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华东交通大学信息与软件工程学院

实验报告册

专 业 2023 计算机

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一、实验名称

Vlan划分与Vlan间通信

二、实验目的

两台交换机连接六台 PC，使其可以相互 Ping 通

三、实验内容

(1) 分别把交换机命名为SWA，SWB。(2) 划分虚拟局域网vlan，并静态地把端口划分到vlan中。

第一，使用两种方法划分vlan。

- 在全局模式下划分vlan：使用这种方法在SWA交换机上创建三个vlan，分别为：vlan2，vlan3和vlan4，vlan名称可任意定义。
- 进入vlandatabase划分vlan：使用这种方法在SWB交换机上创建三个vlan，分别为：vlan2，vlan3和vlan4，vlan名称可任意定义。

第二，按下面的要求把端口静态地划分到vlan中。把SWA交换机上的F0/5端口划分到vlan2,F0/6端口划分到vlan3,F0/7端口划分到vlan4里面。把SWB交换机上的F0/5端口划分到vlan2,F0/6端口划分到vlan3,F0/7端口划分到vlan4里面。第三，删除vlan信息。

- 在SWA交换机上删除vlan2,vlan3信息。
- 在SWB交换机上删除vlan2,vlan3信息。

保留三个vlan, 使用单臂路由达成不同vlan之间的通信

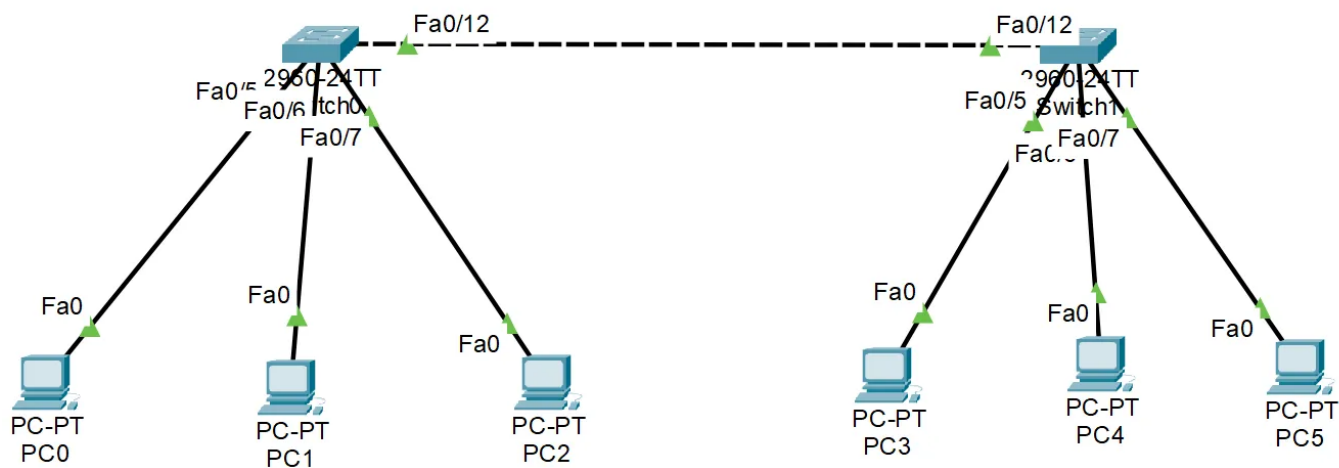
四、实验仪器

Cisco Packet Tracer Version:8.2.2.0400

五、实验原理

六、实验过程及实验结果

1. 连接基本拓扑



名称	相连的接口	IP地址
PC0	F0/5	172.1.1.2
PC1	F0/6	172.1.1.3
PC2	F0/7	172.1.1.4
PC3	F0/5	172.1.1.10
PC4	F0/6	172.1.1.11
PC5	F0/7	172.1.1.12

2. 交换机基本配置

进入Switch0的CLI, 配置如下

```
switch>en
switch#config t
switch(config)#hostname swA
swA(config)#end
swA#
```

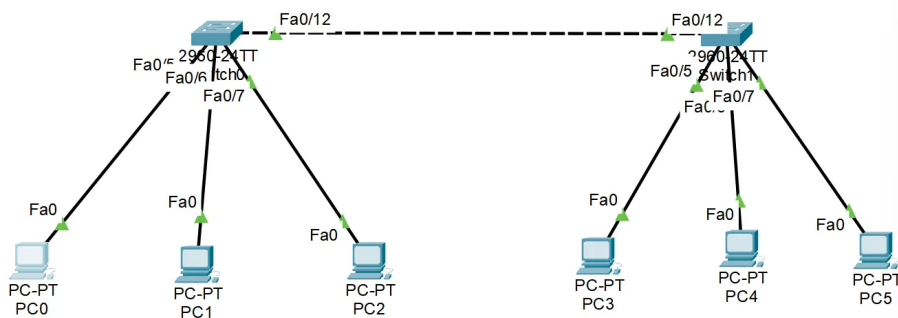
同理对Switch1进行如下配置

```

switch>en
switch#config t
switch(config)#hostname swB
swB(config)#end
swB#

```

此时测试主机之间的通信情况



```

Cisco Packet Tracer PC Command Line 1.0
C:\> ping
C:\> ping 172.1.1.10
Pinging 172.1.1.10 with 32 bytes of data:
Reply from 172.1.1.10: bytes=32 time<1ms TTL=128
Reply from 172.1.1.10: bytes=32 time<1ms TTL=128
Reply from 172.1.1.10: bytes=32 time<1ms TTL=128
Reply from 172.1.1.10: bytes=32 time<1ms TTL=128
Ping statistics for 172.1.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, 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<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
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 = 0ms, Average = 0ms
C:\> ping 172.1.1.12
Pinging 172.1.1.12 with 32 bytes of data:
Reply from 172.1.1.12: bytes=32 time<1ms TTL=128
Reply from 172.1.1.12: bytes=32 time<1ms TTL=128
Reply from 172.1.1.12: bytes=32 time<1ms TTL=128
Reply from 172.1.1.12: bytes=32 time<1ms TTL=128
Ping statistics for 172.1.1.12:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>

```

发现PC1, PC2, PC3, PC4, PC5, PC6都是互通的。

3. 划分vlan和静态地把端口划分到vlan中

1. 划分vlan

swA的配置如下:

```

swA#config t
SWA(config)#vlan 2
swA(config-vlan)#name vlan2
swA(config-vlan)#exit
swA(config)#vlan 3
SWA(config-vlan)#name vlan3
swA(config-vlan)#exit
swA(config)#vlan 4
SWA(config-vlan)#name vlan4
swA(config-vlan)#exit

```

swB配置同上

2. 把端口静态地划分到vlan中

```
swA#config t
swA(config)#int F0/5
swA(config-if)#switchport mode access
swA(config-if)#switchport access vlan 2
swA(config-if)#exit
swA(config)#int F0/6
swA(config-if)#switchport mode access
swA(config-if)#switchport access vlan 3
swA(config-if)#exit
swA(config)#int F0/7
swA(config-if)#switchport mode access
swA(config-if)#switchport access vlan 4
swA(config-if)#end
```

swB配置同上

4. 查看配置

使用 `show vlan` 查看配置

SWA#show vlan										
VLAN Name			Status	Ports						
1	default		active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 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						
2	vlan2		active	Fa0/5						
3	vlan3		active	Fa0/6						
4	vlan4		active	Fa0/7						
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	
2	enet	100002	1500	-	-	-	-	0	0	
3	enet	100003	1500	-	-	-	-	0	0	
4	enet	100004	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							

SWB#show vlan										
VLAN Name		Status	Ports							
1	default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 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							
2	vlan2	active	Fa0/5							
3	vlan3	active	Fa0/6							
4	vlan4	active	Fa0/7							
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	
2	enet	100002	1500	-	-	-	-	0	0	
3	enet	100003	1500	-	-	-	-	0	0	
4	enet	100004	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							
SWB#										

5. 测试vlan间是否互通

在PC0尝试使用ping命令联通PC1 PC3 PC5, 均失败

```
Pinging 172.1.1.2 with 32 bytes of data:
Reply from 172.1.1.2: bytes=32 time=12ms TTL=128
Reply from 172.1.1.2: bytes=32 time=7ms TTL=128
Reply from 172.1.1.2: bytes=32 time<1ms TTL=128
Reply from 172.1.1.2: bytes=32 time=5ms TTL=128

Ping statistics for 172.1.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 12ms, Average = 6ms

C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 172.1.1.10

Pinging 172.1.1.10 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.1.1.10:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 172.1.1.12

Pinging 172.1.1.12 with 32 bytes of data:

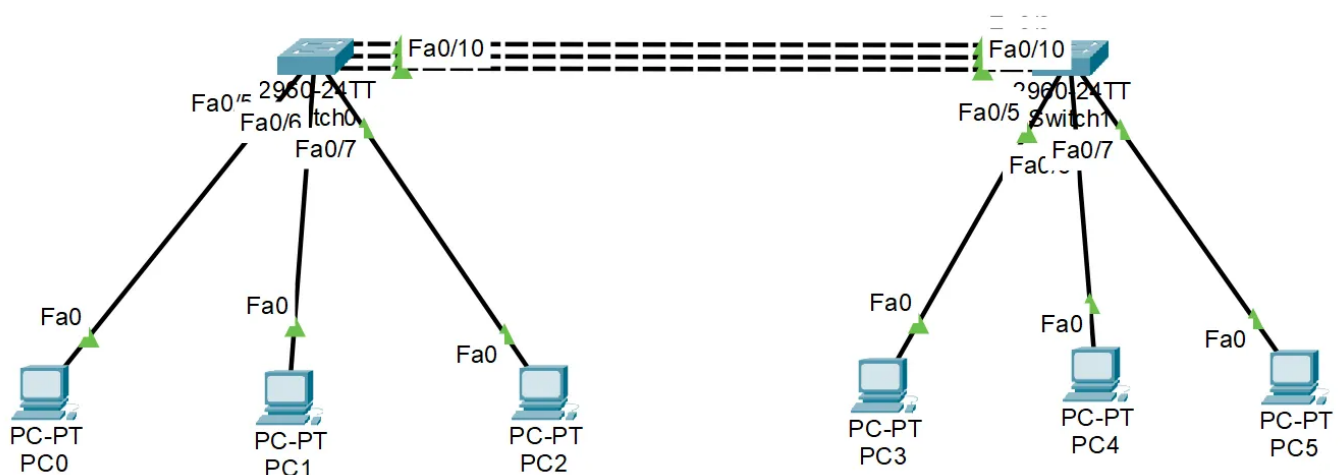
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.1.1.12:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

6. 三根线连接不同vlan

在两个交换机之间连接三条线路，用以连接不同的vlan。其中，两个交换机连接的接口情况为：F0/8—F0/8；F0/9—F0/9；F0/10—F0/10；



将双方的F0/8静态地划分到vlan2中，F0/9静态划分到vlan3，F0/10静态划分到vlan4

```
SWA>en
SWA#conf t
Enter configuration commands, one per line. End with CNTL/Z.
SWA(config)#int f0/8
SWA(config-if)#switchport mode access
SWA(config-if)#switchport access vlan 2
SWA(config-if)#exit
SWA(config)#int f0/9
SWA(config-if)#switchport mode access
SWA(config-if)#switchport access vlan 3
SWA(config-if)#exit
SWA(config)#int f0/10
SWA(config-if)#switchport mode access
SWA(config-if)#switchport access vlan 4
SWA(config-if)#
%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/8 (2),
with SWB FastEthernet0/8 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/9 (3),
with SWB FastEthernet0/9 (1).

%CDP-4-NATIVE_VLAN_MISMATCH: Native VLAN mismatch discovered on FastEthernet0/10 (4),
with SWB FastEthernet0/10 (1).
SWA(config)#exit
SWA#
```

swB配置同上.

在PC0中对其他五台PC发送ping命令, 发现只有PC3能够ping通

```
C:\>ping 172.1.1.10

Pinging 172.1.1.10 with 32 bytes of data:

Reply from 172.1.1.10: bytes=32 time<1ms TTL=128
Reply from 172.1.1.10: bytes=32 time<1ms TTL=128
Reply from 172.1.1.10: bytes=32 time<1ms TTL=128
Reply from 172.1.1.10: bytes=32 time<1ms TTL=128

Ping statistics for 172.1.1.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 172.1.1.3

Pinging 172.1.1.3 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.1.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 172.1.1.12

Pinging 172.1.1.12 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.1.1.12:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>ping 172.1.1.4

Pinging 172.1.1.4 with 32 bytes of data:

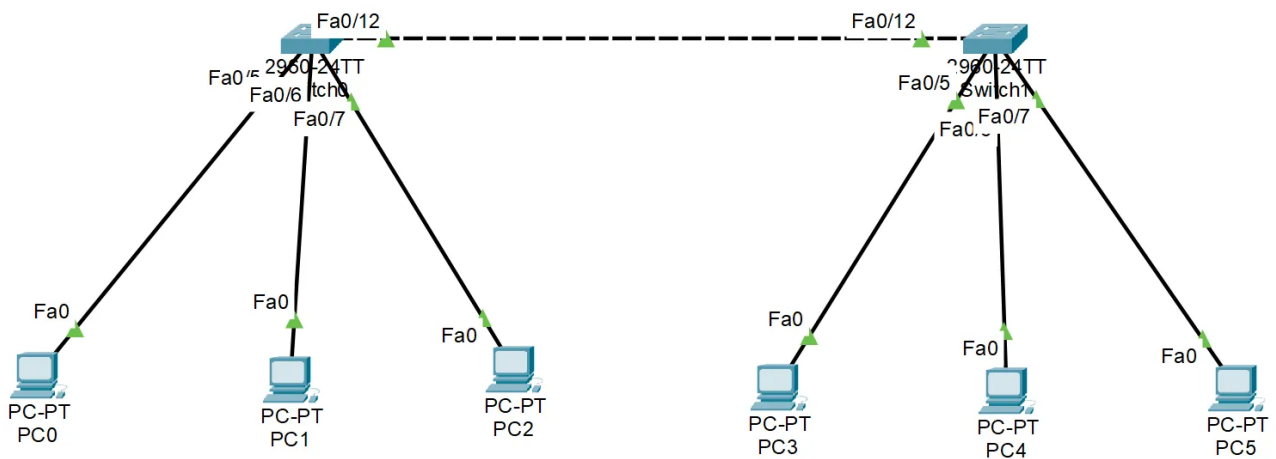
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 172.1.1.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

经过尝试, PC0和PC3能相互ping通, PC1和PC4能够相互ping通, PC2和PC5能够相互ping通, 其余组合均无法ping通

7. 使用一根trunk线连接

在两个交换机之间建立一条trunk中继线线路代替上面的三条连线, 双方都接F0/12。



swA中:

```
SWA>en
SWA#conf t
Enter configuration commands, one per line. End with CNTL/Z.
SWA(config)#int f0/12
SWA(config-if)#switch mode trunk

SWA(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/12, changed state to
down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/12, changed state to up
SWA(config)#exit
SWA#
```

swB配置同上

再次尝试使用ping命令测试各个主机间的连通性, 结论依旧和使用三条线联通交换机的一样

PC0和PC3能相互ping通, PC1和PC4能够相互ping通, PC2和PC5能够相互ping通, 其余组合均无法ping通

8. 删除vlan

在SWA交换机上删除vlan2, vlan3信息

```
SWA>en
SWA#config t
SWA(config)#no vlan 2
SWA(config)#no vlan 3
SWA(config)#end
```

SWB配置同上

此时仅剩PC2和PC5之间能够相互ping通, 其余组合均无法ping通

9. 思考题

把vlan2, vlan3, vlan4都删除了, 两个交换机只连一条线, 也就是在上述基础上再增加一条指令

```
SWA(config)#no vlan 4
```

此时六台PC任意两台都不能相互访问, 还需把各个端口静态地划分到同一个vlan中

```

swA#config t
swA(config)#int F0/5
swA(config-if)#switchport access vlan 1
swA(config-if)#exit
swA(config)#int F0/6
swA(config-if)#switchport access vlan 1
swA(config-if)#exit
swA(config)#int F0/7
swA(config-if)#switchport access vlan 1
swA(config-if)#end

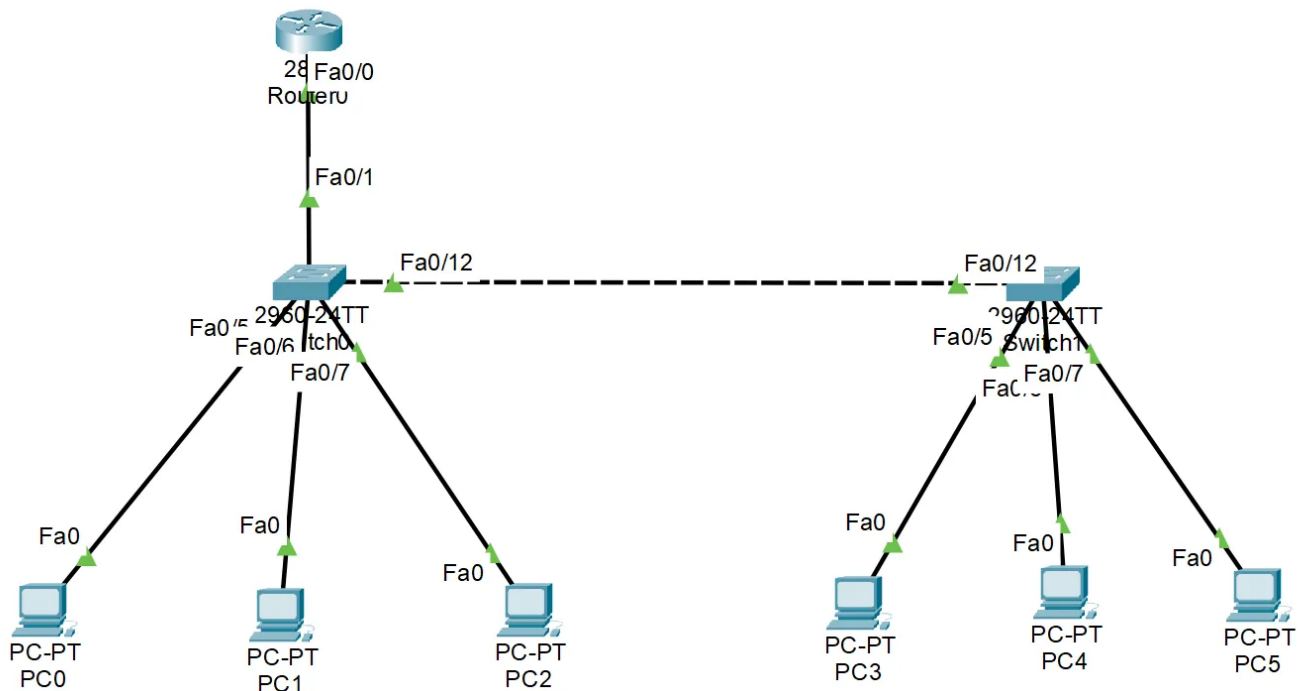
```

swB配置同上

经过测试, 此时任意两台PC相互之间都能ping通, 也就是说任意两台PC之间都能相互访问

10. 单臂路由实现不同vlan间通信

基于第三部分中划分vlan和静态地把端口划分到vlan中的拓扑图, 再用一个路由器2811接在swA上, 电缆连接Router0的Fa0/0端口, 和swA的Fa0/1端口



在swA中配置如下

```
SWA>en
SWA#conf t
Enter configuration commands, one per line. End with CNTL/Z.
SWA(config)#int f0/1
SWA(config-if)#switch mode trunk
```

在Router0中配置如下:

```
Router>en
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int f0/0.2
Router(config-subif)#encapsulation dot1q 2
Router(config-subif)#ip address 192.168.2.254 255.255.255.0
Router(config-subif)#int f0/0.3
Router(config-subif)#encap dot1q 3
Router(config-subif)#ip address 192.168.3.254 255.255.255.0
Router(config-subif)#int f0/0.4
Router(config-subif)#encap dot1q 4
Router(config-subif)#ip address 192.168.4.254 255.255.255.0
Router(config-subif)#int f0/0
Router(config-if)#no shutdown

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

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, 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

%LINK-5-CHANGED: Interface FastEthernet0/0.3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.3, changed state to up

%LINK-5-CHANGED: Interface FastEthernet0/0.4, changed state to up

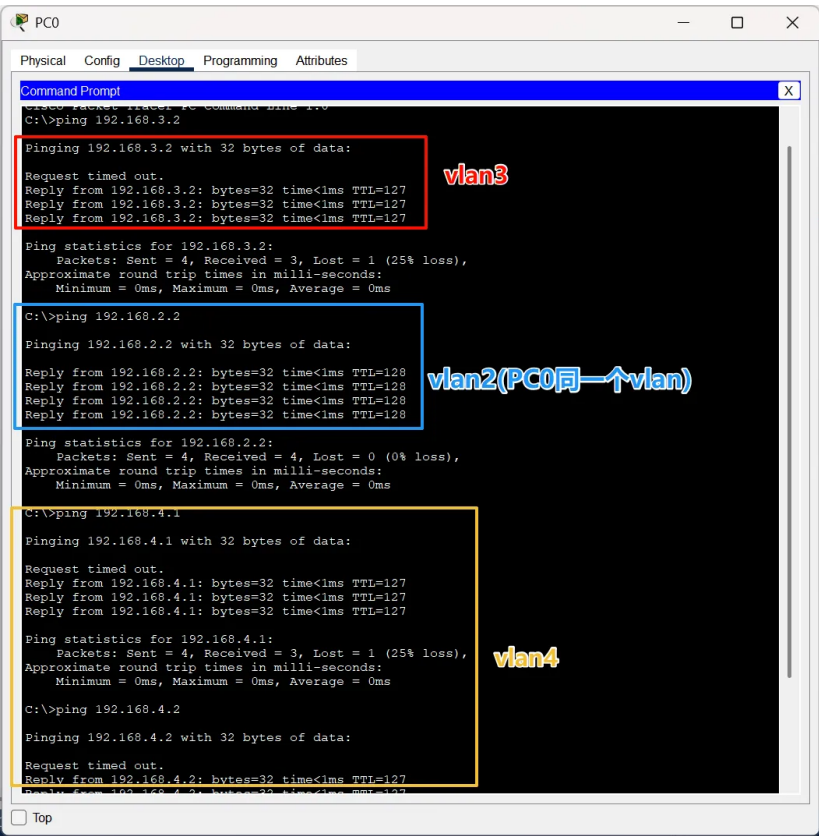
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.4, changed state to up

Router(config-if)#exit
Router(config)#
```

名称	相连的接口	IP地址	网关	子网掩码
PC0	F0/5	192.168.2.1	192.168.2.254	255.255.255.0
PC1	F0/6	192.168.3.1	192.168.3.254	255.255.255.0
PC2	F0/7	192.168.4.1	192.168.4.254	255.255.255.0
PC3	F0/5	192.168.2.2	192.168.2.254	255.255.255.0
PC4	F0/6	192.168.3.2	192.168.3.254	255.255.255.0
PC5	F0/7	192.168.4.2	192.168.4.254	255.255.255.0

再次尝试使用ping命令测试各个主机间的连通性,发现任意两台PC相互之间都能ping通,但是有一个额外的发现:

不同vlan间ping总会在第一个包发生 *Request timed out* ,而相同vlan间不会



七、讨论与结论

实验现象分析

通过本次实验，我们成功地在两个交换机上划分了VLAN，并尝试了不同方式的配置以实现VLAN间的通信。最初的测试表明，在未进行任何VLAN划分时，所有PC之间都是互通的。但是，当根据VLAN进行端口分配后，仅属于相同VLAN的PC能够互相ping通，而不同VLAN之间的通信则被阻断，这符合VLAN的基本工作原理——隔离广播域。

在采用单臂路由方案进行不同VLAN间通信时，观察到首次从一个VLAN内的主机ping另一个VLAN的主机会出现 `Request timed out`，而后续的ping请求则正常，并且第二次ping请求仍然正常。这种现象可能是由于ARP表初始化或路由表和子接口初始化过程中的延迟所引起的。一旦路由器学习到了必要的MAC地址信息，后续的通信就会变得顺畅。这一发现提示我们在设计网络时需要考虑这些初始化延迟，并可能需要优化相关的网络配置以减少此类影响。

实验故障及处理方法

VLAN间通信问题：在实验过程中，我们遇到了VLAN间无法直接通信的问题。这是因为VLAN本质上是用于分隔广播域的技术，默认情况下，不同VLAN间的设备不能直接通信。为了解决这个问题，我们采用了单臂路由（Router on a Stick）的方法，通过路由器的一个物理接口连接到交换机，并创建多个子接口来对应不同的VLAN，从而实现了跨VLAN的通信。

心得体会

这次实验加深了我们对VLAN概念的理解及其在实际网络中的应用。特别是如何利用单臂路由技术解决VLAN间的通信问题，让我们认识到灵活运用网络设备可以有效提高网络性能和安全性。同时，也意识到在网络设计初期做好充分规划的重要性，包括合理的IP地址规划、选择合适的网络拓扑结构等，这些都是构建高效、稳定网络的关键因素。对于首次跨VLAN通信时出现的“Request timed out”现象的理解，进一步增强了我们对网络初始化过程的认识。