中南林業科技大學

Central South University of Forestry & Technology

本科课程设计报告

《计算机网络课程设计》

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实验 16 静态路由

一、 实验名称

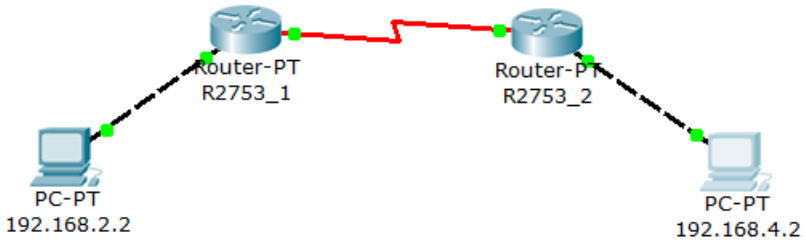
静态路由

二、 实验目的

掌握通过静态路由方式实现网络的连通性。

三、 实验拓扑

注：普通路由器和主机直连时，需要使用交叉线，在 R1762 的以太网接口支持 MDI/MDIX，使用直连线也可以连通。



四、 实验步骤

1、 在路由器 Router1 上配置接口的 IP 地址和串口上的时钟频率。

Router1(config)# interface fastethernet 1/0

Router1(config-if)# ip address 192.168.2.1 255.255.255.0

Route1(config-if)#no shutdown

Router1(config)interface serial 1/2

Router1(config-if)# ip address 192.168.3.1 255.255.255.0

Router1(config-if)cloce rate 64000

Router1(config)#no shutdown

```
R2753_1>enable
R2753_1#conf ter
Enter configuration commands, one per line.  End with CNTL/Z.
R2753_1(config)#interface f0/0
R2753_1(config-if)#ip address 192.168.2.1 255.255.255.0
R2753_1(config-if)#no shutdown

R2753_1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

R2753_1(config-if)#interface serial 2/0
R2753 1(config-if)#ip address 192.168.3.1 255.255.255.0
```

```
R2753_1(config-if)#clock rate 64000
R2753_1(config-if)#no shutdown
```

验证路由器接口的配置。

Router1#show ip interface brief

```
R2753_1#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol


FastEthernet0/0        192.168.2.1     YES manual up                    down

FastEthernet1/0        unassigned      YES unset  administratively down down

Serial2/0              192.168.3.1     YES manual down                  down

Serial3/0              unassigned      YES unset  administratively down down

FastEthernet4/0        unassigned      YES unset  administratively down down

FastEthernet5/0        unassigned      YES unset  administratively down down
```

Router1#show interface serial 1/2

```
R2753_1#show interface serial 2/0
Serial2/0 is down, line protocol is down (disabled)
  Hardware is HD64570
  Internet address is 192.168.3.1/24
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/0/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 96 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
     DCD=down  DSR=down  DTR=down  RTS=down  CTS=down
```

2、 在路由器 Router1 上配置静态路由。

Router1(config-if)# ip route 192.168.4.0 255.255.255.0 192.168.3.2

验证测试 验证 Router1 上配置静态路由配置。

Router1#show ip route

```
R2753_1#show ip route
Codes: C - connected, S - static, I - IGRP, 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

C    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.3.0/24 is directly connected, Serial2/0
S    192.168.4.0/24 [1/0] via 192.168.3.2
```

3、 在路由器 Router2 上配置接口的 IP 地址和串口上的时钟频率。

Router2(config)# interface fastethernet 1/0

Router2(config-if)# ip address 192.168.4.1 255.255.255.0

Route2(config-if)#no shutdown

Router2(config)interface serial 1/2

Router2(config-if)# ip address 192.168.3.2 255.255.255.0

Router2(config-if)cloce rate 64000

Router2(config)#no shutdown

```
R2753_2>enable
R2753_2#conf ter
Enter configuration commands, one per line.  End with CNTL/Z.
R2753_2(config)#interface f0/0
R2753_2(config-if)#ip address 192.168.4.1 255.255.255.0
R2753_2(config-if)#no shutdown

R2753_2(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

R2753_2(config-if)#interface serial2/0
R2753_2(config-if)#ip address 192.168.3.2 255.255.255.0
R2753_2(config-if)#clock rate 64000
This command applies only to DCE interfaces
R2753_2(config-if)#no shutdown
```

验证路由器接口的配置。

Router2#show ip interface brief

```
R2753_2#show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol


FastEthernet0/0        192.168.4.1     YES manual up                    down

FastEthernet1/0        unassigned      YES unset  administratively down down

Serial2/0              192.168.3.2     YES manual up                    up

Serial3/0              unassigned      YES unset  administratively down down

FastEthernet4/0        unassigned      YES unset  administratively down down

FastEthernet5/0        unassigned      YES unset  administratively down down
```

Router2#show interface serial 1/2

```
R2753_2#show interface serial2/0
Serial2/0 is up, line protocol is up (connected)
  Hardware is HD64570
  Internet address is 192.168.3.2/24
  MTU 1500 bytes, BW 128 Kbit, DLY 20000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/0/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 96 kilobits/sec
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 packets output, 0 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

4、验证测试 验证 Router2 上配置静态路由配置。

Router2#show ip route

```
R2753_2#show ip route
Codes: C - connected, S - static, I - IGRP, 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    192.168.2.0/24 [1/0] via 192.168.3.1
C    192.168.3.0/24 is directly connected, Serial2/0
C    192.168.4.0/24 is directly connected, FastEthernet0/0
```

5、测试网络的互连互通性。

从 PC1 ping PC

```
PC>ping 192.168.4.2

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.4.2: bytes=32 time=1ms TTL=126
Reply from 192.168.4.2: bytes=32 time=1ms TTL=126
Reply from 192.168.4.2: bytes=32 time=4ms TTL=126
Reply from 192.168.4.2: bytes=32 time=5ms TTL=126

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 5ms, Average = 2ms
```

五、 实验总结

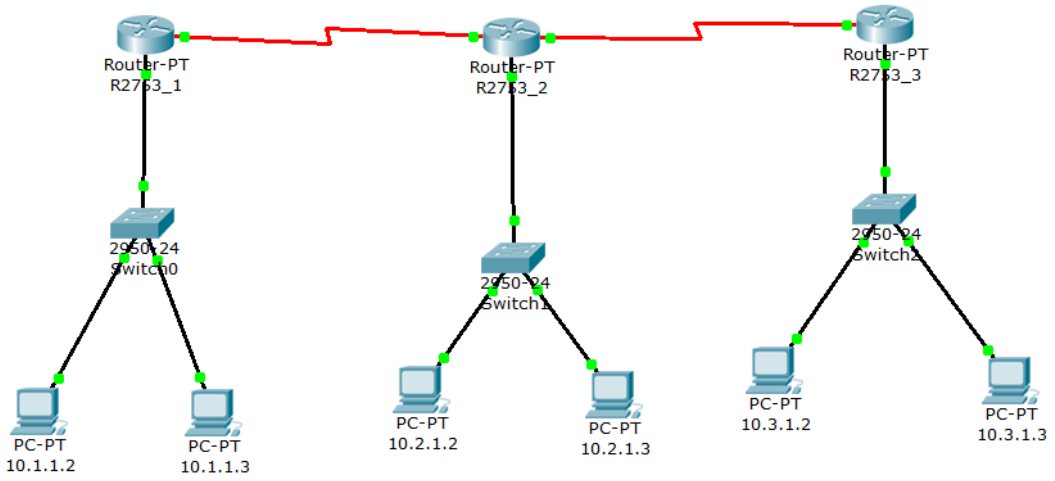
如果两台路由器通过串口直接互连，则必须在其中一端设置时钟频率（DCE）。通过本次实验，成功掌握了通过静态路由方式实现网络的连通性。在实验中，首先理解了静态路由的基本概念和原理，然后在网络设备中配置了适当的静态路由信息。通过正确设置路由表项，成功建立了网络中不同子网之间的通信通道，确保了数据包能够有效地在网络中传输。这次实验的经验使我更加熟悉网络配置和路由管理，为今后设计和维护复杂网络提供了实用的技能基础。

实验 17 配置动态路由 RIP

一、 实验目的

通过 rip 实现动态路由

二、 实验内容



首选根据实验需要配置好 PC 机及路由器各个接口的 IP 地址等参数。

1、三个路由器的基本配置

```
interface FastEthernet0/0
 ip address 10.1.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.0.1 255.255.255.0
 clock rate 64000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router rip
 version 2
 network 10.0.0.0
 network 192.168.0.0
!
ip classless
```

```
interface FastEthernet0/0
 ip address 10.2.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.0.2 255.255.255.0
!
interface Serial3/0
 ip address 192.168.1.1 255.255.255.0
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router rip
 version 2
 network 10.0.0.0
 network 192.168.0.0
 network 192.168.1.0
!
ip classless
```

```
interface FastEthernet0/0
 ip address 10.3.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 no ip address
 shutdown
!
interface Serial3/0
 ip address 192.168.1.2 255.255.255.0
 clock rate 64000
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router rip
 version 2
 network 10.0.0.0
 network 192.168.1.0
!
ip classless
!
```

```
R2753_1#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R       10.0.0.0/8 [120/1] via 192.168.0.2, 00:00:14, Serial2/0
C       10.1.1.0/24 is directly connected, FastEthernet0/0
C    192.168.0.0/24 is directly connected, Serial2/0
R    192.168.1.0/24 [120/1] via 192.168.0.2, 00:00:14, Serial2/0
```

```
R2753_2#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R       10.0.0.0/8 [120/1] via 192.168.1.2, 00:00:02, Serial3/0
                   [120/1] via 192.168.0.1, 00:00:19, Serial2/0
C       10.2.1.0/24 is directly connected, FastEthernet0/0
C    192.168.0.0/24 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, Serial3/0
```

```
R2753_3#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R       10.0.0.0/8 [120/1] via 192.168.1.1, 00:00:00, Serial3/0
C       10.3.1.0/24 is directly connected, FastEthernet0/0
R    192.168.0.0/24 [120/1] via 192.168.1.1, 00:00:00, Serial3/0
C    192.168.1.0/24 is directly connected, Serial3/0
```

2、RIP 路由协议配置

```
R2753_1(config)#router rip
R2753_1(config-router)#network 10.1.1.0
R2753_1(config-router)#network 192.168.0.0
R2753_1(config-router)#
```

图四 R2753_1 的配置 ；10.0.0.0 是 B 类网络，前 8bits 是网络 ID，在配置时应该是 netwok 10.0.0.0

```
R2753_2(config)#router rip
R2753_2(config-router)#network 10.0.0.0
R2753_2(config-router)#network 192.168.0.0
R2753_2(config-router)#network 192.168.1.0
```

图五 R2753_2 的配置

```
R2753_3(config)#router rip
R2753_3(config-router)#network 10.0.0.0
R2753_3(config-router)#192.168.1.0
                      ^
% Invalid input detected at '^' marker.

R2753_3(config-router)#network 192.168.1.0
```

图六 R2753_3 的配置

3、RIP 路由协议的诊断与排错

```
R2753_2#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     10.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
R       10.0.0.0/8 [120/1] via 192.168.0.1, 00:00:05, Serial2/0
                   [120/1] via 192.168.1.2, 00:00:14, Serial3/0
C       10.2.1.0/24 is directly connected, FastEthernet0/0
C    192.168.0.0/24 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, Serial3/0
```

图八 查看路由表 show ip route

```
R2753_2#show ip rip database
10.0.0.0/8    auto-summary
10.0.0.0/8
    [1] via 192.168.0.1, 00:00:24, Serial2/0    [1] via 192.168.1.2, 00:00:08, S
erial3/0
10.2.1.0/24    auto-summary
10.2.1.0/24    directly connected, FastEthernet0/0
192.168.0.0/24    auto-summary
192.168.0.0/24    directly connected, Serial2/0
192.168.1.0/24    auto-summary
192.168.1.0/24    directly connected, Serial3/0
```

图九 show ip rip database

```
R2753_2#debug ip rip
RIP protocol debugging is on
R2753_2#RIP: received v2 update from 192.168.0.1 on Serial2/0
      10.0.0.0/8 via 0.0.0.0 in 1 hops
RIP: sending  v2 update to 224.0.0.9 via FastEthernet0/0 (10.2.1.1)
RIP: build update entries
      10.0.0.0/8 via 0.0.0.0, metric 2, tag 0
      192.168.0.0/24 via 0.0.0.0, metric 1, tag 0
      192.168.1.0/24 via 0.0.0.0, metric 1, tag 0
RIP: sending  v2 update to 224.0.0.9 via Serial2/0 (192.168.0.2)
RIP: build update entries
      10.0.0.0/8 via 0.0.0.0, metric 1, tag 0
      192.168.1.0/24 via 0.0.0.0, metric 1, tag 0
RIP: sending  v2 update to 224.0.0.9 via Serial3/0 (192.168.1.1)
RIP: build update entries
      10.0.0.0/8 via 0.0.0.0, metric 1, tag 0
      192.168.0.0/24 via 0.0.0.0, metric 1, tag 0
RIP: received v2 update from 192.168.1.2 on Serial3/0
      10.0.0.0/8 via 0.0.0.0 in 1 hops
RIP: received v2 update from 192.168.0.1 on Serial2/0
      10.0.0.0/8 via 0.0.0.0 in 1 hops
```

图十 debug ip rip 开启 RIP 诊断，no debug ip rip 关闭 RIP 诊断

4、使用计算机不同网段互 ping 检查网络连通

```
PC>ipconfig

FastEthernet0 Connection:(default port)
Link-local IPv6 Address.....: FE80::20D:BDFF:FE9E:52C5
IP Address.....: 10.2.1.2
Subnet Mask.....: 255.255.255.0
Default Gateway.....: 10.2.1.1

PC>ping 10.1.1.2

Pinging 10.1.1.2 with 32 bytes of data:

Request timed out.
Reply from 10.1.1.2: bytes=32 time=2ms TTL=126
Reply from 10.1.1.2: bytes=32 time=8ms TTL=126
Reply from 10.1.1.2: bytes=32 time=7ms TTL=126

Ping statistics for 10.1.1.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 8ms, Average = 5ms

PC>ping 10.3.1.3

Pinging 10.3.1.3 with 32 bytes of data:

Request timed out.
Reply from 10.3.1.3: bytes=32 time=7ms TTL=126
Reply from 10.3.1.3: bytes=32 time=5ms TTL=126
Reply from 10.3.1.3: bytes=32 time=3ms TTL=126

Ping statistics for 10.3.1.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 3ms, Maximum = 7ms, Average = 5ms

PC>ping 192.168.0.1

Pinging 192.168.0.1 with 32 bytes of data:

Reply from 192.168.0.1: bytes=32 time=1ms TTL=254
Reply from 192.168.0.1: bytes=32 time=1ms TTL=254
Reply from 192.168.0.1: bytes=32 time=5ms TTL=254
Reply from 192.168.0.1: bytes=32 time=5ms TTL=254

Ping statistics for 192.168.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 5ms, Average = 3ms
```

图十一 pc2 可以 ping 通所有的网段

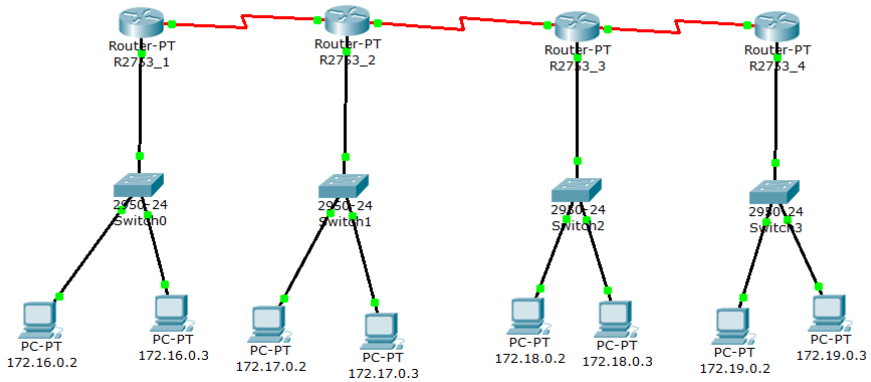
三、 实验总结

通过本次实验，我成功学习并应用了 RIP（Routing Information Protocol）以实现动态路由。首先，我了解了 RIP 的基本原理，包括路由更新、路由表维护等关键概念。随后，在网络设备上配置了 RIP 协议，启用了动态路由的功能。

通过 RIP，网络中的路由信息可以动态地进行更新和交换，使得网络拓扑的变化能够被及时感知和适应。我成功配置了 RIP 路由器，确保了不同子网之间的动态路由通信。这次实验的经验使我更加熟悉动态路由的实施和管理，为将来面对不断变化的网络环境提供了有力的解决方案。

实验 18 Cisoc EIGRP

一、 配置实例拓扑图



图一 共有四个 Cisco 2811 路由器，共六个网段

一、 二、配置 Cisco EIGRP 的基本命令

Router(config)#router eigrp 100 开启 EIGRP 进程，100 为 AS 编号(1——65535)
Router(config-router)#network 10.0.0.0 在网络上通告自己所直接连接的网段

二、 三、配置 Cisco EIGRP 实例

1、基本配置

```
interface FastEthernet0/0
 ip address 172.16.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.0.1 255.255.255.0
 clock rate 64000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.0.0
 network 172.16.0.0
 no auto-summary
!
ip classless
```

```
interface FastEthernet0/0
 ip address 172.17.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.0.2 255.255.255.0
!
interface Serial3/0
 ip address 192.168.1.1 255.255.255.0
 clock rate 64000
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.0.0
 network 192.168.1.0
 network 172.17.0.0
 no auto-summary
!
ip classless
```

```
interface FastEthernet0/0
 ip address 172.18.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.3.1 255.255.255.0
 clock rate 64000
!
interface Serial3/0
 ip address 192.168.1.2 255.255.255.0
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.1.0
 network 192.168.2.0
 network 172.18.0.0
 no auto-summary
!
ip classless
```

```
interface FastEthernet0/0
 ip address 172.19.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.3.2 255.255.255.0
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.2.0
 network 172.19.0.0
 no auto-summary
!
ip classless
!
```

2、启用 EIGRP

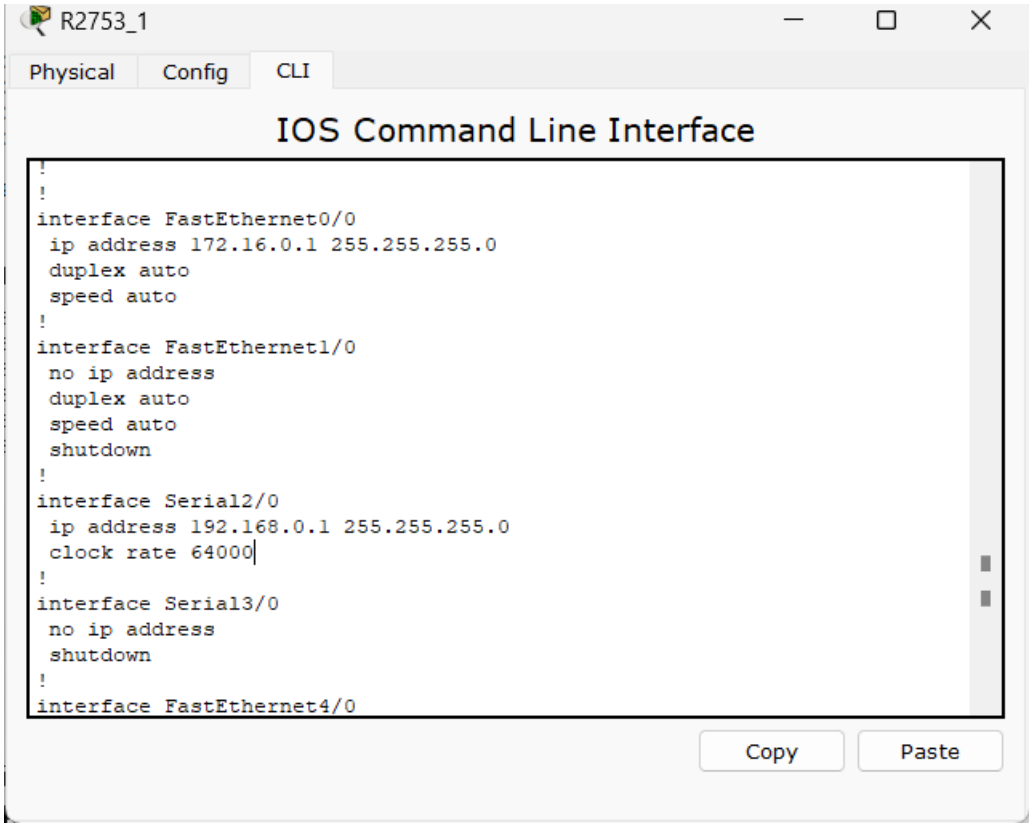
```
R2753_1(config)#router eigrp 100
R2753_1(config-router)#no auto-summary
R2753_1(config-router)#network 192.168.0.0
R2753_1(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 192.168.0.2 (Serial2/0) is up:
acency

R2753_1(config-router)#network 172.16.0.0
R2753_1(config-router)#exit
```

```
R2753_2(config)#router eigrp 100
R2753_2(config-router)#no auto-summary
R2753_2(config-router)#network 192.168.0.0
R2753_2(config-router)#network 192.168.1.0
R2753_2(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 192.168.1.2 (Serial3/0) is up:
acency

R2753_2(config-router)#network 172.17.0.0
R2753_2(config-router)#exit
```

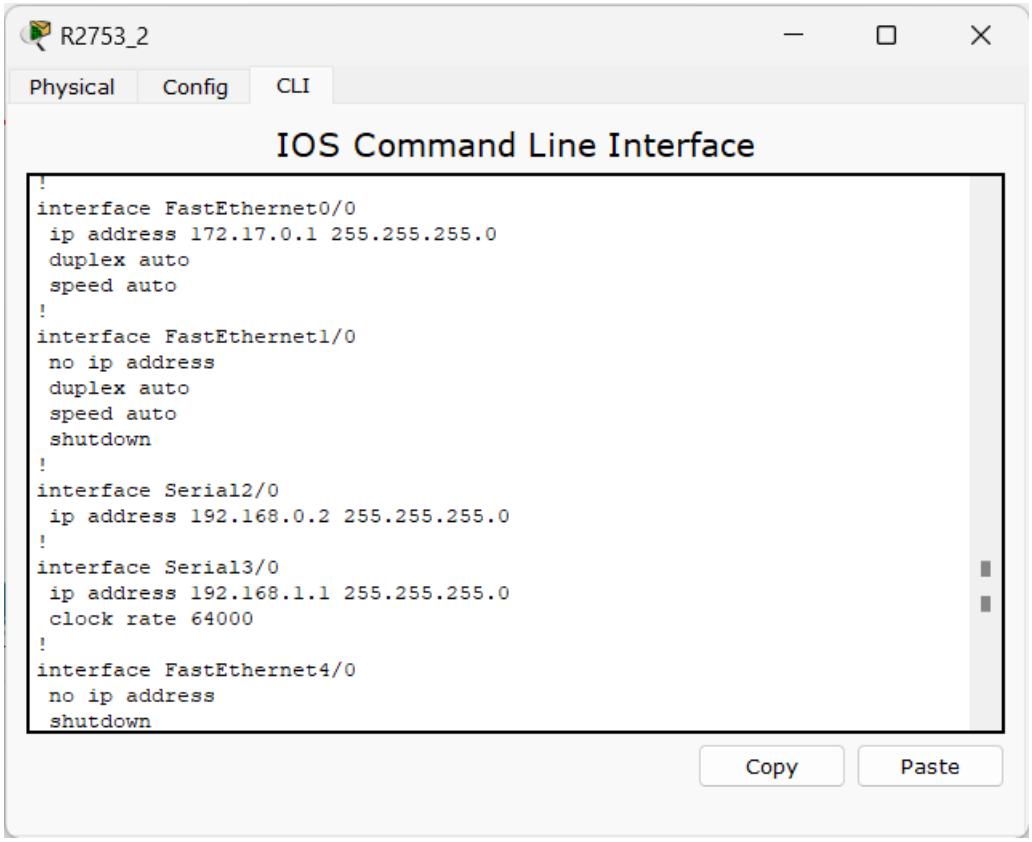
```
R2753_3(config)#router eigrp 100
R2753_3(config-router)#no auto-summary
R2753_3(config-router)#network 192.168.1.0
R2753_3(config-router)#network 192.168.2.0
R2753_3(config-router)#network 172.18.0.0
R2753_3(config-router)#exit
```

```
R2753_4#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2753_4(config)#router eigrp 100
R2753_4(config-router)#no auto-summary
R2753_4(config-router)#network 192.168.2.0
R2753_4(config-router)#network 172.19.0.0
R2753_4(config-router)#exit
```

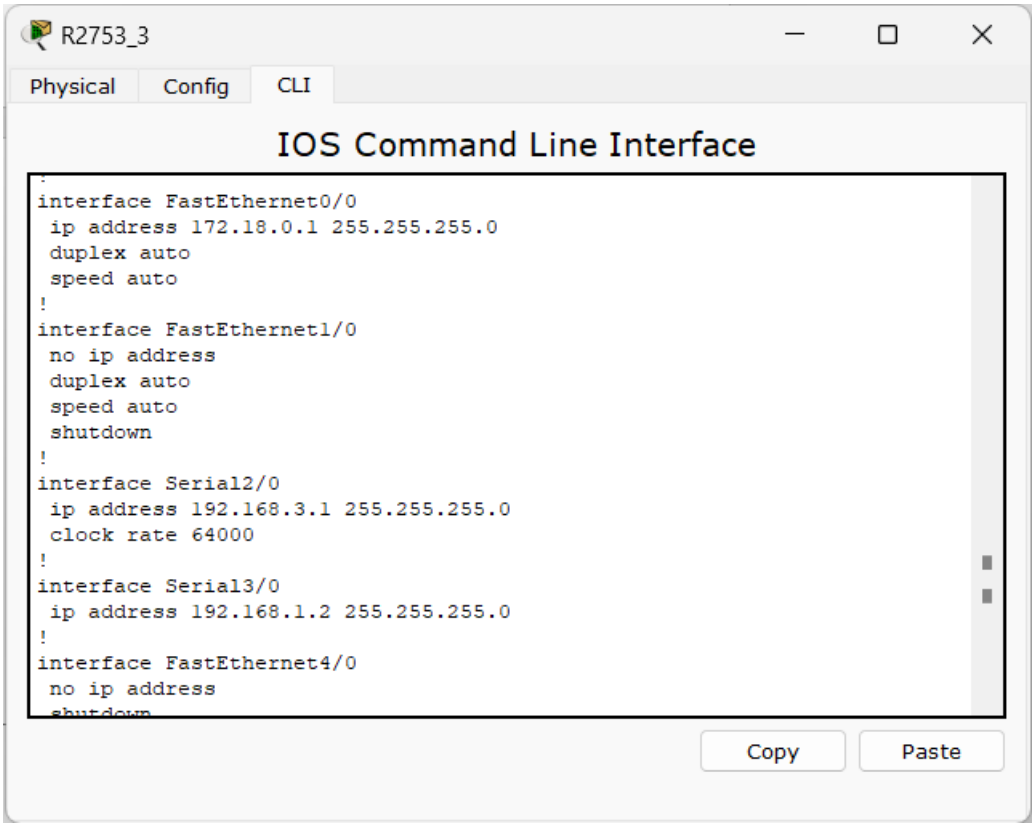
图三



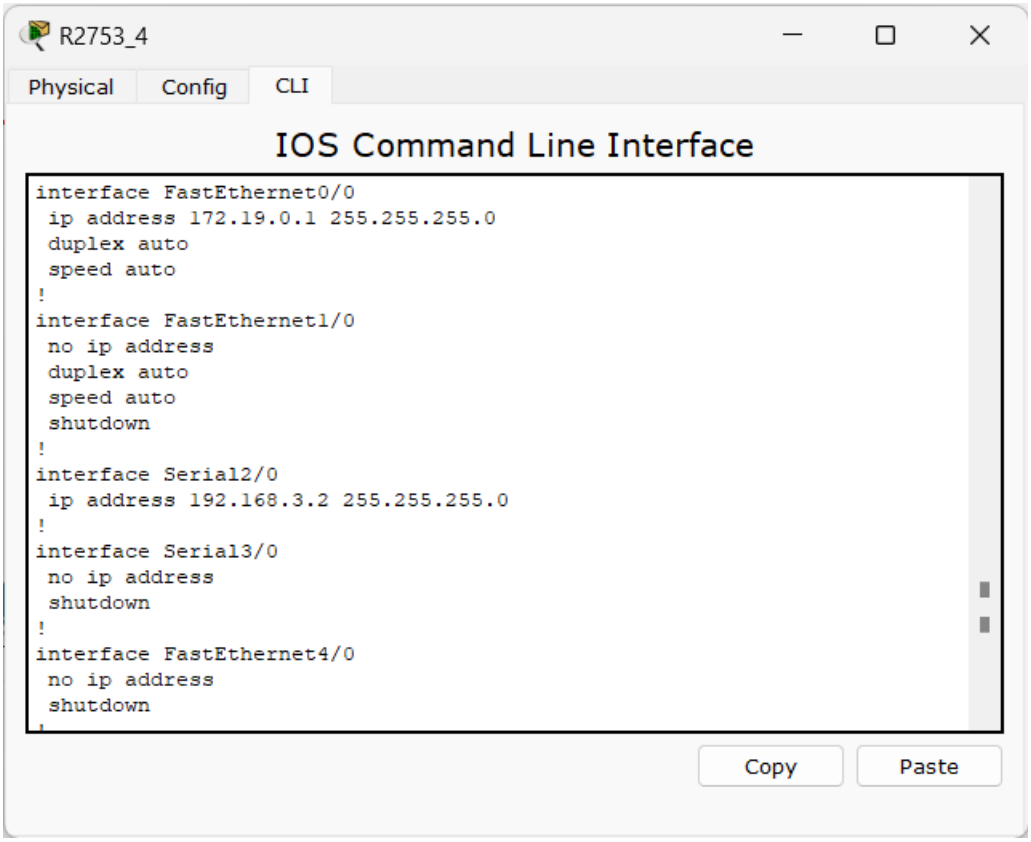
图四 Router1 的配置



图五 Router2 的配置



图六 Router3 的配置



图七 Router4 的配置

```
R2753_2#show ip route
Codes: C - connected, S - static, I - IGRP, 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

     172.16.0.0/24 is subnetted, 1 subnets
D       172.16.0.0 [90/20514560] via 192.168.0.1, 00:10:10, Serial2/0
     172.17.0.0/24 is subnetted, 1 subnets
C       172.17.0.0 is directly connected, FastEthernet0/0
     172.18.0.0/24 is subnetted, 1 subnets
D       172.18.0.0 [90/20514560] via 192.168.1.2, 00:12:16, Serial3/0
C    192.168.0.0/24 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, Serial3/0
```

图八 查看路由表

3、校验与排错

把个网段的 PC 配置好 IP 地址及网关，用 PC4 ping 所有网段都可以 ping 通。

```
PC>ping 172.16.0.2

Pinging 172.16.0.2 with 32 bytes of data:

Request timed out.
Reply from 172.16.0.2: bytes=32 time=3ms TTL=125
Reply from 172.16.0.2: bytes=32 time=2ms TTL=125
Reply from 172.16.0.2: bytes=32 time=6ms TTL=125

Ping statistics for 172.16.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 6ms, Average = 3ms

PC>ping 172.17.0.2

Pinging 172.17.0.2 with 32 bytes of data:

Request timed out.
Reply from 172.17.0.2: bytes=32 time=5ms TTL=126
Reply from 172.17.0.2: bytes=32 time=9ms TTL=126
Reply from 172.17.0.2: bytes=32 time=8ms TTL=126

Ping statistics for 172.17.0.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 5ms, Maximum = 9ms, Average = 7ms
```

图九

```
R2753_2#show ip eigrp neighbors
IP-EIGRP neighbors for process 100
H   Address         Interface       Hold Uptime    SRTT   RTO   Q   Seq
                                    (sec)          (ms)       Cnt Num
0   192.168.1.2     Se3/0           12   00:13:34  40     1000  0   7
1   192.168.0.1     Se2/0           14   00:11:40  40     1000  0   8
```

图十 show ip eigrp neighbors 命令查看 EIGRP 的邻接关系

```
R2753_2#show ip eigrp interfaces
IP-EIGRP interfaces for process 100

                    Xmit Queue   Mean   Pacing Time   Multicast    Pending
Interface        Peers  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Se2/0              1        0/0      1236       0/10          0           0
Se3/0              1        0/0      1236       0/10          0           0
Fa0/0              0        0/0      1236       0/10          0           0
```

图十一 show ip eigrp interfaces

```
R2753_2#show ip eigrp topology
IP-EIGRP Topology Table for AS 100

Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - Reply status

P 192.168.0.0/24, 1 successors, FD is 20512000
         via Connected, Serial2/0
P 192.168.1.0/24, 1 successors, FD is 20512000
         via Connected, Serial3/0
P 172.18.0.0/24, 1 successors, FD is 20514560
         via 192.168.1.2 (20514560/28160), Serial3/0
P 172.17.0.0/24, 1 successors, FD is 28160
         via Connected, FastEthernet0/0
P 172.16.0.0/24, 1 successors, FD is 20514560
         via 192.168.0.1 (20514560/28160), Serial2/0
```

图十二 show ip eigrp topology 查看拓扑表

```
R2753_2#sh ip eigrp traffic
IP-EIGRP Traffic Statistics for process 100
  Hellos sent/received: 607/381
  Updates sent/received: 7/9
  Queries sent/received: 0/0
  Replies sent/received:  0/0
  Acks sent/received:  9/6
  Input queue high water mark 1, 0 drops
  SIA-Queries sent/received: 0/0
  SIA-Replies sent/received: 0/0
```

图十三 show ip eigrp traffic

```
R2753_2#debug eigrp packets
EIGRP Packets debugging is on
    (UPDATE, REQUEST, QUERY, REPLY, HELLO, ACK )
R2753_2#
EIGRP: Sending HELLO on Serial3/0
  AS 100, Flags 0x0, Seq 9/0 idbQ 0/0 iidbQ un/rely 0/0

EIGRP: Received HELLO on Serial3/0 nbr 192.168.1.2
  AS 100, Flags 0x0, Seq 8/0 idbQ 0/0

EIGRP: Sending HELLO on FastEthernet0/0
  AS 100, Flags 0x0, Seq 9/0 idbQ 0/0 iidbQ un/rely 0/0

EIGRP: Sending HELLO on Serial2/0
  AS 100, Flags 0x0, Seq 9/0 idbQ 0/0 iidbQ un/rely 0/0

EIGRP: Received HELLO on Serial2/0 nbr 192.168.0.1
  AS 100, Flags 0x0, Seq 10/0 idbQ 0/0

EIGRP: Sending HELLO on Serial3/0
  AS 100, Flags 0x0, Seq 9/0 idbQ 0/0 iidbQ un/rely 0/0
```

图十四 debug eigrp packets

四、 实验总结

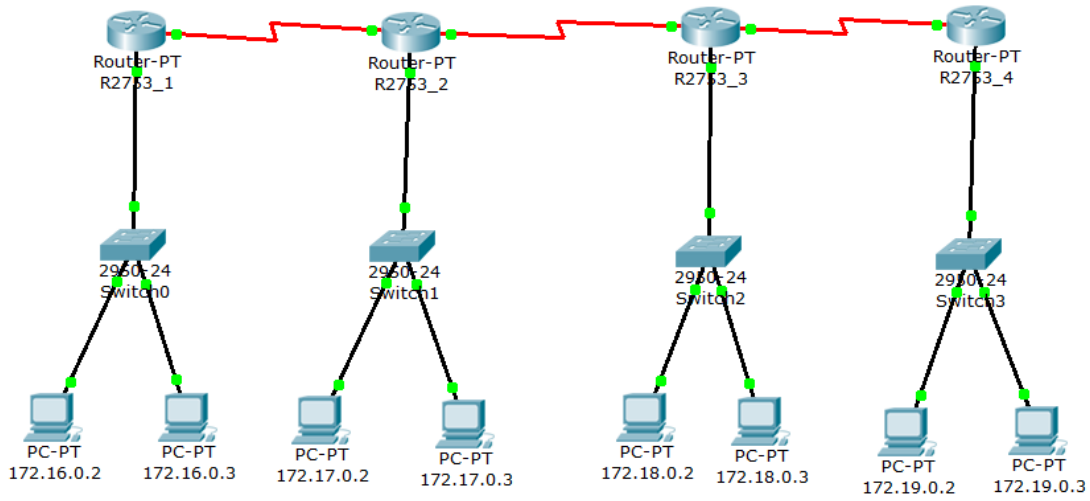
通过本次实验，成功实施了 EIGRP 动态路由，以下是实验总结：

在实验中，首先启用了 EIGRP 协议，指定了 EIGRP 的自治系统号（AS 号）。随后，通过配置网络命令,将相应的网络地址添加到EIGRP进程中,使得EIGRP能够监听和管理这些网络。通过这一步骤，实现了动态路由的自动学习和更新。

EIGRP 的优势在于其快速的收敛性、低带宽消耗以及对多协议的支持。通过实验，我深入了解了 EIGRP 的配置步骤和原理，并成功建立了网络中路由器之间的动态路由。这次实验的经验将为今后面对复杂网络环境提供实用的技能支持，加深了对动态路由协议的理解。

实验 19 配置单区域 OSPF

一、 配置实例拓扑图



二、 OSPF 配置实例

1、路由器基本配置

```
interface FastEthernet0/0
 ip address 172.16.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.0.1 255.255.255.0
 clock rate 64000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.0.0
 network 172.16.0.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 network 192.168.0.0 0.0.0.255 area 0
 network 172.16.0.0 0.0.255.255 area 0
!
ip classless
```

```
interface FastEthernet0/0
 ip address 172.17.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.0.2 255.255.255.0
!
interface Serial3/0
 ip address 192.168.1.1 255.255.255.0
 clock rate 64000
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.0.0
 network 192.168.1.0
 network 172.17.0.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 network 192.168.0.0 0.0.0.255 area 0
 network 192.168.1.0 0.0.0.255 area 0
 network 172.17.0.0 0.0.255.255 area 0
!
ip classless
!
```

```
interface FastEthernet0/0
 ip address 172.18.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.3.1 255.255.255.0
 clock rate 64000
!
interface Serial3/0
 ip address 192.168.1.2 255.255.255.0
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.1.0
 network 192.168.2.0
 network 172.18.0.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.2.0 0.0.0.255 area 0
 network 172.18.0.0 0.0.255.255 area 0
!
ip classless
!
```

```
interface FastEthernet0/0
 ip address 172.19.0.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.3.2 255.255.255.0
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.2.0
 network 172.19.0.0
 no auto-summary
!
router ospf 1
 log-adjacency-changes
 network 192.168.2.0 0.0.0.255 area 0
 network 172.19.0.0 0.0.255.255 area 0
!
ip classless
!
```

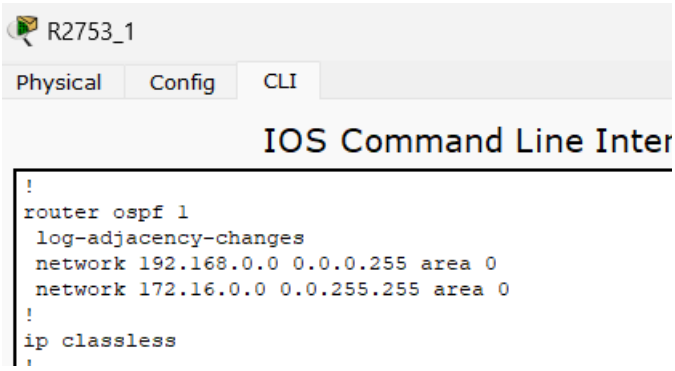
2、启动 OSPF

```
R2753_1(config)#router ospf 1
R2753_1(config-router)#network 192.168.0.0 0.0.0.255 area 0
R2753_1(config-router)#network
00:10:09: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on Serial2/0 from LOADING t
o FULL, Loading Done

% Incomplete command.
R2753_1(config-router)#network 172.16.0.0 0.0.255.255 area 0


R2753_2(config)#router ospf 1
R2753_2(config-router)#network 192.168.0.0 0.0.0.255 area 0
R2753_2(config-router)#network 192.168.1.0 0.0.0.255 area 0
R2753_2(config-router)#network 172.17.0.0 0.0.255.255 area 0
```

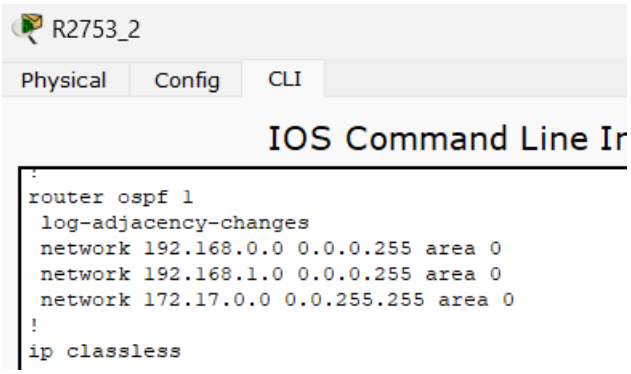
```
R2753_3(config)#router ospf 1
R2753_3(config-router)#network 192.168.1.0 0.0.0.255 area 0
R2753_3(config-router)#network 192.26
00:13:34: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.1 on Serial3/0 from LOADING t
o FULL, Loading Done
8.2.0
                                 ^
% Invalid input detected at '^' marker.

R2753_3(config-router)#network 192.168.2.0 0.0.0.255 area 0
R2753_3(config-router)#network 172.18.0.0 0.0.255.255 area 0
```

```
R2753_4(config)#router ospf 1
R2753_4(config-router)#network 192.168.2.0 0.0.0.255 area 0
R2753_4(config-router)#network 172.19.0.0 0.0.255.255 area 0
R2753_4(config-router)#
```

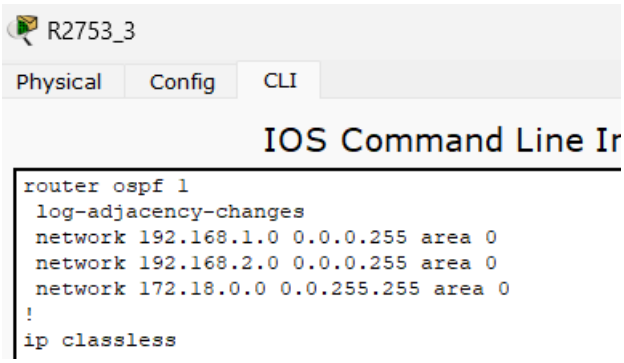
图三



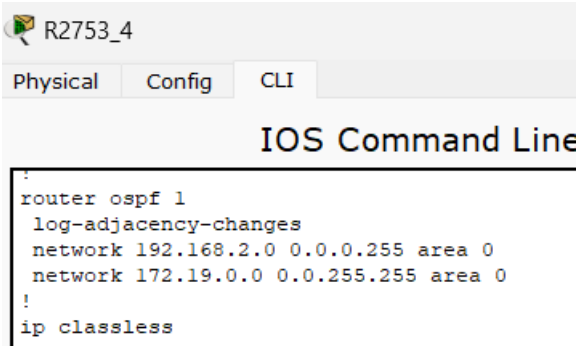
图四 Router1 的 OSPF 配置



图五 Router 2 的 OSPF 配置



图六 Router3 的 OSPF 配置



图七 Router4 的 OSPF 配置

```
R2753_2#sh ip route
Codes: C - connected, S - static, I - IGRP, 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

     172.16.0.0/24 is subnetted, 1 subnets
D       172.16.0.0 [90/20514560] via 192.168.0.1, 00:23:07, Serial2/0
     172.17.0.0/24 is subnetted, 1 subnets
C       172.17.0.0 is directly connected, FastEthernet0/0
     172.18.0.0/24 is subnetted, 1 subnets
D       172.18.0.0 [90/20514560] via 192.168.1.2, 00:23:05, Serial3/0
C    192.168.0.0/24 is directly connected, Serial2/0
C    192.168.1.0/24 is directly connected, Serial3/0
```

图八 查看路由器中的路由表

3、校验、诊断

```
Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 192.168.1.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.0.0 0.0.0.255 area 0
    192.168.1.0 0.0.0.255 area 0
    172.17.0.0 0.0.255.255 area 0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.0.1           110      00:12:56
    192.168.1.1           110      00:10:37
    192.168.3.1           110      00:08:53
  Distance: (default is 110)

R2753_2#
```

图九 show ip protocol 查看路由器中所启用的路由计算协议

```
R2753_2#show ip ospf
 Routing Process "ospf 1" with ID 192.168.1.1
 Supports only single TOS(TOS0) routes
 Supports opaque LSA
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Minimum LSA interval 5 secs. Minimum LSA arrival 1 secs
 Number of external LSA 0. Checksum Sum 0x000000
 Number of opaque AS LSA 0. Checksum Sum 0x000000
 Number of DCbitless external and opaque AS LSA 0
 Number of DoNotAge external and opaque AS LSA 0
 Number of areas in this router is 1. 1 normal 0 stub 0 nssa
 External flood list length 0
    Area BACKBONE(0)
        Number of interfaces in this area is 3
        Area has no authentication
        SPF algorithm executed 7 times
        Area ranges are
        Number of LSA 3. Checksum Sum 0x01bef6
        Number of opaque link LSA 0. Checksum Sum 0x000000
        Number of DCbitless LSA 0
        Number of indication LSA 0
        Number of DoNotAge LSA 0
        Flood list length 0
```

图十 show ip ospf

```
R2753_2#show ip ospf interface
Serial2/0 is up, line protocol is up
  Internet address is 192.168.0.2/24, Area 0
  Process ID 1, Router ID 192.168.1.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:07
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 192.168.0.1
  Suppress hello for 0 neighbor(s)
Serial3/0 is up, line protocol is up
  Internet address is 192.168.1.1/24, Area 0
  Process ID 1, Router ID 192.168.1.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:03
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 192.168.3.1
  Suppress hello for 0 neighbor(s)
FastEthernet0/0 is up, line protocol is up
  Internet address is 172.17.0.1/24, Area 0
  Process ID 1, Router ID 192.168.1.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 192.168.1.1, Interface address 172.17.0.1
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:07
  Index 3/3, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)
```

图十一 show ip ospf interface

```
R2753_2#show ip ospf interface serial2/0
Serial2/0 is up, line protocol is up
  Internet address is 192.168.0.2/24, Area 0
  Process ID 1, Router ID 192.168.1.1, Network Type POINT-TO-POINT, Cost: 64
  Transmit Delay is 1 sec, State POINT-TO-POINT, Priority 0
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:05
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1 , Adjacent neighbor count is 1
    Adjacent with neighbor 192.168.0.1
  Suppress hello for 0 neighbor(s)
```

图十二

```
R2753_2#show ip ospf neighbor

Neighbor ID     Pri   State           Dead Time   Address         Interface
192.168.0.1       0   FULL/  -        00:00:33    192.168.0.1     Serial2/0
192.168.3.1       0   FULL/  -        00:00:36    192.168.1.2     Serial3/0
```

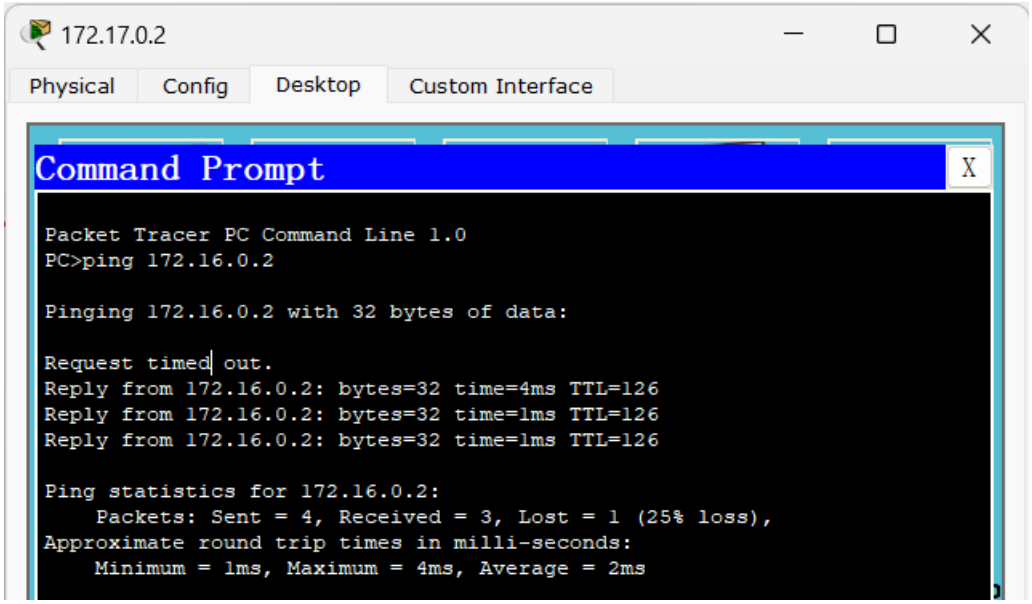
图十三 show ip ospf neighbor 想看邻居

```
R2753_2#show ip ospf database
            OSPF Router with ID (192.168.1.1) (Process ID 1)

                Router Link States (Area 0)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.168.0.1     192.168.0.1     975         0x80000003 0x00746e 3
192.168.1.1     192.168.1.1     836         0x80000005 0x009c5f 5
192.168.3.1     192.168.3.1     732         0x80000003 0x00ae29 3
```

图十四 show ip ospf database

```
R2753_2#debug ip ospf events
OSPF events debugging is on
R2753_2#
00:29:28: OSPF: Rcv hello from 192.168.3.1 area 0 from Serial3/0 192.168.1.2

00:29:28: OSPF: End of hello processing
no debug
00:29:35: OSPF: Rcv hello from 192.168.0.1 area 0 from Serial2/0 192.168.0.1

00:29:35: OSPF: End of hello processing
ip
```

图十五 debug ip ospf events 开启诊断，no debug ip ospf events 关闭诊断



图十六 pc2 ping 通所有网段内的计算机或路由器

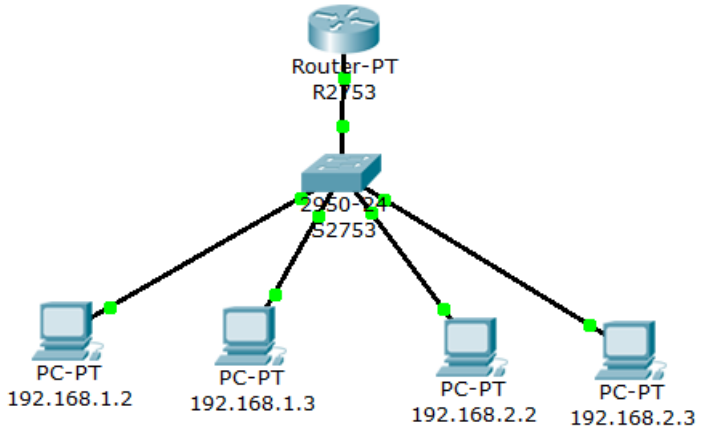
在这里只能进行最为简单的 OSPF 配置了，可以完成 CCNA 的实验。

三、 实验总结

在本次实验中，成功完成了单区域OSPF的配置。通过进入全局配置模式并启用OSPF进程，分配唯一的路由器 ID，以及通过指定网络和区域号的方式配置了 OSPF 在特定网络中的运行。这次实验深化了对 OSPF 协议的理解，特别是在配置过程中考虑到路由器 ID 和区域的重要性。通过这些步骤，实现了网络中的动态路由，为以后更复杂的网络拓扑提供了基础。

实验 20 路由器实现 Vlan 间通信

一、 实验拓扑图



二、 创建 Vlan

```
S2753#vlan database
% Warning: It is recommended to configure VLAN from config mode,
  as VLAN database mode is being deprecated. Please consult user
  documentation for configuring VTP/VLAN in config mode.

S2753(vlan)#vlan 10 name vlan10
VLAN 10 added:
    Name: vlan10
S2753(vlan)#vlan 20 name vlan20
VLAN 20 added:
    Name: vlan20
```

三、 把交换机端口分配给 Vlan

```
S2753(config)#int range f0/2-3
S2753(config-if-range)#switchport mode access
S2753(config-if-range)#switchport access vlan 10
S2753(config-if-range)#int range f0/4-5
S2753(config-if-range)#switchport mode access
S2753(config-if-range)#switchport access vlan 20
```

四、 配置交换机 trunk 端口

```
S2753(config)#int f0/1
S2753(config-if)#switchport mode trunk
S2753(config-if)#no shut
```

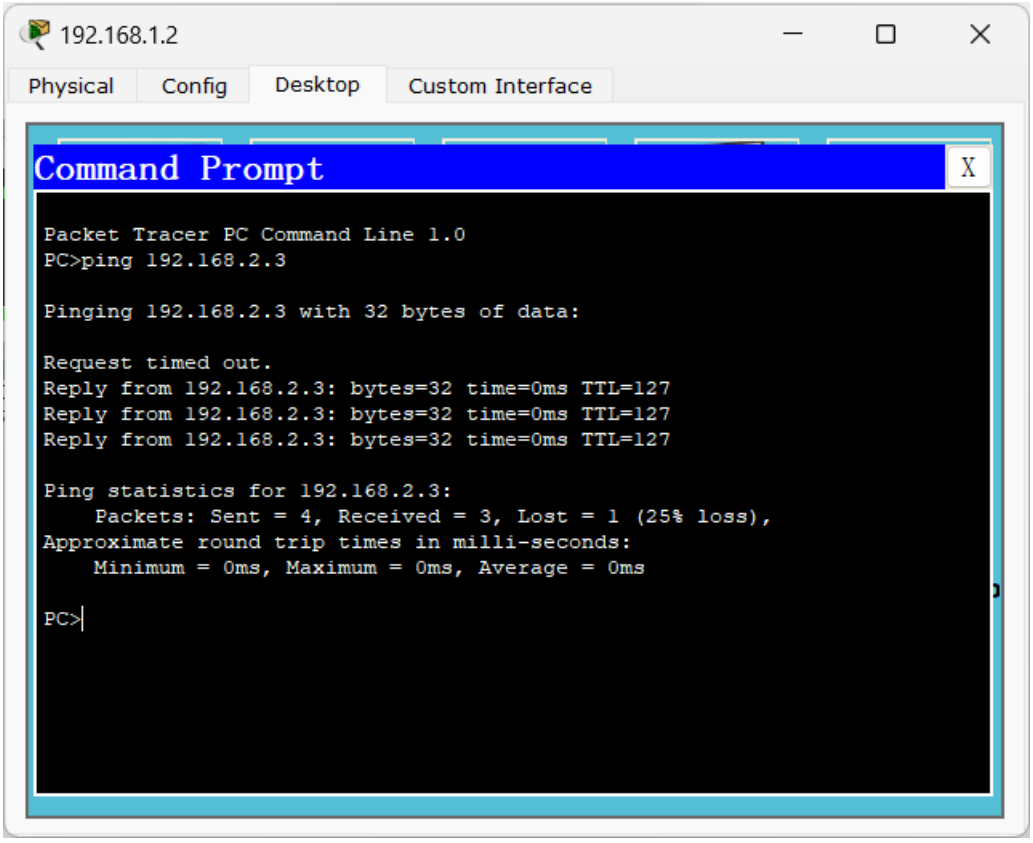
```
S2753#show vlan

VLAN Name                                Status    Ports
---- ----------------------------------- --------- -------------------------------
1    default                             active    Fa0/1, Fa0/6, Fa0/7, Fa0/8
                                                   Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                   Fa0/13, Fa0/14, Fa0/15, Fa0/16
                                                   Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                                   Fa0/21, Fa0/22, Fa0/23, Fa0/24
10   vlan10                              active    Fa0/2, Fa0/3
20   vlan20                              active    Fa0/4, Fa0/5
1002 fddi-default                        act/unsup
1003 token-ring-default                  act/unsup
1004 fddinet-default                     act/unsup
1005 trnet-default                       act/unsup

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
20   enet  100020     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0

Remote SPAN VLANs
```

五、 配置路由器子接口

```
R2753(config)#int f0/0.1
R2753(config-subif)#encapsulation dotlq 10
                                        ^
% Invalid input detected at '^' marker.

R2753(config-subif)#encapsulation dotlq 10
R2753(config-subif)#int f0/0.2
R2753(config-subif)#encapsulation dotlq 20
R2753(config-subif)#ip address 192.168.2.1 255.255.255.0
R2753(config-subif)#int fa 0/0.1
R2753(config-subif)#ip address 192.168.1.1 255.255.255.0
R2753(config-subif)#exit
R2753(config)#int f0/0
R2753(config-if)#no shut

R2753(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

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

%LINK-5-CHANGED: Interface FastEthernet0/0.1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.1, changed state
 to up

%LINK-5-CHANGED: Interface FastEthernet0/0.2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.2, changed state
 to up

R2753(config-if)#

R2753#show ip route
Codes: C - connected, S - static, I - IGRP, 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

C    192.168.1.0/24 is directly connected, FastEthernet0/0.1
C    192.168.2.0/24 is directly connected, FastEthernet0/0.2
```

六、 配置计算机，测试

在本次实验中，pc0 与 pc1 同处于 vlan 10 网段 192.168.1.1；pc2 与 pc3 同处于 Vlan 20 网段 192.168.2.1。



图七 不同网段中的计算机完全可以 ping 通

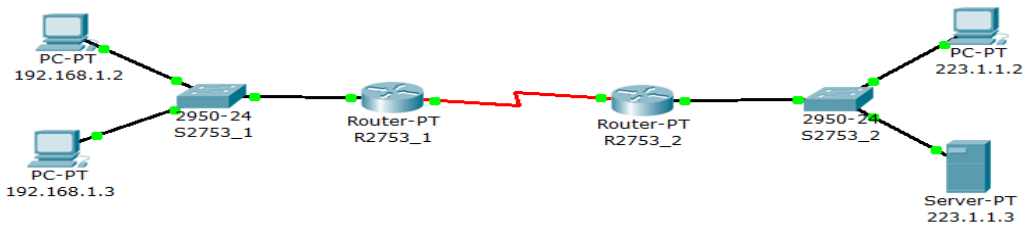
七、 实验总结

在本次实验中，成功完成了在路由器间实现 VLAN 通信的配置。首先，在每个交换机上创建并配置了所需的 VLAN，并将相应接口划分到相应的 VLAN 中，确保了 VLAN 的正确划分。随后，在路由器上为每个 VLAN 配置了子接口，并启用了 IP 路由，为不同 VLAN 提供了互联的通道。通过配置路由协议（如 OSPF 或 EIGRP），在路由器之间建立了通信路径。

最终，通过验证命令检查 VLAN 配置和路由器接口状态，并在不同 VLAN 中的设备上进行 Ping 测试等操作，成功验证了 VLAN 间的通信。通过这次实验，深化了对 VLAN 和路由器配置的理解，为构建更加复杂的网络拓扑提供了实际的经验基础。

实验 21 PAT(基于端口的 NAT)

一、 实验配置拓扑图



图一 私有网段 192.168.1.0/24 通过 R2753_1 路由器的 PAT 技术接入互连网

二、 路由器的基本配置

```
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 ip nat inside
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 221.1.1.2 255.255.255.0
 ip nat outside
 clock rate 64000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
ip nat inside source list 1 interface Serial2/0 overload
ip classless
ip route 0.0.0.0 0.0.0.0 221.1.1.1
!
!
access-list 1 permit 192.168.1.0 0.0.0.255
!
```

```
interface FastEthernet0/0
 ip address 223.1.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 221.1.1.1 255.255.255.0
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
ip classless
!
```

三、 在路由器 Company 上配置 PAT 的命令

```
R2753_1(config)#ip route 0.0.0.0 0.0.0.0 221.1.1.1
R2753_1(config)#access-list 1 permit 192.168.1.0 0.0.0255
                                                 ^
% Invalid input detected at '^' marker.

R2753_1(config)#access-list 1 permit 192.168.1.0 0.0.0.255
R2753_1(config)#ip nat inside source list 1 interface serial2/0 overload
R2753_1(config)#int f0/0
R2753_1(config-if)#ip nat inside
R2753_1(config-if)#int serial2/0
R2753_1(config-if)#ip nat outside
```

四、 校验、查看 PAT 的配置及运行状况

Company#sh ip nat translations

```
R2753_1#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside global
icmp 221.1.1.2:5       192.168.1.2:5      223.1.1.3:5        223.1.1.3:5
icmp 221.1.1.2:6       192.168.1.2:6      223.1.1.3:6        223.1.1.3:6
icmp 221.1.1.2:7       192.168.1.2:7      223.1.1.3:7        223.1.1.3:7
icmp 221.1.1.2:8       192.168.1.2:8      223.1.1.3:8        223.1.1.3:8
```

Company#sh ip nat statistics

```
R2753_1#sh ip nat statistics
Total translations: 0 (0 static, 0 dynamic, 0 extended)
Outside Interfaces: Serial2/0
Inside Interfaces: FastEthernet0/0
Hits: 6  Misses: 8
Expired translations: 8
Dynamic mappings:
```

```
PC>ping 223.1.1.2

Pinging 223.1.1.2 with 32 bytes of data:

Request timed out.
Reply from 223.1.1.2: bytes=32 time=1ms TTL=126
Reply from 223.1.1.2: bytes=32 time=8ms TTL=126
Reply from 223.1.1.2: bytes=32 time=6ms TTL=126

Ping statistics for 223.1.1.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 8ms, Average = 5ms

PC>ping 223.1.1.3

Pinging 223.1.1.3 with 32 bytes of data:

Request timed out.
Reply from 223.1.1.3: bytes=32 time=1ms TTL=126
Reply from 223.1.1.3: bytes=32 time=6ms TTL=126
Reply from 223.1.1.3: bytes=32 time=3ms TTL=126

Ping statistics for 223.1.1.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 6ms, Average = 3ms
```

五、 实验总结

在本次实验中，成功配置了 PAT（Port Address Translation），这是一种基于接口的 NAT（Network Address Translation）技术。通过在路由器上的配置步骤，使用 ACL（Access Control List）来选择需要进行地址转换的内部 IP 地址范围，将它们映射到同一个公共 IP 地址上，同时使用不同的端口号进行区分。

通过验证 PAT 的配置和状态，使用命令 `show ip nat translations` 和 `show ip nat statistics`，确认了 PAT 正常工作并在 NAT 表中维护着正确的映射关系。在测试中，通过内部设备访问互联网等网络活动，成功验证了 PAT 的效果，实现了多个内部 IP 地址共享一个公共 IP 地址的地址转换需求。这次实验为理解和实践地址转换技术提供了重要的实际经验，尤其是在多设备共享有限公共 IP 地址的情境下。

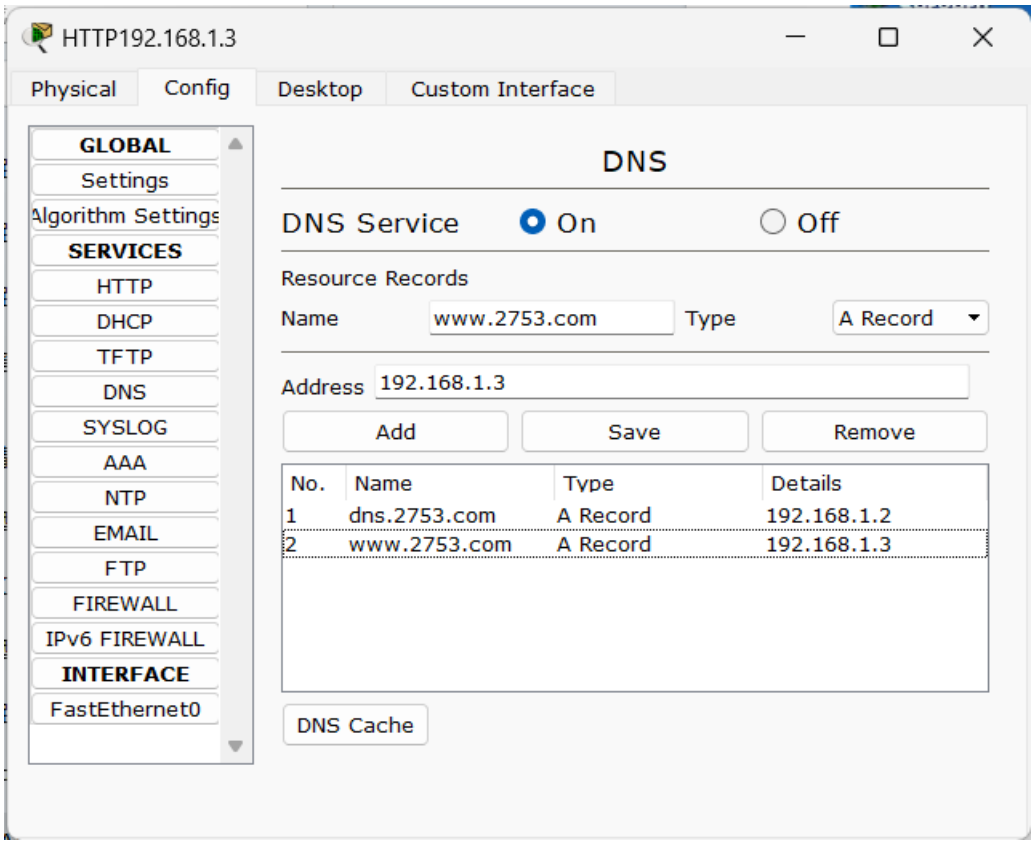
实验 22 ACL 简单的配置

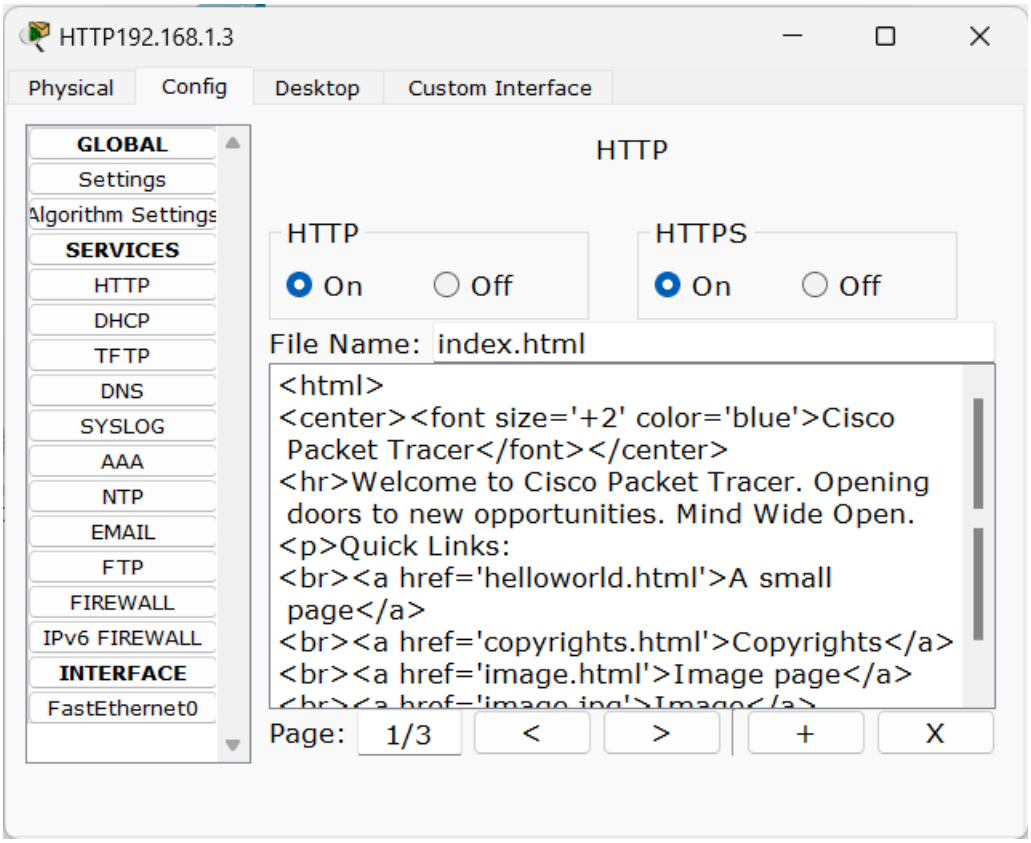
一、 实验配置拓扑图

图一

图二

网络中的 DNS 服务器:192.168.1.2





图三 网络中的 WWW 服务器:192.168.1.3

二、 三个路由器的基本配置

```
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 ip access-group 101 out
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 172.16.1.1 255.255.255.0
 clock rate 72000
!
interface Serial3/0
 ip address 172.18.1.2 255.255.255.0
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.1.0
 network 172.16.0.0
 network 172.18.0.0
 no auto-summary
!
ip classless
!
!
access-list 101 deny icmp 192.168.3.0 0.0.0.255 192.168.1.0 0.0.0.255
access-list 101 permit ip any any
!
```

```
interface FastEthernet0/0
 ip address 192.168.2.1 255.255.255.0
 ip access-group ACL1 in
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 172.17.1.1 255.255.255.0
 clock rate 72000
!
interface Serial3/0
 ip address 172.16.1.2 255.255.255.0
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.2.0
 network 172.16.0.0
 network 172.17.0.0
 no auto-summary
!
ip classless
!
!
access-list 1 permit host 192.168.2.2
ip access-list extended ACL1
 deny tcp host 192.168.2.2 192.168.1.0 0.0.0.255 eq www
 deny udp host 192.168.2.3 192.168.1.0 0.0.0.255 eq domain
 permit ip any any
```

```
interface FastEthernet0/0
 ip address 192.168.3.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 172.18.1.1 255.255.255.0
 clock rate 72000
!
interface Serial3/0
 ip address 172.17.1.2 255.255.255.0
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.3.0
 network 172.17.0.0
 network 172.18.0.0
 no auto-summary
!
ip classless
!

R2753_2(config)#router eigrp 100
R2753_2(config-router)#no auto-summary
R2753_2(config-router)#network 172.17.0.0
R2753_2(config-router)#network 172.16.0.0
R2753_2(config-router)#network 192.168.2.0
R2753_2(config-router)#exit
R2753_2(config)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 172.17.1.2 (Serial2/0) is up: new adja
cency

%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 172.16.1.1 (Serial3/0) is up: new adja
cency

R2753_2(config)#access-list 1 permit host 192.168.2.2
R2753_2(config)#line vty 04
R2753_2(config-line)#access-class 1 in

R2753_3(config)#router eigrp 100
R2753_3(config-router)#network 172.17.0.0
R2753_3(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 172.17.1.1 (Serial3/0) is up: new adja
cency

R2753_3(config-router)#network 172.18.0.0
R2753_3(config-router)#network 192.168.3.0
R2753_3(config-router)#exit
R2753_3(config)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 172.18.1.2 (Serial2/0) is up: new adja
cency

R2753_3(config)#access-list 1 permit host 192.168.3.2
R2753_3(config)#line vty 04
R2753_3(config-line)#access-class 1 in
```

```
R2753_1(config)#router eigrp 100
R2753_1(config-router)#network 172.18.0.0
R2753_1(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 172.18.1.1 (Serial3/0) is up: new adja
cency

R2753_1(config-router)#network 172.16.0.0
R2753_1(config-router)#
%DUAL-5-NBRCHANGE: IP-EIGRP 100: Neighbor 172.16.1.2 (Serial2/0) is up: new adja
cency

R2753_1(config-router)#network 192.168.1.0
```

三、 配置简单的 ACL

1、配置 ACL 限制远程登录到路由器的主机

```
R2753_2(config)#access-list 1 permit host 192.168.2.2
R2753_2(config)#line vty 04
R2753_2(config-line)#access-class 1 in


R2753_3(config)#access-list 1 permit host 192.168.3.2
R2753_3(config)#line vty 04
R2753_3(config-line)#access-class 1 in
```

其它两个路由器配置相似。

2、配置 ACL 禁止 192.168.3.0/24 网段的 icmp 协议数据包通向与 192.168.1.0/24 网段

xixian(config)#access-list 101 deny icmp 192.168.3.0 0.0.0.255 192.168.1.0 0.0.0.255

xixian(config)#access-list 101 permit ip any any

xixian(config)#int fa0/1

xixian(config-if)#ip access-group 101 out

xixian(config-if)#

3、配置 ACL 禁止特点的协议端口通讯

HuangChuang#conf t

Enter configuration commands, one per line. End with CNTL/Z.

HuangChuang(config)#ip access-list extended ACL1

\\创建基于名称的扩展 ACL

HuangChuang(config-ext-nacl)#deny tcp host 192.168.2.2 192.168.1.0 0.0.0.255 eq 80

HuangChuang(config-ext-nacl)#deny udp host 192.168.2.3 192.168.1.0 0.0.0.255 eq 53

HuangChuang(config-ext-nacl)#permit ip any any

HuangChuang(config-ext-nacl)#exit

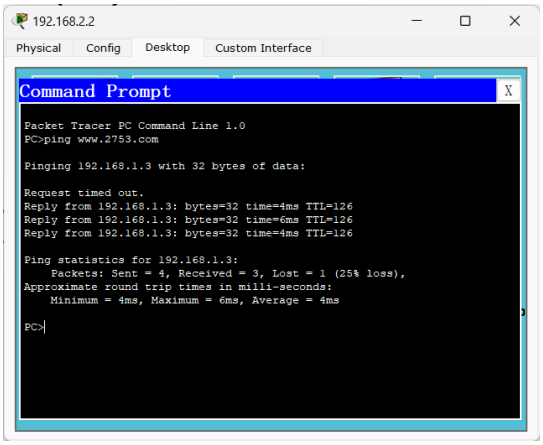
HuangChuang(config)#int fa0/1

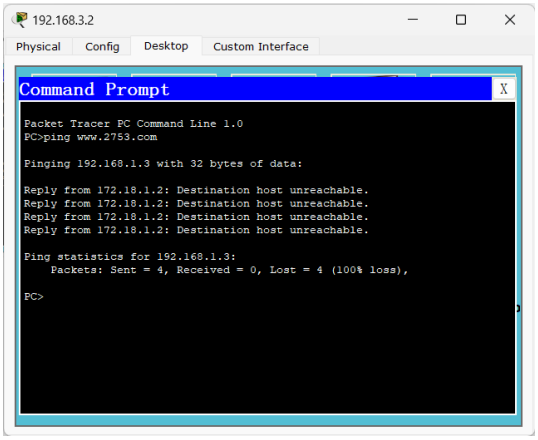
HuangChuang(config-if)#ip access-group ACL1 in

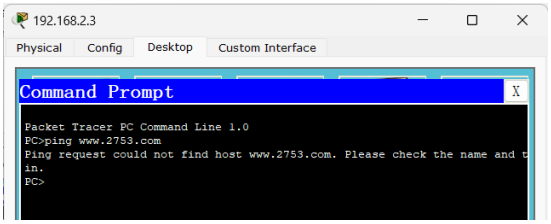
HuangChuang(config-if)#

图四 验证 ACL

四、 实验结果





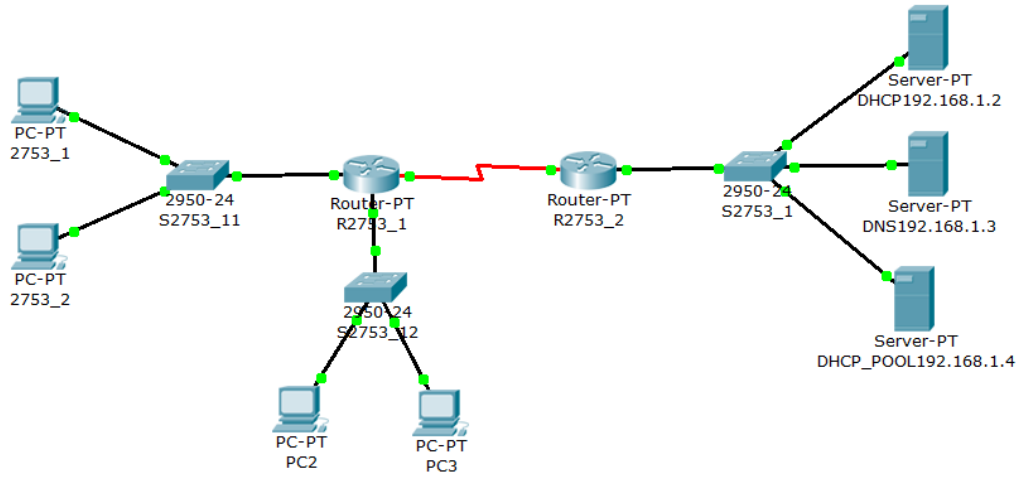


五、 实验总结

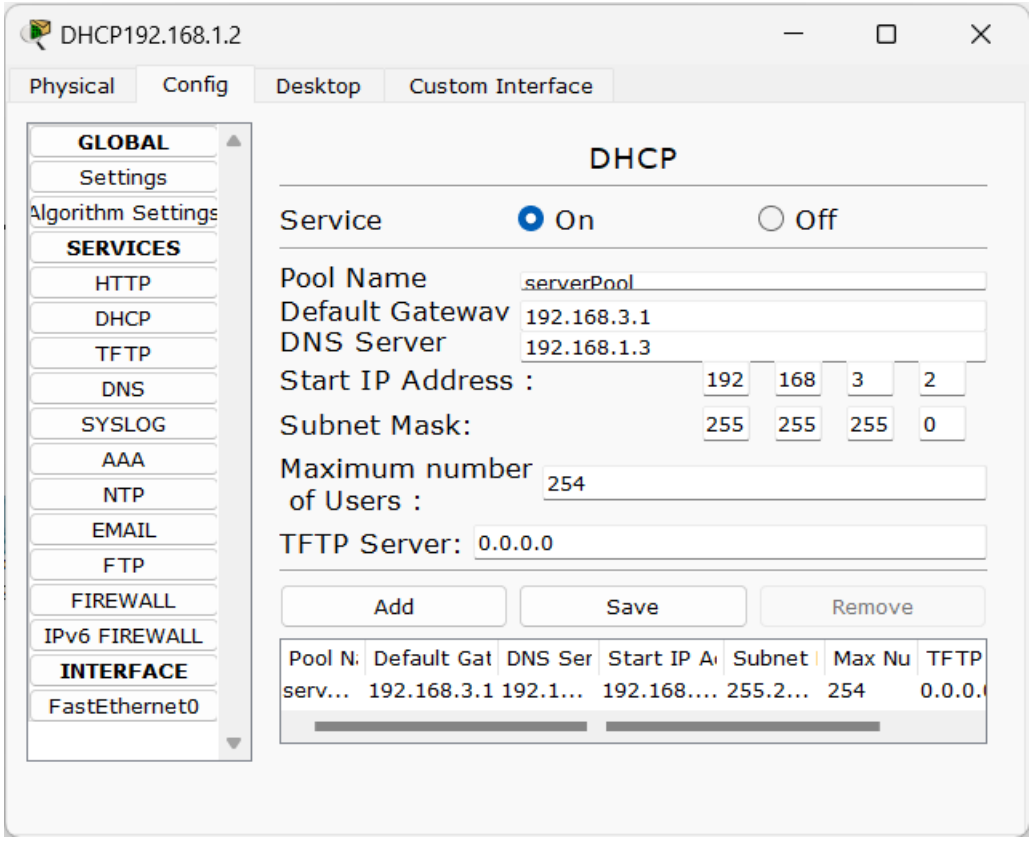
在本次实验中，成功进行了 ACL（Access Control List）的简单配置。通过进入全局配置模式，选择标准或扩展 ACL，并使用 access-list 命令创建 ACL 规则，实现了对网络流量的过滤和控制。标准 ACL 主要基于源 IP 地址的过滤，而扩展 ACL 则支持更复杂的条件，包括源和目标 IP 地址、协议和端口等。这次实验的经验加深了对 ACL 配置的理解，为今后网络安全管理提供了基础。

实验 23 DHCP 中继配置

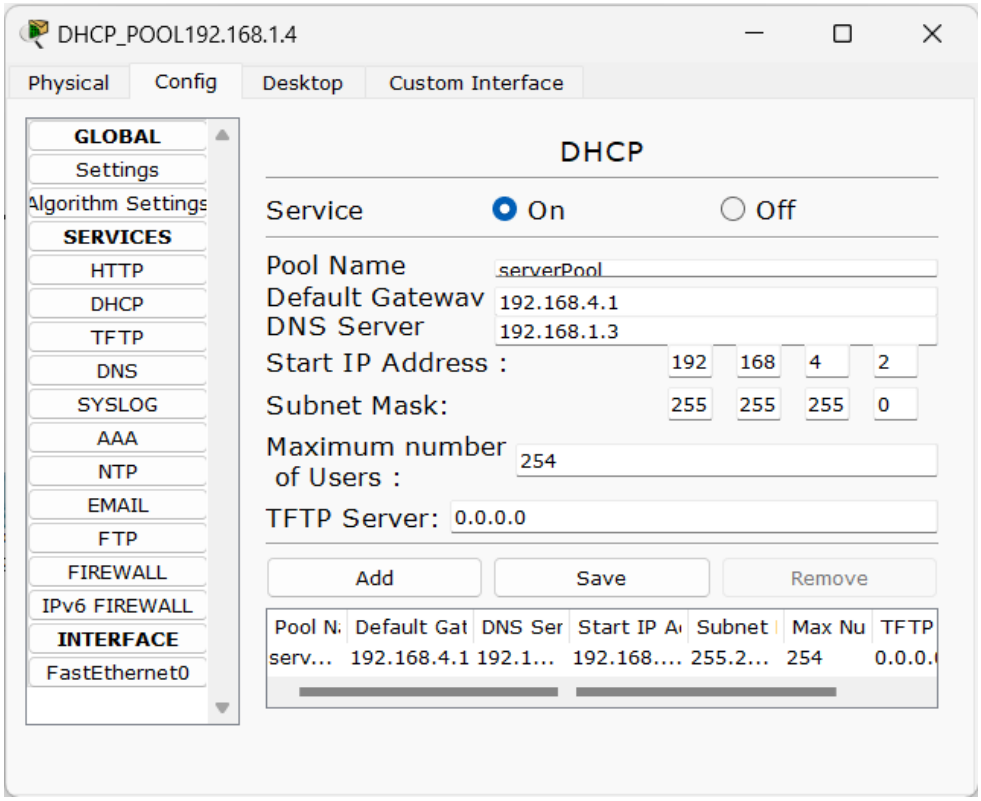
一、 实验配置拓扑图



图一 实验环境说明：由于模拟的服务器只能提供一个地址池，因此我使用两个 DHCP 服务器，分别创建 DHCP 地址池：
192.168.3.0/24:192.168.1.2 及 192.168.4.0/24:192.168.1.4。配置了一个 DNS 服务器 192.168.1.3。



图二 DHCP 服务器地址池配置



图三 DNS 服务器

二、 实验配置

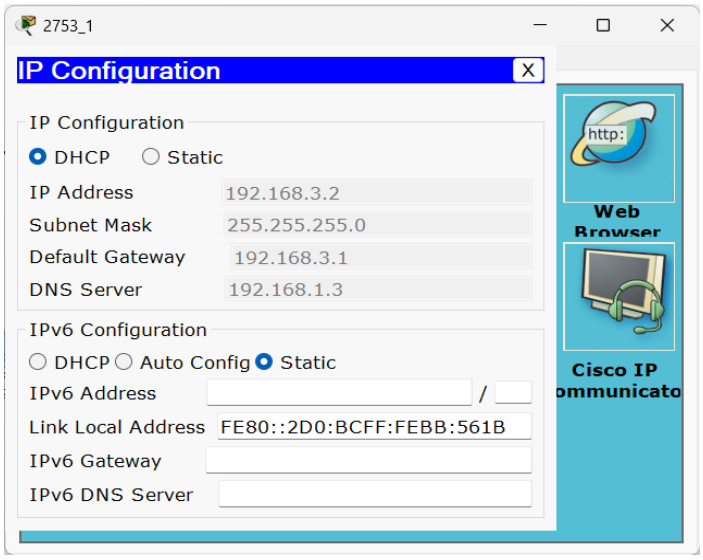
```
interface FastEthernet0/0
 ip address 192.168.3.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 192.168.4.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial2/0
 ip address 192.168.2.1 255.255.255.0
 clock rate 72000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.2.0
 network 192.168.3.0
 network 192.168.4.0
 no auto-summary
!
ip classless
```

```
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.2.2 255.255.255.0
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 192.168.2.0
 network 192.168.1.0
 no auto-summary
!
ip classless
!
```

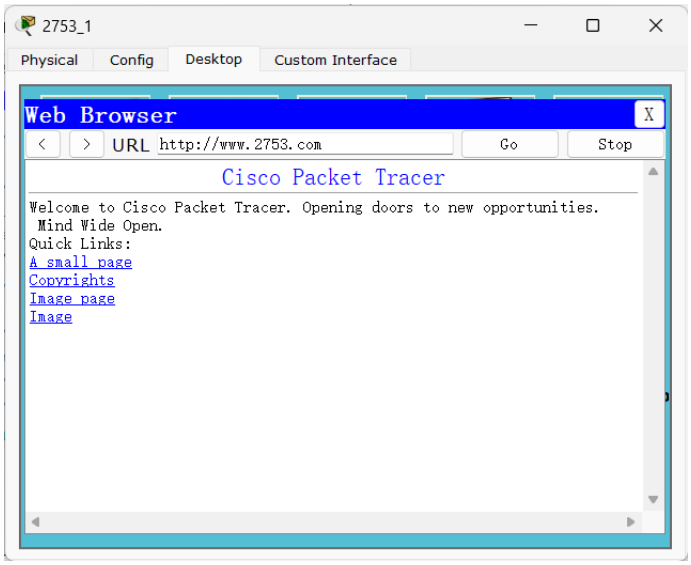
配置 DHCP Client

```
Current configuration : 1094 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R2753_1
!
!
!
!
!
ip dhcp pool ccna
 network 192.168.3.0 255.255.255.0
 default-router 192.168.3.1
 dns-server 192.168.1.3
ip dhcp pool ccnp
 network 192.168.4.0 255.255.255.0
 default-router 192.168.4.1
 dns-server 192.168.1.3
ip dhcp pool ccnb
 network 192.168.3.0 255.255.255.0
 default-router 192.168.3.1
 dns-server 192.168.1.3
```

让客户 PC 动态获取 IP 地址。



测试一下

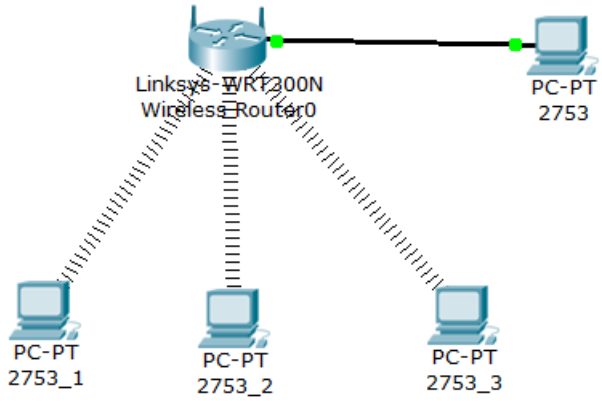


三、 实验总结

在本次实验中，成功配置了 DHCP 中继，通过在路由器的特定接口上使用 `ip helper-address` 命令，将 DHCP 请求中继到指定的 DHCP 服务器。这样的配置允许不同子网上的客户端设备通过 DHCP 中继获取 IP 地址，从而实现了 IP 地址分配服务的跨子网提供。通过验证命令确认配置的正确性，本次实验深化了对 DHCP 中继的理解，为实际网络中更为复杂的 IP 地址分配场景提供了实用经验。

实验 24 WLAN

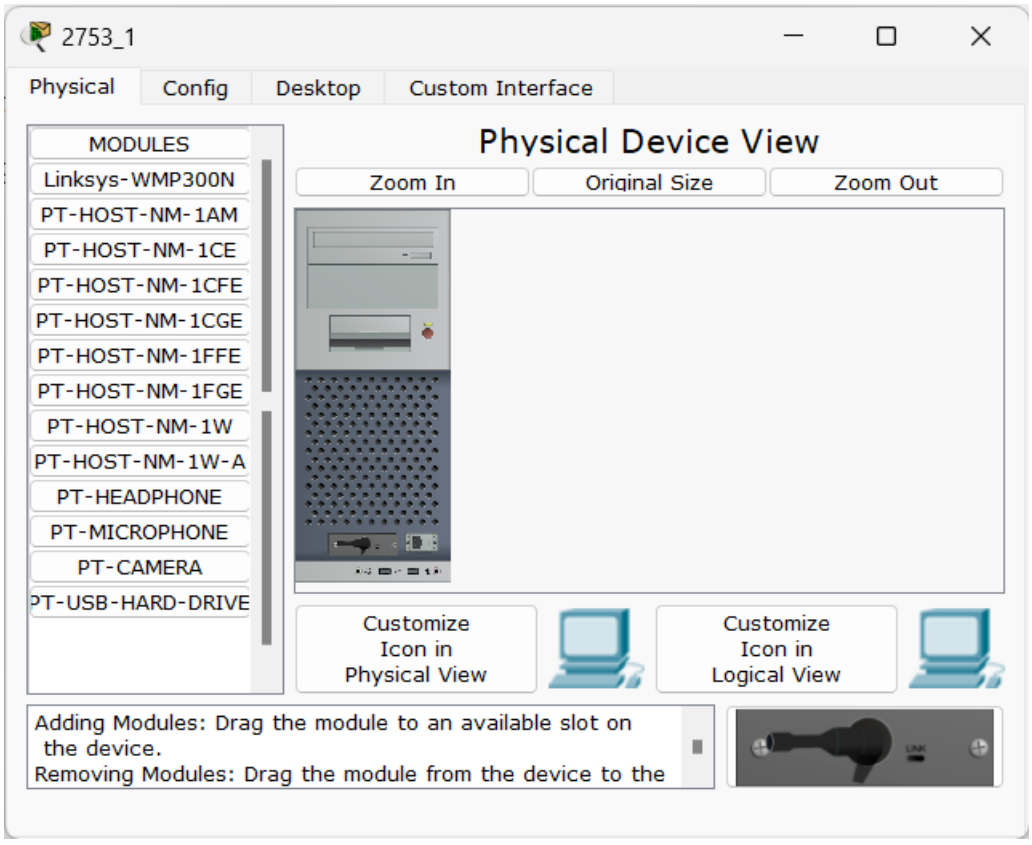
一、 配置实例拓扑图



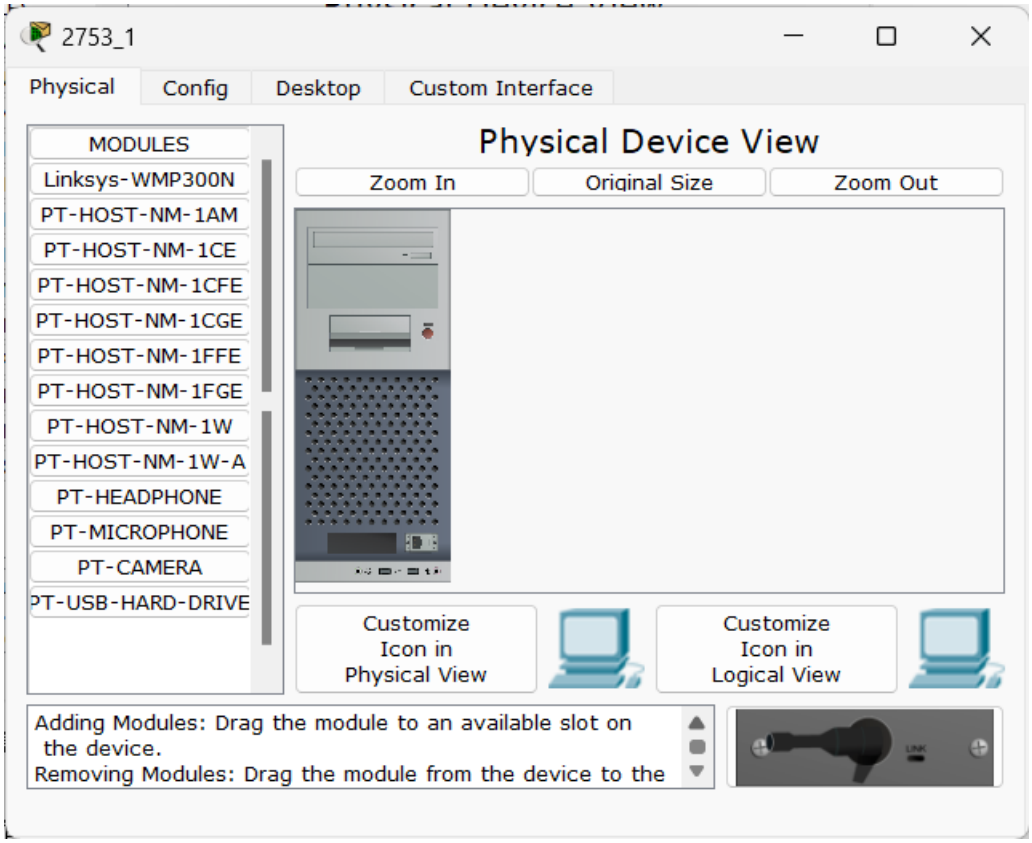
图一

拓扑图的说明：Packet Tracer 5.0 中无线设备是 Linksys WRT300N 无线路由器，该无线路由器共有四个 RJ45 插口，一个 WAN 口，四个 LANEthernet 口；计算机都配置有无线网卡模块，需要我们手动添加该无线网卡模块。计算机添加了无线网卡后会自动与 Linksys WRT300N 相连。在上图中，我另添加了一台计算机与无线路由器的 Ethernet 端口相连，对 Linksys WRT300N 进行配置。

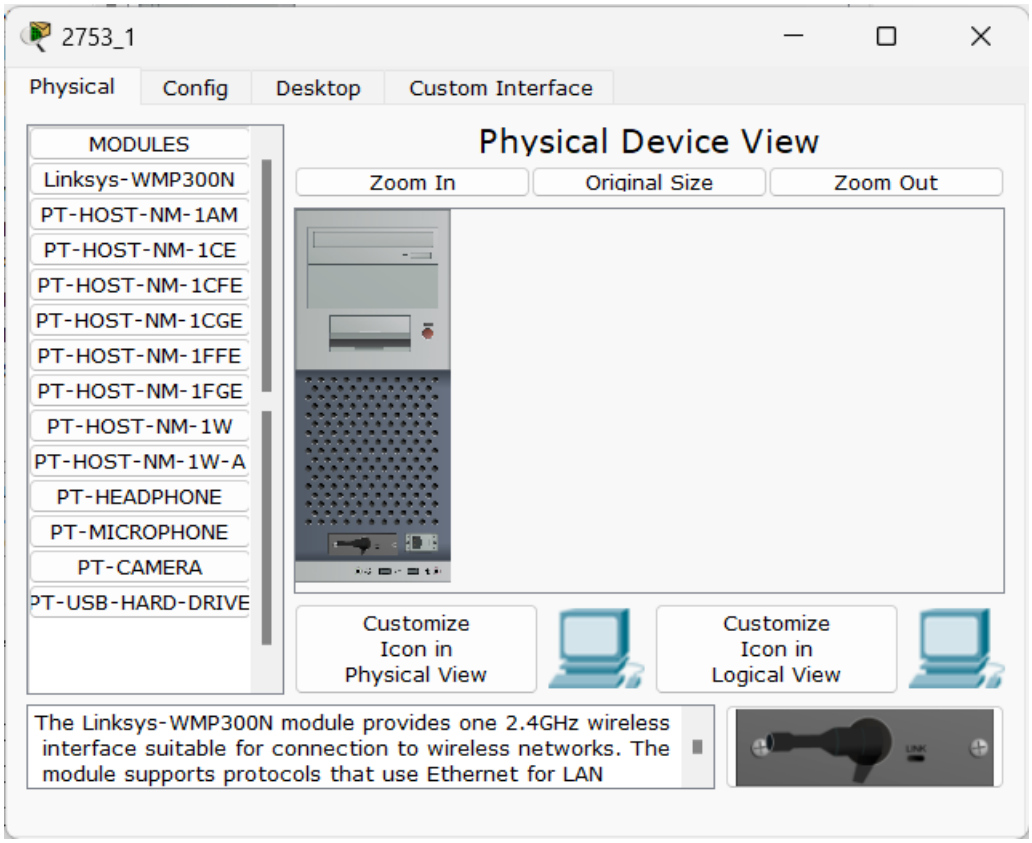
以下是为计算机添加无网卡的步骤，先要关闭计算机电源：



图二 移去计算机的中有线网卡，按箭头方向拖动



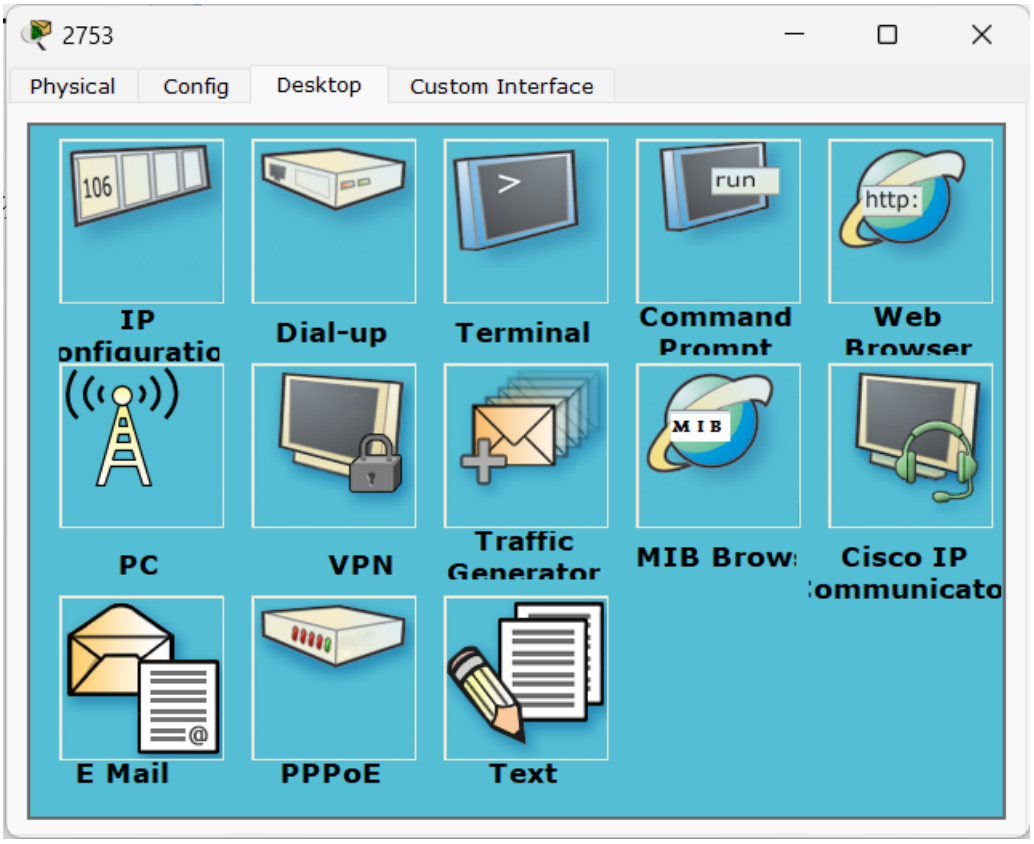
图三 此时，插槽为空



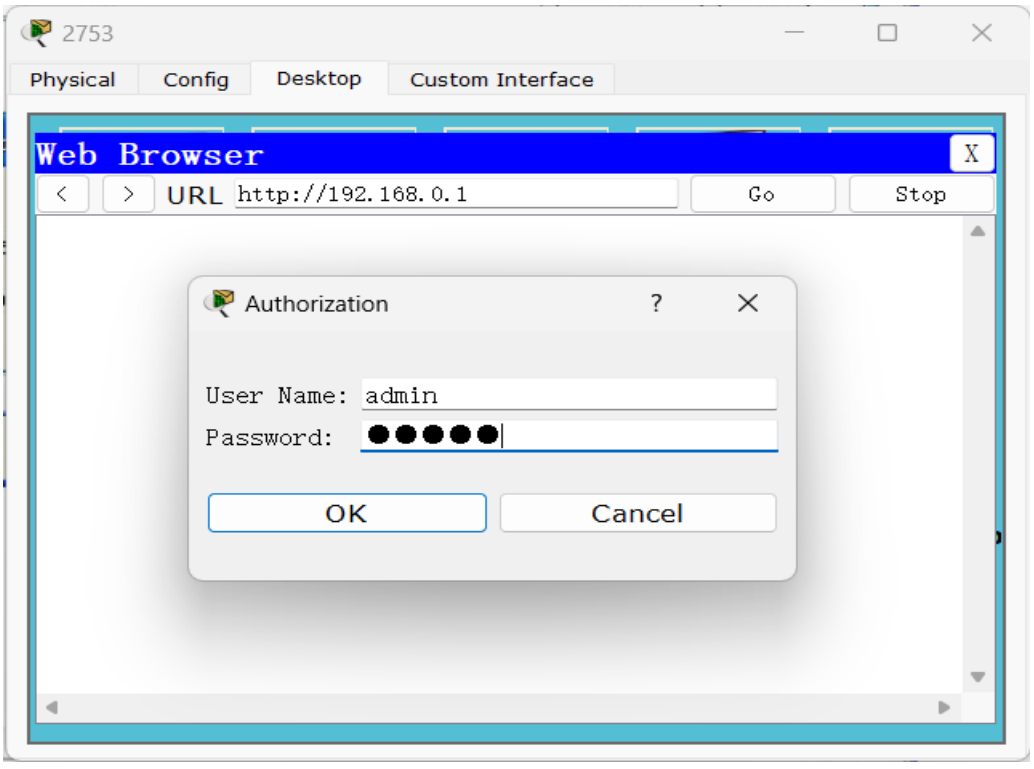
图四 成功添加无线卡

二、 配置 Linksys WRT300N

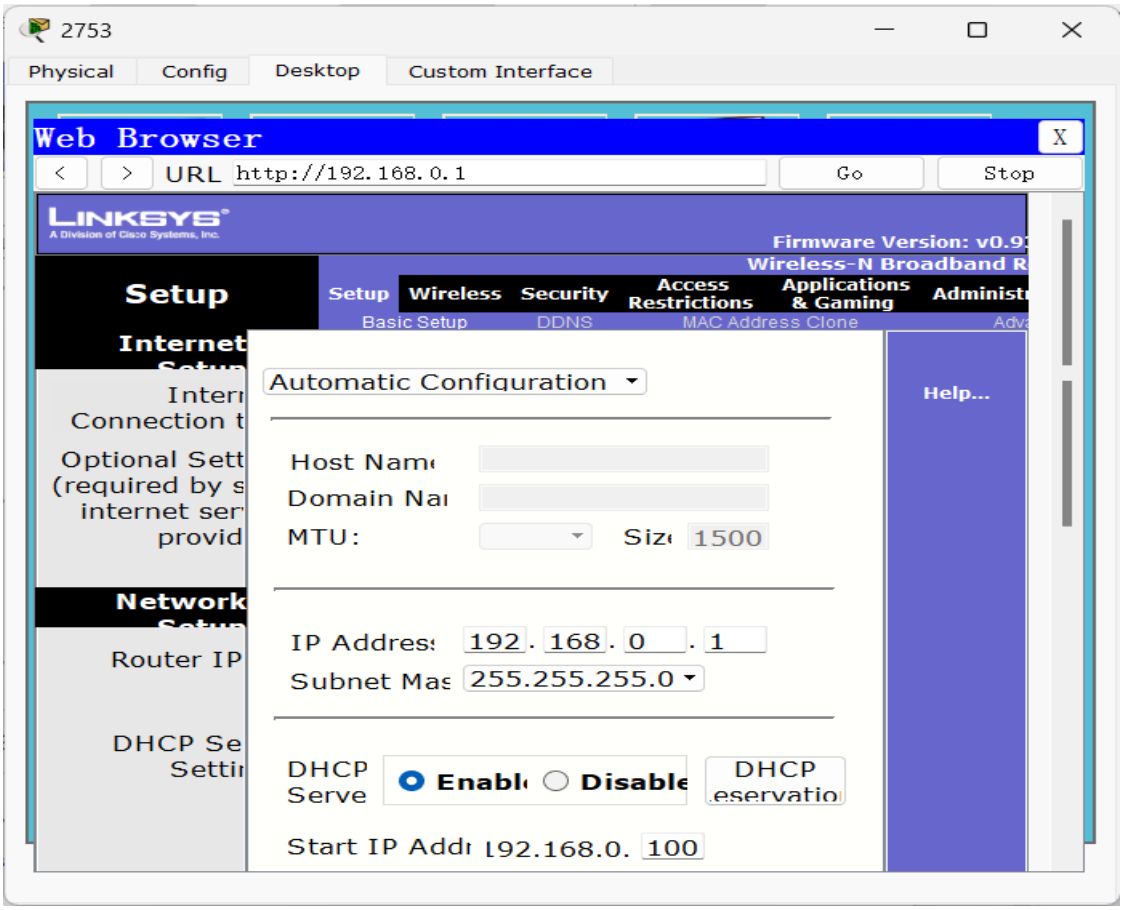
配置 pc3 的 ip 地址与 Linksys WRT300N (默认 ip:192.168.0.1)在同一网段。双击图一中的 PC3，然后切换到“Desktop”选项卡：



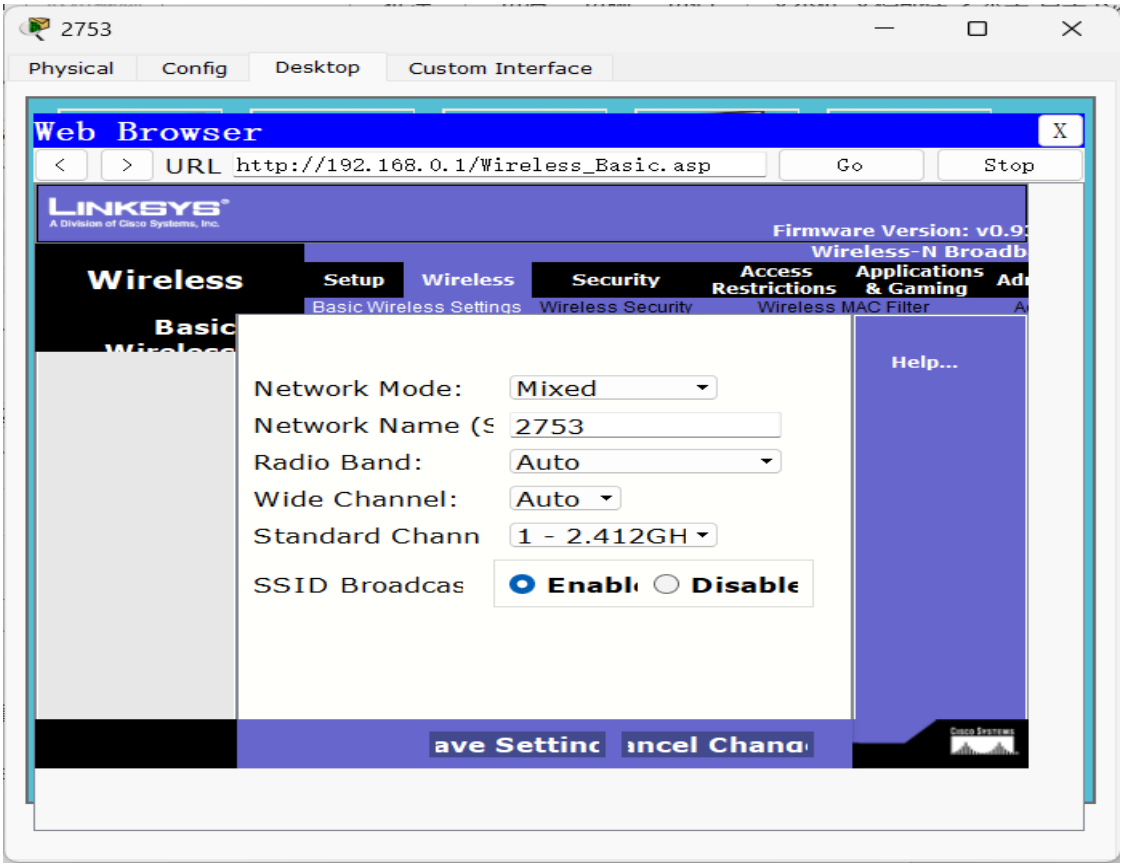
图六



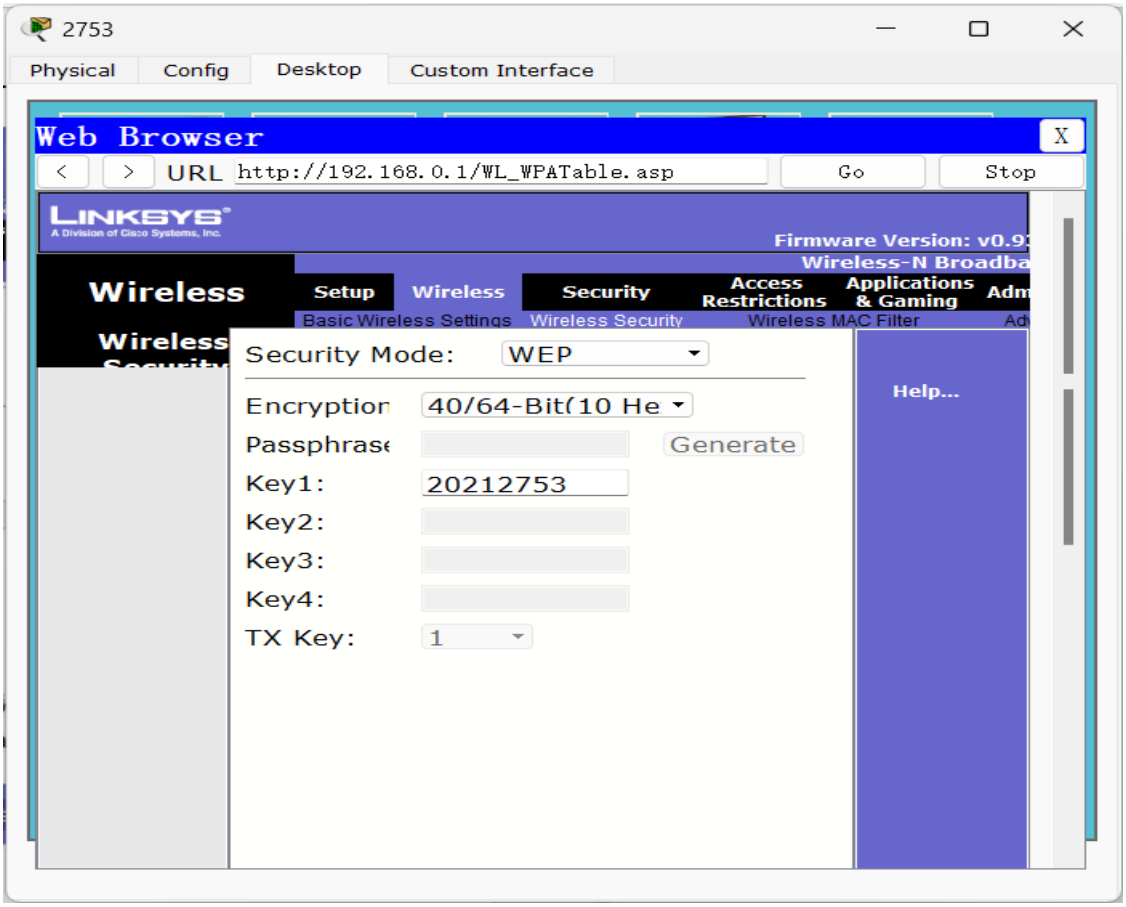
图七 双击“Web Browser”图标运行 web 浏览器



图八 以 web 的方式配置 Linksys WRT300N



图九 配置 WLAN 的 SSID，无线路由器与计算机无线网卡的 SSID 相同



图十 配置 wep 加密密钥

如果对 WLAN 有兴趣，可以更多地配置，使用更多的功能。

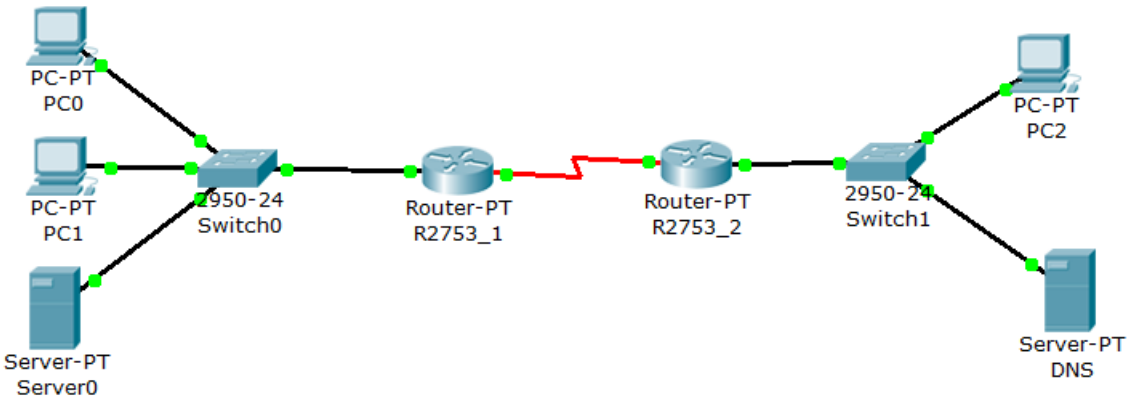
三、 实验总结

本次实验旨在通过思科模拟器配置无线局域网络（WLAN）。通过建立网络拓扑、配置无线路由器和无线接入点，设置 SSID、安全选项和 IP 地址，以及进行连接测试和安全性增强，我深入了解了配置无线网络的基本步骤。此外，通过模拟故障并进行故障排除，我提升了网络管理和维护的技能。这次实验使我能够熟练操作思科模拟器，为实际网络配置和故障处理提供了宝贵经验。

实验 25 终结篇

一、 端口映射

由于 IP 地址紧缺，或者小企业（单位）由于资金投入的原因，只能有一个公网的 IP 地址，使用 NAT(网络地址转换）上网。如果此时还想对外提供服务，那就得进行端口映射。



图一 范例拓扑图

1、配置 NAT（Router Company）

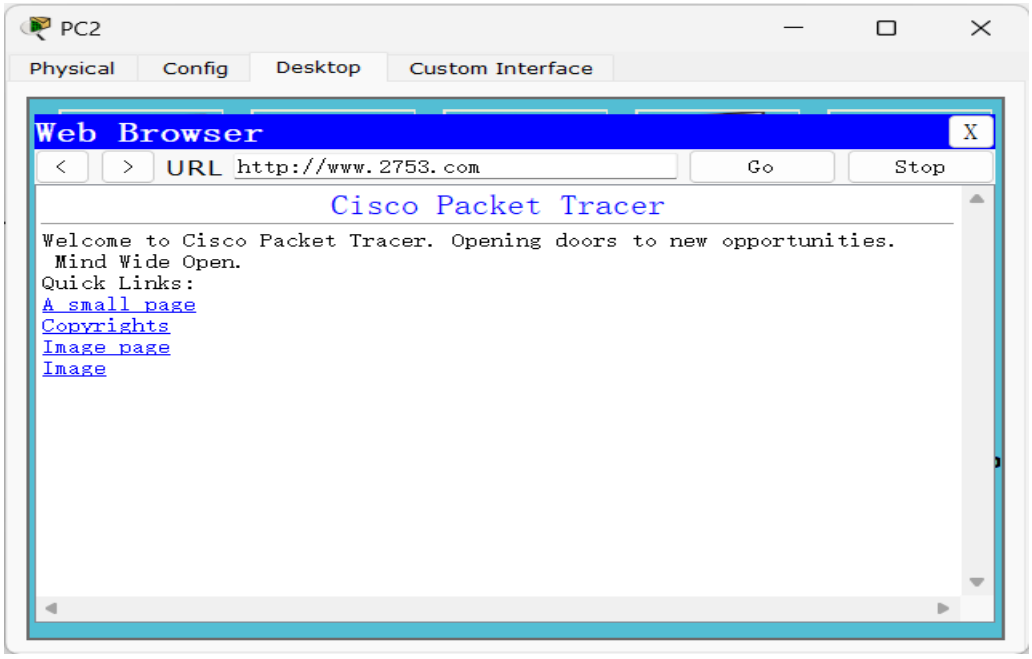
```
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 ip nat inside
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 221.58.58.2 255.255.255.0
 ip nat outside
 clock rate 72000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
router eigrp 100
 network 221.58.58.0
 network 192.168.1.0
 auto-summary
!
ip nat inside source list 1 interface Serial2/0 overload
ip nat inside source static tcp 192.168.1.4 80 221.58.58.2 80
ip classless
ip route 0.0.0.0 0.0.0.0 221.58.58.1
!
!
access-list 1 permit 192.168.1.0 0.0.0.255
```

2、配置端口映像

Router(config)#ip nat inside source static tcp 192.168.1.4 80 221.58.58.2 80

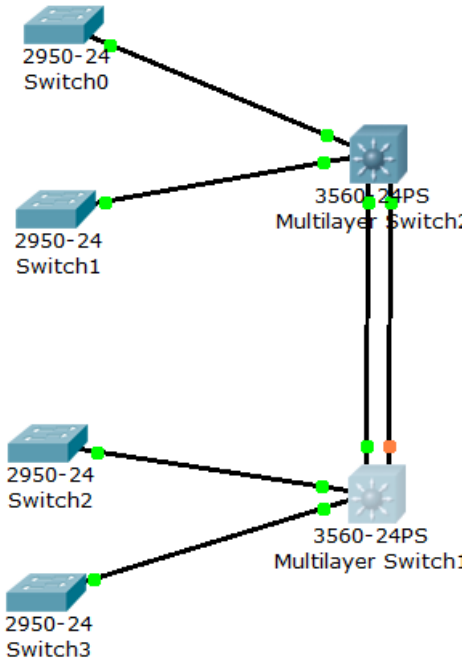
上面的命令意思是：把内网 ip 为 192.168.1.4 的 80 端口与 221.58.58.2 的 80 端口映射，当从互联网上访问 http://221.58.58.2 时，其实就是访问 http://192.168.1.4，假设 221.58.58.2 的域为 www.senya.com，从 pc2 访问：

图二 路由器 Company 的配置：



二、 链路聚合((Link Aggregation)

链路聚合主要是端口捆绑增加带宽及提供冗余备份。

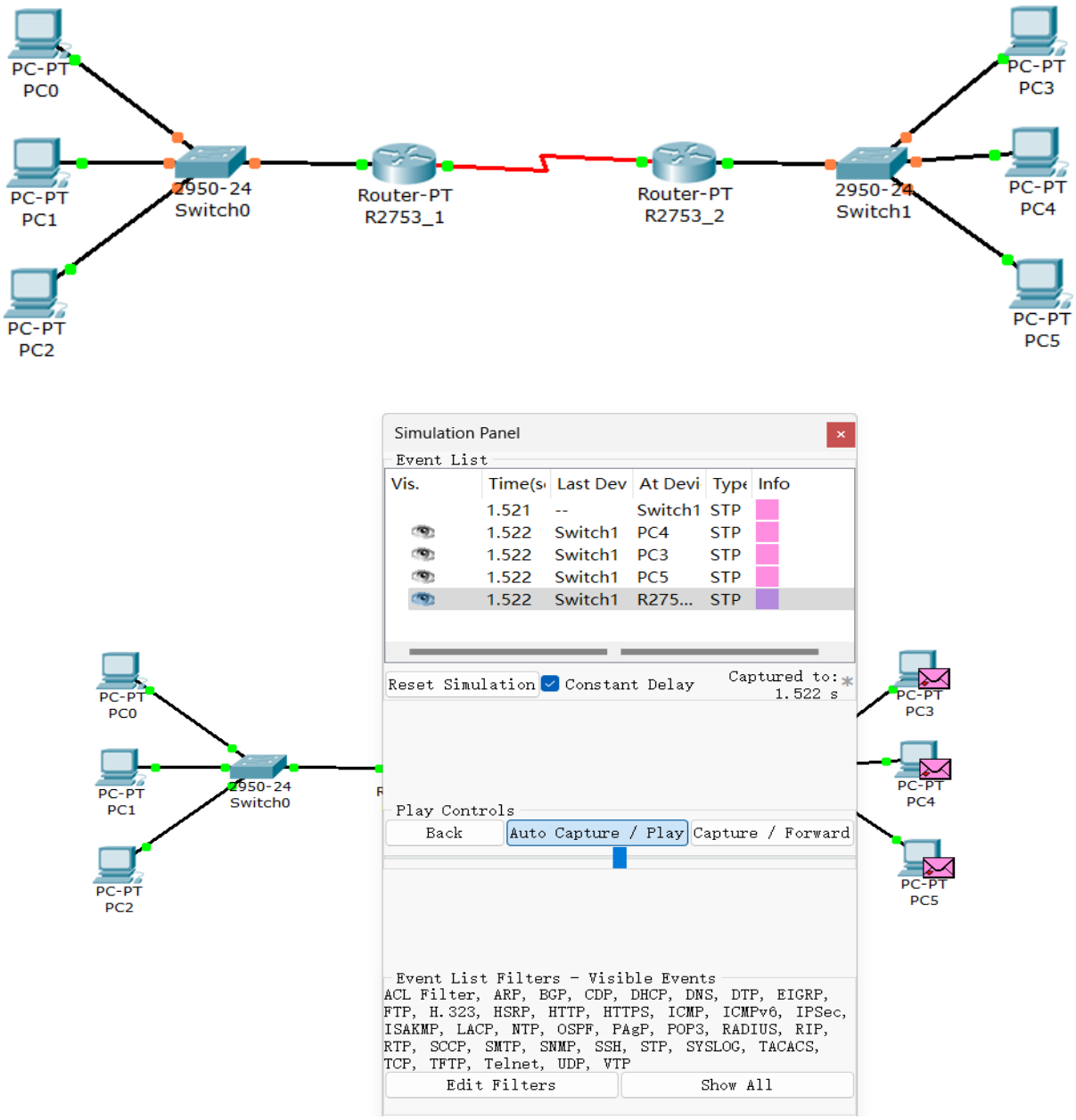


图三 实例拓扑图

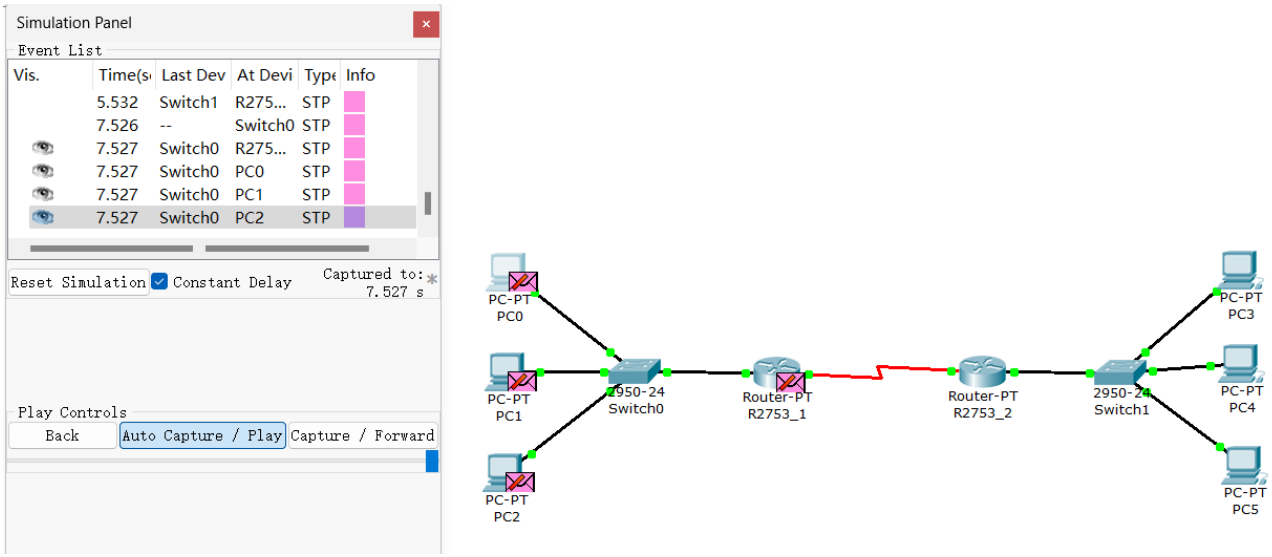
```
interface GigabitEthernet0/1
 channel-group 1 mode desirable
!
interface GigabitEthernet0/2
 channel-group 1 mode desirable
!
```

三、 捕获 PDU(Protocol Data Unit)

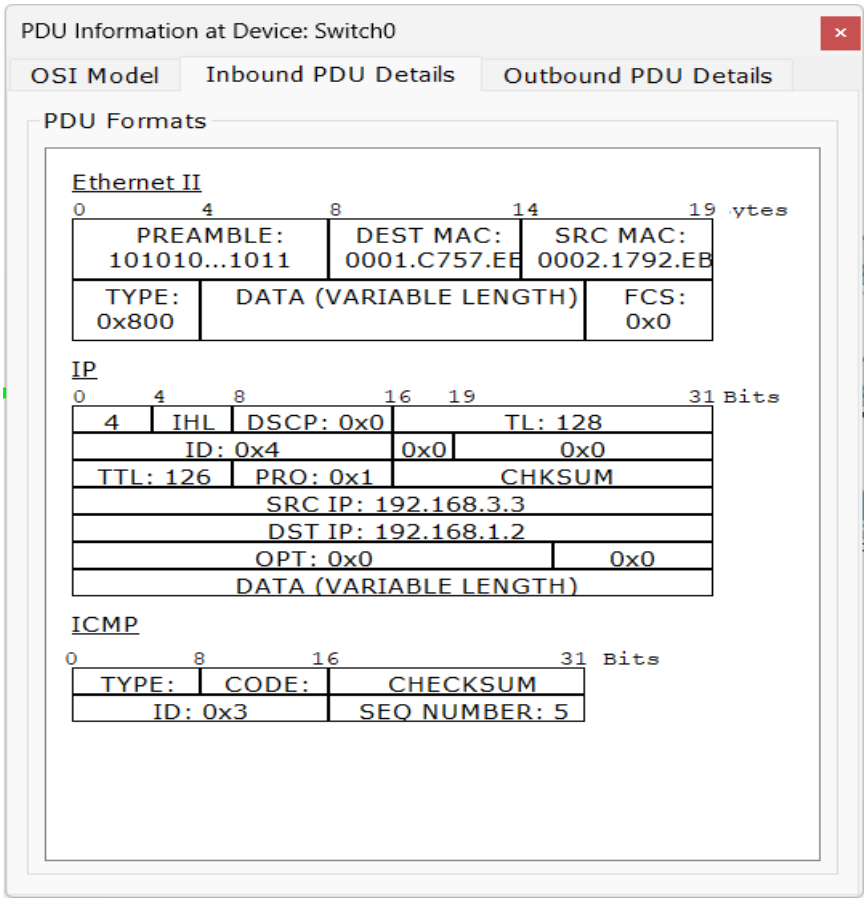
为了更深入了解协议的工作原理，查看数据包的详细内容，可以使用 Packet Tracer 5.0 捕获数据包，查看数据的详细内容：



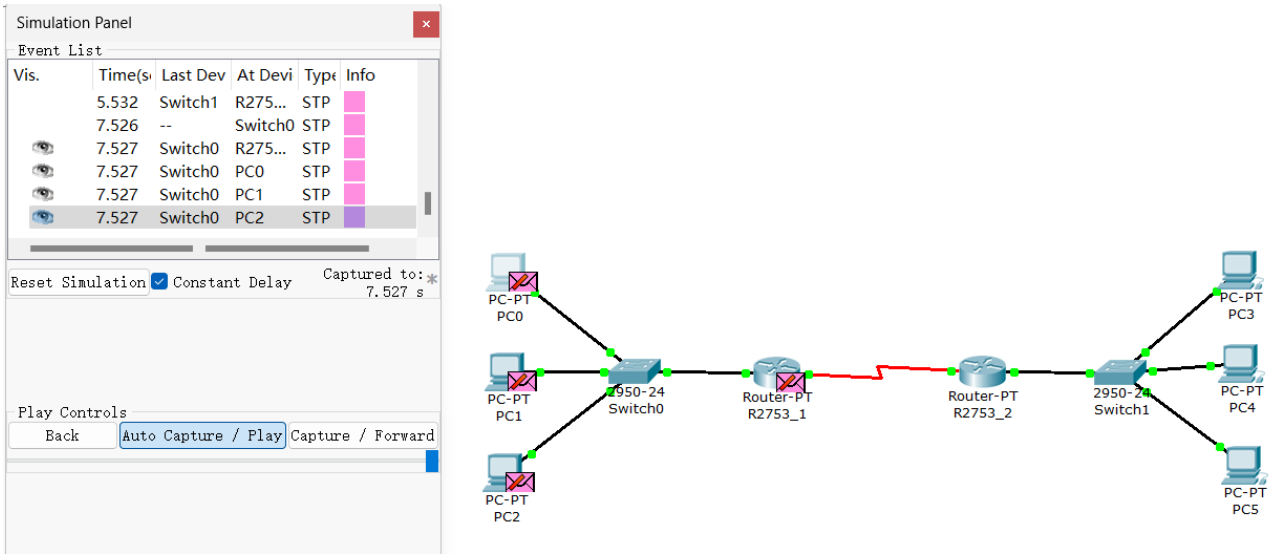
图四 切换到 simulation 模式



图五 捕获数据包



图六 查看数据内容与格式



图七 查看数据的发送

四、 实验总结

通过本次实验，我成功地配置了端口映射，使得外部请求能够访问内部设备的特定服务。这对于搭建和测试网络服务的可达性非常关键，尤其是在模拟复杂网络环境时。

在链路聚合方面，我学到了如何提高网络性能和冗余，通过将多个物理接口聚合成一个逻辑接口。这对于实际网络中的高可用性和负载均衡至关重要。

最后，通过捕获 PDU，我能够深入了解网络中的数据流量。这项技能对于排除网络问题、分析协议交互以及优化网络性能都具有重要意义。

总体而言，这次实验帮助我在思科模拟器上熟练掌握了端口映射、链路聚合和 PDU 捕获的配置和操作，为日后的网络管理和故障排除提供了有力的支持。