

《计算机网络》实验报告

____信息____学院 ____计算机科学与技术____专业____2020____级

实验时间____2022____年____11____月____25____日

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实验名称____开放最短路径优先（OSPF）实验____

实验成绩____

一、实验目的

- (1) 掌握路由器的基本配置：设置路由器接口的 IP 地址。
- (2) 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。

二、实验仪器设备及软件

- (1) Cisco Packet Tracer 8.2.0 模拟器
- (2) 4 台 PC
- (3) 2 台 4331 路由器

三、实验方案

使用 2811 路由器进行实验，PC 两两一组放到两个网段中，路由器相互连接的线路另作为一个网段，并为两个路由器配置接口 IP 地址及 OSPF 协议，

四、实验步骤

1. 路由器的基本配置

- (1) 配置两个路由器的接口 IP 地址并将其开启
- (2) 配置各 PC 的 IP 地址及默认网关

2. 配置 OSPF

- (1) 配置两个路由器的 OSPF 协议，分别向其中添加连接的两个网络的网

络号

(2) 测试两个网段之间是否能连通

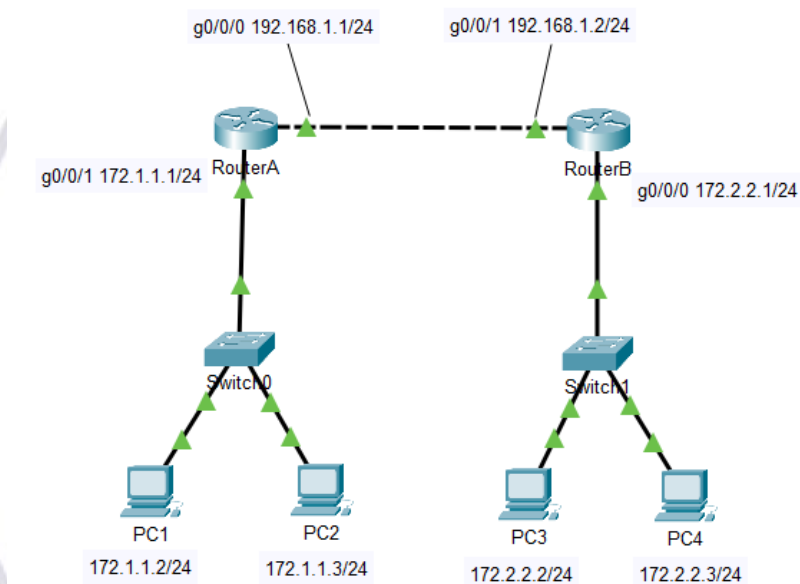
3. 默认路由配置

(1) 给路由器 A 配置默认路由

(2) 查看两个路由的路由表

五、实验结果及分析

网络拓扑结构图如下



1. 路由器的基本配置

路由器 A 的基本配置

RouterA

Physical Config CLI Attributes

IOS Command Line Interface

```
Router>enable
Router#conf 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)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

Router(config-if)#int f0/1
Router(config-if)#ip address 172.1.1.1 255.255.255.0
Router(config-if)#no shutdown

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)#end
```

路由器 B 的基本配置

RouterB

Physical Config CLI Attributes

IOS Command Line Interface

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

RB(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

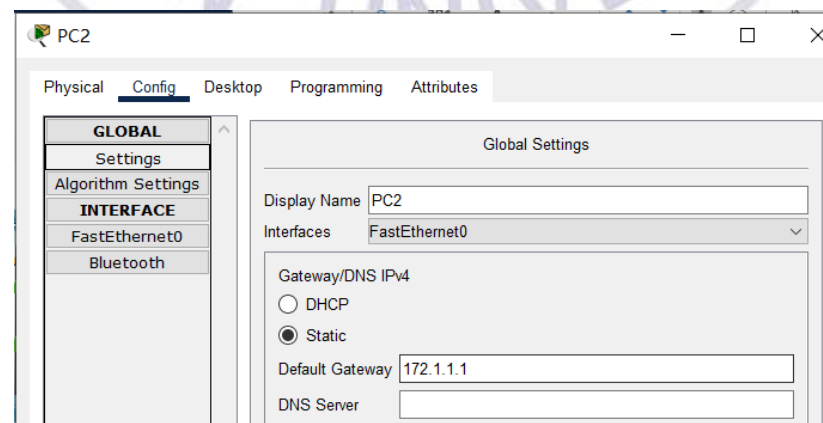
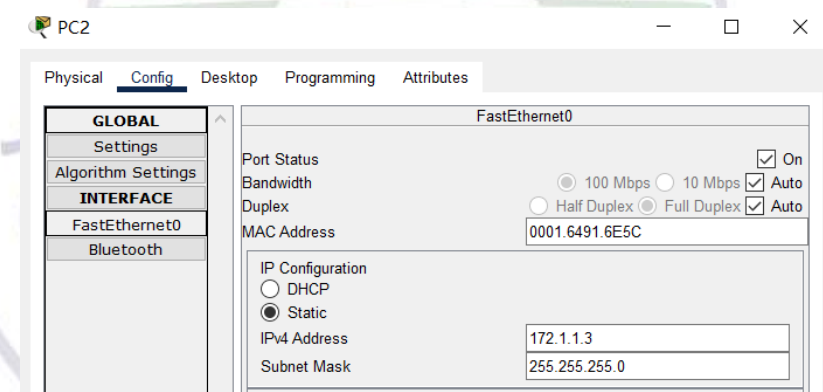
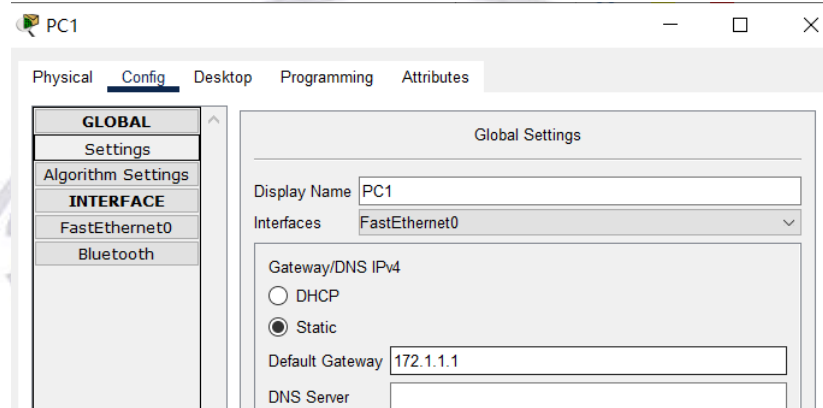
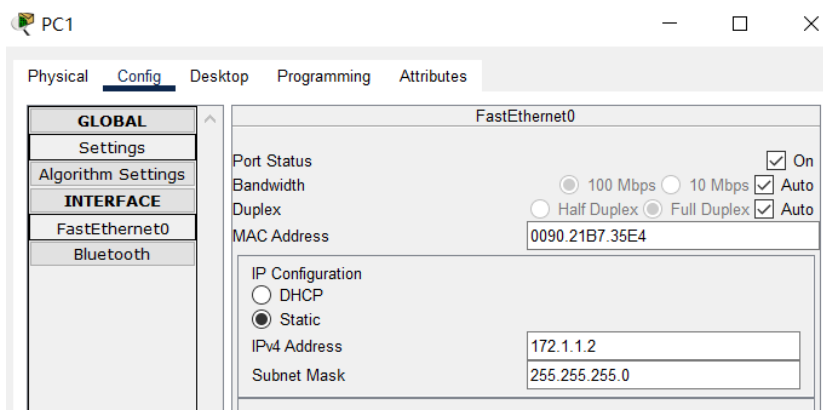
RB(config-if)#int f0/0
RB(config-if)#no shutdown

RB(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed
state to up

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

各台 PC 的 IP 及网关配置



PC3

Physical **Config** Desktop Programming Attributes

GLOBAL

Settings

Algorithm Settings

INTERFACE

FastEthernet0

Bluetooth

FastEthernet0

Port Status ☒ On

Bandwidth ☒ 100 Mbps ☐ 10 Mbps ☒ Auto

Duplex ☐ Half Duplex ☒ Full Duplex ☒ Auto

MAC Address 0001.63D5.707D

IP Configuration

☐ DHCP

☒ Static

IPv4 Address 172.2.2.2

Subnet Mask 255.255.255.0

IPv6 Configuration

PC3

Physical **Config** Desktop Programming Attributes

GLOBAL

Settings

Algorithm Settings

INTERFACE

FastEthernet0

Bluetooth

Global Settings

Display Name PC3

Interfaces FastEthernet0

Gateway/DNS IPv4

☐ DHCP

☒ Static

Default Gateway 172.2.2.1

DNS Server

PC4

Physical **Config** Desktop Programming Attributes

GLOBAL

Settings

Algorithm Settings

INTERFACE

FastEthernet0

Bluetooth

FastEthernet0

Port Status ☒ On

Bandwidth ☒ 100 Mbps ☐ 10 Mbps ☒ Auto

Duplex ☐ Half Duplex ☒ Full Duplex ☒ Auto

MAC Address 00E0.B02A.517E

IP Configuration

☐ DHCP

☒ Static

IPv4 Address 172.2.2.3

Subnet Mask 255.255.255.0

IPv6 Configuration

PC4

Physical **Config** Desktop Programming Attributes

GLOBAL

Settings

Algorithm Settings

INTERFACE

FastEthernet0

Bluetooth

Global Settings

Display Name PC4

Interfaces FastEthernet0

Gateway/DNS IPv4

☐ DHCP

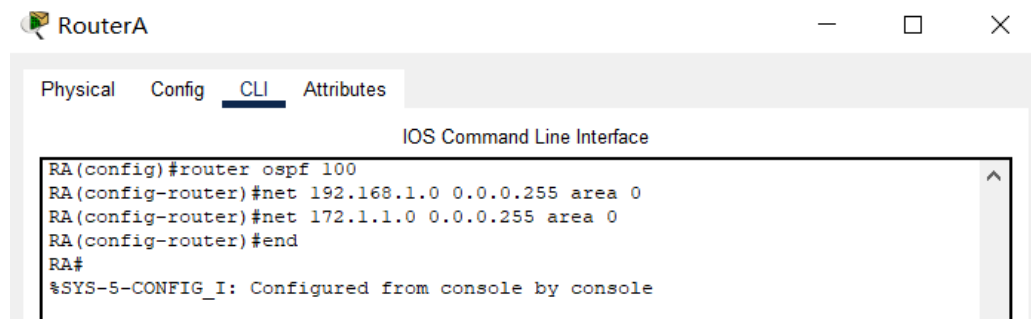
☒ Static

Default Gateway 172.2.2.1

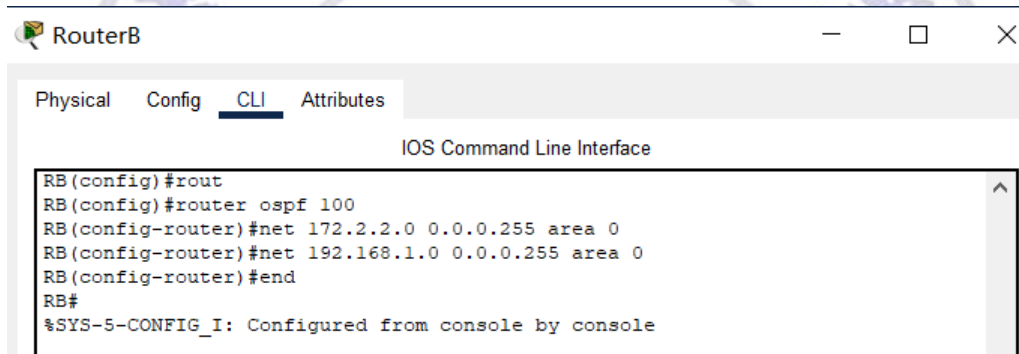
DNS Server

2. 配置 OSPF

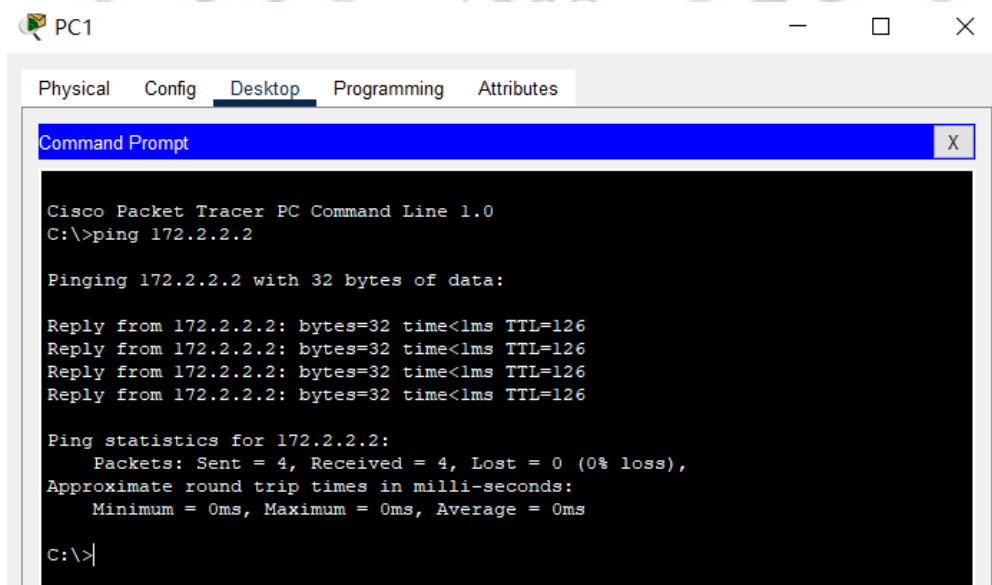
给路由器 A 设置 OSPF 协议，添加 172.1.1.0 与 192.168.1.0 两个网络至路由域 0，即骨干区域



同样配置路由器 B 的 OSPF 协议，添加 172.2.2.0 与 192.168.1.0 两个网络至骨干区域 0

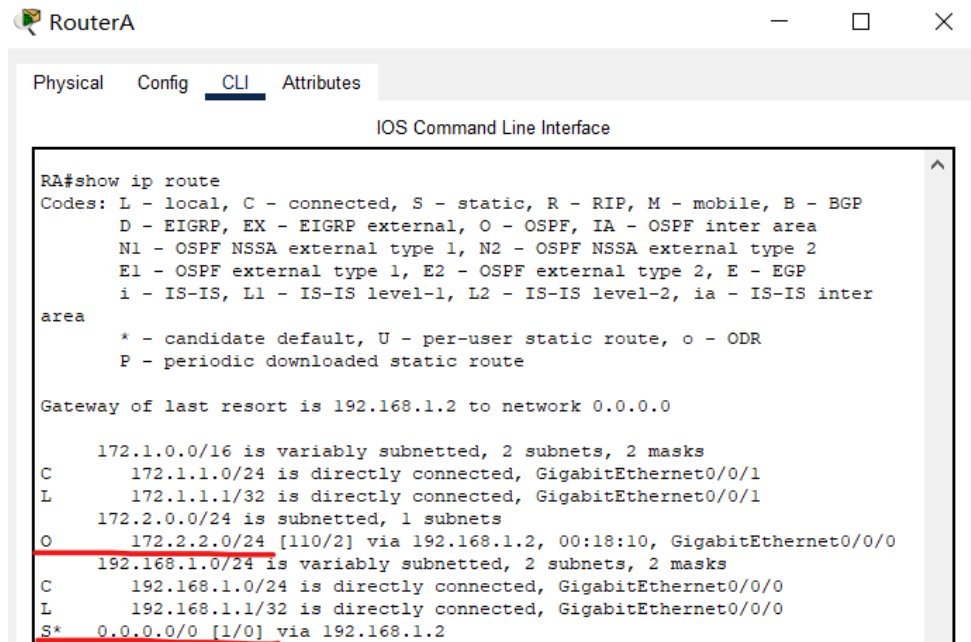


从 PC1 ping PC4 的结果，可以 ping 通



3. 配置路由器的默认路由

将路由器 A 的默认路由设为路由器 B 的 g0/0/1 接口（红色线标注处分别为 OSPF 产生的路由表项和手动配置的默认路由表项）



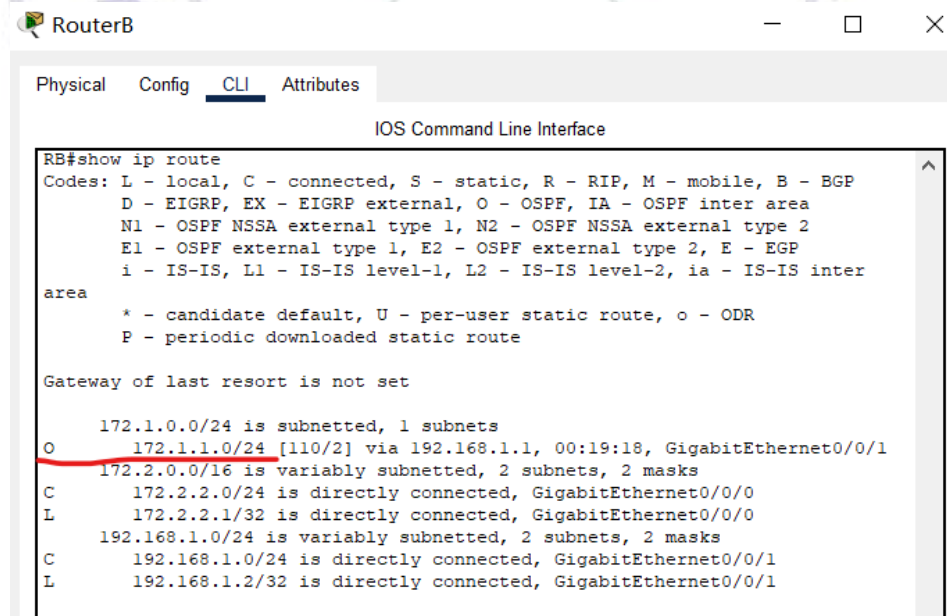
```
RouterA
Physical Config CLI Attributes
IOS Command Line Interface

RA#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 192.168.1.2 to network 0.0.0.0

172.1.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.1.1.0/24 is directly connected, GigabitEthernet0/0/1
L 172.1.1.1/32 is directly connected, GigabitEthernet0/0/1
172.2.0.0/24 is subnetted, 1 subnets
O 172.2.2.0/24 [110/2] via 192.168.1.2, 00:18:10, GigabitEthernet0/0/0
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.1.0/24 is directly connected, GigabitEthernet0/0/0
L 192.168.1.1/32 is directly connected, GigabitEthernet0/0/0
S* 0.0.0.0/0 [1/0] via 192.168.1.2
```

将路由器 B 的路由表如下（红色标注处为 OSPF 产生的路由表项）



```
RouterB
Physical Config CLI Attributes
IOS Command Line Interface

RB#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

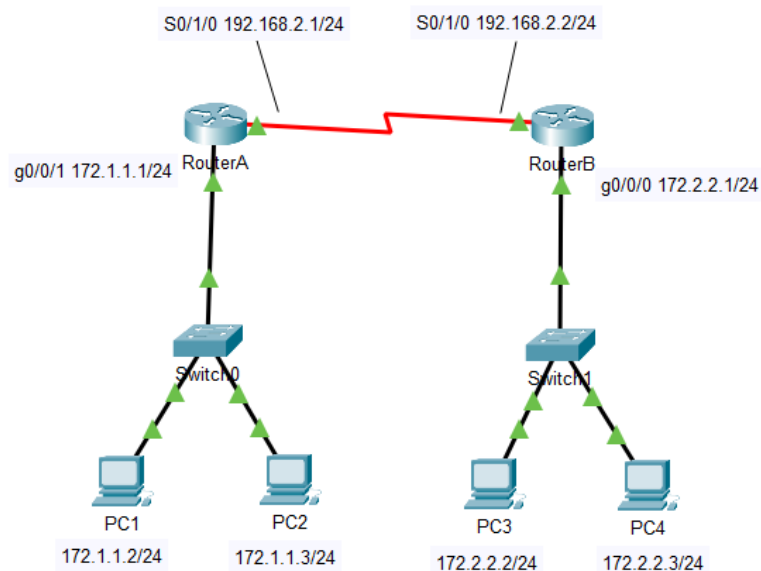
172.1.0.0/24 is subnetted, 1 subnets
O 172.1.1.0/24 [110/2] via 192.168.1.1, 00:19:18, GigabitEthernet0/0/1
172.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
C 172.2.2.0/24 is directly connected, GigabitEthernet0/0/0
L 172.2.2.1/32 is directly connected, GigabitEthernet0/0/0
192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C 192.168.1.0/24 is directly connected, GigabitEthernet0/0/1
L 192.168.1.2/32 is directly connected, GigabitEthernet0/0/1
```

六、实验总结及体会

思考题

(1) 如果实验拓扑图如图 13-8 所示，应该如何配置才能使得所有 PC 机相互通信？

如下图标注中所示配置接口的 IP

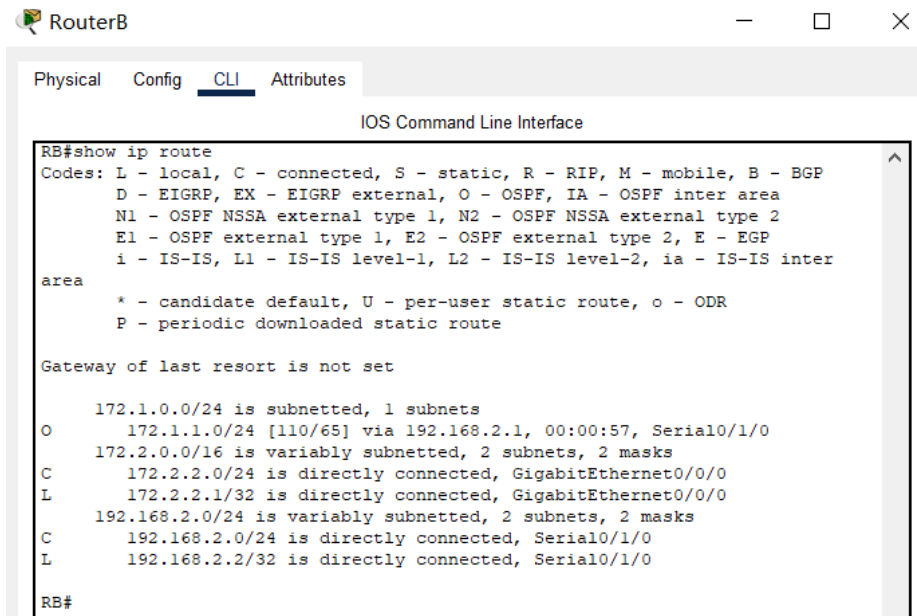


同样配置路由器 A 和路由器 B 的 OSPF，路由器 A 和 B 的路由表如下

```
RouterA
Physical Config CLI Attributes
IOS Command Line Interface
RA#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

172.1.0.0/16 is variably subnetted, 2 subnets, 2 masks
C    172.1.1.0/24 is directly connected, GigabitEthernet0/0/1
L    172.1.1.1/32 is directly connected, GigabitEthernet0/0/1
172.2.0.0/24 is subnetted, 1 subnets
O    172.2.2.0/24 [110/65] via 192.168.2.2, 00:00:25, Serial0/1/0
192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C    192.168.2.0/24 is directly connected, Serial0/1/0
L    192.168.2.1/32 is directly connected, Serial0/1/0
RA#
```

RouterB

Physical Config **CLI** Attributes

IOS Command Line Interface

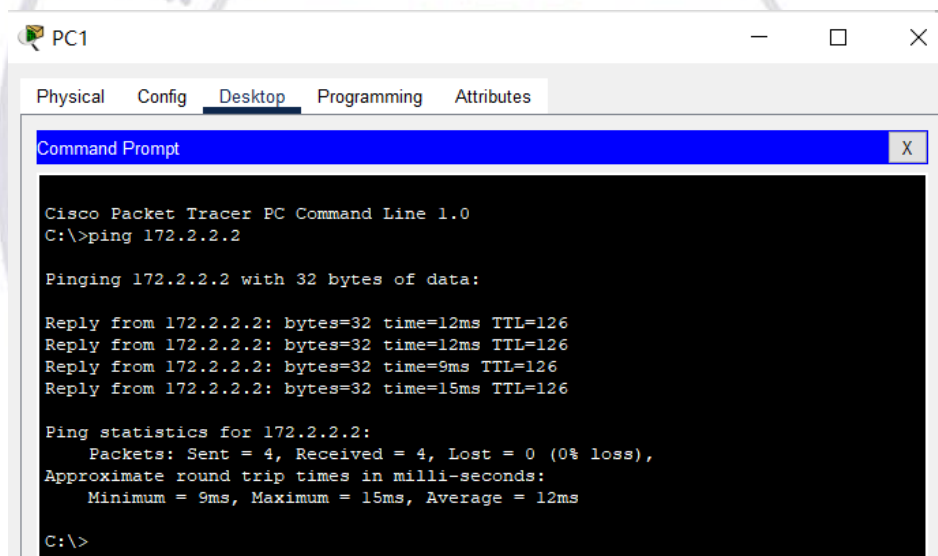
```
RB#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP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

    172.1.0.0/24 is subnetted, 1 subnets
O       172.1.1.0/24 [110/65] via 192.168.2.1, 00:00:57, Serial0/1/0
    172.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.2.2.0/24 is directly connected, GigabitEthernet0/0/0
L       172.2.2.1/32 is directly connected, GigabitEthernet0/0/0
    192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, Serial0/1/0
L       192.168.2.2/32 is directly connected, Serial0/1/0

RB#
```

其中, PC1、PC2 的网关设置为 172.1.1.1; PC3、PC4 的网关设置为 172.2.2.1。
PC1 ping PC3 与 PC4 ping PC1 的结果如下图所示



PC1

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.2.2.2

Pinging 172.2.2.2 with 32 bytes of data:

Reply from 172.2.2.2: bytes=32 time=12ms TTL=126
Reply from 172.2.2.2: bytes=32 time=12ms TTL=126
Reply from 172.2.2.2: bytes=32 time=9ms TTL=126
Reply from 172.2.2.2: bytes=32 time=15ms TTL=126

Ping statistics for 172.2.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 9ms, Maximum = 15ms, Average = 12ms

C:\>
```

```
PC4
Physical Config Desktop Programming Attributes
Command Prompt
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.1.1.2

Pinging 172.1.1.2 with 32 bytes of data:

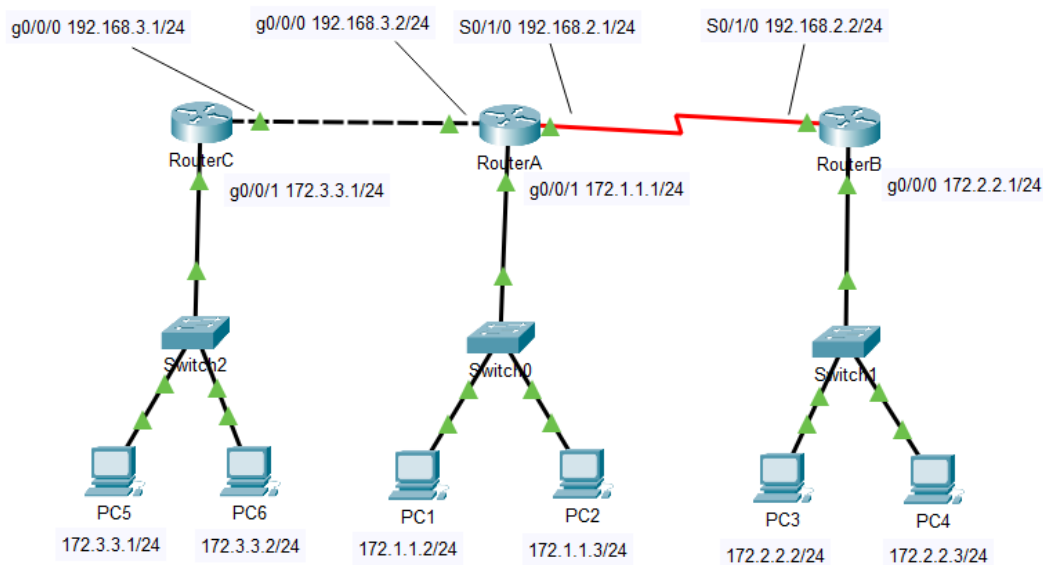
Reply from 172.1.1.2: bytes=32 time=1ms TTL=126
Reply from 172.1.1.2: bytes=32 time=11ms TTL=126
Reply from 172.1.1.2: bytes=32 time=12ms TTL=126
Reply from 172.1.1.2: bytes=32 time=9ms TTL=126

Ping statistics for 172.1.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 12ms, Average = 8ms

C:\>
```

(2) 如果是由三个路由器组成的拓扑图（如图 13-9 所示），应该如何配置才能让所有的 PC 机相互通信？

如下图标注中所示配置各接口的 IP 地址



路由器 A、路由器 B 和路由器 C 的路由表如下所示，给两边的路由器 C 和路由器 B 配置默认路由到路由器 A

IOS Command Line Interface

```
RA#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

    172.1.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.1.1.0/24 is directly connected, GigabitEthernet0/0/1
L       172.1.1.1/32 is directly connected, GigabitEthernet0/0/1
    172.2.0.0/24 is subnetted, 1 subnets
O       172.2.2.0/24 [110/65] via 192.168.2.2, 00:09:36, Serial0/1/0
    172.3.0.0/24 is subnetted, 1 subnets
O       172.3.3.0/24 [110/2] via 192.168.3.1, 00:03:01, GigabitEthernet0/0/0
    192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, Serial0/1/0
L       192.168.2.1/32 is directly connected, Serial0/1/0
    192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.3.0/24 is directly connected, GigabitEthernet0/0/0
L       192.168.3.2/32 is directly connected, GigabitEthernet0/0/0

RA#
```

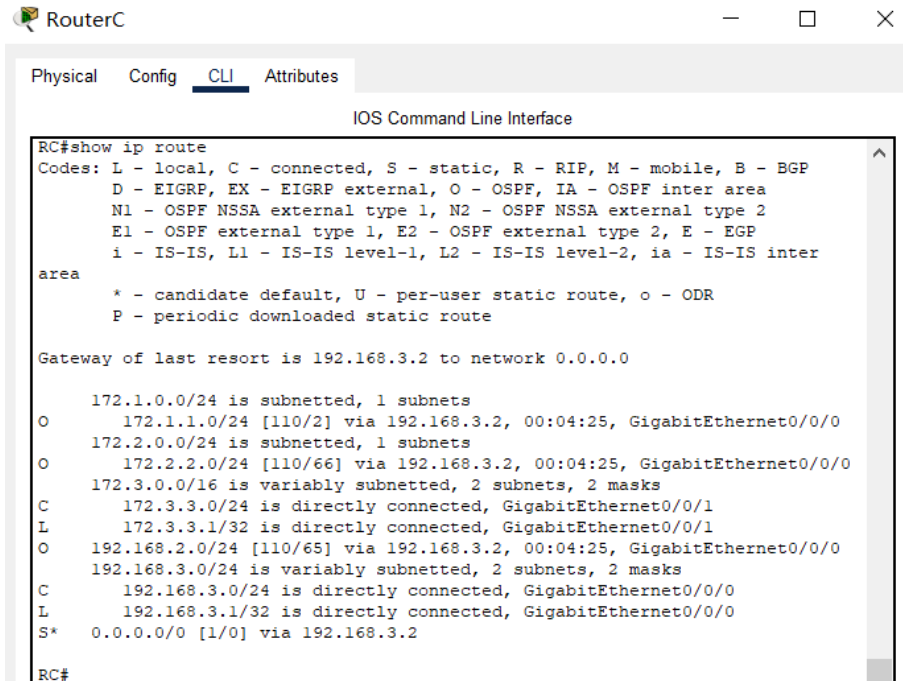
IOS Command Line Interface

```
RB#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 192.168.2.1 to network 0.0.0.0

    172.1.0.0/24 is subnetted, 1 subnets
O       172.1.1.0/24 [110/65] via 192.168.2.1, 00:10:33, Serial0/1/0
    172.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.2.2.0/24 is directly connected, GigabitEthernet0/0/0
L       172.2.2.1/32 is directly connected, GigabitEthernet0/0/0
    172.3.0.0/24 is subnetted, 1 subnets
O       172.3.3.0/24 [110/66] via 192.168.2.1, 00:03:48, Serial0/1/0
    192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, Serial0/1/0
L       192.168.2.2/32 is directly connected, Serial0/1/0
O       192.168.3.0/24 [110/65] via 192.168.2.1, 00:03:58, Serial0/1/0
S*     0.0.0.0/0 [1/0] via 192.168.2.1

RB#
```



RouterC

Physical Config **CLI** Attributes

IOS Command Line Interface

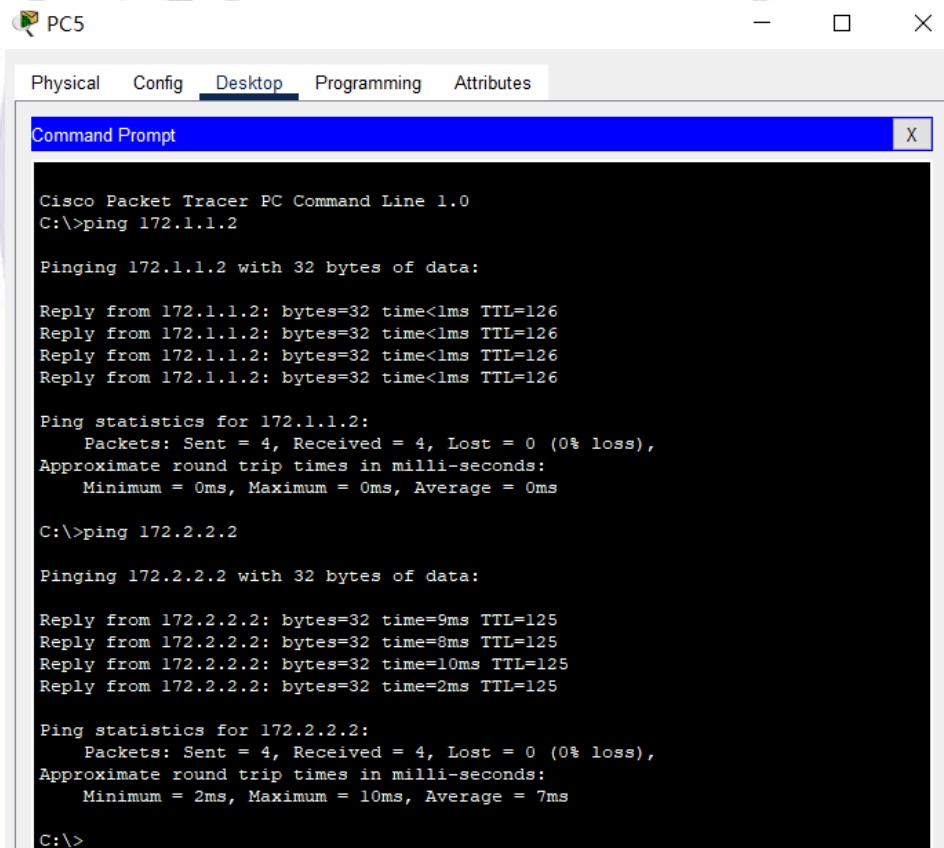
```
RC#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       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 192.168.3.2 to network 0.0.0.0

     172.1.0.0/24 is subnetted, 1 subnets
O       172.1.1.0/24 [110/2] via 192.168.3.2, 00:04:25, GigabitEthernet0/0/0
     172.2.0.0/24 is subnetted, 1 subnets
O       172.2.2.0/24 [110/66] via 192.168.3.2, 00:04:25, GigabitEthernet0/0/0
     172.3.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.3.3.0/24 is directly connected, GigabitEthernet0/0/1
L       172.3.3.1/32 is directly connected, GigabitEthernet0/0/1
O       192.168.2.0/24 [110/65] via 192.168.3.2, 00:04:25, GigabitEthernet0/0/0
     192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.3.0/24 is directly connected, GigabitEthernet0/0/0
L       192.168.3.1/32 is directly connected, GigabitEthernet0/0/0
S*    0.0.0.0/0 [1/0] via 192.168.3.2

RC#
```

PC5 ping PC1、PC3 的结果如下所示



PC5

Physical Config **Desktop** Programming Attributes

Command Prompt

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.1.1.2

Pinging 172.1.1.2 with 32 bytes of data:

Reply from 172.1.1.2: bytes=32 time<1ms TTL=126
Reply from 172.1.1.2: bytes=32 time<1ms TTL=126
Reply from 172.1.1.2: bytes=32 time<1ms TTL=126
Reply from 172.1.1.2: bytes=32 time<1ms TTL=126

Ping statistics for 172.1.1.2:
    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

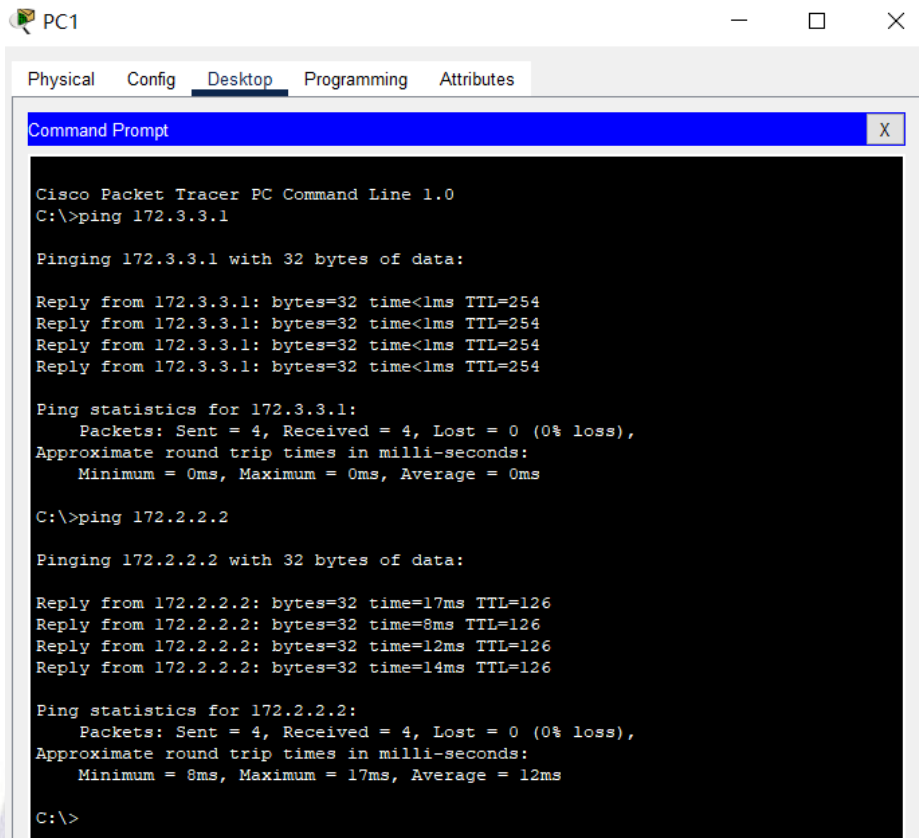
Pinging 172.2.2.2 with 32 bytes of data:

Reply from 172.2.2.2: bytes=32 time=9ms TTL=125
Reply from 172.2.2.2: bytes=32 time=8ms TTL=125
Reply from 172.2.2.2: bytes=32 time=10ms TTL=125
Reply from 172.2.2.2: bytes=32 time=2ms TTL=125

Ping statistics for 172.2.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 10ms, Average = 7ms

C:\>
```

PC1 ping PC5、PC3 的结果如下所示



The screenshot shows the 'PC1' window in Cisco Packet Tracer. The 'Desktop' tab is selected, and a 'Command Prompt' window is open. The text in the Command Prompt is as follows:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.3.3.1

Pinging 172.3.3.1 with 32 bytes of data:

Reply from 172.3.3.1: bytes=32 time<1ms TTL=254
Reply from 172.3.3.1: bytes=32 time<1ms TTL=254
Reply from 172.3.3.1: bytes=32 time<1ms TTL=254
Reply from 172.3.3.1: bytes=32 time<1ms TTL=254

Ping statistics for 172.3.3.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.2.2.2

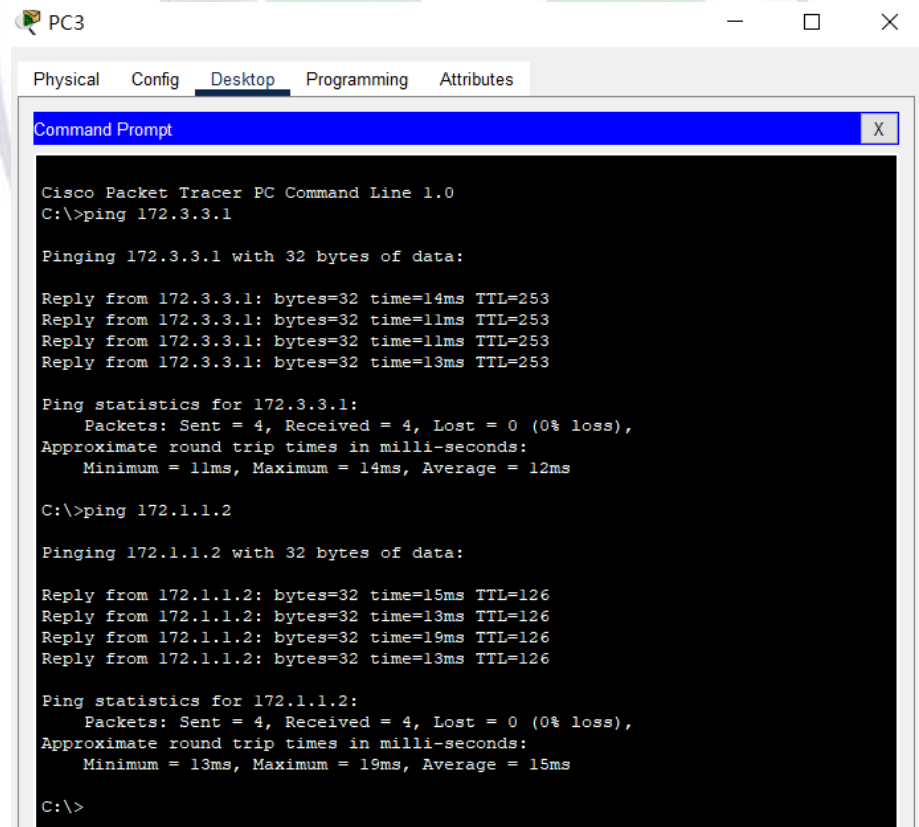
Pinging 172.2.2.2 with 32 bytes of data:

Reply from 172.2.2.2: bytes=32 time=17ms TTL=126
Reply from 172.2.2.2: bytes=32 time=8ms TTL=126
Reply from 172.2.2.2: bytes=32 time=12ms TTL=126
Reply from 172.2.2.2: bytes=32 time=14ms TTL=126

Ping statistics for 172.2.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 8ms, Maximum = 17ms, Average = 12ms

C:\>
```

PC3 ping PC5、PC1 的结果如下所示



The screenshot shows the 'PC3' window in Cisco Packet Tracer. The 'Desktop' tab is selected, and a 'Command Prompt' window is open. The text in the Command Prompt is as follows:

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.3.3.1

Pinging 172.3.3.1 with 32 bytes of data:

Reply from 172.3.3.1: bytes=32 time=14ms TTL=253
Reply from 172.3.3.1: bytes=32 time=11ms TTL=253
Reply from 172.3.3.1: bytes=32 time=11ms TTL=253
Reply from 172.3.3.1: bytes=32 time=13ms TTL=253

Ping statistics for 172.3.3.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 11ms, Maximum = 14ms, Average = 12ms

C:\>ping 172.1.1.2

Pinging 172.1.1.2 with 32 bytes of data:

Reply from 172.1.1.2: bytes=32 time=15ms TTL=126
Reply from 172.1.1.2: bytes=32 time=13ms TTL=126
Reply from 172.1.1.2: bytes=32 time=19ms TTL=126
Reply from 172.1.1.2: bytes=32 time=13ms TTL=126

Ping statistics for 172.1.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 13ms, Maximum = 19ms, Average = 15ms

C:\>
```

七、教师评语

