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一、环境准备

1. 软件：GNS3

2. 路由：c7200

二、实验操作

实验要求：

1、 理解 RIP 协议的工作原理

2、 理解 RIPv1、RIPv2 的特性

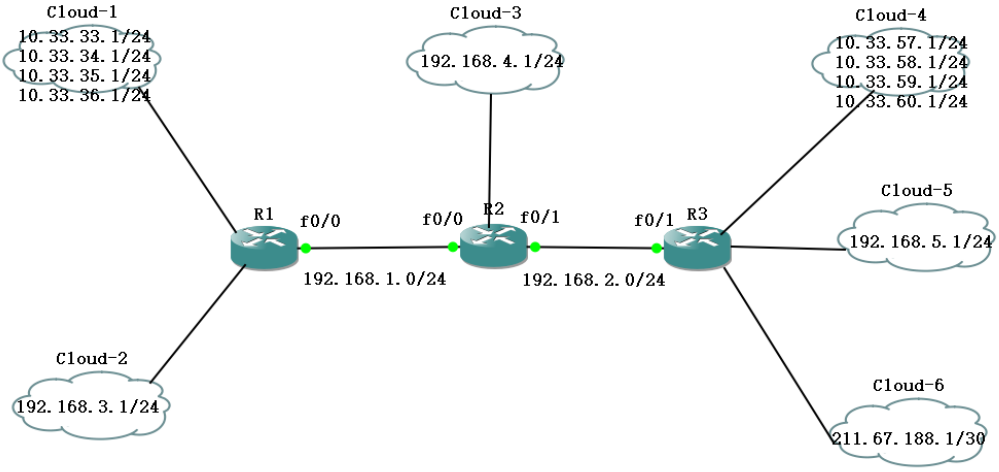
3、 掌握 RIP 协议的基本配置方法

4、 掌握 RIP 自动汇总和手动汇总的方法

5、 掌握 RIP 配置默认路由的方法

6、 掌握 RIP 认证的基本配置

实验拓扑：



实验过程：

1、根据实验拓扑，对路由器各接口配置 IP 地址，配置清单如下。

```
R1 配置：


hostname R1


interface Loopback0
```

```
ip address 10.33.33.1 255.255.255.0 secondary

ip address 10.33.34.1 255.255.255.0 secondary

ip address 10.33.35.1 255.255.255.0 secondary

ip address 10.33.36.1 255.255.255.0

interface Loopback1

ip address 192.168.3.1 255.255.255.0

interface FastEthernet0/0

ip address 192.168.1.1 255.255.255.0
```

R2 配置：

```
hostname R2

interface Loopback0

ip address 192.168.4.1 255.255.255.0

interface FastEthernet0/0

ip address 192.168.1.2 255.255.255.0

interface FastEthernet0/1

ip address 192.168.2.1 255.255.255.0
```

R3 配置：

```
hostname R3
```

```
interface Loopback0

ip address 10.33.57.1 255.255.255.0 secondary

ip address 10.33.58.1 255.255.255.0 secondary

ip address 10.33.59.1 255.255.255.0 secondary

ip address 10.33.60.1 255.255.255.0

interface Loopback1

ip address 192.168.4.1 255.255.255.0

interface Loopback2

ip address 211.67.188.1 255.255.255.252

interface FastEthernet0/1

ip address 192.168.2.2 255.255.255.0
```

2、在路由器中配置 RIP 协议（注，根据步骤 1 所配置的 IP 地址配置 RIP 协议）

```
R1 配置：

router rip

network 10.0.0.0     注 2

network 192.168.1.0

network 192.168.3.0

R2 配置：
```

```
router rip              注 3

network 192.168.1.0

network 192.168.4.0

R3 配置:

router rip              注 4

network 10.0.0.0

network 192.168.2.0

network 192.168.5.0
```

注 2：network 用来添加网络，在 RIP 中只需添加网络号即可。该命令的作用主要有两个：一是声明 RIP 转发哪些网络的路由表；二是声明在路由器的哪些接口上启用 RIP 协议。

注 3：注意这里没有添加 192.168.2.0，所以接口 f0/0 不会发送和接收 RIP 报文

注 4：这里没有添加 211.68.188.0，这是因为 211.67.188.0 连接 Internet，内部路由不能转发到外网，同时内部的网络也不需要知道外网的情况。

问题 1：配置后在每个路由器上查看路由表，在路由器 R1 和 R2 中能看到 192.168.5.0 吗？在路由器 R3 中能看到路由器 R1 和 R2 中的路由吗？

答：在路由器 R1 和 R2 中不能看到 192.168.5.0。

在路由器 R3 中不能看到路由器 R1 和 R2 中的路由。

R1 路由表

```
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        10.33.33.0/24 is directly connected, Loopback0
L        10.33.33.1/32 is directly connected, Loopback0
C        10.33.34.0/24 is directly connected, Loopback0
L        10.33.34.1/32 is directly connected, Loopback0
C        10.33.35.0/24 is directly connected, Loopback0
L        10.33.35.1/32 is directly connected, Loopback0
C        10.33.36.0/24 is directly connected, Loopback0
L        10.33.36.1/32 is directly connected, Loopback0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.1/32 is directly connected, FastEthernet0/0
      192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.3.0/24 is directly connected, Loopback1
L        192.168.3.1/32 is directly connected, Loopback1
R     192.168.4.0/24 [120/1] via 192.168.1.2, 00:00:16, FastEthernet0/0
R1#
```

R2 路由表

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

R     10.0.0.0/8 [120/1] via 192.168.1.1, 00:00:25, FastEthernet0/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.2/32 is directly connected, FastEthernet0/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, FastEthernet0/1
L        192.168.2.1/32 is directly connected, FastEthernet0/1
R     192.168.3.0/24 [120/1] via 192.168.1.1, 00:00:25, FastEthernet0/0
      192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.4.0/24 is directly connected, Loopback0
L        192.168.4.1/32 is directly connected, Loopback0
R2#
```

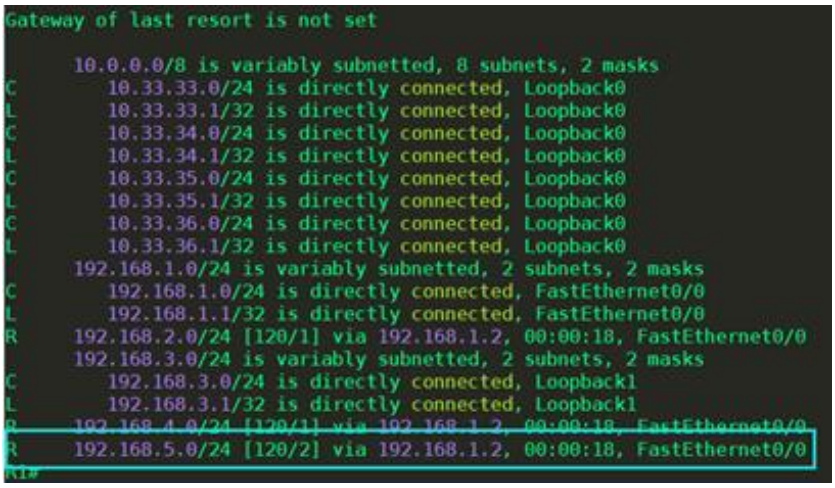
R3 路由表

```
      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        10.33.57.0/24 is directly connected, Loopback0
L        10.33.57.1/32 is directly connected, Loopback0
C        10.33.58.0/24 is directly connected, Loopback0
L        10.33.58.1/32 is directly connected, Loopback0
C        10.33.59.0/24 is directly connected, Loopback0
L        10.33.59.1/32 is directly connected, Loopback0
C        10.33.60.0/24 is directly connected, Loopback0
L        10.33.60.1/32 is directly connected, Loopback0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, FastEthernet0/1
L        192.168.2.2/32 is directly connected, FastEthernet0/1
      192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.4.0/24 is directly connected, Loopback1
L        192.168.4.1/32 is directly connected, Loopback1
      211.67.188.0/24 is variably subnetted, 2 subnets, 2 masks
C        211.67.188.0/30 is directly connected, Loopback2
L        211.67.188.1/32 is directly connected, Loopback2
R3#
```

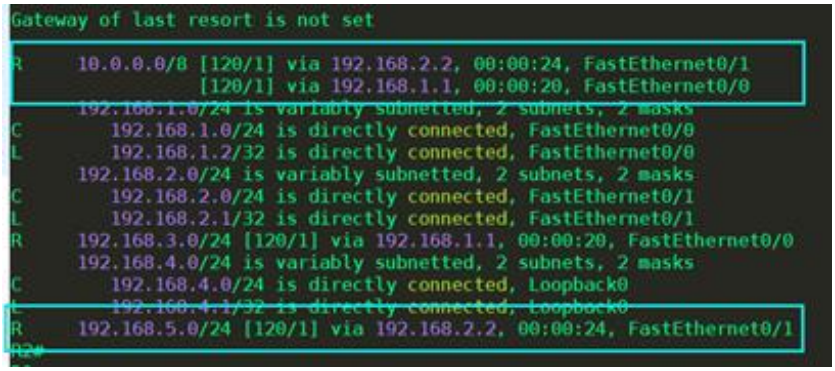
问题 2：现在在路由器 R2 中添加 192.168.2.0，再查看每个路由器的路由表，看有什么变化？

答：每一个路由器都包含其它路由器的路由信息。

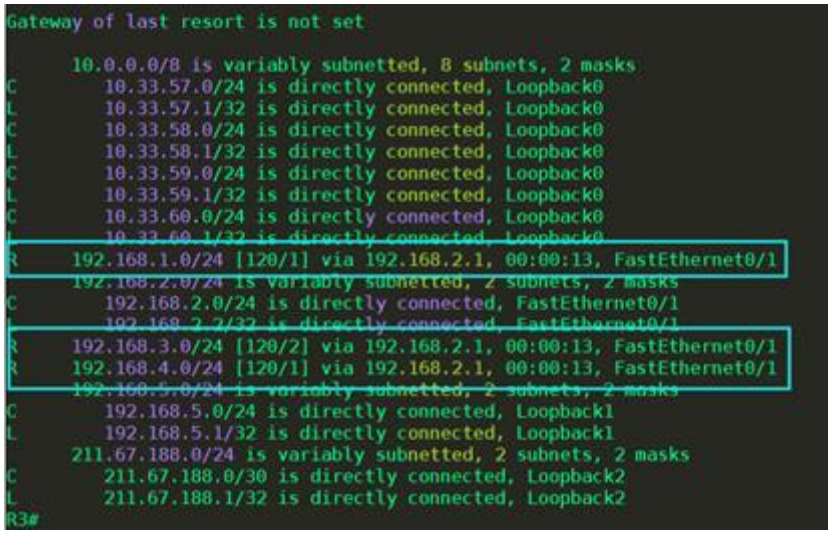
R1 路由表



R2 路由表



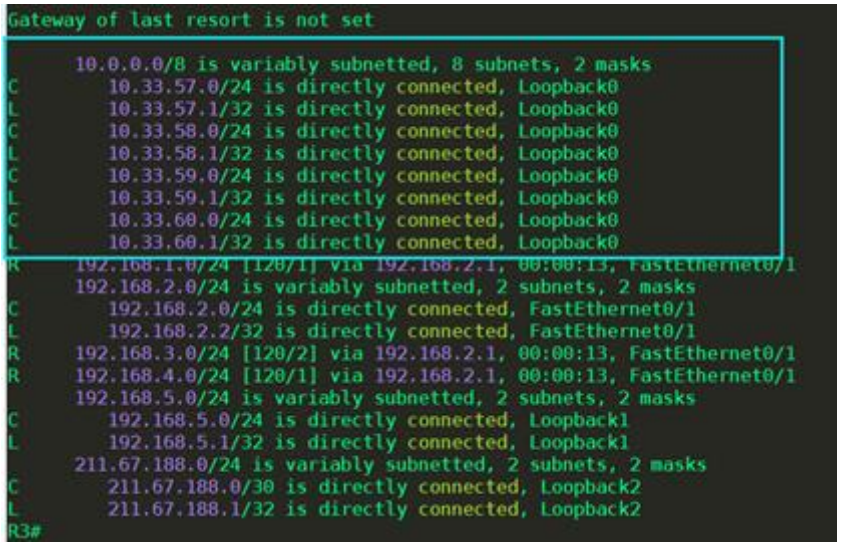
R3 路由表



问题 3：这时在路由器 R3 中 ping 10.33.34.1 看能否 ping 通，为什么？提示：看路由表

答：路由器 R3 ping 10.33.34.1 不能 ping 通。因为 R3 路由表中没有到达 10.33.34.1IP 网络的路由条目。

R3 路由表



3、测试不同版本 RIP 协议之间的数据传递，在路由器 R1 中启用 RIPv2，然后在每个路由器中删除当前路由表，重新生成路由表后，查看各路由器中路由表变化。

```
启用 RIPv2 命令:

R1(config)#router rip

R1(config-router)#version 2

删除路由表命令:

R1#clear ip route *
```

R1 路由表

```
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        10.33.33.0/24 is directly connected, Loopback0
L        10.33.33.1/32 is directly connected, Loopback0
C        10.33.34.0/24 is directly connected, Loopback0
L        10.33.34.1/32 is directly connected, Loopback0
C        10.33.35.0/24 is directly connected, Loopback0
L        10.33.35.1/32 is directly connected, Loopback0
C        10.33.36.0/24 is directly connected, Loopback0
L        10.33.36.1/32 is directly connected, Loopback0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.1/32 is directly connected, FastEthernet0/0
      192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.3.0/24 is directly connected, Loopback1
L        192.168.3.1/32 is directly connected, Loopback1
R1#
```

R2 路由表

```
R2#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is not set

R     10.0.0.0/8 [120/1] via 192.168.2.2, 00:00:19, FastEthernet0/1
                 [120/1] via 192.168.1.1, 00:00:04, FastEthernet0/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.2/32 is directly connected, FastEthernet0/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, FastEthernet0/1
L        192.168.2.1/32 is directly connected, FastEthernet0/1
R     192.168.3.0/24 [120/1] via 192.168.1.1, 00:00:04, FastEthernet0/0
      192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.4.0/24 is directly connected, Loopback0
L        192.168.4.1/32 is directly connected, Loopback0
R     192.168.5.0/24 [120/1] via 192.168.2.2, 00:00:19, FastEthernet0/1
R2#
```

R3 路由表

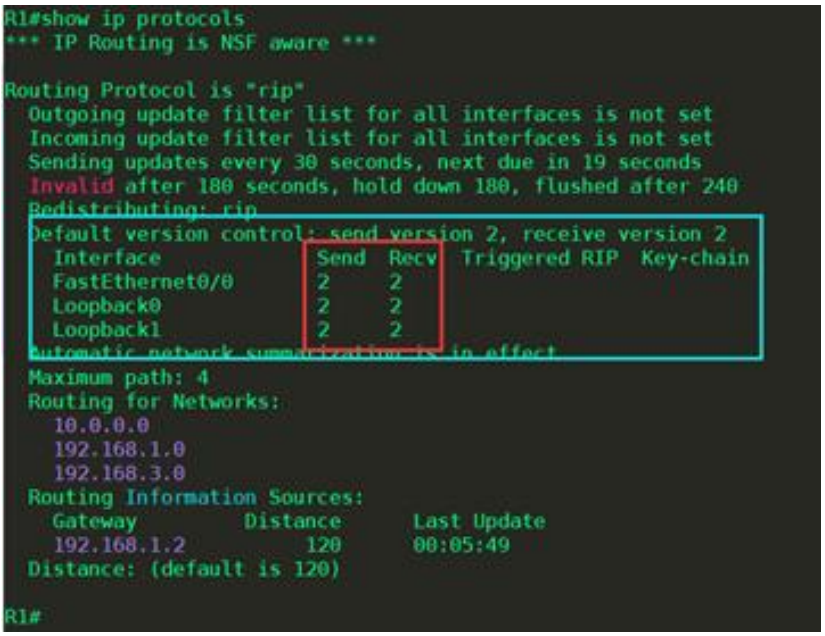
```
Gateway of last resort is not set

      10.0.0.0/8 is variably subnetted, 8 subnets, 2 masks
C        10.33.57.0/24 is directly connected, Loopback0
L        10.33.57.1/32 is directly connected, Loopback0
C        10.33.58.0/24 is directly connected, Loopback0
L        10.33.58.1/32 is directly connected, Loopback0
C        10.33.59.0/24 is directly connected, Loopback0
L        10.33.59.1/32 is directly connected, Loopback0
C        10.33.60.0/24 is directly connected, Loopback0
L        10.33.60.1/32 is directly connected, Loopback0
R     192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:01, FastEthernet0/1
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, FastEthernet0/1
L        192.168.2.2/32 is directly connected, FastEthernet0/1
R     192.168.3.0/24 [120/2] via 192.168.2.1, 00:00:01, FastEthernet0/1
R     192.168.4.0/24 [120/1] via 192.168.2.1, 00:00:01, FastEthernet0/1
      192.168.5.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.5.0/24 is directly connected, Loopback1
L        192.168.5.1/32 is directly connected, Loopback1
      211.67.188.0/24 is variably subnetted, 2 subnets, 2 masks
C        211.67.188.0/30 is directly connected, Loopback2
L        211.67.188.1/32 is directly connected, Loopback2
R3#
```

问题 4：在 R1 中能否看到 R2 和 R3 中的路由？在 R2 中能否看到 R1 的路由。

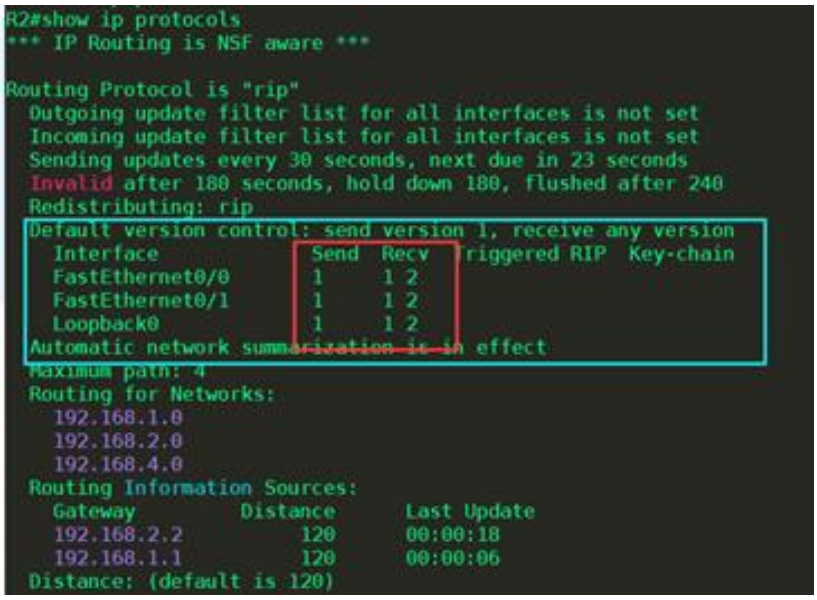
答：1. 在 R1 中不能看到 R2 和 R3 中的路由。因为 R1 接收的是 RIP2 的报文信息，而 R2、R3 发送的是 RIP1 报文信息，所以 R1 没法更新自己的路由表。

2. 在 R2 中能看到 R1 的路由。因为 R2 可以接收来自 R1 使用 RIP2 发送的路由报文信息。

R1 使用的路由协议 //只能 Rec2 的路由报文信息



R2 使用的路由协议 //可以 Rec1、2 的路由报文信息



4、配置手动汇总，解决“问题 3”中无法通信问题。

（1）首先，在 R2 和 R3 中也启用 RIPv2，命令参考 R1 中启用 RIPv2 命令。

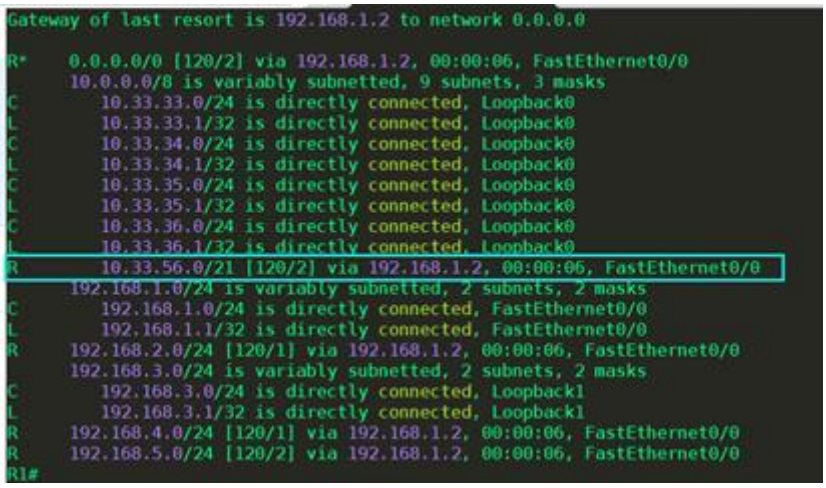
（2）在每个路由器中关闭自动汇总，关闭自动汇总参考命令：

```
R1(config-router)#no auto-summary
```

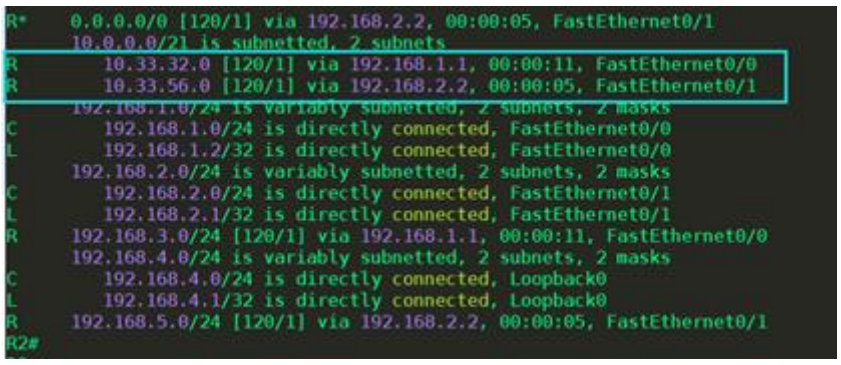
（3）在路由器 R1 的接口 f0/0 、R3 的接口 f0/1 中配置手动汇总：

```
R1(config-if)#interface f0/0


R1(config-if)#ip summary-address rip 10.33.32.0 255.255.248.0  注 5


R3(config-if)#interface f0/1


R3(config-if)#ip summary-address rip 10.33.56.0 255.255.248.0
```

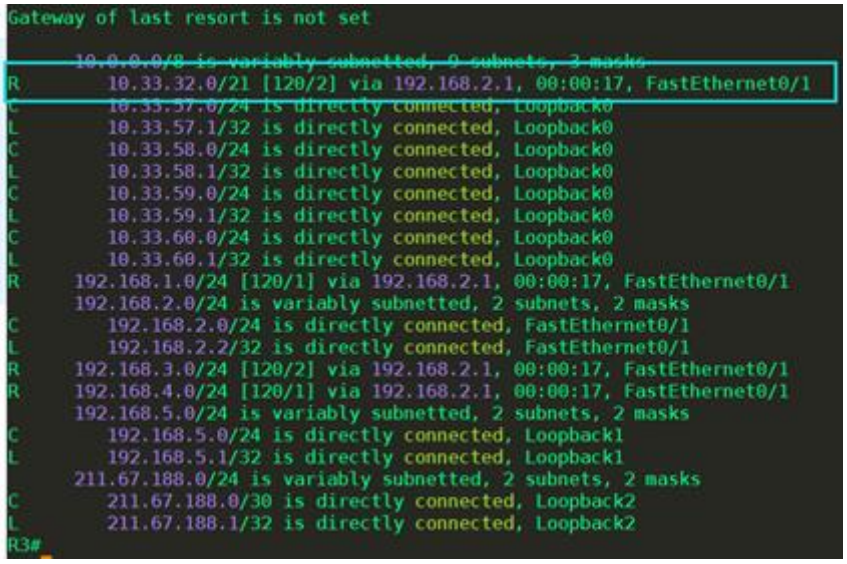
R1 路由表



R2 路由表



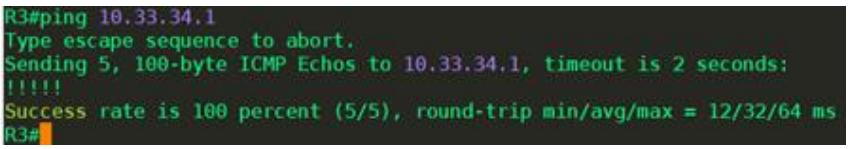
R3 路由表



注 5：该命令格式为 ip summary-address rip 网络地址 子网掩码，命令的作用是在该接口上向外发送路由更新时把多个网络汇总成一个路由条目。

问题 5：此时在路由器 R3 上 ping 10.33.34.1，能否 ping 通？

答：路由器 R3 ping 10.33.34.1 能 ping 通。



5、在路由器 R3 上启用默认路由，让内部网络可以访问 Internet。在路由器 R3 上配置静态默认路由

```
R3(config)#ip route 0.0.0.0 0.0.0.0 211.33.188.2
```

在路由器 R3 中配置向其他路由器注入默认路由

```
R3(config)#router rip


R3(config-router)#default-information originate
```

问题 6：在 R1 和 R2 中查看路由表，有什么变化？此时在 R1 中 ping 211.67.188.1，能否 ping 通？

答：变化：R1、R2 中出现默认路由条目。

在 R1 中 ping 211.67.188.1，能 ping 通。

R1 路由表

```
Gateway of last resort is 192.168.1.2 to network 0.0.0.0

R*    0.0.0.0/0 [120/4] via 192.168.1.2, 00:00:23, FastEthernet0/0
      10.0.0.0/8 is variably subnetted, 9 subnets, 3 masks
C        10.33.33.0/24 is directly connected, Loopback0
L        10.33.33.1/32 is directly connected, Loopback0
C        10.33.34.0/24 is directly connected, Loopback0
L        10.33.34.1/32 is directly connected, Loopback0
C        10.33.35.0/24 is directly connected, Loopback0
L        10.33.35.1/32 is directly connected, Loopback0
C        10.33.36.0/24 is directly connected, Loopback0
L        10.33.36.1/32 is directly connected, Loopback0
```

R2 路由表

```
Gateway of last resort is 192.168.2.2 to network 0.0.0.0

R*    0.0.0.0/0 [120/1] via 192.168.2.2, 00:00:13, FastEthernet0/1
R     10.0.0.0/8 [120/1] via 192.168.2.2, 00:00:13, FastEthernet0/1
                 [120/1] via 192.168.1.1, 00:00:06, FastEthernet0/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.1.0/24 is directly connected, FastEthernet0/0
L        192.168.1.2/32 is directly connected, FastEthernet0/0
      192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.2.0/24 is directly connected, FastEthernet0/1
L        192.168.2.1/32 is directly connected, FastEthernet0/1
R     192.168.3.0/24 [120/1] via 192.168.1.1, 00:00:06, FastEthernet0/0
      192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C        192.168.4.0/24 is directly connected, Loopback0
L        192.168.4.1/32 is directly connected, Loopback0
R     192.168.5.0/24 [120/1] via 192.168.2.2, 00:00:13, FastEthernet0/1
R2#
```

7、 在路由器 R1 和 R2 之间实现认证。

R1 中的配置命令:

```
R1(config)#key chain J

R1(config-keychain)#key 1

R1(config-keychain-key)#key-string 5005170033

R1(config)#interface f0/0

R1(config-if)#ip rip authentication key-chain J

R1(config-if)#ip rip authentication mode md5
```

问题 7: 在 R1 中配置之后，删除 R1 和 R2 的当前路由表，重新生成，在 R1 中能否看到其他路由器上的路由？

答: 在 R1 中不能看到其他路由器上的路由。因为需要认证。

8、 参考 R1 的配置，在 R2 中做同样的认证配置，然后更新路由表，在 R1 中能否看到其他路由器上的路由？注意，R2 中应该在接口 f0/0 中启用认证。

9、 修改路由器 R3 发送出去的路由信息的度量值，参考命令如下：

创建访问控制列表 ACL，配置需要修改 metric 的路由条目

```
R3(config)#access-list 33 permit 192.168.5.0 0.0.0.255

R3(config)#router rip

R3(config-router)#offset-list 33 out 2 f0/1
```

问题 8：修改后查看路由器 R1 上关于 192.168.5.0 的路由，距离是多少？修改前的距离是多少？

答：修改后：4、修改前：2

10、做完所有配置后注意保存，保存命令如下：

R1#write 或者

R1#copy running-config startup-config