

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。

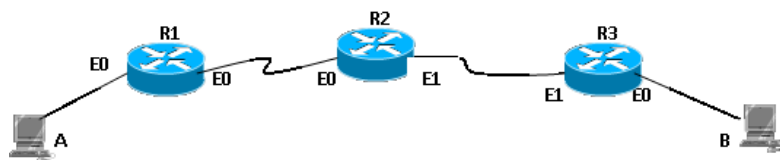


图 1 待建立的网络拓扑

- 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。

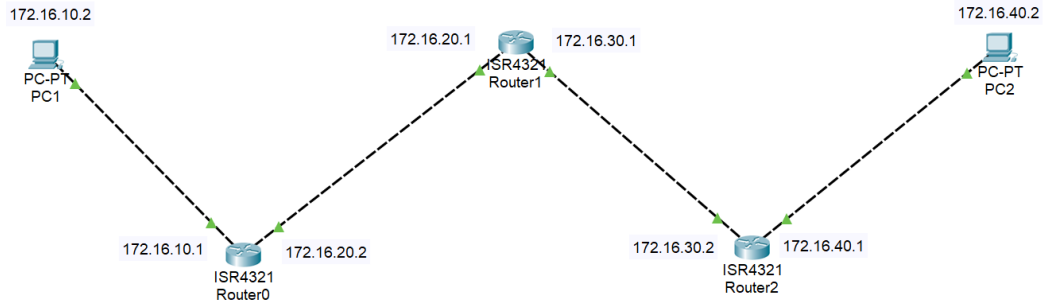


图 2 已建立的网络拓扑

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：

```

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。

```

C:\>ping 172.16.10.1

Pinging 172.16.10.1 with 32 bytes of data:

Reply from 172.16.10.1: bytes=32 time<1ms TTL=255
Reply from 172.16.10.1: bytes=32 time<1ms TTL=255
Reply from 172.16.10.1: bytes=32 time<1ms TTL=255
Reply from 172.16.10.1: bytes=32 time<1ms TTL=255

Ping statistics for 172.16.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.20.1

Pinging 172.16.20.1 with 32 bytes of data:

Request timed out.
Reply from 172.16.20.1: bytes=32 time<1ms TTL=254
Reply from 172.16.20.1: bytes=32 time<1ms TTL=254
Reply from 172.16.20.1: bytes=32 time<1ms TTL=254

Ping statistics for 172.16.20.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.16.30.2

Pinging 172.16.30.2 with 32 bytes of data:

Request timed out.
Reply from 172.16.30.2: bytes=32 time=14ms TTL=253
Reply from 172.16.30.2: bytes=32 time=24ms TTL=253
Reply from 172.16.30.2: bytes=32 time=11ms TTL=253

Ping statistics for 172.16.30.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 11ms, Maximum = 24ms, Average = 16ms

C:\>ping 172.16.40.2

Pinging 172.16.40.2 with 32 bytes of data:

Request timed out.
Reply from 172.16.40.2: bytes=32 time=13ms TTL=125
Reply from 172.16.40.2: bytes=32 time=13ms TTL=125
Reply from 172.16.40.2: bytes=32 time=12ms TTL=125

Ping statistics for 172.16.40.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 13ms, Average = 12ms

C:\>

```

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：

```

Command Prompt

Packet Tracer PC Command Line 1.0
C:\>tracert 172.16.10.2

Tracing route to 172.16.10.2 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    172.16.40.1
  1  0 ms    0 ms    0 ms    172.16.30.1
  2 14 ms    0 ms    14 ms    172.16.20.2
  3  0 ms    0 ms    16 ms    172.16.10.2

Trace complete.

C:\>

```

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：

```
Command Prompt
Trace complete.
C:\>

C:\>tracert 172.16.10.2

Tracing route to 172.16.10.2 over a maximum of 30 hops:

  1  1 ms    0 ms    0 ms    172.16.40.1
  2  0 ms    0 ms    0 ms    172.16.30.1
  3  4 ms    1 ms    13 ms   172.16.20.2
  4 14 ms   13 ms   12 ms   172.16.10.2

Trace complete.
C:\>
```

五、实验分析

- 1、使用 Cisco Packet Tracer 建立网络拓扑如下。

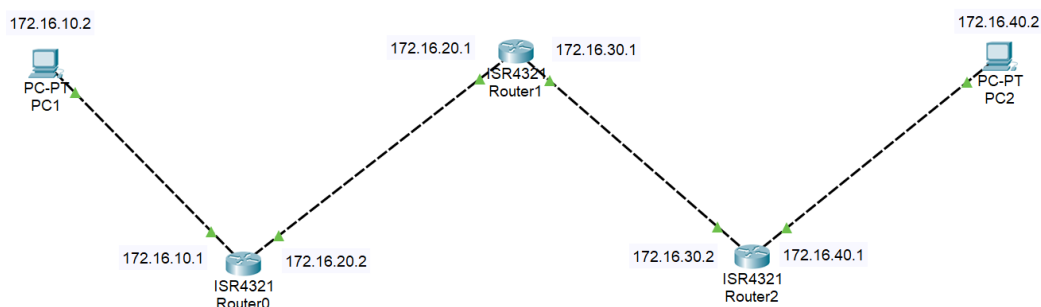


图 12 分析网络拓扑

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。