浙江大学实验报告

专业：计算机科学与技术
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课程名称：计算机网络　指导老师：张泉方　电子邮件：wutongcs@zju.edu.cn
实验名称：静态路由配置　实验类型：操作型　同组同学：无

一、 实验目的

- 掌握路由器的工作原理和配置方法
- 理解路由和交换的区别和联系
- 理解路由表的原理，掌握子网划分原则
- 理解静态路由的概念，掌握设置静态路由和默认路由的方法

二、 实验内容

- 分别采用静态地址分配、动态地址分配构建多种类型的局域网
- 使用多个路由器连接多个局域网
- 分别采用以太网、高速串口等方式连接路由器
- 通过路由器连接真实网络并实现数据通信
- 在路由器上配置 NAT，实现私有网络和共有网络的互联
- 在各路由器上配置静态路由，实现网络互联互通

三、 主要仪器设备

- PC 机（模拟器）
- 交换机（模拟器）
- 路由器（模拟器）

四、 操作方法与实验步骤

- 按拓扑图连接路由器、交换机和 PC 机。
- 设计每个区域内 PC 和路由器接口的 IP 地址及掩码，其中：Zone1 区域的 IP 子网为 10.0.0.0/16；Zone2 区域的 IP 子网为 10.1.0.0/16；Guest 区域使用 DHCP 动态地址分配，IP 子网为 172.16.0.0/24 和 172.16.1.0/24；Private 区域需要经过 NAT 转换后再和其他区域通信，IP 子网为 192.168.0.0/24；External 区域代表外部实际网络。

- 按照上述设计给 PC 配置合适的 IP 地址及掩码。
- 按照上述设计给各路由器接口分配合适的 IP 地址、掩码并激活接口。
- 给 PC 配置默认路由器地址，测试跨路由器通信。
- 在 R4 路由器上配置 DHCP 服务。
- 配置 R1、R2 路由器之间的串口的数据链路层协议为 HDLC，并设置 IP 地址。
- 配置 R1、R4 路由器之间的串口的数据链路层协议为 PPP，并设置 IP 地址。
- 在各路由器上配置静态路由，使得不相邻路由器之间能够相互通信。
- 在 R5 路由器上配置 NAT 服务，使得 PC6、PC7 以 R5 的 f0/0 接口的 IP 地址对外通信。
- 配置 R1 的 f0/0 接口，使其能够与外部真实网络上的主机进行通信。
- 使用 ping 命令测试各个区域的 PC 之间的联通性，根据需要在相应的路由器上补充静态路由设置。

五、 实验数据记录和处理

1. **设计好每个 PC、路由器各接口的 IP 地址及掩码，并标注在拓扑图上。本实验中，R1 与 Cloud1 相连。**

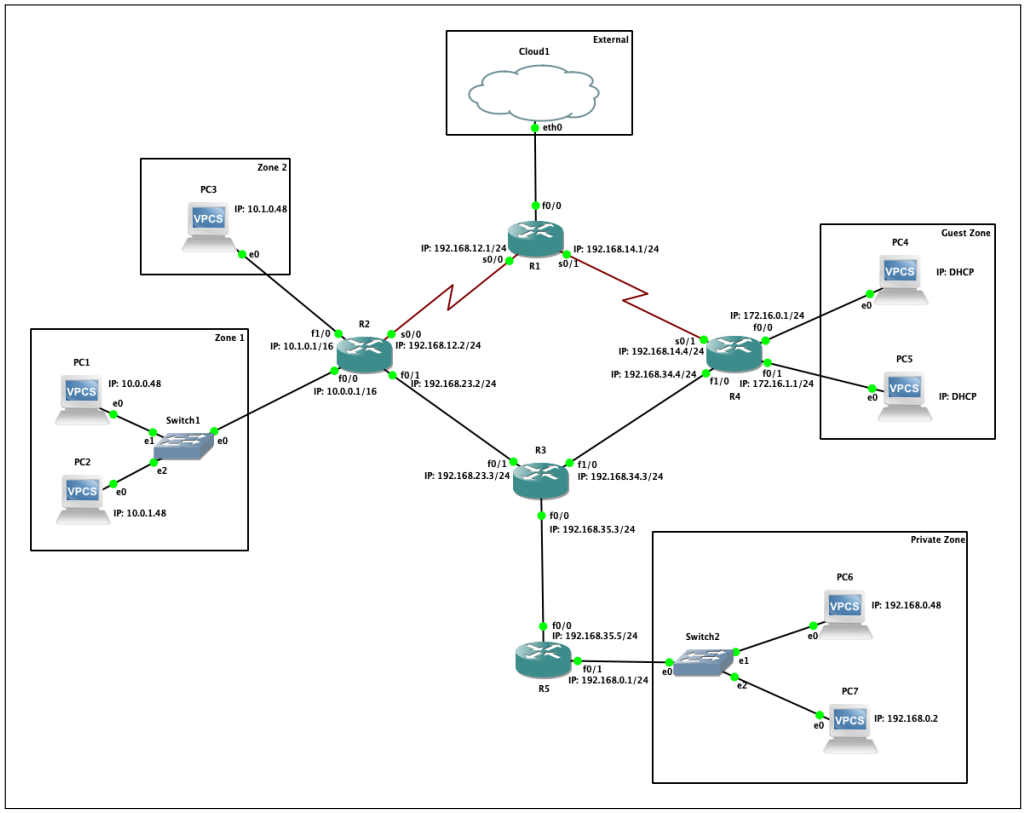

图 1: 实验拓扑图

2. **给 PC1 配置 IP 地址为 10.0.0.48，给 PC2 配置 IP 地址为 10.0.1.48，均使用 24 位长度的掩码，PC1 与 PC2 之间不能 ping 通。**

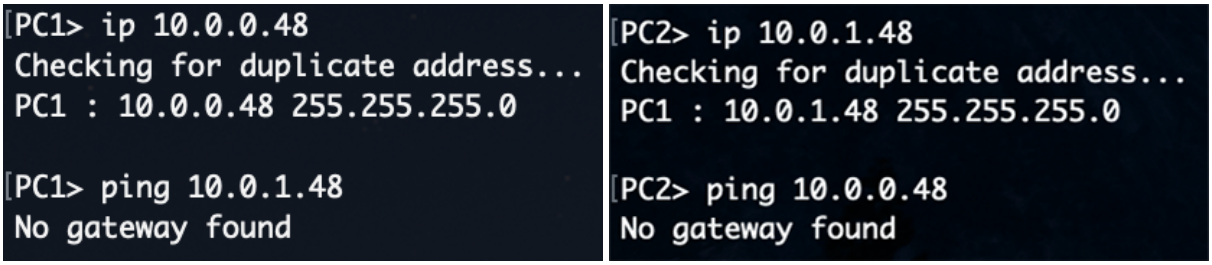

图 2: PC1 与 PC2 不能 ping 通

3. **将 PC1、PC2 的掩码长度均改为 16 位（即 255.255.0.0），PC1 与 PC2 之间能 ping 通。**

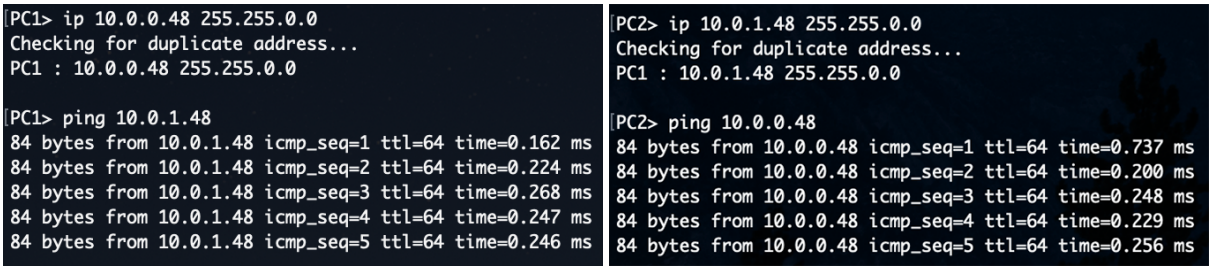

图 3: PC1 与 PC2 能 ping 通

4. **给 R2 的两个接口 f0/0、f1/0 分别配置 IP 地址为 10.0.0.1 和 10.1.0.1，掩码长度均为 16，并激活接口。查看路由表信息。**

输入的命令如下：

```
R2#config terminal
R2(config)#interface f0/0
R2(config-if)#ip address 10.0.0.1 255.255.0.0
R2(config-if)#no shutdown
R2(config-if)#exit
R2(config)#interface f1/0
R2(config-if)#ip address 10.1.0.1 255.255.0.0
R2(config-if)#no shutdown
R2(config-if)#exit
R2(config)#exit
```

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

Gateway of last resort is not set

     10.0.0.0/16 is subnetted, 2 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
C       10.1.0.0 is directly connected, FastEthernet1/0
```

图 4: 路由表信息

5. 给 PC3 配置 IP 地址 10.1.0.48，掩码长度 16 位，PC1 与 PC3 之间不能 ping 通。

```
PC3> ip 10.1.0.48 255.255.0.0
Checking for duplicate address...
PC1 : 10.1.0.48 255.255.0.0

PC3> ping 10.0.0.48
host (255.255.0.0) not reachable
```

图 5: PC1 与 PC3 不能 ping 通

6. 给 PC1、PC3 配置合适的路由器地址，PC1 与 PC3 之间能 ping 通。

输入的命令如下：

```
PC1> ip 10.0.0.48 255.255.0.0 10.0.0.1
```

```
PC3> ip 10.1.0.48 255.255.0.0 10.1.0.1
```

```
PC1> ip 10.0.0.48 255.255.0.0 10.0.0.1
Checking for duplicate address...
PC1 : 10.0.0.48 255.255.0.0 gateway 10.0.0.1

PC1> ping 10.1.0.48
84 bytes from 10.1.0.48 icmp_seq=1 ttl=63 time=20.428 ms
84 bytes from 10.1.0.48 icmp_seq=2 ttl=63 time=18.760 ms
84 bytes from 10.1.0.48 icmp_seq=3 ttl=63 time=19.646 ms
84 bytes from 10.1.0.48 icmp_seq=4 ttl=63 time=17.875 ms
84 bytes from 10.1.0.48 icmp_seq=5 ttl=63 time=20.034 ms
```

```
PC3> ip 10.1.0.48 255.255.0.0 10.1.0.1
Checking for duplicate address...
PC1 : 10.1.0.48 255.255.0.0 gateway 10.1.0.1

PC3> ping 10.0.0.48
84 bytes from 10.0.0.48 icmp_seq=1 ttl=63 time=15.081 ms
84 bytes from 10.0.0.48 icmp_seq=2 ttl=63 time=14.155 ms
84 bytes from 10.0.0.48 icmp_seq=3 ttl=63 time=20.437 ms
84 bytes from 10.0.0.48 icmp_seq=4 ttl=63 time=17.584 ms
84 bytes from 10.0.0.48 icmp_seq=5 ttl=63 time=16.259 ms
```

图 6: PC1 与 PC3 能 ping 通

7. 给 R4 的 f0/0、f0/1 两个接口配置 IP 地址并激活接口。

输入的命令如下：

```
R4#config terminal
R4(config)#interface f0/0
R4(config-if)#ip address 172.16.0.1 255.255.255.0
R4(config-if)#no shutdown
R4(config-if)#interface f0/1
R4(config-if)#ip address 172.16.1.1 255.255.255.0
R4(config-if)#no shutdown
R4(config-if)#exit
R4(config)#exit
```

8. 在 R4 上为 f0/0 接口连接的子网配置 DHCP 服务。

输入的命令如下：

```
R4(config)#ip dhcp pool 1
R4(dhcp-config)#network 172.16.0.0 /24
R4(dhcp-config)#default-router 172.16.0.1
```

9. 在 PC4 上使用 DHCP 动态分配地址，查看获得的 IP 地址。

```
PC4> ip dhcp
DDORA IP 172.16.0.2/24 GW 172.16.0.1
```

图 7: PC4 获得的 IP 地址

10. 在 R4 上为 f0/1 接口配置 DHCP 服务。

输入的命令如下：

```
R4(config)#ip dhcp pool 2
```

```
R4(dhcp-config)#network 172.16.1.0 /24
R4(dhcp-config)#default-router 172.16.1.1
```

11. 在 PC5 上使用 DHCP 动态分配地址，查看获得的 IP 地址。

图 8: PC5 获得的 IP 地址

12. 测试 PC4、PC5 之间的连通性，PC4 与 PC5 之间能 ping 通。

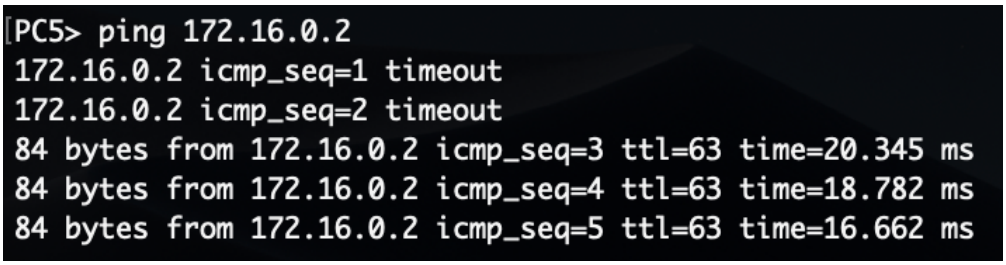

图 9: PC4 与 PC5 能 ping 通

13. 显示 R4 上的已分配 DHCP 主机信息。

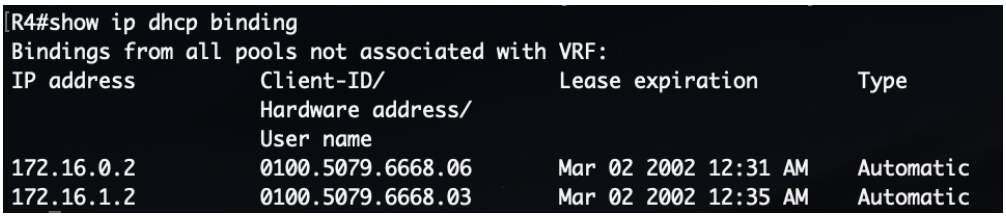

图 10: R4 上的已分配 DHCP 主机信息

14. 配置 R1、R2 路由器之间的串口，设置数据链路层协议为 HDLC，在其中一台路由器上设置时钟速率，设置 IP 地址，激活接口，测试两个路由器之间的连通性。

输入的命令如下：

```
R1(config)#interface s0/0
R1(config-if)#ip address 192.168.12.1 255.255.255.0
R1(config-if)#encapsulation hdlc
R1(config-if)#clock rate 128000
R1(config-if)#no shutdown
```

```
R2(config)#interface s0/0
R2(config-if)#ip address 192.168.12.2 255.255.255.0
R2(config-if)#encapsulation hdlc
R2(config-if)#no shutdown
```

```
R1#ping 192.168.12.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.12.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/22/100 ms
```

图 11: R1 与 R2 能 ping 通

15. 配置 R1、R4 路由器之间的串口，设置 IP 地址，设置数据链路层协议为 PPP，设置 PPP 认证模式为 CHAP，为对方设置认证用户名和密码。激活接口，查看串口状态并测试两个路由器之间的连通性。

输入的命令如下：

```
R1(config)#username R4 password 1234
R1(config)#interface s0/1
R1(config-if)#ip address 192.168.14.1 255.255.255.0
R1(config-if)#encapsulation ppp
R1(config-if)#ppp authentication chap
R1(config-if)#no shutdown
```

```
R4(config)#interface s0/1
R4(config-if)#ip address 192.168.14.4 255.255.255.0
R4(config-if)#encapsulation ppp
R4(config-if)#ppp authentication chap
R4(config-if)#no shutdown
R4(config-if)#exit
R4(config)#username R1 password 1234
```

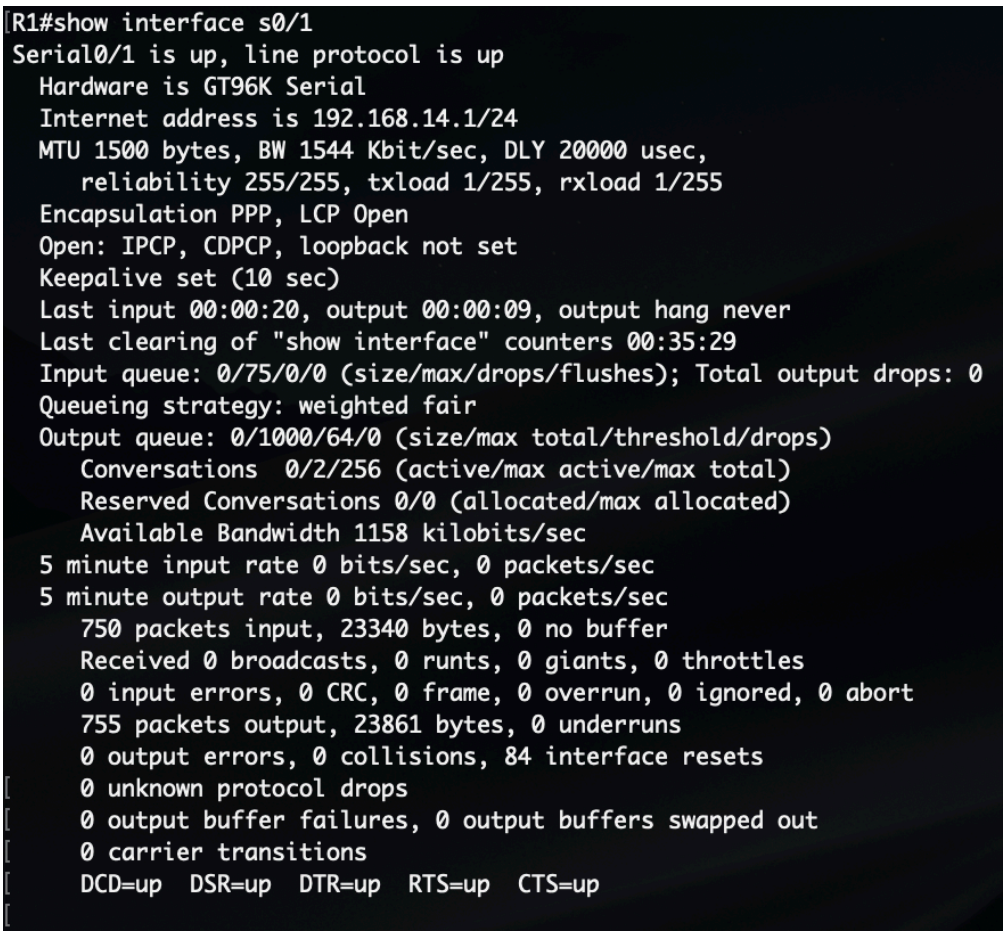

图 12: PPP 的 LCP 已经协商完成，身份验证通过

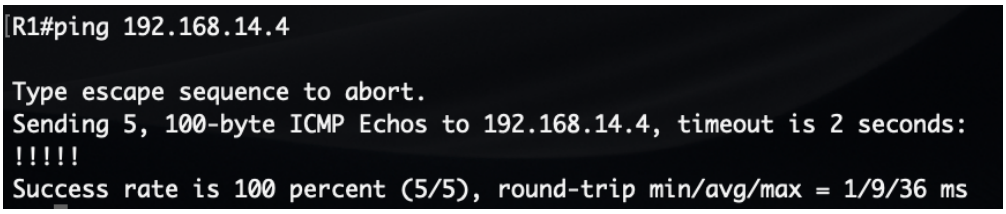

图 13: R1 与 R4 能 ping 通

16. 配置 R2、R3 路由器之间接口的 IP 地址，激活接口，并测试两个路由器之间的连通性。

输入的命令如下：

```
R2(config)#interface f0/1
R2(config-if)#ip address 192.168.23.2 255.255.255.0
R2(config-if)#no shutdown
```

```
R3(config)#interface f0/1
```

```
R3(config-if)#ip address 192.168.23.3 255.255.255.0
R3(config-if)#no shutdown
```

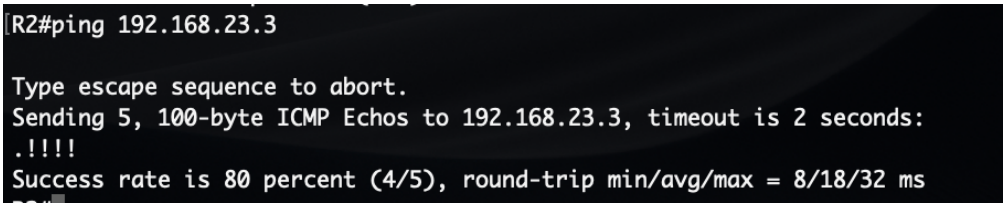

图 14: R2 与 R3 能 ping 通

17. 配置 R3、R4 路由器之间接口的 IP 地址，激活接口，并测试两个路由器之间的连通性。

输入的命令如下：

```
R3(config)#interface f1/0
R3(config-if)#ip address 192.168.34.3 255.255.255.0
R3(config-if)#no shutdown
```

```
R4(config)#interface f1/0
R4(config-if)#ip address 192.168.34.4 255.255.255.0
R4(config-if)#no shutdown
```

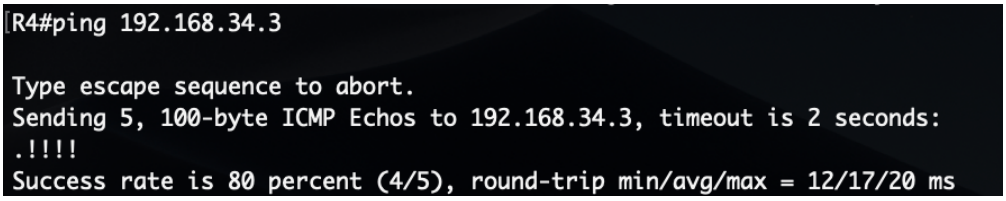

图 15: R3 与 R4 能 ping 通

18. 分别测试 PC1 与 PC4、PC1 与 PC5、PC3 与 PC4、PC3 与 PC5 之间的连通性。

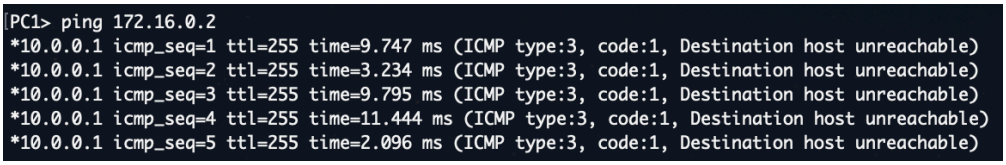

图 16: PC1 与 PC4 的连通情况

```
PC1> ping 172.16.1.2
*10.0.0.1 icmp_seq=1 ttl=255 time=1.987 ms (ICMP type:3, code:1, Destination host unreachable)
*10.0.0.1 icmp_seq=2 ttl=255 time=1.919 ms (ICMP type:3, code:1, Destination host unreachable)
*10.0.0.1 icmp_seq=3 ttl=255 time=10.341 ms (ICMP type:3, code:1, Destination host unreachable)
*10.0.0.1 icmp_seq=4 ttl=255 time=11.205 ms (ICMP type:3, code:1, Destination host unreachable)
*10.0.0.1 icmp_seq=5 ttl=255 time=8.996 ms (ICMP type:3, code:1, Destination host unreachable)
```

图 17: PC1 与 PC5 的连通情况

```
PC3> ping 172.16.0.2
*10.1.0.1 icmp_seq=1 ttl=255 time=9.721 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=2 ttl=255 time=3.967 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=3 ttl=255 time=7.694 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=4 ttl=255 time=3.007 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=5 ttl=255 time=1.184 ms (ICMP type:3, code:1, Destination host unreachable)
```

图 18: PC3 与 PC4 的连通情况

```
PC3> ping 172.16.1.2
*10.1.0.1 icmp_seq=1 ttl=255 time=9.622 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=2 ttl=255 time=13.406 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=3 ttl=255 time=8.185 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=4 ttl=255 time=4.795 ms (ICMP type:3, code:1, Destination host unreachable)
*10.1.0.1 icmp_seq=5 ttl=255 time=5.666 ms (ICMP type:3, code:1, Destination host unreachable)
```

图 19: PC3 与 PC5 的连通情况

19. 查看各路由器的路由表信息。

```
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, Serial0/0
     192.168.14.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.14.4/32 is directly connected, Serial0/1
C       192.168.14.0/24 is directly connected, Serial0/1
```

图 20: R1 路由表信息

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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, Serial0/0
     10.0.0.0/16 is subnetted, 2 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
C       10.1.0.0 is directly connected, FastEthernet1/0
C    192.168.23.0/24 is directly connected, FastEthernet0/1
```

图 21: R2 路由表信息

```
R3#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.23.0/24 is directly connected, FastEthernet0/1
C    192.168.34.0/24 is directly connected, FastEthernet1/0
```

图 22: R3 路由表信息

```
R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     192.168.14.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.14.0/24 is directly connected, Serial0/1
C       192.168.14.1/32 is directly connected, Serial0/1
     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.0.0 is directly connected, FastEthernet0/0
C       172.16.1.0 is directly connected, FastEthernet0/1
C    192.168.34.0/24 is directly connected, FastEthernet1/0
```

图 23: R4 路由表信息

20. 在各个路由器上为相应的目标网络添加静态路由，使上述三个区内的 PC 能够互相 Ping 通。记录最后的路由表信息。

输入的命令如下：

```
R2(config)#ip route 172.16.0.0 255.255.255.0 192.168.23.3
R2(config)#ip route 172.16.1.0 255.255.255.0 192.168.23.3
```

```
R3(config)#ip route 172.16.0.0 255.255.255.0 192.168.34.4
R3(config)#ip route 172.16.1.0 255.255.255.0 192.168.34.4
R3(config)#ip route 10.0.0.0 255.255.255.0 192.168.23.2
R3(config)#ip route 10.1.0.0 255.255.255.0 192.168.23.2
```

```
R4(config)#ip route 192.168.23.0 255.255.255.0 192.168.34.3
R4(config)#ip route 192.168.23.0 255.255.255.0 192.168.34.3
R4(config)#ip route 10.0.0.0 255.255.255.0 192.168.34.3
R4(config)#ip route 10.1.0.0 255.255.255.0 192.168.34.3
```

```
PC1> ping 172.16.0.2
84 bytes from 172.16.0.2 icmp_seq=1 ttl=61 time=541.715 ms
84 bytes from 172.16.0.2 icmp_seq=2 ttl=61 time=42.510 ms
84 bytes from 172.16.0.2 icmp_seq=3 ttl=61 time=41.044 ms
84 bytes from 172.16.0.2 icmp_seq=4 ttl=61 time=61.985 ms
84 bytes from 172.16.0.2 icmp_seq=5 ttl=61 time=60.370 ms
```

图 24: PC1 与 PC4 的连通情况

```
PC1> ping 172.16.1.2
172.16.1.2 icmp_seq=1 timeout
84 bytes from 172.16.1.2 icmp_seq=2 ttl=61 time=69.680 ms
84 bytes from 172.16.1.2 icmp_seq=3 ttl=61 time=49.331 ms
84 bytes from 172.16.1.2 icmp_seq=4 ttl=61 time=35.641 ms
84 bytes from 172.16.1.2 icmp_seq=5 ttl=61 time=47.119 ms
```

图 25: PC1 与 PC5 的连通情况

```
PC3> ping 172.16.0.2
172.16.0.2 icmp_seq=1 timeout
172.16.0.2 icmp_seq=2 timeout
84 bytes from 172.16.0.2 icmp_seq=3 ttl=61 time=56.617 ms
84 bytes from 172.16.0.2 icmp_seq=4 ttl=61 time=39.667 ms
84 bytes from 172.16.0.2 icmp_seq=5 ttl=61 time=61.037 ms
```

图 26: PC3 与 PC4 的连通情况

```
PC3> ping 172.16.1.2
84 bytes from 172.16.1.2 icmp_seq=1 ttl=61 time=42.119 ms
84 bytes from 172.16.1.2 icmp_seq=2 ttl=61 time=45.036 ms
84 bytes from 172.16.1.2 icmp_seq=3 ttl=61 time=57.775 ms
84 bytes from 172.16.1.2 icmp_seq=4 ttl=61 time=61.748 ms
84 bytes from 172.16.1.2 icmp_seq=5 ttl=61 time=60.825 ms
```

图 27: PC3 与 PC5 的连通情况

```
R1#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, Serial0/0
     192.168.14.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.14.4/32 is directly connected, Serial0/1
C       192.168.14.0/24 is directly connected, Serial0/1
```

图 28: R1 路由表信息

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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, Serial0/0
     172.16.0.0/24 is subnetted, 2 subnets
S       172.16.0.0 [1/0] via 192.168.23.3
S       172.16.1.0 [1/0] via 192.168.23.3
     10.0.0.0/16 is subnetted, 2 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
C       10.1.0.0 is directly connected, FastEthernet1/0
C    192.168.23.0/24 is directly connected, FastEthernet0/1
```

图 29: R2 路由表信息

```
R3#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
S       172.16.0.0 [1/0] via 192.168.34.4
S       172.16.1.0 [1/0] via 192.168.34.4
     10.0.0.0/24 is subnetted, 2 subnets
S       10.0.0.0 [1/0] via 192.168.23.2
S       10.1.0.0 [1/0] via 192.168.23.2
C    192.168.23.0/24 is directly connected, FastEthernet0/1
C    192.168.34.0/24 is directly connected, FastEthernet1/0
```

图 30: R3 路由表信息

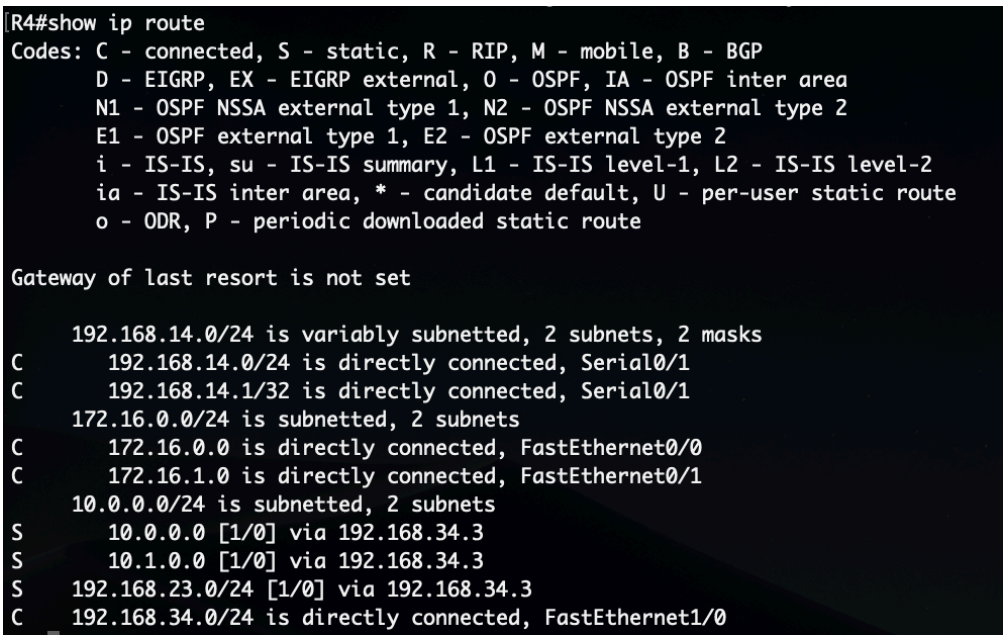

图 31: R4 路由表信息

21. 在 R2 和 R4 上增加备用路由，选择串口线路作为下一跳的路径，并将路由距离设置成 30。此时查看路由表，该新增路由信息并不会出现，但在主路由链路断开时，该路由会被自动添加进路由表。

输入的命令如下：

```
R1(config)#ip route 172.16.0.0 255.255.255.0 192.168.14.4
R1(config)#ip route 172.16.1.0 255.255.255.0 192.168.14.4
R1(config)#ip route 10.0.0.0 255.255.255.0 192.168.12.2
R1(config)#ip route 10.1.0.0 255.255.255.0 192.168.12.2
```

```
R2(config)#ip route 172.16.0.0 255.255.255.0 192.168.12.1 30
R2(config)#ip route 172.16.1.0 255.255.255.0 192.168.12.1 30
```

```
R4(config)#ip route 10.0.0.0 255.255.255.0 192.168.14.1 30
R4(config)#ip route 10.1.0.0 255.255.255.0 192.168.14.1 30
```

R2-R3、R3-R4 间链路断开前：

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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, Serial0/0
     172.16.0.0/24 is subnetted, 2 subnets
S       172.16.0.0 [1/0] via 192.168.23.3
S       172.16.1.0 [1/0] via 192.168.23.3
     10.0.0.0/16 is subnetted, 2 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
C       10.1.0.0 is directly connected, FastEthernet1/0
C    192.168.23.0/24 is directly connected, FastEthernet0/1
```

图 32: R2 路由表信息

```
R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     192.168.14.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.14.0/24 is directly connected, Serial0/1
C       192.168.14.1/32 is directly connected, Serial0/1
     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.0.0 is directly connected, FastEthernet0/0
C       172.16.1.0 is directly connected, FastEthernet0/1
     10.0.0.0/24 is subnetted, 2 subnets
S       10.0.0.0 [1/0] via 192.168.34.3
S       10.1.0.0 [1/0] via 192.168.34.3
S    192.168.23.0/24 [1/0] via 192.168.34.3
C    192.168.34.0/24 is directly connected, FastEthernet1/0
```

图 33: R4 路由表信息

```
PC1> trace 172.16.0.2
trace to 172.16.0.2, 8 hops max, press Ctrl+C to stop
 1   10.0.0.1   10.042 ms  10.039 ms  10.700 ms
 2   192.168.23.3   29.577 ms  30.424 ms  30.881 ms
 3   192.168.34.4   63.841 ms  95.889 ms  50.443 ms
 4     *  *  *
 5   *172.16.0.2   48.345 ms (ICMP type:3, code:3, Destination port unreachable)
```

图 34: PC1 上的路由跟踪

R2-R3、R3-R4 间链路断开后：

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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, Serial0/0
     172.16.0.0/24 is subnetted, 2 subnets
S       172.16.0.0 [30/0] via 192.168.12.1
S       172.16.1.0 [30/0] via 192.168.12.1
     10.0.0.0/16 is subnetted, 2 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
C       10.1.0.0 is directly connected, FastEthernet1/0
```

图 35: R2 路由表信息

```
R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     192.168.14.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.14.0/24 is directly connected, Serial0/1
C       192.168.14.1/32 is directly connected, Serial0/1
     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.0.0 is directly connected, FastEthernet0/0
C       172.16.1.0 is directly connected, FastEthernet0/1
     10.0.0.0/24 is subnetted, 2 subnets
S       10.0.0.0 [30/0] via 192.168.14.1
S       10.1.0.0 [30/0] via 192.168.14.1
```

图 36: R4 路由表信息

```
PC1> trace 172.16.0.2
trace to 172.16.0.2, 8 hops max, press Ctrl+C to stop
 1   10.0.0.1   9.837 ms  10.003 ms  10.643 ms
 2   192.168.12.1   10.085 ms  9.706 ms  11.729 ms
 3   192.168.14.4   19.315 ms  10.501 ms  10.841 ms
 4     *  *  *
 5   *172.16.0.2   6.483 ms (ICMP type:3, code:3, Destination port unreachable)
```

图 37: PC1 上的路由跟踪

R2-R3、R3-R4 间链路重新打开后：

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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, Serial0/0
     172.16.0.0/24 is subnetted, 2 subnets
S       172.16.0.0 [1/0] via 192.168.23.3
S       172.16.1.0 [1/0] via 192.168.23.3
     10.0.0.0/16 is subnetted, 2 subnets
C       10.0.0.0 is directly connected, FastEthernet0/0
C       10.1.0.0 is directly connected, FastEthernet1/0
C    192.168.23.0/24 is directly connected, FastEthernet0/1
```

图 38: R2 路由表信息

```
R4#show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

     192.168.14.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.14.0/24 is directly connected, Serial0/1
C       192.168.14.1/32 is directly connected, Serial0/1
     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.0.0 is directly connected, FastEthernet0/0
C       172.16.1.0 is directly connected, FastEthernet0/1
     10.0.0.0/24 is subnetted, 2 subnets
S       10.0.0.0 [1/0] via 192.168.34.3
S       10.1.0.0 [1/0] via 192.168.34.3
S    192.168.23.0/24 [1/0] via 192.168.34.3
C    192.168.34.0/24 is directly connected, FastEthernet1/0
```

图 39: R4 路由表信息

```
PC1> trace 172.16.0.2
trace to 172.16.0.2, 8 hops max, press Ctrl+C to stop
 1   10.0.0.1   3.841 ms  10.001 ms  9.329 ms
 2     *192.168.23.3   38.594 ms  31.663 ms
 3     *192.168.34.4   43.669 ms  40.929 ms
 4   *172.16.0.2   50.040 ms (ICMP type:3, code:3, Destination port unreachable)
```

图 40: PC1 上的路由跟踪

22. 在 R2 上分别使用 f1/0、s0/0 接口的 IP 地址作为源地址，测试到 R4 的 s0/1 接口地址的连通性。

输入的命令如下：

```
R1(config)#ip route 192.168.14.0 255.255.255.0 192.168.14.4
```

```
R2(config)#ip route 192.168.14.0 255.255.255.0 192.168.12.1
```

```
R4(config)#ip route 192.168.12.0 255.255.255.0 192.168.14.1
R4(config)#ip route 10.1.0.0 255.255.0.0 192.168.14.1
```

```
R2#ping 192.168.14.4 source 10.0.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.14.4, timeout is 2 seconds:
Packet sent with a source address of 10.0.0.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/18/24 ms
```

图 41: R2 的 f0/0 与 R4 的 s0/1 的连通情况

```
R2#ping 192.168.14.4 source 192.168.23.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.14.4, timeout is 2 seconds:
Packet sent with a source address of 192.168.23.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/18/28 ms
```

图 42: R2 的 f0/1 与 R4 的 s0/1 的连通情况

```
R2#ping 192.168.14.4 source 10.1.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.14.4, timeout is 2 seconds:
Packet sent with a source address of 10.1.0.1
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/20/24 ms
```

图 43: R2 的 f1/0 与 R4 的 s0/1 的连通情况

```
R2#ping 192.168.14.4 source 192.168.12.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.14.4, timeout is 2 seconds:
Packet sent with a source address of 192.168.12.2
.....
Success rate is 0 percent (0/5)
R2#ping 192.168.14.4 source 192.168.12.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.14.4, timeout is 2 seconds:
Packet sent with a source address of 192.168.12.2
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/2/4 ms
```

图 44: R2 的 s0/0 与 R4 的 s0/1 的连通情况

23. 给 R3 的 f0/0 接口配置 IP 地址，给 R5 各接口配置 IP 地址，激活接口，并测试两个路由器之间的连通性。

输入的命令如下：

```
R3(config-if)#interface f0/0
R3(config-if)#ip address 192.168.35.3 255.255.255.0
R3(config-if)#no shutdown
```

```
R5(config)#interface f0/0
R5(config-if)#ip address 192.168.35.5 255.255.255.0
R5(config-if)#no shutdown
R5(config)#interface f0/1
R5(config-if)#ip address 192.168.0.1 255.255.255.0
R5(config-if)#no shutdown
```

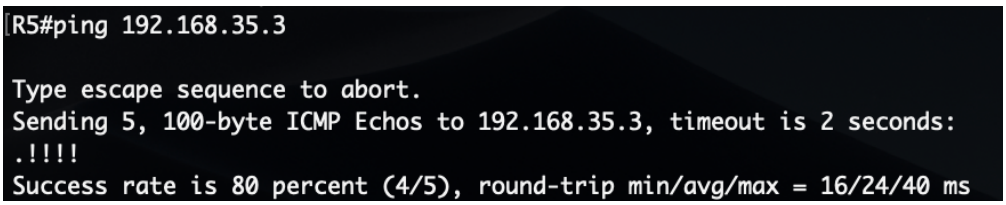

图 45: R3 与 R5 之间能 ping 通

24. 给 PC6、PC7 配置 IP 地址及默认路由器地址。

输入的命令如下：

```
PC6> ip 192.168.0.48 255.255.255.0 192.168.0.1
```

```
PC7> ip 192.168.0.2 255.255.255.0 192.168.0.1
```

25. 在 R5 路由器上配置 NAT 服务，定义 f0/0 接口为外部接口，定义 f0/1 接口为内部接口。配置完成后同时在 PC6、PC7 上持续 ping 路由器 R3 的 f0/0 接口地址，ping 通后在 R5 上显示 NAT 信息。

输入的命令如下：

```
R5(config)#interface f0/1
R5(config-if)#ip nat inside
R5(config-if)#exit
R5(config)#interface f0/0
R5(config-if)#ip nat outside
R5(config-if)#exit
R5(config)#access-list 1 permit 192.168.0.0 0.0.0.255
R5(config)#ip nat inside source list 1 interface f0/0 overload
```

```
R5#show ip nat translation
Pro Inside global      Inside local       Outside local      Outside global
icmp 192.168.35.5:45571 192.168.0.2:45571 192.168.35.3:45571 192.168.35.3:45571
icmp 192.168.35.5:45827 192.168.0.2:45827 192.168.35.3:45827 192.168.35.3:45827
icmp 192.168.35.5:1024 192.168.0.2:46083  192.168.35.3:46083 192.168.35.3:1024
icmp 192.168.35.5:1025 192.168.0.2:46339  192.168.35.3:46339 192.168.35.3:1025
icmp 192.168.35.5:1026 192.168.0.2:46595  192.168.35.3:46595 192.168.35.3:1026
icmp 192.168.35.5:1027 192.168.0.2:46851  192.168.35.3:46851 192.168.35.3:1027
icmp 192.168.35.5:1028 192.168.0.2:47107  192.168.35.3:47107 192.168.35.3:1028
icmp 192.168.35.5:1029 192.168.0.2:47363  192.168.35.3:47363 192.168.35.3:1029
icmp 192.168.35.5:1030 192.168.0.2:47619  192.168.35.3:47619 192.168.35.3:1030
icmp 192.168.35.5:1031 192.168.0.2:47875  192.168.35.3:47875 192.168.35.3:1031
icmp 192.168.35.5:1032 192.168.0.2:48131  192.168.35.3:48131 192.168.35.3:1032
icmp 192.168.35.5:48643 192.168.0.2:48643 192.168.35.3:48643 192.168.35.3:48643
icmp 192.168.35.5:48899 192.168.0.2:48899 192.168.35.3:48899 192.168.35.3:48899
icmp 192.168.35.5:49155 192.168.0.2:49155 192.168.35.3:49155 192.168.35.3:49155
icmp 192.168.35.5:49411 192.168.0.2:49411 192.168.35.3:49411 192.168.35.3:49411
icmp 192.168.35.5:49667 192.168.0.2:49667 192.168.35.3:49667 192.168.35.3:49667
icmp 192.168.35.5:49923 192.168.0.2:49923 192.168.35.3:49923 192.168.35.3:49923
icmp 192.168.35.5:50179 192.168.0.2:50179 192.168.35.3:50179 192.168.35.3:50179
icmp 192.168.35.5:50435 192.168.0.2:50435 192.168.35.3:50435 192.168.35.3:50435
icmp 192.168.35.5:50691 192.168.0.2:50691 192.168.35.3:50691 192.168.35.3:50691
icmp 192.168.35.5:50947 192.168.0.2:50947 192.168.35.3:50947 192.168.35.3:50947
icmp 192.168.35.5:51203 192.168.0.2:51203 192.168.35.3:51203 192.168.35.3:51203
```

图 46: R5 上的 NAT 信息

26. 在各路由器上增加静态路由信息，使得 PC6 能够与 Zone1、Zone2、Guest Zone 的 PC 机通信。

输入的命令如下：

```
R2(config)#ip route 192.168.35.0 255.255.255.0 192.168.23.3
```

```
R4(config)#ip route 192.168.35.0 255.255.255.0 192.168.34.3
```

```
R5(config)#ip route 0.0.0.0 0.0.0.0 192.168.35.3
```

```
PC6> ping 10.0.0.48
10.0.0.48 icmp_seq=1 timeout
10.0.0.48 icmp_seq=2 timeout
84 bytes from 10.0.0.48 icmp_seq=3 ttl=61 time=40.229 ms
84 bytes from 10.0.0.48 icmp_seq=4 ttl=61 time=59.188 ms
84 bytes from 10.0.0.48 icmp_seq=5 ttl=61 time=46.729 ms
```

图 47: PC6 与 PC1 的连通情况

```
PC6> ping 10.1.0.48
10.1.0.48 icmp_seq=1 timeout
10.1.0.48 icmp_seq=2 timeout
84 bytes from 10.1.0.48 icmp_seq=3 ttl=61 time=57.568 ms
84 bytes from 10.1.0.48 icmp_seq=4 ttl=61 time=55.329 ms
84 bytes from 10.1.0.48 icmp_seq=5 ttl=61 time=45.173 ms
```

图 48: PC6 与 PC3 的连通情况

```
PC6> ping 172.16.0.2
172.16.0.2 icmp_seq=1 timeout
172.16.0.2 icmp_seq=2 timeout
84 bytes from 172.16.0.2 icmp_seq=3 ttl=61 time=39.834 ms
84 bytes from 172.16.0.2 icmp_seq=4 ttl=61 time=39.497 ms
84 bytes from 172.16.0.2 icmp_seq=5 ttl=61 time=36.110 ms
```

图 49: PC6 与 PC4 的连通情况

```
PC6> ping 172.16.1.2
84 bytes from 172.16.1.2 icmp_seq=1 ttl=61 time=43.309 ms
84 bytes from 172.16.1.2 icmp_seq=2 ttl=61 time=64.916 ms
84 bytes from 172.16.1.2 icmp_seq=3 ttl=61 time=58.990 ms
84 bytes from 172.16.1.2 icmp_seq=4 ttl=61 time=56.683 ms
84 bytes from 172.16.1.2 icmp_seq=5 ttl=61 time=44.218 ms
```

图 50: PC6 与 PC5 的连通情况

27. 采用动态分配方式配置 R1 的 f0/0 接口，在电脑主机上 ping 一下 R1 的 IP 地址。

输入的命令如下：

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

```
[→  ~ ping 172.16.176.129
PING 172.16.176.129 (172.16.176.129): 56 data bytes
64 bytes from 172.16.176.129: icmp_seq=0 ttl=255 time=34.432 ms
64 bytes from 172.16.176.129: icmp_seq=1 ttl=255 time=295.594 ms
64 bytes from 172.16.176.129: icmp_seq=2 ttl=255 time=9.459 ms
64 bytes from 172.16.176.129: icmp_seq=3 ttl=255 time=7.202 ms
64 bytes from 172.16.176.129: icmp_seq=4 ttl=255 time=5.606 ms
64 bytes from 172.16.176.129: icmp_seq=5 ttl=255 time=5.773 ms
64 bytes from 172.16.176.129: icmp_seq=6 ttl=255 time=9.838 ms
64 bytes from 172.16.176.129: icmp_seq=7 ttl=255 time=7.747 ms
64 bytes from 172.16.176.129: icmp_seq=8 ttl=255 time=9.856 ms
^C
--- 172.16.176.129 ping statistics ---
9 packets transmitted, 9 packets received, 0.0% packet loss
round-trip min/avg/max/stddev = 5.606/42.834/295.594/89.758 ms
```

图 51: 电脑主机与 R1 的连通情况

28. 在 R1 上配置 NAT 服务，并且在 R2 上添加电脑主机的子网路由，使得 Zone 1 的 PC 机也能与电脑主机通信。

输入的命令如下：

```
R1(config)#interface f0/0
R1(config-if)#ip nat outside
R1(config-if)#exit
R1(config)#interface s0/0
R1(config-if)#ip nat inside
R1(config-if)#exit
R1(config)#access-list 2 permit 10.0.0.0 0.255.255.255
R1(config)#ip nat inside source list 2 interface f0/0 overload
```

```
R2(config)#ip route 172.16.176.0 255.255.255.0 192.168.12.1
```

```
[→  ~ ifconfig vmnet1
vmnet1: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
        ether 00:50:56:c0:00:01
        inet 172.16.176.1 netmask 0xffffff00 broadcast 172.16.176.255
```

图 52: 电脑主机的 IP 地址

29. **将 R1 的 f0/0 口改为连接 Cloud1 的 eth2 接口，重新给 R1 的 f0/0 口配置 IP 地址，设置 R1 的默认路由地址为真实网络上的默认网关，在 R2 上为主机 H 的子网配置路由，测试 R1 以及 PC1 能否 ping 通该主机。**

图 53: VMware 上 eth2 设置为桥接模式

输入的命令如下：

```
R1(config)#interface f0/0
R1(config-if)#ip address dhcp
R1(config-if)#exit
R1(config)#ip route 0.0.0.0 0.0.0.0 192.168.1.1
```

```
R2(config)#ip route 0.0.0.0 0.0.0.0 192.168.12.1
```

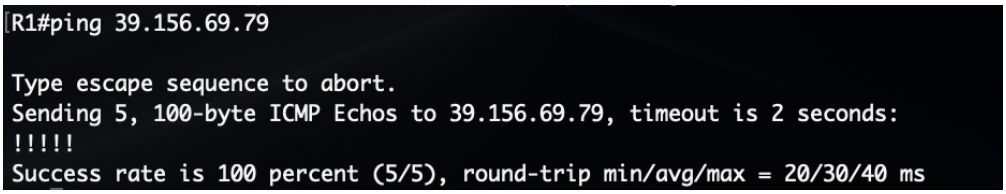

图 54: R1 能 ping 通百度

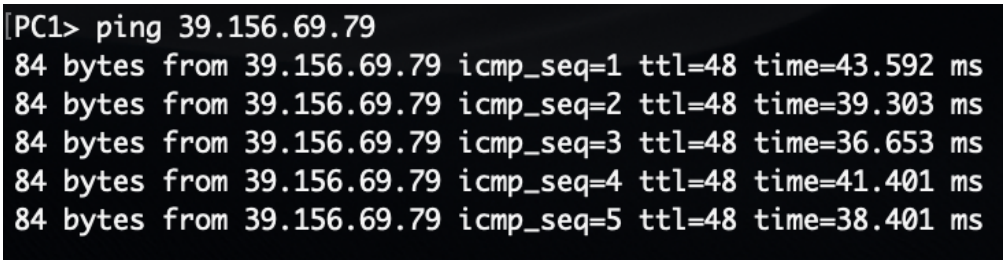

图 55: PC1 能 ping 通百度

30. 整理各路由器的当前运行配置，选择与本实验相关的内容记录在文本文件中，随实验报告一起打包上传。

R1.txt

```
R1#show running-config
Building configuration...

Current configuration : 2552 bytes
!
hostname R1
!
username R4 password 0 1234
!
interface FastEthernet0/0
 ip address dhcp
 ip nat outside
 ip virtual-reassembly
 duplex auto
 speed auto
!
interface Serial0/0
 ip address 192.168.12.1 255.255.255.0
 ip nat inside
 ip virtual-reassembly
 clock rate 128000
!
interface Serial0/1
 ip address 192.168.14.1 255.255.255.0
 encapsulation ppp
 clock rate 2000000
 ppp authentication chap
!
ip forward-protocol nd
ip route 0.0.0.0 0.0.0.0 192.168.1.1
ip route 10.0.0.0 255.255.255.0 192.168.12.2
ip route 10.1.0.0 255.255.255.0 192.168.12.2
ip route 172.16.0.0 255.255.255.0 192.168.14.4
ip route 172.16.1.0 255.255.255.0 192.168.14.4
ip route 192.168.14.0 255.255.255.0 192.168.14.4
!
no ip http server
no ip http secure-server
ip nat inside source list 2 interface FastEthernet0/0 overload
!
access-list 2 permit 10.0.0.0 0.255.255.255
no cdp log mismatch duplex
!
end
```

R2.txt

```
R2#show running-config
Building configuration...

Current configuration : 2422 bytes
!
hostname R2
!
interface FastEthernet0/0
 ip address 10.0.0.1 255.255.0.0
 duplex auto
 speed auto
!
interface Serial0/0
 ip address 192.168.12.2 255.255.255.0
 clock rate 2000000
!
interface FastEthernet0/1
 ip address 192.168.23.2 255.255.255.0
 duplex auto
 speed auto
!
ip forward-protocol nd
ip route 0.0.0.0 0.0.0.0 192.168.12.1
ip route 172.16.0.0 255.255.255.0 192.168.23.3
ip route 172.16.0.0 255.255.255.0 192.168.12.1 30
ip route 172.16.1.0 255.255.255.0 192.168.23.3
ip route 172.16.1.0 255.255.255.0 192.168.12.1 30
ip route 172.16.176.0 255.255.255.0 192.168.12.1
ip route 192.168.14.0 255.255.255.0 192.168.12.1
ip route 192.168.35.0 255.255.255.0 192.168.23.3
!
end
```

R3.txt

```
R3#show running-config
Building configuration...

Current configuration : 2233 bytes
!
hostname R3
!
interface FastEthernet0/0
 ip address 192.168.35.3 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
```

```
 ip address 192.168.23.3 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 192.168.34.3 255.255.255.0
 duplex auto
 speed auto
!
ip forward-protocol nd
ip route 10.0.0.0 255.255.255.0 192.168.23.2
ip route 10.1.0.0 255.255.255.0 192.168.23.2
ip route 172.16.0.0 255.255.255.0 192.168.34.4
ip route 172.16.1.0 255.255.255.0 192.168.34.4
!
end
```

R4.txt

```
R4#show running-config
Building configuration...

Current configuration : 2702 bytes
!
hostname R4
!
ip dhcp pool 1
  network 172.16.0.0 255.255.255.0
  default-router 172.16.0.1
!
ip dhcp pool 2
  network 172.16.1.0 255.255.255.0
  default-router 172.16.1.1
!
username R1 password 0 1234
!
interface FastEthernet0/0
 ip address 172.16.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 172.16.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial0/1
 ip address 192.168.14.4 255.255.255.0
 encapsulation ppp
 clock rate 2000000
```

```
 ppp authentication chap
!
interface FastEthernet1/0
 ip address 192.168.34.4 255.255.255.0
 duplex auto
 speed auto
!
ip forward-protocol nd
ip route 10.0.0.0 255.255.255.0 192.168.34.3
ip route 10.0.0.0 255.255.255.0 192.168.14.1 30
ip route 10.1.0.0 255.255.0.0 192.168.14.1
ip route 10.1.0.0 255.255.255.0 192.168.34.3
ip route 10.1.0.0 255.255.255.0 192.168.14.1 30
ip route 192.168.12.0 255.255.255.0 192.168.14.1
ip route 192.168.23.0 255.255.255.0 192.168.34.3
ip route 192.168.35.0 255.255.255.0 192.168.34.3
!
end
```

R5.txt

```
R5#show running-config
Building configuration...

Current configuration : 2255 bytes
!
hostname R5
!
interface FastEthernet0/0
 ip address 192.168.35.5 255.255.255.0
 ip nat outside
 ip virtual-reassembly
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 192.168.0.1 255.255.255.0
 ip nat inside
 ip virtual-reassembly
 duplex auto
 speed auto
!
ip forward-protocol nd
ip route 0.0.0.0 0.0.0.0 192.168.35.3
!
no ip http server
no ip http secure-server
ip nat inside source list 1 interface FastEthernet0/0 overload
!
access-list 1 permit 192.168.0.0 0.0.0.255
```

```
no cdp log mismatch duplex
!
end
```

六、 实验结果与分析

1. 路由器的接口为什么会出现：FastEthernet0/1 is up, line protocol is down 的状态？

出现这种状态，说明路由器上的端口已经打开，但与这一端口相连的对端设备没有正确配置，或没有设置时钟，导致数据链路出现问题。

2. 路由起什么作用？什么是静态路由？

路由对目的地址跨网段的数据包进行转发，把数据从源设备发送到下一台设备。静态路由是对于不直连的设备，人为添加路由规则，指定某一目的网段的数据包的下一跳的地址。

3. 需要为每个 PC 的 IP 地址添加路由，还是只需要为其网络地址添加路由？

只需要为其网络地址添加路由。

4. 添加静态路由时，下一跳地址是填写本路由器的端口地址，还是对方路由器的端口地址，或者是目的地网络的路由器端口地址？

对方路由器的端口地址。

5. 什么是默认路由？添加默认路由的命令格式是什么？

如果在目的地址不在当前的路由表中，路由器就会使用默认路由。添加默认路由的命令格式是：

ip route 0.0.0.0 0.0.0.0 [下一跳 IP 地址]

6. 在同一个局域网内的 2 台 PC 机，IP 地址分别为 10.0.0.x/24 和 10.0.1.x/24，都属于 VLAN1，一开始不能互相 ping 通，为什么把子网掩码长度从 24 位变成 16 位，就通了？

子网掩码为 24 位时，这两个 IP 位于不同的网段，没有三层路由的转发不能 ping 通。子网掩码为 16 位时，这两个 IP 位于同一网段，所以能 ping 通。

7. 如果仅仅是为了让不同区域内的 PC 之间能够互相 ping 通，在设置静态路由时，路由器之间互联的子网是否全部都要加入到所有路由器的路由表中？为什么？

不必加入到所有路由器的路由表中。只要能保证两个区域之间有一条通路即可。

七、 讨论与心得

本次实验是用 GNS3 模拟器配置静态路由。与上次实验相比，这次实验的工作量较多，并且有一些步骤需要自己思考如何写静态路由的配置。在实验进行到倒数第二步时，由于我的 VMware 上原本没有 eth2 网卡，我在 VMware 的设置中对网络适配器进行了修改。但我直接将虚拟机关机，虚拟机重新启动后 GNS3 内的设备都无法连接，也无法关闭。后来我重建了工程，根据前序步骤中记录下的拓扑图和输入的命令重新配置各个设备。如果在实验开始前就配置好虚拟机的设置，就不会有这样的麻烦了。