实验(十一)：VLAN配置实验

一.实验目的

- 对于企业而言，可能含有许多部门，为便于管理，常常以部门为单位，构建多个物理子网。传统网络工程，只有相近的办公室才可以组成同一个物理子网，鉴于种种原因，很可能同个部门的两个办公室位于不同楼层，甚至不同大楼。虚拟局域网(Virtual Local Area Network,VLAN),标准编号为IEEE 802.1Q,可以实现将两个相距较远的办公室组成同一个物理子网。实验利用交换机提供虚拟局域网功能，实现VLAN划分。
    - 掌握VLAN的基本原理
    - 了解如何在交换机上配置VLAN
    - 通过实验加深对VLAN的理解并掌握相关配置命令

二.实验原理

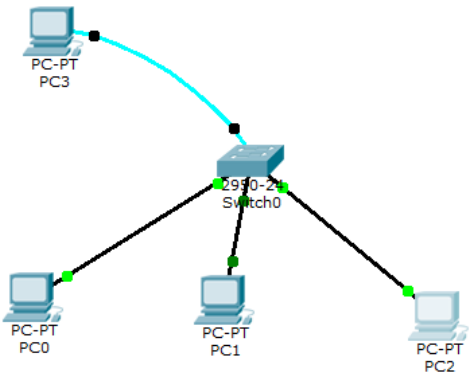
- `虚拟局域网（VLAN）`是一种网络技术，旨在将处于不同地理位置的主机逻辑上组织到同一个局域网内。这种技术允许网络管理员将交换机网络上的端口分组到不同的VLAN中，每个VLAN都表现得如同一个独立的物理局域网。这样，即使主机物理上分散在不同的地点，它们也可以互相通信，就好像它们连接到同一个局域网交换机上一样。VLAN的实现确保了不同VLAN之间的通信是隔离的，只有通过第3层的路由功能，才能实现不同VLAN间的互联。VLAN的配置非常灵活，支持多种不同的划分方法，从而满足不同的网络设计和安全需求。
- `以太网交换机`是网络通信中的核心设备之一，起初用于扩展物理网络的覆盖范围。作为网桥的一种高级形态，交换机能够通过内部软件逻辑上对网络端口进行分组，从而实现VLAN功能。这种分组使得每个端口组成的虚拟网络操作起来就像是一个独立的物理网络。通过在交换机上配置VLAN，网络管理员可以在一个物理网络基础设施上创建多个虚拟网络，实现资源的高效利用和数据流的有效隔离。利用交换机提供的VLAN功能，实验室和企业可以灵活地设计和部署复杂的网络拓扑结构，满足特定的通信需求和安全策略。

三.实验环境

- 操作系统：Windows 10
- 网络环境：局域网
- 软件：`Cisco Packet Tracer`虚拟实验环境

四.实验步骤

- 按照下图连接设备，构成网络。



- 在不进行任何操作的情况下三台主机`PC0`、`PC1`、`PC2`之间互相`ping`，观察结果
- 通过Config图形化界面为三台PC机配置IP及掩码，依次如下：
  - PC0配置：`192.168.1.1` mask`255.255.255.0` `F0/1` `VLAN10`
  - PC1配置：`192.168.1.11` mask`255.255.255.0` `F0/2` `VLAN20`
  - PC2配置：`192.168.1.21` mask`255.255.255.0` `F0/3` `VLAN30`
- 通过命令行，分别为`PC0、PC1、PC2`分别配置`vlan10、 vlan20、 vlan30`
- 使用`sh vlan`命令查看配置
- 测试：`PC0, PC1, PC2`之间相互`ping`，查看结果

五、实验现象

- 在不进行任何操作情况下，`PC0`、`PC1`、`PC2`两两之间`ping`通信成功

```
PC>ping 192.168.1.11

Pinging 192.168.1.11 with 32 bytes of data:

Reply from 192.168.1.11: bytes=32 time=0ms TTL=128
Reply from 192.168.1.11: bytes=32 time=0ms TTL=128
Reply from 192.168.1.11: bytes=32 time=0ms TTL=128
Reply from 192.168.1.11: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>ping 192.168.1.21

Pinging 192.168.1.21 with 32 bytes of data:

Reply from 192.168.1.21: bytes=32 time=0ms TTL=128
Reply from 192.168.1.21: bytes=32 time=0ms TTL=128
Reply from 192.168.1.21: bytes=32 time=0ms TTL=128
Reply from 192.168.1.21: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
PC>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Reply from 192.168.1.1: bytes=32 time=0ms TTL=128
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>192.168.1.21
Invalid Command.

PC>ping 192.168.1.21

Pinging 192.168.1.21 with 32 bytes of data:

Reply from 192.168.1.21: bytes=32 time=1ms TTL=128
Reply from 192.168.1.21: bytes=32 time=0ms TTL=128
Reply from 192.168.1.21: bytes=32 time=0ms TTL=128
Reply from 192.168.1.21: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.1.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
PC>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Reply from 192.168.1.1: bytes=32 time=0ms TTL=128
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128
Reply from 192.168.1.1: bytes=32 time=2ms TTL=128
Reply from 192.168.1.1: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

PC>ping 192.168.1.11

Pinging 192.168.1.11 with 32 bytes of data:

Reply from 192.168.1.11: bytes=32 time=0ms TTL=128
Reply from 192.168.1.11: bytes=32 time=0ms TTL=128
Reply from 192.168.1.11: bytes=32 time=0ms TTL=128
Reply from 192.168.1.11: bytes=32 time=0ms TTL=128

Ping statistics for 192.168.1.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

- 使用`sh vlan`命令查看配置

```
Switch>enable
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 10
VLAN 10 added:
    Name: VLAN0010
Switch(vlan)#exit
APPLY completed.
Exiting....
Switch#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface f0/1
Switch(config-if)#switchport a vlan 10
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch#sh vlan

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/2, 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
10   VLAN0010                         active    Fa0/1
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
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
 --More--
```

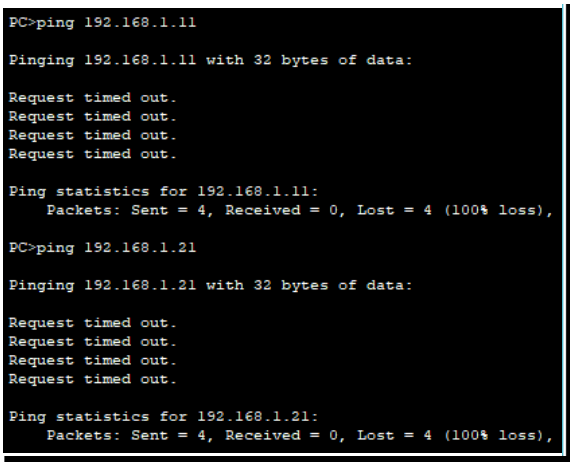
```
VLAN 30 added:
    Name: VLAN0030
Switch(vlan)#exit
APPLY completed.
Exiting....
Switch#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface f0/3
Switch(config-if)#switchport a vlan 30
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

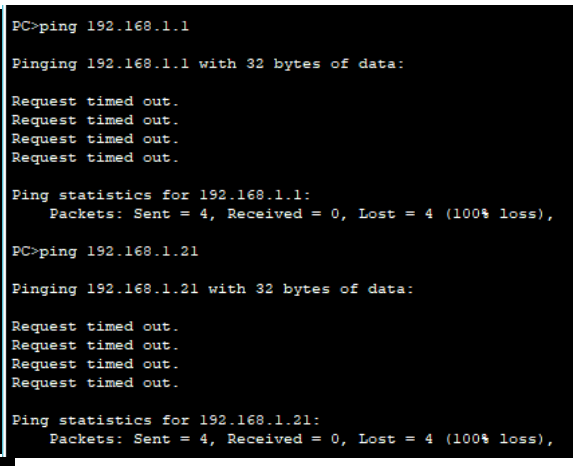
```
Switch#sh vlan

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
                                                Fa0/16, Fa0/17, Fa0/18, Fa0/19
                                                Fa0/20, Fa0/21, Fa0/22, Fa0/23
                                                Fa0/24
10   VLAN0010                         active    Fa0/1
20   VLAN0020                         active    Fa0/2
30   VLAN0030                         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  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

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


Primary Secondary Type              Ports
```

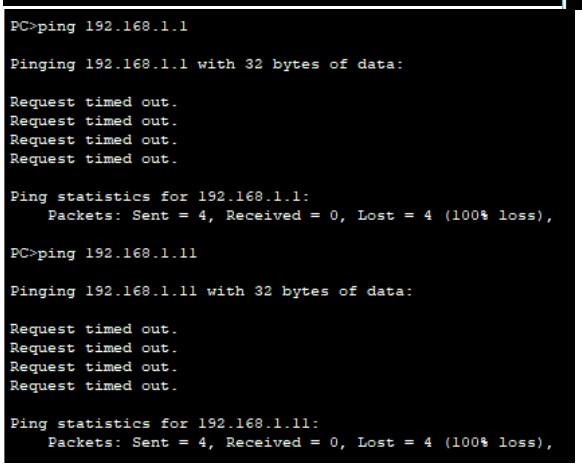
```
Switch#vlan database
% Warning: It is recommended to configure VLAN from config mode,
  as VLAN database mode is being deprecated. Please consult user
  documentation for configuring VTP/VLAN in config mode.

Switch(vlan)#vlan 20
VLAN 20 modified:
Switch(vlan)#exit
APPLY completed.
Exiting....
Switch#config terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#interface f0/2
Switch(config-if)#switchport a vlan 20
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch#sh 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
10   VLAN0010                         active    Fa0/1
20   VLAN0020                         active    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  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
 --More--
```

- 为`PC1`、`PC2`、`PC3`配置好`ip`和掩码后再次互相`ping`，结果请求全部失败







六、实验结论

- 本实验通过Cisco Packet Tracer虚拟实验环境，演示了如何在一个网络中创建和配置虚拟局域网（VLAN）。通过为网络中的主机分配到不同的VLAN，我们成功地模拟了一个多部门企业环境，其中不同部门的网络通信是隔离的。实验的起始状态显示，在未进行VLAN配置时，所有主机之间能够自由通信，说明它们处于同一个广播域中。这反映了传统的局域网设置，其中所有设备都可以互相发现和通信，不论它们的物理或逻辑位置如何。随后，实验通过为每台PC配置不同的VLAN（VLAN10、VLAN20、VLAN30）和相应的IP地址及子网掩码，展示了VLAN划分的过程。配置VLAN后，使用`sh vlan`命令验证了配置的正确性，确认每个VLAN中只有一个主机。最终，通过ping测试验证了VLAN配置的效果。结果表明，不同VLAN之间的主机无法相互ping通，这符合VLAN设计的目标：隔离不同的广播域，确保网络的安全性和效率。这一结果突出了VLAN技术在实现网络逻辑分割和提高网络安全性方面的重要作用。
- VLAN（虚拟局域网）技术的深入理解和应用是现代网络设计和管理中的关键要素。通过本实验，我不仅学习了VLAN的概念和配置过程，还体验了其在实际网络环境中的作用。VLAN通过在单一物理网络基础设施上创建多个逻辑网络，从而实现了对网络资源的高效利用和对网络流量的精细控制。此外，VLAN技术的应用显著提高了网络的安全性。通过将网络流量隔离到不同的VLAN中，可以有效地限制潜在的安全威胁仅在其对应的VLAN内传播，从而减少跨VLAN攻击的风险。例如，一个企业可以将其财务部门的网络流量与其他部门的网络流量隔离，确保敏感信息的安全。VLAN配置的灵活性也为网络设计提供了巨大的自由度。网络管理员可以根据组织的具体需求，如部门划分、项目团队或安全要求，灵活地配置VLAN。这种灵活性确保了网络架构可以随着组织需求的变化而轻松调整，而无需重建整个网络基础设施。