# 路由器配置实验

## 一、实验目的

1. 认识路由器的端口、型号
2. 掌握路由器的路由配置
3. 理解网络互联的基本原理

## 二、实验环境与设备

本实验在 PC 机上利用模拟软件 Packet Tracer V6 进行操作。

## 三、实验内容

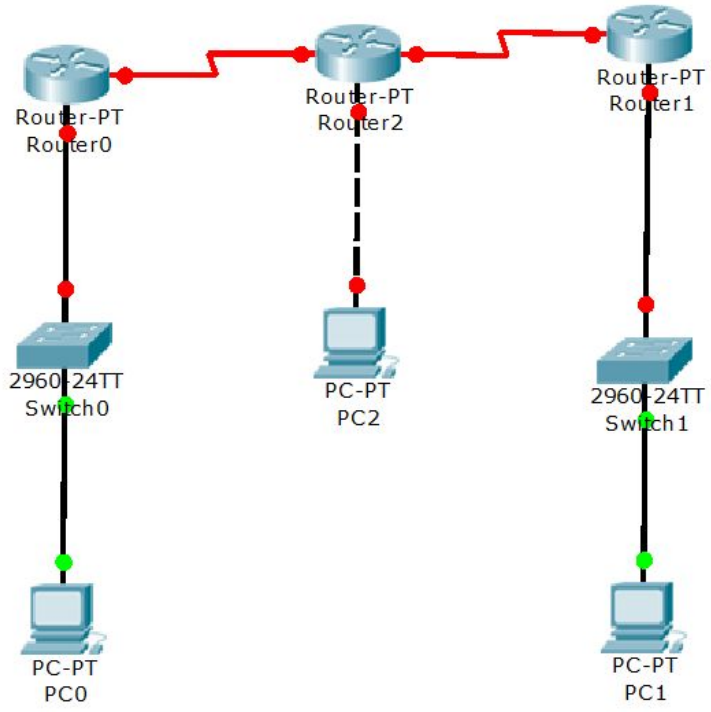
1. 路由器接口的配置
2. 静态路由配置
3. 默认路由配置
4. 动态路由配置

本次实验的主要任务是了解路由器的基本设置，和网络之间的连接关系。通过这次的实验很好的掌握了各个网段之间的，各个路由器下的 pc 的连接情况。通过对静态，默认，动态路由配置，使得各个路由器下的 PC 相互通信。

## 四、实验步骤

1. 路由器接口的配置

创建如图所示的拓扑结构图。




（1） 为主机 PC0，PC1，PC2 配置 IP 地址、子网掩码和默认网关。

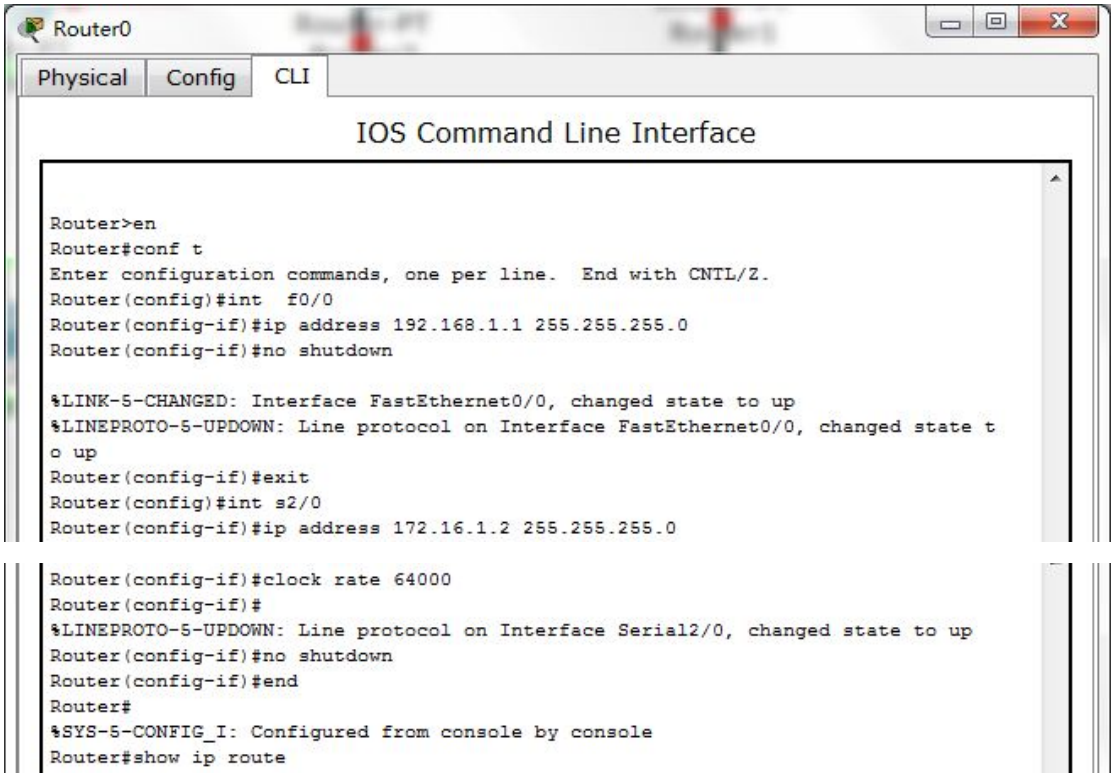
| 网络设备 | 接口 | IP 地址 | 子网掩码 | 默认网关 |
|---|---|---|---|---|
| PC0 | FastEthernet | 192.168.1.2 | 255.255.255.0 | 192.168.1.1 |

| | | | | |
|---|---|---|---|---|
| PC1 | FastEthernet | 192.168.2.2 | 255.255.255.0 | 192.168.2.1 |
| PC2 | FastEthernet | 192.168.3.2 | 255.255.255.0 | 192.168.3.1 |

（2） 为路由器的各个接口分配 IP 地址和子网掩码，交换机不用配置。

| 网络设备 | 接口 | IP 地址 | 子网掩码 | 默认网关 |
|---|---|---|---|---|
| Router0 | F0/0 | 192.168.1.1 | 255.255.255.0 | |
| | S2/0 | 172.16.1.2 | 255.255.255.0 | |
| Router1 | F0/0 | 192.168.2.1 | 255.255.255.0 | |
| | S3/0 | 172.16.2.2 | 255.255.255.0 | |
| Router2 | F0/0 | 192.168.3.1 | 255.255.255.0 | |
| | S2/0 | 172.16.1.1 | 255.255.255.0 | |
| | S3/0 | 172.16.2.1 | 255.255.255.0 | |

（4） 如配置 Router0







（5） 查看路由器的路由表

使用命令：show ip route 显示路由表中的路由信息。保存此时路由器显示的路由信息，以便与后面的实验结果进行比较。（C 表示直连路由）

Router0 的路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
Router#
```

Router1 的路由表：

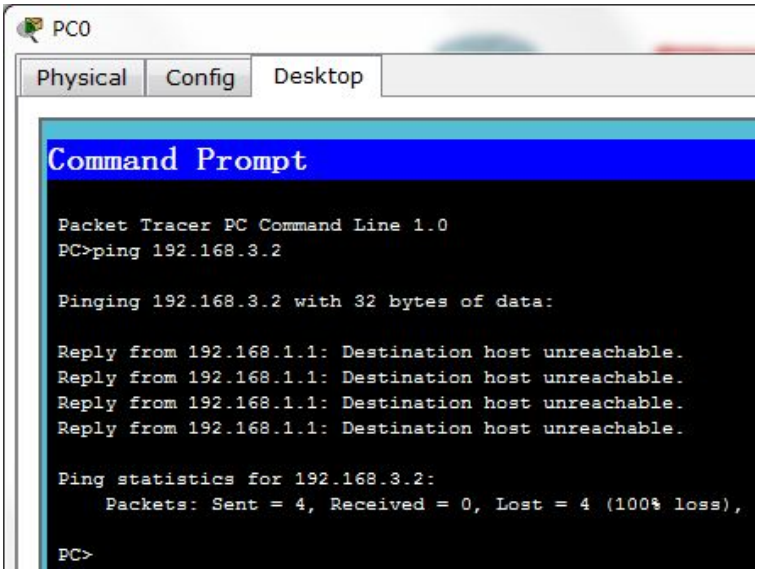
```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.2.0 is directly connected, Serial3/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
Router#
```

Router2 的路由表：

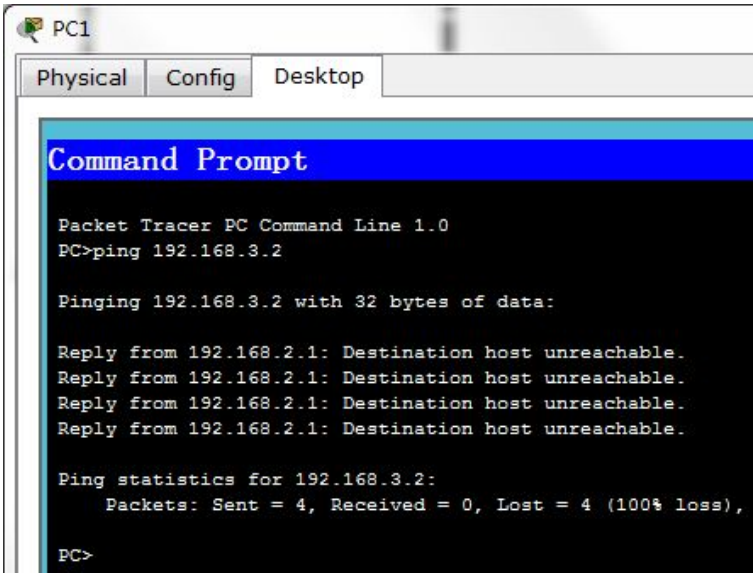
```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, Serial2/0
C       172.16.2.0 is directly connected, Serial3/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
Router#
```

（6）测试主机之间的连通性

PC0 与 PC2 的连通性：




PC1 与 PC2 的连通性：




原因：因为不在同一个网段。

2. 配置静态路由

（1）在 Router0 中添加一条到网络 192.168.3.0 的静态路由，命令如下：

Router(config)#ip route 192.168.3.0 255.255.255.0 172.16.1.1

（2）再去查看 Router0 路由表，与步骤（2）中的路由表进行对比，观察路由表的变化情况。

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
S    192.168.3.0/24 [1/0] via 172.16.1.1
Router#
```

（3）在 Router2 中添加一条到网络 192.168.1.0 的路由后，路由表如下：

Router(config)#ip route 192.168.1.0 255.255.255.0 172.16.1.2

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, Serial2/0
C       172.16.2.0 is directly connected, Serial3/0
S    192.168.1.0/24 [1/0] via 172.16.1.2
C    192.168.3.0/24 is directly connected, FastEthernet0/0
Router#
```

（4）测试 PC0 与 PC2 的连通性

PC0 与 PC2 的连通性如下图：

```
PC>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.3.2: bytes=32 time=125ms TTL=126
Reply from 192.168.3.2: bytes=32 time=124ms TTL=126
Reply from 192.168.3.2: bytes=32 time=96ms TTL=126

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 96ms, Maximum = 125ms, Average = 115ms

PC>
```

（5）在 Router1 和 Router2 中各添加一条静态路由，以实现 PC1 与 PC2 的互通。

在 Router1 中添加静态路由：

```
Router#en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip route 192.168.3.0 255.255.255.0 172.16.2.1
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
Router#shoe ip route
```

Router1 路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.2.0 is directly connected, Serial3/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
S    192.168.3.0/24 [1/0] via 172.16.2.1
Router#
```

在 Router2 中添加静态路由：

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip route 192.168.2.0 255.255.255.0 172.16.2.2
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
Router#show ip route
```

Router2 路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, Serial2/0
C       172.16.2.0 is directly connected, Serial3/0
S    192.168.1.0/24 [1/0] via 172.16.1.2
S    192.168.2.0/24 [1/0] via 172.16.2.2
C    192.168.3.0/24 is directly connected, FastEthernet0/0
Router#
```

P1 与 P2 的连通性：

```
PC>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:

Reply from 192.168.3.2: bytes=32 time=125ms TTL=126
Reply from 192.168.3.2: bytes=32 time=124ms TTL=126
Reply from 192.168.3.2: bytes=32 time=125ms TTL=126
Reply from 192.168.3.2: bytes=32 time=125ms TTL=126

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 124ms, Maximum = 125ms, Average = 124ms

PC>
```

（6）测试 PC0 与 PC1 的连通性

此时，PC0 与 PC2 可以互通，PC1 与 PC2 可以互通，那么，PC0 与 PC1 的连通情况是如何的呢？

```
PC>ping 192.168.2.2

Pinging 192.168.2.2 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 192.168.2.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

查看 Router0 的路由表可知，其中不存在到达 PC1 所在网络（192.168.2.0）的路由，查看 Router2 的路由表可知，其中不存在到达 PC0 所在网络（192.168.1.0）的路由，因此，PC0 与 PC1 的连通性为不通。

（7）请分别在 Router0 和 Router1 中添加静态路由，以实现 PC0 与 PC1 的互通。请在实验报告中记录你所使用的配置命令、主机间的连通性测试结果以及 Router0 和 Router1 的路由表（以截图形式）。

在 Router0 添加静态路由：

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#ip route 192.168.2.0 255.255.255.0 172.16.1.1
Router(config)#end
```

路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
S    192.168.2.0/24 [1/0] via 172.16.1.1
S    192.168.3.0/24 [1/0] via 172.16.1.1
Router#
```

在 Router1 中添加静态路由：

```
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#exit
Router(config)#ip route 192.168.1.0 255.255.255.0 172.16.2.1
Router(config)#end
```

路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.2.0 is directly connected, Serial3/0
S    192.168.1.0/24 [1/0] via 172.16.2.1
C    192.168.2.0/24 is directly connected, FastEthernet0/0
S    192.168.3.0/24 [1/0] via 172.16.2.1
Router#
```

P0 与 P1 连通性测试：

```
PC>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Reply from 192.168.2.2: bytes=32 time=188ms TTL=125
Reply from 192.168.2.2: bytes=32 time=171ms TTL=125
Reply from 192.168.2.2: bytes=32 time=187ms TTL=125
Reply from 192.168.2.2: bytes=32 time=188ms TTL=125

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 171ms, Maximum = 188ms, Average = 183ms

PC>
```

3. 设置默认路由

经过上一个实验（配置静态路由）的实验操作后，路由器 Router0 的路由表如下：（S 表示静态路由）

```
C       172.16.1.0 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
S    192.168.2.0/24 [1/0] via 172.16.1.1
S    192.168.3.0/24 [1/0] via 172.16.1.1
```

PC0 想要访问 PC1 和 PC2 所在网络，需要在 Router0 中添加两条静态路由。这两条静态路由的下一跳 IP 地址相同，并且 Router0 所在网络只有一条通路连接其它网络。这种情况下，如果使用默认路由，则 Router0 只需设置一条默认路由就可使 PC0 可访问 PC1 和 PC2，这样 Router0 的路由表将更加简单。下面我们来看看默认路由的配置：

（1）首先删除 Router0 中到达 PC1 和 PC2 所在网络的静态路由，参考命令如下：

Router#conf t

Router(config)#no ip route 192.168.2.0 255.255.255.0

Router(config)#no ip route 192.168.3.0 255.255.255.0

Router(config)#exit

Router#show ip route //查看是否删除成功

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
```

（2）在 Router0 中添加一条默认路由，命令为：

Router#conf t

Router(config)#ip route 0.0.0.0 0.0.0.0 172.16.1.1

Router(config)#exit

Router#show ip route

路由表中的路由信息为：（S*为默认路由）

```
Gateway of last resort is 172.16.1.1 to network 0.0.0.0

     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 [1/0] via 172.16.1.1
```

（3）再测试 PC0 与 PC1,PC2 的连通性（通）。

```
PC>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Reply from 192.168.2.2: bytes=32 time=188ms TTL=125
Reply from 192.168.2.2: bytes=32 time=187ms TTL=125
Reply from 192.168.2.2: bytes=32 time=185ms TTL=125
Reply from 192.168.2.2: bytes=32 time=140ms TTL=125

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 140ms, Maximum = 188ms, Average = 175ms
```

```
PC>ping 192.168.3.2

Pinging 192.168.3.2 with 32 bytes of data:

Reply from 192.168.3.2: bytes=32 time=125ms TTL=126
Reply from 192.168.3.2: bytes=32 time=125ms TTL=126
Reply from 192.168.3.2: bytes=32 time=110ms TTL=126
Reply from 192.168.3.2: bytes=32 time=110ms TTL=126

Ping statistics for 192.168.3.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 110ms, Maximum = 125ms, Average = 117ms
```

4. 动态路由协议 RIP 的配置

本实验使用与上一个实验相同的网络拓扑结构，在配置 RIP 协议之前，先把三个路由器中的静态路由和默认路由全部删除，然后按如下步骤操作。

（1）查看三个路由器的路由表信息，可看到此时路由表中只有直连路由 C。

（2）在 Router0 上配置 RIP 协议，配置命令如下：

Router#conf t

Router(config)#router rip  //设置 RIP 协议

Router(config-router)#network 192.168.1.0

Router(config-router)#network 172.16.1.0

//network 命令功能：发布直连路由

Router(config-router)#exit

Router(config)#

```
     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.1.0 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
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 172.16.1.0
Router(config-router)#exit
Router(config)#
```

（3）在 Router1，Router2 上配置 RIP 协议的命令同上。请在实验报告中记录你所使用的命令。

Router1：

```
     172.16.0.0/24 is subnetted, 1 subnets
C       172.16.2.0 is directly connected, Serial3/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 172.16.2.0
Router(config-router)#networl 192.168.2.0
                           ^
% Invalid input detected at '^' marker.

Router(config-router)#network 192.168.2.0
Router(config-router)#exit
Router(config)#
```

Router2：

```
     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, Serial2/0
C       172.16.2.0 is directly connected, Serial3/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router rip
Router(config-router)#network 172.16.1.0
Router(config-router)#network 172.16.2.0
Router(config-router)#network 192.168.3.0
Router(config-router)#exit
Router(config)#
```

（4）查看三个路由器的路由表，可看到各路由器学到的网段。下图是运行 RIP 协议后路由器中的路由信息：（R 为 RIP 动态路由）

Router0 的路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, Serial2/0
R       172.16.2.0 [120/1] via 172.16.1.1, 00:00:19, Serial2/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
R    192.168.2.0/24 [120/2] via 172.16.1.1, 00:00:19, Serial2/0
R    192.168.3.0/24 [120/1] via 172.16.1.1, 00:00:19, Serial2/0
Router#
```

Router1 的路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
R       172.16.1.0 [120/1] via 172.16.2.1, 00:00:18, Serial3/0
C       172.16.2.0 is directly connected, Serial3/0
R    192.168.1.0/24 [120/2] via 172.16.2.1, 00:00:18, Serial3/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
R    192.168.3.0/24 [120/1] via 172.16.2.1, 00:00:18, Serial3/0
Router#
```

Router2 的路由表：

```
Gateway of last resort is not set

     172.16.0.0/24 is subnetted, 2 subnets
C       172.16.1.0 is directly connected, Serial2/0
C       172.16.2.0 is directly connected, Serial3/0
R    192.168.1.0/24 [120/1] via 172.16.1.2, 00:00:13, Serial2/0
R    192.168.2.0/24 [120/1] via 172.16.2.2, 00:00:16, Serial3/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
Router#
```

（5）测试各主机间的连通性。

PC0 和 PC1 的连通性（通）

PC0 和 PC2 的连通性（通）

PC1 和 PC2 的连通性（通）

```
PC>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Reply from 192.168.2.2: bytes=32 time=187ms TTL=125
Reply from 192.168.2.2: bytes=32 time=187ms TTL=125
Reply from 192.168.2.2: bytes=32 time=188ms TTL=125
Reply from 192.168.2.2: bytes=32 time=171ms TTL=125

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 171ms, Maximum = 188ms, Average = 183ms
```

五、实验总结