Packet Tracer 5.0 实验(一) 交换机的基本配置与管理

一、实验目标

掌握交换机基本信息的配置与管理

二、技术原理

交换机的管理方式基本分为两种：带内管理和带外管理。

- 通过交换机的 Console 端口管理交换机属于带外管理：这种管理方式不占用交换机的网络端口，第一次配置交换机必须利用 Console 端口进行配置。
- 通过远程 Telnet、拨号等方式属于带内管理。

三、交换机的命令行操作模式

主要包括：

用户模式　　Switch>

特权模式　　Switch#

全局配置模式　　Switch(config)#

端口模式　　Switch(config-if)#

四、实验步骤

1、实验拓扑

2、交换机基本配置命令

a. 进入特权模式

Switch>enable //en=enable

Switch#

b. 进入全局配置模式

Switch#configure terminal //conf t=configure terminal

Enter configuration commands, one per line. End with CNTL/Z.

c. 进入交换机端口视图模式

Switch(config)#interface fastEthernet 0/1 //int f0/1=interface fastEthernet 0/1

Switch(config-if)#

d. 配置交换机端口速度

Switch(config-if)#speed ?

```
10    Force 10 Mbps operation
100   Force 100 Mbps operation
auto  Enable AUTO speed configuration
```

Switch(config-if)#speed 100

e. 配置交换机端口双工模式

Switch(config-if)#duplex ?

```
auto Enable AUTO duplex configuration
full Force full duplex operation
half Force half-duplex operation
```

Switch(config-if)#duplex full

f. 退回到上一级模式

Switch(config-if)#exit

Switch(config)#

g. 直接退回到特权模式

Switch(config-if)#end

Switch#

%SYS-5-CONFIG_I: Configured from console by console

Switch#

h. 查看交换机版本信息

Switch#show version

```
Cisco IOS Software, C2960 Software (C2960-LANBASE-M), Version
12.2(25)FX, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Wed 12-Oct-05 22:05 by pt_team

ROM: C2960 Boot Loader (C2960-HBOOT-M) Version 12.2(25r)FX, RELEASE
SOFTWARE (fc4)

System returned to ROM by power-on

Cisco WS-C2960-24TT (RC32300) processor (revision C0) with 21039K
bytes of memory.


24 FastEthernet/IEEE 802.3 interface(s)
2 Gigabit Ethernet/IEEE 802.3 interface(s)
```

```
63488K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address       : 0040.0B69.8831
Motherboard assembly number     : 73-9832-06
Power supply part number        : 341-0097-02
Motherboard serial number       : FOC103248MJ
Power supply serial number      : DCA102133JA
Model revision number           : B0
Motherboard revision number     : C0
Model number                    : WS-C2960-24TT
System serial number            : FOC1033Z1EY
  --More--
...
Configuration register is 0xF
```

i. 查看当前生效的配置信息

Switch#show running-config

```
Building configuration...

Current configuration : 1033 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
!
!
interface FastEthernet0/1
 duplex full
 speed 100
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
 --More--
...
```

```
!
!
end
```

j. 帮助信息

① Switch#?

```
Exec commands:
  <1-99>     Session number to resume
  clear      Reset functions
  clock      Manage the system clock
  configure   Enter configuration mode
  connect    Open a terminal connection
  copy       Copy from one file to another
  debug      Debugging functions (see also 'undebug')
  delete     Delete a file
  dir        List files on a filesystem
  disable    Turn off privileged commands
  disconnect  Disconnect an existing network connection
  enable     Turn on privileged commands
  erase      Erase a filesystem
  exit       Exit from the EXEC
  logout     Exit from the EXEC
  more       Display the contents of a file
  no         Disable debugging informations
  ping       Send echo messages
  reload     Halt and perform a cold restart
  resume     Resume an active network connection
  setup      Run the SETUP command facility
 --More--
```

② Switch#co?

```
configure  connect  copy
```

③ Switch#copy ?

```
  flash:          Copy from flash: file system
  ftp:            Copy from ftp: file system
  running-config  Copy from current system configuration
  startup-config  Copy from startup configuration
  tftp:           Copy from tftp: file system
```

Packet Tracer 5.0 实验(二) 交换机的 Telnet 远程登录设置

一、实验目标

掌握采用 telnet 方式配置交换机的方法

二、技术原理

- 配置交换机的管理 IP 地址(计算机的 IP 地址与交换机管理 IP 地址在同一网段)；
- 为 telnet 用户配置用户名和登录口令：

Switch(config)#enble password xxxx //设置进入特权模式的密码；

Switch(config-line)#password xxxx //可以设置通过 console 端口连接设备及 telnet 远程登录时所需要的密码。

```
Switch(config)#line console 0
Switch(config-line)#password xxxx          //设置通过 console 端口连接设备的密码
Switch(config-line)#login
Switch(config)#line vty 0 4
Switch(config-line)#password xxxx          //设置 telnet 远程登录密码
Switch(config-line)#login
```

三、实验步骤

实验拓扑

Switch>en
Switch#conf t
Enter configuration commands, one per line. End with CNTL/Z.

1、配置交换机的管理 IP 地址

Switch(config)#interface vlan 1 //默认情况

下交换机所有端口都处于 vlan 1 当中

Switch(config-if)#ip address 192.168.1.1

255.255.255.0 //配置交换机管理 IP 地址

Switch(config-if)#no shutdown //开启

Interface Vlan1

%LINK-5-CHANGED: Interface Vlan1, changed state to up

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up

Switch(config-if)#exit

2、设置进入特权模式的密码

Switch(config)#enable password 123456 //设置进入特

权模式的密码

```
Switch(config)#line console ?
  <0-0>  First Line number
```

3、设置通过 console 端口连接设备的密码

```
Switch(config)#line console 0
Switch(config-line)#password asdf                    //设置通过
```

console 端口连接设备的密码

```
Switch(config-line)#login
Switch(config-line)#exit
Switch(config)#line vty ?
  <0-15>  First Line number
```

4、设置 telnet 远程登录密码

```
Switch(config)#line vty 0 4
Switch(config-line)#password abc123                  //设置
```

telnet 远程登录密码

```
Switch(config-line)#login
Switch(config-line)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

5、查看配置情况

```
Switch#show running-config
Building configuration...

Current configuration : 1064 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
enable password 123456
```

```
!
!
!
interface FastEthernet0/1
!
......
!
interface FastEthernet0/24
!
interface GigabitEthernet1/1
!
interface GigabitEthernet1/2
!
interface Vlan1
 ip address 192.168.1.1 255.255.255.0
!
!
line con 0
 password asdf
 login
!
line vty 0 4
 password abc123
 login
line vty 5 15
 login
!
!
end


Switch#
```

四、验证

1、验证通过 console 端口连接设备的密码

```
Press RETURN to get started.


User Access Verification
```

Password: //这里输入 asdf

Switch>

2、验证进入特权模式的密码

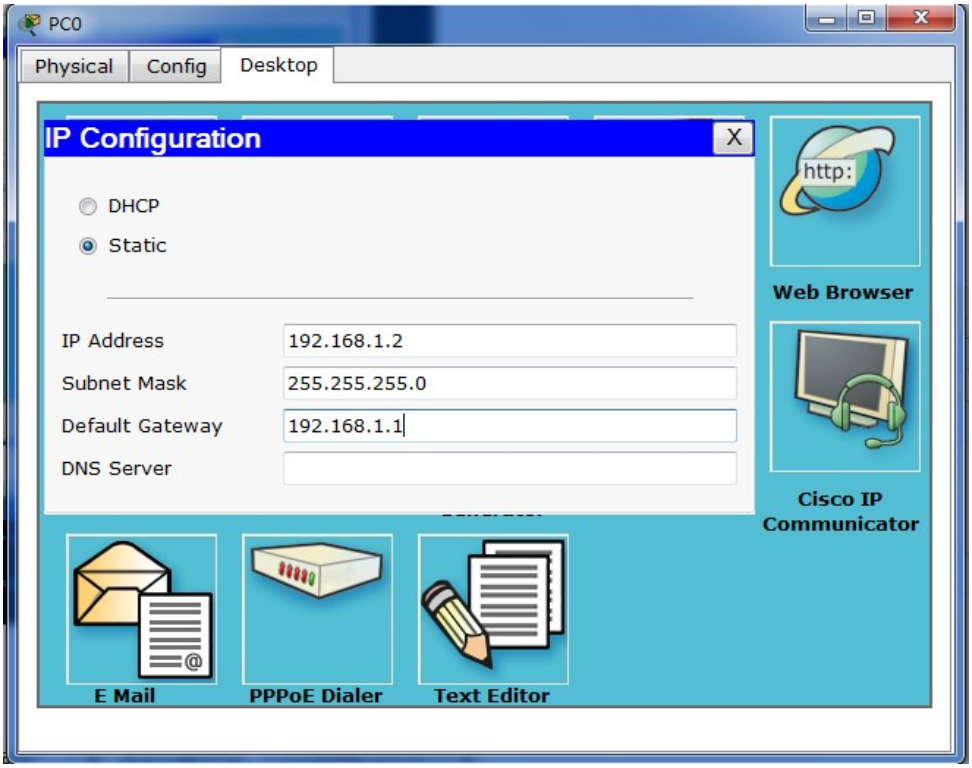
Switch>en

Password: //这里输入 123456

Switch#

3、验证 telnet 远程登录密码

a. 给 PC 机设置 IP 地址



b. 打开 Command Prompt

Packet Tracer PC Command Line 1.0

PC>ipconfig

IP Address.....: 192.168.1.2

Subnet Mask.....: 255.255.255.0

Default Gateway.....: 192.168.1.1

PC>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:

Request timed out.

Reply from 192.168.1.1: bytes=32 time=32ms TTL=255

Reply from 192.168.1.1: bytes=32 time=32ms TTL=255

Reply from 192.168.1.1: bytes=32 time=31ms TTL=255

Ping statistics for 192.168.1.1:

Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),

Approximate round trip times in milli-seconds:

Minimum = 31ms, Maximum = 32ms, Average = 31ms

PC>telnet 192.168.1.1 //远程登录

Trying 192.168.1.1 ...Open

User Access Verification

Password: //vty 密码

Switch>en

Password: //enable 密码

```
Switch#show running-config
Building configuration...

Current configuration : 1063 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
enable password 123456
!
!
!
interface FastEthernet0/1
!
......
interface FastEthernet0/24
!
interface GigabitEthernet1/1
!
interface GigabitEthernet1/2
!
interface Vlan1
 ip address 192.168.1.1 255.255.255.0
!
```

```
!
line con 0
 password asdf
 login
!
line vty 0 4
 password abc123
 login
line vty 5 15
 login
!
!
end

Switch#
```

Packet Tracer 5.0 实验(三) 交换机划分 VLAN 配置

一、实验目标

- 理解虚拟 LAN(VLAN)基本原理；
- 掌握一般交换机按端口划分 VLAN 的配置方法；
- 掌握 Tag VLAN 配置方法。

二、实验背景

某一公司内财务部、销售部的 PC 通过 2 台交换机实现通信；要求财务部和销售部内的 PC 可以互通，但为了数据安全起见，销售部和财务部需要进行隔离，现要在交换机上做适当配置来实现这一目的。

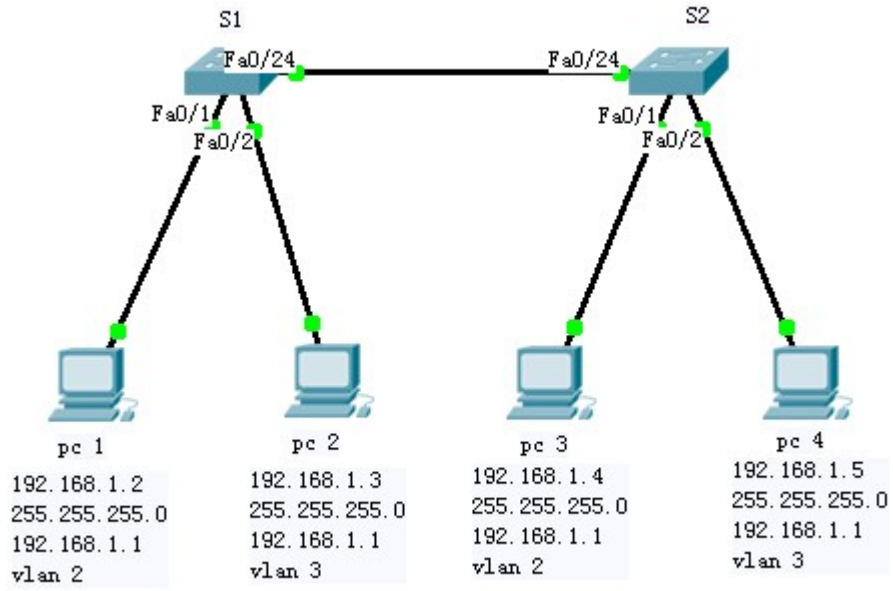
三、技术原理

- VLAN 是指在一个物理网段内，进行逻辑的划分，划分成若干个虚拟局域网。VLAN 最大的特性是不受物理位置的限制，可以进行灵活的划分。VLAN 具备了一个物理网段所具备的特性。相同 VLAN 内的主机可以相互直接通信，不同 VLAN 间的主机之间互相访问必须经由路由设备进行转发。广播数据包只可以在本 VLAN 内进行广播，不能传输到其他 VLAN 中。
- Port VLAN 是实现 VLAN 的方式之一，它利用交换机的端口进行 VLAN 的划分，一个端口只能属于一个 VLAN。

- Tag VLAN 是基于交换机端口的另外一种类型，主要用于使交换机的相同 VLAN 内的主机之间可以直接访问，同时对于不同 VLAN 的主机进行隔离。Tag VLAN 遵循 IEEE802.1Q 协议的标准。在使用配置了 Tag VLAN 的端口进行数据传输时，需要在数据帧内添加 4 个字节的 802.1Q 标签信息，用于标示该数据帧属于哪个 VLAN，便于对端交换机收到数据帧后进行准确的过滤。

四、实验步骤

实验拓扑



1、设置四台 PC 机 IP 地址如图所示。

2、对交换机 S1 进行设置。

```
Switch>en
Switch#conf t
```

```
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S1                          //设置主机名
S1(config)#vlan 2                                  //划分 VLAN 2
S1(config-vlan)#exit
S1(config)#vlan 3                                  //划分 VLAN 3
S1(config-vlan)#exit
S1(config)#interface fa0/1
S1(config-if)#switchport access vlan 2              //将 fa0/1 划分到
VLAN 2
S1(config-if)#exit
S1(config)#interface fa0/2
S1(config-if)#switchport access vlan 3              //将 fa0/2 划分到
VLAN 3
S1(config-if)#exit
S1(config)#interface fa0/24                         //设置 fa0/24 端口
模式为 trunk
S1(config-if)#switchport mode trunk
S1(config-if)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#show vlan                                       //查看 VLAN 划分情况

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, Gig1/1, Gig1/2
2    VLAN0002                     active    Fa0/1
3    VLAN0003                     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
TranS1
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------
------
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

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



Primary Secondary Type              Ports
------- --------- -----------------
-----------------------------------------
S1#show running-config
Building configuration...

Current configuration : 1080 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S1
!
!
!
interface FastEthernet0/1
 switchport access vlan 2
!
interface FastEthernet0/2
 switchport access vlan 3
!
interface FastEthernet0/3
!
.......
!
```

```
interface FastEthernet0/24
 switchport mode trunk
!
interface GigabitEthernet1/1
!
interface GigabitEthernet1/2
!
interface Vlan1
 no ip address
 shutdown
!
!
line con 0
!
line vty 0 4
 login
line vty 5 15
 login
!
!
end


S1#
```

3、对交换机 S2 进行设置。

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S2
S2(config)#vlan 2
S2(config-vlan)#exit
S2(config)#vlan 3
S2(config-vlan)#exit
S2(config)#interface fa0/1
S2(config-if)#switchport access vlan 2
S2(config-if)#exit
S2(config)#interface fa0/2
S2(config-if)#switchport access vlan 3
S2(config-if)#exit
S2(config)#interface fa0/24
S2(config-if)#switchport mode trunk
S2(config-if)#end
```

```
S2#
%SYS-5-CONFIG_I: Configured from console by console

S2#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
                                               Fa0/11, Fa0/12, Fa0/13,
Fa0/14
                                               Fa0/15, Fa0/16, Fa0/17,
Fa0/18
                                               Fa0/19, Fa0/20, Fa0/21,
Fa0/22
                                               Fa0/23, Gig1/1, Gig1/2
2    VLAN0002                         active    Fa0/1
3    VLAN0003                         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
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

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



Primary Secondary Type              Ports
```

```
------- --------- -----------------
----------------------------------------
S2#show running-config
Building configuration...

Current configuration : 1080 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S2
!
!
!
interface FastEthernet0/1
 switchport access vlan 2
!
interface FastEthernet0/2
 switchport access vlan 3
!
interface FastEthernet0/3
!
......
!
interface FastEthernet0/24
 switchport mode trunk
!
interface GigabitEthernet1/1
!
interface GigabitEthernet1/2
!
interface Vlan1
 no ip address
 shutdown
!
!
line con 0
!
line vty 0 4
 login
line vty 5 15
 login
```

```
!
!
end


S2#
```

五、验证

打开 PC1 的 Command Prompt

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address.....................: 192.168.1.2
Subnet Mask....................: 255.255.255.0
Default Gateway................: 192.168.1.1

PC>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Request timed out.                          //不同 VLAN 间无法 PING 通
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.1.3:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),


PC>ping 192.168.1.4

Pinging 192.168.1.4 with 32 bytes of data:

Reply from 192.168.1.4: bytes=32 time=172ms TTL=128              //
相同 VLAN 可以 PING 通
Reply from 192.168.1.4: bytes=32 time=78ms TTL=128
Reply from 192.168.1.4: bytes=32 time=63ms TTL=128
Reply from 192.168.1.4: bytes=32 time=79ms 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 = 63ms, Maximum = 172ms, Average = 98ms
```

Packet Tracer 5.0 实验(四) 利用三层交换机实现 VLAN 间路由

一、实验目标

- 掌握交换机 Tag VLAN 的配置；
- 掌握三层交换机基本配置方法；
- 掌握三层交换机 VLAN 路由的配置方法；
- 通过三层交换机实现 VLAN 间相互通信；

二、实验背景

某企业有两个主要部门，技术部和销售部，分处于不同的办公室，为了安全和便于管理，对两个部门的主机进行了 VLAN 的划分，技术部和销售部分处于不同的 VLAN。现由于业务的需求，需要销售部和技术部的主机能够相互访问，获得相应的资源，两个部门的交换机通过一台三层交换机进行了连接。

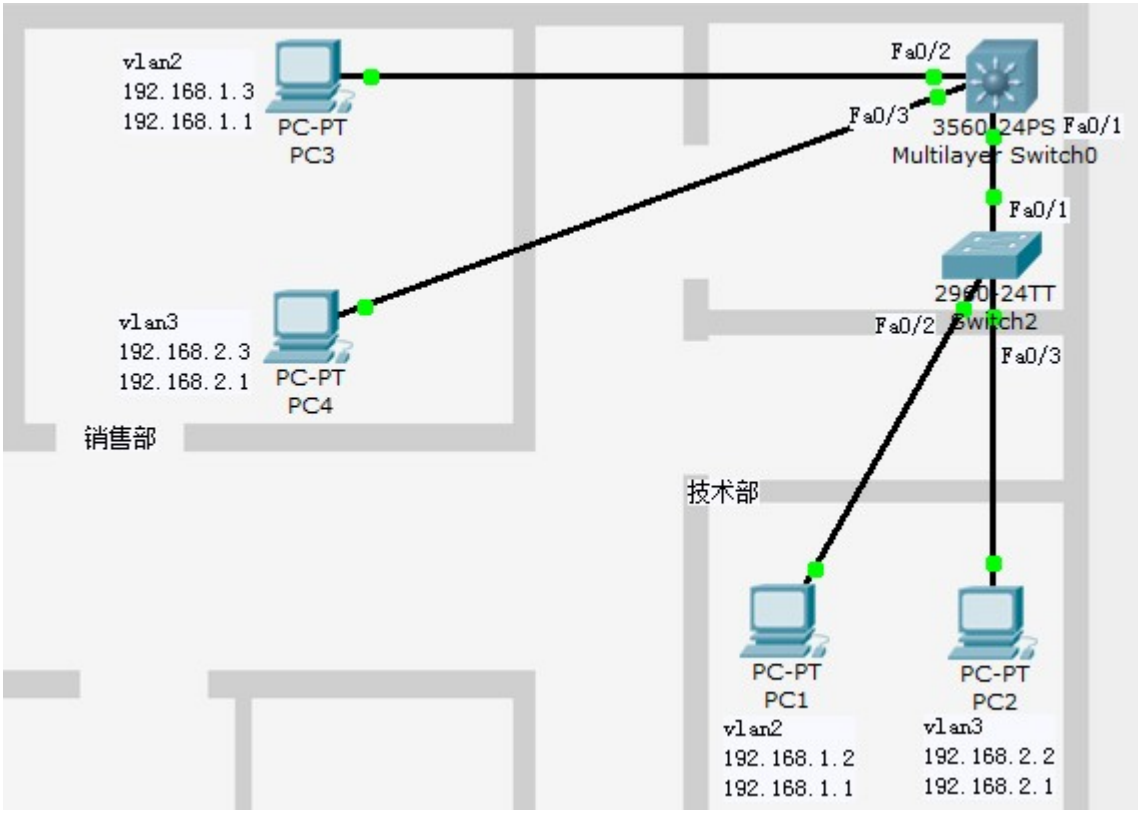
三、技术原理

三层交换机具备网络层的功能，实现 VLAN 间相互访问的原理是：利用三层交换机的路由功能，通过识别数据包的 IP 地址，查找路由表进行选路转发。三层交换机利用直连路由可以实现不同 VLAN 之间的互相访问。三层交换机给接口配置 IP 地址，采用 SVI(交换虚拟接口)的方式实现

VLAN 间互连。SVI 是指为交换机中的 VLAN 创建虚拟接口，并且配置 IP 地址。

四、实验步骤

实验拓扑



1、在二层交换机上配置 VLAN 2、VLAN 3，分别将端口 2、端口 3 划到 VLAN 2、VLAN 3；

2、将二层交换机与三层交换机相连的端口 Fa0/1 定义为 Tag VLAN 模式；

```
Switch>en
Switch#conf t
```

```
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 2
Switch(config-vlan)#exit
Switch(config)#vlan 3
Switch(config-vlan)#exit
Switch(config)#interface fa0/2
Switch(config-if)#switchport access vlan 2
Switch(config-if)#exit
Switch(config)#interface fa0/3
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#interface fa0/1
Switch(config-if)#switchport mode trunk

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up

Switch(config-if)#
```

3、在三层交换机上配置 VLAN 2、VLAN 3，分别将端口 2、端口 3 划到 VLAN 2、VLAN 3；

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 2
Switch(config-vlan)#exit
Switch(config)#vlan 3
Switch(config-vlan)#exit
Switch(config)#interface fa0/2
Switch(config-if)#switchport access vlan 2
Switch(config-if)#exit
Switch(config)#interface fa0/3
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#
```

4、设置三层交换机 VLAN 间通信，创建 VLAN 2、VLAN 3 的虚拟接口，并配置虚拟接口 VLAN 2、VLAN 3 的 IP 地址；

```
Switch(config)#interface vlan 2                                    //创建
VLAN 2 的虚拟接口
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan2, changed state
to up

Switch(config-if)#ip address 192.168.1.1 255.255.255.0          //
配置虚拟接口 VLAN 2 的 IP 地址
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface vlan 3                                    //创建
VLAN 2 的虚拟接口
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan3, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan3, changed state
to up

Switch(config-if)#ip address 192.168.2.1 255.255.255.0          //
配置虚拟接口 VLAN 2 的 IP 地址
Switch(config-if)#no shutdown
Switch(config-if)#end
Switch#
```

5、查看三层交换机路由表

```
Switch#show ip route
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   192.168.1.0/24 is directly connected, Vlan2
C   192.168.2.0/24 is directly connected, Vlan3
Switch#
```

6、将 VLAN 2、VLAN 3 下的主机默认网关分别设置为相应虚拟接口的 IP 地址；

五、验证

打开 PC1 Command Prompt

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address.....................: 192.168.1.2
Subnet Mask....................: 255.255.255.0
Default Gateway................: 192.168.1.1

PC>ping 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time=187ms TTL=128
Reply from 192.168.1.3: bytes=32 time=93ms TTL=128
Reply from 192.168.1.3: bytes=32 time=110ms TTL=128
Reply from 192.168.1.3: bytes=32 time=93ms 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 = 93ms, Maximum = 187ms, Average = 120ms

PC>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.2: bytes=32 time=188ms TTL=127
Reply from 192.168.2.2: bytes=32 time=112ms TTL=127
Reply from 192.168.2.2: bytes=32 time=125ms TTL=127

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
```

```
    Minimum = 112ms, Maximum = 188ms, Average = 141ms

PC>ping 192.168.2.3

Pinging 192.168.2.3 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.3: bytes=32 time=125ms TTL=127
Reply from 192.168.2.3: bytes=32 time=78ms TTL=127
Reply from 192.168.2.3: bytes=32 time=64ms TTL=127

Ping statistics for 192.168.2.3:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 64ms, Maximum = 125ms, Average = 89ms
```

Packet Tracer 5.0 实验(五) 快速生成树配置

一、实验目标

- 理解生成树协议工作原理；
- 掌握快速生成树协议 RSTP 基本配置方法；

二、实验背景

学校为了开展计算机教学和网络办公，建立了一个计算机教室和一个校办公区，这两处的计算机网络通过两台交换机互相连接组成内部校园网，为了提高网络的可靠性，作为网络管理员，你要用 2 条链路将交换机互连，现要求在交换机上做适当的配置，使网络避免环路。

三、技术原理

生成树协议(spanning-tree)，作用是在交换网络中提供冗余备份链路，并且解决交换网络中的环路问题；

生成树协议是利用 SPA 算法，在存在交换环路的网络中生成一个没有环路的树形网络。运用该算法将交换网络的冗余备份链路从逻辑上断开，当主链路出现故障时，能够自动的切换到备份链路，保证数据的正常转发；

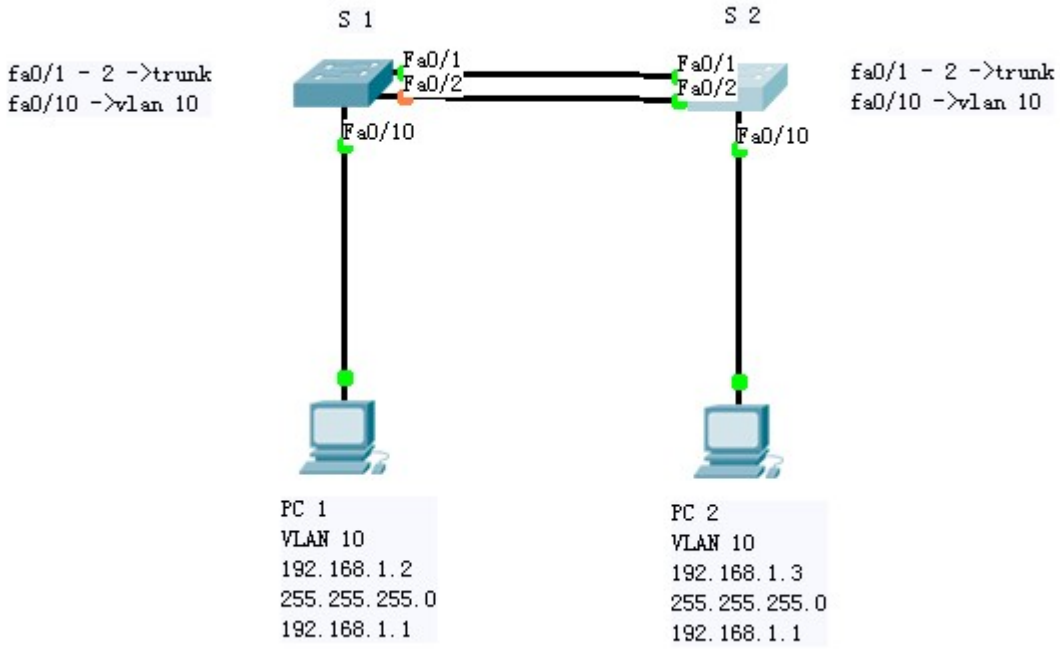
生成树协议版本：STP、RSTP(快速生成树)、MSTP(多生成树协议)；

生成树协议的特点是收敛时间长，从主要链路出现故障到切换至备份链路需要 50 秒的时间；

快速生成树协议在生成树协议的基础上增加了两种端口角色：替换端口和备份端口，分别做为根端口和指定端口的冗余端口。当根端口或指定端口出现故障时，冗余端口不需要经过 50 秒的收敛时间，可以直接切换到替换端口或备份端口，从而实现 RSTP 协议小于 1 秒的快速收敛。

四、实验步骤

实验拓扑



默认情况下 STP 协议启用的，通过两台交换机之间传送 BPDU 协议数据单元，选出根交换机、根端口等，以便确定端口的转发状态。上图中标记为橙色的端口处于 block 堵塞状态。

设置 RSTP

查看交换机 show spanning-tree 状态，了解根交换机和根端口情况；

通过更改交换机生成树的优先级 spanning-tree vlan * priority 4096

可以变化根交换机的角色；

S1：

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S1
S1(config)#end
S1#
%SYS-5-CONFIG_I: Configured from console by console

S1#show spanning-tree                                    //查看交换机
spanning-tree 状态
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0060.5C36.5620
             Cost        19
             Port        1(FastEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0060.7078.8BDE
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- --------
--------------------------------
Fa0/10           Desg FWD 19        128.10   P2p
Fa0/1            Root FWD 19        128.1    P2p
Fa0/2            Altn BLK 19        128.2    P2p

S1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
S1(config)#interface fa0/10
```

```
S1(config-if)#switchport access vlan 10                          //将
fa0/10 划分到 vlan 10
% Access VLAN does not exist. Creating vlan 10
S1(config-if)#exit
S1(config)#interface range fa0/1 - 2                             //设
置 fa0/1,fa0/2 端口状态为 trunk 模式
S1(config-if-range)#switchport mode trunk

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up


%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to up

S1(config-if-range)#exit
S1(config)#spanning-tree mode ?                                  //设置
spanning-tree 为 RSTP 模式
  pvst       Per-Vlan spanning tree mode
  rapid-pvst  Per-Vlan rapid spanning tree mode
S1(config)#spanning-tree mode rapid-pvst
S1(config)#
```

S2:

```
Switch>en
Switch#show spanning-tree
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0060.5C36.5620
             This bridge is the root                             //根交
换机
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0060.5C36.5620
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
```

```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- --------
--------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/10           Desg FWD 19        128.10   P2p

Switch#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2,
changed state to up

Switch#
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S2
S2(config)#interface fa0/10
S2(config-if)#switchport access vlan 10
% Access VLAN does not exist. Creating vlan 10
S2(config-if)#exit
S2(config)#interface range fa0/1 - 2
S2(config-if-range)#switchport mode trunk
S2(config-if-range)#exit
S2(config)#spanning-tree mode rapid-pvst
S2(config)#
```

五、测试

当主链路处于 down 状态时，能够自动的切换到备份链路，保证数据的正常转发。

在 S2 上 shutdown 掉 fa0/1

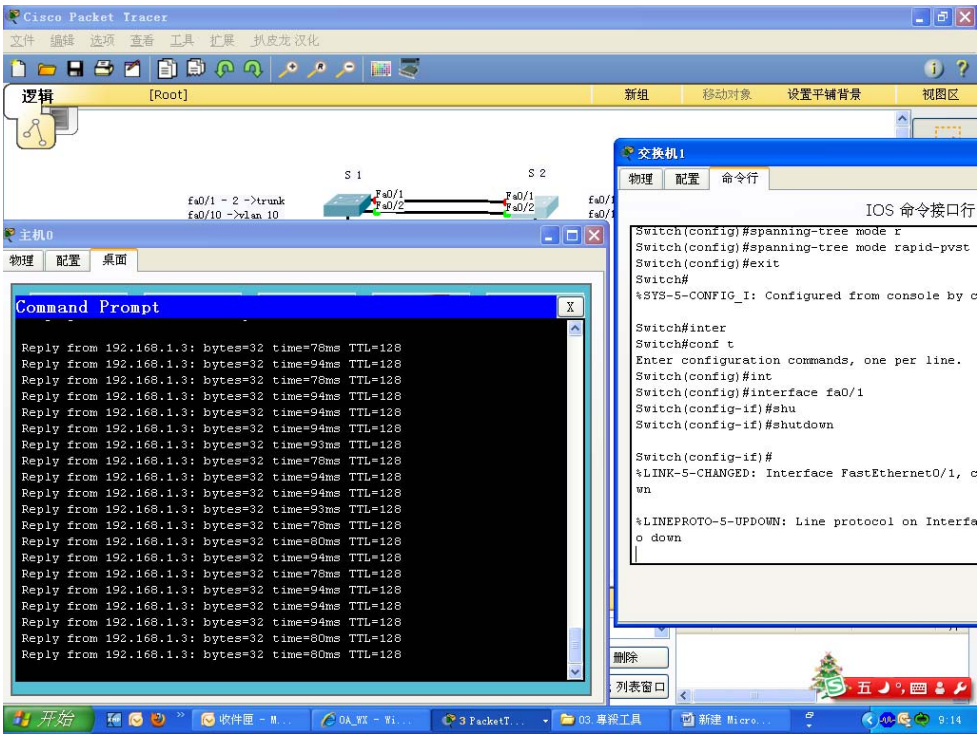
```
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int
Switch(config)#interface fa0/1
Switch(config-if)#shu
Switch(config-if)#shutdown
//shutdown fa0/1 端口

Switch(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to
administratively down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to down


Switch#show spanning-tree
VLAN0001
  Spanning tree enabled protocol rstp
  Root ID    Priority    32769
             Address     0001.63E2.4A7A
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0001.63E2.4A7A
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface       Role Sts Cost     Prio.Nbr Type
---------------- ---- --- --------- --------
--------------------------------
Fa0/1           Desg FWD 19       128.1    P2p
Fa0/2           Desg FWD 19       128.2    P2p

VLAN0010

  Spanning tree enabled protocol rstp
  Root ID    Priority    32778
             Address     0001.63E2.4A7A
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
```

```
 Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
           Address     0001.63E2.4A7A
           Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
           Aging Time  20

Interface       Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- --------
--------------------------------
Fa0/1           Desg FWD 19        128.1    P2p
Fa0/2           Desg FWD 19        128.2    P2p
Fa0/10          Desg FWD 19        128.10   P2p

Switch#
```

PC1:

```
PC>ipconfig

IP Address......................: 192.168.1.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.1.1

PC>ping -t 192.168.1.3

Pinging 192.168.1.3 with 32 bytes of data:

Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=93ms TTL=128
Reply from 192.168.1.3: bytes=32 time=93ms TTL=128
Reply from 192.168.1.3: bytes=32 time=62ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=79ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
......
```

测试效果:


Cisco Packet Tracer
文件 编辑 选项 查看 工具 扩展 扒皮龙 汉化
逻辑
[Root]
新组
移动对象
设置平铺背景
视图区
S1
S2
fa0/1 - 2 ->trunk
fa0/10 ->vlan 10
Fa0/1
Fa0/2
主机0
物理
配置
桌面
Command Prompt
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=93ms TTL=128
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=93ms TTL=128
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=80ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=78ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=94ms TTL=128
Reply from 192.168.1.3: bytes=32 time=80ms TTL=128
Reply from 192.168.1.3: bytes=32 time=80ms TTL=128
交换机1
物理
配置
命令行
IOS 命令接口行
Switch(config)#spanning-tree mode r
Switch(config)#spanning-tree mode rapid-pvst
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by c
Switch#inter
Switch#conf t
Enter configuration commands, one per line.
Switch(config)#int
Switch(config)#interface fa0/1
Switch(config-if)#shu
Switch(config-if)#shutdown
Switch(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, c
wn
%LINEPROTO-5-UPDOWN: Line protocol on Interfa
o down
删除
列表窗口
开始
9:14

Packet Tracer 5.0 实验(六) 路由器基本配置

一、实验目标

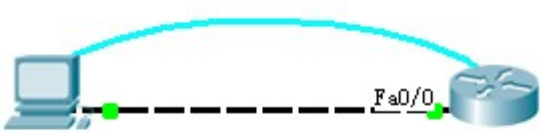
- 掌握路由器几种常用配置方法；
- 掌握采用 Console 线缆配置路由器的方法；
- 掌握采用 telnet 方式配置路由器的方法；
- 熟悉路由器不同的命令行操作模式以及各种模式之间的切换；
- 掌握路由器的基本配置命令；

二、技术原理

路由器的管理方式基本分为两种：带内管理和带外管理。通过路由器的 Console 口管理路由器属于带外管理，不占用路由器的网络接口，其特点是需要使用配置线缆，近距离配置。第一次配置时必须利用 Console 端口进行配置。

三、实验步骤

实验拓扑



1、用标准 console 线缆连接计算机的串口和路由器的 console 口，在计算机上启用超级终端，并配置超级终端的参数，使计算机与路由器通过 console 口建立连接；

2、配置路由器的管理 IP 地址，并为 telnet 用户配置用户名和登录口令。配置计算机的 IP 地址(与路由器管理 IP 地址在同一个网段)，通过网线将计算机和路由器相连，通过计算机 telnet 到路由器上进行查看配置；

3、更改路由器的主机名；

4、擦除配置信息、保存配置信息、显示配置信息；

5、显示当前配置信息；

6、显示历史命令；

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface fa0/0
Router(config-if)#no shutdown                              //路由器端口默认关闭，开启 fa0/0 端口

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#hostname R1                                 //修改路由器主机名
R1(config)#enable password 123456                          //设置进入特权模式密码
R1(config)#line vty 0 4
R1(config-line)#password abc123                            //设置 telnet 远程登录密码
R1(config-line)#login
```

```
R1(config-line)#exit
R1(config)#interface fa0/0
R1(config-if)#ip address 192.168.1.1 255.255.255.0          //配置路由器的管理 IP 地址
R1(config-if)#no shutdown                                    //开启端口
R1(config-if)#end

%SYS-5-CONFIG_I: Configured from console by console
R1#
```

四、PC 端登录测试

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address.....................: 192.168.1.2
Subnet Mask....................: 255.255.255.0
Default Gateway................: 192.168.1.1

PC>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time=12ms TTL=128
Reply from 192.168.1.2: bytes=32 time=0ms 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 = 12ms, Average = 3ms

PC>telnet 192.168.1.1
Trying 192.168.1.1 ...Open


User Access Verification

Password:                  //输入 vty 密码
R1>en
Password:                  //输入 enable 密码
```

```
R1#
R1#show running-config      //查看配置信息
Building configuration...

Current configuration : 501 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
!
!
enable password 123456
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Vlan1
```

```
 no ip address
 shutdown
!
ip classless
!
!
!
!
!
!
!
line con 0
line vty 0 4
 password abc123
 login
!
!
!
end


R1#
```

Packet Tracer 5.0 实验(七) 路由器单臂路由配置

一、实验目标

- 掌握单臂路由配置方法；
- 通过单臂路由实现不同 VLAN 间互相通信；

二、实验背景

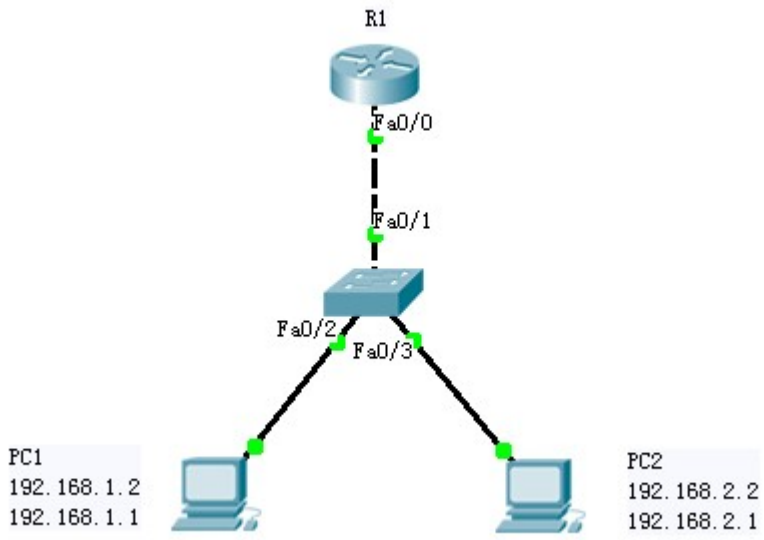
某企业有两个主要部门：技术部和销售部，分处于不同的办公室，为了安全和便于管理，对两个部门的主机进行了 VLAN 的划分，技术部和销售部分处于不同的 VLAN。现由于业务的需求，需要销售部和技术部的主机能够相互访问，获得相应的资源，两个部门的交换机通过一台路由器进行了连接。

三、技术原理

单臂路由：是为实现 VLAN 间通信的三层网络设备路由器，它只需要一个以太接口，通过创建子接口可以承担所有 VLAN 的网关，而在不同的 VLAN 间转发数据。

四、实验步骤

实验拓扑



1、当交换机设置成两个 vlan 时，逻辑上已经成为两个网络，广播被隔离了。两个 vlan 的网络要通信，必须通过路由器，如果接入路由器的只有一个物理端口，则必须有两个子接口分别与两个 vlan 对应，同时还要求与路由器相连的交换机的端口 f0/1 要设置为 trunk，因为这个口要通过两个 vlan 的数据包。

2、检查设置情况，应该能正确的看到 vlan 和 trunk 的信息。

3、计算机的网关分别指向路由器的子接口。

4、配置子接口，开启路由器物理接口。

5、默认封装为 dot1q 协议。

6、配置路由器子接口 ip 地址。

Switch:

```
Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
```

```
Switch(config)#vlan 2
Switch(config-vlan)#exit
Switch(config)#vlan 3
Switch(config-vlan)#exit
Switch(config)#interface fa0/2
Switch(config-if)#switchport access vlan 2
Switch(config-if)#exit
Switch(config)#interface fa0/3
Switch(config-if)#switchport access vlan 3
Switch(config-if)#exit
Switch(config)#interface fa0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#
```

R1:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fa0/0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up

R1(config-if)#exit
R1(config)#interface fa0/0.1

%LINK-5-CHANGED: Interface FastEthernet0/0.1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.1,
changed state to up
R1(config-subif)#encapsulation dot1Q 2
R1(config-subif)#ip address 192.168.1.1 255.255.255.0
R1(config-subif)#exit
R1(config)#interface fa0/0.2

%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
R1(config-subif)#encapsulation dot1Q 3
```

```
R1(config-subif)#ip address 192.168.2.1 255.255.255.0
R1(config-subif)#
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#show ip route
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    192.168.1.0/24 is directly connected, FastEthernet0/0.1
C    192.168.2.0/24 is directly connected, FastEthernet0/0.2
R1
```

五、测试

PC2：

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 192.168.2.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.2.1

PC>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.1.2: bytes=32 time=8ms TTL=127
Reply from 192.168.1.2: bytes=32 time=8ms TTL=127
Reply from 192.168.1.2: bytes=32 time=17ms TTL=127

Ping statistics for 192.168.1.2:
```

```
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 8ms, Maximum = 17ms, Average = 11ms

PC>
```

Packet Tracer 5.0 实验(八) 路由器静态路由配置

一、实验目标

- 掌握静态路由的配置方法和技巧；
- 掌握通过静态路由方式实现网络的连通性；
- 熟悉广域网线缆的连接方式；

二、实验背景

学校有新旧两个校区，每个校区是一个独立的局域网，为了使新旧校区能够正常相互通讯，共享资源，每个校区出口利用一台路由器进行连接，两台路由器间学校申请了一条 2M 的 DDN 专线进行相连，要求你做适当配置实现两个校区间的正常相互访问。

三、技术原理

路由器属于网络层设备，能够根据 IP 包头的信息，选择一条最佳路径将数据包转发出去，实现不同网段的主机之间的互相访问。路由器是根据路由表进行选路和转发的，而路由表就是由一条条路由信息组成。

生成路由表主要有两种方法：手工配置和动态配置，即静态路由协议配置和动态路由协议配置。

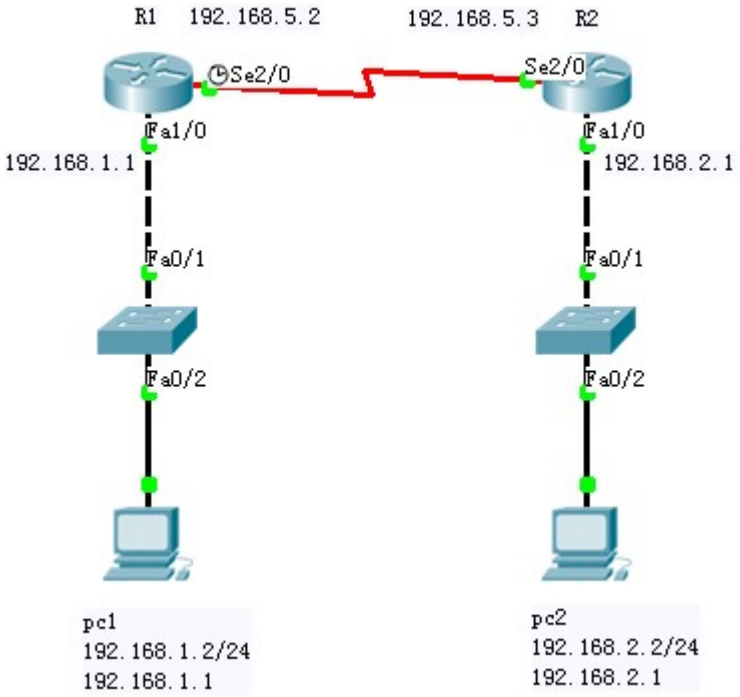
静态路由是指由网络管理员手工配置的路由信息。

静态路由除了具有简单、高效、可靠的优点外，它的另一个好处是网络安全保密性高。

缺省路由可以看作是静态路由的一种特殊情况。当数据在查找路由表时，没有找到和目标相匹配的路由表项时，为数据指定的路由。

四、实验步骤

实验拓扑



1、在路由器 R1、R2 上配置接口的 IP 地址和 R1 串口上的时钟频率；

2、查看路由器生成的直连路由；

3、在路由器 R1、R2 上配置静态路由；

4、验证 R1、R2 上的静态路由配置；

5、将 PC1、PC2 主机默认网关分别设置为与路由器接口 f1/0 IP 地址；

6、PC1、PC2 主机之间可以互相通信；

R1：

```
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fa1/0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0,
changed state to up

R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#exit
R1(config)#interface serial 2/0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
R1(config-if)#clock rate 64000
R1(config-if)#ip address 192.168.5.2 255.255.255.0
R1(config-if)#end

%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
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   192.168.1.0/24 is directly connected, FastEthernet1/0
R1#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
```

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up

R1#show ip route
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    192.168.1.0/24 is directly connected, FastEthernet1/0
C    192.168.5.0/24 is directly connected, Serial2/0
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip route 192.168.2.0 255.255.255.0 192.168.5.3
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console

R1#show ip route
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    192.168.1.0/24 is directly connected, FastEthernet1/0
S    192.168.2.0/24 [1/0] via 192.168.5.3
C    192.168.5.0/24 is directly connected, Serial2/0
R1#
```

R2:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#interface fa1/0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0,
changed state to up

R2(config-if)#ip address 192.168.2.1 255.255.255.0
R2(config-if)#exit
R2(config)#interface serial 2/0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up

R2(config-if)#ip address 192.168.5.3 255.255.255.0
R2(config-if)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#show ip route
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   192.168.2.0/24 is directly connected, FastEthernet1/0
C   192.168.5.0/24 is directly connected, Serial2/0
R2#conf t
```

```
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#ip route 192.168.1.0 255.255.255.0 192.168.5.2
R2(config)#end

%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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

S    192.168.1.0/24 [1/0] via 192.168.5.2
C    192.168.2.0/24 is directly connected, FastEthernet1/0
C    192.168.5.0/24 is directly connected, Serial2/0
R2#
```

五、测试

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 192.168.1.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.1.1

PC>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.2.2: bytes=32 time=17ms TTL=126
Reply from 192.168.2.2: bytes=32 time=21ms TTL=126
Reply from 192.168.2.2: bytes=32 time=16ms TTL=126

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
```

```
    Minimum = 16ms, Maximum = 21ms, Average = 18ms

PC>
```

Packet Tracer 5.0 实验(九) 路由器 RIP 动态路由配置

一、实验目标

- 掌握 RIP 协议的配置方法；
- 掌握查看通过动态路由协议 RIP 学习产生的路由；
- 熟悉广域网线缆的连接方式；

二、实验背景

假设校园网通过一台三层交换机连到校园网出口路由器上，路由器再和校园外的另一台路由器连接。现要做适当配置，实现校园网内部主机与校园网外部主机之间的相互通信。为了简化网管的管理维护工作，学校决定采用 RIP V2 协议实现互通。

三、技术原理

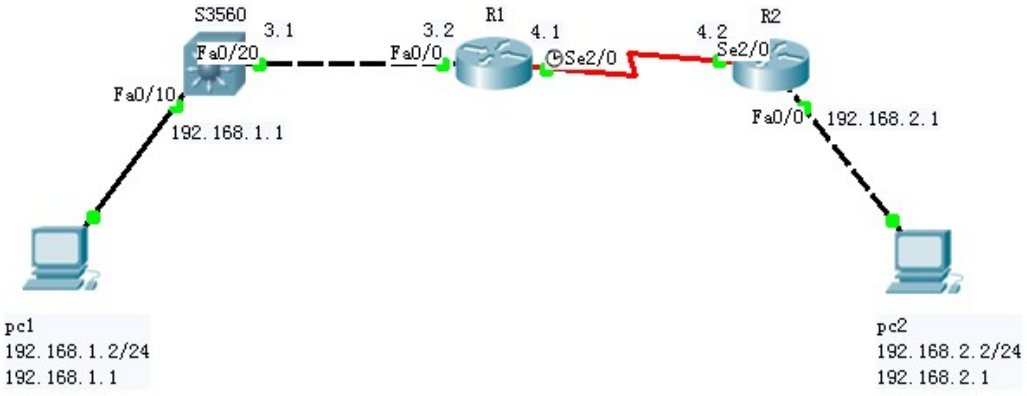
RIP（Routing Information Protocols），路由信息协议，是应用较早、使用较普通的 IGP 内部网关协议，适用于小型同类网络，是距离矢量协议；

RIP 协议以跳数衡量路径开销，RIP 协议里规定最大跳数为 15；

RIP 协议有两个版本：RIPv1 和 RIPv2，RIPv1 属于有类路由协议，不支持 VLSM，以广播形式进行路由信息的更新，更新周期为 30 秒；RIPv2 属于无类路由协议，支持 VLSM，以组播形式进行路由更新。

四、实验步骤

实验拓扑



1、在三层交换机上划分 VLAN10 和 VLAN20，其中 VLAN10 用于连接校园网主机，VLAN20 用于连接 R1；

2、路由器之间通过 V.35 电缆通过串口连接，DCE 端连接在 R1 上，配置其时间频率为 64000；

3、主机和交换机通过直连线连接，主机与路由器通过交叉线连接；

4、在 S3560 上配置 RIPv2 路由协议；

5、在路由器 R1、R2 上配置 RIPv2 路由协议；

6、将 PC1、PC2 主机默认网关分别设置为与直连网络设备接口 IP 地址；

7、验证 PC1、PC2 主机之间可以互相通信；

S3560:

```
Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S3560
S3560(config)#vlan 10
S3560(config-vlan)#exit
S3560(config)#vlan 20
S3560(config-vlan)#exit
S3560(config)#interface fa0/10
S3560(config-if)#switchport access vlan 10
S3560(config-if)#exit
S3560(config)#interface fa0/20
S3560(config-if)#switchport access vlan 20
S3560(config-if)#exit
S3560(config)#interface vlan 10

%LINK-5-CHANGED: Interface Vlan10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up
S3560(config-if)#ip address 192.168.1.1 255.255.255.0
S3560(config-if)#exit
S3560(config)#interface vlan 20

%LINK-5-CHANGED: Interface Vlan20, changed state to up

S3560(config-if)#ip address 192.168.3.1 255.255.255.0
S3560(config-if)#exit
S3560(config)#router rip
S3560(config-router)#network 192.168.1.0
S3560(config-router)#network 192.168.3.0
S3560(config-router)#version 2
S3560(config-router)#
%LINK-5-CHANGED: Interface FastEthernet0/20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/20, changed state
to up
```

```
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

S3560(config-router)#end
S3560#
%SYS-5-CONFIG_I: Configured from console by console

S3560#show ip route
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    192.168.1.0/24 is directly connected, Vlan10
C    192.168.3.0/24 is directly connected, Vlan20
S3560#show ip route                                                    //当配置好所有 RIPv2 后，再查看路由信息
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    192.168.1.0/24 is directly connected, Vlan10
R    192.168.2.0/24 [120/2] via 192.168.3.2, 00:00:01, Vlan20
C    192.168.3.0/24 is directly connected, Vlan20
R    192.168.4.0/24 [120/1] via 192.168.3.2, 00:00:01, Vlan20
S3560#
```

R1:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fa0/0
R1(config-if)#no shutdown
```

```
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state
to up

R1(config-if)#ip address 192.168.3.2 255.255.255.0
R1(config-if)#exit
R1(config)#interface serial 2/0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
R1(config-if)#clock rate 64000
R1(config-if)#ip address 192.168.4.1 255.255.255.0
R1(config-if)#exit
R1(config)#router rip
R1(config-router)#network 192.168.3.0
R1(config-router)#network 192.168.4.0
R1(config-router)#version 2
R1(config-router)#end

%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
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

R    192.168.1.0/24 [120/1] via 192.168.3.1, 00:00:15, FastEthernet0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
R1#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

R1#show ip route                                                    //当配置好所
有 RIPv2 后，再查看路由信息
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

R    192.168.1.0/24 [120/1] via 192.168.3.1, 00:00:19, FastEthernet0/0
R    192.168.2.0/24 [120/1] via 192.168.4.2, 00:00:11, Serial2/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
C    192.168.4.0/24 is directly connected, Serial2/0
R1#
```

R2:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#interface fa0/0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state
to up

R2(config-if)#ip address 192.168.2.1 255.255.255.0
R2(config-if)#exit
R2(config)#interface serial 2/0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed state to up

R2(config-if)#ip address 192.168.4.2 255.255.255.0
R2(config-if)#exit
R2(config)#end

%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.4.0/24 is directly connected, Serial2/0
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#router rip
R2(config-router)#network 192.168.2.0
R2(config-router)#network 192.168.4.0
R2(config-router)#version 2
R2(config-router)#end

%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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

R    192.168.1.0/24 [120/2] via 192.168.4.1, 00:00:00, Serial2/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
R    192.168.3.0/24 [120/1] via 192.168.4.1, 00:00:00, Serial2/0
C    192.168.4.0/24 is directly connected, Serial2/0
R2#
```

五、测试

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 192.168.2.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.2.1
```

```
PC>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Request timed out.
Request timed out.
Reply from 192.168.1.2: bytes=32 time=16ms TTL=125
Reply from 192.168.1.2: bytes=32 time=17ms TTL=125

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 16ms, Maximum = 17ms, Average = 16ms

PC>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Reply from 192.168.1.2: bytes=32 time=19ms TTL=125
Reply from 192.168.1.2: bytes=32 time=16ms TTL=125
Reply from 192.168.1.2: bytes=32 time=13ms TTL=125
Reply from 192.168.1.2: bytes=32 time=15ms TTL=125

Ping statistics for 192.168.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 13ms, Maximum = 19ms, Average = 15ms

PC>
```

Packet Tracer 5.0 实验(十) 路由器 OSPF 动态路由配置

一、实验目标

- 掌握 OSPF 协议的配置方法；
- 掌握查看通过动态路由协议 OSPF 学习产生的路由；
- 熟悉广域网线缆的连接方式；

二、实验背景

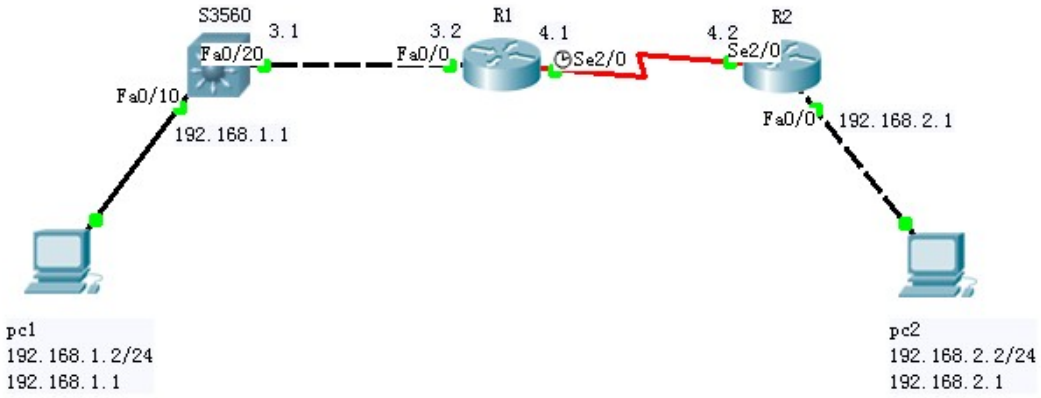
假设某公司通过一台三层交换机连到公司出口路由器上，路由器再和公司外的另一台路由器连接。现要做适当配置，实现公司内部主机与公司外部主机之间的相互通信。为了简化网管的管理维护工作，公司决定采用 OSPF 协议实现互通。

三、技术原理

OSPF 开放式最短路径优先协议，是目前网络中应用最广泛的路由协议之一。属于内部网关路由协议，能够适应各种规模的网络环境，是典型的链路状态协议。OSPF 路由协议通过向全网扩散设备的链路状态信息，使网络中每台设备最终同步一个具有全网链路状态的数据库，然后路由器采用 SPF 算法，以自己为根，计算到达其他网络的最短路径，最终形成全网路由信息。

四、实验步骤

实验拓扑



1、在三层交换机上划分 VLAN10 和 VLAN20，其中 VLAN10 用于连接校园网主机，VLAN20 用于连接 R1；

2、路由器之间通过 V.35 电缆通过串口连接，DCE 端连接在 R1 上，配置其时间频率为 64000；

3、主机和交换机通过直连线连接，主机与路由器通过交叉线连接；

4、在 S3560 上配置 OSPF 路由协议；

5、在路由器 R1、R2 上配置 OSPF 路由协议；

6、将 PC1、PC2 主机默认网关分别设置为与直连网络设备接口 IP 地址；

7、验证 PC1、PC2 主机之间可以互相通信；

S3560:

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S3560
S3560(config)#vlan 10
S3560(config-vlan)#exit
S3560(config)#vlan 20
S3560(config-vlan)#exit
```

```
S3560(config)#interface fa0/10
S3560(config-if)#switchport access vlan 10
S3560(config-if)#exit
S3560(config)#interface fa0/20
S3560(config-if)#switchport access vlan 20
S3560(config-if)#exit
S3560(config)#interface vlan 10
S3560(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state
to up

S3560(config-if)#ip address 192.168.1.1 255.255.255.0
S3560(config-if)#exit
S3560(config)#interface vlan 20

%LINK-5-CHANGED: Interface Vlan20, changed state to up
S3560(config-if)#ip address 192.168.3.1 255.255.255.0
S3560(config-if)#exit
S3560(config)#router ospf ?
  <1-65535>  Process ID
S3560(config)#router ospf 1
S3560(config-router)#network 192.168.1.0 ?
  A.B.C.D  OSPF wild card bits
S3560(config-router)#network 192.168.1.0 0.0.0.255 ?
  area  Set the OSPF area ID
S3560(config-router)#network 192.168.1.0 0.0.0.255 area ?
  <0-4294967295>  OSPF area ID as a decimal value
  A.B.C.D         OSPF area ID in IP address format
S3560(config-router)#network 192.168.1.0 0.0.0.255 area 0
S3560(config-router)#network 192.168.3.0 0.0.0.255 area 0
S3560(config-router)#end
S3560#
%SYS-5-CONFIG_I: Configured from console by console

S3560#show ip route
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   192.168.1.0/24 is directly connected, Vlan10
C   192.168.3.0/24 is directly connected, Vlan20
S3560#
00:10:01: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.4.1 on Vlan20 from
LOADING to FULL, Loading Done

S3560#show ip route
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   192.168.1.0/24 is directly connected, Vlan10
O   192.168.2.0/24 [110/783] via 192.168.3.2, 00:00:00, Vlan20
C   192.168.3.0/24 is directly connected, Vlan20
O   192.168.4.0/24 [110/782] via 192.168.3.2, 00:01:40, Vlan20
S3560#
```

R1:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fa0/0
R1(config-if)#no shutdown

R1(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
```

```
R1(config-if)#ip address 192.168.3.2 255.255.255.0
R1(config-if)#exit
R1(config)#interface serial 2/0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
R1(config-if)#clock rate 64000
R1(config-if)#ip address 192.168.4.1 255.255.255.0
R1(config-if)#exit
R1(config)#router ospf 1
R1(config-router)#network 192.168.3.0 0.0.0.255 area 0
R1(config-router)#network 192.168.4.0 0.0.0.255 area 0
R1(config-router)#
00:09:57: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on
FastEthernet0/0 from LOADING to FULL, Loading Done

R1(config-router)#end

%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
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

O   192.168.1.0/24 [110/2] via 192.168.3.1, 00:00:09,
FastEthernet0/0
C   192.168.3.0/24 is directly connected, FastEthernet0/0
R1#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up

00:12:53: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.4.2 on Serial2/0 from
LOADING to FULL, Loading Done
```

```
R1#show ip route
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

O   192.168.1.0/24 [110/2] via 192.168.3.1, 00:02:58,
FastEthernet0/0
O   192.168.2.0/24 [110/782] via 192.168.4.2, 00:00:02, Serial2/0
C   192.168.3.0/24 is directly connected, FastEthernet0/0
C   192.168.4.0/24 is directly connected, Serial2/0
R1#
```

R2:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#interface fa0/0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up

R2(config-if)#ip address 192.168.2.1 255.255.255.0
R2(config-if)#exit
R2(config)#interface serial 2/0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial2/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up

R2(config-if)#ip address 192.168.4.2 255.255.255.0
```

```
R2(config-if)#exit
R2(config)#router ospf 1
R2(config-router)#network 192.168.2.0 0.0.0.255 area 0
R2(config-router)#network 192.168.4.0 0.0.0.255 area 0
R2(config-router)#end

%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.4.0/24 is directly connected, Serial2/0
R2#show ip route
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

O    192.168.1.0/24 [110/783] via 192.168.4.1, 00:00:01, Serial2/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
O    192.168.3.0/24 [110/782] via 192.168.4.1, 00:00:01, Serial2/0
C    192.168.4.0/24 is directly connected, Serial2/0
R2#
```

五、测试

```
Packet Tracer PC Command Line 1.0
```

```
PC>ipconfig

IP Address.....................: 192.168.1.2
Subnet Mask....................: 255.255.255.0
Default Gateway................: 192.168.1.1

PC>ping 192.168.2.2

Pinging 192.168.2.2 with 32 bytes of data:

Reply from 192.168.2.2: bytes=32 time=11ms TTL=125
Reply from 192.168.2.2: bytes=32 time=15ms TTL=125
Reply from 192.168.2.2: bytes=32 time=14ms TTL=125
Reply from 192.168.2.2: bytes=32 time=14ms TTL=125

Ping statistics for 192.168.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 11ms, Maximum = 15ms, Average = 13ms

PC>
```

Packet Tracer 5.2 实验(十一) 路由器综合路由配置

一、实验目标

- 掌握综合路由的配置方法；
- 掌握查看通过路由重分布学习产生的路由；
- 熟悉广域网线缆的连接方式；

二、实验背景

假设某公司通过一台三层交换机连到公司出口路由器 R1 上，路由器 R1 再和公司外的另一台路由器 R2 连接。三层与 R1 间运行 RIPv2 路由协议，R1 与 R2 间运行 OSPF 路由协议。现要做适当配置，实现公司内部主机与公司外部主机之间的相互通信。

三、技术原理

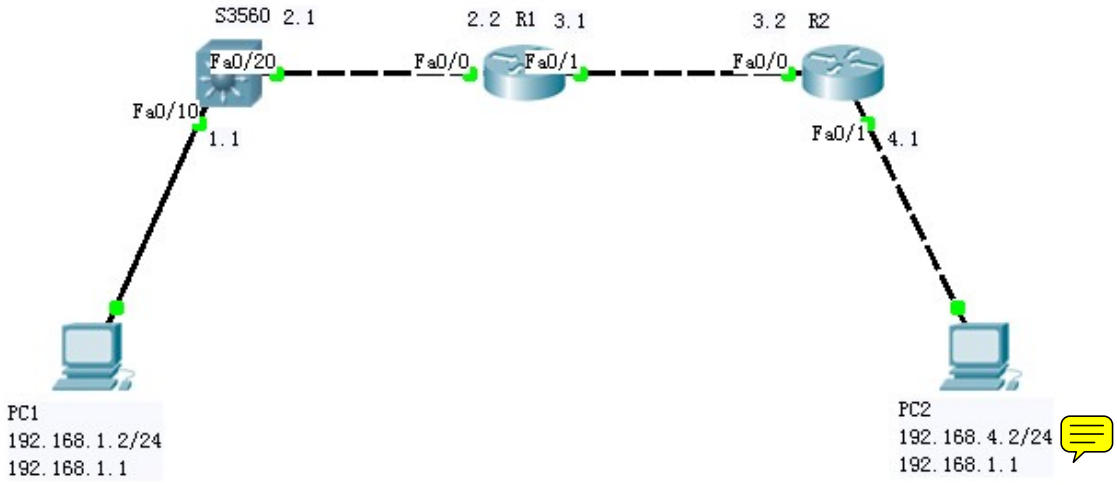
为了支持本设备能够运行多个路由协议进程，系统软件提供路由信息从一个路由进程重分布到另外一个路由进程的功能。比如你可以将 OSPF 路由域的路由重新分布后通告 RIP 路由域中，也可以将 RIP 路由域的路由重新分布后通告到 OSPF 路由域中。路由的相互重分布可以在所有的 IP 路由协议之间进行。

要把路由从一个路由域分布到另一个路由域，并且进行控制路由重分布，在路由进程配置模式中执行以下命令：

redistribute protocol [metric metric] [metric-type metric-type] [match internal | external type | nssa-external type] [tag tag] [route-map route-map-name] [subnets]

四、实验步骤

实验拓扑



1、PC 与交换机间用直连线连接；PC 与路由、路由与路由之间用交叉线连接。

2、在三层上划分 2 个 VLAN，运行 RIPv2 协议；R2 运行 OSPF 协议；

3、在路由器 R1 上左侧配置 RIPv2 路由协议；右侧配置 OSPF 协议；

4、在 R1 路由器进程中引入外部路由，进行路由重分布；

5、将 PC1、PC2 主机默认网关分别设置为与直连网络设备接口 IP 地址；

6、验证 PC1、PC2 主机之间可以互相通信；

S3560:

```
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#hostname S3560
```

```
S3560(config)#vlan 10
S3560(config-vlan)#exit
S3560(config)#vlan 20
S3560(config-vlan)#exit
S3560(config)#interface fa0/10
S3560(config-if)#switchport access vlan 10
S3560(config-if)#exit
S3560(config)#interface fa0/20
S3560(config-if)#switchport access vlan 20
S3560(config-if)#exit
S3560(config)#interface vlan 10
S3560(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state
to up
S3560(config-if)#ip address 192.168.1.1 255.255.255.0
//配置 vlan 10 虚接口 IP 地址
S3560(config-if)#exit
S3560(config)#interface vlan 20

%LINK-5-CHANGED: Interface Vlan20, changed state to
upS3560(config-if)#
S3560(config-if)#ip address 192.168.2.1 255.255.255.0
//配置 vlan 20 虚接口 IP 地址
S3560(config-if)#no shut
S3560(config-if)#exit
S3560(config)#router rip
//配置 RIPv2 协议
S3560(config-router)#network 192.168.1.0
S3560(config-router)#network 192.168.2.0
S3560(config-router)#version 2
S3560(config-router)#end
S3560#
%SYS-5-CONFIG_I: Configured from console by console
S3560#show ip route
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    192.168.1.0/24 is directly connected, Vlan10
S3560#
S3560#
S3560#
%LINK-5-CHANGED: Interface FastEthernet0/20, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/20,
changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state
to up
S3560#show ip route
//三台设备配置好后的路由信息
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    192.168.1.0/24 is directly connected, Vlan10
C    192.168.2.0/24 is directly connected, Vlan20
S3560#show ip route
//路由重分布后的路由信息
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    192.168.1.0/24 is directly connected, Vlan10
C    192.168.2.0/24 is directly connected, Vlan20
R    192.168.3.0/24 [120/1] via 192.168.2.2, 00:00:28, Vlan20
R    192.168.4.0/24 [120/2] via 192.168.2.2, 00:00:28, Vlan20
S3560#
S3560#show running-config
Building configuration...

Current configuration : 1276 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname S3560
!
...
!
interface FastEthernet0/1
!
...
!
interface FastEthernet0/10
 switchport access vlan 10
!
...
!
interface FastEthernet0/20
 switchport access vlan 20
!
...
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan10
 ip address 192.168.1.1 255.255.255.0
!
interface Vlan20
 ip address 192.168.2.1 255.255.255.0
!
```

```
router rip
 version 2
 network 192.168.1.0
 network 192.168.2.0
!
ip classless
!
...
!
line con 0
line vty 0 4
 login
!
!
!
end


S3560#
```

R1:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fa0/0
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R1(config-if)#ip address 192.168.2.2 255.255.255.0
R1(config-if)#exit
R1(config)#interface fa0/1
R1(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
R1(config-if)#ip address 192.168.3.1 255.255.255.0
R1(config-if)#exit
R1(config)#router rip
//R1 左侧配置 RIPv2 路由协议
R1(config-router)#network 192.168.2.0
R1(config-router)#version 2
R1(config-router)#exit
```

```
R1(config)#router ospf 1
//R1 右侧配置 OSPF 路由协议
R1(config-router)#network 192.168.3.1 0.0.0.255 area 0
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
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

R    192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:14,
FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/1
R1#
R1#
R1#
R1#show ip route
//三台设备配置好后的路由信息
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

R    192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:06,
FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
```

```
C    192.168.3.0/24 is directly connected, FastEthernet0/1
O    192.168.4.0/24 [110/2] via 192.168.3.2, 00:01:22,
FastEthernet0/1
R1#ping 192.168.1.2
//从 R1 ping 左侧主机，可以 ping 通

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.2, timeout is 2 seconds:
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 3/5/8 ms

R1#ping 192.168.4.2
//从 R1 ping 右侧主机，可以 ping 通
                                                                    //此
时左侧主机 ping 不通右侧主机
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.4.2, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 3/5/7 ms

R1#
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router rip
R1(config-router)#redistribute ospf 1
R1(config-router)#exit
R1(config)#router ospf 1
R1(config-router)#redistribute rip ?
  metric       Metric for redistributed routes
  metric-type  OSPF/IS-IS exterior metric type for redistributed
routes
  subnets      Consider subnets for redistribution into OSPF
  tag          Set tag for routes redistributed into OSPF
  <cr>
R1(config-router)#redistribute rip subnets
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
//路由重分布后的路由信息
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

R    192.168.1.0/24 [120/1] via 192.168.2.1, 00:00:03,
FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/1
O    192.168.4.0/24 [110/2] via 192.168.3.2, 00:02:41,
FastEthernet0/1
R1#
R1#
R1#show running-config
Building configuration...

Current configuration : 643 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
...
!
interface FastEthernet0/0
 ip address 192.168.2.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 192.168.3.1 255.255.255.0
 duplex auto
 speed auto
!
interface Vlan1
 no ip address
```

```
 shutdown
!
router ospf 1
 log-adjacency-changes
 redistribute rip subnets
 network 192.168.3.0 0.0.0.255 area 0
!
router rip
 version 2
 redistribute ospf 1
 network 192.168.2.0
!
ip classless
!
...
!
line con 0
line vty 0 4
 login
!
!
!
end


R1#
```

R2:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#interface fa0/1
R2(config-if)#ip address 192.168.4.1 255.255.255.0
R2(config-if)#no shutdown

%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up
R2(config-if)#exit
R2(config)#interface fa0/0
R2(config-if)#ip address 192.168.3.2 255.255.255.0
R2(config-if)#no shutdown
```

```
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R2(config-if)#
R2(config-if)#exit
R2(config)#router ospf
% Incomplete command.
R2(config)#router ospf 1                                    //配置
R2 OSPF路由协议
R2(config-router)#network 192.168.3.0 0.0.0.255 area 0
R2(config-router)#network 192.168.4.0 0.0.0.255 area 0
R2(config-router)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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    192.168.3.0/24 is directly connected, FastEthernet0/0
C    192.168.4.0/24 is directly connected, FastEthernet0/1
R2#
00:06:39: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on
FastEthernet0/0 from LOADING to FULL, Loading Done
R2#show ip route
//路由重分布后的路由信息
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

O E2 192.168.1.0/24 [110/20] via 192.168.3.1, 00:00:05,
FastEthernet0/0
O E2 192.168.2.0/24 [110/20] via 192.168.3.1, 00:00:05,
FastEthernet0/0
C    192.168.3.0/24 is directly connected, FastEthernet0/0
C    192.168.4.0/24 is directly connected, FastEthernet0/1
R2#
```

PC1：

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address.....................: 192.168.1.2
Subnet Mask....................: 255.255.255.0
Default Gateway................: 192.168.1.1

PC>ping 192.168.4.2                                    //路由重分布前，
左右主机无法 ping 通

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.
Reply from 192.168.1.1: Destination host unreachable.

Ping statistics for 192.168.4.2:
   Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>ping 192.168.4.2                                    //路由重分布后，
左右主机可以 ping 通

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.4.2: bytes=32 time=15ms TTL=125
Reply from 192.168.4.2: bytes=32 time=10ms TTL=125
Reply from 192.168.4.2: bytes=32 time=16ms TTL=125
Reply from 192.168.4.2: bytes=32 time=10ms TTL=125

Ping statistics for 192.168.4.2:
```

```
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 10ms, Maximum = 16ms, Average = 12ms

PC>
```

Packet Tracer 5.2 实验(十二) 标准 IP 访问控制列表配置

一、实验目标

- 理解标准 IP 访问控制列表的原理及功能；
- 掌握编号的标准 IP 访问控制列表的配置方法；

二、实验背景

公司的经理部、财务部和销售部分别属于不同的 3 个网段，三部门之间用路由器进行信息传递，为了安全起见，公司领导要求销售部不能对财务部进行访问，但经理部可以对财务部进行访问。

三、技术原理

ACLs 的全称为接入控制列表（Access Control Lists），也称为访问列表（Access List），俗称为防火墙，在有的文档中还称之为包过滤。ACLs 通过定义一些规则对网络设备接口上的数据报文进行控制：允许通过或丢弃，从而提高网络可管理性和安全性；

IP ACL 分为两种：标准 IP 访问列表和扩展 IP 访问列表，编号范围分别为 1~99、1300~1999，100~199、2000~2699；

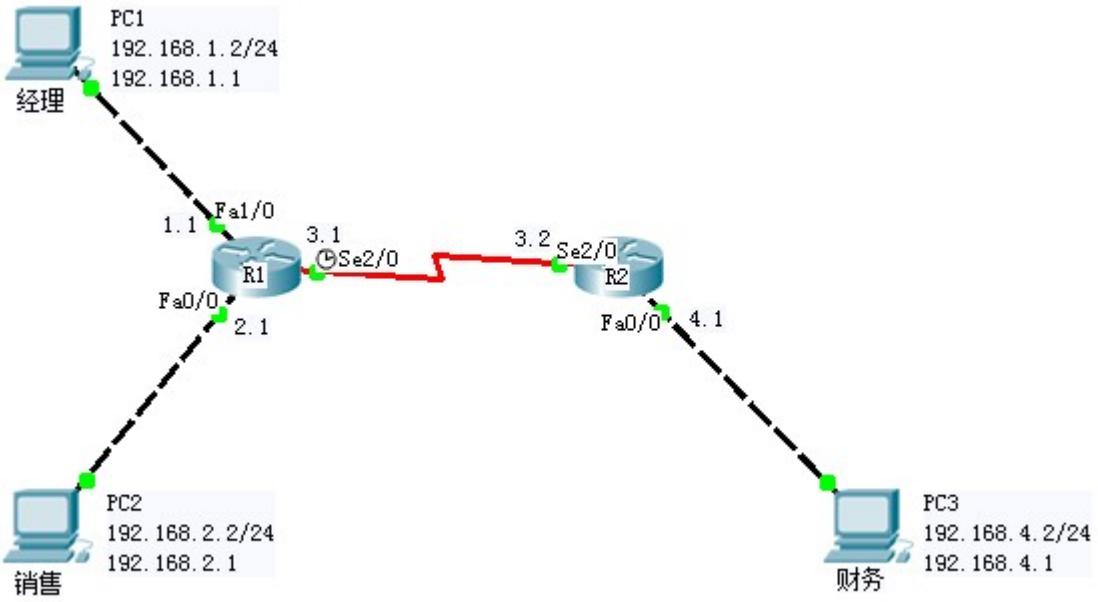
标准 IP 访问列表可以根据数据包的源 IP 地址定义规则，进行数据包的过滤；

扩展 IP 访问列表可以根据数据包的源 IP、目的 IP、源端口、目的端口、协议来定义规则，进行数据包的过滤；

IP ACL 基于接口进行规则的应用，分为：入栈应用和出栈应用；

四、实验步骤

实验拓扑



1、路由器之间通过 V.35 电缆串口连接，DCE 端连接在 R1 上，配置其时间频率为 64000；主机与路由器通过交叉线连接；

2、配置路由器接口 IP 地址；

3、在路由器上配置 OSPF 路由协议，让三台 PC 能相互 ping 通，因为只有在互通的前提下才能涉及到访问控制列表；

4、在 R1 上配置编号的 IP 标准访问控制列表；

5、将标准 IP 访问列表应用到接口上；

6、验证主机之间的互通性；

R1:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#interface fa1/0
R1(config-if)#ip address 192.168.1.1 255.255.255.0
R1(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0,
changed state to up
R1(config-if)#exit
R1(config)#int fa0/0
R1(config-if)#ip add 192.168.2.1 255.255.255.0
R1(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R1(config-if)#exit
R1(config)#int se2/0
R1(config-if)#clock rate 64000
R1(config-if)#ip add 192.168.3.1 255.255.255.0
R1(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
R1(config-if)#exit
R1(config)#
R1(config)#router ospf 1
R1(config-router)#network 192.168.1.0 0.0.0.255 area 0
R1(config-router)#network 192.168.2.0 0.0.0.255 area 0
R1(config-router)#network 192.168.3.0 0.0.0.255 area 0
R1(config-router)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
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   192.168.1.0/24 is directly connected, FastEthernet1/0
C   192.168.2.0/24 is directly connected, FastEthernet0/0
R1#
R1#
R1#show ip route
//两台路由器配置好后的路由信息
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    192.168.1.0/24 is directly connected, FastEthernet1/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
C    192.168.3.0/24 is directly connected, Serial2/0
O    192.168.4.0/24 [110/782] via 192.168.3.2, 00:00:15, Serial2/0
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip ?
  access-list       Named access-list
  default-network   Flags networks as candidates for default routes
  dhcp              Configure DHCP server and relay parameters
  domain            IP DNS Resolver
  domain-lookup     Enable IP Domain Name System hostname translation
  domain-name       Define the default domain name
  forward-protocol  Controls forwarding of physical and directed IP
broadcasts
  host              Add an entry to the ip hostname table
  name-server       Specify address of name server to use
  nat               NAT configuration commands
  route             Establish static routes
```

```
  tcp               Global TCP parameters
R1(config)#ip ac
R1(config)#ip access-list ?
  extended  Extended Access List
  standard  Standard Access List
R1(config)#ip access-list sta
R1(config)#ip access-list standard ?
  <1-99>  Standard IP access-list number
  WORD    Access-list name
R1(config)#ip access-list standard david ?
  <cr>
R1(config)#ip access-list standard david                        //配
置名为 david 的 IP 标准访问控制列表
R1(config-std-nacl)#?
  default  Set a command to its defaults
  deny     Specify packets to reject
  exit     Exit from access-list configuration mode
  no       Negate a command or set its defaults
  permit   Specify packets to forward
  remark   Access list entry comment
R1(config-std-nacl)#permit 192.168.1.0 ?
  A.B.C.D  Wildcard bits
  <cr>
R1(config-std-nacl)#permit 192.168.1.0 0.0.0.255 ?
  <cr>
R1(config-std-nacl)#permit 192.168.1.0 0.0.0.255                 //
允许 192.168.1.0 网段通过
R1(config-std-nacl)#deny ?
  A.B.C.D  Address to match
  any      Any source host
  host     A single host address
R1(config-std-nacl)#deny 192.168.2.0 ?
  A.B.C.D  Wildcard bits
  <cr>
R1(config-std-nacl)#deny 192.168.2.0 0.0.0.255 ?
  <cr>
R1(config-std-nacl)#deny 192.168.2.0 0.0.0.255                   //
禁止 192.168.2.0 网段通过
R1(config-std-nacl)#exit
R1(config)#inter
R1(config)#interface se2/0
R1(config-if)#?
  bandwidth          Set bandwidth informational parameter
  cdp                CDP interface subcommands
```

```
  clock              Configure serial interface clock
  crypto             Encryption/Decryption commands
  custom-queue-list  Assign a custom queue list to an interface
  delay              Specify interface throughput delay
  description        Interface specific description
  encapsulation      Set encapsulation type for an interface
  exit               Exit from interface configuration mode
  fair-queue         Enable Fair Queuing on an Interface
  frame-relay        Set frame relay parameters
  hold-queue         Set hold queue depth
  ip                 Interface Internet Protocol config commands
  keepalive          Enable keepalive
  mtu                Set the interface Maximum Transmission Unit (MTU)
  no                 Negate a command or set its defaults
  ppp                Point-to-Point Protocol
  priority-group     Assign a priority group to an interface
  service-policy     Configure QoS Service Policy
  shutdown           Shutdown the selected interface
  tx-ring-limit      Configure PA level transmit ring limit
  zone-member        Apply zone name
R1(config-if)#ip ?
  access-group        Specify access control for packets
  address             Set the IP address of an interface
  hello-interval      Configures IP-EIGRP hello interval
  helper-address      Specify a destination address for UDP
broadcasts
  inspect             Apply inspect name
  ips                 Create IPS rule
  mtu                 Set IP Maximum Transmission Unit
  nat                 NAT interface commands
  ospf                OSPF interface commands
  split-horizon       Perform split horizon
  summary-address     Perform address summarization
  virtual-reassembly  Virtual Reassembly
R1(config-if)#ip ac
R1(config-if)#ip access-group ?
  <1-199>  IP access list (standard or extended)
  WORD     Access-list name
R1(config-if)#ip access-group david ?
  in   inbound packets
  out  outbound packets
R1(config-if)#ip access-group david out ?
  <cr>
R1(config-if)#ip access-group david out                          //
```

```
将名为 david 的 IP 标准访问控制列表应用到 se2/0 端口
R1(config-if)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show running-config
Building configuration...

Current configuration : 928 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
...
!
interface FastEthernet0/0
 ip address 192.168.2.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface Serial2/0
 ip address 192.168.3.1 255.255.255.0
 ip access-group david out
 clock rate 64000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
```

```
!
router ospf 1
 log-adjacency-changes
 network 192.168.1.0 0.0.0.255 area 0
 network 192.168.2.0 0.0.0.255 area 0
 network 192.168.3.0 0.0.0.255 area 0
!
ip classless
!
!
ip access-list standard david
 permit 192.168.1.0 0.0.0.255
 deny 192.168.2.0 0.0.0.255
!
...
!
line con 0
line vty 0 4
 login
!
!
!
end


R1#
```

R2:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#int fa0/0
R2(config-if)#ip add 192.168.4.1 255.255.255.0
R2(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R2(config-if)#exit
R2(config)#int se2/0
R2(config-if)#ip add 192.168.3.2 255.255.255.0
R2(config-if)#no shut
```

```
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
R2(config-if)#exit
R2(config)#router ospf 1
R2(config-router)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up

R2(config-router)#network 192.168.3.0 0.0.0.255 area 0
R2(config-router)#network 192.168.4.0 0.0.0.255 area 0
00:11:23: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.1 on Serial2/0 from
LOADING to FULL, Loading Do
R2(config-router)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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

O    192.168.1.0/24 [110/782] via 192.168.3.1, 00:00:09, Serial2/0
O    192.168.2.0/24 [110/782] via 192.168.3.1, 00:00:09, Serial2/0
C    192.168.3.0/24 is directly connected, Serial2/0
C    192.168.4.0/24 is directly connected, FastEthernet0/0
R2#
```

五、测试

PC1:

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 192.168.1.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.1.1
```

```
PC>ping 192.168.4.2                                    //ACL 前

Pinging 192.168.4.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.4.2: bytes=32 time=15ms TTL=126
Reply from 192.168.4.2: bytes=32 time=9ms TTL=126
Reply from 192.168.4.2: bytes=32 time=15ms TTL=126

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 9ms, Maximum = 15ms, Average = 13ms

PC>ping 192.168.4.2                                    //ACL 后

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.4.2: bytes=32 time=10ms TTL=126
Reply from 192.168.4.2: bytes=32 time=9ms TTL=126
Reply from 192.168.4.2: bytes=32 time=16ms TTL=126
Reply from 192.168.4.2: bytes=32 time=13ms TTL=126

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 9ms, Maximum = 16ms, Average = 12ms

PC>
```

PC2：

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 192.168.2.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.2.1

PC>ping 192.168.4.2                                    //ACL 前

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.4.2: bytes=32 time=17ms TTL=126
Reply from 192.168.4.2: bytes=32 time=10ms TTL=126
```

```
Reply from 192.168.4.2: bytes=32 time=11ms TTL=126
Reply from 192.168.4.2: bytes=32 time=9ms TTL=126

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 9ms, Maximum = 17ms, Average = 11ms

PC>ping 192.168.4.2                                    //ACL 后

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.2.1: Destination host unreachable.
Reply from 192.168.2.1: Destination host unreachable.
Reply from 192.168.2.1: Destination host unreachable.
Reply from 192.168.2.1: Destination host unreachable.

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>
```

Packet Tracer 5.2 实验(十三) 扩展 IP 访问控制列表配置

一、实验目标

- 理解扩展 IP 访问控制列表的原理及功能；
- 掌握编号的扩展 IP 访问控制列表的配置方法；

二、实验背景

分公司和总公司分别属于不同的网段，部门之间用路由器进行信息传递，为了安全起见，分公司领导要求部门主机只能访问总公司服务器的 WWW 服务，不能对其使用 ICMP 服务。

三、技术原理

访问列表中定义的典型规则主要有以下：源地址、目标地址、上层协议、时间区域；

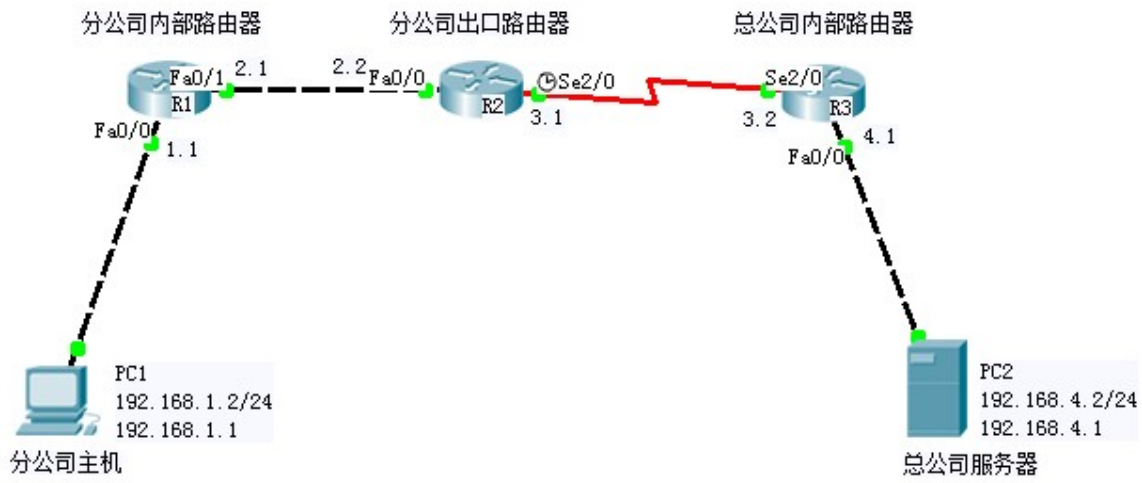
扩展 IP 访问列表（编号为 100~199，2000~2699）使用以上四种组合来进行转发或阻断分组；可以根据数据包的源 IP、目的 IP、源端口、目的端口、协议来定义规则，进行数据包的过滤；

扩展 IP 访问列表的配置包括以下两步：

- 定义扩展 IP 访问列表
- 将扩展 IP 访问列表应用于特定接口上

四、实验步骤

实验步骤



1、分公司出口路由器与外部路由器之间通过 V.35 电缆串口连接，DCE 端连接在 R2 上，配置其时钟频率 64000；主机与路由器通过交叉线连接；

2、配置 PC 机、服务器及路由器接口 IP 地址；

3、在各路由器上配置静态路由协议，让 PC 间能互相 ping 通，因为只有在互通的前提下才能涉及到访问控制列表；

4、在 R2 上配置编号的 IP 扩展访问控制列表；

5、将扩展 IP 访问列表应用到接口上；

6、验证主机之间的互通性；

R1:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#int fa0/0
```

```
R1(config-if)#ip add 192.168.1.1 255.255.255.0                    //配
置端口 IP 地址
R1(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R1(config-if)#exit
R1(config)#int fa0/1
R1(config-if)#ip add 192.168.2.1 255.255.255.0                    //配
置端口 IP 地址
R1(config-if)#no shut

R1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up
R1(config-if)#exit
R1(config)#ip route 0.0.0.0 0.0.0.0 192.168.2.2                    //
配置 default route
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route                                                  //查看路由
表
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 192.168.2.2 to network 0.0.0.0

C    192.168.1.0/24 is directly connected, FastEthernet0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/1
S*   0.0.0.0/0 [1/0] via 192.168.2.2
R1#
R1#show run
Building configuration...
```

```
Current configuration : 510 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
...
!
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 192.168.2.1 255.255.255.0
 duplex auto
 speed auto
!
interface Vlan1
 no ip address
 shutdown
!
ip classless
ip route 0.0.0.0 0.0.0.0 192.168.2.2
!
...
!
line con 0
line vty 0 4
 login
!
!
!
end


R1#
```

R2:

```
Router>en
Router#conf t
```

```
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#int fa0/0
R2(config-if)#ip add 192.168.2.2 255.255.255.0                  //配
置端口 IP 地址
R2(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R2(config-if)#exit
R2(config)#int s2/0
R2(config-if)#ip add 192.168.3.1 255.255.255.0                  //配
置端口 IP 地址
R2(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
R2(config-if)#clock rate 64000                                  //配置
时钟频率
R2(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up
R2(config-if)#exit
R2(config)#ip route 192.168.1.0 255.255.255.0 192.168.2.1       //
配置目标网段 1.0 的静态路由
R2(config)#ip route 192.168.4.0 255.255.255.0 192.168.3.2       //
配置目标网段 4.0 的静态路由
R2(config)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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
```

```
S   192.168.1.0/24 [1/0] via 192.168.2.1
C   192.168.2.0/24 is directly connected, FastEthernet0/0
C   192.168.3.0/24 is directly connected, Serial2/0
S   192.168.4.0/24 [1/0] via 192.168.3.2
R2#
R2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#ac
R2(config)#access-list ?
  <1-99>     IP standard access list
  <100-199>  IP extended access list
R2(config)#access-list 100 ?
  deny    Specify packets to reject
  permit  Specify packets to forward
  remark  Access list entry comment
R2(config)#access-list 100 per
R2(config)#access-list 100 permit ?
  eigrp  Cisco's EIGRP routing protocol
  gre    Cisco's GRE tunneling
  icmp   Internet Control Message Protocol
  ip     Any Internet Protocol
  ospf   OSPF routing protocol
  tcp    Transmission Control Protocol
  udp    User Datagram Protocol
R2(config)#access-list 100 permit tcp ?
//web 服务使用的是 tcp 协议
  A.B.C.D  Source address
  any      Any source host
  host     A single source host
R2(config)#access-list 100 permit tcp host ?
  A.B.C.D  Source address
R2(config)#access-list 100 permit tcp host 192.168.1.2 ?
//源主机地址
  A.B.C.D  Destination address
  any      Any destination host
  eq       Match only packets on a given port number
  gt       Match only packets with a greater port number
  host     A single destination host
  lt       Match only packets with a lower port number
  neq      Match only packets not on a given port number
  range    Match only packets in the range of port numbers
R2(config)#access-list 100 permit tcp host 192.168.1.2 host ?
  A.B.C.D  Destination address
R2(config)#access-list 100 permit tcp host 192.168.1.2 host
```

```
192.168.4.2 ?   //目标主机地址
  dscp         Match packets with given dscp value
  eq           Match only packets on a given port number
  established  established
  gt           Match only packets with a greater port number
  lt           Match only packets with a lower port number
  neq          Match only packets not on a given port number
  precedence   Match packets with given precedence value
  range        Match only packets in the range of port numbers
  <cr>
R2(config)#access-list 100 permit tcp host 192.168.1.2 host
192.168.4.2 eq ?
  <0-65535>  Port number
  ftp        File Transfer Protocol (21)
  pop3       Post Office Protocol v3 (110)
  smtp       Simple Mail Transport Protocol (25)
  telnet     Telnet (23)
  www        World Wide Web (HTTP, 80)
R2(config)#access-list 100 permit tcp host 192.168.1.2 host
192.168.4.2 eq www ?     //www服务
  dscp         Match packets with given dscp value
  established  established
  precedence   Match packets with given precedence value
  <cr>
R2(config)#access-list 100 permit tcp host 192.168.1.2 host
192.168.4.2 eq www
R2(config)#
R2(config)#access-list 100 deny ?
  eigrp  Cisco's EIGRP routing protocol
  gre    Cisco's GRE tunneling
  icmp   Internet Control Message Protocol
  ip     Any Internet Protocol
  ospf   OSPF routing protocol
  tcp    Transmission Control Protocol
  udp    User Datagram Protocol
R2(config)#access-list 100 deny icmp ?                  //禁止icmp
协议，也就是ping使用的协议
  A.B.C.D  Source address
  any      Any source host
  host     A single source host
R2(config)#access-list 100 deny icmp host ?
  A.B.C.D  Source address
R2(config)#access-list 100 deny icmp host 192.168.1.2 ?
  A.B.C.D  Destination address
```

```
  any      Any destination host
  host     A single destination host
R2(config)#access-list 100 deny icmp host 192.168.1.2 host
192.168.4.2 ?
  <0-256>              type-num
  echo                 echo
  echo-reply           echo-reply
  host-unreachable     host-unreachable
  net-unreachable      net-unreachable
  port-unreachable     port-unreachable
  protocol-unreachable  protocol-unreachable
  ttl-exceeded         ttl-exceeded
  unreachable          unreachable
  <cr>
R2(config)#access-list 100 deny icmp host 192.168.1.2 host
192.168.4.2 echo ?
  <cr>
R2(config)#access-list 100 deny icmp host 192.168.1.2 host
192.168.4.2 echo
R2(config)#
R2(config)#int s2/0
R2(config-if)#?
  bandwidth          Set bandwidth informational parameter
  cdp                CDP interface subcommands
  clock              Configure serial interface clock
  crypto             Encryption/Decryption commands
  custom-queue-list  Assign a custom queue list to an interface
  delay              Specify interface throughput delay
  description        Interface specific description
  encapsulation      Set encapsulation type for an interface
  exit               Exit from interface configuration mode
  fair-queue         Enable Fair Queuing on an Interface
  frame-relay        Set frame relay parameters
  hold-queue         Set hold queue depth
  ip                 Interface Internet Protocol config commands
  keepalive          Enable keepalive
  mtu                Set the interface Maximum Transmission Unit (MTU)
  no                 Negate a command or set its defaults
  ppp                Point-to-Point Protocol
  priority-group     Assign a priority group to an interface
  service-policy     Configure QoS Service Policy
  shutdown           Shutdown the selected interface
  tx-ring-limit      Configure PA level transmit ring limit
  zone-member        Apply zone name
```

```
R2(config-if)#ip ?
  access-group        Specify access control for packets
  address             Set the IP address of an interface
  hello-interval      Configures IP-EIGRP hello interval
  helper-address      Specify a destination address for UDP
broadcasts
  inspect             Apply inspect name
  ips                 Create IPS rule
  mtu                 Set IP Maximum Transmission Unit
  nat                 NAT interface commands
  ospf                OSPF interface commands
  split-horizon       Perform split horizon
  summary-address     Perform address summarization
  virtual-reassembly  Virtual Reassembly
R2(config-if)#ip ac
R2(config-if)#ip access-group ?
  <1-199>  IP access list (standard or extended)
  WORD     Access-list name
R2(config-if)#ip access-group 100 ?
  in   inbound packets
  out  outbound packets
R2(config-if)#ip access-group 100 out ?
  <cr>
R2(config-if)#ip access-group 100 out                    //将控制列
表应用于 s2/0 端口
R2(config-if)#
R2(config-if)#
R2(config-if)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#show run
R2#show running-config
Building configuration...

Current configuration : 901 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R2
!
...
```

```
!
interface FastEthernet0/0
 ip address 192.168.2.2 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.3.1 255.255.255.0
 ip access-group 100 out
 clock rate 64000
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
ip classless
ip route 192.168.1.0 255.255.255.0 192.168.2.1
ip route 192.168.4.0 255.255.255.0 192.168.3.2
!
!
access-list 100 permit tcp host 192.168.1.2 host 192.168.4.2 eq www
access-list 100 deny icmp host 192.168.1.2 host 192.168.4.2 echo
!
...
!
line con 0
line vty 0 4
 login
!
!
```

```
!
end


R2#
```

R3:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R3
R3(config)#int fa0/0
R3(config-if)#ip add 192.168.4.1 255.255.255.0
R3(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R3(config-if)#exit
R3(config)#int s2/0
R3(config-if)#ip add 192.168.3.2 255.255.255.0
R3(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to up
R3(config-if)#
R3(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up
R3(config-if)#exit
R3(config)#ip route 0.0.0.0 0.0.0.0 192.168.3.1
R3(config)#end
R3#
%SYS-5-CONFIG_I: Configured from console by console
R3#show ip route
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 192.168.3.1 to network 0.0.0.0

C    192.168.3.0/24 is directly connected, Serial2/0
C    192.168.4.0/24 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 [1/0] via 192.168.3.1
R3#
R3#
R3#show run
Building configuration...

Current configuration : 667 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R3
!
...
!
interface FastEthernet0/0
 ip address 192.168.4.1 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 192.168.3.2 255.255.255.0
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
```

```
 no ip address
 shutdown
!
ip classless
ip route 0.0.0.0 0.0.0.0 192.168.3.1
!
...
!
line con 0
line vty 0 4
 login
!
!
!
end


R3#
```

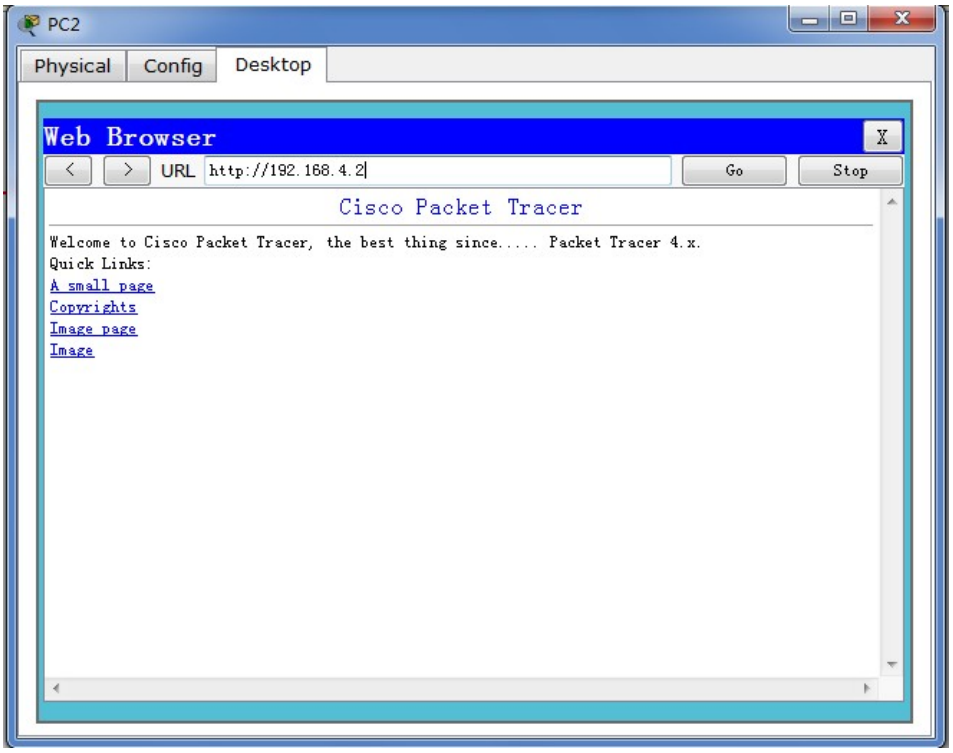
PC1：

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 192.168.1.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.1.1

PC>ping 192.168.4.2

Pinging 192.168.4.2 with 32 bytes of data:

Request timed out.
Request timed out.
Reply from 192.168.4.2: bytes=32 time=18ms TTL=125
//ACL 前
Reply from 192.168.4.2: bytes=32 time=12ms TTL=125

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 18ms, Average = 15ms

PC>ping 192.168.4.2
```

```
Pinging 192.168.4.2 with 32 bytes of data:

Reply from 192.168.2.2: Destination host unreachable.
//ACL 后
Reply from 192.168.2.2: Destination host unreachable.
Reply from 192.168.2.2: Destination host unreachable.
Reply from 192.168.2.2: Destination host unreachable.

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

PC>
```

PC1-WEB 测试：

ACL 前后都可以访问 web 服务



Packet Tracer 5.2 实验(十四) 网络地址转换 NAT 配置

一、实验目标

- 理解 NAT 网络地址转换的原理及功能；
- 掌握静态 NAT 的配置，实现局域网访问互联网；

二、实验背景

公司欲发布 WWW 服务，现要求将内网 Web 服务器 IP 地址映射为全局 IP 地址，实现外部网络可访问公司内部 Web 服务器。

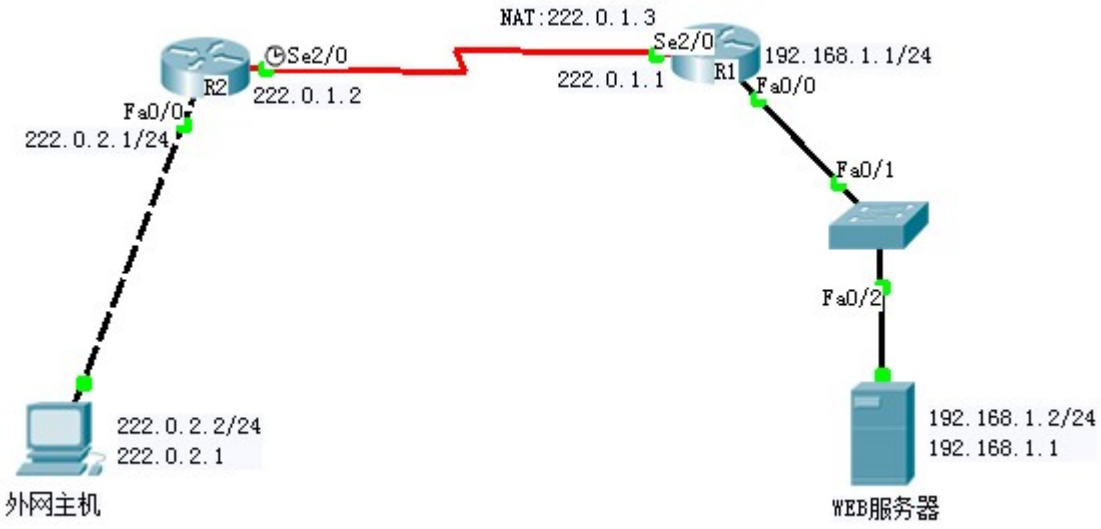
三、技术原理

- 网络地址转换 NAT（Network Address Translation），被广泛应用于各种类型 Internet 接入方式和各种类型的网络中。原因很简单，NAT 不仅完美解决了 IP 地址不足的问题，而且还能够有效地避免来自网络外部的攻击，隐藏并保护网络内部的计算机。
- 默认情况下，内部 IP 地址是无法被路由到外网的，内部主机 10.1.1.1 要与外部 internet 通信，IP 包到达 NAT 路由器时，IP 包头的源地址 10.1.1.1 被替换成一个合法的外网 IP，并在 NAT 转换表中保存这条记录。当外部主机发送一个应答到内网时，NAT 路由器收到后，查看当前 NAT 转换表，用 10.1.1.1 替换掉这个外网地址。
- NAT 将网络划分为内部网络和外部网络两部分，局域网主机利用 NAT 访问网络时，是将局域网内部的本地地址转换为全局地址（互联网合法的 IP 地址）后转发数据包。

- NAT 分为两种类型：NAT（网络地址转换）和 NAPT（网络端口地址转换 IP 地址对应一个全局地址）。
- 静态 NAT：实现内部地址与外部地址一对一的映射。现实中，一般都用于服务器；
- 动态 NAT：定义一个地址池，自动映射，也是一对一的。现实中，用得比较少；
- NAPT：使用不同的端口来映射多个内网 IP 地址到一个指定的外网 IP 地址，多对一。

四、实验步骤

实验拓扑



1、R1 为公司出口路由器，其与外部路由之间通过 V.35 电缆串口连接，DCE 端连接在 R2 上，配置其时钟频率为 64000；

2、配置 PC 机、服务器及路由器接口 IP 地址；

3、在各路由器上配置静态路由协议，让 PC 间能相互 ping 通；

4、在 R1 上配置静态 NAT；

5、在 R1 上定义内外部网络接口；

6、验证主机之间的互通性。

R1：

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R1
R1(config)#int fa0/0
R1(config-if)#ip add 192.168.1.1 255.255.255.0
R1(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R1(config-if)#exit
R1(config)#int s2/0
R1(config-if)#ip add 222.0.1.1 255.255.255.0
R1(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
R1(config-if)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up
R1(config-if)#
R1(config-if)#
R1(config-if)#exit
R1(config)#ip route 222.0.2.0 255.255.255.0 222.0.1.2
//配置到 222.0.2.0 网段的静态路由
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
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    192.168.1.0/24 is directly connected, FastEthernet0/0
C    222.0.1.0/24 is directly connected, Serial2/0
S    222.0.2.0/24 [1/0] via 222.0.1.2
R1#
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int fa0/0
R1(config-if)#?
  arp                Set arp type (arpa, probe, snap) or timeout
  bandwidth          Set bandwidth informational parameter
  cdp                CDP interface subcommands
  crypto             Encryption/Decryption commands
  custom-queue-list  Assign a custom queue list to an interface
  delay              Specify interface throughput delay
  description        Interface specific description
  duplex             Configure duplex operation.
  exit               Exit from interface configuration mode
  fair-queue         Enable Fair Queuing on an Interface
  hold-queue         Set hold queue depth
  ip                 Interface Internet Protocol config commands
  mac-address        Manually set interface MAC address
  mtu                Set the interface Maximum Transmission Unit (MTU)
  no                 Negate a command or set its defaults
  priority-group     Assign a priority group to an interface
  service-policy     Configure QoS Service Policy
  shutdown           Shutdown the selected interface
  speed              Configure speed operation.
  tx-ring-limit      Configure PA level transmit ring limit
  zone-member        Apply zone name
R1(config-if)#ip ?
  access-group        Specify access control for packets
  address             Set the IP address of an interface
```

```
  hello-interval      Configures IP-EIGRP hello interval
  helper-address      Specify a destination address for UDP
broadcasts
  inspect             Apply inspect name
  ips                 Create IPS rule
  mtu                 Set IP Maximum Transmission Unit
  nat                 NAT interface commands
  ospf                OSPF interface commands
  split-horizon       Perform split horizon
  summary-address     Perform address summarization
  virtual-reassembly  Virtual Reassembly
R1(config-if)#ip nat ?
  inside   Inside interface for address translation
  outside  Outside interface for address translation
R1(config-if)#ip nat inside ?
  <cr>
R1(config-if)#ip nat inside
R1(config-if)#exit
R1(config)#int s2/0
R1(config-if)#ip nat outside ?
  <cr>
R1(config-if)#ip nat outside
R1(config-if)#exit
R1(config)#
R1#
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#ip ?
  access-list       Named access-list
  default-network   Flags networks as candidates for default routes
  dhcp              Configure DHCP server and relay parameters
  domain            IP DNS Resolver
  domain-lookup     Enable IP Domain Name System hostname translation
  domain-name       Define the default domain name
  forward-protocol  Controls forwarding of physical and directed IP
broadcasts
  host              Add an entry to the ip hostname table
  name-server       Specify address of name server to use
  nat               NAT configuration commands
  route             Establish static routes
  tcp               Global TCP parameters
R1(config)#ip nat ?
  inside   Inside address translation
```

```
  outside  Outside address translation
  pool     Define pool of addresses
R1(config)#ip nat inside ?
  source  Source address translation
R1(config)#ip nat inside source ?
  list    Specify access list describing local addresses
  static  Specify static local->global mapping
R1(config)#ip nat inside source static ?
  A.B.C.D  Inside local IP address
  tcp      Transmission Control Protocol
  udp      User Datagram Protocol
R1(config)#ip nat inside source static 192.168.1.2 ?
  A.B.C.D  Inside global IP address
R1(config)#ip nat inside source static 192.168.1.2 222.0.1.3 ?
  <cr>
R1(config)#ip nat inside source static 192.168.1.2 222.0.1.3
//配置内网到外网的静态 NAT 映射
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip nat ?
  statistics    Translation statistics
  translations  Translation entries
R1#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside
global
---  222.0.1.3         192.168.1.2        ---                ---

R1#
R1#show ip nat translations
Pro  Inside global     Inside local       Outside local      Outside
global
---  222.0.1.3         192.168.1.2        ---                ---
tcp
222.0.1.3:80       192.168.1.2:80     222.0.2.2:1025     222.0.2.2
:1025

R1#
R1#show running-config
Building configuration...

Current configuration : 753 bytes
!
version 12.2
```

```
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
...
!
interface FastEthernet0/0
 ip address 192.168.1.1 255.255.255.0
 ip nat inside
 duplex auto
 speed auto
!
interface FastEthernet1/0
 no ip address
 duplex auto
 speed auto
 shutdown
!
interface Serial2/0
 ip address 222.0.1.1 255.255.255.0
 ip nat outside
!
interface Serial3/0
 no ip address
 shutdown
!
interface FastEthernet4/0
 no ip address
 shutdown
!
interface FastEthernet5/0
 no ip address
 shutdown
!
ip nat inside source static 192.168.1.2 222.0.1.3
ip classless
ip route 222.0.2.0 255.255.255.0 222.0.1.2
!
...
!
line con 0
line vty 0 4
```

```
 login
!
!
!
end


R1#
```

R2:

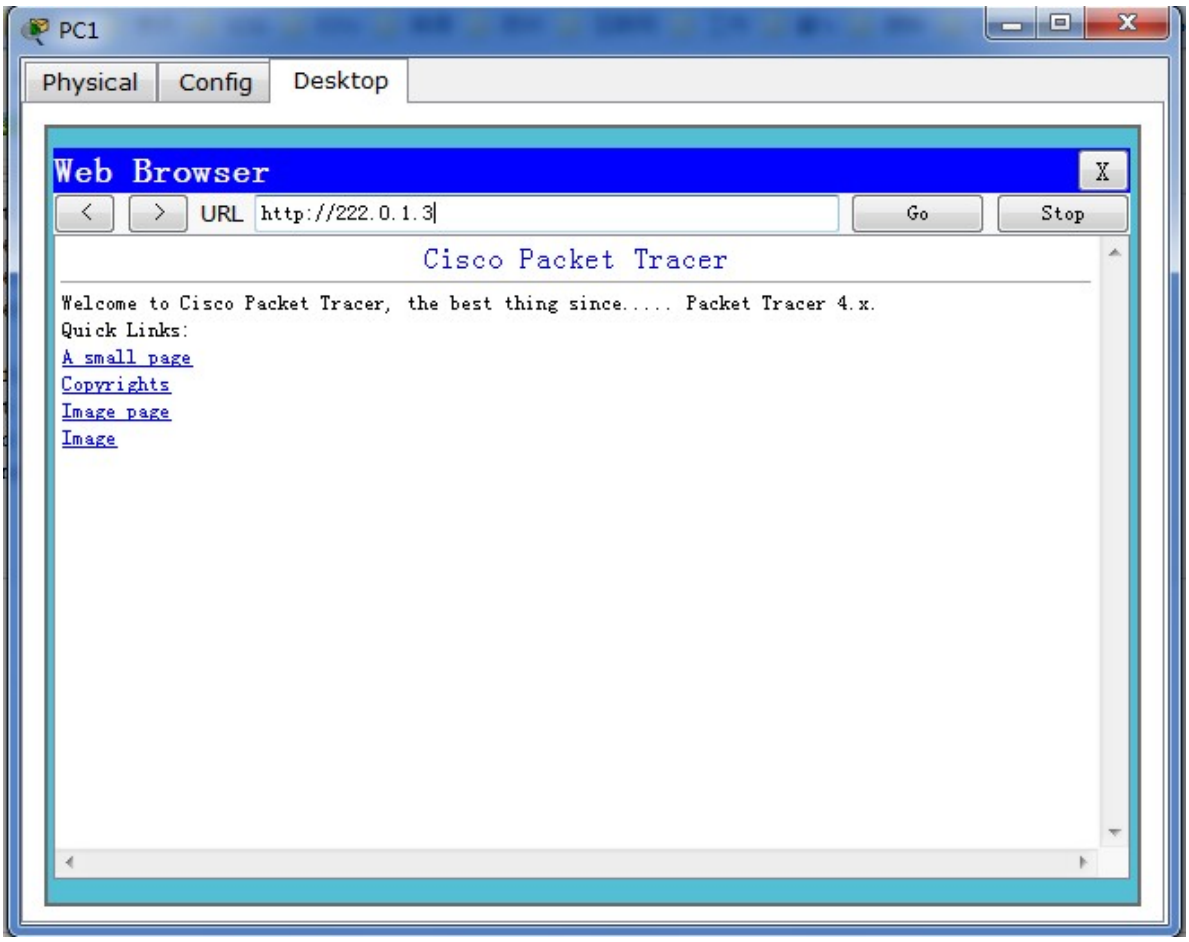
```
Router>
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#int fa0/0
R2(config-if)#ip add 222.0.2.1 255.255.255.0
R2(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R2(config-if)#exit
R2(config)#int s2/0
R2(config-if)#ip add 222.0.1.2 255.255.255.0
R2(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to up
R2(config-if)#clock rate 64000
R2(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up
R2(config-if)#
R2(config-if)#
R2(config-if)#exit
R2(config)#ip route 192.168.1.0 255.255.255.0 222.0.1.1
R2(config)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
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

S   192.168.1.0/24 [1/0] via 222.0.1.1
C   222.0.1.0/24 is directly connected, Serial2/0
C   222.0.2.0/24 is directly connected, FastEthernet0/0
R2#
```

PC1：

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 222.0.2.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 222.0.2.1

PC>ping 192.168.1.2

Pinging 192.168.1.2 with 32 bytes of data:

Request timed out.
Reply from 192.168.1.2: bytes=32 time=19ms TTL=126
Reply from 192.168.1.2: bytes=32 time=17ms TTL=126
Reply from 192.168.1.2: bytes=32 time=15ms TTL=126

Ping statistics for 192.168.1.2:
   Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
   Minimum = 15ms, Maximum = 19ms, Average = 17ms

PC>
```

PC1-WEB：


PC1
Physical
Config
Desktop
Web Browser
X
URL
http://222.0.1.3
Go
Stop
Cisco Packet Tracer
Welcome to Cisco Packet Tracer, the best thing since..... Packet Tracer 4.x.
Quick Links:
A small page
Copyrights
Image page
Image

Packet Tracer 5.2 实验(十五) 网络端口地址转换 NAPT 配置

一、实验目标

- 理解 NAT 网络地址转换的原理及功能；
- 掌握 NAPT 的配置，实现局域网访问互联网；

二、实验背景

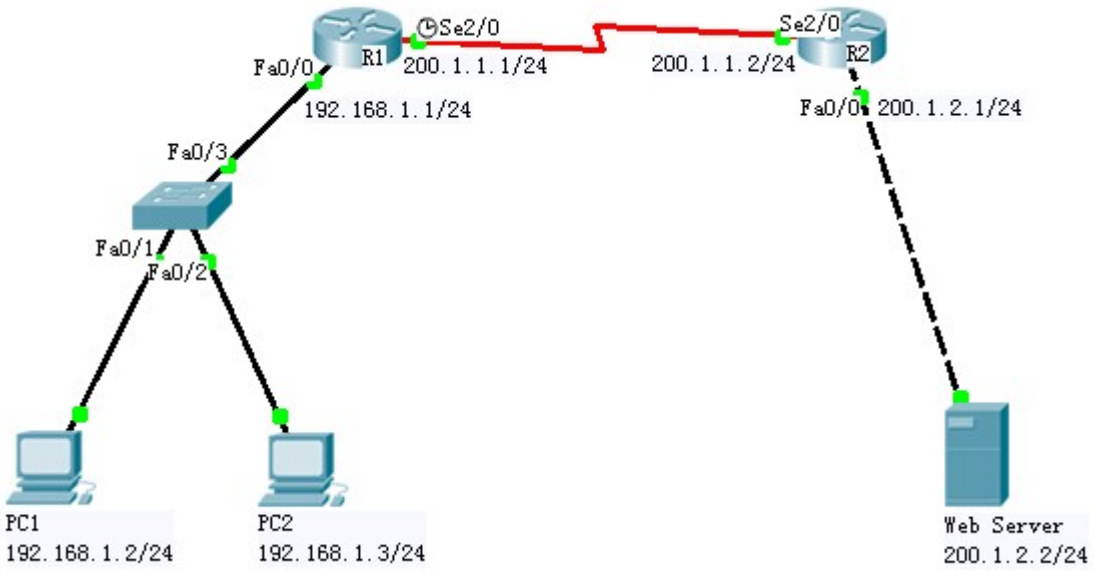
公司办公网需要接入互联网，公司只向 ISP 申请了一条专线，该专线分配了一个公网 IP 地址，配置实现全公司的主机都能访问外网。

三、技术原理

- NAT 将网络划分为内部网络和外部网络两部分，局域网主机利用 NAT 访问网络时，是将局域网内部的本地地址转换为全局地址（互联网合法的 IP 地址）后转发数据包；
- NAT 分为两种类型：NAT（网络地址转换）和 NAPT（网络端口地址转换 IP 地址对应一个全局地址）。
- NAPT：使用不同的端口来映射多个内网 IP 地址到一个指定的外网 IP 地址，多对一。
- NAPT 采用端口多路复用方式。内部网络的所有主机均可共享一个合法外部 IP 地址实现对 Internet 的访问，从而可以最大限度节约 IP 地址资源。同时，又可隐藏网络内部的所有主机，有效避免来自 Internet 的攻击。因此，目前网络中应用最多的就是端口多路复用方式。

四、实验步骤

实验拓扑



1、R1 为公司出口路由器，其与 ISP 路由器之间通过 V.35 电缆串口连接，DCE 端连接在 R1 上，配置其时钟频率为 64000；

2、配置 PC 机、服务器及路由器接口 IP 地址；

3、在各路由器上配置静态路由协议，让 PC 间能相互 ping 通；

4、在 R1 上配置 NAPT；

5、在 R1 上定义内外部网络接口；

6、验证主机之间的互通性。

R1：

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
```

```
Router(config)#host R1
R1(config)#int fa0/0
R1(config-if)#ip add 192.168.1.1 255.255.255.0
R1(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R1(config-if)#exit
R1(config)#int s2/0
R1(config-if)#ip add 200.1.1.1 255.255.255.0
R1(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to down
R1(config-if)#clock rate 64000
R1(config-if)#exit
R1(config)#
R1(config)#
R1(config)#
R1(config)#
%LINK-5-CHANGED: Interface Serial2/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up
R1(config)#
R1(config)#ip route 200.1.2.0 255.255.255.0 200.1.1.2
//配置静态路由
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip route
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    192.168.1.0/24 is directly connected, FastEthernet0/0
C    200.1.1.0/24 is directly connected, Serial2/0
```

```
S   200.1.2.0/24 [1/0] via 200.1.1.2
R1#
R1#
R1#
R1#
R1#
R1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#int fa0/0
R1(config-if)#ip nat inside
R1(config-if)#exit
R1(config)#int s2/0
R1(config-if)#ip nat outside
R1(config-if)#exit
R1(config)#access-list ?
  <1-99>    IP standard access list
  <100-199>  IP extended access list
R1(config)#access-list 1 ?
  deny   Specify packets to reject
  permit  Specify packets to forward
  remark  Access list entry comment
R1(config)#access-list 1 permit ?
  A.B.C.D  Address to match
  any     Any source host
  host    A single host address
R1(config)#access-list 1 permit 192.168.1.0 ?
  A.B.C.D  Wildcard bits
  <cr>
R1(config)#access-list 1 permit 192.168.1.0 0.0.0.255 ?
  <cr>
R1(config)#access-list 1 permit 192.168.1.0 0.0.0.255
//定义访问控制列表
R1(config)#ip nat ?
  inside   Inside address translation
  outside  Outside address translation
  pool    Define pool of addresses
R1(config)#ip nat pool ?
  WORD  Pool name
R1(config)#ip nat pool david ?
  A.B.C.D  Start IP address
R1(config)#ip nat pool david 200.1.1.3 ?
  A.B.C.D  End IP address
R1(config)#ip nat pool david 200.1.1.3 200.1.1.3 ?
  netmask  Specify the network mask
```

```
R1(config)#ip nat pool david 200.1.1.3 200.1.1.3 netmask ?
  A.B.C.D  Network mask
R1(config)#ip nat pool david 200.1.1.3 200.1.1.3 netmask
255.255.255.0 ?
  <cr>
R1(config)#ip nat pool david 200.1.1.3 200.1.1.3 netmask
255.255.255.0
R1(config)#ip nat inside ?
  source  Source address translation
R1(config)#ip nat inside source ?
  list    Specify access list describing local addresses
  static  Specify static local->global mapping
R1(config)#ip nat inside source list 1 ?
  interface  Specify interface for global address
  pool       Name pool of global addresses
R1(config)#ip nat inside source list 1 pool ?
  WORD  Name pool of global addresses
R1(config)#ip nat inside source list 1 pool david ?
  overload  Overload an address translation
  <cr>
R1(config)#ip nat inside source list 1 pool david overload ?
  <cr>
R1(config)#ip nat inside source list 1 pool david overload
R1(config)#end
R1#
%SYS-5-CONFIG_I: Configured from console by console
R1#show ip nat ?
  statistics    Translation statistics
  translations  Translation entries
R1#show ip nat translations
//没有主机访问 Web Server 的时候，没有记录
R1#
R1#show ip nat translations
//有主机访问 Web Server，产生记录
Pro  Inside global     Inside local       Outside local      Outside
global
tcp 200.1.1.3:1026     192.168.1.2:1026   200.1.2.2:80
200.1.2.2:80

R1#show ip nat translations
//来自 1.2 和 1.3 的主机访问
Pro  Inside global     Inside local       Outside local      Outside
global
```

```
tcp 200.1.1.3:1026    192.168.1.2:1026   200.1.2.2:80
200.1.2.2:80
tcp 200.1.1.3:1025    192.168.1.3:1025   200.1.2.2:80
200.1.2.2:80

R1#show ip nat translations
Pro  Inside global    Inside local      Outside local     Outside
global
tcp 200.1.1.3:1026    192.168.1.2:1026   200.1.2.2:80
200.1.2.2:80
tcp 200.1.1.3:1027    192.168.1.2:1027   200.1.2.2:80
200.1.2.2:80
tcp 200.1.1.3:1025    192.168.1.3:1025   200.1.2.2:80
200.1.2.2:80
tcp 200.1.1.3:1024    192.168.1.3:1026   200.1.2.2:80
200.1.2.2:80

R1#
```

R2:

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#hostname R2
R2(config)#int fa0/0
R2(config-if)#ip add 200.1.2.1 255.255.255.0
R2(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up
R2(config-if)#exit
R2(config)#int s2/0
R2(config-if)#ip add 200.1.1.2 255.255.255.0
R2(config-if)#no shut

%LINK-5-CHANGED: Interface Serial2/0, changed state to up
R2(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial2/0, changed
state to up
R2(config-if)#
R2(config-if)#
R2(config-if)#exit
R2(config)#ip route 192.168.1.0 255.255.255.0 200.1.1.1
```

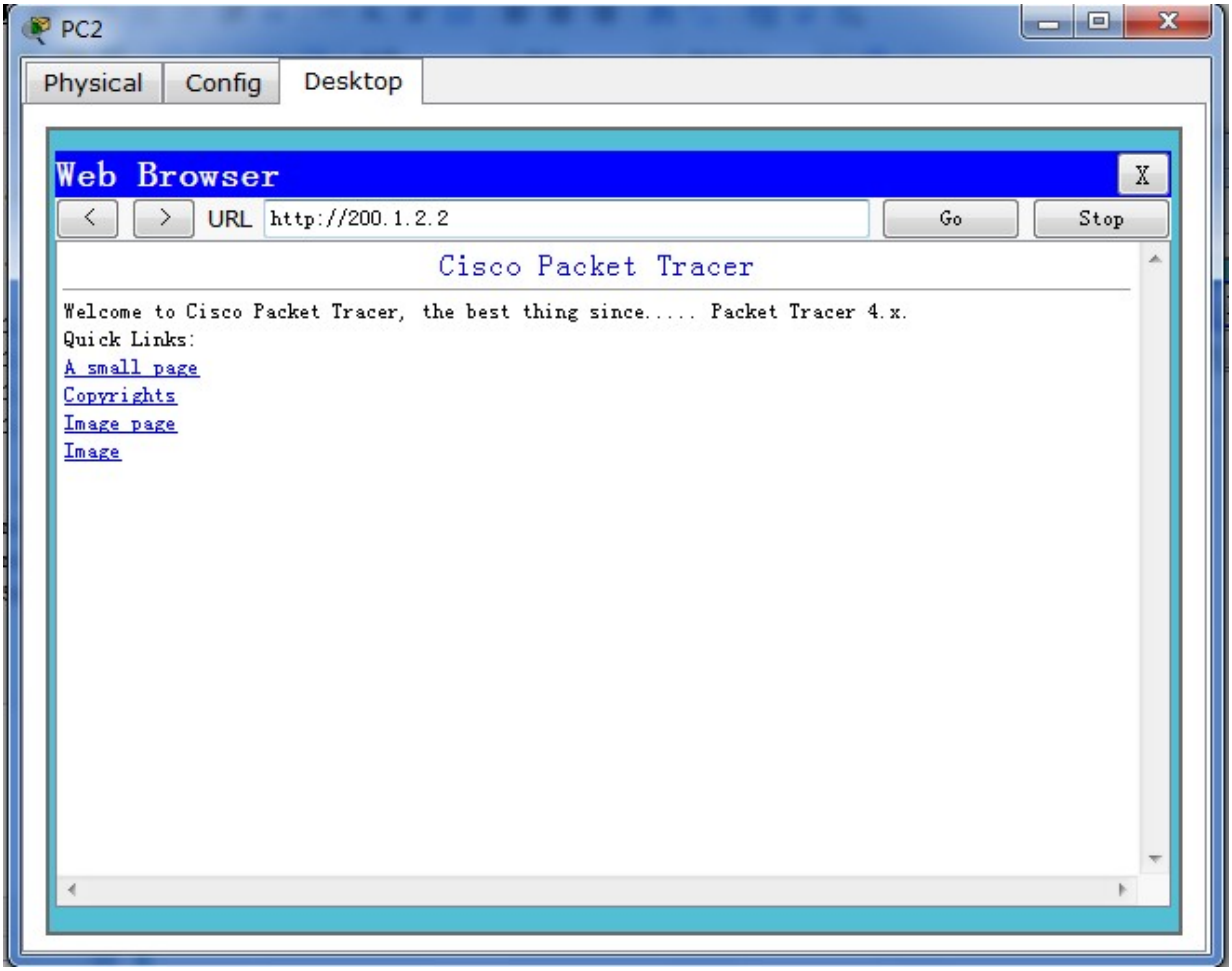
```
R2(config)#end
R2#
%SYS-5-CONFIG_I: Configured from console by console
R2#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B
- BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 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

S    192.168.1.0/24 [1/0] via 200.1.1.1
C    200.1.1.0/24 is directly connected, Serial2/0
C    200.1.2.0/24 is directly connected, FastEthernet0/0
R2#
R2#
R2#
R2#
```

PC1:

```
Packet Tracer PC Command Line 1.0
PC>ipconfig

IP Address......................: 192.168.1.2
Subnet Mask.....................: 255.255.255.0
Default Gateway.................: 192.168.1.1

PC>ping 200.1.2.2

Pinging 200.1.2.2 with 32 bytes of data:

Reply from 200.1.2.2: bytes=32 time=15ms TTL=126
Reply from 200.1.2.2: bytes=32 time=16ms TTL=126
Reply from 200.1.2.2: bytes=32 time=16ms TTL=126
Reply from 200.1.2.2: bytes=32 time=15ms TTL=126

Ping statistics for 200.1.2.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
```

```
    Minimum = 15ms, Maximum = 16ms, Average = 15ms

PC>
```

PC-WEB:



Packet Tracer 5.3 实验(十六) 网络设备系统升级

一、TFTP 简介

TFTP（Trivial File Transfer Protocol,简单文件传输协议）是 TCP/IP 协议族中的一个用来在客户机与服务器之间进行简单文件传输的协议，提供不复杂、开销不大的文件传输服务。TFTP 承载在 UDP 上，使用 69 号端口。提供不可靠的数据流传输服务，不提供存取授权与认证机制，使用超时重传方式来保证数据的到达。与 FTP 相 比，TFTP 的大小要小的多。

TFTP 与 FTP 的区别

1、TFTP --简单文件传输协议，udp，69；

2、FTP --文件传输协议，tcp，20，21；

3、TFTP 传输速度比 FTP 快，但是相对没有 FTP 安全。

二、TFTP 实验环境

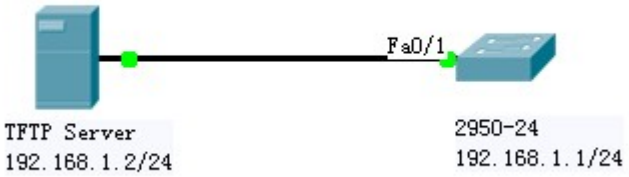
一台装有 TFTP 服务器软件的电脑，交换机（或者路由器）设备，以太网线；

三、TFTP 配置过程

1. 配置主机、设备 ip 地址；
2. 使用 copy 命令；

四、下面将在模拟器中来看一下系统 bin 文件的 TFTP 备份过程

1、拓扑图



2、设置服务器的 IP 地址 192.168.1.2，子网掩码 255.255.255.0；

3、设置交换机的虚接口 IP 地址 192.168.1.1，子网掩码 255.255.255.0；

```
Switch>
Switch>en
Switch#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#int vlan 1
Switch(config-if)#ip add 192.168.1.1 255.255.255.0
Switch(config-if)#no shut

%LINK-5-CHANGED: Interface Vlan1, changed state to up

Switch(config-if)#
```

4、显示交换机 flash 目录；

```
Switch#dir
Directory of flash:/

    1  -rw-     3058048          <no
date>  c2950-i6q4l2-mz.121-22.EA4.bin

64016384 bytes total (60958336 bytes free)
Switch#
```

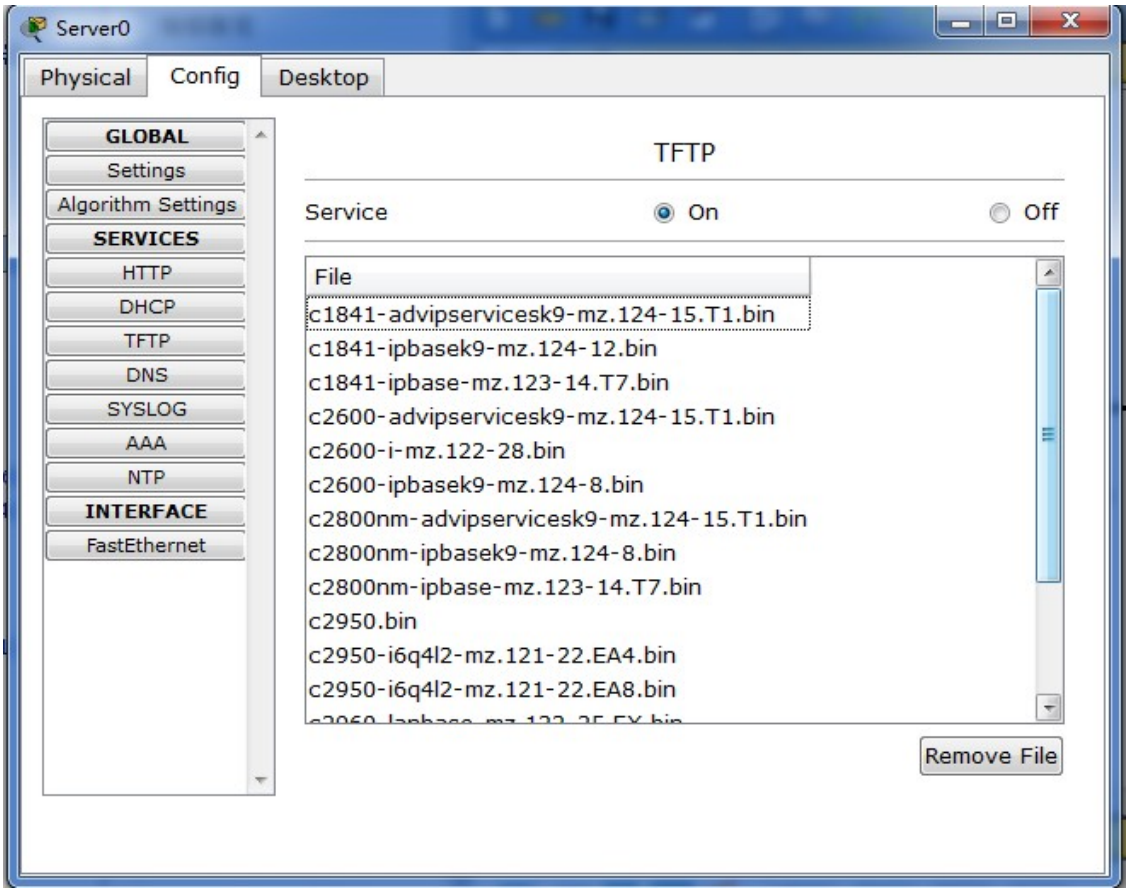
说明：交换机里有一个名为“c2950-i6q4l2-mz.121-22.EA4.bin”的文件。

5、在升级前先备份该文件；

```
Switch#copy flash: tftp:                                          //从
flash 中复制到 tftp 服务器中
Source filename []?c2950-i6q4l2-mz.121-22.EA4.bin                  //
要复制的源文件名
Address or name of remote host []? 192.168.1.2                     //
目标服务器地址
Destination filename [c2950-i6q4l2-mz.121-22.EA4.bin]? c2950.bin
//目标文件名
.!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 3058048 bytes]

3058048 bytes copied in 4.953 secs (617000 bytes/sec)
```

6、下面到 TFTP 服务器上去看是否有了这个文件？

进入服务器，单击配置，选择 TFTP，在右边的文件列表中可以看到 c2950.bin。说明文件已经写入 TFTP 服务器了。



7、现在要实现从 TFTP 服务器上传升级 bin 文件；

1）首先在交换机上删除 c2950-i6q4l2-mz.121-22.EA4.bin 这个文件；

```
Switch#delete c2950-i6q4l2-mz.121-22.EA4.bin
Delete filename [c2950-i6q4l2-mz.121-22.EA4.bin]?                //
回车
Delete flash:/c2950-i6q4l2-mz.121-22.EA4.bin? [confirm]          //
回车

Switch#dir
Directory of flash:/

No files in directory

64016384 bytes total (64016384 bytes free)
Switch#
```

交换机 flash 的目录中已经没有文件了。在此，先将 bin 文件删除了。

请注意：在现实中如果空间足够的话，不要删除 bin 文件。

8、从 TFTP 服务器中下载升级文件；

```
Switch#copy tftp: flash:                                          //
从 tftp 服务器到交换机 flash
Address or name of remote host []? 192.168.1.2                    //
源主机 IP 地址
Source filename []? c2950.bin                                     //
源文件名称
Destination filename [c2950.bin]? c2950-i6q4l2-mz.121-22.EA4.bin
//目标文件名称
Accessing tftp://192.168.1.2/c2950.bin....
Loading c2950.bin from
192.168.1.2: !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!
[OK - 3058048 bytes]

3058048 bytes copied in 4.907 secs (623201 bytes/sec)
```

下载完成

9、使用 dir 显示文件

```
Switch#dir
Directory of flash:/

   2  -rw-    3058048         <no date>
c2950-i6q4l2-mz.121-22.EA4.bin

64016384 bytes total (60958336 bytes free)
Switch#
```

说明：文件又下载到了交换机的 flash 中。

10、在完成系统升级后，要 reload 重启系统；

```
Switch#
Switch#reload
Proceed with reload? [confirm]    //回车
C2950 Boot Loader (C2950-HBOOT-M) Version 12.1(11r)EA1, RELEASE
SOFTWARE (fc1)
Compiled Mon 22-Jul-02 18:57 by miwang
Cisco WS-C2950-24 (RC32300) processor (revision C0) with 21039K bytes
of memory.
2950-24 starting...
Base ethernet MAC Address: 0030.A35C.4165
Xmodem file system is available.
Initializing Flash...
flashfs[0]: 1 files, 0 directories
flashfs[0]: 0 orphaned files, 0 orphaned directories
flashfs[0]: Total bytes: 64016384
flashfs[0]: Bytes used: 3058048
flashfs[0]: Bytes available: 60958336
flashfs[0]: flashfs fsck took 1 seconds.
...done Initializing Flash.

Boot Sector Filesystem (bs:) installed, fsid: 3
Parameter Block Filesystem (pb:) installed, fsid: 4


Loading "flash:/c2950-i6q4l2-mz.121-22.EA4.bin"...
###################################################################
######### [OK]
           Restricted Rights Legend
```

```
Use, duplication, or disclosure by the Government is
subject to restrictions as set forth in subparagraph
(c) of the Commercial Computer Software - Restricted
Rights clause at FAR sec. 52.227-19 and subparagraph
(c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.

         cisco Systems, Inc.
         170 West Tasman Drive
         San Jose, California 95134-1706



Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(22)EA4,
RELEASE SOFTWARE(fc1)
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 18-May-05 22:31 by jharirba

Cisco WS-C2950-24 (RC32300) processor (revision C0) with 21039K bytes
of memory.
Processor board ID FHK0610Z0WC
Running Standard Image
24 FastEthernet/IEEE 802.3 interface(s)

63488K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address: 0030.A35C.4165
Motherboard assembly number: 73-5781-09
Power supply part number: 34-0965-01
Motherboard serial number: FOC061004SZ
Power supply serial number: DAB0609127D
Model revision number: C0
Motherboard revision number: A0
Model number: WS-C2950-24
System serial number: FHK0610Z0WC

Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(22)EA4,
RELEASE SOFTWARE(fc1)
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 18-May-05 22:31 by jharirba

Press RETURN to get started!
```

```
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1,
changed state to up

Switch>en
Switch#show running-config
Building configuration...

Current configuration : 970 bytes
!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
ip name-server 0.0.0.0
!
!
interface FastEthernet0/1
!
...
!
interface Vlan1
 no ip address
 shutdown
!
!
line con 0
!
line vty 0 4
 login
line vty 5 15
 login
!
!
end


Switch#
```

此时系统将重装 bin 文件

11、重新显示配置内容，会发现原来的设置都没了。证明重传成功了。

```
Switch>en
Switch#show running-config
Building configuration...

Current configuration : 970 bytes
!
version 12.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
ip name-server 0.0.0.0
!
!
interface FastEthernet0/1
!
...
!
interface Vlan1
 no ip address
 shutdown
!
!
line con 0
!
line vty 0 4
 login
line vty 5 15
 login
!
!
end


Switch#
```

五、FTP 方式备份与还原网络设备系统

FTP 由于使用的是 tcp 可靠传输模式，速度没有 tftp 快，但是有了用户名和密码，相对比 tftp 要安全些。

六、FTP 实验环境

FTP 服务器、路由器、以太网线缆；

七、配置过程

1、配置服务器和路由器的 ip 地址；

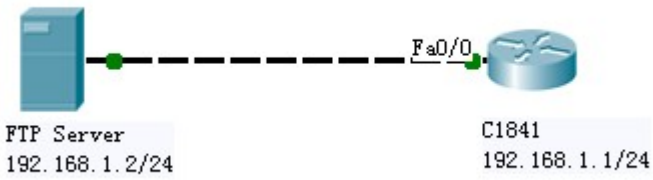
2、在 ftp 服务器中新建用户名和密码；

3、在路由器中指定与 ftp 服务器中用户名、密码相关联；

4、使用 copy 命令即可。

八、实验步骤

实验拓扑

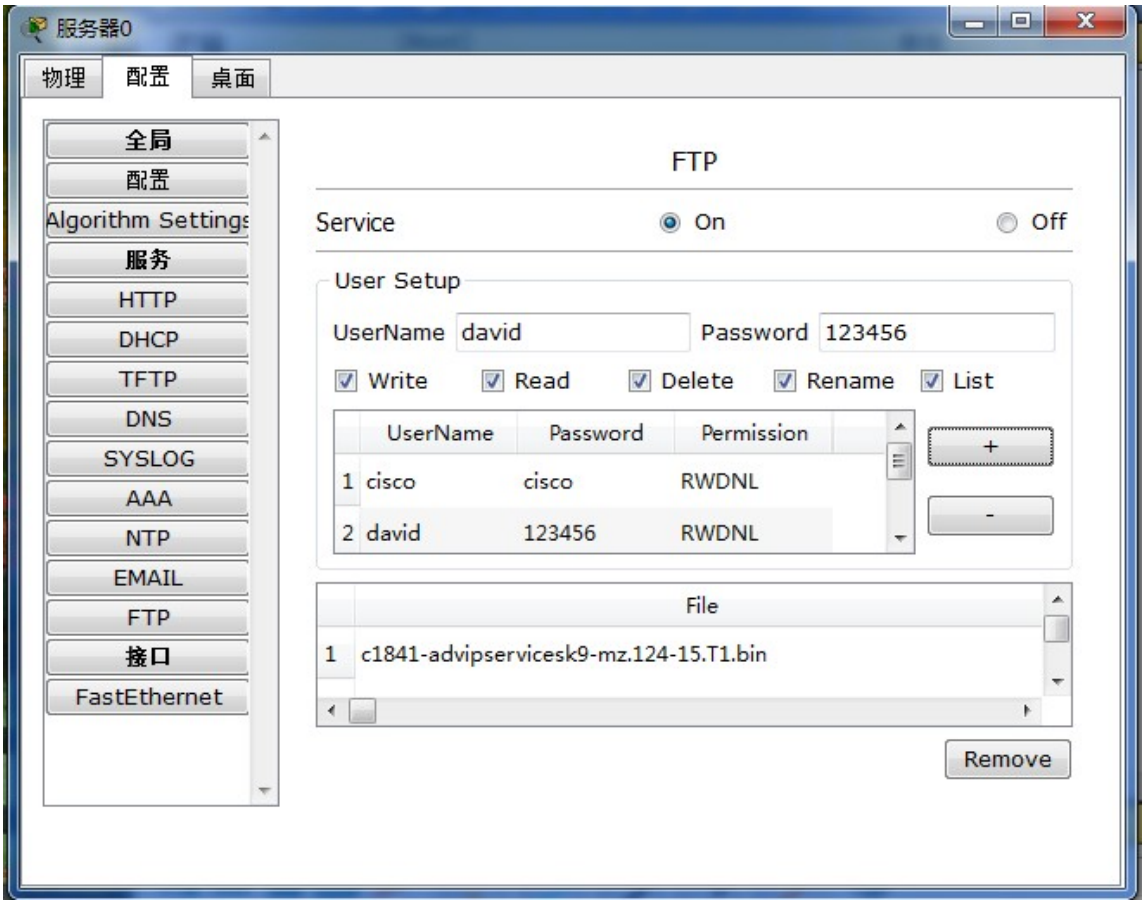


1、设置 FTP 服务器的 IP 地址 192.168.1.2，子网掩码 255.255.255.0；

2、设置路由器 Fa0/0 的 IP 地址 192.168.1.1，子网掩码 255.255.255.0；

```
Router>en
Router#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#int fa0/0
Router(config-if)#ip add 192.168.1.1 255.255.255.0
Router(config-if)#no shut

%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0,
changed state to up

Router(config-if)#exit
```

3、在 FTP 服务器中新建用户名和密码；



4、在路由器中指定与 ftp 服务器中用户名、密码相关联；

```
Router(config)#ip ftp ?
  password  Specify password for FTP connections
  username  Specify username for FTP connections
```

```
Router(config)#ip ftp use
Router(config)#ip ftp username david ?
  <cr>
Router(config)#ip ftp username david
Router(config)#ip ftp pass
Router(config)#ip ftp password ?
  <0-7>  Encryption type (0 to disable encryption, 7 for proprietary
  LINE   LINE The password
Router(config)#ip ftp password 123456
Router(config)#end
```

5、显示路由器 flash 目录；

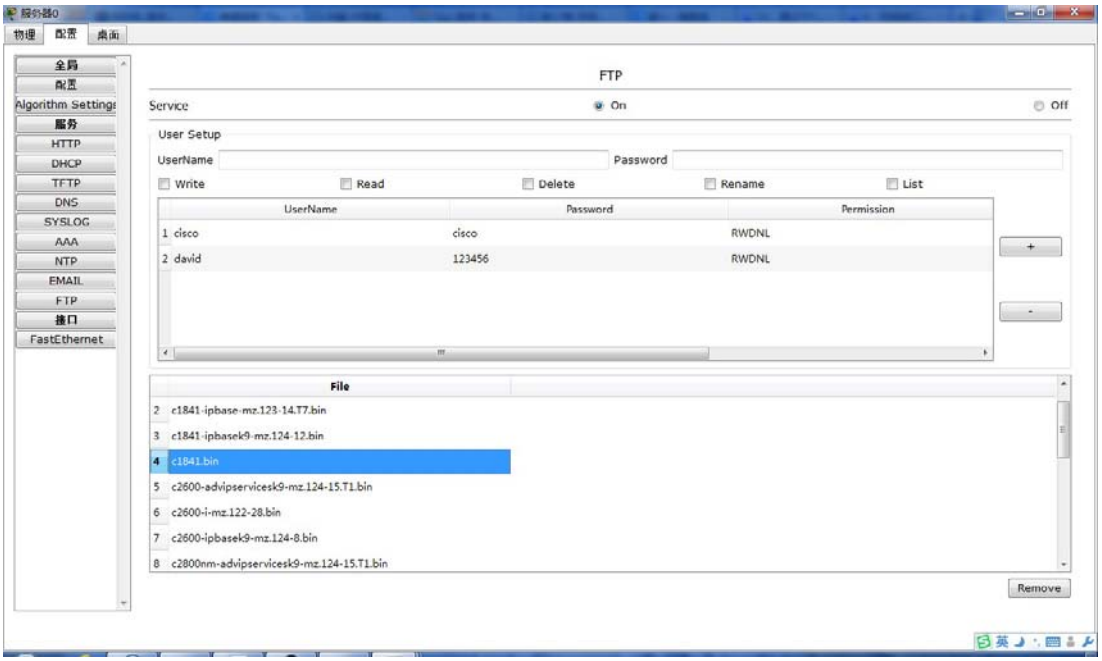
```
Router#dir
Directory of flash:/

   3  -rw-    33591768         <no date>
c1841-advipservicesk9-mz.124-15.T1.bin
   2  -rw-       28282         <no date>  sigdef-category.xml
   1  -rw-      227537         <no date>  sigdef-default.xml

64016384 bytes total (30168797 bytes free)
Router#cop
```

6、在升级前先备份该文件；

```
Router#copy fl
Router#copy flash: ?
  ftp:           Copy to ftp: file system
  running-config  Update (merge with) current system configuration
  startup-config  Copy to startup configuration
  tftp:          Copy to tftp: file system
Router#copy flash: ft
Router#copy flash: ftp:
Source filename []? c1841-advipservicesk9-mz.124-15.T1.bin
Address or name of remote host []? 192.168.1.2
Destination filename [c1841-advipservicesk9-mz.124-15.T1.bin]?
c1841.bin

Writing c1841-advipservicesk9-mz.124-15.T1.bin...
[OK - 33591768 bytes]

33591768 bytes copied in 346.13 secs (97000 bytes/sec)
Router#
```

```
Router#
Router#
```

7、到 FTP 服务器上去看是否有了这个文件；



有 c1841.bin 文件了，说明备份成功。

8、还原升级和 TFTP 升级方法类似，不再赘述。