实验报告

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班 级 18

【实验题目】VLAN 间**路由实验**

【实验目的】掌握 VLAN 间静态路由的配置和使用方法，熟悉三层交换机的配置方法。

【注意事项】

- 2950 为二层交换机，只有透明网桥和生成树协议，不能配置虚接口和三层接口（下个实验会用到）。
- 3560 是三层交换机，有透明网桥和生成树协议，还可以配置虚接口和三层接口。
- 所有路由器都可以配置子接口。
- 配置时很可能与预期不同,可以保存 pkt 文件后重新打开。

【实验命令】

- **交换机配置 VLAN**

```
(config)#vlan 3                    !建立 VLAN 3
(config)#interface f0/2
(config-if)#switchport access vlan 3  ! 把接口 f0/2 配置为 vlan3 主机接口
(config)#interface f0/4
 (config)#switchport trunk encapsulation dot1q
(config-if)#switchport mode trunk      ! 把接口 f0/4 配置为主干接口
```

- **路由器配置子接口**

```
(config)#interface f0/2
(config-if)#no ip address              !删除 F0/2 已配置的 IP 地址
(config-if)#exit
(config)#interface f0/2.30             !定义子接口 f0/2.30（编号可以不和 VLAN ID 一样）
(config-if)#encapsulation dot1q 30     !用 802.1Q 标准封装成 VLAN 帧(VLAN ID 为 30)
(config-if)#ip address 192.168.30.23 255.255.255.0    !配置子接口的 IP 地址
(config-if)#no shut


(config)#interface f0/2.40                 !定义子接口 f0/2.40
  ……
```

- **配置虚接口**

```
(config)#int vlan 40                                    ! 进入虚接口模式
(config-vlan)#ip address 192.168.30.1 255.255.255.0     ! 配置 vlan40 的 IP 地址
(config-vlan)#
```

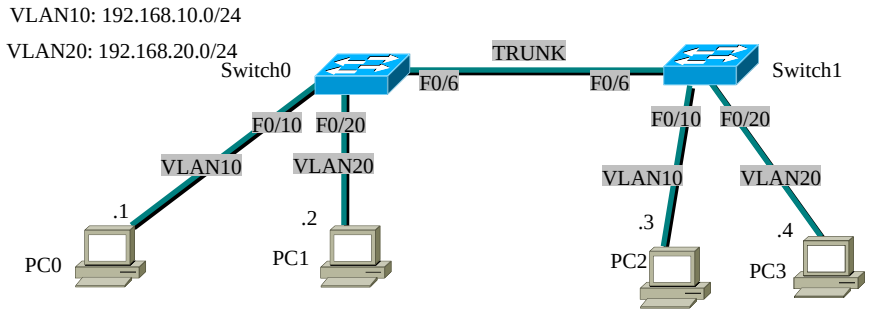
- **显示信息**

```
#show interface [f0/1]       ! 显示所有接口(或接口 f0/1)的详细信息
#show ip interface [f0/1]    ! 显示所有接口(或接口 f0/1)的简略信息
                             ! f0/1 is up(物理层正确，即接线正确)，line protocol is
                             !     up(数据链路层正确，有类似 KeepAlive 信号)
#show ip interface brief     ! 显示所有接口的简略信息
#show ip route               ! 显示路由表
#show vlan                   ! 显示所有 VLAN 接口
#show running-config         ! 显示当前配置文件
```

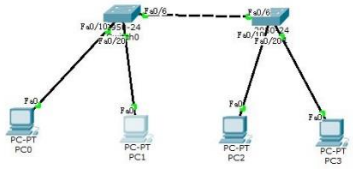
实验报告

【实验任务】

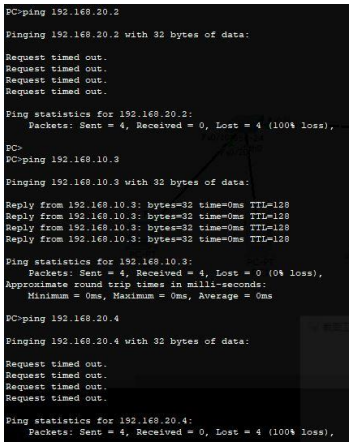
1、 (switch1.pkt)完成下图的“VLAN 实验”。



[1a、连线图截屏]

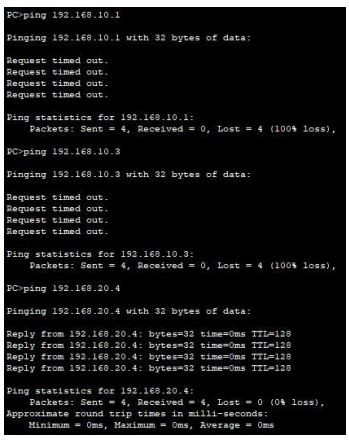


[1b、PC0 Ping 其它 PC 并截屏]



```
PC>ping 192.168.20.2

Pinging 192.168.20.2 with 32 bytes of data:

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

Ping statistics for 192.168.20.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>
PC>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.10.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>ping 192.168.20.4

Pinging 192.168.20.4 with 32 bytes of data:

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

Ping statistics for 192.168.20.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

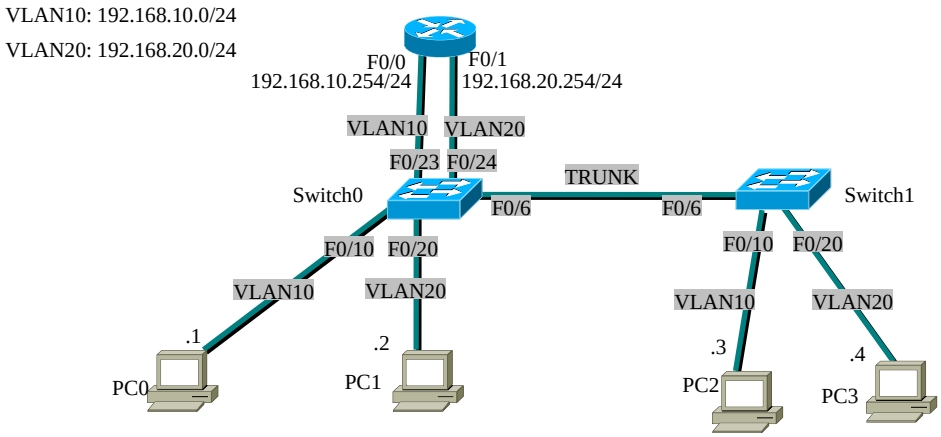
[1c、PC1 Ping 其它 PC 并截屏]



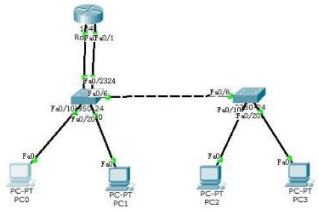
```
PC>ping 192.168.10.1

Pinging 192.168.10.1 with 32 bytes of data:

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

Ping statistics for 192.168.10.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

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

Ping statistics for 192.168.10.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>ping 192.168.20.4

Pinging 192.168.20.4 with 32 bytes of data:

Reply from 192.168.20.4: bytes=32 time=0ms TTL=128
Reply from 192.168.20.4: bytes=32 time=0ms TTL=128
Reply from 192.168.20.4: bytes=32 time=0ms TTL=128
Reply from 192.168.20.4: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.20.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

2、 (switch2.pkt)在上一步的基础上，加上一个路由器，完成下图“多臂路由实验”(通过路由器的多个以太网接口实现 VLAN 间路由)，要求所有主机之间可以相互 ping 通。

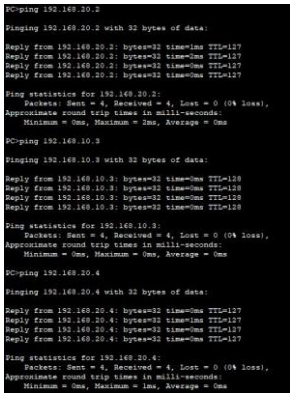
Router0



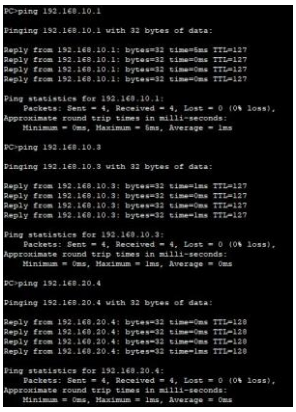
[2a、连线图截屏]



[2b、PC0 Ping 其它 PC 并截屏]



[2c、PC1 Ping 其它 PC 并截屏]



[2d、显示 Router0 的路由表]

```
Router#sh ip rou
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    192.168.10.0/24 is directly connected, FastEthernet0/0
C    192.168.20.0/24 is directly connected, FastEthernet0/1
```

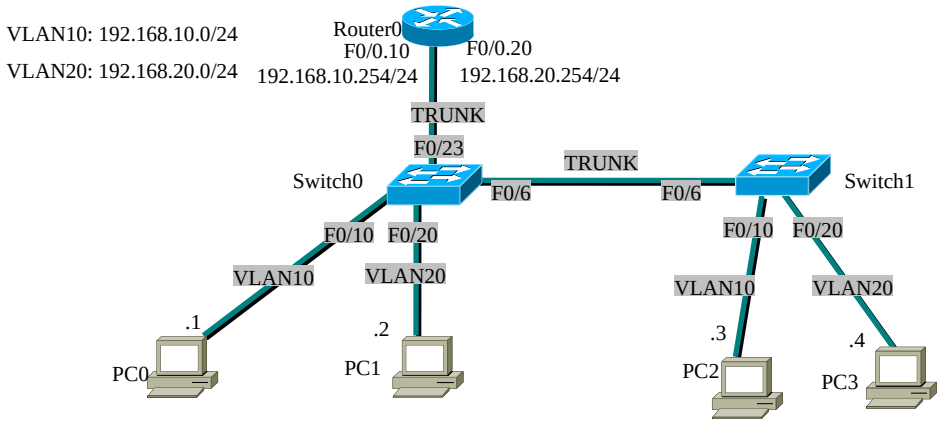
[2e、Switch0#show vlan 并截屏]

```
Switch#sh vl

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                 Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                 Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                 Fa0/19, Fa0/21, Fa0/22
10   VLAN10                            active    Fa0/10, Fa0/23
20   VLAN0020                          active    Fa0/20, Fa0/24
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
```

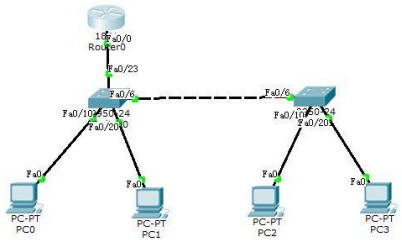
[2f、Switch1#show vlan 并截屏]

```
Switch#sh vl

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                 Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                 Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                 Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                 Fa0/19, Fa0/21, Fa0/22, Fa0/23
                                                 Fa0/24
10   VLAN10                            active    Fa0/10
20   VLAN0020                          active    Fa0/20
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
```

3、 (switch3.pkt)采用子接口实现单臂路由 (通过路由器的单个以太网接口实现 VLAN 间路由)。



[3a、连线图截屏]



[3b、先配置子接口 F0/0.10，PC0 ping 其他 PC]

```
PC>ping 192.168.20.2

Pinging 192.168.20.2 with 32 bytes of data:

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

Ping statistics for 192.168.20.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.10.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>ping 192.168.20.4

Pinging 192.168.20.4 with 32 bytes of data:

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

Ping statistics for 192.168.20.4:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

[3c、显示 Router0 的路由表]

```
Router#sh ip rou
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    192.168.10.0/24 is directly connected, FastEthernet0/0.10
```

[3d、再配置子接口 F0/0.20，然后 PC0 ping 其他 PC]

```
PC>ping 192.168.20.2

Pinging 192.168.20.2 with 32 bytes of data:

Reply from 192.168.20.2: bytes=32 time=0ms TTL=127
Reply from 192.168.20.2: bytes=32 time=0ms TTL=127
Reply from 192.168.20.2: bytes=32 time=0ms TTL=127
Reply from 192.168.20.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.20.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=6ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.10.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 6ms, Average = 1ms

PC>ping 192.168.20.4

Pinging 192.168.20.4 with 32 bytes of data:

Request timed out.
Reply from 192.168.20.4: bytes=32 time=0ms TTL=127
Reply from 192.168.20.4: bytes=32 time=0ms TTL=127
Reply from 192.168.20.4: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.20.4:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

[3e、显示 Router0 的路由表]

```
Router#sh ip rou
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    192.168.10.0/24 is directly connected, FastEthernet0/0.10
C    192.168.20.0/24 is directly connected, FastEthernet0/0.20
```

[3f、Switch0#show vlan 并截屏]

```
Switch#sh vl

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/21, Fa0/22
10   VLAN10                           active    Fa0/10
20   VLAN0020                         active    Fa0/20, Fa0/24
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

[3g、Switch1#show vlan 并截屏]

```
Switch#sh vl

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/2, Fa0/3, Fa0/4
                                                Fa0/5, Fa0/7, Fa0/8, Fa0/9
                                                Fa0/11, Fa0/12, Fa0/13, Fa0/14
                                                Fa0/15, Fa0/16, Fa0/17, Fa0/18
                                                Fa0/19, Fa0/21, Fa0/22, Fa0/23
                                                Fa0/24
10   VLAN10                           active    Fa0/10
20   VLAN0020                         active    Fa0/20
1002 fddi-default                     act/unsup
1003 token-ring-default               act/unsup
1004 fddinet-default                  act/unsup
1005 trnet-default                    act/unsup
```

[3h、Router0#show run 并截屏]

```
Router#show run
Building configuration...

Current configuration : 697 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!

interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet0/0.10
 encapsulation dot1Q 10
 ip address 192.168.10.254 255.255.255.0
!
interface FastEthernet0/0.20
 encapsulation dot1Q 20
 ip address 192.168.20.254 255.255.255.0
!
interface FastEthernet0/1
 ip address 192.168.20.254 255.255.255.0
 duplex auto
 speed auto
 shutdown
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
 login
!
!
!
end
```

[3i、写出 PC0 ping PC3 的 Echo 请求包和 Echo 响应包所经过的所有设备（通过模拟观察），例如：PC0-S0-S1-S0-R0…（非实际路径）]

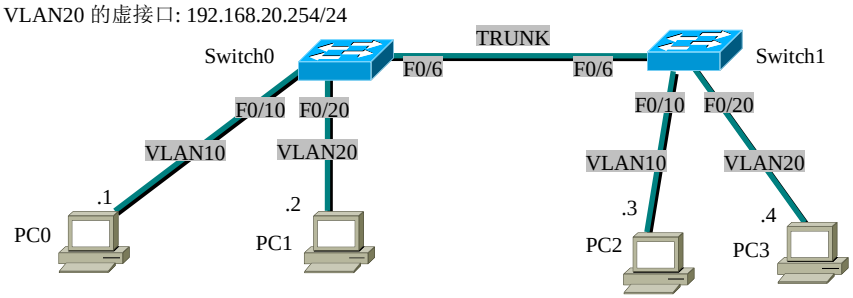
请求包：PC0-S0-R0-S0-S1-PC3

响应包：PC3-S1-S0-R0-S0-PC0

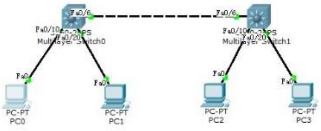
4、 (switch4.pkt)在 Switch1（三层交换机）上配置 VLAN10 和 VLAN20 的虚接口,要求所有主机之间可以

相互 ping 通。

VLAN10 的虚接口: 192.168.10.254/24
VLAN20 的虚接口: 192.168.20.254/24



[4a、连线图截屏]



[4b、PC0 Ping 其它 PC 后截屏]

```
PC>ping 192.168.20.2

Pinging 192.168.20.2 with 32 bytes of data:

Reply from 192.168.20.2: bytes=32 time=1ms TTL=127
Reply from 192.168.20.2: bytes=32 time=0ms TTL=127
Reply from 192.168.20.2: bytes=32 time=0ms TTL=127
Reply from 192.168.20.2: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.20.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>ping 192.168.10.3

Pinging 192.168.10.3 with 32 bytes of data:

Reply from 192.168.10.3: bytes=32 time=1ms TTL=128
Reply from 192.168.10.3: bytes=32 time=0ms TTL=128
Reply from 192.168.10.3: bytes=32 time=1ms TTL=128
Reply from 192.168.10.3: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.10.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>ping 192.168.20.4

Pinging 192.168.20.4 with 32 bytes of data:

Request timed out.
Reply from 192.168.20.4: bytes=32 time=1ms TTL=127
Reply from 192.168.20.4: bytes=32 time=0ms TTL=127
Reply from 192.168.20.4: bytes=32 time=0ms TTL=127

Ping statistics for 192.168.20.4:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

[4c、显示 Switch1 的路由表]

```
Switch#sh ip rou
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    192.168.10.0/24 is directly connected, Vlan10
C    192.168.20.0/24 is directly connected, Vlan20
```

[4d、 Switch1 从接口收到一帧，它是如何确定对该帧进行二层转发帧（只用透明网桥算法）还是进行三层转发（要查路由表和重新封装帧），并通过模拟观察 PC0 ping PC2 和 PC0 ping PC3 进行分析]

有帧传到 Switch1 时，它先查看这个帧是不是能传到 VLAN 相同的直连网终端上，如果是，它就根据透明网桥协议直接把帧发往该终端，这个过程实际上没有经过网络层，所以包内的 TTL 不变，都是 128，如在 ping PC2 时。否则，它就拆帧重新封装帧，然后通过虚接口进行路由，发往合适的下一跳，这个过程 TTL 会减小，变为 127，如在 ping PC1 和 ping PC3 时。

【实验讨论】

请讨论并比较上述三种 VLAN 间路由实现方法(2~4)的优缺点。

2：搭建简单，但需要额外的一个路由器。

3：和 2 其实相差不大，只是用了子端口，可以少用一条线。

4：节省了路由器，但交换机也要相应地升级。

【完成情况】

实验报告

是否完成以下步骤？（√完成 -未做完 ×未做）

(1) [√] (2) [√] (3) [√] (4) [√]

【实验体会】

写出实验过程中的问题，思考及解决方法，简述实验体会（如果有的话）。

1.配置三层交换机干道时不能像二层时那样直接在窗口中配置，而是需要使用命令配置。

2.分析帧的变化情况时，看 TTL 是一个非常有力的手段。

【交实验报告】

上传网址：http://103.26.79.35/netdisk/default.aspx?vm=18net

截止日期（不迟于）：2020 年 7 月 7 日（周二）23:00

上传文件名：学号_姓名_VLAN 间路由.doc

学号_姓名_VLAN 间路由.rar （包含所有.pkt 文件）