《计算机网络》实验报告

信息 学院 智能科学与技术 专业 2020 级

实验时间 2022 年 11 月 25 日

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实验名称 路由器相关配置实验

实验成绩

一、实验目的

（一）实验 12 路由信息协议（RIP）实验

掌握路由器的基本配置：设置路由器接口的 IP 地址。

根据以上拓扑划分出的三个网段配置 RIP 路由，使所有主机都能相互通信。

（二）实验 13 开放最短路径优先（OSPF）实验

掌握路由器的基本配置：设置路由器接口的 IP 地址

根据以上拓扑划分出的三个网段配置 OSPF 路由，使所有主机都能相互通信

熟悉 Packet Tracer 8.0 模拟软件的使用

（三）实验 14 访问控制列表(ACL)实验

ACL 能正常工作的前提是所有主机都能 ping 通。

掌握路由器的基本配置：设置路由器接口 IP 地址、配置 RIP 路由。

根据以上拓扑划分出的两个网段，禁止主机 PC6 访问 172.1.1.0/24 网段

二、实验仪器设备及软件

Packet Tracer 8.2.0

三、实验方案

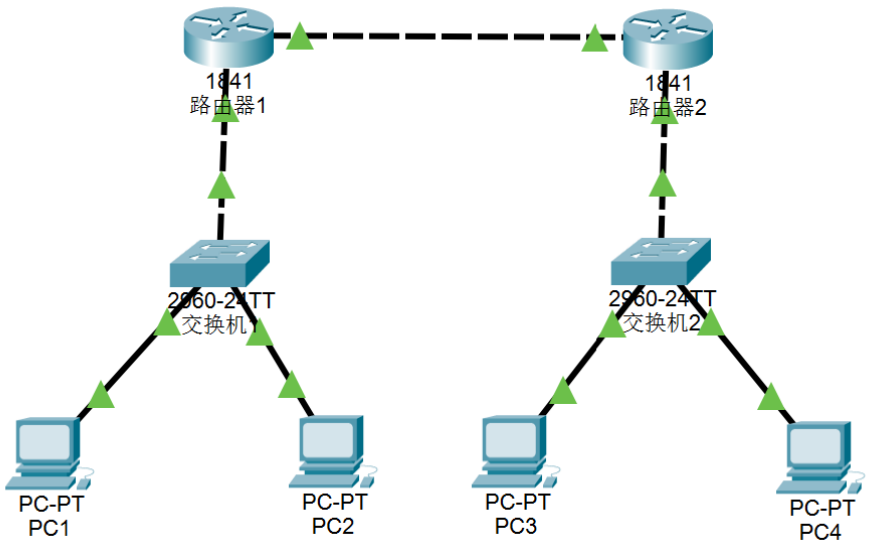
部署好网络拓扑，并且配置好 IP 地址。然后按照实验指导书的内容，逐步

完成本次实验的配置步骤。

四、实验步骤

（一）实验 12 路由信息协议（RIP）实验

1. 建立如图所示的网络拓扑



名称	接口	IP 地址	网关
Router A	F0/0	192.168.1.1/24	
	F0/1	172.1.1.1/24	
Router B	F0/0	172.2.2.1/24	
	F0/1	192.168.1.2/24	
PC1		172.1.1.2/24	172.1.1.1
PC2		172.1.1.3/24	172.1.1.1
PC3		172.2.2.2/24	172.2.2.1
PC4		172.2.2.3/24	172.2.2.1

2. 分别配置 Router A 和 Router B 的基本配置

```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#no ip domain-look
Router(config)#int f0/0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#int f0/1
Router(config-if)#ip address 172.1.1.1 255.255.255.0
Router(config-if)#no shut
Router(config-if)#end
Router#
```

（配置 Router A）

```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#no ip domain-look
Router(config)#int f0/0
Router(config-if)#ip address 172.2.2.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#int f0/1
Router(config-if)#ip address 192.168.1.2 255.255.255.0
Router(config-if)#no shut
Router(config-if)#end
Router#
```

（配置 Router B）

3. 配置 Router A 和 Router B 的 RIP 路由。

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 172.1.1.0
Router(config-router)#network 192.168.1.0
Router(config-router)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

（配置 Router A 的 RIP）

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 172.2.2.0
Router(config-router)#network 192.168.1.0
Router(config-router)#end
Router#
%SYS-5-CONFIG I: Configured from console by console
```

（配置 Router B 的 RIP）

4. 在两个路由器上展示各自的路由配置信息

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#version 2
Router(config-router)#network 172.1.1.0
Router(config-router)#network 192.168.1.0
Router(config-router)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     172.1.0.0/24 is subnetted, 1 subnets
C       172.1.1.0 is directly connected, FastEthernet0/1
     172.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
R       172.2.0.0/16 [120/1] via 192.168.1.2, 00:00:12, FastEthernet0/0
S       172.2.2.0/24 [1/0] via 192.168.1.2
C    192.168.1.0/24 is directly connected, FastEthernet0/0

Router#
```

（Router A 展示路由信息）

```
Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     172.1.0.0/16 is variably subnetted, 2 subnets, 2 masks
R       172.1.0.0/16 [120/1] via 192.168.1.1, 00:00:21, FastEthernet0/1
S       172.1.1.0/24 [1/0] via 192.168.1.1
     172.2.0.0/24 is subnetted, 1 subnets
C       172.2.2.0 is directly connected, FastEthernet0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/1

Router#
```

（Router B 展示路由信息）

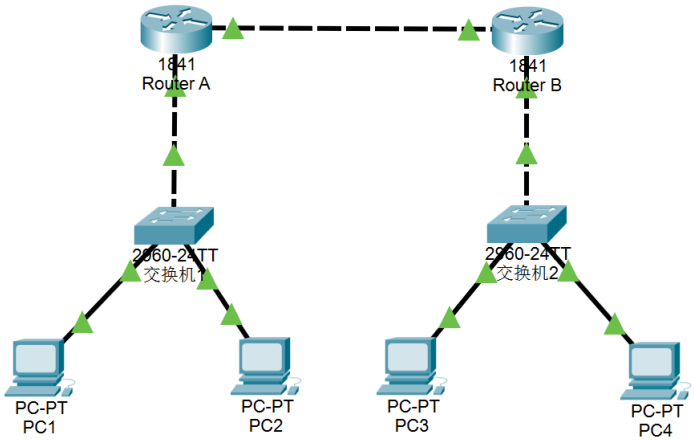
5. 使用 PC1 测试连通性

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Reply from 172.1.1.3: bytes=32 time=1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.2.2.2

Pinging 172.2.2.2 with 32 bytes of data:

Request timed out.
Reply from 172.2.2.2: bytes=32 time=1ms TTL=126
Reply from 172.2.2.2: bytes=32 time=1ms TTL=126
Reply from 172.2.2.2: bytes=32 time=10ms TTL=126

Ping statistics for 172.2.2.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 4ms

C:\>ping 172.2.2.1

Pinging 172.2.2.1 with 32 bytes of data:

Reply from 172.2.2.1: bytes=32 time<1ms TTL=254
Reply from 172.2.2.1: bytes=32 time=1ms TTL=254
Reply from 172.2.2.1: bytes=32 time<1ms TTL=254
Reply from 172.2.2.1: bytes=32 time<1ms TTL=254

Ping statistics for 172.2.2.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

（使用 PC1 ping PC2、PC3、PC4，均成功连通，说明实验成功）

（二）实验 13 开放最短路径优先（OSPF）实验

1. 建立如图所示的网络拓扑



名称	接口	IP 地址	网关
Router A	F0/0	192.168.1.1/24	
	F0/1	172.1.1.1/24	
Router B	F0/0	172.2.2.1/24	
	F0/1	192.168.1.2/24	
PC1		172.1.1.2/24	172.1.1.1
PC2		172.1.1.3/24	172.1.1.1
PC3		172.2.2.2/24	172.2.2.1
PC4		172.2.2.3/24	172.2.2.1

2. 分别配置两个路由器的基础配置

```
Router#en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#no ip domain-look
Router(config)#int f0/0
Router(config-if)#ip address 192.168.1.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#int f0/1
Router(config-if)#ip address 172.1.1.1 255.255.255.0
Router(config-if)#no shut
Router(config-if)#end
Router#
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#no ip domain-look
Router(config)#int f0/0
Router(config-if)#ip address 172.2.2.1 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#exit
Router(config)#int f0/1
Router(config-if)#ip address 192.168.1.2 255.255.255.0
Router(config-if)#no shut
Router(config-if)#end
Router#
```

（分别配置 Router A 和 Router B 的 F0/0 和 F0/1 的 IP 地址）

3. 分别配置两个路由器的 OSPF 设置

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 100
Router(config-router)#net 172.1.1.0 0.0.0.255 area 0
Router(config-router)#net 192.168.1.0 0.0.0.255 area 0
Router(config-router)#end
Router#
```

```
Router#en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 100
Router(config-router)#net 172.2.2.0 0.0.0.255 area 0
Router(config-router)#net 192.168.1.0 0.0.0.255 area 0
Router(config-router)#end
Router#
```

4. 展示两个路由器的 OSPF 配置结果

```
show ip route
Codes: C - connected, S - static, I - IGRP, 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

     172.1.0.0/24 is subnetted, 1 subnets
C       172.1.1.0 is directly connected, FastEthernet0/1
     172.2.0.0/24 is subnetted, 1 subnets
O       172.2.2.0 [110/2] via 192.168.1.2, 00:00:01, FastEthernet0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0

Router#
Router#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     172.1.0.0/24 is subnetted, 1 subnets
O       172.1.1.0 [110/2] via 192.168.1.1, 00:00:29, FastEthernet0/1
     172.2.0.0/24 is subnetted, 1 subnets
C       172.2.2.0 is directly connected, FastEthernet0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/1

Router#
```

（Router A、Router B 的 IP route 配置中，都有一个以 O 标识的，表示 OSPF 配置成功）

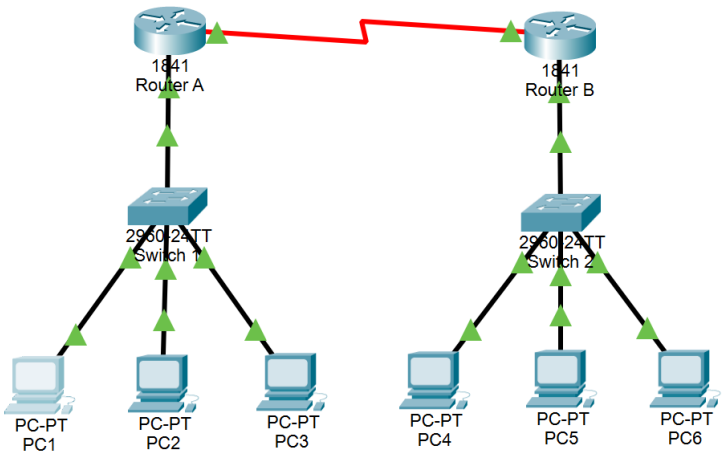
5. 在 PC1 上测试

PC1 ping PC2、PC3、PC4 均成功。

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.2.2.2

Pinging 172.2.2.2 with 32 bytes of data:

Request timed out.
Reply from 172.2.2.2: bytes=32 time<1ms TTL=126
Reply from 172.2.2.2: bytes=32 time<1ms TTL=126
Reply from 172.2.2.2: bytes=32 time<1ms TTL=126

Ping statistics for 172.2.2.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.2.2.3

Pinging 172.2.2.3 with 32 bytes of data:

Request timed out.
Reply from 172.2.2.3: bytes=32 time<1ms TTL=126
Reply from 172.2.2.3: bytes=32 time<1ms TTL=126
Reply from 172.2.2.3: bytes=32 time<1ms TTL=126

Ping statistics for 172.2.2.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

（三） 实验 14 访问控制列表(ACL)实验

1. 建立如图所示的网络拓扑



名称	接口	IP 地址	网关
Router A	Se0/1/0	192.168.1.1/24	

Router B	F0/1	172.1.1.1/24	
	Se0/1/0	192.168.1.2/24	
	F0/1	172.2.2.1/24	
PC1		172.1.1.2/24	172.1.1.1
PC2		172.1.1.3/24	172.1.1.1
PC3		172.1.1.4/24	172.1.1.1
PC4		172.2.2.2/24	172.2.2.1
PC5		172.2.2.3/24	172.2.2.1
PC6		172.2.2.4/24	172.2.2.1

2. Router A 和 Router B 基本配置

```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int f0/1
Router(config-if)#ip address 172.1.1.1 255.255.255.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#int s0/1/0
Router(config-if)#ip add 192.168.1.1 255.255.255.0
Router(config-if)#clock rate 64000
Router(config-if)#no shut

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to down
Router(config-if)#end
Router#
```

```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int f0/1
Router(config-if)#ip address 172.2.2.1 255.255.255.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#s0/1/0
                ^
% Invalid input detected at '^' marker.

Router(config)#int s0/1/0
Router(config-if)#ip add 192.168.1.2 255.255.255.0
Router(config-if)#no shut

Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up

Router(config-if)#end
Router#
```

3. Router A 和 Router B 配置 RIP

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.1.0
Router(config-router)#network 172.1.1.0
Router(config-router)#end
Router#

Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 192.168.1.0
Router(config-router)#network 172.2.2.0
Router(config-router)#end
Router#
```

4. 测试连通性

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time=10ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time=1ms TTL=128

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms

C:\>ping 172.2.2.2

Pinging 172.2.2.2 with 32 bytes of data:

Request timed out.
Reply from 172.2.2.2: bytes=32 time=11ms TTL=126
Reply from 172.2.2.2: bytes=32 time=11ms TTL=126
Reply from 172.2.2.2: bytes=32 time=2ms TTL=126

Ping statistics for 172.2.2.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 11ms, Average = 8ms

C:\>ping 172.2.2.3

Pinging 172.2.2.3 with 32 bytes of data:

Request timed out.
Reply from 172.2.2.3: bytes=32 time=14ms TTL=126
Reply from 172.2.2.3: bytes=32 time=1ms TTL=126
Reply from 172.2.2.3: bytes=32 time=16ms TTL=126

Ping statistics for 172.2.2.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 16ms, Average = 10ms

C:\>ping 172.2.2.4

Pinging 172.2.2.4 with 32 bytes of data:
```

（使用 PC1 ping PC2、4、5、6 均成功）

5. 在 Router A 上禁止 PC6 访问 172.1.1.0/24 网段，并查看

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#access-list 1 deny 172.2.2.4 0.0.0.0
Router(config)#access-list 1 permit any
Router(config)#int f0/1
Router(config-if)#ip access-group 1 out
Router(config-if)#end
Router#
```

（首先创建一条 access-list，然后拒绝来自 PC6 的访问；下一行允许其他的设备访问；然后转到接口 F0/1，将其应用）

```
Router#show access-lists 1
Standard IP access list 1
    deny host 172.2.2.4
    permit any

Router#
```

（展示配置结果）

6. 测试禁止访问的效果

```
C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

（此时 PC6 ping 172.1.1.3(PC2)失败）

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Request timed out.
Reply from 172.1.1.3: bytes=32 time=13ms TTL=126
Reply from 172.1.1.3: bytes=32 time=1ms TTL=126
Reply from 172.1.1.3: bytes=32 time=15ms TTL=126

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 15ms, Average = 9ms

C:\>
```

（PC5 ping 172.1.1.3 成功）

```
C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Reply from 172.1.1.3: bytes=32 time=15ms TTL=126
Reply from 172.1.1.3: bytes=32 time=18ms TTL=126
Reply from 172.1.1.3: bytes=32 time=1ms TTL=126
Reply from 172.1.1.3: bytes=32 time=35ms TTL=126

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 35ms, Average = 17ms

C:\>
```

（PC4 ping 172.1.1.3 成功）

PC6 ping 不通的 PC5、PC4 能成功，说明禁止访问的配置成功。

7. 删除 ACL 并显示

```
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int f0/1
Router(config-if)#no ip access-group 1 out
Router(config-if)#no access-list 1
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show access-lists 1
Router#
```

（删除以后 show access-lists 1 没有结果，说明删除成功）

8. PC6 再次尝试 ping 172.1.1.3

```
C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Reply from 172.1.1.3: bytes=32 time=36ms TTL=126
Reply from 172.1.1.3: bytes=32 time=8ms TTL=126
Reply from 172.1.1.3: bytes=32 time=1ms TTL=126
Reply from 172.1.1.3: bytes=32 time=1ms TTL=126

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 36ms, Average = 11ms

C:\>
```

（此时 PC6 ping 172.1.1.3(PC2)就非常顺畅，证明 ACL 已成功删除）

五、实验结果及分析

本次实验的实验结果符合指导书的预期。在第一节学习了使用 OSPF 算法动态更新路由表。

六、实验总结及体会

在本次实验中，主要学习了路由器及路由算法的配置、选择，并直观理解了网络层在网络传输过程中的作用，对路由器的功能有了更深的理解。

七、教师评语