

实验任务 3：静态路由设计与实施

一、实验目的

分析网络需求，设计网络静态路由，配置路由进行网络测试，通过抓取 ARP 数据包，分析 ARP 工作原理。

二、实验任务

- 1) 设计静态路由
- 2) 路由测试
- 3) ARP 分析

三、实验内容：

3.1 静态路由设计

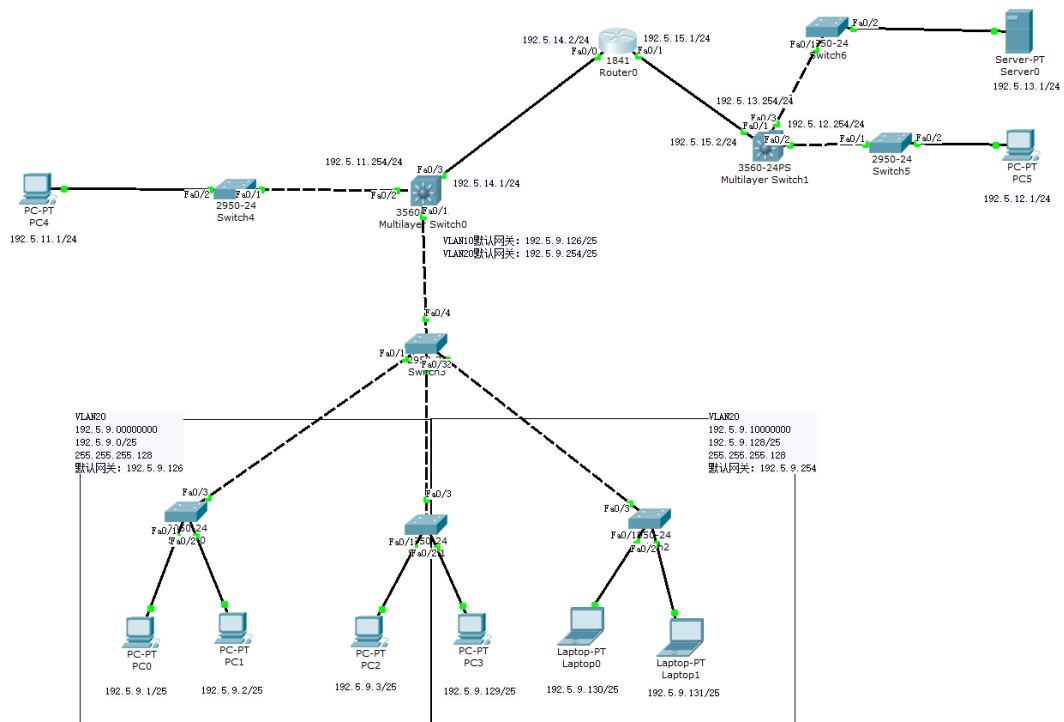


图 3.1 企业网拓扑示意图

3.2 网络设备

我们使用了三层交换。三层交换机性价比高，部署方便，可以作为单位网络部署的主要设备。路由器主要作为企业网络的边界路由器，或者园区的边界路由器，主要负责骨干网络的交换。

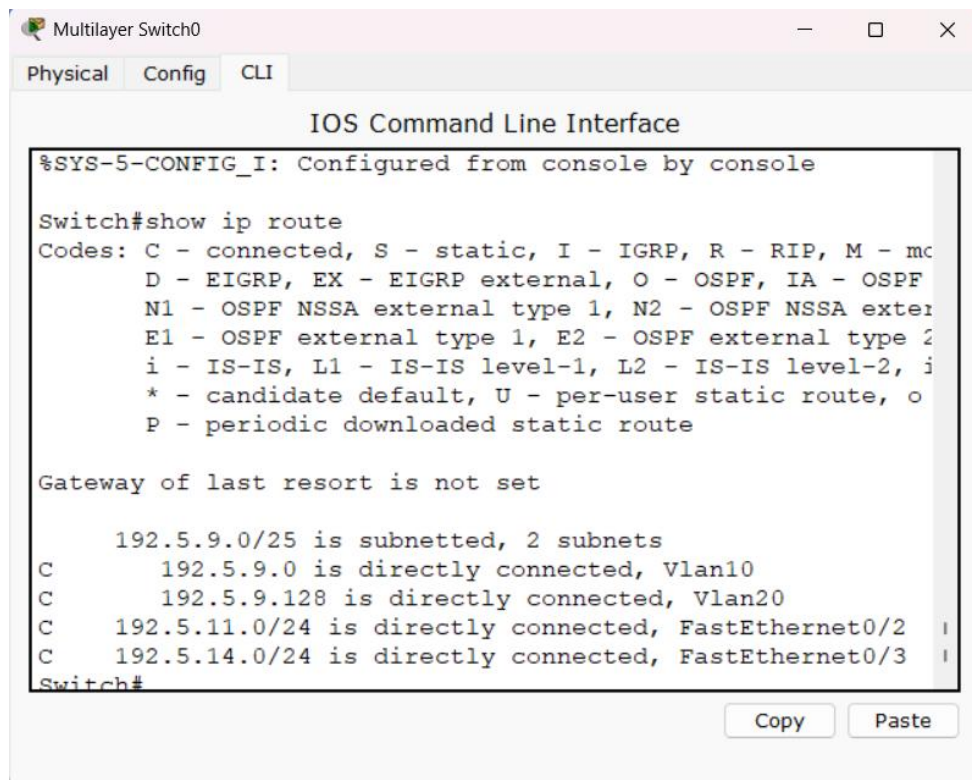
3.3 配置过程

三层交换机是属于交换机设备，具有二层交换机的所有功能（没有 IP 地址）。但集成了三层交换的功能，即具有路由的作用。三层交换机的端口默认是交换端口模式（switchport），如果需要作为路由功能设备，需要将端口转换为非交换端口模式。我配置的时候忘了截图，所以这里附上配置的命令：

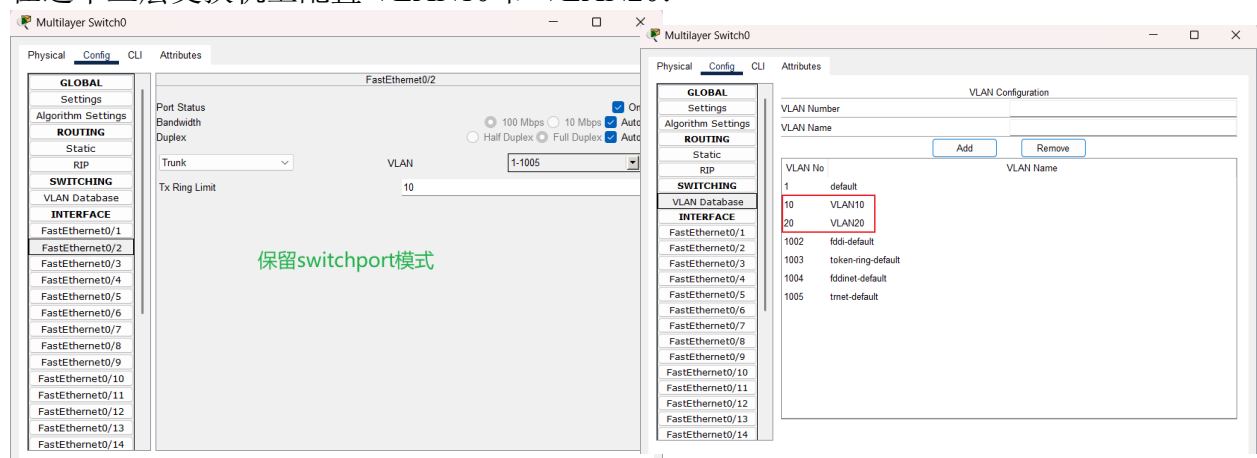
```
Switch>enable
Switch#configure terminal
Switch(config)#interface f0/1
Switch(config-if)#no switchport
#（将端口的交换模式转换为非交换端口模式，简化命令 no sw）
# 在对应端口执行 no switchport 后，端口转换为非交换模式，就可以继续配置 IP 地址（网关地址）：
Switch(config-if)#no shutdown
Switch(config-if)#exit
# 现在可以使用图形化界面配置 ip 地址

# 对接口 f0/3 进行配置
Switch(config)#interface f0/3
Switch(config-if)#no switchport
Switch(config-if)#no shutdown
Switch(config-if)#exit

# 最后启用三层交换机的路由功能，这一步非常重要
Switch(config)#ip routing
```



现在问题来了，三层交换机的 f0/2 怎么配置，这个接口是 VLAN10 和 VLAN20 的默认网关，所以这个接口需要进行特殊处理，首先这个接口需要保持 switchport 模式，并且在这个三层交换机上配置 VLAN10 和 VLAN20：



然后为三层交换机的虚拟三层接口 f0/2 配置 ip 地址，下面附上命令：

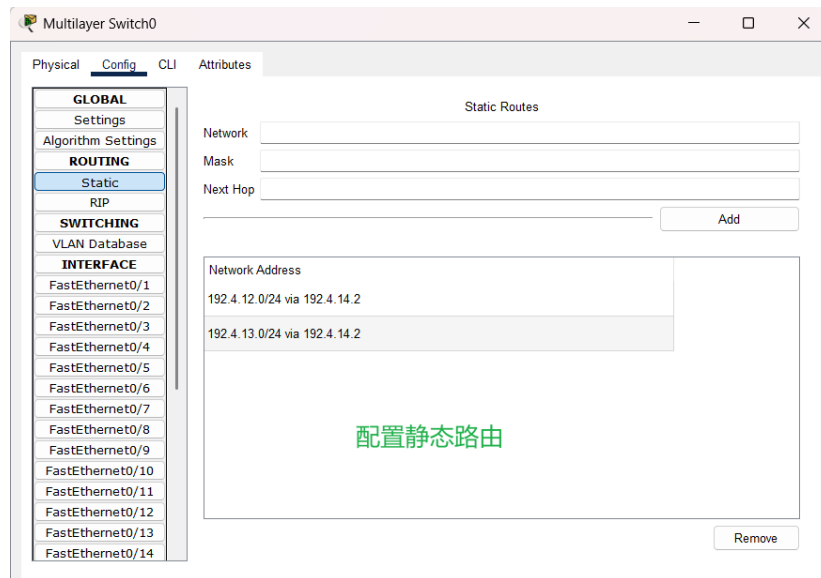
```
Switch(config)# interface vlan 10
Switch(config-if)# ip address 192.5.9.126 255.255.255.128
Switch(config-if)# no shutdown
Switch(config-if)# exit

Switch(config)# interface vlan 20
Switch(config-if)# ip address 192.5.9.254 255.255.255.128
Switch(config-if)# no shutdown
Switch(config-if)# exit
```

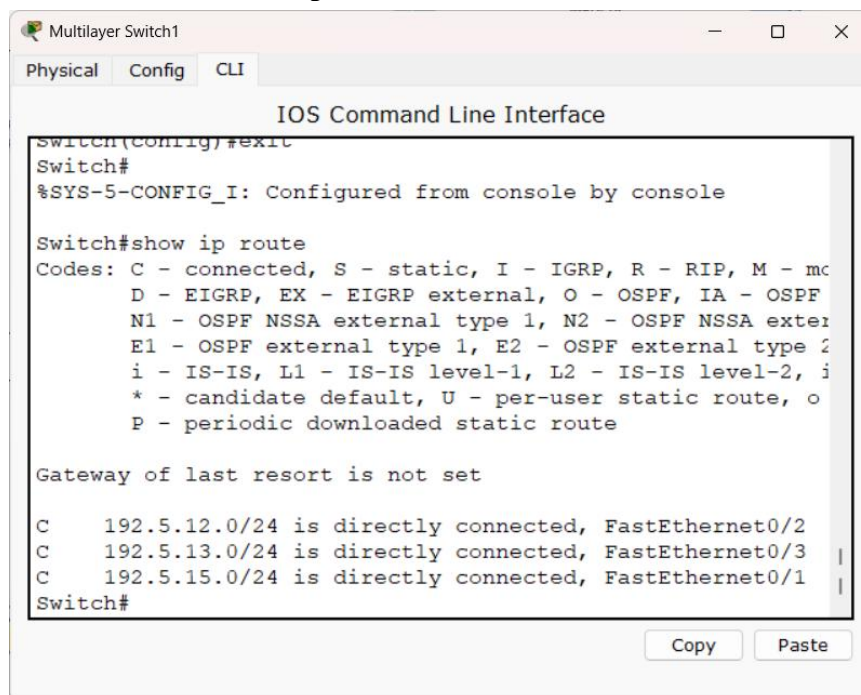
VLAN10 主机的默认网管是：192.5.9.126

VLAN20 主机的默认网管是：192.5.9.254

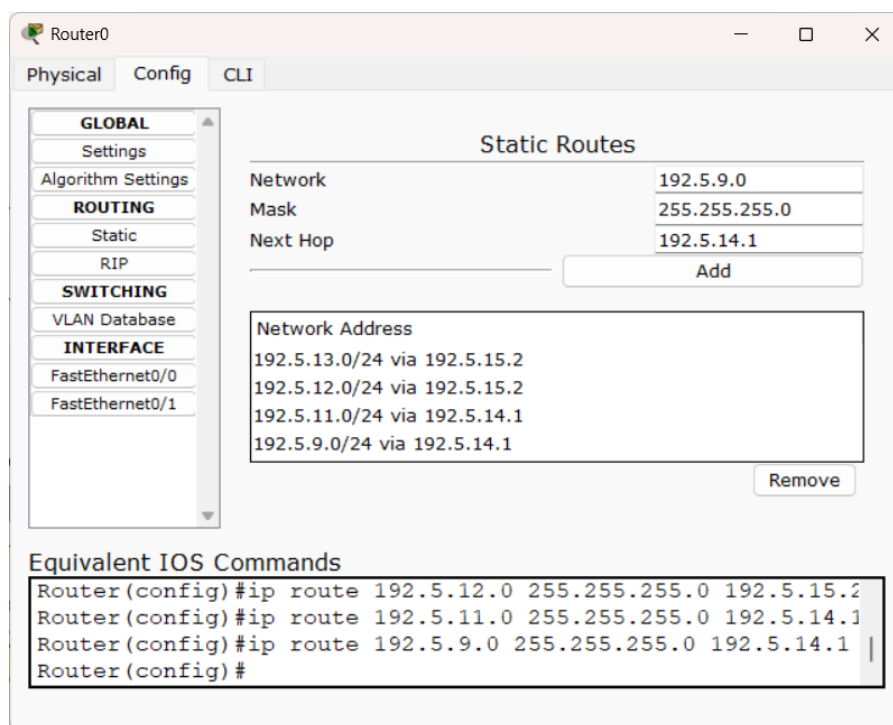
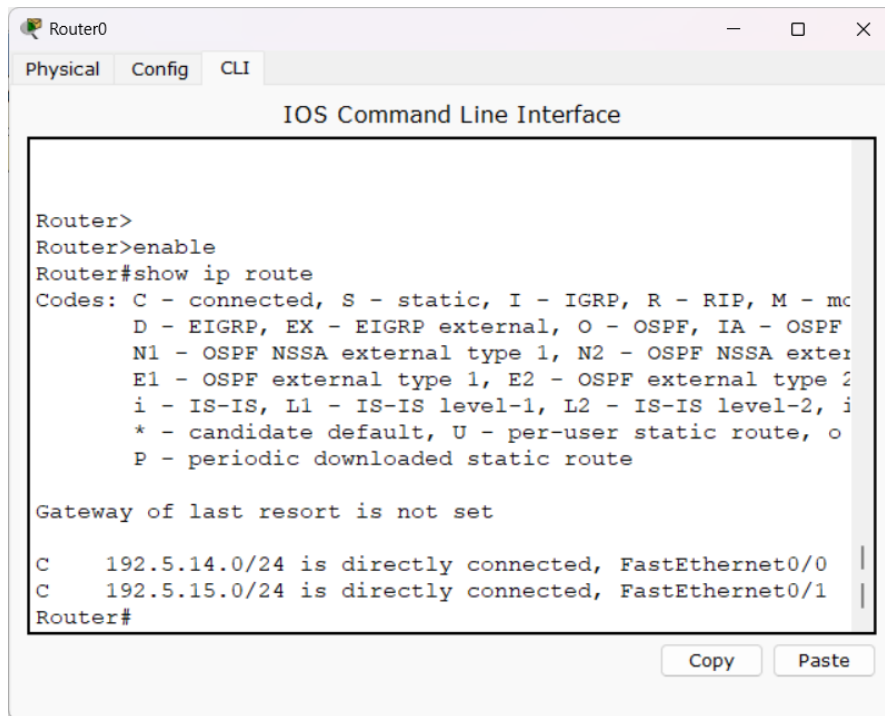
配置静态路由：



同理，右边的三层交换机也进行 ip 地址配置：

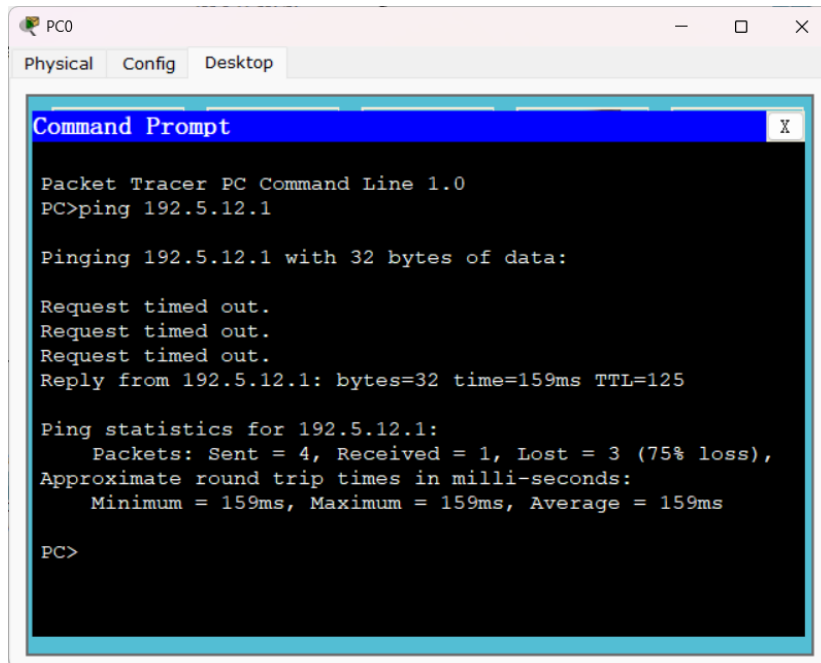


边界路由器进行 ip 地址配置：



3.4 连通性测试

Pc0 (192.5.9.1/25) ping pc5 (192.5.12.1/24) :



The screenshot shows a Packet Tracer PC window for PC0. The 'Desktop' tab is active, displaying a 'Command Prompt' window. The command prompt shows the execution of the command 'ping 192.5.12.1'. The output indicates that the first three requests timed out, and the fourth request was successful, returning 32 bytes of data with a time of 159ms and a TTL of 125. The ping statistics show a 75% loss (3 out of 4 packets lost).

```
PC0
Physical Config Desktop

Command Prompt

Packet Tracer PC Command Line 1.0
PC>ping 192.5.12.1

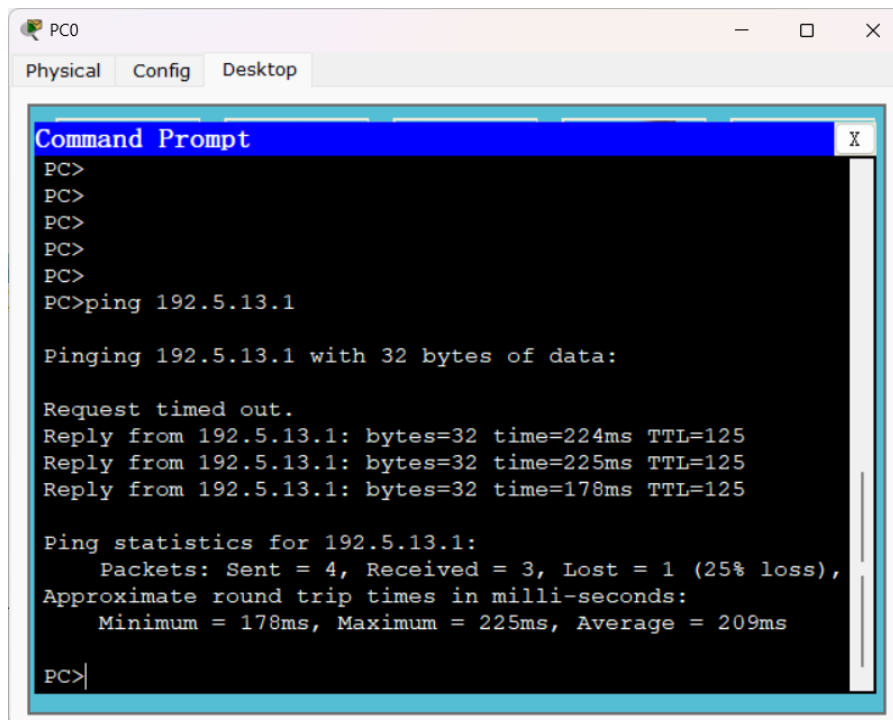
Pinging 192.5.12.1 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Reply from 192.5.12.1: bytes=32 time=159ms TTL=125

Ping statistics for 192.5.12.1:
    Packets: Sent = 4, Received = 1, Lost = 3 (75% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 159ms, Maximum = 159ms, Average = 159ms

PC>
```

Pc0 (192.5.9.1/25) ping 服务器 server0 (192.5.13.1/24) :



The screenshot shows the same Packet Tracer PC window for PC0. The 'Command Prompt' window now shows the execution of the command 'ping 192.5.13.1'. The output indicates that the first request timed out, and the next three requests were successful, returning 32 bytes of data with times of 224ms, 225ms, and 178ms, all with a TTL of 125. The ping statistics show a 25% loss (1 out of 4 packets lost) and an average round trip time of 209ms.

```
PC0
Physical Config Desktop

Command Prompt

PC>
PC>
PC>
PC>
PC>
PC>ping 192.5.13.1

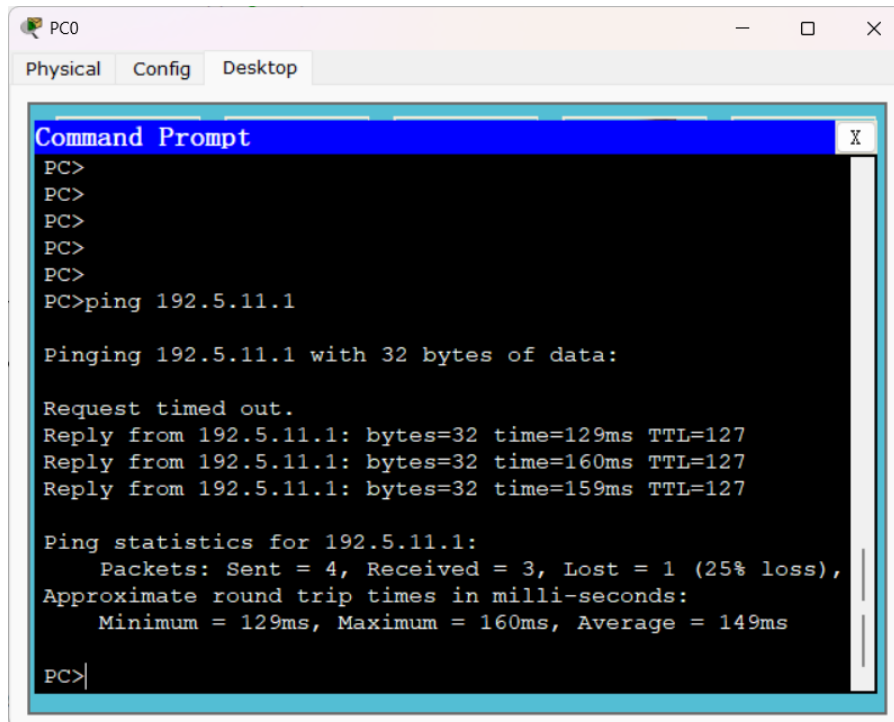
Pinging 192.5.13.1 with 32 bytes of data:

Request timed out.
Reply from 192.5.13.1: bytes=32 time=224ms TTL=125
Reply from 192.5.13.1: bytes=32 time=225ms TTL=125
Reply from 192.5.13.1: bytes=32 time=178ms TTL=125

Ping statistics for 192.5.13.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 178ms, Maximum = 225ms, Average = 209ms

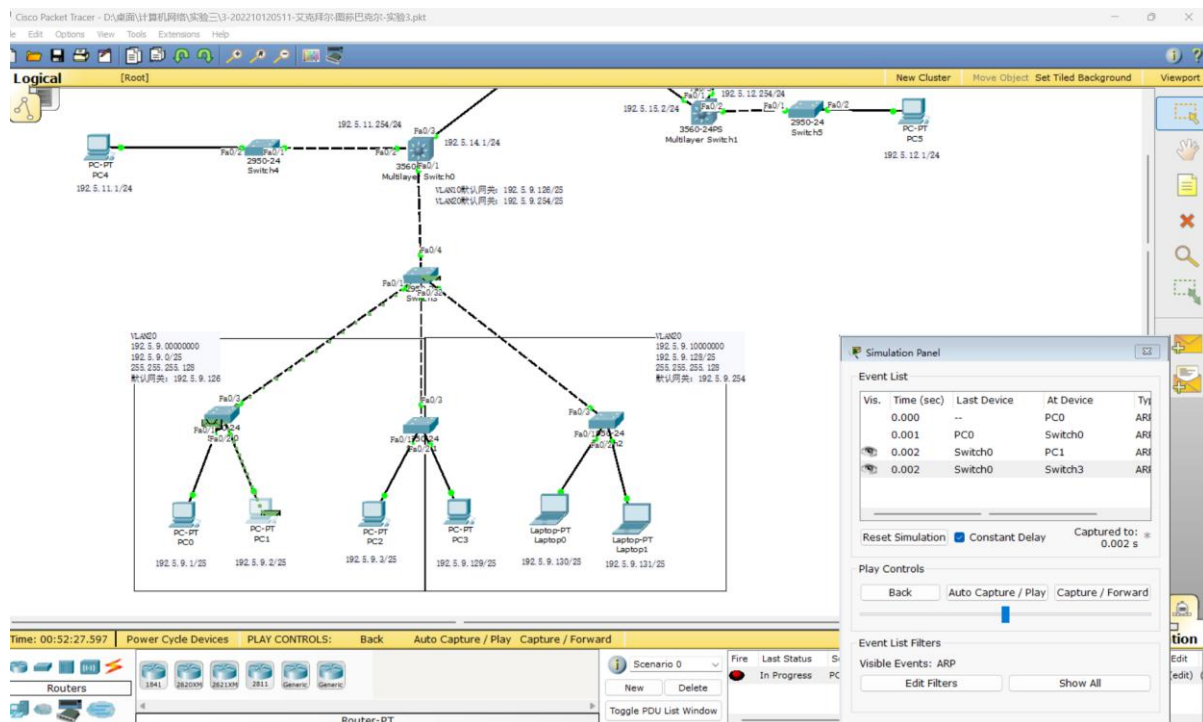
PC>
```

Pc0 (192.5.9.1/25) ping pc4 (192.5.11.1/24) :



3.5 ARP 抓包

为了简单起见，只进行 pc0 到 pc1 的 arp 抓包分析：



PDU Information at Device: PC0
OSI Model
Outbound PDU Details

At Device: PC0
Source: PC0
Destination: Broadcast

In Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2
Layer1

Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2: Ethernet II Header
000A.F366.D417 >> FFFF.FFFF.FFFF
ARP Packet Src. IP: 192.5.9.1, Dest. IP: 192.5.9.2
Layer 1: Port(s): FastEthernet

1. The ARP process constructs a request for the target IP address.
2. The device encapsulates the PDU into an Ethernet frame.

PDU Information at Device: PC0
OSI Model
Outbound PDU Details

PDU Formats

Ethernet II
0 4 8 14 19 Bytes
PREAMBLE: 101010...1011 DEST MAC: FFFF.FFFF.FFFF SRC MAC: 000A.F366.D417
TYPE: 0x806 DATA (VARIABLE LENGTH) FCS: 0x0

ARP
0 8 16 31 Bits
HARDWARE TYPE: 0x1 PROTOCOL TYPE:
HLEN: 0x6 PLEN: 0x4 OPCODE: 0x1
SOURCE MAC: 000A.F366.D417 (48 bits) SOURCE IP (32 bits)
192.5.9.1
TARGET MAC: 0000.0000.0000 (48 bits)
TARGET IP: 192.5.9.2 (32 bits)

因为主机 pc0 现在不知道目标主机的 mac 地址，所以目标主机 pc0 的 mac 地址是 0000.0000.0000

PDU Information at Device: PC1
OSI Model
Inbound PDU Details
Outbound PDU Details

At Device: PC1
Source: PC0
Destination: Broadcast

In Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2: Ethernet II Header
000A.F366.D417 >> FFFF.FFFF.FFFF
ARP Packet Src. IP: 192.5.9.1, Dest. IP: 192.5.9.2
Layer 1: Port FastEthernet

Out Layers
Layer7
Layer6
Layer5
Layer4
Layer3
Layer2: Ethernet II Header
00E0.B073.51EE >> 000A.F366.D417 ARP Packet Src. IP: 192.5.9.2, Dest. IP: 192.5.9.1
Layer 1: Port(s): FastEthernet

1. FastEthernet receives the frame.

PDU Information at Device: PC1
OSI Model
Inbound PDU Details
Outbound PDU Details

PDU Formats

Ethernet II
0 4 8 14 19 Bytes
PREAMBLE: 101010...1011 DEST MAC: FFFF.FFFF.FFFF SRC MAC: 000A.F366.D417
TYPE: 0x806 DATA (VARIABLE LENGTH) FCS: 0x0

ARP
0 8 16 31 Bits
HARDWARE TYPE: 0x1 PROTOCOL TYPE:
HLEN: 0x6 PLEN: 0x4 OPCODE: 0x1
SOURCE MAC: 000A.F366.D417 (48 bits) SOURCE IP (32 bits)
192.5.9.1
TARGET MAC: 0000.0000.0000 (48 bits)
TARGET IP: 192.5.9.2 (32 bits)

PDU Information at Device: PC1
OSI Model
Inbound PDU Details
Outbound PDU Details

PDU Formats

Ethernet II
0 4 8 14 19 Bytes
PREAMBLE: 101010...1011 DEST MAC: 000A.F366.D417 SRC MAC: 00E0.B073.51EE
TYPE: 0x806 DATA (VARIABLE LENGTH) FCS: 0x0

ARP
0 8 16 31 Bits
HARDWARE TYPE: 0x1 PROTOCOL TYPE:
HLEN: 0x6 PLEN: 0x4 OPCODE: 0x2
SOURCE MAC: 00E0.B073.51EE (48 bits) SOURCE IP (32 bits)
192.5.9.2
TARGET MAC: 000A.F366.D417 (48 bits)
TARGET IP: 192.5.9.1 (32 bits)