

# 《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\_\_\_\_14\_\_\_\_日

姓名\_\_\_\_胡诚皓\_\_\_\_学号\_\_\_\_20201060330\_\_\_\_

实验名称\_\_\_\_静态路由实验\_\_\_\_

实验成绩\_\_\_\_

## 一、实验目的

- (1) 掌握路由器的基本配置：关闭域名解释、设置路由器接口 IP 地址。
- (2) 根据以上拓扑划分出的三个网段配置静态路由，使所有主机都能相互通信。
- (3) 配置默认路由。
- (4) 了解 ping 命令和 trace 命令的原理和使用方法

## 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 2811 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，并为两个路由器配置接口 IP 地址及静态路由。最后查看路由表并使用 trace 测试路由的路线。

## 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. 配置静态路由

- (1) 给路由器 A 和路由器 B 分别配上路由表项，使能互相到达
- (2) 测试两个网段是否能够互相 ping 通
- (3) 在 PC1 上使用 tracert 命令测试到 PC3 的路由路径

## 3. 配置路由器的默认路由

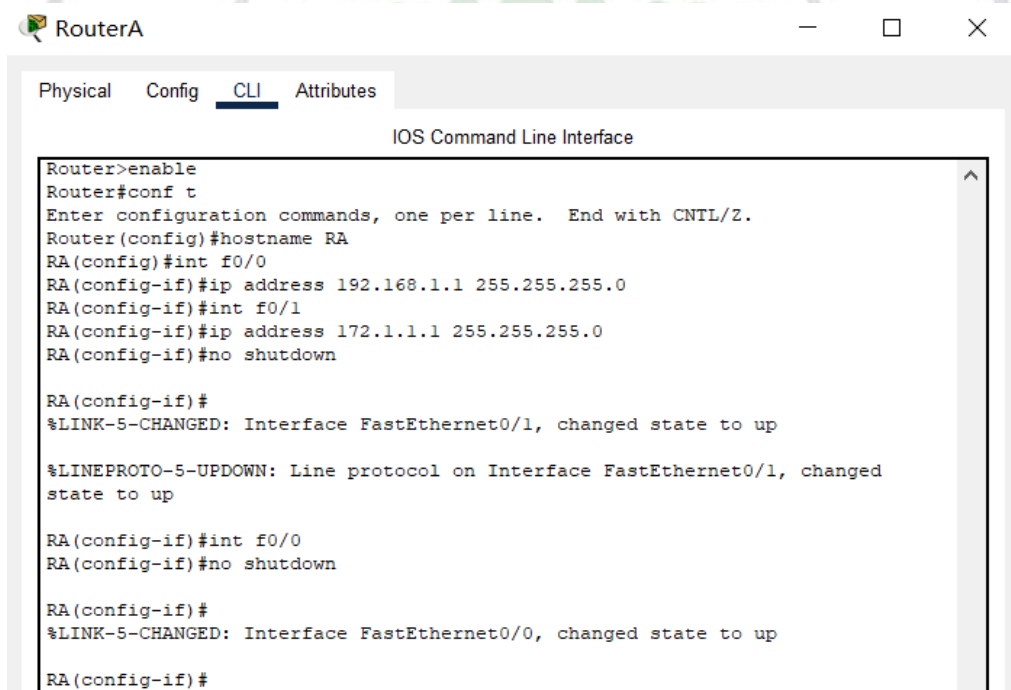
- (1) 配置两个路由器的默认路由

## 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)#hostname RA
RA(config)#int f0/0
RA(config-if)#ip address 192.168.1.1 255.255.255.0
RA(config-if)#int f0/1
RA(config-if)#ip address 172.1.1.1 255.255.255.0
RA(config-if)#no shutdown

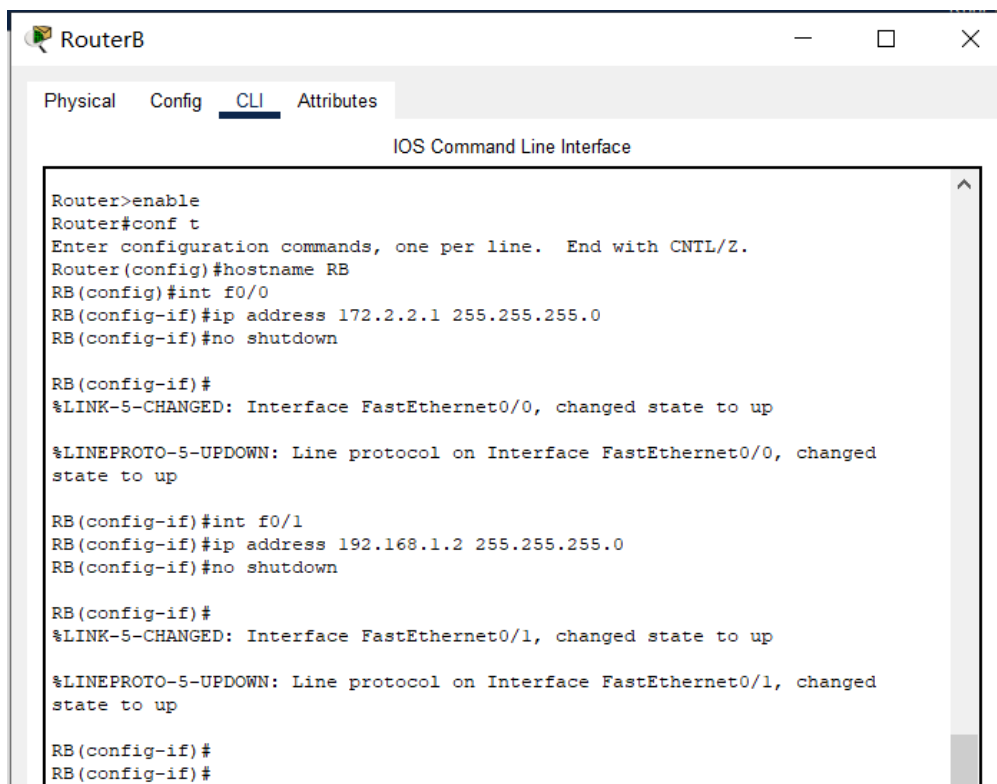
RA(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

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

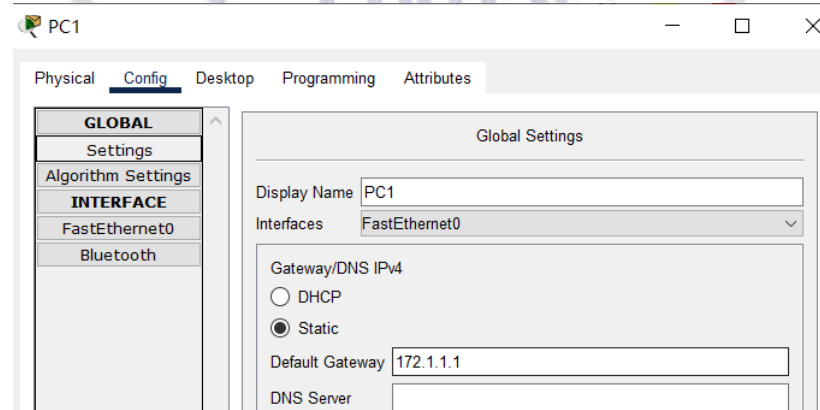
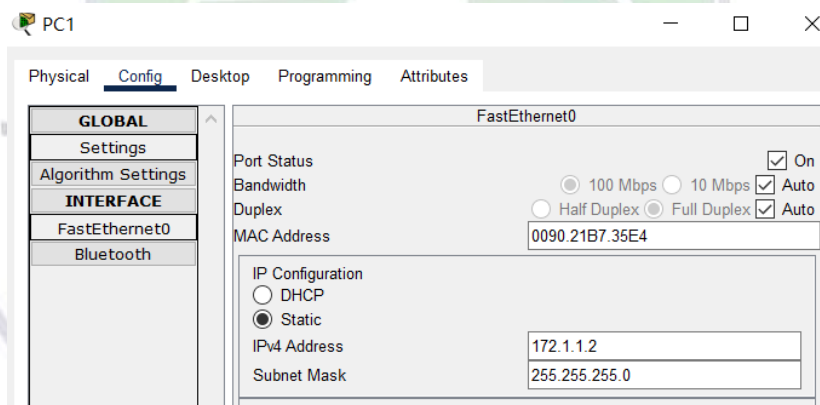
RA(config-if)#int f0/0
RA(config-if)#no shutdown

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

路由器 B 的基本配置



各台 PC 的 IP 及网关配置



PC2

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 0001.6491.6E5C

IP Configuration

☐ DHCP

☒ Static

IPv4 Address 172.1.1.3

Subnet Mask 255.255.255.0

PC2

Physical **Config** Desktop Programming Attributes

**GLOBAL**

Settings

Algorithm Settings

**INTERFACE**

FastEthernet0

Bluetooth

Global Settings

Display Name PC2

Interfaces FastEthernet0

Gateway/DNS IPv4

☐ DHCP

☒ Static

Default Gateway 172.1.1.1

DNS Server

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

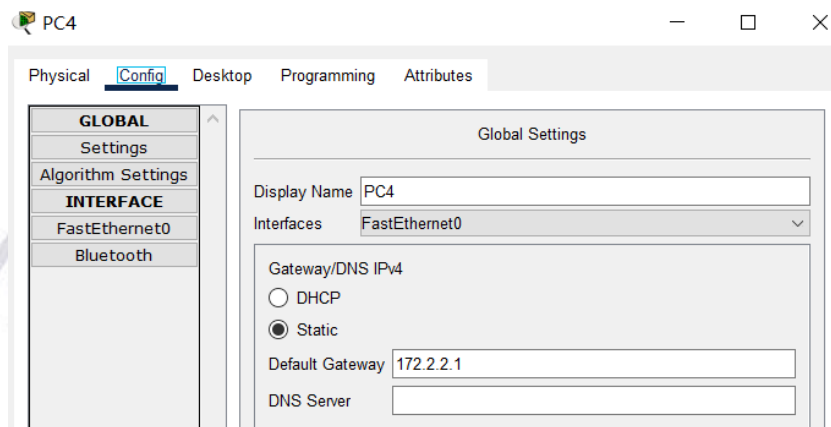
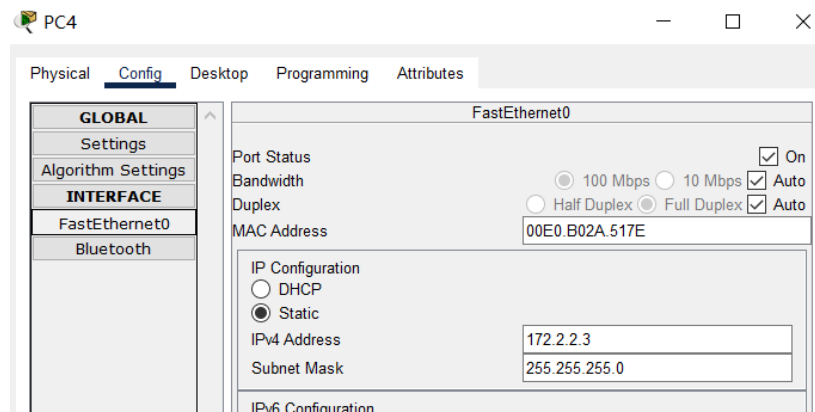
Gateway/DNS IPv4

☐ DHCP

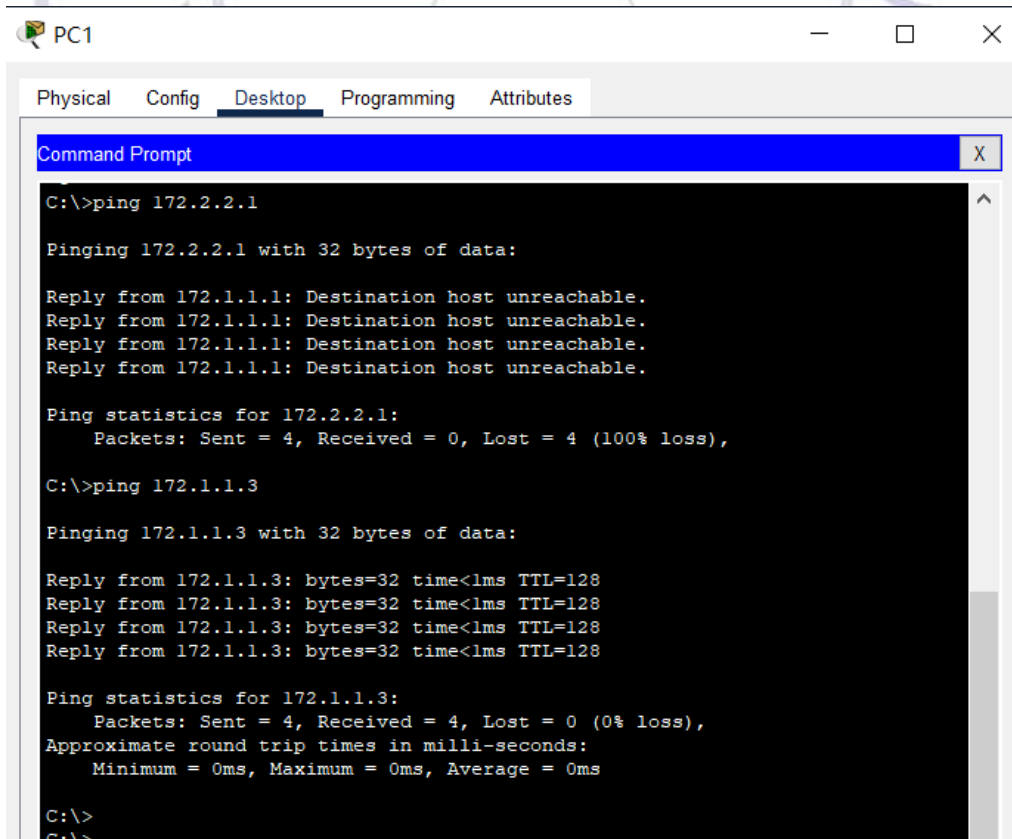
☒ Static

Default Gateway 172.2.2.1

DNS Server



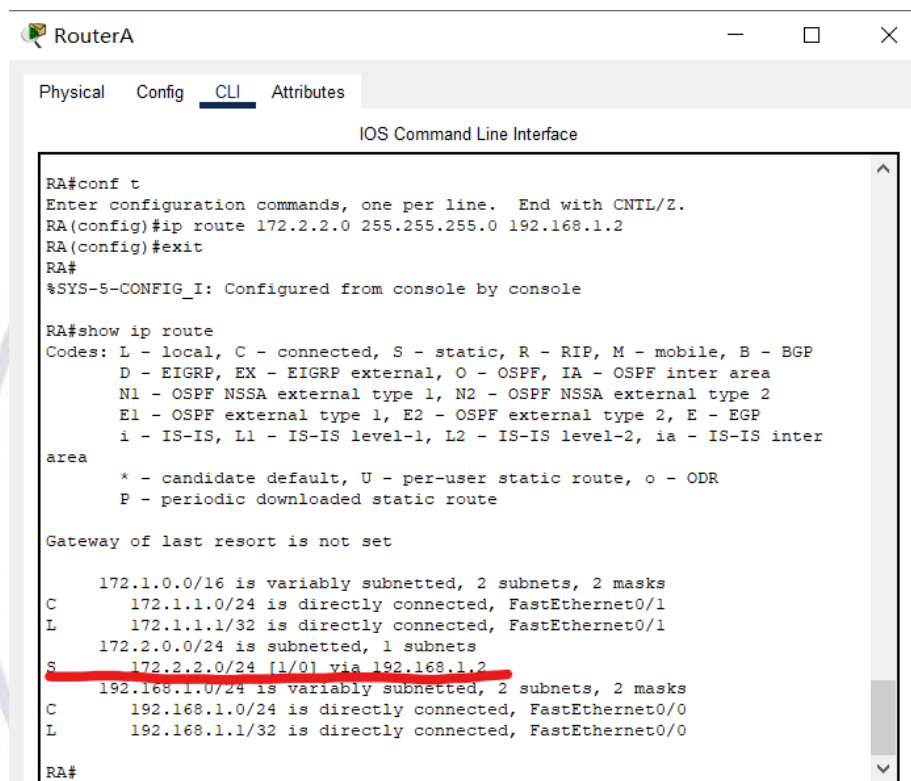
分别 ping 路由器 B 的 f0/0 接口与 PC2，结果如下图：



可以发现，PC1 ping 路由器 B 的 f0/0 接口（即 172.2.2.0/24 网段），显示“Destination host unreachable”，说明本网络（172.2.2.0/24 网段）根本没有到目标地址的路由路径。PC1 ping PC2（172.1.1.3）可以成功 ping 通，这是数据是通过交换机 A 直接转发给 PC2 的。

## 2. 配置静态路由

路由器 A 的静态路由配置及路由表，红色部分为手动配置的静态路由



```
RouterA
Physical Config CLI Attributes
IOS Command Line Interface
RA#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RA(config)#ip route 172.2.2.0 255.255.255.0 192.168.1.2
RA(config)#exit
RA#
%SYS-5-CONFIG_I: Configured from console by console

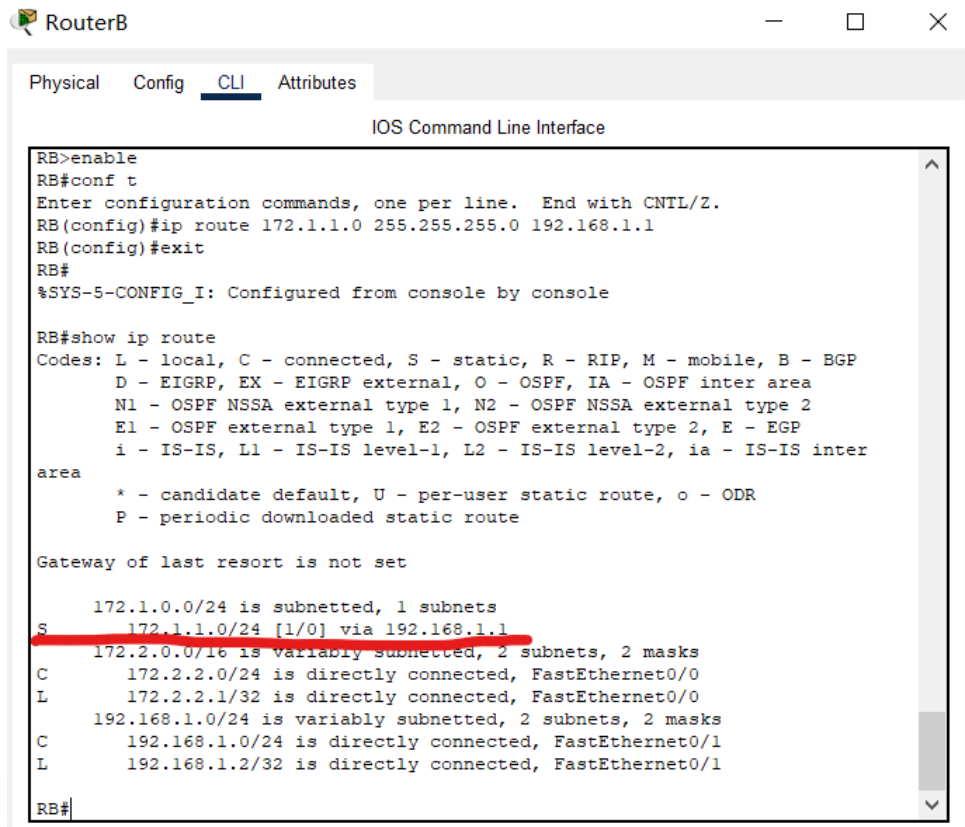
RA#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       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, FastEthernet0/1
L       172.1.1.1/32 is directly connected, FastEthernet0/1
    172.2.0.0/24 is subnetted, 1 subnets
S       172.2.2.0/24 [1/0] via 192.168.1.2
    192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, FastEthernet0/0
L       192.168.1.1/32 is directly connected, FastEthernet0/0

RA#
```

路由器 B 的静态路由配置及路由表，红色部分为手动配置的静态路由



RouterB

Physical Config CLI Attributes

IOS Command Line Interface

```
RB>enable
RB#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RB(config)#ip route 172.1.1.0 255.255.255.0 192.168.1.1
RB(config)#exit
RB#
%SYS-5-CONFIG_I: Configured from console by console

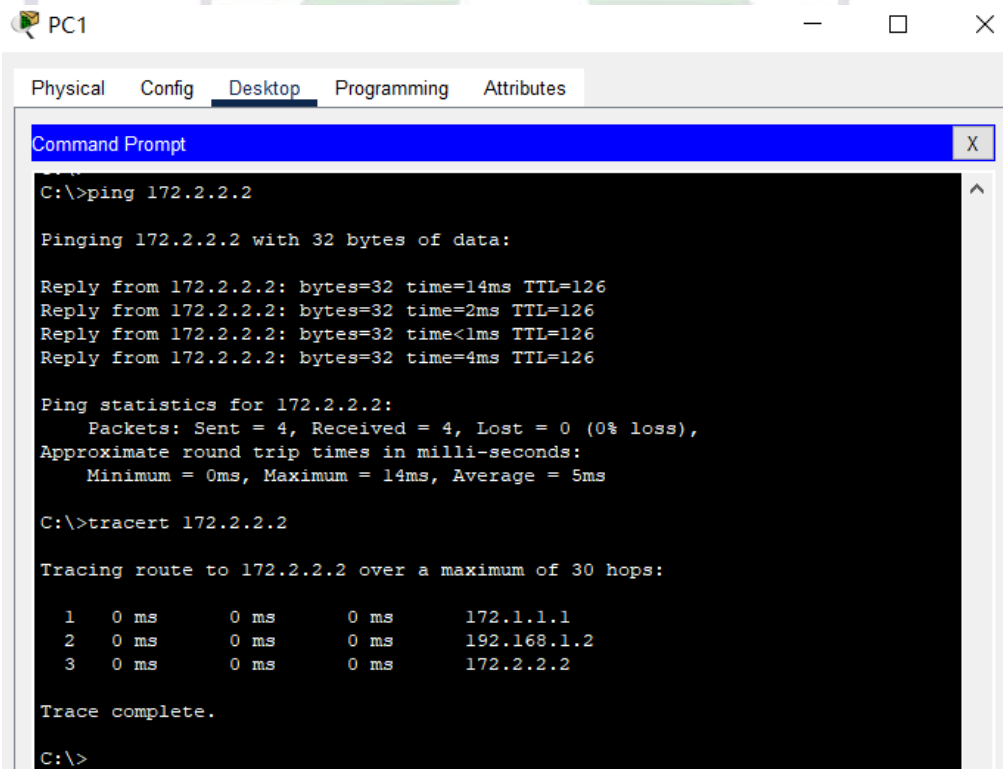
RB#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       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
S       172.1.1.0/24 [1/0] via 192.168.1.1
      172.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.2.2.0/24 is directly connected, FastEthernet0/0
L       172.2.2.1/32 is directly connected, FastEthernet0/0
      192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, FastEthernet0/1
L       192.168.1.2/32 is directly connected, FastEthernet0/1

RB#
```

PC1 可以 ping 通 PC3，两个网段是连通的，路由跟踪的结果如下图



PC1

Physical Config Desktop Programming Attributes

Command Prompt

```
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=14ms TTL=126
Reply from 172.2.2.2: bytes=32 time=2ms TTL=126
Reply from 172.2.2.2: bytes=32 time<1ms TTL=126
Reply from 172.2.2.2: bytes=32 time=4ms 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 = 0ms, Maximum = 14ms, Average = 5ms

C:\>tracert 172.2.2.2

Tracing route to 172.2.2.2 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms    172.1.1.1
  1  0 ms    0 ms    0 ms    192.168.1.2
  2  0 ms    0 ms    0 ms    172.2.2.2

Trace complete.

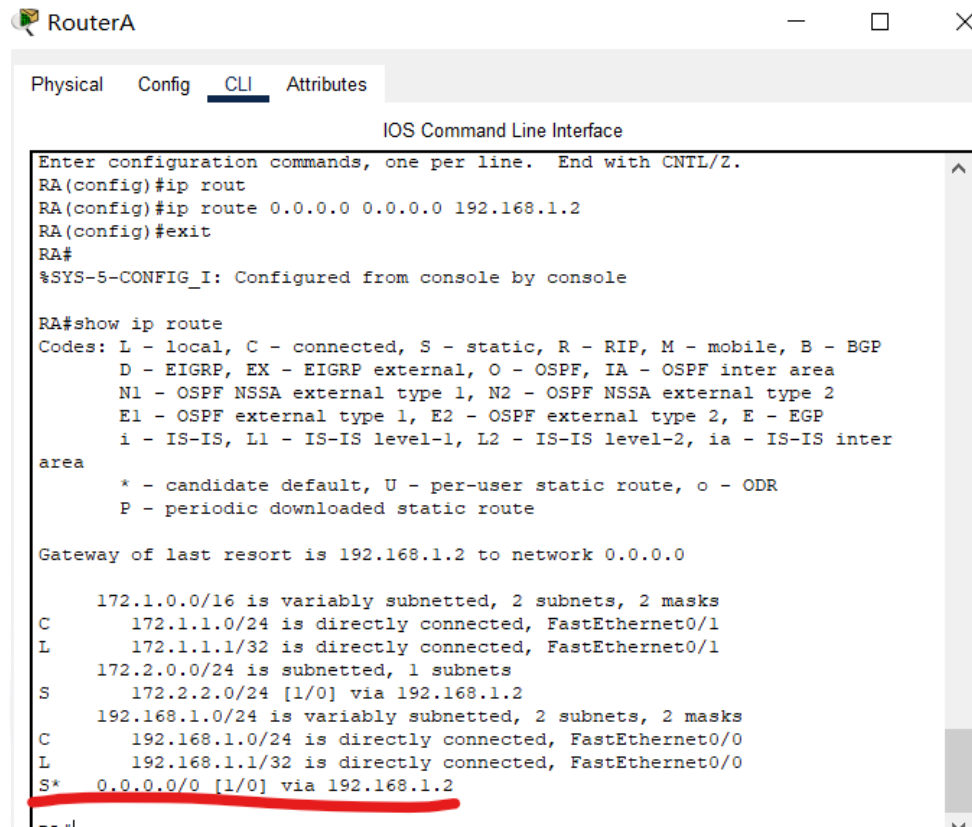
C:\>
```

可以发现，路由跟踪跟踪的是每个下一跳的 IP 地址，对于 PC1 来说，下一跳为路由器 A 的 f0/1 接口；对于路由器 A 来说，下一跳为路由器 B 的 f0/1 接

口；对于路由器 B 来说，下一跳为 PC3。

### 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 f0/1 接口（红色线标注处）



The screenshot shows the CLI of RouterA. The user has entered the command `ip route 0.0.0.0 0.0.0.0 192.168.1.2` to configure a default static route. The output of the `show ip route` command is displayed, showing the route table. The route `0.0.0.0/0 [1/0] via 192.168.1.2` is highlighted with a red line, indicating the default route configuration.

```
RouterA
Physical Config CLI Attributes
IOS Command Line Interface
Enter configuration commands, one per line. End with CNTL/Z.
RA(config)#ip rout
RA(config)#ip route 0.0.0.0 0.0.0.0 192.168.1.2
RA(config)#exit
RA#
%SYS-5-CONFIG_I: Configured from console by console

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, FastEthernet0/1
L       172.1.1.1/32 is directly connected, FastEthernet0/1
L       172.2.0.0/24 is subnetted, 1 subnets
S       172.2.2.0/24 [1/0] via 192.168.1.2
       192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, FastEthernet0/0
L       192.168.1.1/32 is directly connected, FastEthernet0/0
S*    0.0.0.0/0 [1/0] via 192.168.1.2
```

将路由器 B 的默认路由设为路由器 A 的 f0/0 接口（红色线标注处）



```
RouterB
Physical Config CLI Attributes
IOS Command Line Interface
RB#conf t
Enter configuration commands, one per line. End with CNTL/Z.
RB(config)#ip route 0.0.0.0 0.0.0.0 192.168.1.1
RB(config)#exit
RB#
%SYS-5-CONFIG_I: Configured from console by console

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 192.168.1.1 to network 0.0.0.0

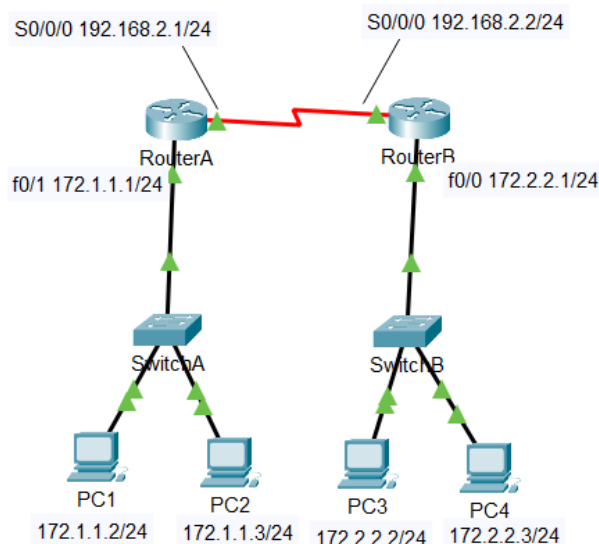
    172.1.0.0/24 is subnetted, 1 subnets
    S    172.1.1.0/24 [1/0] via 192.168.1.1
    C    172.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
    C    172.2.2.0/24 is directly connected, FastEthernet0/0
    L    172.2.2.1/32 is directly connected, FastEthernet0/0
    C    192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
    C    192.168.1.0/24 is directly connected, FastEthernet0/1
    L    192.168.1.2/32 is directly connected, FastEthernet0/1
    S*   0.0.0.0/0 [1/0] via 192.168.1.1
RB#
```

## 六、实验总结及体会

### 思考题

(1) 如果实验拓扑图如图 11-8 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



路由器 A 和路由器 B 的路由表如下所示

```
RA>enable
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, FastEthernet0/1
L       172.1.1.1/32 is directly connected, FastEthernet0/1
    172.2.0.0/24 is subnetted, 1 subnets
S       172.2.2.0/24 [1/0] via 192.168.2.2
    192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, Serial0/0/0
L       192.168.2.1/32 is directly connected, Serial0/0/0
RA#

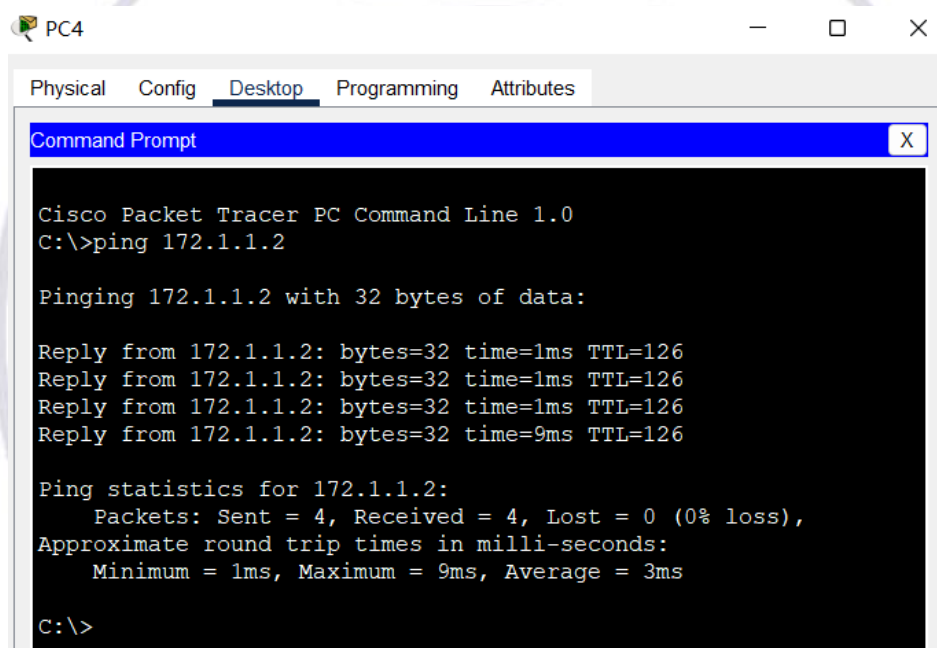
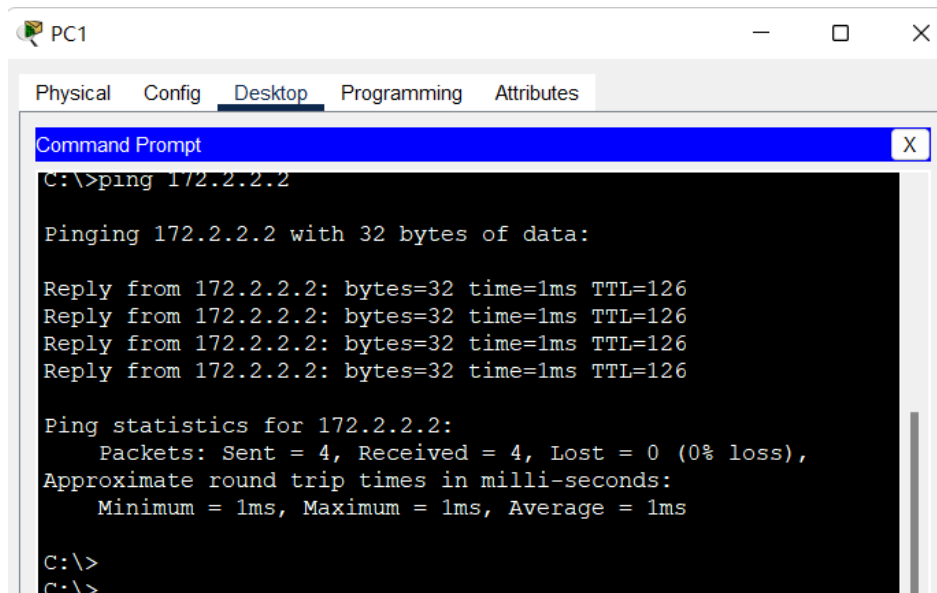
RB>enable
RB#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, 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
S       172.1.1.0/24 [1/0] via 192.168.2.1
    172.2.0.0/16 is variably subnetted, 2 subnets, 2 masks
C       172.2.2.0/24 is directly connected, FastEthernet0/0
L       172.2.2.1/32 is directly connected, FastEthernet0/0
    192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, Serial0/0/0
L       192.168.2.2/32 is directly connected, Serial0/0/0
RB#
```

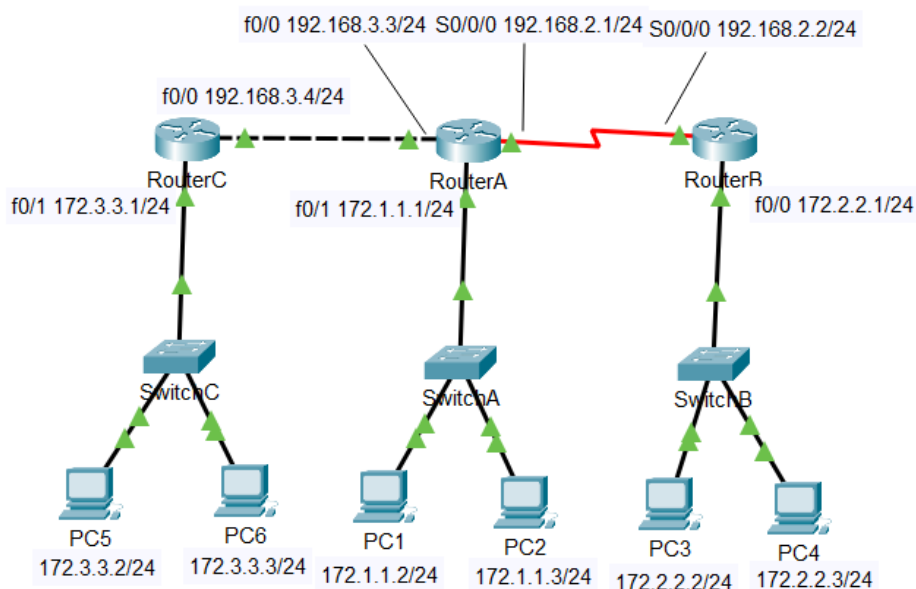
其中, PC1、PC2 的网关设置为 172.1.1.1; PC3、PC4 的网关设置为 172.2.2.1。

PC1 ping PC3 与 PC4 ping PC1 的结果如下图所示



(2) 如果是由三个路由器组成的拓扑图（如图 11-9 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



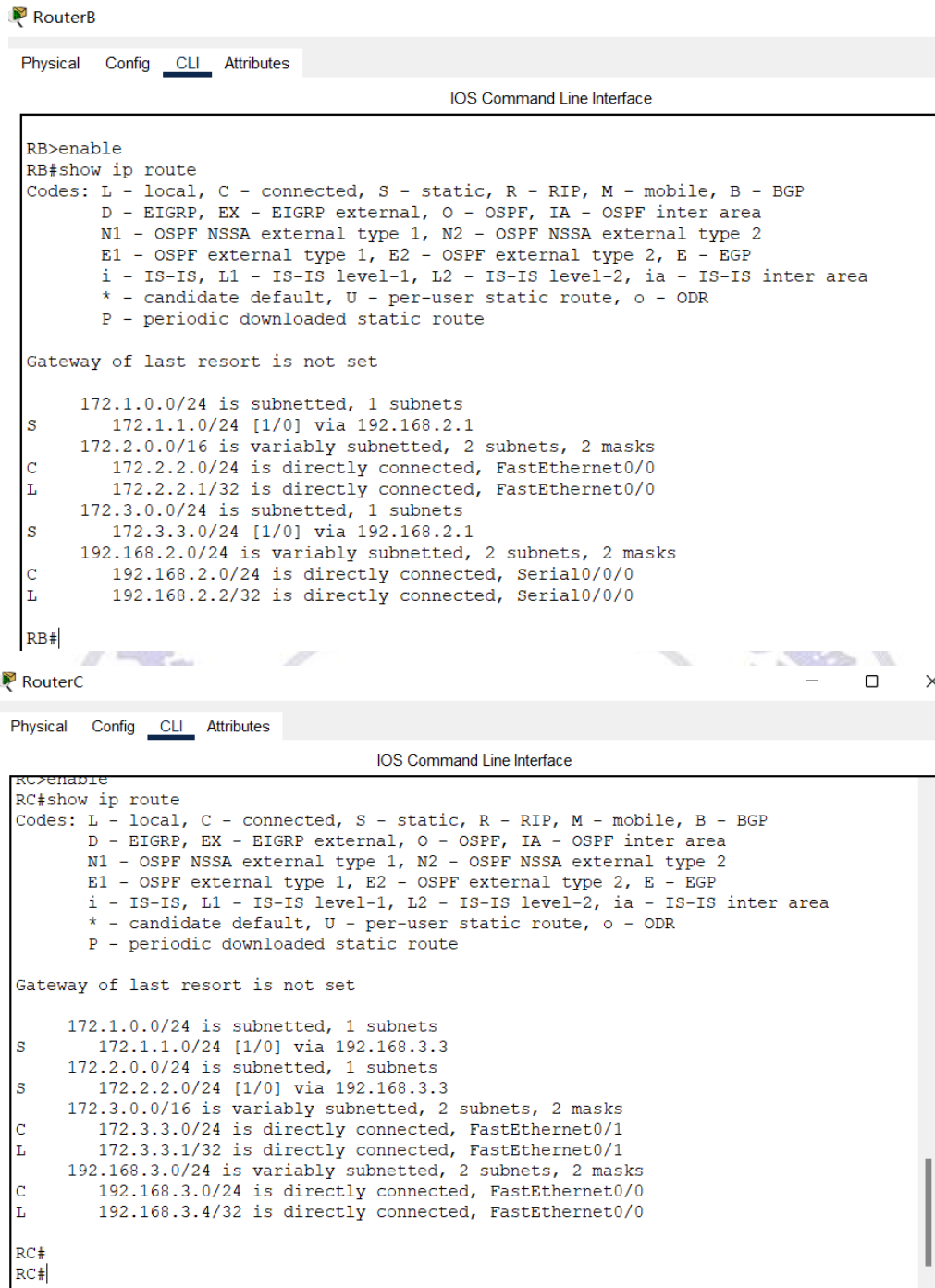
路由器 A、路由器 B 和路由器 C 的路由表如下所示

```

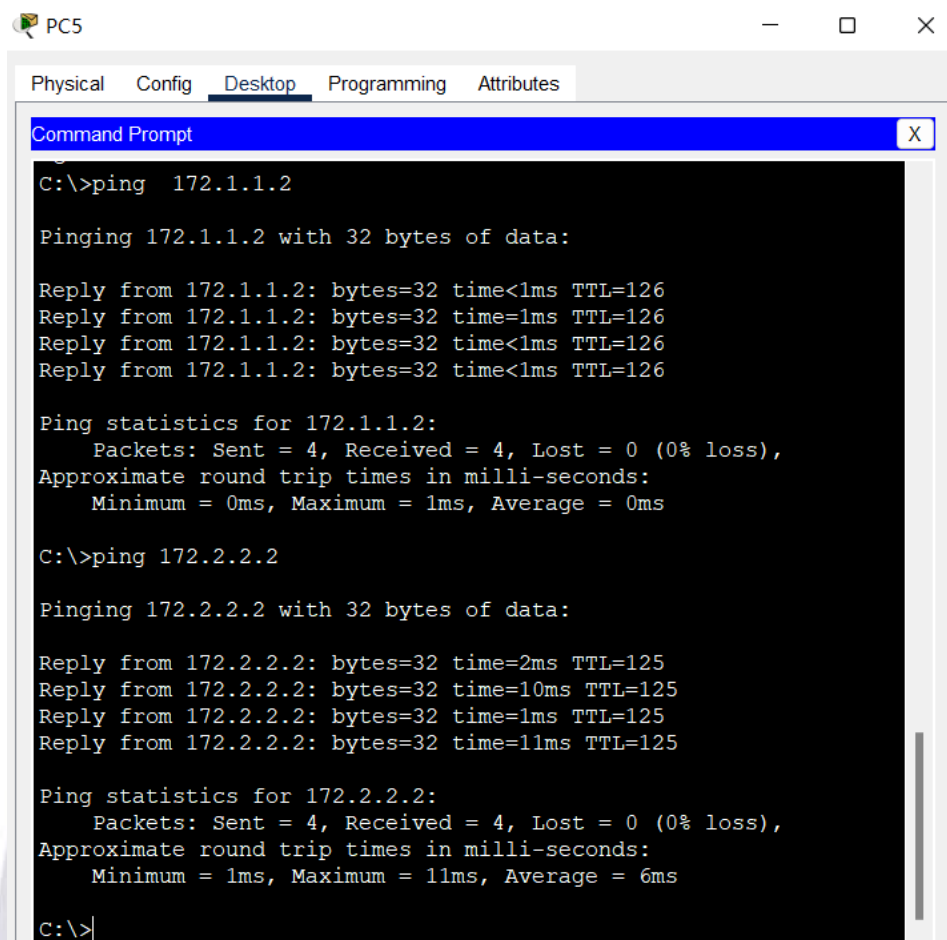
RouterA
Physical Config CLI Attributes
IOS Command Line Interface
RA>enable
RA#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 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, FastEthernet0/1
L       172.1.1.1/32 is directly connected, FastEthernet0/1
    172.2.0.0/24 is subnetted, 1 subnets
S       172.2.2.0/24 [1/0] via 192.168.2.2
    172.3.0.0/24 is subnetted, 1 subnets
S       172.3.3.0/24 [1/0] via 192.168.3.4
    192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, Serial0/0/0
L       192.168.2.1/32 is directly connected, Serial0/0/0
    192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.3.0/24 is directly connected, FastEthernet0/0
--More--
  
```



PC5 ping PC1、PC3 的结果如下所示



The screenshot shows a window titled "PC5" with tabs for "Physical", "Config", "Desktop", "Programming", and "Attributes". The "Desktop" tab is active, displaying a "Command Prompt" window. The Command Prompt shows the execution of two ping commands. The first command is "C:\>ping 172.1.1.2", which results in four successful replies from 172.1.1.2 with 32 bytes of data, each taking less than 1ms and having a TTL of 126. The statistics show 4 packets sent and received, with 0% loss, and round trip times of 0ms minimum, 1ms maximum, and 0ms average. The second command is "C:\>ping 172.2.2.2", which results in four successful replies from 172.2.2.2 with 32 bytes of data. The round trip times are 2ms, 10ms, 1ms, and 11ms respectively, all with a TTL of 125. The statistics show 4 packets sent and received, with 0% loss, and round trip times of 1ms minimum, 11ms maximum, and 6ms average. The Command Prompt ends with "C:\>".

```
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 = 1ms, Average = 0ms

C:\>ping 172.2.2.2

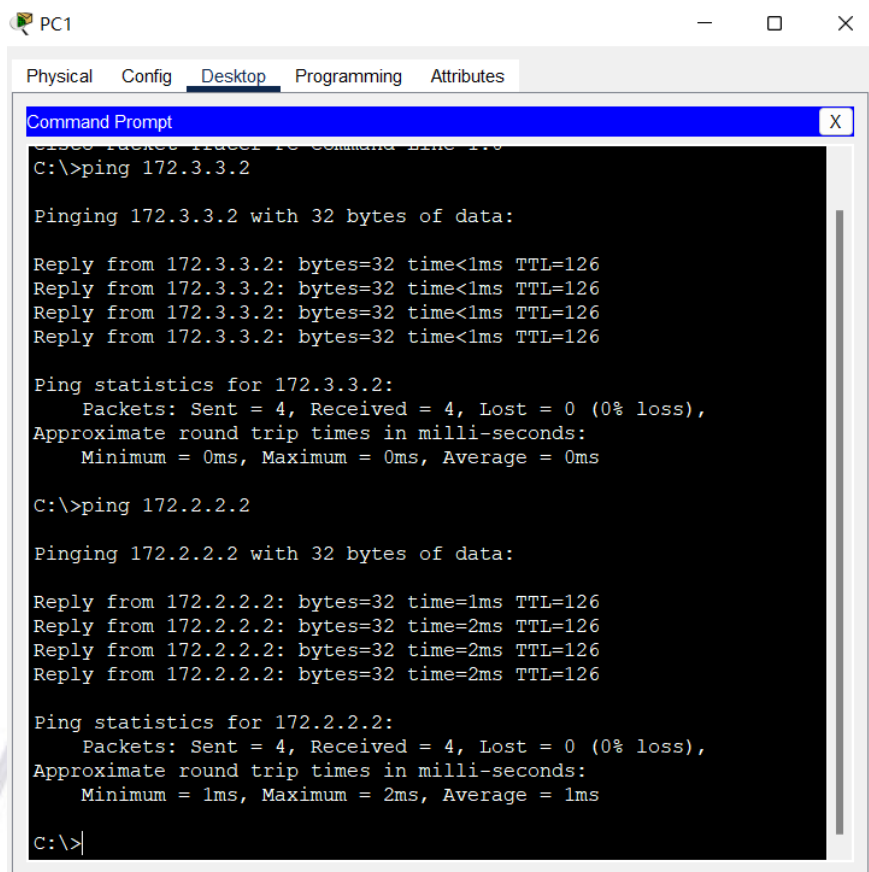
Pinging 172.2.2.2 with 32 bytes of data:

Reply from 172.2.2.2: bytes=32 time=2ms TTL=125
Reply from 172.2.2.2: bytes=32 time=10ms TTL=125
Reply from 172.2.2.2: bytes=32 time=1ms TTL=125
Reply from 172.2.2.2: bytes=32 time=11ms 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 = 1ms, Maximum = 11ms, Average = 6ms

C:\>
```

PC1 ping PC5、PC3 的结果如下所示



PC1

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.3.3.2

Pinging 172.3.3.2 with 32 bytes of data:

Reply from 172.3.3.2: bytes=32 time<1ms TTL=126
Reply from 172.3.3.2: bytes=32 time<1ms TTL=126
Reply from 172.3.3.2: bytes=32 time<1ms TTL=126
Reply from 172.3.3.2: bytes=32 time<1ms TTL=126

Ping statistics for 172.3.3.2:
    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

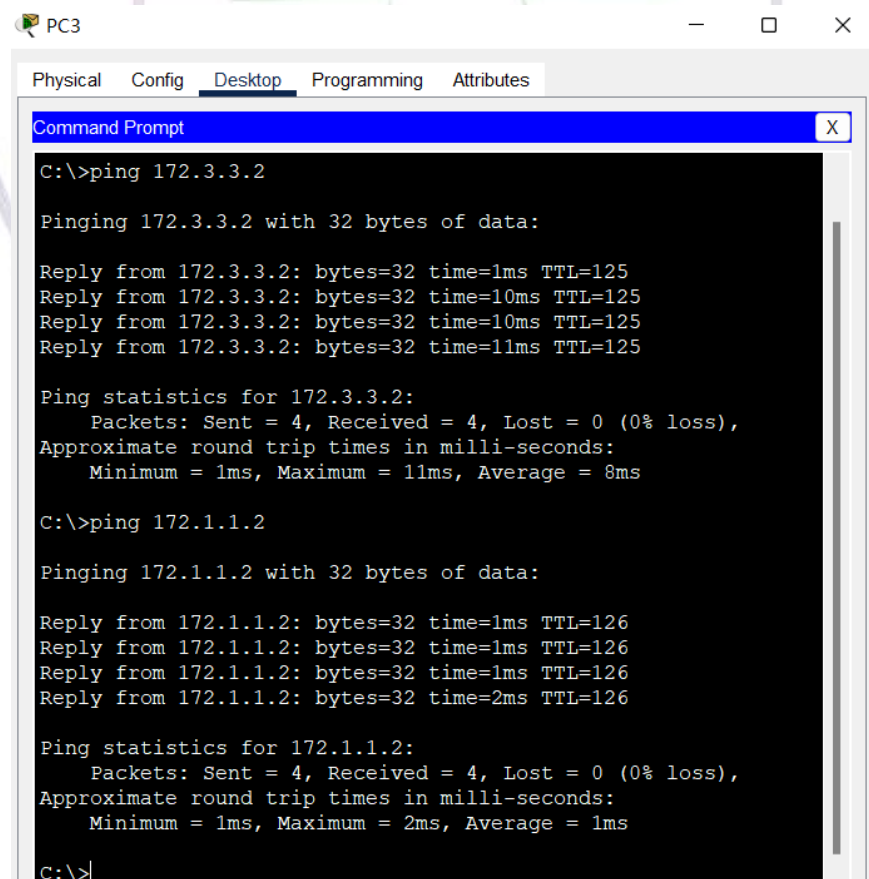
Pinging 172.2.2.2 with 32 bytes of data:

Reply from 172.2.2.2: bytes=32 time=1ms TTL=126
Reply from 172.2.2.2: bytes=32 time=2ms TTL=126
Reply from 172.2.2.2: bytes=32 time=2ms 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 = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 2ms, Average = 1ms

C:\>
```

PC3 ping PC5、PC1 的结果如下所示



PC3

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>ping 172.3.3.2

Pinging 172.3.3.2 with 32 bytes of data:

Reply from 172.3.3.2: bytes=32 time=1ms TTL=125
Reply from 172.3.3.2: bytes=32 time=10ms TTL=125
Reply from 172.3.3.2: bytes=32 time=10ms TTL=125
Reply from 172.3.3.2: bytes=32 time=11ms TTL=125

Ping statistics for 172.3.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 11ms, Average = 8ms

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=2ms 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 = 2ms, Average = 1ms

C:\>
```

---

七、教师评语

