

计算机网络第四次实验

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1 配置各主机

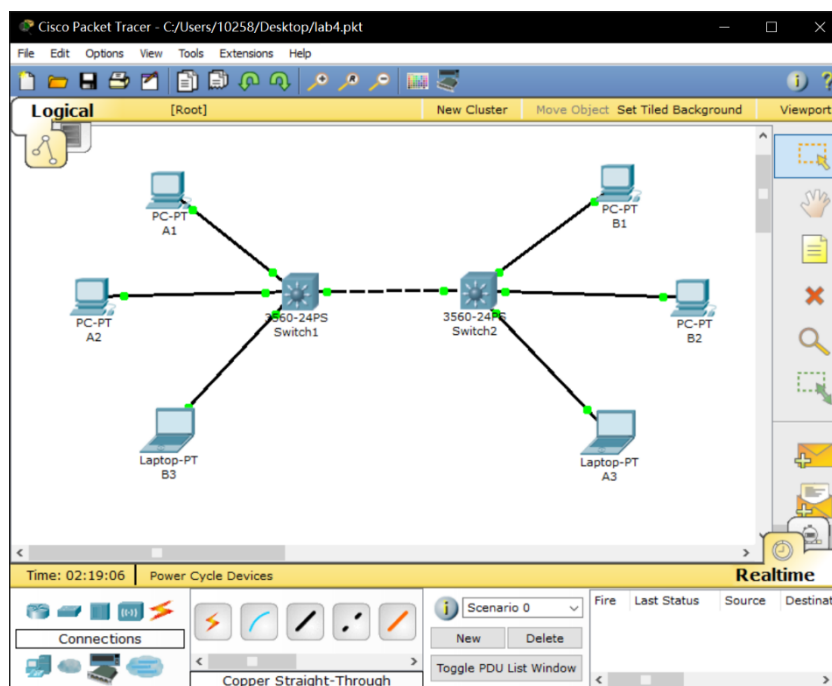
1.1 交换机端口连接配置

Switch1 Interfaces		Switch2 Interfaces	
From	To	From	To
FastEthernet 0/1	A1	FastEthernet 0/1	B1
FastEthernet 0/2	A2	FastEthernet 0/2	B2
FastEthernet 0/3	A3	FastEthernet 0/3	B3
FastEthernet 0/16	Switch2, FastEthernet 0/16	FastEthernet 0/16	Switch1, FastEthernet 0/16

1.2 主机 IP 地址配置

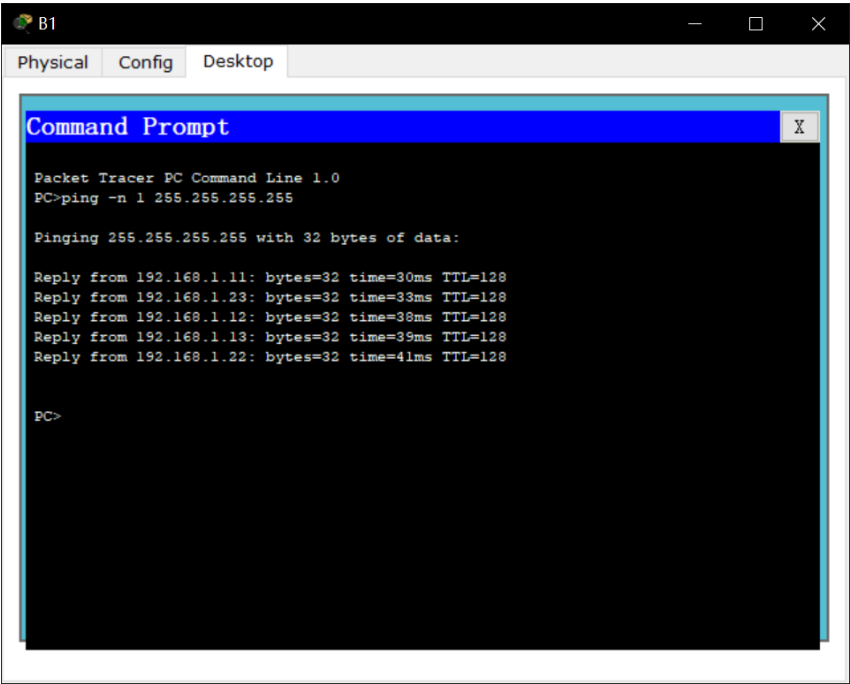
主机	IP 地址	子网掩码
A1	192.168.1.11	255.255.255.0
A2	192.168.1.12	255.255.255.0
A3	192.168.1.13	255.255.255.0
B1	192.168.1.21	255.255.255.0
B2	192.168.1.22	255.255.255.0
B3	192.168.1.23	255.255.255.0

1.3 搭建好的网络拓扑图



1.4 问题 1 的回答

从 B1 发起受限广播，结果发现其他主机都可以 ping 通，这是因为此时他们还处于同一个局域网内。



1.5 配置主机 MAC 地址

主机	MAC 地址
A1	0010.1117.11A1
A2	0003.E489.11A2
B3	0003.E4B6.11B3
B1	0040.0B61.22B1
B2	00D0.5841.22B2
A3	00E0.F9E5.22A3

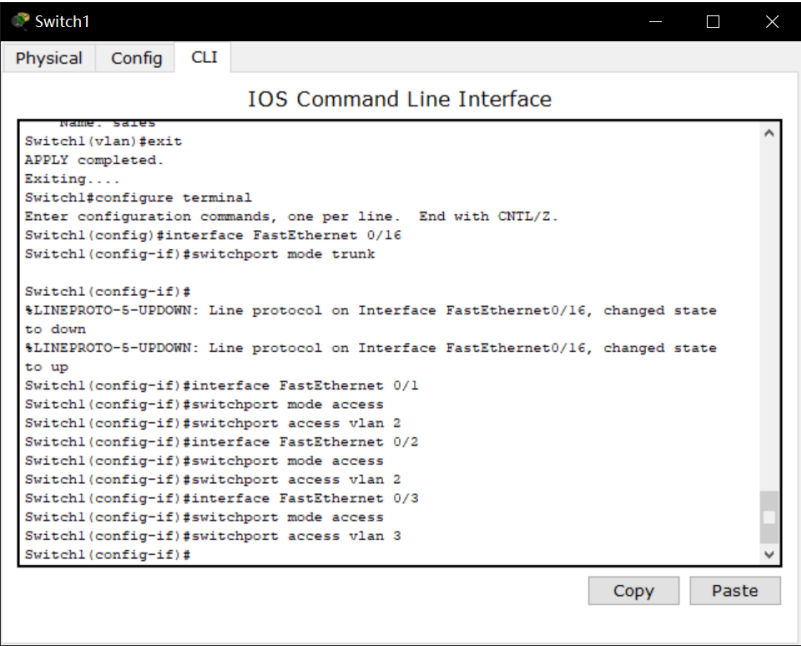
2 在交换机上配置 VLAN

2.1 VLAN 配置

VLAN num	VLAN name	Switch port
2	tech	Switch1, port 1, 2; Switch2, port 3
3	sales	Switch2, port 1, 2; Switch1, port 3

2.2 在 Switch1 上创建 VLAN

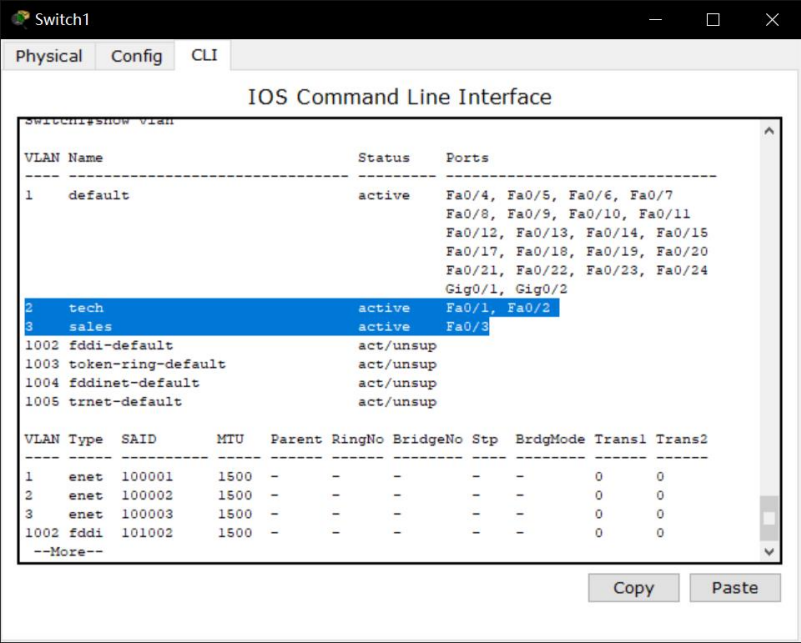
在 Switch1 上配置 VLAN 过程如下：



```
Switch1
Physical Config CLI
IOS Command Line Interface
name: sales
Switch1(vlan)#exit
APPLY completed.
Exiting...
Switch1#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch1(config)#interface FastEthernet 0/16
Switch1(config-if)#switchport mode trunk

Switch1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to up
Switch1(config-if)#interface FastEthernet 0/1
Switch1(config-if)#switchport mode access
Switch1(config-if)#switchport access vlan 2
Switch1(config-if)#interface FastEthernet 0/2
Switch1(config-if)#switchport mode access
Switch1(config-if)#switchport access vlan 2
Switch1(config-if)#interface FastEthernet 0/3
Switch1(config-if)#switchport mode access
Switch1(config-if)#switchport access vlan 3
Switch1(config-if)#
```

配置结果如下：



```
Switch1#show vlan

VLAN Name                Status    Ports
-----
1    default                active    Fa0/4, Fa0/5, Fa0/6, Fa0/7
                                           Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                           Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                           Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                           Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                           Gig0/1, Gig0/2
2    tech                   active    Fa0/1, Fa0/2
3    sales                   active    Fa0/3
1002 fddi-default         act/unsup
1003 token-ring-default   act/unsup
1004 fddinet-default      act/unsup
1005 trnet-default         act/unsup

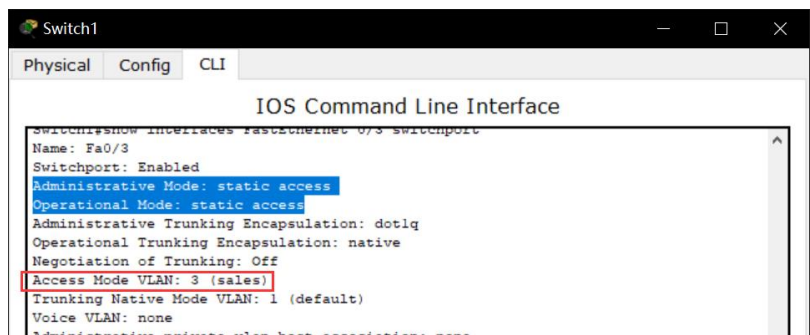
VLAN Type  SAID      MTU    Parent RingNo BridgeNo Stp  BrgdMode Transl Trans2
-----
1    enet  100001   1500    -     -     -     -     0      0
2    enet  100002   1500    -     -     -     -     0      0
3    enet  100003   1500    -     -     -     -     0      0
1002 fddi  101002   1500    -     -     -     -     0      0
--More--
```

在 Switch1 上用 show interfaces FastEthernet 0/1 switchport 查看端口信息如下：



```
Switch1#show interfaces FastEthernet 0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 2 (tech)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
```

在 Switch1 上用 show interfaces FastEthernet 0/3 switchport 查看端口信息如下：



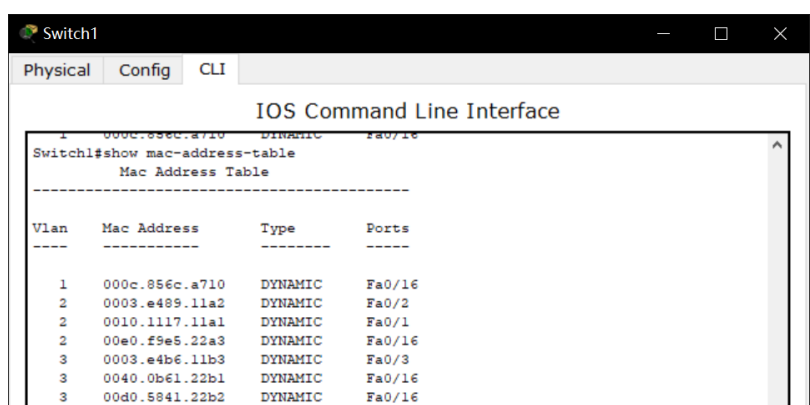
```
Switch1#show interfaces FastEthernet 0/3 switchport
Name: Fa0/3
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 3 (sales)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
```

在 Switch1 上用 show interfaces FastEthernet 0/16 switchport 查看端口信息如下：



```
Switch1#show interfaces FastEthernet 0/16 switchport
Name: Fa0/16
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
Administrative private-vlan host-association: none
```

在 Switch1 上用 show mac-address-table 查看端口信息如下：

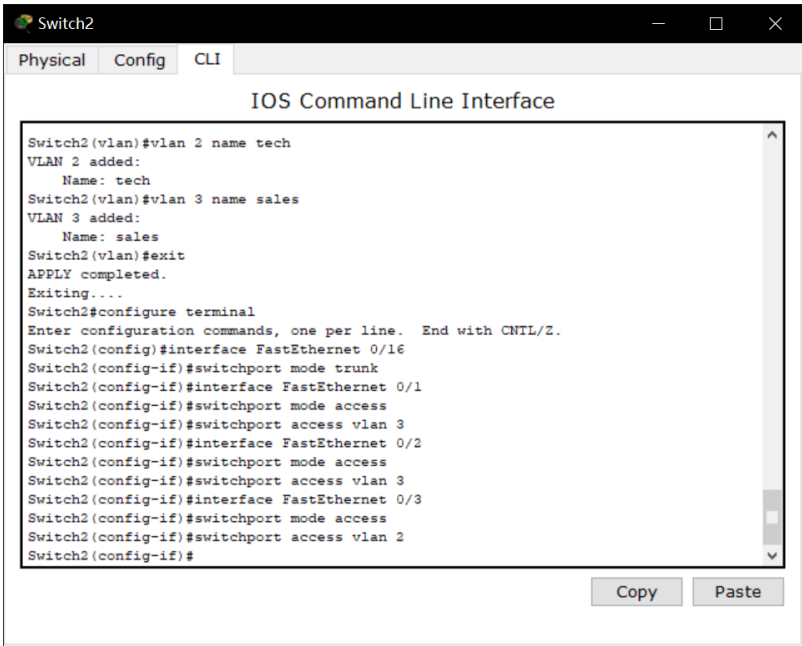


```
Switch1#show mac-address-table
Mac Address Table
-----
Vlan    Mac Address      Type      Ports
----    -
1       000c.856c.a710   DYNAMIC   Fa0/16
2       0003.e489.11a2   DYNAMIC   Fa0/2
2       0010.1117.11a1   DYNAMIC   Fa0/1
2       00e0.f9e5.22a3   DYNAMIC   Fa0/16
3       0003.e4b6.11b3   DYNAMIC   Fa0/3
3       0040.0b61.22b1   DYNAMIC   Fa0/16
3       00d0.5841.22b2   DYNAMIC   Fa0/16
```

在查看 MAC 地址表时，一开始只有上面的第一条记录，这是因为主机之间没有通信、没在交换机中留下信息导致的。选取两侧主机分别发出受限广播之后，再查看 MAC 地址表，即可看到上图结果。

2.3 在 Switch2 上创建 VLAN

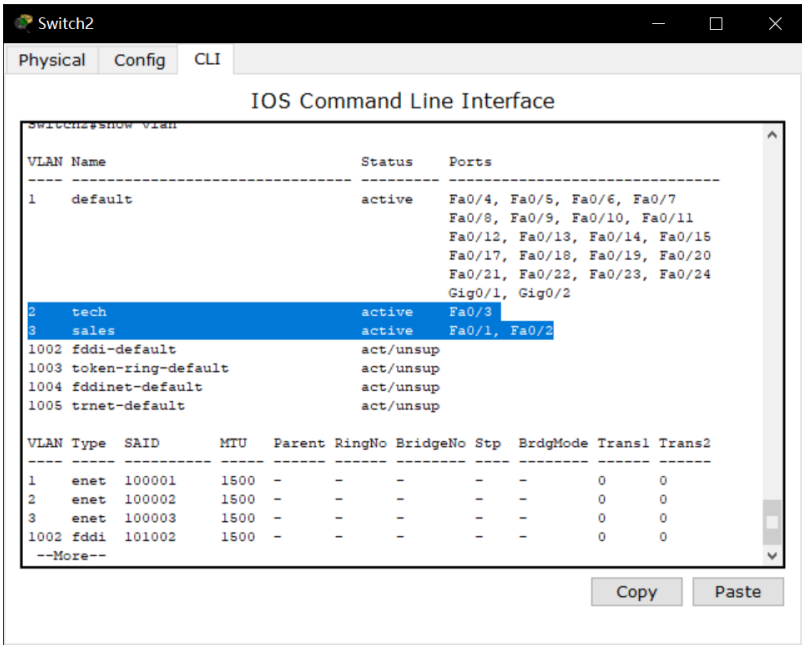
在 Switch2 上配置 VLAN 过程如下：



```
Switch2
Physical Config CLI
IOS Command Line Interface

Switch2(vlan)#vlan 2 name tech
VLAN 2 added:
  Name: tech
Switch2(vlan)#vlan 3 name sales
VLAN 3 added:
  Name: sales
Switch2(vlan)#exit
APPLY completed.
Exiting....
Switch2#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch2(config)#interface FastEthernet 0/16
Switch2(config-if)#switchport mode trunk
Switch2(config-if)#interface FastEthernet 0/1
Switch2(config-if)#switchport mode access
Switch2(config-if)#switchport access vlan 3
Switch2(config-if)#interface FastEthernet 0/2
Switch2(config-if)#switchport mode access
Switch2(config-if)#switchport access vlan 3
Switch2(config-if)#interface FastEthernet 0/3
Switch2(config-if)#switchport mode access
Switch2(config-if)#switchport access vlan 2
Switch2(config-if)#
```

配置结果如下：



```
Switch2
Physical Config CLI
IOS Command Line Interface

Switch2#show vlan

VLAN Name                Status    Ports
-----
1    default                active    Fa0/4, Fa0/5, Fa0/6, Fa0/7
                                           Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                           Fa0/12, Fa0/13, Fa0/14, Fa0/15
                                           Fa0/17, Fa0/18, Fa0/19, Fa0/20
                                           Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                           Gig0/1, Gig0/2
2    tech                  active    Fa0/3
3    sales                 active    Fa0/1, Fa0/2
1002 fddi-default         act/unsup
1003 token-ring-default   act/unsup
1004 fddinet-default      act/unsup
1005 trnet-default        act/unsup

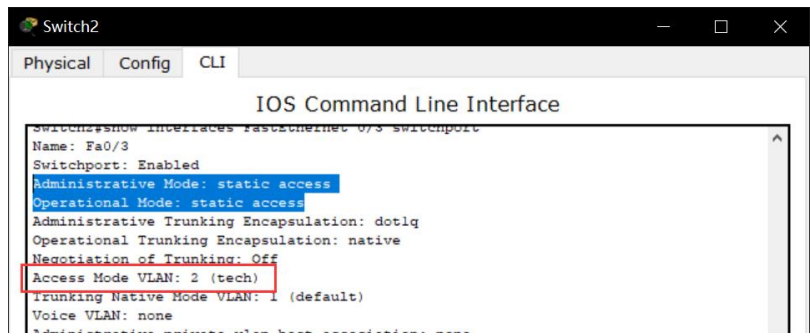
VLAN Type  SAID      MTU    Parent RingNo BridgeNo Stp    BrgdMode Transl Trans2
-----
1    enet  100001   1500    -     -     -     -     -     0      0
2    enet  100002   1500    -     -     -     -     -     0      0
3    enet  100003   1500    -     -     -     -     -     0      0
1002 fddi  101002   1500    -     -     -     -     -     0      0
--More--
```

在 Switch2 上用 show interfaces FastEthernet 0/1 switchport 查看端口信息如下：



```
Switch2#show interfaces FastEthernet 0/1 switchport
Name: Fa0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 3 (sales)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
```

在 Switch2 上用 show interfaces FastEthernet 0/3 switchport 查看端口信息如下：



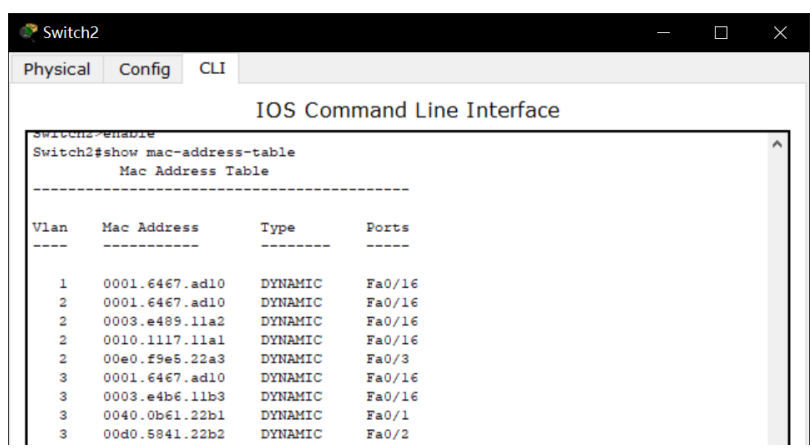
```
Switch2#show interfaces FastEthernet 0/3 switchport
Name: Fa0/3
Switchport: Enabled
Administrative Mode: static access
Operational Mode: static access
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: native
Negotiation of Trunking: Off
Access Mode VLAN: 2 (tech)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
```

在 Switch2 上用 show interfaces FastEthernet 0/16 switchport 查看端口信息如下：



```
Switch2#show interfaces FastEthernet 0/16 switchport
Name: Fa0/16
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
```

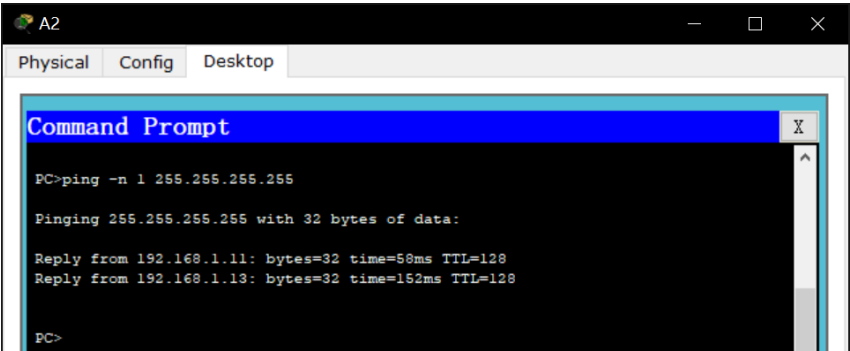
在 Switch2 上用 show mac-address-table 查看端口信息如下：



```
Switch2#enable
Switch2#show mac-address-table
Mac Address Table
-----
Vlan    Mac Address      Type      Ports
-----
1       0001.6467.ad10   DYNAMIC   Fa0/16
2       0001.6467.ad10   DYNAMIC   Fa0/16
2       0003.e489.11a2   DYNAMIC   Fa0/16
2       0010.1117.11a1   DYNAMIC   Fa0/16
2       00e0.f9e5.22a3   DYNAMIC   Fa0/3
3       0001.6467.ad10   DYNAMIC   Fa0/16
3       0003.e4b6.11b3   DYNAMIC   Fa0/16
3       0040.0b61.22b1   DYNAMIC   Fa0/1
3       00d0.5841.22b2   DYNAMIC   Fa0/2
```

2.4 问题 2 的回答

使用受限广播对每台主机进行测试，仅截图展示 A2 主机的 ping 结果：



所有结果汇总列表如下：

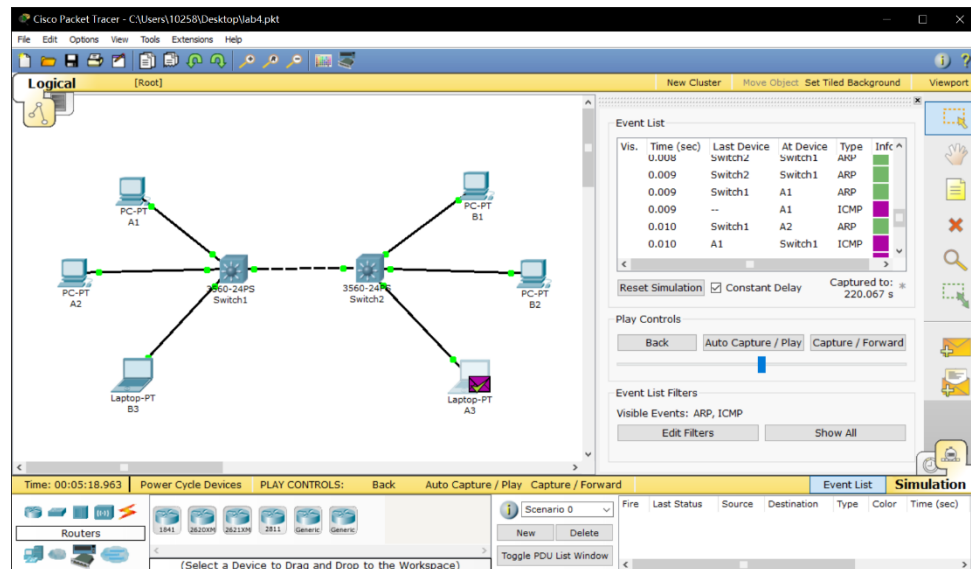
主机名	可连通的主机名
A1	A2
	A3
A2	A1
	A3
A3	A1
	A2
B1	B2
	B3
B2	B1
	B3
B3	B1
	B2

可见：在同一个 VLAN 下的主机可以连通（A1、A2、A3 与 B1、B2、B3），不在同一个 VLAN 下的主机不能联通。因为同一个 VLAN 下的主机处于同一虚拟局域网内。

3 VLAN 对广播包的处理

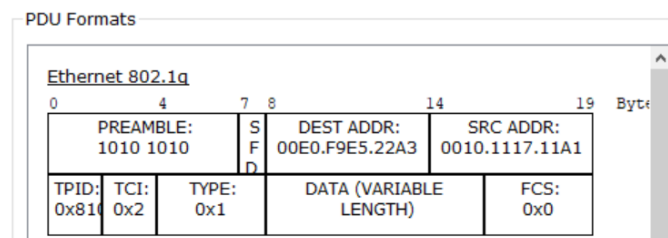
3.1 观察广播包处理过程

对 A3 主机尝试 ping -n 1 255.255.255.255:



观察结果：数据报从 A3 传到了 A1 和 A2，这三者都在同一 VLAN 下。经过 Switch2 的 ICMP 数据报在到达 A1 和 A2 前，先使用 ARP 分组广播查询 A1 和 A2 的 MAC 地址，等到 A3 收到 ARP 响应报文后，再发送对应的 ICMP 报文。

3.2 观察 802.1Q 帧封装信息



以上图所示为例，其各字段说明如下：

PREAMBLE: 前导字段，7 字节。Pre 字段中 1 和 0 交互使用，接收站通过该字段来知晓要导入帧，并且该字段提供了同步化接收物理层帧接收部分和导入比特流的方法

DEST ADDR: 目的地址字段，这里是 00E0.F9E5.22A3，即 A3

SRC ADDR: 源地址字段，这里是 0010.1117.11A1，即 A1

TPID: 标记协议标识字段，值为 0x8100。当帧中的以太网类型字段值也为 0x8100 时，该帧传送标签 IEEE 802.1q/802.1p

TCI: 标签控制信息字段，这里表示 VLAN ID 是 2

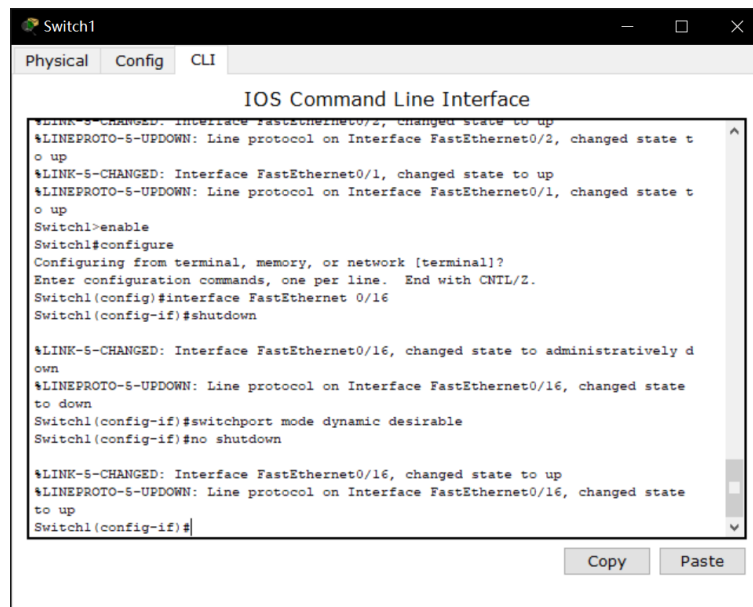
TYPE: 类型标识字段，这里是 0x1，表示 ARP 协议

DATA: 数据字段

FCS: 帧校验序列字段，4 字节。该序列包括 32 位的循环冗余校验（CRC）值，由发送 MAC 方生成，通过接收 MAC 方进行计算得出以校验被破坏的帧

4 DTP 的配置

将 Switch1 的 FastEthernet 0/16 接口的 Trunk 配置为 desirable 模式：

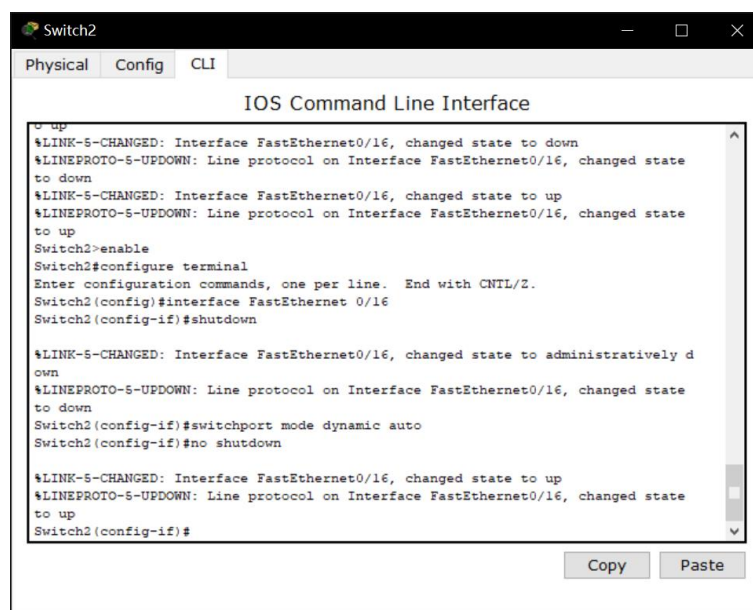


```
Switch1
Physical Config CLI
IOS Command Line Interface
%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state t
o up
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state t
o up
Switch1>enable
Switch1#configure
Configuring from terminal, memory, or network [terminal]?
Enter configuration commands, one per line. End with CNTRL/Z.
Switch1(config)#interface FastEthernet 0/16
Switch1(config-if)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/16, changed state to administratively d
own
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to down
Switch1(config-if)#switchport mode dynamic desirable
Switch1(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/16, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to up
Switch1(config-if)#
```

将 Switch2 的 FastEthernet 0/16 接口的 Trunk 配置为 auto 模式：

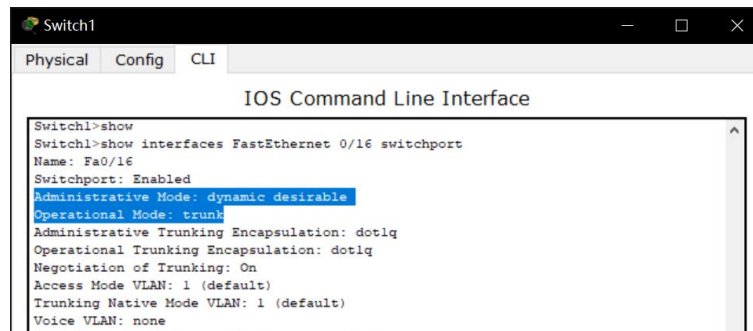


```
Switch2
Physical Config CLI
IOS Command Line Interface
%LINK-5-CHANGED: Interface FastEthernet0/16, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to down
%LINK-5-CHANGED: Interface FastEthernet0/16, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to up
Switch2>enable
Switch2#configure terminal
Enter configuration commands, one per line. End with CNTRL/Z.
Switch2(config)#interface FastEthernet 0/16
Switch2(config-if)#shutdown

%LINK-5-CHANGED: Interface FastEthernet0/16, changed state to administratively d
own
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to down
Switch2(config-if)#switchport mode dynamic auto
Switch2(config-if)#no shutdown

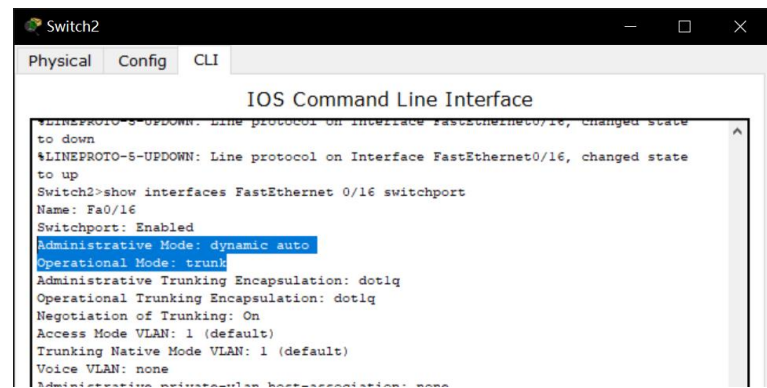
%LINK-5-CHANGED: Interface FastEthernet0/16, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state
to up
Switch2(config-if)#
```

在 Switch1 上用 show interfaces FastEthernet 0/16 switchport 查看 端口信息：



```
Switch1
Physical Config CLI
IOS Command Line Interface
Switch1>show
Switch1>show interfaces FastEthernet 0/16 switchport
Name: Fa0/16
Switchport: Enabled
Administrative Mode: dynamic desirable
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Voice VLAN: none
```

在 Switch2 上用 show interfaces FastEthernet 0/16 switchport 查看端口信息：



4.1 回答问题 1

经实验，结果如下：

是否可以形成 trunk	Switch2 trunk	Switch2 dynamic desirable	Switch2 dynamic auto
Switch1 trunk	√	√	√
Switch1 dynamic desirable	√	√	√
Switch1 dynamic auto	√	√	×

4.2 回答问题 2

经实验，结果如下：

是否可以形成 trunk	Switch2 trunk	Switch2 dynamic desirable	Switch2 dynamic auto
Switch1 trunk	√	√	√
Switch1 dynamic desirable	×	×	×
Switch1 dynamic auto	×	×	×

区别：将 Switch1 设置为 nonegotiate 模式时，Switch1 不能设置成 dynamic desirable 或 dynamic auto 模式了。