《计算机网络》实验报告

信息 学院 智能科学与技术 专业 2020 级

实验时间 2022 年 10 月 31 日

姓名 学号

实验名称 三层交换机相关配置实验

实验成绩

一、实验目的

（一）实验 7 三层交换机的配置

深入了解三层交换机的功能、特点及工作原理

掌握三层交换机实现路由功能的方法

熟练使用 Packet Tracer 仿真软件

（二）实验 8 三层交换机的访问控制

ACL（标准访问控制列表）能正常工作的前提是所有主机都能 ping 通

设置三层交换机的 IP 地址及配置路由信息协议（RIP）路由

根据以上拓扑划分出的两个网段，要求进制主机 PC4 访问 172.1.1.0/24 网段

（三）实验 9 三层交换机的综合实验

通过三层交换机让不同虚拟局域网的计算机之间能相互通信

设定三层交换机为整个网络的生成树的根

为每台交换机设定管理 IP 并可通过管理 IP 进行远程管理

二、实验仪器设备及软件

Packet Tracer 8.2.0

三、实验方案

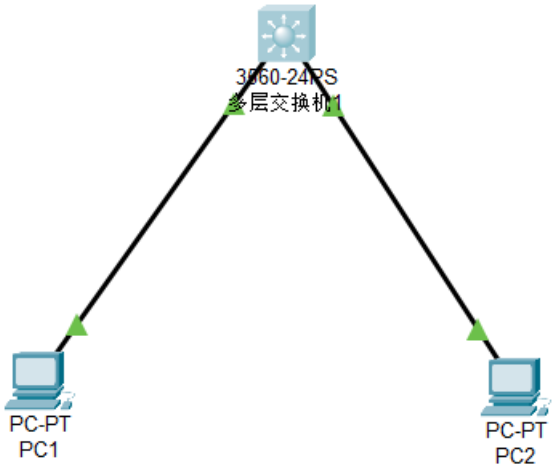
部署好网络拓扑，并且配置好 IP 地址。然后按照实验指导书的内容，逐步完成本次实验的配置步骤。

四、实验步骤

（一）实验 7 三层交换机的配置

1. 通过虚拟局域网 IP 地址做网关，实现不同虚拟局域网间的路由

1.1 首先建立如图所示的网络拓扑：



名称	IP 地址	网关
PC1	192.168.1.1/24	192.168.1.2
PC2	192.168.2.1/24	192.168.2.2

1.2 在交换机上建立两个 vlan，分别将 F0/1 和 F0/2 放入 vlan2、vlan3，再分别设置两个 vlan 的 IP 地址。

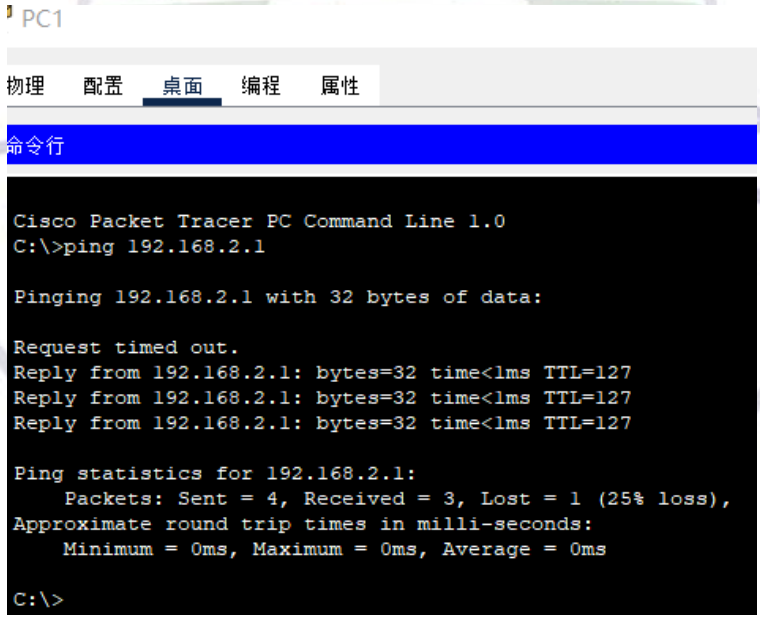
```
Switch>en
Switch#vlan database
% Warning: It is recommended to configure VLAN from config mode,
  as VLAN database mode is being deprecated. Please consult user
  documentation for configuring VTP/VLAN in config mode.

Switch(vlan)#vlan 2
VLAN 2 added:
    Name: VLAN0002
Switch(vlan)#vlan 3
VLAN 3 added:
    Name: VLAN0003
```

（创建两个 vlan，分别为 vlan 2 和 vlan 3）

```
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int f0/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 2
Switch(config-if)#description connected PC1
Switch(config-if)#int f0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 3
Switch(config-if)#description connected PC2
Switch(config-if)#exit
Switch(config)#int vlan 2
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to up

Switch(config-if)#ip address 192.168.1.2 255.255.255.0
Switch(config-if)#vlan 3
Switch(config-vlan)#exit
Switch(config)#int vlan 3
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan3, changed state to up

Switch(config-if)#ip address 192.168.2.2 255.255.255.0
Switch(config-if)#exit
Switch(config)#ip routing
Switch(config)#end
```

（将 F0/1 和 F0/2 放入 vlan2、vlan3，再分别设置两个 vlan 的 IP 地址）

1.3 测试三层交换机配置



（PC1 ping PC2 成功，说明配置完成）

2. 通过设置接口的三层工作模式实现不同网络的路由

2.1 关闭交换机接口的二层功能，设置接口的 IP 地址

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int f0/1
Switch(config-if)#no switchport
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed
state to down

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

Switch(config-if)#ip address 192.168.1.2 255.255.255.0
Switch(config-if)#int f0/2
Switch(config-if)#no switchport
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed
state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed
state to up

Switch(config-if)#ip address 192.168.2.2 255.255.255.0
Switch(config-if)#exit
Switch(config)#ip routing
Switch(config)#end
Switch#
```

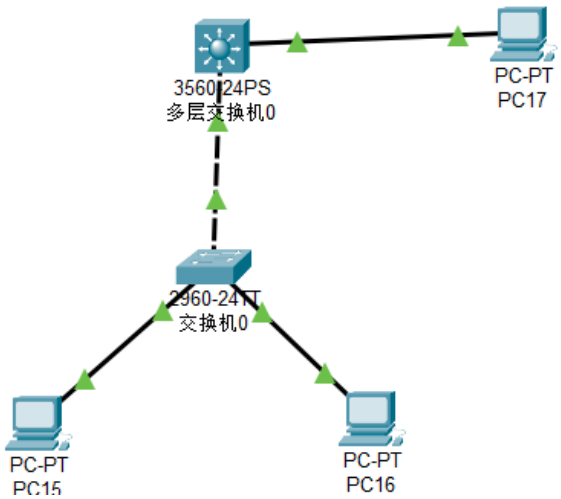
2.2 PC1 ping PC2 成功

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.2.1

Pinging 192.168.2.1 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.1: bytes=32 time<1ms TTL=127
Reply from 192.168.2.1: bytes=32 time=11ms TTL=127
Reply from 192.168.2.1: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.2.1:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 11ms, Average = 3ms

C:\>
```

（PC1 ping PC2 成功，说明配置完成）

3. 三层、二层交换机联合配置

3.1 建立如图所示的网络拓扑



3.2 2960 交换机相关配置：配置为 vtp，vtp domain 为 abc，F0/4 配置为 trunk，并划分接口

```
Switch(config)#vtp domain abc
Changing VTP domain name from NULL to abc
Switch(config)#vtp mode client
Setting device to VTP CLIENT mode.
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int f0/4
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed
state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/4, changed
state to up

Switch(config-if)#int f0/2
Switch(config-if)#switchport access vlan 2
Switch(config-if)#int f0/6
Switch(config-if)#switchport access vlan 3
Switch(config-if)#
```

3.3 3560 交换机相关配置：配置为 vtp server，F0/4 设为 trunk，划分 vlan 并分配 IP

```
Switch>en
Switch#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.

Switch(vlan)#vtp domain abc
Changing VTP domain name from NULL to abc
Switch(vlan)#vtp server
Device mode already VTP SERVER.
Switch(vlan)#exit
APPLY completed.
Exiting....
```

（配置为 vtp server）

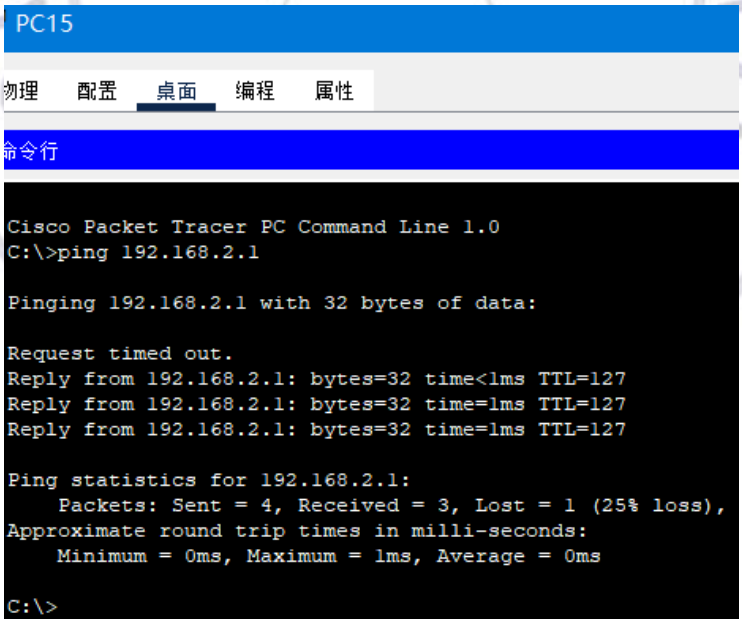
```
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int f0/4
Switch(config-if)#switchport mode trunk
```

（F0/4 设置为 trunk）

```
Switch#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.

Switch(vlan)#vlan 2
VLAN 2 added:
    Name: VLAN0002
Switch(vlan)#vlan 3
VLAN 3 added:
    Name: VLAN0003
Switch(vlan)#exit
APPLY completed.
Exiting....
Switch#
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int vlan 2
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state to up

Switch(config-if)#ip address 192.168.1.2 255.255.255.0
Switch(config-if)#int vlan 3
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan3, changed state to up

Switch(config-if)#ip address 192.168.2.2 255.255.255.0
Switch(config-if)#exit
Switch(config)#ip routing
Switch(config)#end
Switch#
```

（创建 vlan 并分配 IP）

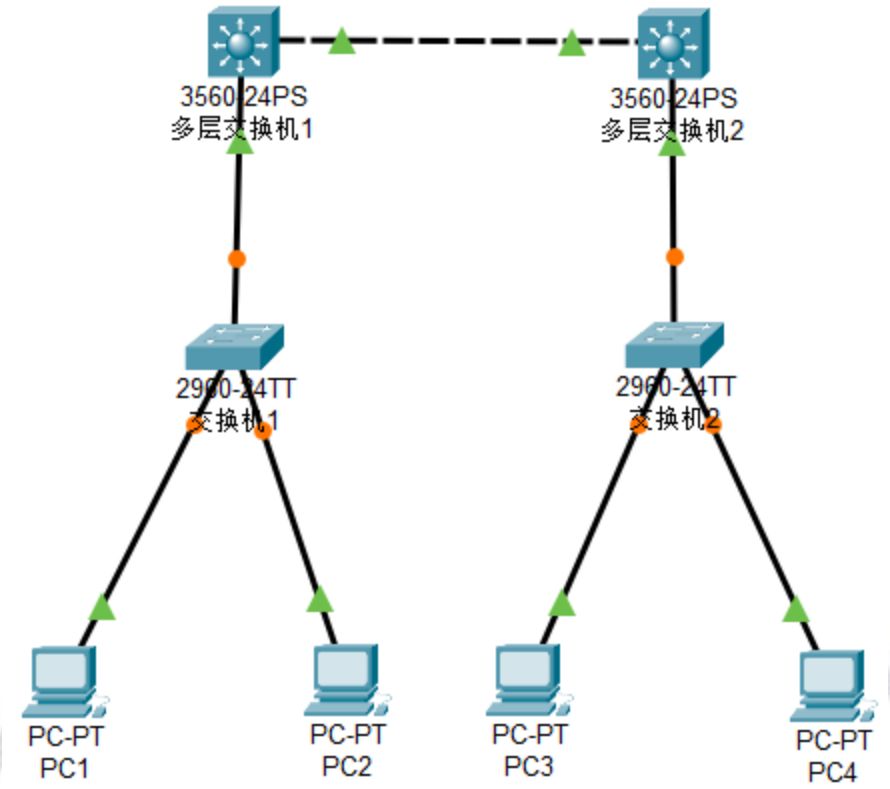
3.4 PC15 ping PC16



（PC15 ping PC16 成功，实验通过）

（二）实验 8 三层交换机的访问控制

1. 建立如图所示的网络拓扑



名称	接口	IP 地址	网关
Switch A	F0/1	192.168.1.1/24	
	F0/2	172.1.1.1/24	
Switch B	F0/1	192.168.1.2/24	
	F0/2	172.2.2.1/24	
PC1		172.1.1.2/24	172.1.1.1
PC2		172.1.1.3/24	172.1.1.1
PC3		172.2.2.2/24	172.2.2.1
PC4		172.2.2.3/24	172.2.2.1

2. Switch A 配置 IP 和 RIP

```
Switch(config)#interface FastEthernet0/1
Switch(config-if)#no switchport
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

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

Switch(config-if)#ip address 192.168.1.1 255.255.255.0
Switch(config-if)#int f0/2
Switch(config-if)#no switchport
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up

Switch(config-if)#ip address 172.1.1.1 255.255.255.0
Switch(config-if)#exit
Switch(config)#ip routing
Switch(config)#end
Switch#
```

（设置两个接口的 IP）

```
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#router rip
Switch(config-router)#version 2
Switch(config-router)#network 172.1.1.0
Switch(config-router)#network 192.168.1.0
Switch(config-router)#
```

（配置 RIP 路由）

3. Switch B 配置 IP 和 RIP

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int f0/1
Switch(config-if)#no switchport
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

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

Switch(config-if)#ip address 192.168.1.2 255.255.255.0
Switch(config-if)#int f0/2
Switch(config-if)#no switchport
Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up

Switch(config-if)#ip address 172.2.2.1 255.255.255.0
Switch(config-if)#exit
Switch(config)#ip routing
Switch(config)#end
Switch#
```

（设置两个接口的 IP）

```
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#router rip
Switch(config-router)#version 2
Switch(config-router)#network 172.2.2.0
Switch(config-router)#network 192.168.1.0
Switch(config-router)#
```

（配置 RIP 路由）

4. 检测互通情况：

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.2.2.2

Pinging 172.2.2.2 with 32 bytes of data:

Request timed out.
Reply from 172.2.2.2: bytes=32 time<1ms TTL=126
Reply from 172.2.2.2: bytes=32 time<1ms TTL=126
Reply from 172.2.2.2: bytes=32 time<1ms TTL=126

Ping statistics for 172.2.2.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.2.2.3

Pinging 172.2.2.3 with 32 bytes of data:

Request timed out.
Reply from 172.2.2.3: bytes=32 time<1ms TTL=126
Reply from 172.2.2.3: bytes=32 time<1ms TTL=126
Reply from 172.2.2.3: bytes=32 time=12ms TTL=126

Ping statistics for 172.2.2.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 12ms, Average = 4ms

C:\>
```

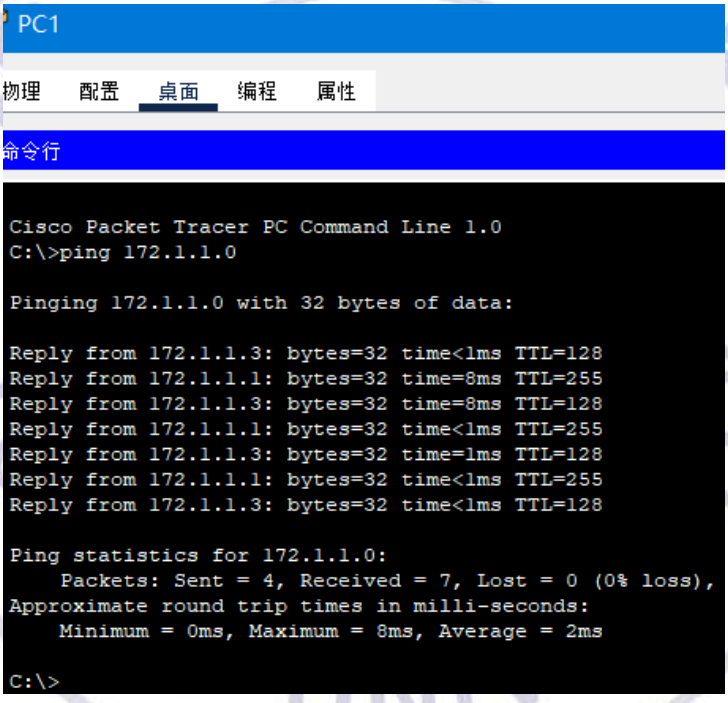
（使用 PC1，ping PC3、PC4 成功）

5. 对 Switch A 设置 ACL

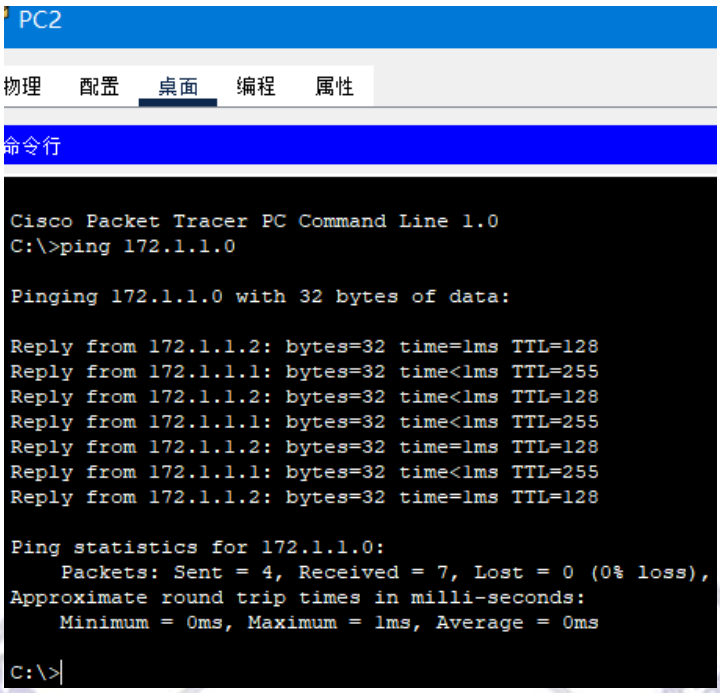
```
Switch>en
Switch#config t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#access-list 100 deny ip 172.2.2.3 0.0.0.0 172.1.1.0 0.0.0.255
Switch(config)#access-list 100 permit ip 172.2.2.0 0.0.0.255 172.1.1.0 0.0.0.255
Switch(config)#int f0/2
Switch(config-if)#ip access-group 100 out
Switch(config-if)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#show access-lists 100
Extended IP access list 100
    deny ip host 172.2.2.3 172.1.1.0 0.0.0.255
    permit ip 172.2.2.0 0.0.0.255 172.1.1.0 0.0.0.255

Switch#
```

6. 连通性检验

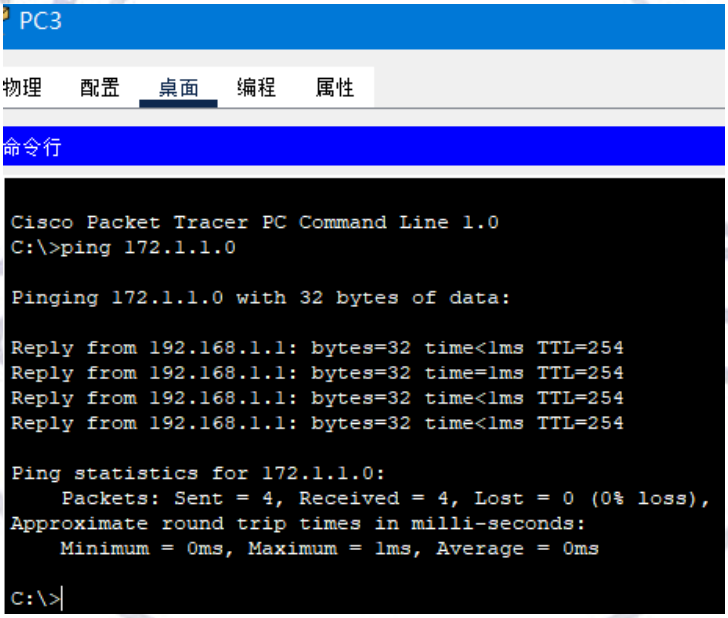
6.1 PC1：能够与 172.1.1.0/24 连通



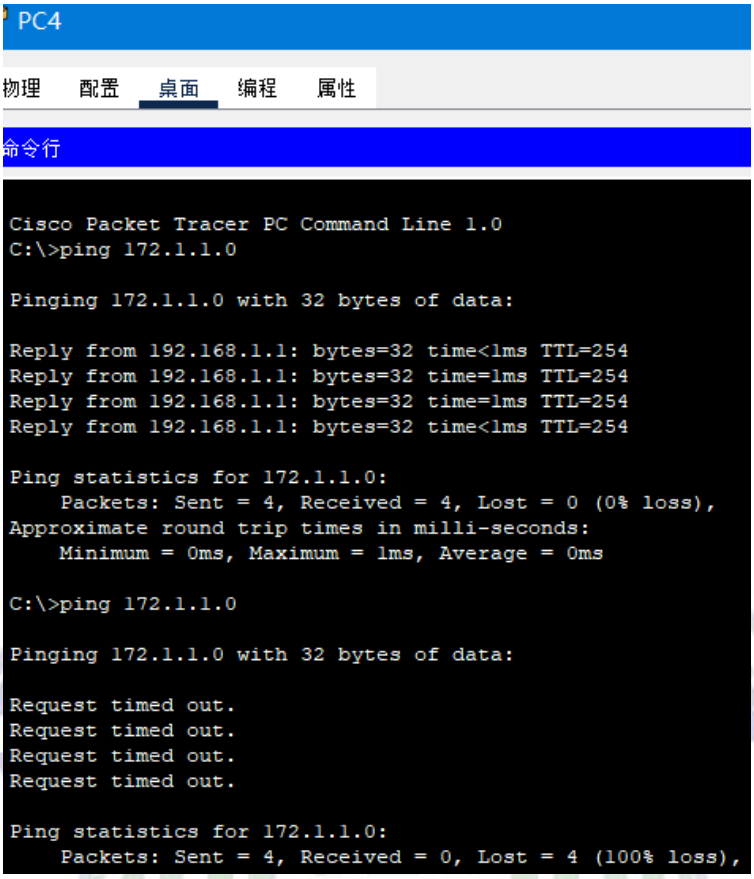
6.2 PC2：能够与 172.1.1.0/24 连通



6.3 PC3：能够与 172.1.1.0/24 连通



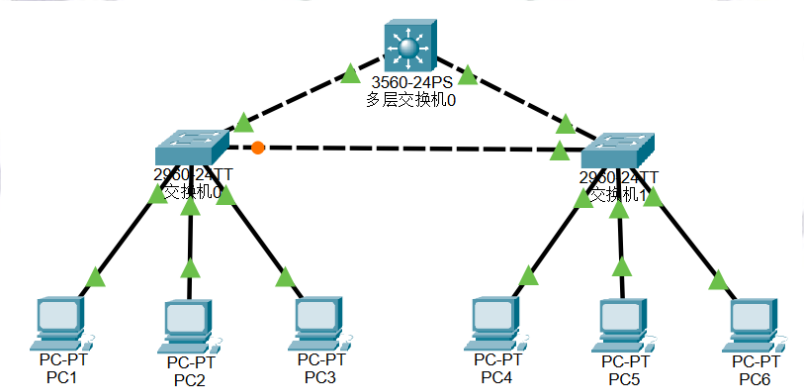
6.4 PC4：不能与 172.1.1.0/24 连通



说明实验成功。

（三）实验 9 三层交换机综合实验

1. 首先建立如图所示的网络拓扑：



名称	相连的接口	IP 地址	网关
PC1	F0/3	172.1.1.2/28	172.1.1.1/28
PC2	F0/4	172.1.1.18/28	172.1.1.17/28
PC3	F0/5	172.1.1.34/28	172.1.1.33/28
PC4	F0/3	172.1.1.3/28	172.1.1.1/28
PC5	F0/4	172.1.1.19/28	172.1.1.17/28
PC6	F0/5	172.1.1.35/28	172.1.1.33/28

2. 随后对两个交换机各创建三个 vlan 并查看，结果是一样的，都如下图所示。

物理　配置　命令行界面　属性

IOS命令行界面

```
Switch#en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#exit
Switch(config)#vlan 30
Switch(config-vlan)#exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#show vlan

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, Fa0/4, Fa0/5
                                                 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, Gig0/1
                                                 Gig0/2
10   VLAN0010                          active    Fa0/3
20   VLAN0020                          active
30   VLAN0030                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

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
30   enet  100030     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

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
```

3. 将交换机 1 和 2 的 f/01 设为 trunk 模式，并查看

```
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface f0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changec

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changec

Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#
```

```
Switch>en
Switch#show interfaces trunk
Port        Mode         Encapsulation  Status        Native vlan
Fa0/1       on           802.1q         trunking      1

Port        Vlans allowed on trunk
Fa0/1       1-1005

Port        Vlans allowed and active in management domain
Fa0/1       1,10,20,30

Port        Vlans in spanning tree forwarding state and not pruned
Fa0/1       1,10,20,30

Switch#
```

可见上图中，Status 为 trunking，说明 trunk 已经配置完成了。

4. 在三层交换机上建立三个对应的 vlan，并查看情况

```
Switch>en
Switch#show vlan

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/3, Fa0/4, Fa0/5, 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, Gig0/1, Gig0/2
10   VLAN0010                          active
20   VLAN0020                          active
30   VLAN0030                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

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
30   enet  100030     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

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------

Remote SPAN VLANs
------------------------------------------------------------------------------

Primary Secondary Type              Ports
------- --------- ----------------- ------------------------------------------
```

5. 分别为 vlan 10、20、30 配置 IP 地址和子网掩码，其状况如下图

```
Switch>en
Switch#show interface vlan 10
Vlan10 is up, line protocol is up
  Hardware is CPU Interface, address is 000a.f351.bb01 (bia 000a.f351.bb01)
  Internet address is 172.1.1.1/28
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000000 usec,

Switch#show interface vlan 20
Vlan20 is up, line protocol is up
  Hardware is CPU Interface, address is 000a.f351.bb02 (bia 000a.f351.bb02)
  Internet address is 172.1.1.17/28
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000000 usec,

Switch#show interface vlan 30
Vlan30 is up, line protocol is up
  Hardware is CPU Interface, address is 000a.f351.bb03 (bia 000a.f351.bb03)
  Internet address is 172.1.1.33/28
  MTU 1500 bytes, BW 100000 Kbit, DLY 1000000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
```

可见不同 vlan 的 IP 地址已经配置完成。

6. 改编三层交换机的优先级，将三层交换机设置为根桥，并查看生成树状态

```
Switch#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    1
             Address     000A.F351.BB23
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    1  (priority 0 sys-id-ext 1)
             Address     000A.F351.BB23
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/1            Desg FWD 19        128.1    P2p

VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority    10
             Address     000A.F351.BB23
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    10  (priority 0 sys-id-ext 10)
             Address     000A.F351.BB23
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/1            Desg FWD 19        128.1    P2p

VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    20
             Address     000A.F351.BB23
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    20  (priority 0 sys-id-ext 20)
             Address     000A.F351.BB23
```

7. 配置完成，在 PC1 上进行检验

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 172.1.1.1

Pinging 172.1.1.1 with 32 bytes of data:

Reply from 172.1.1.1: bytes=32 time<1ms TTL=255
Reply from 172.1.1.1: bytes=32 time<1ms TTL=255
Reply from 172.1.1.1: bytes=32 time=1ms TTL=255
Reply from 172.1.1.1: bytes=32 time=1ms TTL=255

Ping statistics for 172.1.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Reply from 172.1.1.3: bytes=32 time=10ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128
Reply from 172.1.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 10ms, Average = 2ms
```

根据上图结果可以看出，PC1 无论是 ping 网关（172.1.1.1）还是 ping 同一 vlan 下的 PC4（172.1.1.3）都能 ping 通，说明实验成功。

五、实验结果及分析

本次实验的实验结果符合指导书的预期。在配置好之后，三层交换机充当了路由器的作用，将两个交换机的 vlan 连接起来。

六、实验总结及体会

在本次实验中，主要学习了三层交换机的基本配置、访问控制与综合运用，并了解了其作用效果，对交换机的功能有了更深的理解。

七、教师评语