

实验 10：静态路由配置实验

姓名	学号	合作学生	指导教师	实验地点	实验时间
林继申	2250758	无	陈伟超	济事楼 330	2024/03/28

【实验目的】

- 掌握静态路由的基本原理：通过本实验，深入理解静态路由的定义、工作机制以及如何在网络中应用。静态路由作为一种预设的、不随网络状况动态改变的路由选择方法，其稳定性和可靠性在特定场景下非常重要。
- 学习静态路由的配置命令：实验的一个重要部分是通过实践学习和掌握在不同网络设备上配置静态路由的具体命令。这包括如何为路由器接口设置 IP 地址、启用端口、配置目标网段和下一跳地址等关键配置步骤。
- 理解静态路由的优缺点：通过对比分析，了解静态路由相比于动态路由的优势和局限。例如，静态路由在网络安全性和可控性方面的优点，以及在大型或复杂网络环境中的局限性。
- 实际操作静态路由的配置：通过在模拟或实际网络环境中配置静态路由，获得实际的操作经验。这不仅包括路由配置的步骤，还包括对配置结果的验证和问题排错。
- 验证静态路由的通信功能：实验的最后一步是验证配置的静态路由是否能够成功地指导网络流量。通过测试网络中不同节点间的通信，学生可以直观地看到静态路由配置是否正确，以及它是如何影响数据包的传输路径的。

【实验原理】

一、静态路由的原理

静态路由是网络路由的一种基本形式，其中路由信息是由网络管理员手动配置的，而非通过动态路由协议自动发现和更新。这意味着，无论是指定数据包的转发路径还是定义目的地网络与下一跳地址的映射，都需要管理员直接介入。

在网络的拓扑结构或链路状态发生变化时，静态路由不会自动更新。任何必要的路由信息修改都需要管理员手动进行。静态路由通常适用于结构相对简单、稳定的网络环境，其中网络的拓扑结构较为固定，便于管理员理解和配置。

二、静态路由的优缺点

与动态路由相比，静态路由由于不需要路由器之间频繁交换路由信息，因而

能更好地保护网络的拓扑结构和地址信息不被外泄，从而提高网络的安全保密性。

在大型或复杂的网络环境中，维护静态路由表可能非常困难。网络管理员可能难以全面掌握网络的拓扑结构，且当网络结构或链路状态发生变化时，需要手动进行大量的调整，增加了管理的难度和复杂度。

三、静态路由的配置命令

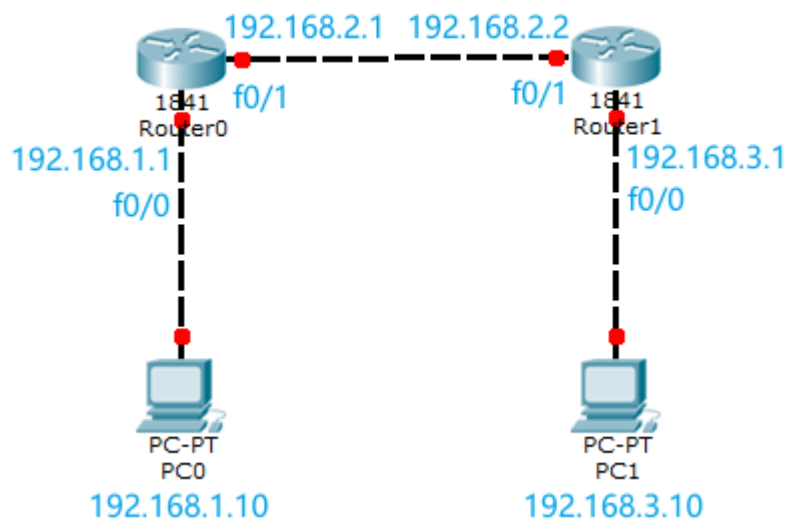
1. 设置 IP 地址和子网掩码：ip address [IP 地址] [子网掩码]
2. 启用端口：No shutdown
3. 指定目标网段、子网掩码和下一跳地址：ip route [目标网段 IP 地址] [目标子网掩码] [下一跳地址]
4. 指定目标网段、子网掩码和送出接口：ip route [目标网段 IP 地址] [目标子网掩码] [接口]
5. 查看路由配置情况：show ip route

【实验设备】

1. 操作系统：Windows 10
2. 网络环境：局域网
3. 应用程序：Cisco Packet Tracer 6.0

【实验步骤】

1. 启动 Cisco Packet Tracer 来模拟网络环境。
2. 按照如下拓扑图连接设备，子网掩码是 255.255.255.0，PC0 的网关是 192.168.1.1，PC1 的网关是 192.168.3.1。



3. 配置路由器 Router0。

- FastEthernet0/0 接口配置 IP 地址为 192.168.1.1，子网掩码为 255.255.255.0。
- FastEthernet0/1 接口配置 IP 地址为 192.168.2.1，子网掩码为 255.255.255.0。
- 添加静态路由：要到达 192.168.3.0/24 网络应该通过 192.168.2.2，要到达 192.168.3.0/24 网络，应该通过 f0/1 接口。
- 也可以通过 CLI 窗口输入命令进行配置：

```
interface f0/0
ip address 192.168.1.1 255.255.255.0
no shutdown
interface f0/1
ip address 192.168.2.1 255.255.255.0
no shutdown
ip route 192.168.3.0 255.255.255.0 192.168.2.2
ip route 192.168.3.0 255.255.255.0 f0/1
```

The screenshot shows the Router0 configuration window with the 'Config' tab selected. The left sidebar shows a tree view with 'INTERFACE' expanded, and 'FastEthernet0/0' selected. The main area displays the configuration for 'FastEthernet0/0'. The 'Port Status' is set to 'On'. 'Bandwidth' is set to 'Auto' (100 Mbps). 'Duplex' is set to 'Auto' (Half Duplex). The 'MAC Address' is '0006.2ADE.3D01'. The 'IP Address' is '192.168.1.1' and the 'Subnet Mask' is '255.255.255.0', both of which are highlighted with a red box. The 'Tx Ring Limit' is set to '10'. At the bottom, the 'Equivalent IOS Commands' section shows the following commands:

```
Router(config-if)#exit
Router(config)#interface FastEthernet0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#
```

Router0

PhysicalConfigCLI

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

FastEthernet0/0

FastEthernet0/1

FastEthernet0/1

FastEthernet0/1

Port Status☒ On

Bandwidth☒ Auto

☐ 10 Mbps☒ 100 Mbps

Duplex☒ Auto

☒ Full Duplex☐ Half Duplex

MAC Address0006.2ADE.3D02

IP Address192.168.2.1

Subnet Mask255.255.255.0

Tx Ring Limit10

Equivalent IOS Commands

Router(config-if)#exit
Router(config)#interface FastEthernet0/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface FastEthernet0/1
Router(config-if)#

Router0

PhysicalConfigCLI

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

FastEthernet0/0

FastEthernet0/1

FastEthernet0/1

Static Routes

Network

Mask

Next Hop

Add

Network Address

192.168.3.0/24 via 192.168.2.2

192.168.3.0/24 via FastEthernet0/1

Remove

Equivalent IOS Commands

Router(config)#interface FastEthernet0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#

4. 配置路由器 Router1。

- FastEthernet0/0 接口配置 IP 地址为 192.168.3.1，子网掩码为 255.255.255.0。
- FastEthernet0/1 接口配置 IP 地址为 192.168.2.2，子网掩码为 255.255.255.0。
- 添加静态路由：要到达 192.168.1.0/24 网络应该通过 192.168.2.1，要到达 192.168.1.0/24 网络，应该通过 f0/1 接口。
- 也可以通过 CLI 窗口输入命令进行配置：

```
interface f0/0
ip address 192.168.3.1 255.255.255.0
no shutdown
interface f0/1
ip address 192.168.2.2 255.255.255.0
no shutdown
ip route 192.168.1.0 255.255.255.0 192.168.2.1
ip route 192.168.1.0 255.255.255.0 f0/1
```

The screenshot shows the configuration window for Router1, specifically the 'Config' tab. The left sidebar shows a tree view with categories: GLOBAL, ROUTING, SWITCHING, and INTERFACE. Under the INTERFACE category, 'FastEthernet0/0' is selected. The main area displays the configuration for 'FastEthernet0/0'. The 'Port Status' is set to 'On'. 'Bandwidth' is set to 'Auto' (100 Mbps). 'Duplex' is set to 'Auto' (Half Duplex). The 'MAC Address' is '000A.4143.6901'. The 'IP Address' is '192.168.3.1' and the 'Subnet Mask' is '255.255.255.0', both of which are highlighted with a red rectangle. The 'Tx Ring Limit' is set to '10'. At the bottom, there is a section for 'Equivalent IOS Commands' showing the following commands:

```
Router(config)#interface FastEthernet0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#
Router(config)#interface FastEthernet0/0
Router(config-if)#
```

Router1

PhysicalConfigCLI

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

FastEthernet0/0

FastEthernet0/1

FastEthernet0/1

FastEthernet0/1

Port Status☒ On

Bandwidth☒ Auto

☐ 10 Mbps☒ 100 Mbps

Duplex☒ Auto

☒ Full Duplex☐ Half Duplex

MAC Address000A.4143.6902

IP Address192.168.2.2

Subnet Mask255.255.255.0

Tx Ring Limit10

Equivalent IOS Commands

Router(config-if)#exit

Router(config)#interface FastEthernet0/0

Router(config-if)#

Router(config-if)#exit

Router(config)#interface FastEthernet0/1

Router(config-if)#

Router1

PhysicalConfigCLI

GLOBAL

Settings

Algorithm Settings

ROUTING

Static

RIP

SWITCHING

VLAN Database

INTERFACE

FastEthernet0/0

FastEthernet0/1

FastEthernet0/1

Static Routes

Network

Mask

Next Hop

Add

Network Address

192.168.1.0/24 via 192.168.2.1

192.168.1.0/24 via FastEthernet0/1

Remove

Equivalent IOS Commands

Router(config)#interface FastEthernet0/1

Router(config-if)#

Router(config-if)#exit

Router(config)#

5. 配置 PC0 的网关、IP 地址与子网掩码。

The screenshot shows the 'Global Settings' window for PC0. The left sidebar has 'GLOBAL' selected, with 'Settings' highlighted. The main area is titled 'Global Settings'. Under 'Gateway/DNS', the 'Static' radio button is selected, and the 'Gateway' field is set to '192.168.1.1' (highlighted with a red box). The 'DNS Server' field is empty. Under 'Gateway/DNS IPv6', the 'Static' radio button is also selected, with empty fields for 'IPv6 Gateway' and 'IPv6 DNS Server'.

PC0

Physical Config Desktop Custom Interface

GLOBAL

Settings

Algorithm Settings

Firewall

IPv6 Firewall

INTERFACE

FastEthernet0

Global Settings

Display Name

Gateway/DNS

☐ DHCP

☒ Static

Gateway

DNS Server

Gateway/DNS IPv6

☐ DHCP

☐ Auto Config

☒ Static

IPv6 Gateway

IPv6 DNS Server

The screenshot shows the 'FastEthernet0' configuration window for PC0. The left sidebar has 'INTERFACE' selected, with 'FastEthernet0' highlighted. The main area is titled 'FastEthernet0'. Under 'Port Status', 'On' is checked. Under 'Bandwidth', 'Auto' is checked. Under 'Duplex', 'Half Duplex' is selected, and 'Auto' is checked. The 'MAC Address' is '0030.F272.AC25'. Under 'IP Configuration', the 'Static' radio button is selected, and the 'IP Address' (192.168.1.10) and 'Subnet Mask' (255.255.255.0) fields are highlighted with a red box. Under 'IPv6 Configuration', the 'Static' radio button is selected, with 'Link Local Address' set to 'E80::230:F2FF:FE72:AC25' and an empty 'IPv6 Address' field.

PC0

Physical Config Desktop Custom Interface

GLOBAL

Settings

Algorithm Settings

Firewall

IPv6 Firewall

INTERFACE

FastEthernet0

FastEthernet0

Port Status ☒ On

Bandwidth ☒ Auto

☐ 10 Mbps ☐ 100 Mbps

Duplex ☒ Auto

☐ Full Duplex ☒ Half Duplex

MAC Address

IP Configuration

☐ DHCP

☒ Static

IP Address

Subnet Mask

IPv6 Configuration

Link Local Address:

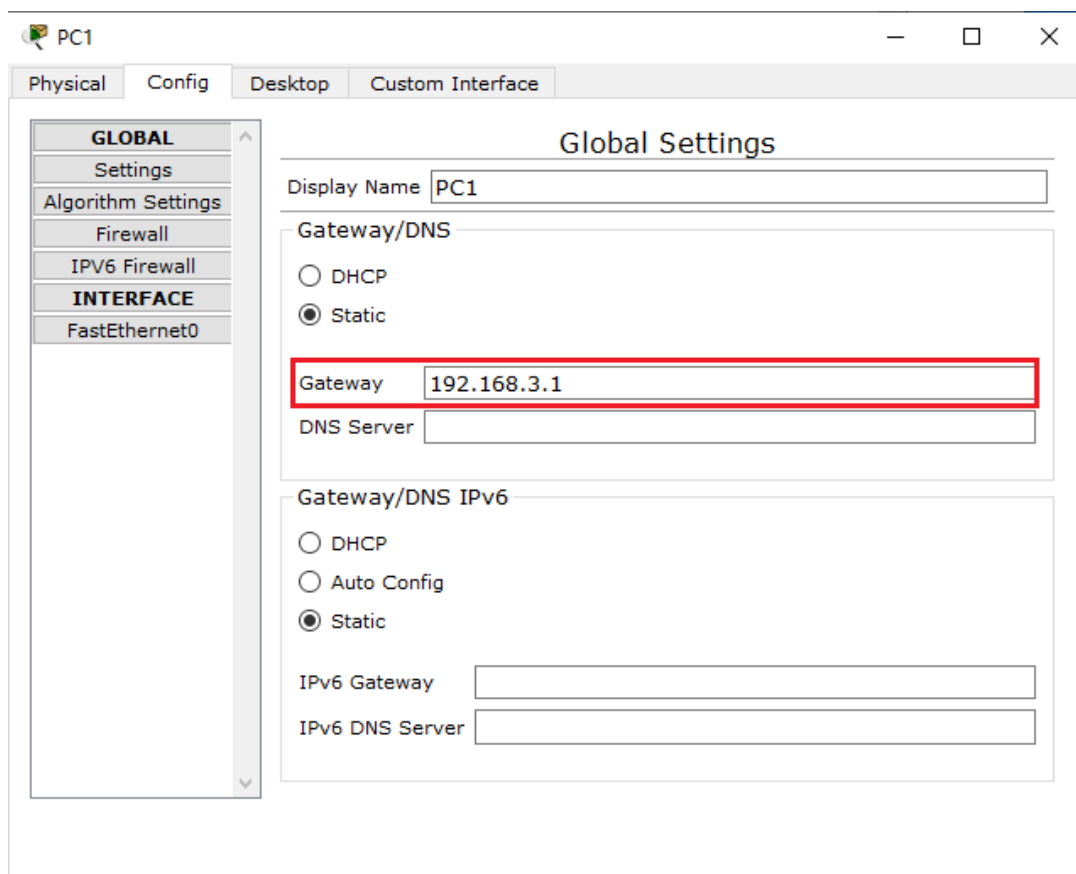
☐ DHCP

☐ Auto Config

☒ Static

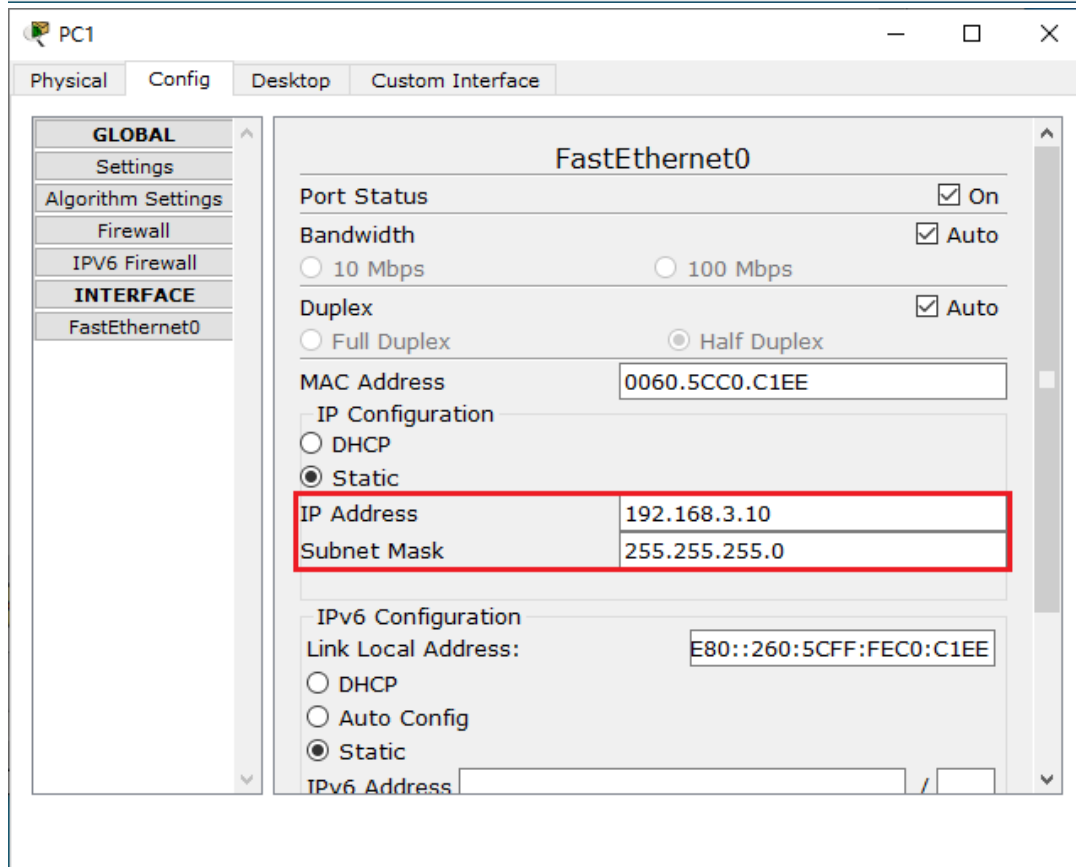
IPv6 Address

6. 配置 PC1 的网关、IP 地址与子网掩码。



The screenshot shows the 'Global Settings' window for PC1. The left sidebar has 'GLOBAL' selected, with sub-items 'Settings', 'Algorithm Settings', 'Firewall', and 'IPv6 Firewall'. Under 'INTERFACE', 'FastEthernet0' is selected. The main area is titled 'Global Settings' and contains the following fields:

- Display Name:** PC1
- Gateway/DNS:**
 - ☐ DHCP
 - ☒ Static
 - Gateway:** 192.168.3.1 (highlighted with a red box)
 - DNS Server:** (empty)
- Gateway/DNS IPv6:**
 - ☐ DHCP
 - ☐ Auto Config
 - ☒ Static
 - IPv6 Gateway:** (empty)
 - IPv6 DNS Server:** (empty)



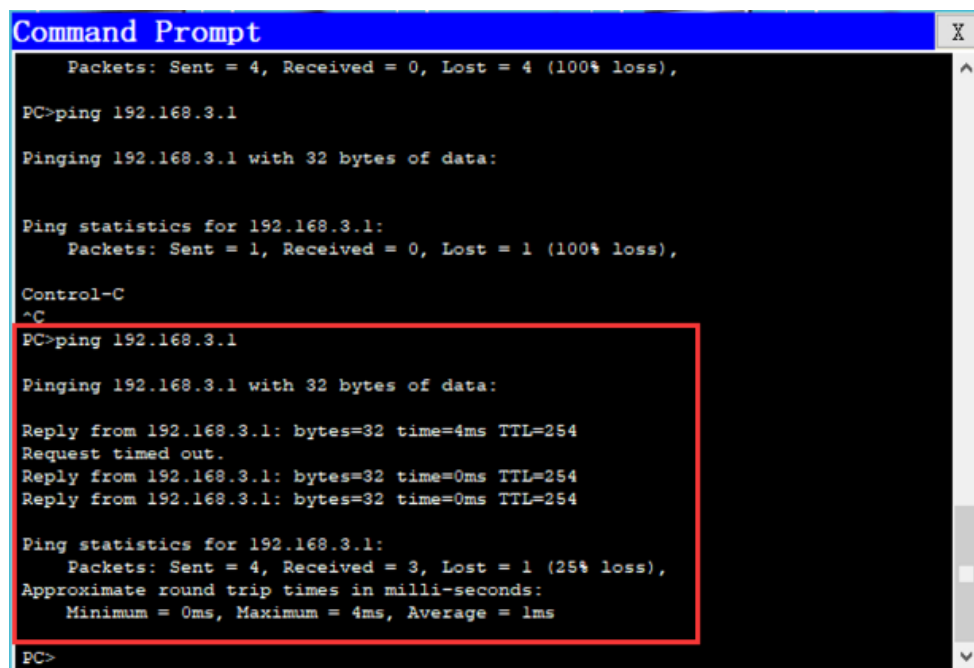
The screenshot shows the 'FastEthernet0' configuration window for PC1. The left sidebar is the same as the previous window. The main area is titled 'FastEthernet0' and contains the following fields:

- Port Status:** ☒ On
- Bandwidth:** ☒ Auto
 - ☐ 10 Mbps
 - ☐ 100 Mbps
- Duplex:** ☒ Auto
 - ☐ Full Duplex
 - ☒ Half Duplex
- MAC Address:** 0060.5CC0.C1EE
- IP Configuration:**
 - ☐ DHCP
 - ☒ Static
 - IP Address:** 192.168.3.10 (highlighted with a red box)
 - Subnet Mask:** 255.255.255.0 (highlighted with a red box)
- IPv6 Configuration:**
 - Link Local Address:** E80::260:5CFF:FEC0:C1EE
 - ☐ DHCP
 - ☐ Auto Config
 - ☒ Static
 - IPv6 Address:** (empty)

7. 测试 PC0 与 PC1 之间相互通信。
 - 在 PC0 的 Prompt Terminal 输入 ping 192.168.3.1 命令接收 PC1 消息。
 - 在 PC1 的 Prompt Terminal 输入 ping 192.168.1.1 命令接收 PC0 消息。
8. 在 Route0 与 Route1 的 CLI 中分别输入 show ip route 命令查看其对应的静态路由表。

【实验现象】

1. 在 PC0 的 Prompt Terminal 中输入 ping 192.168.3.1 命令接收 PC1 的消息。



```
Command Prompt
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>ping 192.168.3.1

Pinging 192.168.3.1 with 32 bytes of data:

Ping statistics for 192.168.3.1:
    Packets: Sent = 1, Received = 0, Lost = 1 (100% loss),

Control-C
^C
PC>ping 192.168.3.1

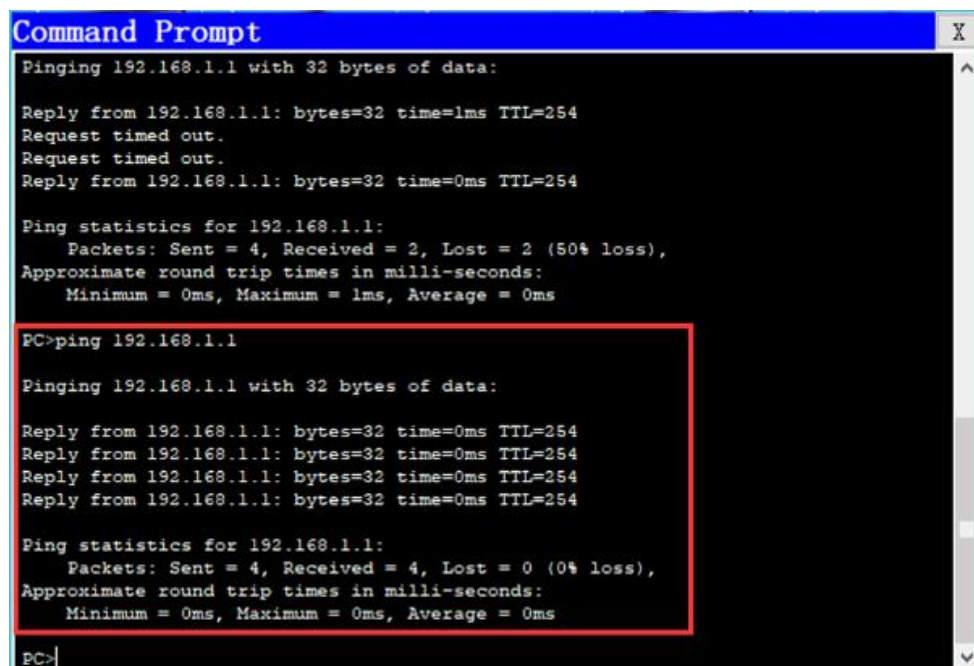
Pinging 192.168.3.1 with 32 bytes of data:

Reply from 192.168.3.1: bytes=32 time=4ms TTL=254
Request timed out.
Reply from 192.168.3.1: bytes=32 time=0ms TTL=254
Reply from 192.168.3.1: bytes=32 time=0ms TTL=254

Ping statistics for 192.168.3.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 4ms, Average = 1ms

PC>
```

2. 在 PC1 的 Prompt Terminal 中输入 ping 192.168.1.1 命令接收 PC0 的消息。



```
Command Prompt
Pinging 192.168.1.1 with 32 bytes of data:

Reply from 192.168.1.1: bytes=32 time=1ms TTL=254
Request timed out.
Request timed out.
Reply from 192.168.1.1: bytes=32 time=0ms TTL=254

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Reply from 192.168.1.1: bytes=32 time=0ms TTL=254
Reply from 192.168.1.1: bytes=32 time=0ms TTL=254
Reply from 192.168.1.1: bytes=32 time=0ms TTL=254
Reply from 192.168.1.1: bytes=32 time=0ms TTL=254

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>
```

3. 在 Route0 的 CLI 中输入 show ip route 命令查看静态路由表。

```
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

192.168.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.1.0/24 is directly connected, GigabitEthernet0/0
L       192.168.1.1/32 is directly connected, GigabitEthernet0/0
192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, GigabitEthernet0/1
L       192.168.2.1/32 is directly connected, GigabitEthernet0/1
S       192.168.3.0/24 [1/0] via 192.168.2.2
              is directly connected, GigabitEthernet0/1
```

4. 在 Route1 的 CLI 中输入 show ip route 命令查看静态路由表。

```
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

S       192.168.1.0/24 [1/0] via 192.168.2.1
              is directly connected, GigabitEthernet0/1
192.168.2.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.2.0/24 is directly connected, GigabitEthernet0/1
L       192.168.2.2/32 is directly connected, GigabitEthernet0/1
192.168.3.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.168.3.0/24 is directly connected, GigabitEthernet0/0
L       192.168.3.1/32 is directly connected, GigabitEthernet0/0
```

【分析讨论】

本次实验的主要目标是通过配置静态路由来实现不同网络之间的通信。通过 Cisco Packet Tracer 软件，模拟了一个包含两个路由器和两台 PC 的网络环境。实验步骤包括为路由器和 PC 配置 IP 地址、子网掩码，以及配置静态路由规则来指定数据包的转发路径。

成功配置静态路由后，从 PC0 向 PC1 以及从 PC1 向 PC0 发送的 ping 命令均成功，这表明静态路由正确配置，数据包能够根据预定路由规则在网络中正确转发。通过执行 show ip route 命令观察到的静态路由表明确显示了目标网络、子网掩码以及下一跳地址或指定接口。

通过本次实验，我深刻理解了静态路由的工作原理和配置方法。静态路由的优点在于配置简单、稳定可靠，非常适合结构简单或网络拓扑变化不大的场景。然而，静态路由也有其局限性，主要表现在网络扩展或拓扑变化时，需要手动更新路由信息，管理维护成本较高。本次实验不仅加深了我对网络路由原理的理解，也提高了我的实践操作能力，为进一步学习网络技术打下了坚实的基础。