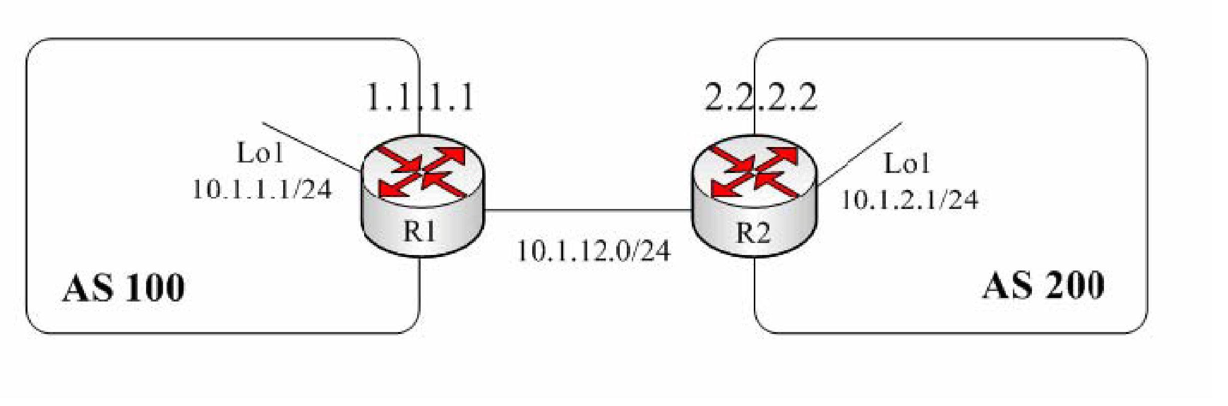
```
ip sla monitor 123
 type echo protocol ipIcmpEcho 23.1.1.3 source-ipaddr 12.1.1.1
 frequency 10
ip sla monitor schedule 123 life forever start-time now

track 1 rtr 123 reachability

ip route 23.1.1.0 255.255.255.0 12.1.1.2 track 1
ip route 23.1.1.0 255.255.255.0 12.1.1.2
```

BGP分解试验部分

LAB1:Basic EBGP试验

需求:

在R1,R2之间建立EBGP连接，R1的BGP Router-ID 1.1.1.1 ,R2的BGP



Router-ID 2.2.2.2 .R1.R2互相通告自己的loopback接口给对方。

配置:

R1

```
router bgp 100
 no synchronization
 bgp router-id 1.1.1.1
 bgp log-neighbor-changes
 network 10.1.1.0 mask 255.255.255.0   宣告自己的网段
 neighbor 10.1.12.2 remote-as 200      配置EBGP邻居，指定对方的AS为200
 no auto-summary
```

R2

```
router bgp 200
 no synchronization
 bgp router-id 2.2.2.2
```

```
 bgp log-neighbor-changes
 network 10.1.2.0 mask 255.255.255.0
 neighbor 10.1.12.1 remote-as 100
 no auto-summary
```

检验：

确定BGP邻居是否起来，可以使用两种方法来查看

第一种：show ip bgp summary，简单方便

第二种：show ip bgp neighbor x.x.x.x

确认BGP state是否是established

```
R1#show ip bgp summary
BGP router identifier 1.1.1.1, local AS number 100
BGP table version is 3, main routing table version 3
2 network entries using 234 bytes of memory
2 path entries using 104 bytes of memory
3/2 BGP path/bestpath attribute entries using 372 bytes of memory
1 BGP AS-PATH entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 734 total bytes of memory
BGP activity 3/1 prefixes, 3/1 paths, scan interval 60 secs

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
12.1.1.2        4   200       7       7        3    0    0 00:03:03        1
```

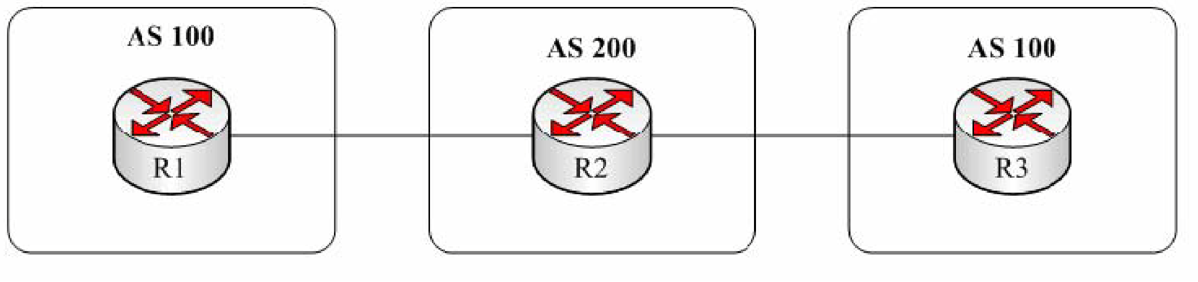
```
R1#show ip bgp neighbors 12.1.1.2
BGP neighbor is 12.1.1.2,  remote AS 200, external link
  BGP version 4, remote router ID 2.2.2.2
  BGP state = Established, up for 00:04:59
  Last read 00:00:59, last write 00:00:59, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received(old & new)
    Address family IPv4 Unicast: advertised and received
```

查看BGP路由

```
R1#show ip bgp
BGP table version is 3, local router ID is 1.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.1.0/24      0.0.0.0                  0         32768 i
*> 10.1.2.0/24      12.1.1.2                 0             0 200 i
```

LAB2:EBGP 防环机制试验

需求：
验证BGP AS-PATH的防环机制，观察R1起源的路由R3是否可以接受到。
考虑：这里是R2根本没有发给R3，还是R3拒绝了R2的update?



EBGP防环机制：as-path ,收到的BGP路由中不能包含有自己的AS号
配置：

R1

```
router bgp 100
 no synchronization
 bgp router-id 1.1.1.1
 bgp log-neighbor-changes
 network 10.1.1.0 mask 255.255.255.0
 neighbor 12.1.1.2 remote-as 200
 no auto-summary
```

R2

```
router bgp 200
 no synchronization
 bgp router-id 2.2.2.2
 bgp log-neighbor-changes
 network 10.1.2.0 mask 255.255.255.0
 neighbor 12.1.1.1 remote-as 100
 neighbor 23.1.1.3 remote-as 100
 no auto-summary
```

R3

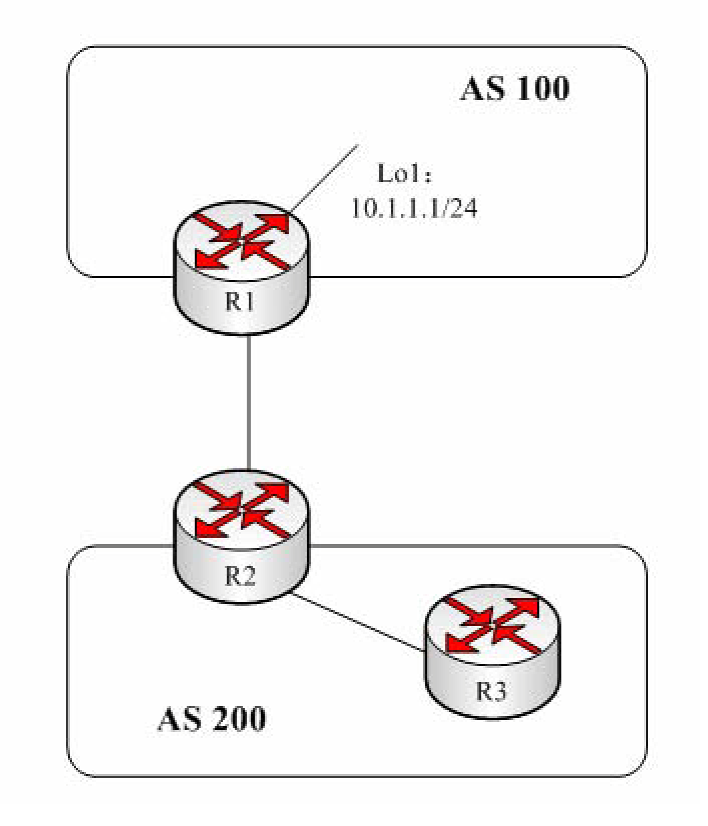
```
router bgp 100
 no synchronization
 bgp router-id 3.3.3.3
 bgp log-neighbor-changes
 network 10.1.3.0 mask 255.255.255.0
 neighbor 23.1.1.2 remote-as 200
 no auto-summary
```

检验：

观察R3路由表是否收到R1路由

```
R3#show ip bgp
BGP table version is 3, local router ID is 3.3.3.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
          r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.2.0/24      23.1.1.2                 0             0 200 i
*> 10.1.3.0/24      0.0.0.0                  0         32768 i
```

LAB3:Next-hop属性试验



需求：

R1,R2之间运行EBGP,R2,R3之间运行IBGP，R1通告直连网络，在R3上使用 show ip bgp观察这条路由的下一一跳。

基本配置：

R1

```
router bgp 100
 no synchronization
 bgp router-id 1.1.1.1
 bgp log-neighbor-changes
 network 10.1.1.0 mask 255.255.255.0
 neighbor 12.1.1.2 remote-as 200
 no auto-summary
```

R2

```
router bgp 200
 no synchronization
 bgp router-id 2.2.2.2
 bgp log-neighbor-changes
 network 10.1.2.0 mask 255.255.255.0
 neighbor 12.1.1.1 remote-as 100
 neighbor 23.1.1.3 remote-as 200
 no auto-summary
```

R3

```
router bgp 200
 no synchronization
 bgp router-id 3.3.3.3
 bgp log-neighbor-changes
 network 10.1.3.0 mask 255.255.255.0
 neighbor 23.1.1.2 remote-as 200
```

```
no auto-summary
```

检验：

注意观察到R3收到的R1 路由下一跳是R1的IP。

```
R3#show ip bgp
BGP table version is 1, local router ID is 3.3.3.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
* i10.1.1.0/24      12.1.1.1                 0    100      0 100 i
```

继续观察R3路由表

```
R3#show ip route

Gateway of last resort is not set

     23.0.0.0/24 is subnetted, 1 subnets
C       23.1.1.0 is directly connected, Serial1/3
     10.0.0.0/24 is subnetted, 1 subnets
C       10.1.3.0 is directly connected, Loopback0
```

在观察R3 BGP路由表

R3路由表中没有R1的路由(12.1.1.0)，所以它认为这条路由是不可达的。

```
R3#show ip bgp 10.1.1.0/24
BGP routing table entry for 10.1.1.0/24, version 0
Paths: (1 available, no best path)
  Not advertised to any peer
  100
    12.1.1.1 (inaccessible) from 23.1.1.2 (2.2.2.2)
      Origin IGP, metric 0, localpref 100, valid, internal
```

解决方法：

1.

t-hop-self改变路由的下一跳

注意：

工程里面推荐大家在BGP的边界路由器上对内部IBGP邻居做next-hop-self

R2配置next-hop-self

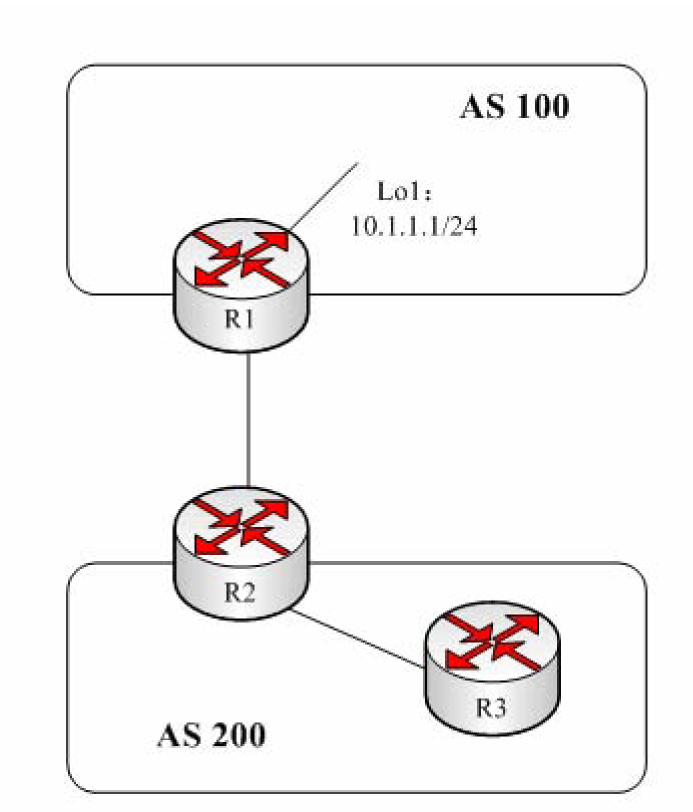
```
router bgp 200
neighbor 23.1.1.3 next-hop-self
```

再次在R3观察下一跳是否可达

```
R3#show ip bgp
BGP table version is 2, local router ID is 3.3.3.3
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i10.1.1.0/24      23.1.1.2                 0    100      0 100 i
```

下一跳变为了R2的IP23.1.1.2,此IP和R3是直连接口路由，自然可达。

LAB4：使用loopback接口建立BGP连接



需求：
R2,R3之间使用loopback0接口建立IBGP连接，R1,R2之间用loopback0接口建立EBGP连接

配置：
R1

```
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 network 10.1.1.0 mask 255.255.255.0
 neighbor 2.2.2.2 remote-as 200
 neighbor 2.2.2.2 ebgp-multihop 255          EBGP必须要指定多跳
 neighbor 2.2.2.2 update-source Loopback0    指定更新源的接口是loopback0
 no auto-summary
ip route 2.2.2.0 255.255.255.0 12.1.1.2     配置到达R2loopback0接口路由
```

R2

```
router rip    R2/R3的IBGP之间宣告RIP协议，以便能够互相学习到loopback接口路由
 version 2
 network 2.0.0.0
 network 23.0.0.0
 no auto-summary

router bgp 200
 no synchronization
 bgp log-neighbor-changes
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 ebgp-multihop 255
 neighbor 1.1.1.1 update-source Loopback0
 neighbor 3.3.3.3 remote-as 200
```

```
 neighbor 3.3.3.3 update-source Loopback0
 neighbor 3.3.3.3 next-hop-self
 no auto-summary
ip route 1.1.1.0 255.255.255.0 12.1.1.1
```

R3

```
router rip
 version 2
 network 3.0.0.0
 network 23.0.0.0
 no auto-summary
router bgp 200
 no synchronization
 bgp router-id 3.3.3.3
 bgp log-neighbor-changes
 network 10.1.3.0 mask 255.255.255.0
 neighbor 2.2.2.2 remote-as 200
 neighbor 2.2.2.2 update-source Loopback0
 no auto-summary
```

注意事项：

.

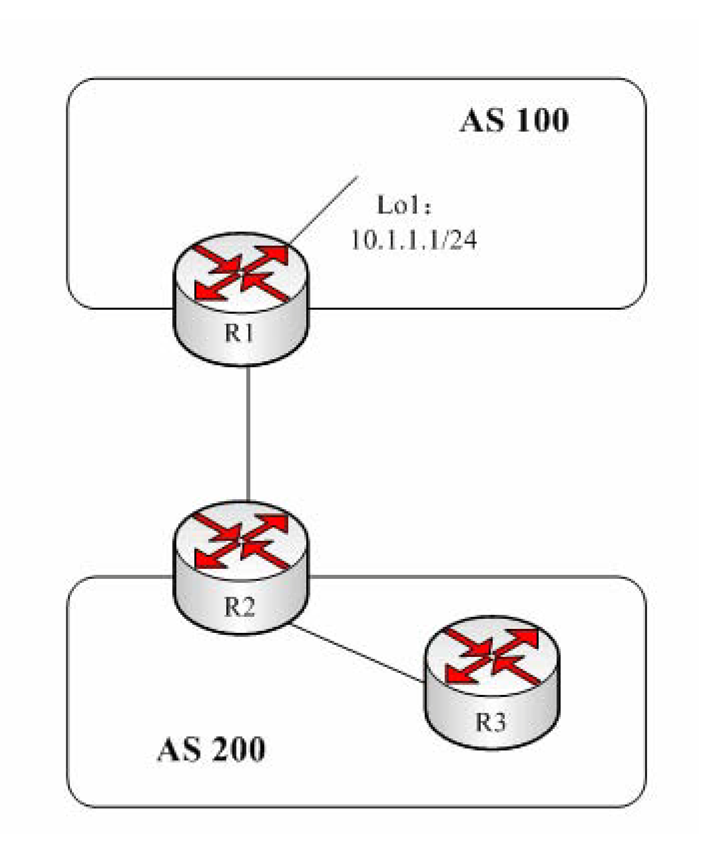
用loopback接口建立邻居可以充分利用邻居间的多条链路实现冗余。

EBGP要使用多条 **ebgp-mulihop number** ，因为缺省情况下，**EBGP**邻居是直接相连的，如果使用**loopback**，需要从物理接口在到还口这样至少需要**2**跳

检验：

```
R1#show ip bgp
BGP table version is 3, local router ID is 10.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i -
internal,
            r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.1.0/24      0.0.0.0              0         32768 i
*> 10.1.3.0/24      2.2.2.2                            0 200 i
```

LAB5:bgp同步试验



什么是BGP同步规则?
如果路由器仅通过BGP协议学习到关于某个网络路由,而此路由并没有存在于本地IGPs路由表中,则认定为不同步.
如果路由器通过BGP路由协议学习到某条路由,同时,也从IGPs中学习到同样的路由时, 被认定为同步.

BGP不允许将未同步的路由转发给其它的EBGP对等体。
注意：BGP同步规则是一个陈旧的属性，在IOS 12.2以后BGP默认就关闭了同步规则

需求：

R2,R3之间运行某种IGP，R2通过将BGP引入到IGP，从而让R3完成BGP同步，在R3上show ip bgp看到效果（路由变为*>）。

配置：

```
R1
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 network 10.1.1.0 mask 255.255.255.0
 neighbor 12.1.1.2 remote-as 200
 no auto-summary
R2
router bgp 200
 synchronization   开启BGP同步
 bgp log-neighbor-changes
 neighbor 12.1.1.1 remote-as 100
 neighbor 23.1.1.3 remote-as 200
 neighbor 23.1.1.3 next-hop-self
 no auto-summary
R3
router bgp 200
 synchronization   开启BGP同步
 bgp log-neighbor-changes
neighbor 23.1.1.2 remote-as 200
```

查看R3BGP表

```
R3#sh ip bgp
BGP table version is 1, local router ID is 23.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
* i10.1.1.0/24      23.1.1.2                 0    100      0 100 i
```

```
R3#show ip bgp 10.1.1.0
BGP routing table entry for 10.1.1.0/24, version 0
Paths: (1 available, no best path)
  Not advertised to any peer
  100
    23.1.1.2 from 23.1.1.2 (23.1.1.2)
      Origin IGP, metric 0, localpref 100, valid, internal, not synchronized
```

BGP路由现在处在非同步状态

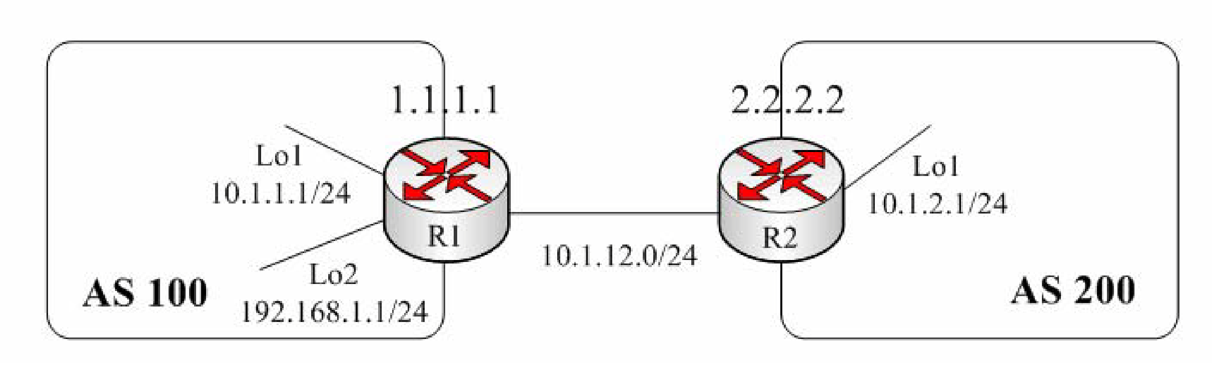
解决:
我们在R2上面重发布BGP进IGP，让IGP也学习到10.1.1.0路由，让BGP能够同步
R2

```
router rip
redistribute bgp 200 metric 1
```

再次在R3查看BGP是否同步

```
R3#sh ip bgp 10.1.1.0
BGP routing table entry for 10.1.1.0/24, version 3
Paths: (1 available, best #1, table Default-IP-Routing-Table, RIB-failure(17))
Flag: 0x820
  Not advertised to any peer
  100
    23.1.1.2 from 23.1.1.2 (23.1.1.2)
      Origin IGP, metric 0, localpref 100, valid, internal, synchronized, best
```

LAB6：BGP Origin属性试验



需求：

R1的L01直接宣告进BGP，L02重发布进BGP，观察show ip bgp输出中的起源代码。
注入**BGP**路由表有三种方式 一种是用**Network**命令进行，在**BGP**路由表显示为**i**（源属性：**0**），另一种是再发布**EGP**获得的，在路由表中显示为**e**（源属性：**1**），最后一种是从**IGP**或静态路由再发布过来的，显示为？（源属性：**2**）。

配置：

R1

```
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 network 10.1.1.0 mask 255.255.255.0
 redistribute connected route-map conn
 neighbor 12.1.1.2 remote-as 200
 no auto-summary
route-map conn permit 10
 match interface Loopback1
```

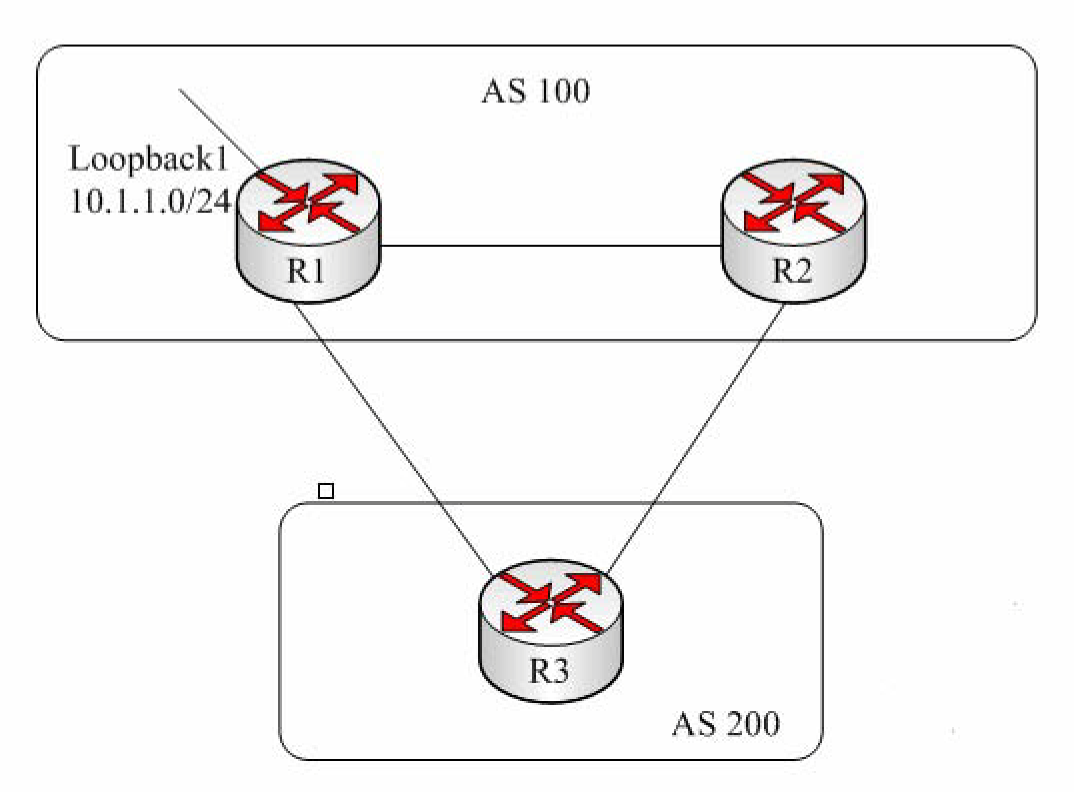
检验：

```
R2#sh ip bgp
BGP table version is 3, local router ID is 23.1.1.2
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.1.0/24      12.1.1.1                 0             0 100 i
*> 192.168.1.0      12.1.1.1                 0             0 100 ?
```

可以看到直接宣告进BGP的origin属性显示为I ，重发布IGP进来的显示为?

LAB7：BGP weight试验

需求：



R3从R1/R2都会收到关于10.1.1.0的路由，利用CISCO特有的权重属性改变R3最优路径的选择。
注意：weight属性只在本地有效，不会传递给任何邻居。

基本配置：

3台路由器分别配置好基本的BGP，R1宣告10.1.1.0 BGP路由。

检验：
查看R3现在优选哪条路径到达R1 10.1.1.0网络

上图中我们看到R3优选13.1.1.1，也就是R1到达

```
R3#sh ip bgp
BGP table version is 2, local router ID is 23.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*  10.1.1.0/24      23.1.1.2                          0 100 i
*>                  13.1.1.1                 0        0 100 i
```

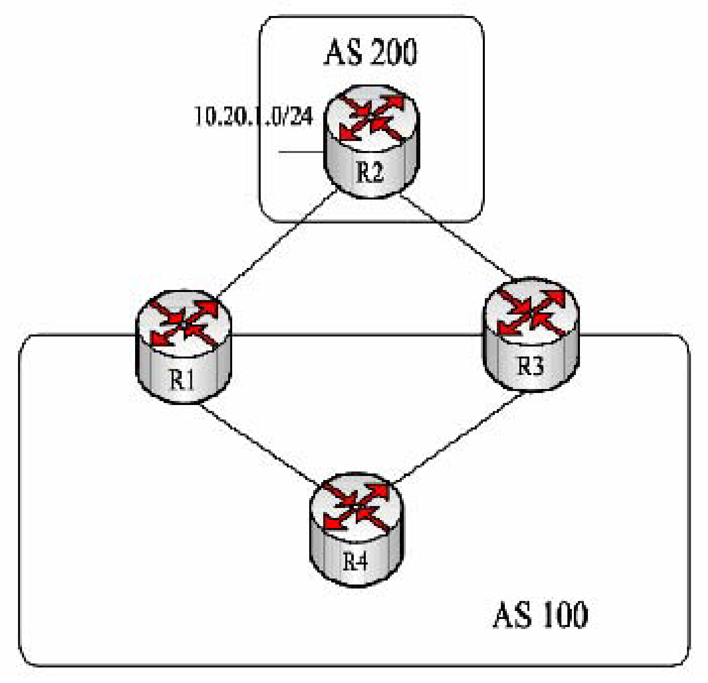
修改weight属性
R3
router bgp 200
neighbor 23.1.1.2 route-map wei in

access-list 1 permit 10.1.1.0
route-map wei permit 10
 match ip address 1
 set weight 1
做完之后cle ip bgp * 清除一下BGP，让BGP重新学习和收敛

再次查看R3是否改变了最优路径的选择

```
R3#show ip bgp
BGP table version is 2, local router ID is 23.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*  10.1.1.0/24      13.1.1.1                 0        0 100 i
*>                  23.1.1.2                          1 100 i
```

LAB8：BGP Local-preference试验



需求：

R4从2个IBGP邻居都会收到R2的路由，通过本地优先级属性改变R4的最优路径的选择。

注意：本地优先级属性在整个AS内传递

基本配置：

R1

```
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 neighbor 12.1.1.2
remote-as 200
 neighbor 14.1.1.4
remote-as 100
 neighbor 14.1.1.4
next-hop-self
 no auto-summary
```

R2

```
router bgp 200
 no synchronization
 bgp log-neighbor-changes
```

```
 network 10.20.1.0 mask 255.255.255.0
 neighbor 12.1.1.1 remote-as 100
 neighbor 23.1.1.3 remote-as 100
 no auto-summary
R3
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 neighbor 23.1.1.2 remote-as 200
 neighbor 34.1.1.4 remote-as 100
 neighbor 34.1.1.4 next-hop-self
 no auto-summary
R4
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 neighbor 14.1.1.1 remote-as 100
 neighbor 34.1.1.3 remote-as 100
 no auto-summary
```

检验：

在R4查看优选哪条路径

```
R4#sh ip bgp
BGP table version is 3, local router ID is 34.1.1.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i10.20.1.0/24     34.1.1.3                 0    100      0 200 i
* i                 14.1.1.1                 0    100      0 200 i
```

使用本地优先级属性改变R4的选择

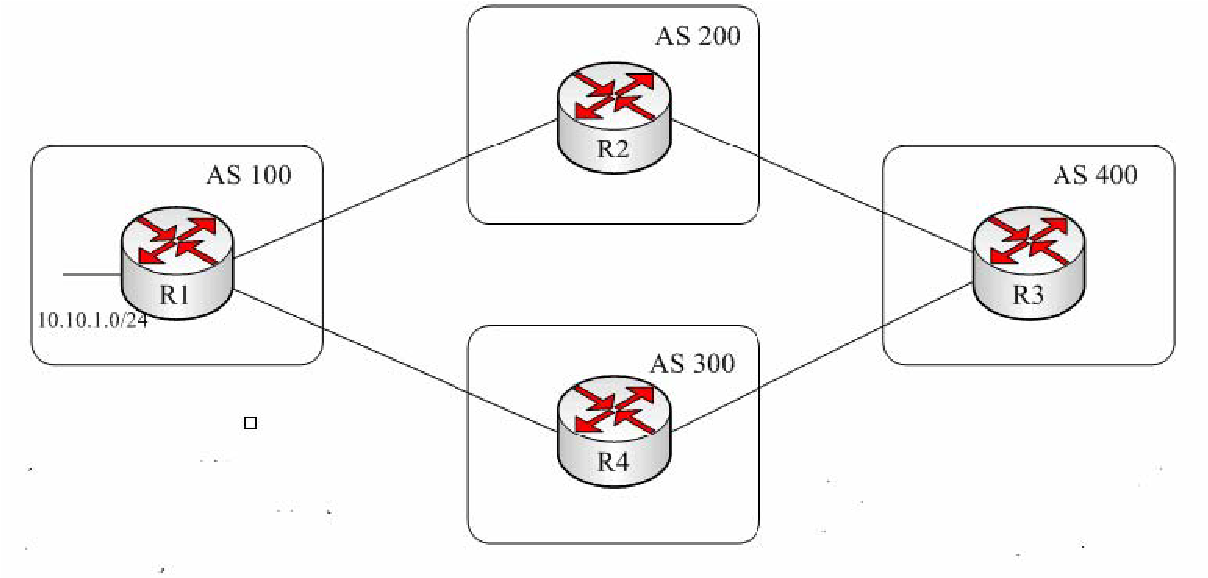
R1

```
access-list 1 permit 10.20.1.0
route-map local permit 10
 match ip address 1
 set local-preference 101
route-map local permit 20
router bgp 100
neighbor 14.1.1.4 route-map local out
```

再次在R4查看：

```
R4#sh ip bgp
BGP table version is 6, local router ID is 34.1.1.4
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
* i10.20.1.0/24     34.1.1.3                 0    100      0 200 i
*>i                 14.1.1.1                 0    101      0 200 i
```

LAB9：AS-Path prepend试验



需求：

R1利用as-path prepend影响R3的选路，使其通过R4到达R1通告的网段。

配置：

每台路由器配置基本的BGP。步骤省略。参考上面配置

验证：

没有配置之前，**R3**优选**R2**到达**R1**

R1配置as-path prepend

R1:

router bgp 100

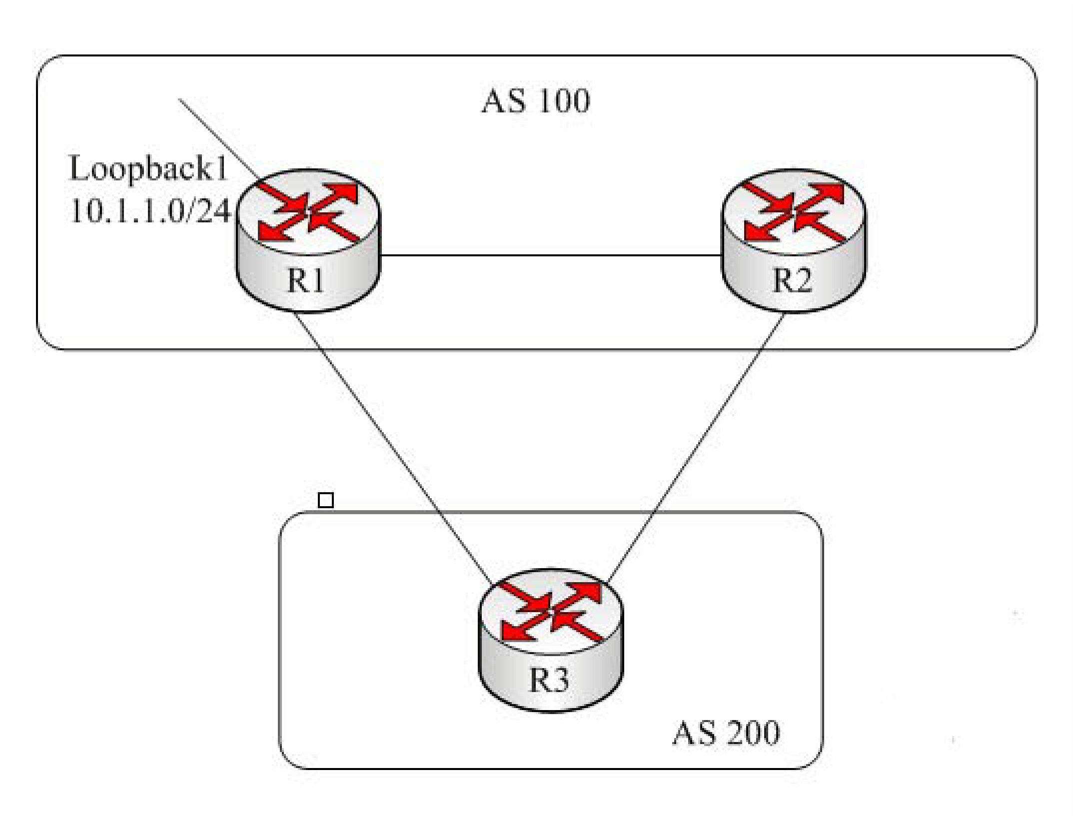
neighbor 12.1.1.2 route-map AS-PATH out

```
access-list 1 permit 10.1.1.0
route-map AS-PATH permit 10
 match ip address 1
 set as-path prepend 500 600
```

清除一下BGP表clear ip bgp * 再次查看R3的选路

```
R3#show ip bgp
BGP table version is 5, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*  10.1.1.0/24      23.1.1.2                             0 200 100 500 600 i
*>                  34.1.1.4                             0 300 100 i
```

LAB10：MED试验



需求：

R3会从R1/R2都收到关于10.1.1.0的路由，要求在R1/R2上设置MED，影响R3的选路。

基本配置：

每台路由器配置基本的BGP。步骤省略。参考上面配置

验证：

首先确认R3选择哪条路径到达R1网络

R1/R2更改MED

```
R3#sh ip bgp
BGP table version is 2, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
          r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

  Network          Next Hop            Metric LocPrf Weight Path
* 10.1.1.0/24      23.1.1.2                               0 100 i
*>                 13.1.1.1                 0             0 100 i
```

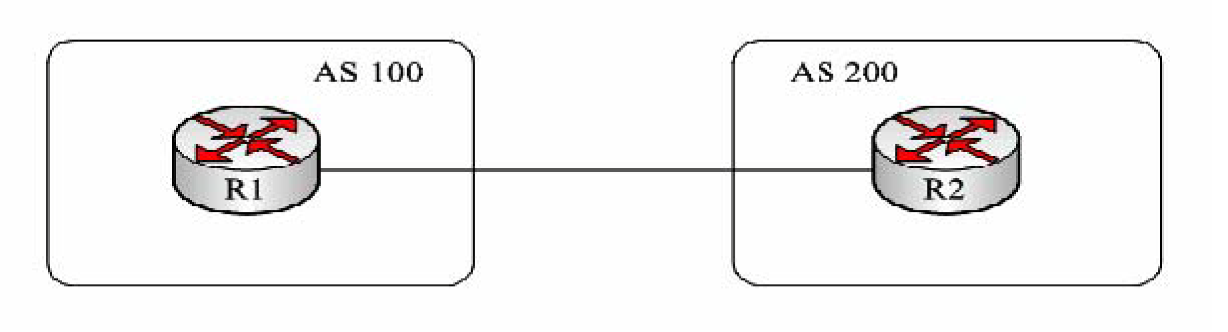
```
R1
router bgp 100
neighbor 13.1.1.3 route-map med out
route-map med permit 10
 set metric 10
R2
router bgp 100
neighbor 23.1.1.3 route-map med out
route-map med permit 10
 set metric 5
```

注意：MED选择值小的

再次查看R3的BGP表

```
R3#show ip bgp
BGP table version is 3, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.1.0/24      23.1.1.2                 5             0 100 i
*                   13.1.1.1                10             0 100 i
```

LAB11：BGP认证



需求：

R1/R2之间的EBGP使用neighbor password认证，保证路由的安全性。
注意：BGP验证采用的是MED的认证方式

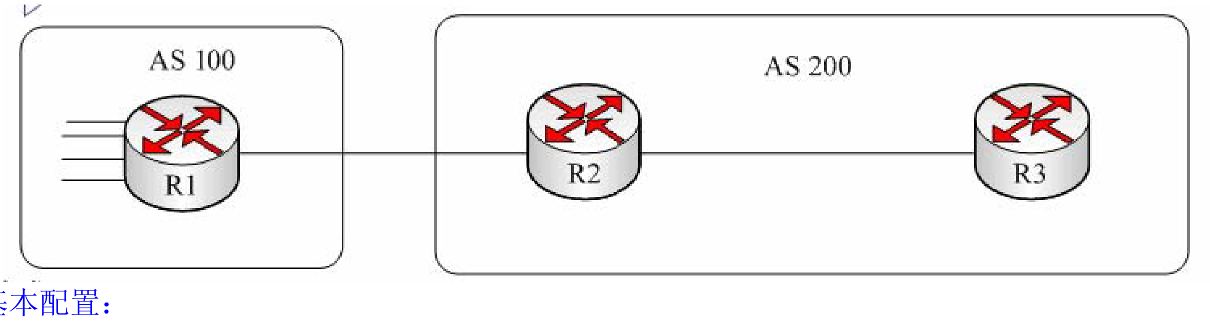
配置：

neighbor 12.1.1.2 password cisco

LAB12:BGP基本汇总

需求：

1.R1向R2发送4条路由，10.10.0.0/24 ,10.10.1.0/24 ,10.10.2.0/24 ,10.10.3.0/24
R2上做汇总，R3收到所有明细和汇总路由。



基本配置：

R1

```
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 network 10.10.0.0 mask 255.255.255.0
 network 10.10.1.0 mask 255.255.255.0
```

```
 network 10.10.2.0 mask 255.255.255.0
 network 10.10.3.0 mask 255.255.255.0
 neighbor 12.1.1.2 remote-as 200
 no auto-summary
R2
router bgp 200
 no synchronization
 bgp log-neighbor-changes
 neighbor 12.1.1.1 remote-as 100
 neighbor 23.1.1.3 remote-as 200
 neighbor 23.1.1.3 next-hop-self
 no auto-summary
R3
router bgp 200
 no synchronization
 bgp log-neighbor-changes
 neighbor 23.1.1.2 remote-as 200
 no auto-summary
```

检查R3的BGP路由表是否收到正确的路由

R2进行BGP的汇总

```
R3#show ip bgp
BGP table version is 5, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i10.10.0.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.1.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.2.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.3.0/24     23.1.1.2                 0    100      0 100 i
```

R2(config)#router bgp 200
R2(config-router)#aggregate-address 10.10.0.0 255.255.248.0

检验：

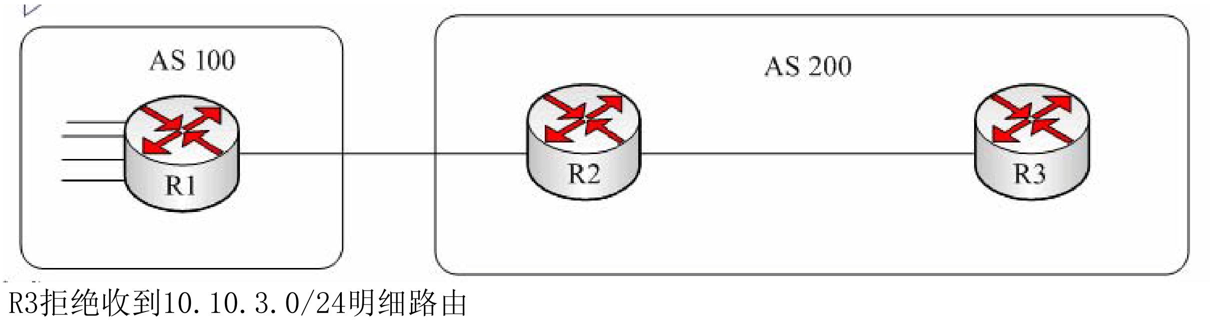
我们发现和IGP汇总不同，BGP汇总后R3明细和汇总都是可以收到的。

```
R3#sh ip bgp
BGP table version is 6, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
          r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i10.10.0.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.0.0/21     23.1.1.2                 0    100      0 i
*>i10.10.1.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.2.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.3.0/24     23.1.1.2                 0    100      0 100 i
```

LAB13:BGP汇总属性应用

需求：

1.R1向R2发送4条路由，10.10.0.0/24 ,10.10.1.0/24 ,10.10.2.0/24 ,10.10.3.0/24
R2上做汇总，R3只能够收到汇总路由。



2.R3拒绝收到10.10.3.0/24明细路由

配置：

如果我们要去掉明细路由可以在R2上面汇总添加一个汇总属性summary-only
R2(config-router)#aggregate-address 10.10.0.0 255.255.248.0 summary-only

在R3查看

```
R3#show ip bgp
BGP table version is 10, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i10.10.0.0/21     23.1.1.2                 0    100      0 i
```

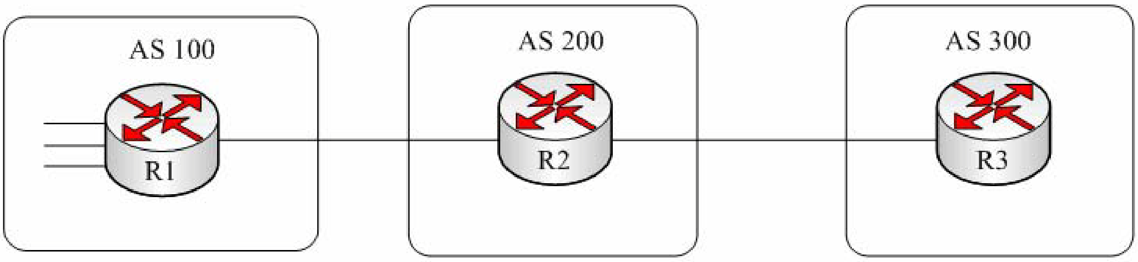
需求2的配置

```
R2
router bgp 200
aggregate-address 10.10.0.0 255.255.248.0 suppress-map agg
access-list 10 permit 10.10.3.0
route-map agg permit 10
 match ip address 10
```

在R3查看BGP表，确认没有收到10.10.3.0/24路由

```
R3#s ip bgp
BGP table version is 17, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i10.10.0.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.0.0/21     23.1.1.2                 0    100      0 i
*>i10.10.1.0/24     23.1.1.2                 0    100      0 100 i
*>i10.10.2.0/24     23.1.1.2                 0    100      0 100 i
```

LAB14:BGP过滤—使用prefix-list



需求：R1宣告4条路由，10.10.0.0/24、10.10.1.0/24、10.10.2.0/24、10.10.3.0/24以及1条汇总路由10.10.0.0/16，R1在指向R2 out方向使用prefix-list做过滤，过滤掉10.10.0.0/24这条路由，当R2把路由传递给R3时，R3在in方向作路由过滤，过滤掉10.1.2.0/24这条路由。

基本配置;

省略，参照上面试验配置

首先确保R3收到所有BGP路由

```
R3#sh ip bgp
BGP table version is 8, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
          r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.10.0.0/24     23.1.1.2                               0 200 100 i
*> 10.10.0.0/16     23.1.1.2                 0             0 200 i
*> 10.10.1.0/24     23.1.1.2                               0 200 100 i
*> 10.10.2.0/24     23.1.1.2                               0 200 100 i
*> 10.10.3.0/24     23.1.1.2                               0 200 100 i
```

R1做过滤过滤掉10.10.0.0/24

```
 ip prefix-list cisco seq 5 deny 10.10.0.0/24
 ip prefix-list cisco seq 10 permit 0.0.0.0/0 le 32
router bgp 100
 neighbor 12.1.1.2 prefix-list cisco out
```

R3过滤10.1.2.0/24

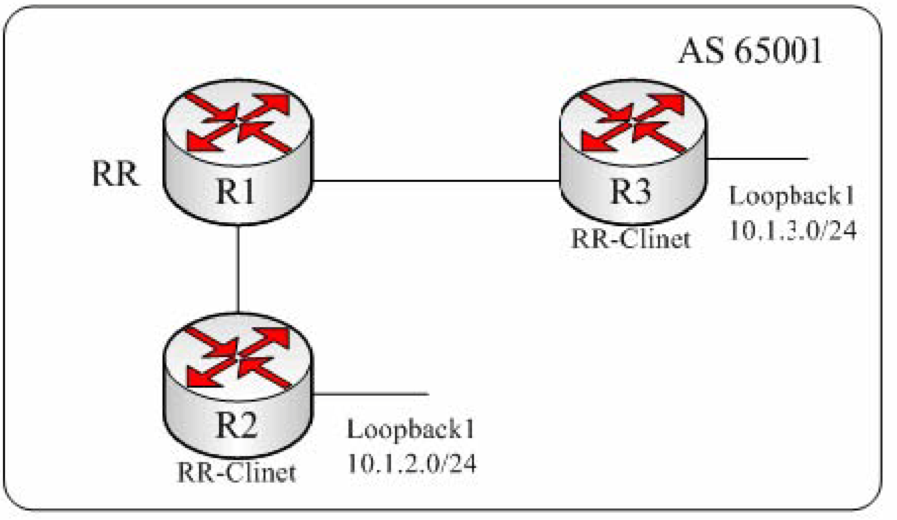
```
ip prefix-list cisco seq 5 deny 10.10.2.0/24
ip prefix-list cisco seq 10 permit 0.0.0.0/0 le 32
router bgp 300
neighbor 23.1.1.2 prefix-list cisco in
```

查看R3的BGP表确认路由被过滤

```
R3#sh ip bgp
BGP table version is 10, local router ID is 34.1.1.3
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.10.0.0/16     23.1.1.2                 0             0 200 i
*> 10.10.1.0/24     23.1.1.2                               0 200 100 i
*> 10.10.3.0/24     23.1.1.2                               0 200 100 i
```

LAB15:BGP路由反射器

适用场合：



IBGP在默认情况下有这样一个原则“从IBGP邻居学来的路由不会再传给其他的IBGP邻居”.这样一来在AS内部为了保证IBGP间路由收敛,需要进行全互联。IBGP邻接数目为 n(n-1)/2.

如果采用RR话,就可以有效的减小邻接数目，适合IBGP对等体关系很多的情况下使用。

RFC 1966定义了三个规则，根据学习到路由的途径，**RR**通过这三条规则来决定将路由公布给谁**:**

(1)如果路由是从非客户的**IBGP**对等学习到的，只将它反射给客户。

(2)如果路由是从客户处学习到的，将它反射给除了发起该路由的客户外的所有非客户以及客户。

(3)如果路由是从**EBGP**对等处学习到的，将它反射给所有的客户和非客户

需求：

R1/R2/R3建立起来IBGP对等体关系，R2/R3不建立IBGP对等体关系。利用RR让R2/R3互相学习到对方的BGP路由，R2/R3的loopback1接口宣告进BGP。

基本配置;

R1

```
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 neighbor 12.1.1.2 remote-as 100
 neighbor 13.1.1.3 remote-as 100
 no auto-summary
```

R2

```
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 network 10.1.2.0 mask 255.255.255.0
 neighbor 12.1.1.1 remote-as 100
 no auto-summary
ip route 13.1.1.0 255.255.255.0 12.1.1.1 确保BGP下一跳可达的静态路由
```

R3

```
router bgp 100
 no synchronization
 bgp log-neighbor-changes
 network 10.1.3.0 mask 255.255.255.0
 neighbor 13.1.1.1 remote-as 100
 no auto-summary
ip route 12.1.1.0 255.255.255.0 13.1.1.1确保BGP下一跳可达的静态路由
```

首先我们查看R2/R3的BGP路由表，发现并没有互相学习到IBGP路由，因为这是IBGP水平分割原则造成。

R1配置RR反射器

router bgp 100

neighbor 12.1.1.2 route-reflector-client

```
R2#sh ip bgp
BGP table version is 2, local router ID is 10.1.2.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.2.0/24      0.0.0.0                  0         32768 i
```

neighbor 13.1.1.3 route-reflector-client

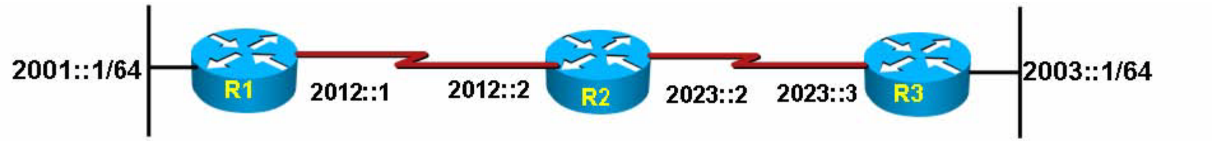
再次查看R2/R3路由，发现可以通过RR学习到对方的IBGP路由

```
R2#sh ip bgp
BGP table version is 3, local router ID is 10.1.2.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.1.2.0/24      0.0.0.0                  0         32768 i
*>i10.1.3.0/24      13.1.1.3                 0    100      0 i
```

IPV6分解试验部分

LAB1:IPV6静态路由试验

试验需求：



配置IPV6静态路由保证全网互通

配置：

配置接口IP

```
interface Serial1/2
ipv6 address 2012::1/64
```

其他接口配置省略....

配置静态路由

R1

```
ipv6 unicast-routing        开启IPV6单播路由功能。类似于IPV4的ip routing.
ipv6 route 2003::/64 2012::2
ipv6 route 2023::/64 2012::2
```

R2

```
ipv6 unicast-routing
ipv6 route 2001::/64 2012::1
ipv6 route 2003::/64 2023::3
```

R3

```
ipv6 unicast-routing
ipv6 route 2012::/64 2023::2
ipv6 route 2001::/64 2023::2
```

检验：

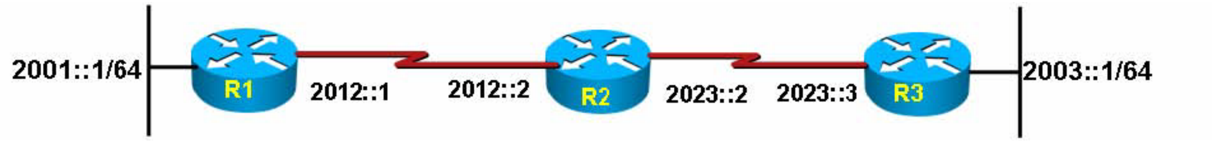
```
R1#show ipv6 route
IPv6 Routing Table - 8 entries

C   2001::/64 [0/0]
     via ::, Loopback0
L   2001::1/128 [0/0]
     via ::, Loopback0
S   2003::/64 [1/0]
     via 2012::2
C   2012::/64 [0/0]
     via ::, Serial1/2
L   2012::1/128 [0/0]
     via ::, Serial1/2
S   2023::/64 [1/0]
     via 2012::2
L   FE80::/10 [0/0]
     via ::, Null0
L   FF00::/8 [0/0]
     via ::, Null0
```

PING测试

```
R1#ping 2003::1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2003::1, timeout is 2 seconds:
!!!!!
```

LAB2：RIPNG基本试验

RIP基本概述：



其基本原理和IPV4 RIP基本一致。都是距离矢量的算法。部分区别如下：

·

UDP端口号：IPv4中的RIP使用UDP520号端口，IPv6中的RIPng使用UDP521号端口

本地链路地址：使用本地链路地址作为更新消息的源地址

组播地址：IPv4中的RIP使用224.0.0.9， IPv6中的RIPng使用FF02::9

Metric值：在RIPng中，默认情况下，进入路由选择表之前RIPng度量值加1

需求：配置RIPNG全网互通

配置：

R1

```
ipv6 router rip cisco     开启RIP进程 名称为cisco
interface Loopback0
ipv6 address 2001::1/64
 ipv6 rip cisco enable    接口下调用RIP，类似于IPV4 RIP的宣告
interface Serial1/2
ipv6 address 2012::1/64
 ipv6 rip cisco enable
```

其他路由器配置类似，省略...

检验：

```
R1#show ipv6 route
IPv6 Routing Table - 8 entries

C   2001::/64 [0/0]
     via ::, Loopback0
L   2001::1/128 [0/0]
     via ::, Loopback0
R   2003::/64 [120/3]
     via FE80::CE00:FFF:FEB8:0, Serial1/2
C   2012::/64 [0/0]
     via ::, Serial1/2
L   2012::1/128 [0/0]
     via ::, Serial1/2
R   2023::/64 [120/2]
     via FE80::CE00:FFF:FEB8:0, Serial1/2
L   FE80::/10 [0/0]
     via ::, Null0
L   FF00::/8 [0/0]
     via ::, Null0
```

.

注意观察RIP度量是3不是2，为什么呢？因为进入路由选择表之前RIPng度量值加1

LAB3:RIPng发放缺省路由方法

试验需求：

R1向R2发放缺省路由

配置：

R1

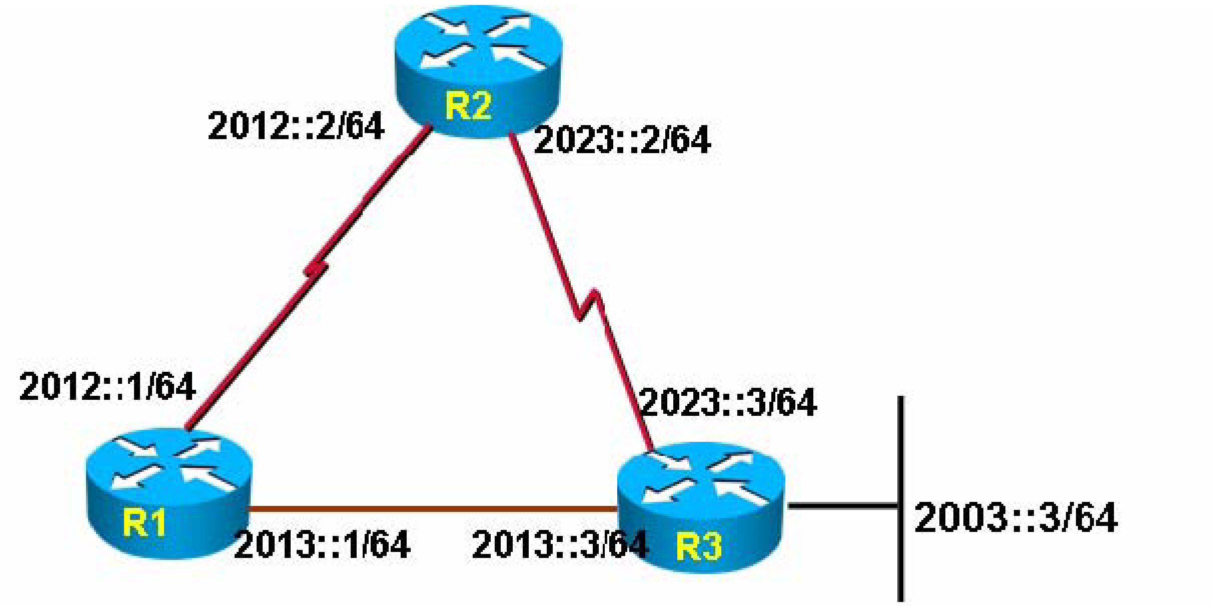
```
ipv6 unicast-routing
interface Serial1/2
ipv6 address 2012::1/64
 ipv6 rip cisco enable
 ipv6 rip cisco default-information originate 发放缺省
ipv6 router rip cisco
```

R2配置省略…

检验：

```
R2#show ipv route
IPv6 Routing Table - 7 entries

R   ::/0 [120/2]
     via FE80::CE00:6FF:FE4C:0, Serial1/3
C   2001::/64 [0/0]
     via ::, Serial1/3
L   2001::2/128 [0/0]
     via ::, Serial1/3
C   2012::/64 [0/0]
     via ::, Serial1/3
L   2012::2/128 [0/0]
     via ::, Serial1/3
L   FE80::/10 [0/0]
     via ::, Null0
L   FF00::/8 [0/0]
     via ::, Null0
```

LAB4:调整RIPng度量



试验需求:

R2正常情况下访问2003::3肯定会优选R3到达，因为它的跳数少。现在我们通过调整RIPng的度量来影响R2的选路，让它优选R1到达R3身后网络。

配置:

每个路由器配置好接口IPV6地址，开启RIPNG进程。步骤省略。参考上面试验的配置。

检验:

```
R2#show ipv route rip
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
R   2003::/64 [120/2]
     via FE80::CE00:DFF:FE74:0, Serial1/2
R   2013::/64 [120/2]
     via FE80::CE00:6FF:FE4C:0, Serial1/3
```

上图可以看到，R2选择S1/2接口出去到达2003网络。也就是选择R3到达

修改度量

R2

interface Serial1/2

ipv6 rip cisco metric-offset 4　把度量加大为4

再次查看

```
R2#show ipv route rip
IPv6 Routing Table - 8 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
R   2003::/64 [120/3]
     via FE80::CE00:6FF:FE4C:0, Serial1/3
R   2013::/64 [120/2]
     via FE80::CE00:6FF:FE4C:0, Serial1/3
```

选择S1/3接口到达R3。也就是选择了R1-R3这条路径。

LAB5:Eigrp IPV6

概述：

EIGRP IPV6不是所有IOS都支持，本次试验采用的是ADVENTERPRISEK9-M, Version 12.4(15)T1的版本。

EIGRP IPV6的原理和IPV4的EIGRP原理基本一致。

配置：

```
R1(config)#ipv6 unicast-routing
R1(config)#ipv6 router eigrp 1
R1(config-rtr)#router-id 1.1.1.1   必须要配置，不然邻居起不来。特别注意
R1(config-rtr)#no shutdown         激活EIGRP，也是必须要配置

R1(config)#interface fastEthernet 0/0
R1(config-if)#ipv6 eigrp 1
R1(config)#interface loopback 0
R1(config-if)#ipv6 eigrp 1
```

R2配置类似，省略.....

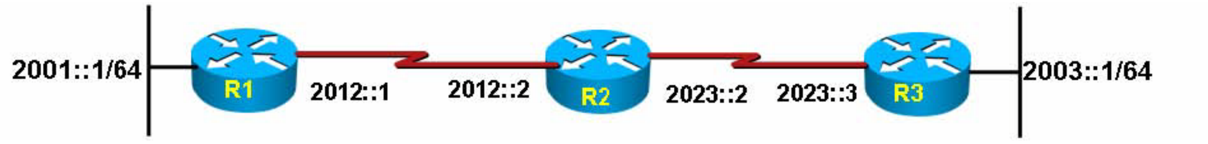
检验：

```
R1#show ipv6 eigrp neighbors
IPv6-EIGRP neighbors for process 1
H   Address              Interface      Hold Uptime   SRTT   RTO  Q  Seq
                                        (sec)         (ms)        Cnt Num
0   Link-local address:  Fa0/0          11 00:03:33   64     576  0  3
    FE80::C200:17FF:FE24:0
```

```
R1#show ipv6 route eigrp

D   2002::/64 [90/409600]
     via FE80::C200:17FF:FE24:0, FastEthernet0/0
```

LAB6:OSPF V3基本配置和认证

概述:



使用相同的数据包类型，如**hello**、**DBD**、**LSR**、**LSU**、**LSAck**。

- 邻居关系建立机制相同。
- **LSA**泛洪和衰老机制相同。

- **OSPFv3** 不向下兼容，它不支持**IPv4**环境。
- **OSPFv3**和**OSPFv2**认证模式不一样
- **OSPFv2**使用**IP**协议号**89**；在**OSPFv3**的**IPv6**包中，**next-header**值为**89**。
- **OSPFv3**的**Router-ID**、**Area-ID**、**LSA ID**依然使用**32bit**长度。
- **OSPFv3**的源地址和下一跳地址使用本地链路地址。
- **OSPFv3**的组播地址为**FF02::5**和**FF02::6**

配置:

R1

```
ipv6 unicast-routing

ipv6 router ospf 1
 router-id 1.1.1.1
 log-adjacency-changes


interface Loopback0
 no ip address
 ipv6 address 2001::1/64
```

```
 ipv6 ospf 1 area 0

interface FastEthernet0/0
 ipv6 address 2012::1/64
 ipv6 ospf 1 area 0
```

其他路由器配置参考R1，省略.....

认证配置：

配置OSPF认证,就要使用安全策略,安全策略由SPI,key组成,所有在配置认证的时候要求配置SPI和key值

Interface fastethernet0/0

```
 ipv6 ospf authentication ipsec spi 256 md5 1234567890ABCDEF1234567890ABCD0E
```

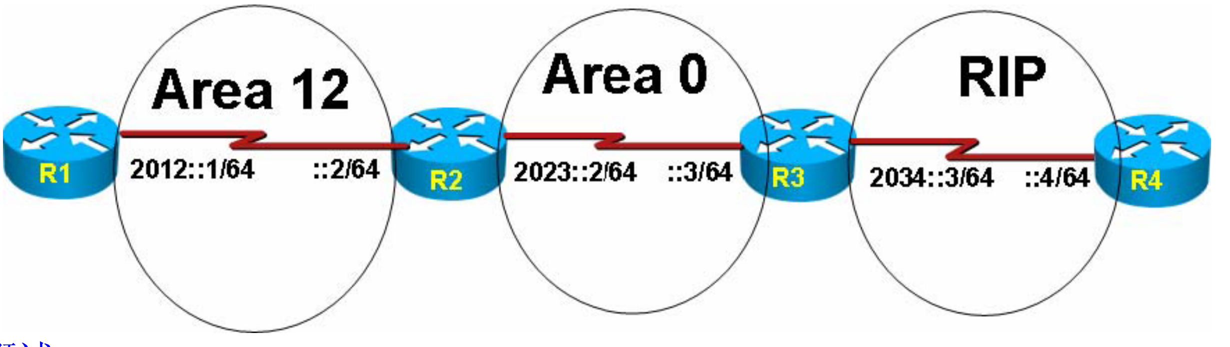
SPI是安全参数索引值，md5是加密算法，最后面是加密的key 必须要达到32位

检验：

```
R1#show ipv6 ospf nei

Neighbor ID     Pri   State           Dead Time   Interface ID    Interface
2.2.2.2           1   FULL/DR         00:00:39    4               FastEthernet0/0
```

```
R1#show ipv6 route ospf
IPv6 Routing Table - 6 entries

O   2002::2/128 [110/10]
     via FE80::C200:17FF:FE24:0, FastEthernet0/0
```

LAB7:OSPF V3多区域



概述：

OSPFv3 LSAs		OSPFv2 LSAs	
LS Type	Name	Type	Name
0x2001	Router LSA	1	Router LSA
0x2002	Network LSA	2	Network LSA
0x2003	Inter-Area Prefix LSA	3	Network Summary LSA
0x2004	Inter-Area Router LSA	4	ASBR Summary LSA
0x4005	AS-External LSA	5	AS-External LSA
0x2006	Group Membership LSA	6	Group Membership LSA
0x2007	Type-7 LSA	7	NSSA External LSA
0x0008	Link LSA		No Corresponding LSA
0x2009	Intra-Area Prefix LSA		No Corresponding LSA

上图是OSPF V3和V2的LSA类型的对比，V3增加了2中新的LSA类型。分别是**Intra-Area-Prefix-LSA**及**Link-LSA**

Intra-area Prefix LSA作用：

在**OSPFv3**中，**Router LSA**和**Network LSA**只提供拓扑信息。

- 链路的前缀由**Intra-area Prefix LSA**通告。
- 当链路的前缀发生改变时，只需要将**Intra-area Prefix LSA**通告到整个**AS**，而不用重新进行**SPF**运算。
- 增强了**OSPF**的稳定性。

Link-LSA作用：

□.

0x2008 Link LSA

用于两个直连邻居之间的通信。

由于**flooding scope**的限制，**link-LSA**不会被转发到其他链路上。

列出连接到此链路上的所有**IPv6**的前缀

原来的**2**个**LSA**被改名

Summary-LSA被改名为**Inter-Area-Prefix-LSA**

ASBR-Summary-LSA被改名为**Inter-Router-Prefix-LSA**

试验需求：

查看掌握OSPF V3的区域类型。

配置：

```
R1
interface Loopback0
 no ip address
 ipv6 address 2001::1/64
 ipv6 ospf 1 area 12


interface Serial1/2
 no ip address
```

```
 ipv6 address 2012::1/64
 ipv6 ospf 1 area 12

ipv6 router ospf 1
 router-id 1.1.1.1

R2
interface Loopback0
 no ip address
 ipv6 address 2002::2/64
 ipv6 ospf 1 area 12


interface Serial1/2
 no ip address
 ipv6 address 2023::2/64
 ipv6 ospf 1 area 0

interface Serial1/3
 no ip address
 ipv6 address 2012::2/64
 ipv6 ospf 1 area 12

ipv6 router ospf 1
 router-id 2.2.2.2
 log-adjacency-changes
R3

interface Loopback0
```

```
 no ip address
 ipv6 address 2003::3/64
 ipv6 ospf 1 area 0

interface Serial1/2
 no ip address
 ipv6 address 2034::3/64
 ipv6 rip cisco enable
interface Serial1/3
 no ip address
 ipv6 address 2023::3/64
 ipv6 ospf 1 area 0

ipv6 router ospf 1
 router-id 3.3.3.3
 log-adjacency-changes
 redistribute rip cisco
ipv6 router rip cisco
```

检验：

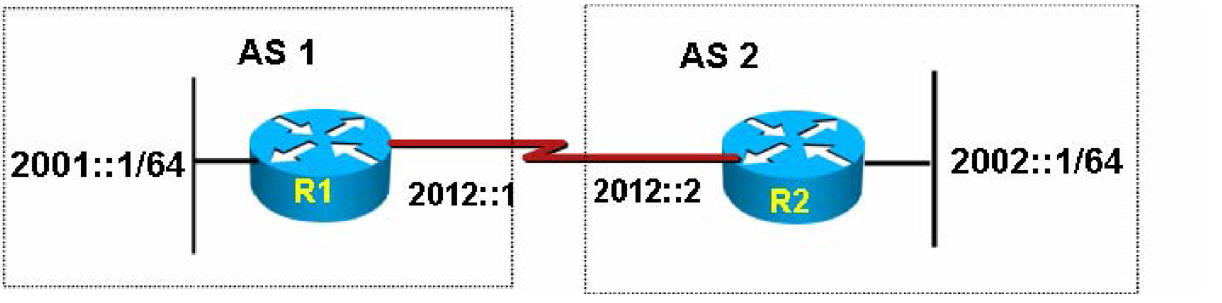
查看路由表

```
R1#show ipv6 route
IPv6 Routing Table - 10 entries

C   2001::/64 [0/0]
     via ::, Loopback0
L   2001::1/128 [0/0]
     via ::, Loopback0
O   2002::2/128 [110/64]
     via FE80::CE00:14FF:FE94:0, Serial1/2
OI  2003::3/128 [110/128]
     via FE80::CE00:14FF:FE94:0, Serial1/2
OE2  2004::/64 [110/20]
     via FE80::CE00:14FF:FE94:0, Serial1/2
C   2012::/64 [0/0]
     via ::, Serial1/2
L   2012::1/128 [0/0]
     via ::, Serial1/2
OI  2023::/64 [110/128]
     via FE80::CE00:14FF:FE94:0, Serial1/2
L   FE80::/10 [0/0]
     via ::, Null0
L   FF00::/8 [0/0]
     via ::, Null0
```

查看LSDB

```
R1#show ipv6 ospf database

        OSPFv3 Router with ID (1.1.1.1) (Process ID 1)

          Router Link States (Area 12)  ——→  1号LSA

ADV Router     Age       Seq#        Fragment ID  Link count  Bits
1.1.1.1        471       0x80000003  0            1           None
2.2.2.2        459       0x80000003  0            1           B

          Inter Area Prefix Link States (Area 12)  ——→  3号LSA

ADV Router     Age       Seq#        Prefix
2.2.2.2        458       0x80000001  2023::/64
2.2.2.2        183       0x80000001  2003::3/128

          Inter Area Router Link States (Area 12)  ——→  4号LSA

ADV Router     Age       Seq#        Link ID    Dest RtrID
2.2.2.2        352       0x80000001  50529027   3.3.3.3

          Link (Type-8) Link States (Area 12)  ——→  8号LSA

ADV Router     Age       Seq#        Link ID    Interface
1.1.1.1        499       0x80000001  10         Se1/2
2.2.2.2        473       0x80000001  11         Se1/2

          Intra Area Prefix Link States (Area 12)  ——→  9号LSA

ADV Router     Age       Seq#        Link ID    Ref-lstype  Ref-LSID
1.1.1.1        494       0x80000002  0          0x2001      0
2.2.2.2        460       0x80000002  0          0x2001      0

          Type-5 AS External Link States  ——→  5号LSA

ADV Router     Age       Seq#        Prefix
3.3.3.3        358       0x80000001  2004::/64
```

LAB8:BGP 4+基本试验



BGP 4+概述：

·

传统的BGP-4 只能管理IPv4的路由信息，对于使用其它网络层协议（如IPv6等）的应用，在跨自治系统传播时就受到一定限制。

为了提供对多种网络层协议的支持，IETF对BGP-4 进行了扩展，形成BGP4+，目前 的BGP4+ 标准是RFC2858（Multiprotocol Extensions for BGP-4，BGP-4多协议扩展）。

配置：

R1

```
router bgp 1
 bgp router-id 1.1.1.1
 no bgp default ipv4-unicast
neighbor 2012::2 remote-as 2

 address-family ipv6
 neighbor 2012::2 activate
 network 2001::/64
 exit-address-family
```

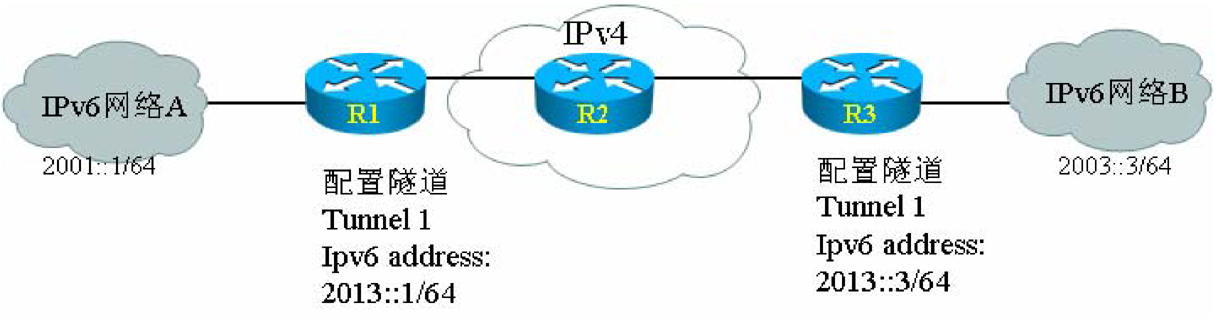
R2省略.....

检验：

```
R1#show bgp ipv6 unicast summary
BGP router identifier 1.1.1.1, local AS number 1
BGP table version is 3, main routing table version 3
2 network entries using 298 bytes of memory
2 path entries using 152 bytes of memory
3/2 BGP path/bestpath attribute entries using 372 bytes of memory
1 BGP AS-PATH entries using 24 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 846 total bytes of memory
BGP activity 2/0 prefixes, 2/0 paths, scan interval 60 secs

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
2012::2         4     2       5       5        3    0    0 00:01:59        1
```

```
R1#show bgp ipv6 unicast
BGP table version is 3, local router ID is 1.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 2001::/64        ::                       0         32768 i
*> 2002::/64        2012::2                  0             0 2 i
```

LAB9:IPV6 to IPV4 tunnel



需求:

上图中，中间3台路由器运行的IPV4的网络。IPV6网络被分割。我们通过配置TUNNEL技术解决这个问题，能够让IPV6网络之间能够通讯。

配置:

首先配置好三台路由器的IPV4地址，设置好静态路由，配置省略....

```
R1
interface Loopback0
 no ip address
 ipv6 address 2001::1/64
interface Tunnel1
 no ip address
 ipv6 address 2013::1/64
 tunnel source Serial1/2
 tunnel destination 23.1.1.3
 tunnel mode ipv6ip
ipv6 route 2003::/64 Tunnel1 把路由引导到TUNNEL接口中
R3
interface Loopback0
 no ip address
 ipv6 address 2003::3/64
interface Tunnel1
 no ip address
 ipv6 address 2013::3/64
```

```
 tunnel source Serial1/3
 tunnel destination 12.1.1.1
 tunnel mode ipv6ip
ipv6 route 2001::/64 Tunnel1
```

检验:

测试IPV6网络之间能否PING通？