实验一

实验目的

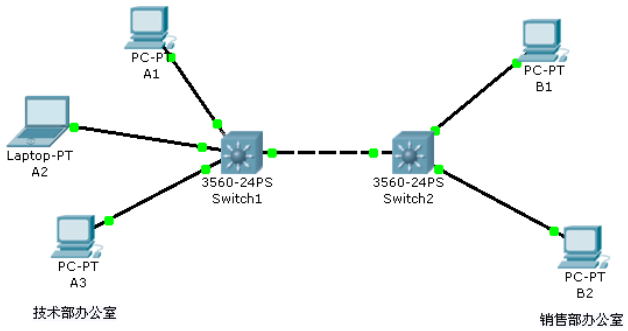
1. 了解 VLAN 交换机的特性与应用场合
2. 掌握 VLAN 交换机组网的基本配置方法

实验环境

模拟软件 Cisco Packet Tracer

实验器材：3560 交换机 2 台，PC 机 5 台，连接线若干

网络拓扑图如下：



图中：A1、A2、A3 连接在 Switch1 上，B1、B2 连接在 Switch2 上

实验内容

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 0/11	Switch1, FastEthernet 0/11
FastEthernet 0/11	Switch2, FastEthernet 0/11		

主机 IP 地址配置

PC主机	IP地址	子网掩码
A1	192. 168. 1. 1	255. 255. 255. 0
A2	192. 168. 1. 2	255. 255. 255. 0
A3	192. 168. 1. 3	255. 255. 255. 0
B1	192. 168. 1. 4	255. 255. 255. 0
B2	192. 168. 1. 5	255. 255. 255. 0

配置主机 IP 地址

- 点击 主机 图标，在弹出的窗口中，点击“Desktop”选项卡，在“IP Configuration”里直接配置 IP 地址和子网掩码。
- 或者在“Command Prompt”里，输入命令

  ipconfig ip_addr net_mask

回答问题：

1. 每台主机相互 ping，查看哪些主机可以连通，哪些不可以？为什么？

   如下图，A1 可以 ping 通 A2 和 B1：

```
C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.1.4

Pinging 192.168.1.4 with 32 bytes of data:

Reply from 192.168.1.4: bytes=32 time=1ms TTL=128
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

   如下图，B1 可以 ping 通 A3 和 B2：

```
C:\>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time<1ms TTL=128
Reply from 192.168.1.3: bytes=32 time<1ms TTL=128
Reply from 192.168.1.3: bytes=32 time<1ms TTL=128
Reply from 192.168.1.3: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 192.168.1.4

Pinging 192.168.1.4 with 32 bytes of data:

Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128
Reply from 192.168.1.4: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

显然，每台主机都是相互连通的，因为交换机的自学习算法会生成帧交换表，交换机会根据帧交换表将收到的帧进行转发。如果交换机不知道从哪个端口转发帧，就会将其通过除进入交换机的接口外的其他所有接口转发。

2. 注：可以用 ping -n 1 255.255.255.255 发起一个受限广播，（参数 -n 1 指明只发送一次，免得默认发送 4 次受到干扰），观察都收到了哪些主机的回复？

如图所示，5 台主机均不支持 ping -n 1 255.255.255.255 指令。

```
C:\>ping -n 1 255.255.255.255
Ping request could not find host 255.255.255.255. Please check the name and
try again.
```

VLAN 配置如下：

VLAN num	VLAN name	Switch port
2	tech	Switch1, port 2, 3
3	sales	Switch1, port1; Switch2, port2, 3

点击 交换机 图标，在弹出的窗口中，点击“CLI”，进入交换机配置终端。

在 Switch1 上创建 VLAN

进入特权模式：

Switch>enable

进入 VLAN 配置模式：

Switch#vlan database

Switch(vlan)#vlan 2 name tech

Switch(vlan)#vlan 3 name sales

Switch(vlan)#exit

进入全局设置模式

Switch#configure terminal

将 Switch1 的各端口划分在 VLAN 中

Switch(config)#interface FastEthernet 0/1

Switch(config-if)#switchport mode access

Switch(config-if)#switchport access vlan 2

Switch(config-if)#interface FastEthernet 0/2

Switch(config-if)#switchport mode access

Switch(config-if)#switchport access vlan 3

Switch(config-if)#interface FastEthernet 0/3

Switch(config-if)#switchport mode access

Switch(config-if)#switchport access vlan 2

配置与 Switch2 连接的 Trunk 接口

Switch(config-if)#interface FastEthernet 0/11

Switch(config-if)#switchport mode trunk

在 Switch2 上创建 VLAN

Switch>enable

Switch#vlan database

Switch(vlan)#vlan 3 name sales

Switch(vlan)#exit

Switch#configure terminal

将 Switch2 的各端口划分在 VLAN 中

Switch(config)#interface FastEthernet 0/1

Switch(config-if)#switchport mode access

Switch(config-if)#switchport access vlan 3

Switch(config-if)#interface FastEthernet 0/2

Switch(config-if)#switchport mode access

Switch(config-if)#switchport access vlan 3

配置与 Switch1 连接的 Trunk 接口

Switch(config-if)#interface FastEthernet 0/11

Switch(config-if)#switchport mode trunk

DTP 的配置

将 Switch1 的 FastEthernet 0/11 接口的 Trunk 配置为 desirable 模式：

Switch1(config)#interface FastEthernet 0/11

Switch1(config-if)#shutdown

Switch1(config-if)#switchport mode dynamic desirable

Switch1(config-if)#no shutdown

将 Switch2 的 FastEthernet 0/11 接口的 Trunk 配置为 auto 模式：

Switch2(config)#interface FastEthernet 0/11

Switch2(config-if)#shutdown

Switch2(config-if)#switchport mode dynamic auto

Switch2(config-if)#no shutdown

实验结果

在 Switch1 上用 show vlan 查看 VLAN 信息

```
Switch#show vlan

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/4, Fa0/5, Fa0/6, Fa0/7
                                                 Fa0/8, Fa0/9, Fa0/10, 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    tech                              active    Fa0/1, Fa0/3
3    sales                             active    Fa0/2
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
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
------- --------- ----------------- ------------------------------------------
```

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

```
Switch#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
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

在 Switch1 上用 show interfaces FastEthernet 0/2 switchport 查看端口信息

```
Switch#show interfaces FastEthernet 0/2 switchport
Name: Fa0/2
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
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

在 Switch1 上用 show interfaces FastEthernet 0/11 switchport 查看端口信息

```
Switch#show interfaces FastEthernet 0/11 switchport
Name: Fa0/11
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
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

在 Switch2 上用 show vlan 查看 VLAN 信息

```
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
                                                 Fa0/12, 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
3    sales                             active    Fa0/1, Fa0/2
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
3    enet  100003     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
------- --------- ----------------- ------------------------------------------
```

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

```
Switch#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
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

在 Switch2 上用 show interfaces FastEthernet 0/11 switchport 查看端口信息

```
Switch#show interfaces FastEthernet 0/11 switchport
Name: Fa0/11
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
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

在配置 VLAN 之后，回答【问题 2】:

1. 每台主机相互 ping，查看哪些主机可以连通，哪些不可以？为什么？

   如下图，A1 可以 ping 通 A3：

```
C:\>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time<1ms TTL=128
Reply from 192.168.1.3: bytes=32 time=4ms TTL=128
Reply from 192.168.1.3: bytes=32 time<1ms TTL=128
Reply from 192.168.1.3: bytes=32 time=4ms TTL=128

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 4ms, Average = 2ms
```

   如下图，A1 不能 ping 通 A2：

```
C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

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

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

如下图，A1 不能 ping 通 B2：

```
C:\>ping 192.168.1.5

Pinging 192.168.1.5 with 32 bytes of data:

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

Ping statistics for 192.168.1.5:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

如下图，B1 可以 ping 通 A2：

```
C:\>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128
Reply from 192.168.1.2: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

如下图，B1 不能 ping 通 A1：

```
C:\>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

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

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

如下图，B1 可以 ping 通 B2：

```
C:\>ping 192.168.1.5

Pinging 192.168.1.5 with 32 bytes of data:

Reply from 192.168.1.5: bytes=32 time<1ms TTL=128
Reply from 192.168.1.5: bytes=32 time<1ms TTL=128
Reply from 192.168.1.5: bytes=32 time<1ms TTL=128
Reply from 192.168.1.5: bytes=32 time<1ms TTL=128

Ping statistics for 192.168.1.5:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

显然，A1 和 A3 之间是相互连通的，A2、B1 和 B2 之间是相互连通的，而 A1、A3 与 A2、B1、B2 之间是不连通的。因为 A1 和 A3 在 vlan 2 中，而 A2、B1 和 B2 在 vlan 3 中。

2. 注：可以用 ping -n 1 255.255.255.255 发起一个受限广播，（参数 -n 1 指明只

发送一次，免得默认发送 4 次受到干扰），观察都收到了哪些主机的回复？

如图所示，5 台机器均不支持 ping -n 1 255.255.255.255 指令。

```
C:\>ping -n 1 255.255.255.255
Ping request could not find host 255.255.255.255. Please check the name and
try again.
```

经过 DTP 配置：

在 Switch1 上用 show interfaces FastEthernet 0/11 switchport 查看端口信息

```
Switch#show interfaces FastEthernet 0/11 switchport
Name: Fa0/11
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
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

在 Switch2 上用 show interfaces FastEthernet 0/11 switchport 查看端口信息

```
Switch#show interfaces FastEthernet 0/11 switchport
Name: Fa0/11
Switchport: Enabled
Administrative Mode: dynamic auto
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
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: All
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL
Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

课堂实验

1、将 Switch1 和 Switch2 都设置为 negotiate 模式，考察以下组合，哪些可以形成 Trunk？

	Switch2 trunk	Switch2 dynamic desirable	Switch2 dynamic auto
Switch1 trunk	✔	✔	✔
Switch1 dynamic desirable	✔	✔	✔
Switch1 dynamic auto	✔	✔	✘

2、将 Switch1 设置为 nonegotiate 模式，Switch2 仍为 negotiate 模式，再考察以下组合，哪些可以形成 Trunk？在配置时与两者都是 negotiate 模式时有什么区别？（注意：考虑将 Switch1 设置为 nonegotiate 模式时，Switch1 还能否设置为 dynamic desirable 或 dynamic auto 模式？）

	Switch2 trunk	Switch2 dynamic desirable	Switch2 dynamic auto
Switch1 trunk	✔	✔	✘
Switch1 dynamic desirable	✘	✘	✘
Switch1 dynamic auto	✘	✘	✘

将 Switch1 设置为 nonegotiate 模式时，Switch1 只能设置为 trunk 模式或 access 模式。