广州大学学生实验报告

开课学院及实验室：计算机科学与工程实验室 518　　2019 年 11 月 18 日

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实验课程名称	计算机网络实验					成绩	
实验项目名称	配置网络路由					指导老师	唐琳

一、实验目的

了解路由器的特点、基本功能及配置方法；使用模拟软件 Packet Tracer 熟悉 Cisco 路由器的操作；配置静态路由和距离矢量路由协议 RIP，实现给定网络的连通；从而加深对 IP 编址、路由转发机制、路由协议、路由表的建立等的认识。

二、实验环境

安装有 Packet Tracer 软件的计算机。

三、实验内容

1、 安装 Packet Tracer。
2、 建立如下网络拓扑，进行 IP 编址。

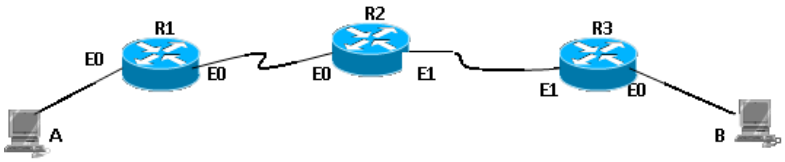


图 1 待建立的网络拓扑

3、 在路由器上配置静态路由，使全网互通。
4、 使用默认路由改写路由表，使全网互通。
5、 以 RIP 方式配置路由，使全网互通。

四、实验步骤、记录和结果

1、 **建立网络拓扑** 从软件工具栏中将 PC 模块和路由模块拖入主视图中。使用 Copper cross-over（铜双绞线）依次连接图中的各个模块，配置各个模块的 IP 地址，并配置 PC 的默认网关为直接相连的路由器的 IP 地址。建立网络拓扑如图所示。

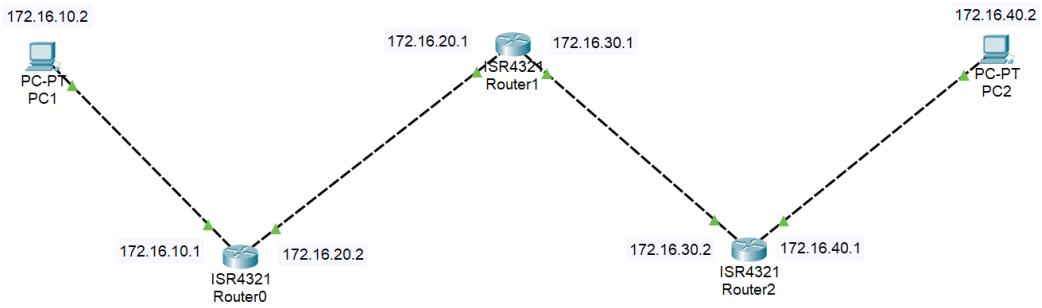


图 2 已建立的网络拓扑

2、 **配置静态路由** 通过图形界面配置各个路由器的路由表如下：

```
% Ambiguous command:  "5"
Router0#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, E - EGP
       i - IS-IS, 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

     172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
C       172.16.10.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.10.1/32 is directly connected, GigabitEthernet0/0/1
C       172.16.20.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.20.2/32 is directly connected, GigabitEthernet0/0/0
S       172.16.30.0/24 [1/0] via 172.16.20.1
S       172.16.40.0/24 [1/0] via 172.16.20.1

Router0#
```

图 3 Router0 静态路由

```
Router1#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, E - EGP
       i - IS-IS, 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

     172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
S       172.16.10.0/24 [1/0] via 172.16.20.2
C       172.16.20.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.20.1/32 is directly connected, GigabitEthernet0/0/1
C       172.16.30.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.30.1/32 is directly connected, GigabitEthernet0/0/0
S       172.16.40.0/24 [1/0] via 172.16.30.2

Router1#
```

图 4 Router1 静态路由

```
Router2#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, E - EGP
       i - IS-IS, 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

     172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
S       172.16.10.0/24 [1/0] via 172.16.30.1
S       172.16.20.0/24 [1/0] via 172.16.30.1
C       172.16.30.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.30.2/32 is directly connected, GigabitEthernet0/0/0
C       172.16.40.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.40.1/32 is directly connected, GigabitEthernet0/0/1

Router2#
```

图 5 Router2 静态路由

在 PC1 上 ping 各个路由，验证全网可通。

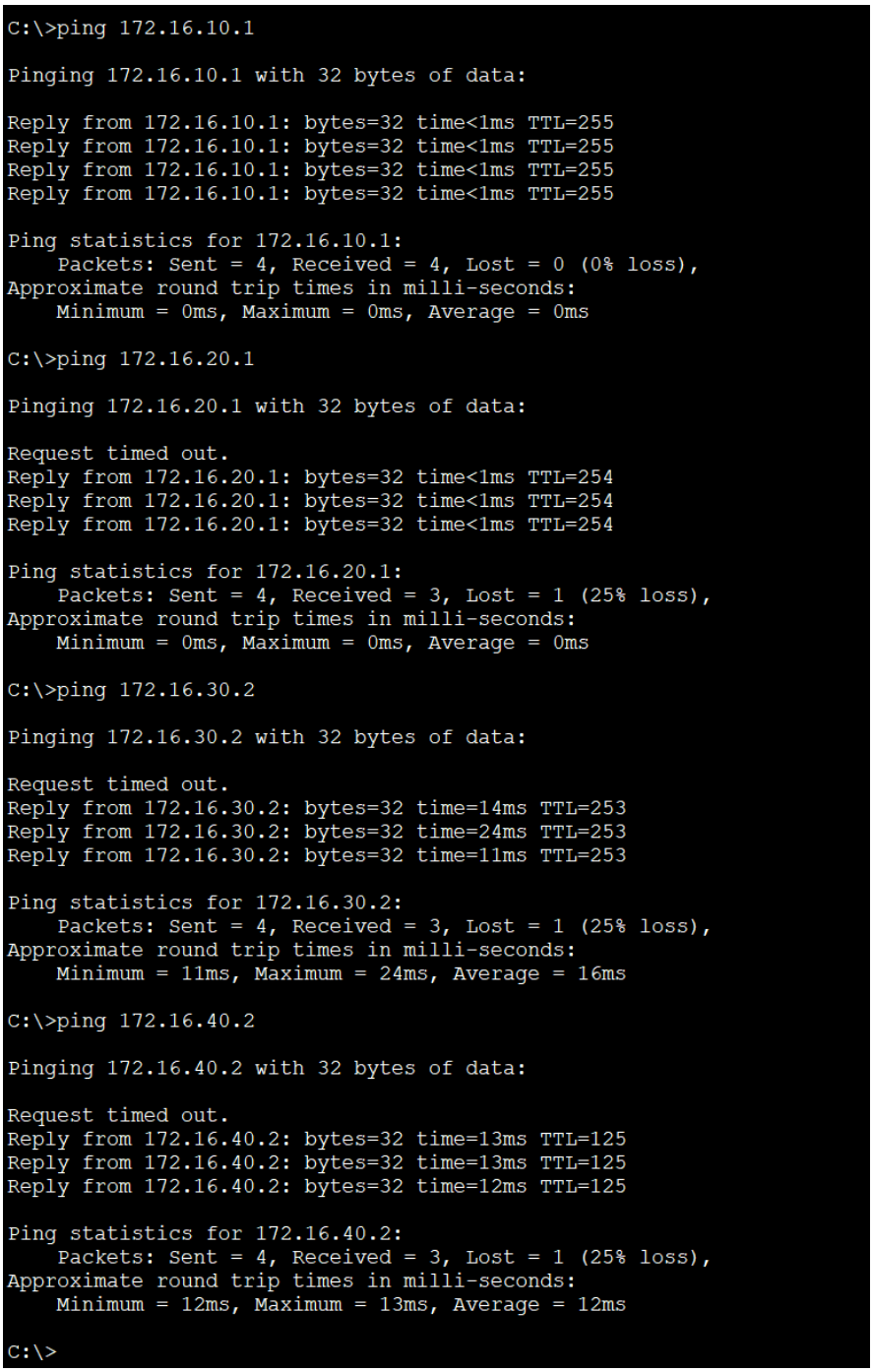


图 6 验证静态路由方式下全网可通

3、 **使用默认路由改写路由表** 对于 R0 和 R2 路由，可以使用默认路由方式改写路由表。方法是先清空 R0 和 R2 中的静态路由表，然后添加一条“0.0.0.0/0 via 相应下一跳地址”记录。

```
Router0#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, E - EGP
       i - IS-IS, 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 172.16.20.1 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
C       172.16.10.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.10.1/32 is directly connected, GigabitEthernet0/0/1
C       172.16.20.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.20.2/32 is directly connected, GigabitEthernet0/0/0
S*   0.0.0.0/0 [1/0] via 172.16.20.1
```

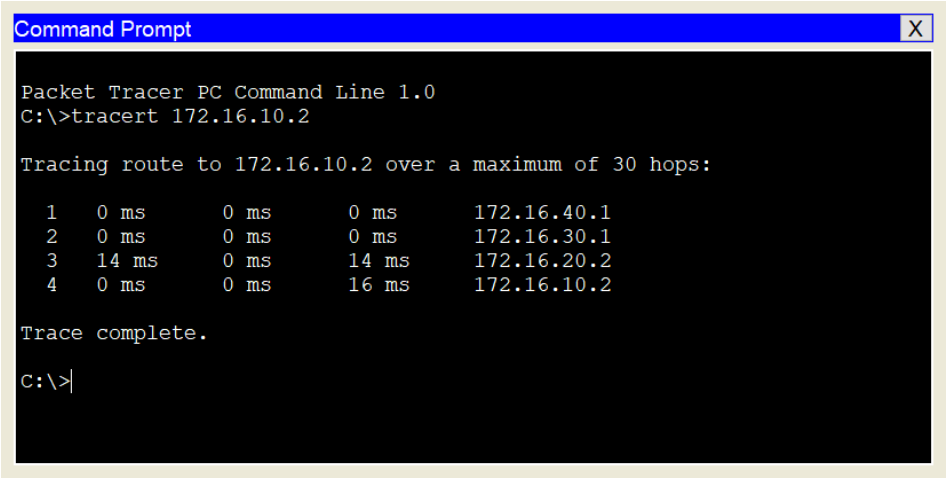
图 7 R0 的默认路由表

```
Router2#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, E - EGP
       i - IS-IS, 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 172.16.30.1 to network 0.0.0.0

     172.16.0.0/16 is variably subnetted, 4 subnets, 2 masks
C       172.16.30.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.30.2/32 is directly connected, GigabitEthernet0/0/0
C       172.16.40.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.40.1/32 is directly connected, GigabitEthernet0/0/1
S*   0.0.0.0/0 [1/0] via 172.16.30.1

Router2#
```

图 8 R2 的默认路由表

R1 路由表保持不变。

在 PC2 上运行 tracert PC1，验证全网可通：



4、 **使用 RIP 协议自动配置路由表** 先清空所有路由的静态路由表，然后配置路由器 RIP

协议的 network address 为 172.16.0.0。

```
Router0#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, E - EGP
       i - IS-IS, 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

     172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
C       172.16.10.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.10.1/32 is directly connected, GigabitEthernet0/0/1
C       172.16.20.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.20.2/32 is directly connected, GigabitEthernet0/0/0
R       172.16.30.0/24 [120/1] via 172.16.20.1, 00:00:19, GigabitEthernet0/0/0
R       172.16.40.0/24 [120/2] via 172.16.20.1, 00:00:19, GigabitEthernet0/0/0

Router0#
```

图 9 R0 自动配置的路由表

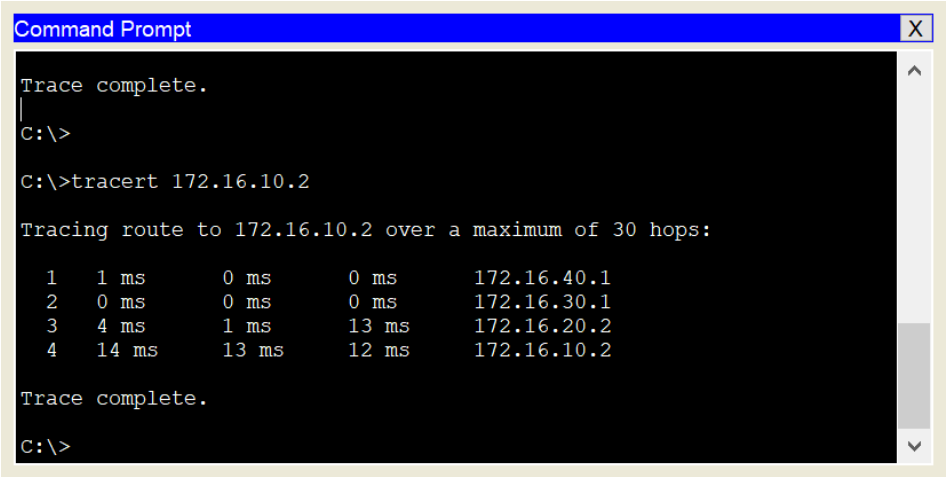
```
show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, 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

     172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
R       172.16.10.0/24 [120/1] via 172.16.20.2, 00:00:23, GigabitEthernet0/0/1
C       172.16.20.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.20.1/32 is directly connected, GigabitEthernet0/0/1
C       172.16.30.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.30.1/32 is directly connected, GigabitEthernet0/0/0
R       172.16.40.0/24 [120/1] via 172.16.30.2, 00:00:21, GigabitEthernet0/0/0

Router1#
```

图 10 R1 自动配置的路由表

```
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, E - EGP
       i - IS-IS, 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

     172.16.0.0/16 is variably subnetted, 6 subnets, 2 masks
R       172.16.10.0/24 [120/2] via 172.16.30.1, 00:00:16, GigabitEthernet0/0/0
R       172.16.20.0/24 [120/1] via 172.16.30.1, 00:00:16, GigabitEthernet0/0/0
C       172.16.30.0/24 is directly connected, GigabitEthernet0/0/0
L       172.16.30.2/32 is directly connected, GigabitEthernet0/0/0
C       172.16.40.0/24 is directly connected, GigabitEthernet0/0/1
L       172.16.40.1/32 is directly connected, GigabitEthernet0/0/1

Router2#
```

图 11 R2 自动配置的路由表

在 PC2 上 tracert PC1，验证 RIP 协议下全网可通：



五、实验分析

1、 使用 Cisco Packet Tracer 建立网络拓扑如下。

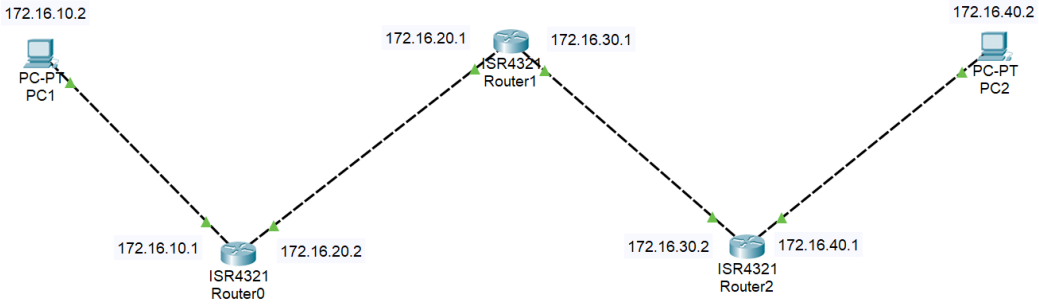


图 12 分析网络拓扑

如图所示。连接时使用 Copper cross-over 类型的线缆，此种类型的线缆通常用于连接同种类型的网络设备。为 PC 设备和路由器统一分配 172.16.0.0/16 网段下的 IP，方便后续 RIP 协议实验的进行。进一步将 172.16.0.0/16 划分为 172.16.10.0/24，172.16.20.0/24，172.16.30.0/24，172.16.40.0/24 共计四个子网。每个路由器沟通两个网段，因此具有两个不同网段的 IP 地址。

2、 配置静态路由时，需要将目标网段和下一跳地址写入静态路由表。网络中有 4 个子网段，为了实现全网可通，需要将路由器不直接连接的网段的下一跳地址写入路由表。因此，对于 R0 而言，需要写入“172.16.20.0/24 via 172.20.1”、“172.16.30.0/24 via 172.16.20.1”以及“172.16.40.0/24 via 172.16.20.1”。以此类推。

3、 对于用于连接端系统的路由（R0 和 R2）而言，由于其上游路由只有一个 R1，因此可以使用默认路由的方式来简化路由表的配置。例如，对于 R0 而言，它的路由表为“0.0.0.0/0 via 172.16.20.1”。

4、 使用 RIP 协议可自动完成同一网络下的路由配置。在本次实验中进行配置时，为了体现同一网络的概念，Network Address 参数应该设为 172.16.0.0。

六、实验建议

建议在指导书内增加对 Packet Tracer 基本操作的指导。