

华北电力大学

课程设计报告

(2017-- 2018 年度第 2 学期)

名 称: 计算机网络课程设计

题 目: 计算机网络课程设计

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实验一、网络设备认知及基本配置操作

一、课程设计的目的与要求

1. 了解路由器、交换机等网络设备结构。
2. 完成以下实验，掌握路由器、交换机等的配置方法，理解相关网络协议。

二、设计正文

1. 交换机的基本配置

(1) 实验目的

掌握交换机命令行各种操作模式的区别，能够使用各种帮助信息，以及用命令进行基本的配置

(2) 需求分析

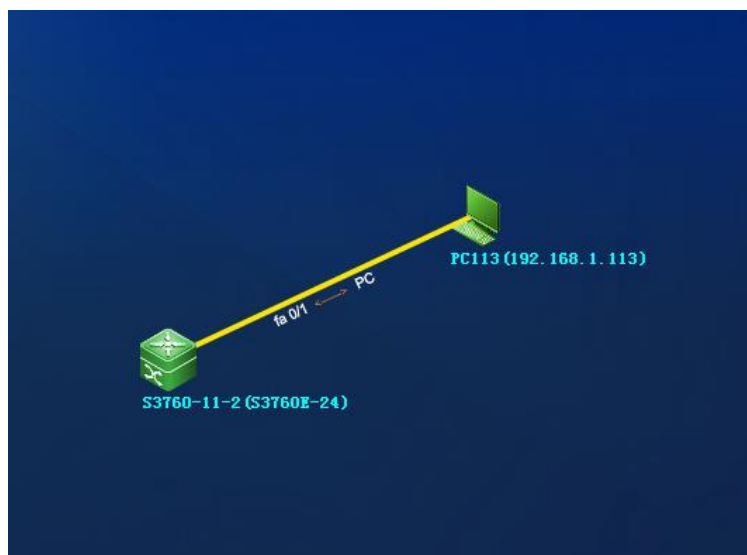
需要在交换机上熟悉各种不同的配置模式以及如何在配置模式间切换,使用命令进行基本的配置，并熟悉命令行界面的操作技巧。

(3) 实验器材

3 层交换机一台

PC 一台

(4) 实验拓扑



(5) 实验原理

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 口管理交换机属于带外管理，不占用交换机的网络接口，其特点是需要使用配置线缆，近距离配置。

第一次配置交换机时必须利用 Console 端口进行配置。

交换机的命令行操作模式，主要包括：用户模式、特权模式、全局配置模式、端口模式等几种。

(6) 实验步骤

第一步：交换机各个操作模式直接的切换

```
Ruijie#enable
Ruijie#conf
Ruijie#configure ter
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
[Help cmd]      [Example]      [Presented inf]      [Config mode]
-----
function+help    acl help        typical config example privileged mode
keyword+help     ip-mac help     single cmd example   current cmd mode
view+function    view acl        main status or config mode of different levels
Ruijie(config)#interface fastEthernet 0/1
Ruijie(config-if-FastEthernet 0/1)#
Ruijie(config-if-FastEthernet 0/1)#exit
Ruijie(config)#interface fastEthernet 0/2
Ruijie(config-if-FastEthernet 0/2)#end
Ruijie#*Jul  2 10:30:13: %SYS-5-CONFIG_I: Configured from console by console
```

第二步：交换机命令行界面基本功能

Exec commands:

<1-99>	Session number to resume
aaa	AAA help
access-list	Access-list help
address-bind	Address binding table
aggregateport	Aggregateport help
anti-arp-spoofing	Anti-arp-spoofing help
arp-check	Arp-check help
cd	Change current working directory
cfm	Connectivity Fault Management
clear	Reset functions
clock	Manage the system clock
configure	Enter configuration mode
copy	Copy from one file to another
cpu-protect	Cpu-protect help
dai	DAI help
debug	Debugging functions (see also 'undebug')
delete	Delete files
dhcp	Dhcp help
dhcp-relay	Dhcp-relay help
dhcp-server	Dhcp-server help
dhcp-snooping	Dhcp-snooping help
diagnostic	Diagnostic cmd
dir	List directory contents
disable	Turn off privileged commands
disconnect	Disconnect an existing network connection

```

Ruijie#en
Ruijie#en en
Ruijie#en
Ruijie#enable
Ruijie#con?
configure
Ruijie#con
Enter configuration commands, one per line. End with CNTL/Z.
Ruijie(config)#conf t
% Unknown command.
Ruijie(config)#interface ?
Aggregateport      Aggregate port interface
Dialer              Dialer interface
FastEthernet        Fast IEEE 802.3
GigabitEthernet     Gigabit Ethernet interface
Loopback            Loopback interface
Multilink            Multilink-group interface
Null                Null interface
Tunnel              Tunnel interface
Virtual-ppp          Virtual PPP interface
Virtual-template     Virtual Template interface
Vlan                 Vlan interface
range               Interface range command
Ruijie(config)#interface
% Incomplete command.
Ruijie(config)#interface
% Incomplete command.
Ruijie(config)#interface fastEthernet 0/1
Ruijie(config-if-FastEthernet 0/1)#
Ruijie##*Jul  2 10:32:03: %SYS-5-CONFIG_I: Configured from console by console
Ruijie#ping 1.1.1.1
Sending 5, 100-byte ICMP Echoes to 1.1.1.1, timeout is 2 seconds:
< press Ctrl+C to break >.
Success rate is 0 percent (0/1)

```

第三步：配置交换机的名称和每日提示信息
 Ruijie(config)#hostname SW-1

第四步：配置接口状态
 SW-1(config)#interface fastEthernet 0/1
 SW-1(config-if)#speed 10
 SW-1(config-if)#duplex half
 SW-1(config-if)#no shutdown
 SW-1(config-if)#description "This is a Accessport."
 SW-1(config-if)#end
 SW-1#
 SW-1#show interface fastEthernet 0/1
 SW-1(config)#interface fastEthernet 0/1
 SW-1(config-if)#default bandwidth
 SW-1(config-if)#default description
 SW-1(config-if)#default duplex

```
SW-1(config-if)#end
SW-1#Nov 25 22:11:13 %SYS-5-CONFIG_I: Configured from console by console
SW-1#
SW-1#show interface fastEthernet 0/1
第五步：查看交换机的系统和配置信息
SW-1#show version
SW-1#show running-config
```

第六步：保存配置

下面的3 条命令都可以保存配置

```
SW-1#copy running-config startup-config
SW-1#write memory
SW-1#write
```

2. 路由器的基本操作

(1) 实验目的

理解路由器的工作原理，掌握路由器的基本操作

(2) 需求分析

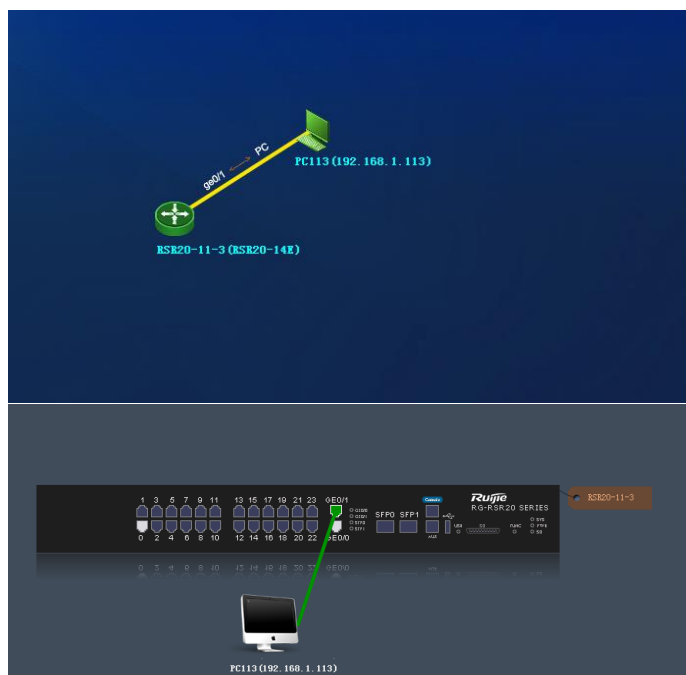
将计算机的 Com 口和路由器的 Console 口通过 Console 线缆连接起来，使用 Windows 提供的超级终端工具进行连接，登录路由器的命令行界面进行配置。

(3) 实验器材

路由器一台

计算机一台

(4) 实验拓扑



(5) 实验原理

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，但特点是线缆特殊，需要近距离配置。第一次配置路由器时必须利用Console进行配置，使其支持telnet远程管理。

路由器的命令行操作模式，主要包括：用户模式、特权模式、全局配置模式、端口模式等等几种。

(6) 实验步骤

第一步：路由器命令行的基本功能

```
[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]
```

```
[Message : Connection is established.Device is RSR20-11-3]
```

```
Ruijie>?
```

```
Exec commands:
```

<1-99>	Session number to resume
disable	Turn off privileged commands
disconnect	Disconnect an existing network connection
enable	Turn on privileged commands
exit	Exit from the EXEC
help	Description of the interactive help system
lock	Lock the terminal
ping	Send echo messages
show	Show running system information
start-terminal-service	Start terminal service
telnet	Open a telnet connection
traceroute	Trace route to destination

```
Ruijie>e?
```

```
enable exit
```

```
Ruijie>een
```

```
Ruijie>eenen
```

```
Translating "eenen"...
```

```
% Unrecognized host or address, or protocol not running.
```

```
Ruijie>en
```

```
Ruijie>enable
```

```
Ruijie#copy ?
```

WORD	Copy from current file system
flash:	Copy from flash: file system
running-config	Copy from current system configuration
sd0:	Copy from sd0: file system
startup-config	Copy from startup configuration
tftp:	Copy from tftp: file system
usb0:	Copy from usb0: file system
usb1:	Copy from usb1: file system

```

xmodem:          Copy from xmodem: file system
Ruijie#copy
% Incomplete command.

Ruijie#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#
Ruijie(config)#exit
Ruijie#*Jul  2 11:18:27: %SYS-5-CONFIG_I: Configured from console by console
Ruijie#interface fastEthernet 0/0
% Unknown command.
Ruijie#
Ruijie#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#interface fastEthernet 1/0
Ruijie(config-if-FastEthernet 1/0)#
Ruijie#*Jul  2 11:23:11: %SYS-5-CONFIG_I: Configured from console by console
Ruijie#ping 1.1.1.1
Sending 5, 100-byte ICMP Echoes to 1.1.1.1, timeout is 2 seconds:
  < press Ctrl+C to break >
.....
Success rate is 0 percent (0/5)

```

第二步：配置路由器的名称和每日提示信息

```

Ruijie#
Ruijie#enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#hostname RouterA
RouterA(config)#
RouterA(config)#banner motd &
Enter TEXT message.  End with the character '&'.
Welcome to RouterA, if you are admin, you can config it.
If you are not admin, please EXIT.
&
RouterA(config)#
RouterA(config)#exit
RouterA#*Jul  2 11:25:22: %SYS-5-CONFIG_I: Configured from console by console
RouterA#exit
RouterA CON0 is now available
Press RETURN to get started
Welcome to RouterA, if you are admin, you can config it.
If you are not admin, please EXIT.
第三步：配置路由器的接口并查看接口配置
RouterA>

```

```

RouterA>#configure terminal
% Unknown command.
RouterA>configure terminal
% Unknown command.
RouterA>enable
RouterA#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
RouterA(config)#interface fastEthernet 1/0
RouterA(config-if-FastEthernet 1/0)#*Jul  2 11:40:38:  %LINK-3-UPDOWN:
Interface FastEthernet 1/0, changed state to up.
*Jul  2 11:40:38: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet
1/0, changed state to up.
RouterA(config)#interface GigabitEthernet 0/1
RouterA(config-if-GigabitEthernet 0/1)#ip address 192.168.1.1 255.255.255.0
RouterA(config-if-GigabitEthernet 0/1)#no shutdown
RouterA(config-if-GigabitEthernet 0/1)#end
RouterA#*Jul  2 14:59:05: %SYS-5-CONFIG_I: Configured from console by console
RouterA#show interfaces GigabitEthernet 0/1
Index(dec):4 (hex):4
GigabitEthernet 0/1 is UP , line protocol is UP
Hardware is OCTEN GE CONTROLLER GigabitEthernet, address is 1414.4b31.e2b3 (bia
1414.4b31.e2b3)
Interface address is: 192.168.1.1/24
ARP type: ARPA, ARP Timeout: 3600 seconds
MTU 1500 bytes, BW 1000000 Kbit
Encapsulation protocol is Ethernet-II, loopback not set
Keepalive interval is 10 sec , set
Carrier delay is 2 sec
Rxload is 1/255, Txload is 1/255
Queueing strategy: FIFO
Output queue 0/40, 0 drops;
Input queue 0/75, 0 drops
Link Mode: 100M/Full-Duplex, media-type is twisted-pair.
Output flowcontrol is off;Input flowcontrol is off.
5 minutes input rate 717 bits/sec, 0 packets/sec
5 minutes output rate 0 bits/sec, 0 packets/sec
2686 packets input, 277930 bytes, 0 no buffer, 0 dropped
Received 2686 broadcasts, 0 runts, 0 giants
0 input errors, 0 CRC, 0 frame, 0 overrun, 0 abort
2 packets output, 92 bytes, 0 underruns , 0 dropped
0 output errors, 0 collisions, 0 interface resets

```

第四步：查看路由器的配置

```
RouterA#show version
```



```

System description      : Ruijie Router (RSR20-14E) by Ruijie Networks
System start time      : 2018-07-02 8:20:11
System uptime          : 0:6:39:53
System hardware version : 1.01
System software version : RGOS 10.4(3b12) Release(151012)
System BOOT version    : 10.4(3b12) Release(151012)
System serial number    : G1G40AA00071C
System fpga version     : 2.2.1.5
System cpld1 version    : 1.0.0.5
System cpld2 version    : 1.0.0.6
RouterA#show ip route
Codes: C - connected, S - static, R - RIP, B - BGP
       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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default
Gateway of last resort is no set
C    192.168.1.0/24 is directly connected, GigabitEthernet 0/1
C    192.168.1.1/32 is local host.
RouterA#show running-config
Building configuration...
Current configuration : 1739 bytes
!
version RGOS 10.4(3b12) Release(151012) (Fri Dec 28 19:23:27 CST 2012 -ngcf67)
hostname RouterA
!
diffserv domain default
!!!!!!
vlan 1
!!
no service password-encryption
!!!!!!
RouterA#

```

3. OSPF 基本配置

(1) 实验目的

掌握在路由器上配置 OSPF 单区域

(2) 需求分析

需要在路由器和交换机上配置OSPF路由协议,使全网互通,从而实现信息的共享和传递。

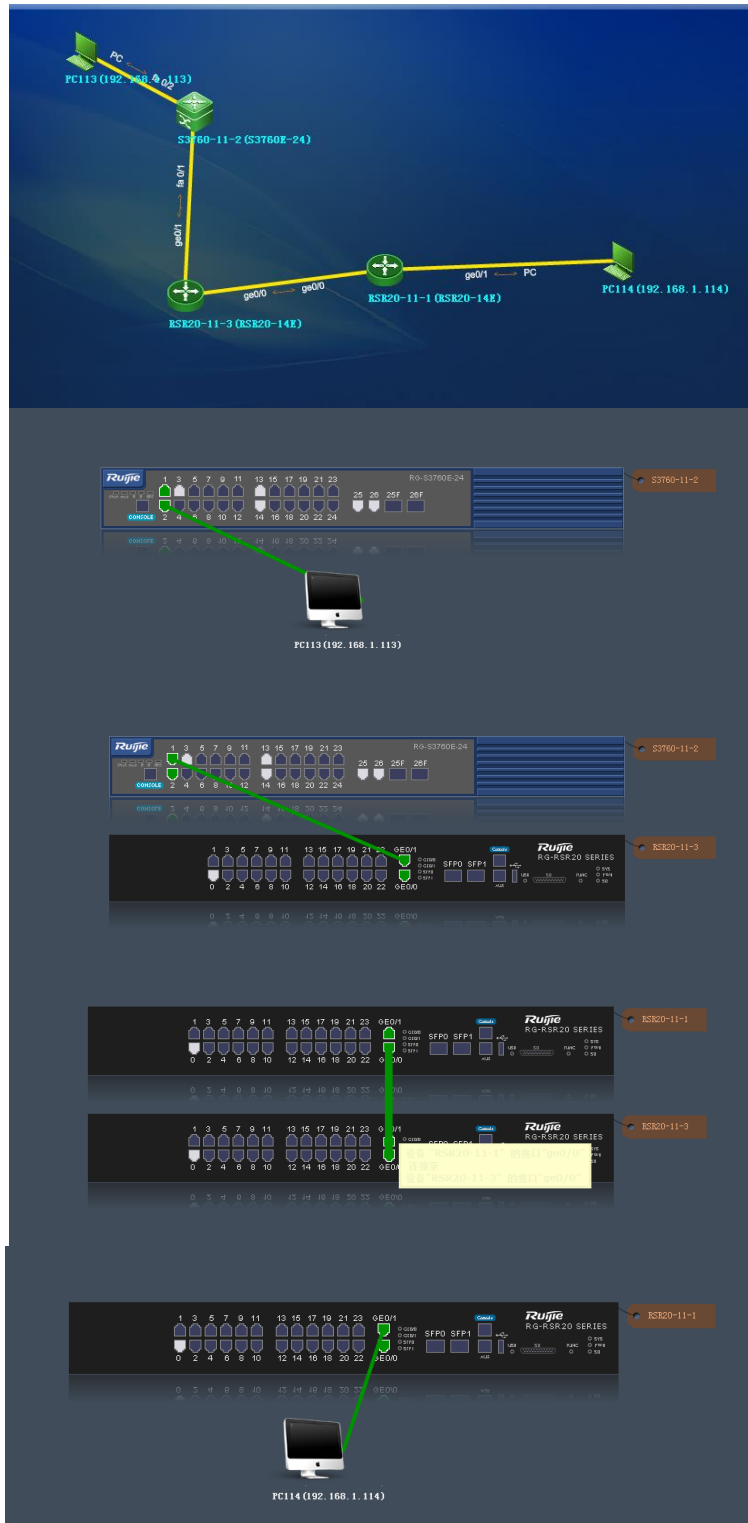
(3) 实验器材

三层交换机 1 台

路由器 2 台

交叉线或直连线 3 条

(4) 实验拓扑



(5) 实验原理

OSPF（Open Shortest Path First，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（link-state）协议。

OSPF路由协议通过向全网扩散本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（LSDB），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。

OSPF属于无类路由协议，支持VLSM（变长子网掩码）。OSPF是以组播的形式进行链路状态的通告的。

在大模型的网络环境中，OSPF支持区域的划分，将网络进行合理规划。划分区域时必须存在area0（骨干区域）。其他区域和骨干区域直接相连，或通过虚链路的方式连接。

（6）实验步骤

设置交换机

```
[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]
```

```
[Message : Connection is established.Device is S3760-11-2]
```

```
Ruijie>enable
```

```
Ruijie#configure terminal
```

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

```
Ruijie(config)#hostname S3750
```

```
S3750(config)#vlan 10
```

```
S3750(config-vlan)#exit
```

```
S3750(config)#vlan 50
```

```
S3750(config-vlan)#exit
```

```
S3750(config)#interface f0/1
```

```
S3750(config-if-FastEthernet 0/1)#switchport access vlan 10
```

```
S3750(config-if-FastEthernet 0/1)#exit
```

```
S3750(config)#interface f0/2
```

```
S3750(config-if-FastEthernet 0/2)#switchport access vlan 50
```

```
S3750(config-if-FastEthernet 0/2)#exit
```

```
S3750(config)#interface vlan 10
```

```
S3750(config-if-VLAN 10)#*Jul  2 15:21:21: %LINEPROTO-5-UPDOWN: Line protocol on Interface VLAN 10, changed state to up.
```

```
S3750(config-if-VLAN 10)#ip address 172.16.1.2 255.255.255.0
```

```
S3750(config-if-VLAN 10)#no shutdown
```

```
S3750(config-if-VLAN 10)#exit
```

```
S3750(config)#interface vlan 50
```

```
S3750(config-if-VLAN 50)#*Jul  2 15:25:54: %LINEPROTO-5-UPDOWN: Line protocol on Interface VLAN 50, changed state to up.
```

```
S3750(config-if-VLAN 50)#ip address 172.16.5.1 255.255.255.0
```

```
S3750(config-if-VLAN 50)#no shutdown
```

```

S3750(config-if-VLAN 50)#exit
S3750(config)#
S3750 CON0 is now available
Press RETURN to get started
*Jul  2 15:41:05: %SYS-5-CONFIG_I: Configured from console by console
S3750>enable
S3750#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
S3750(config)#router ospf
S3750(config-router)#network 172.16.5.0 0.0.0.255 area 0
S3750(config-router)#network 172.16.1.0 0.0.0.255 area 0
S3750(config-router)#end
S3750#*Jul  2 15:45:38: %SYS-5-CONFIG_I: Configured from console by console
S3750#*Jul  2 15:46:11: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.2.1-VLAN 10 from
Down to Init, HelloReceived.
*Jul  2 15:46:56: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.2.1-VLAN 10 from
Loading to Full, LoadingDone.
S3750#show vlan

```

VLAN Name	Status	Ports
1 VLAN0001	STATIC	Fa0/3, Fa0/4, Fa0/5, Fa0/6 Fa0/7, Fa0/8, Fa0/9, Fa0/10 Fa0/11, Fa0/12, Fa0/13, Fa0/14 Fa0/15, Fa0/16, Fa0/17, Fa0/18 Fa0/19, Fa0/20, Fa0/21, Fa0/22 Fa0/23, Fa0/24, Gi0/25, Gi0/26
10 VLAN0010	STATIC	Fa0/1
50 VLAN0050	STATIC	Fa0/2

```

S3750#show ip interface brief

```

Interface	Status	Protocol	IP-Address (Pri)	IP-Address (Sec)
VLAN 10	up	up	172.16.1.2/24	no address
VLAN 50	up	up	172.16.5.1/24	no address

```

S3750#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP
        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
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default
Gateway of last resort is no set
C    172.16.1.0/24 is directly connected, VLAN 10
C    172.16.1.2/32 is local host.
O    172.16.2.0/24 [110/2] via 172.16.1.1, 00:01:18, VLAN 10
C    172.16.5.0/24 is directly connected, VLAN 50
C    172.16.5.1/32 is local host.
S3750#show running-config
Building configuration...
Current configuration : 1491 bytes
!
version RGOS 10.4(3)p1 Release(143925) (Mon Sep 10 01:08:31 CST 2012 -ngcf67)
hostname S3750
!!!!!!
nfpp
!!
vlan 1
!
vlan 10
!
vlan 50
!!
no service password-encryption
S3750#

```

设置路由器 A

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is RSR20-11-3]

Ruijie>enable

Ruijie#hostname RouterA

% Unknown command.

Ruijie#configure terminal

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

Ruijie(config)#hostname RouterA

RouterA(config)#interface giga 0/1

RouterA(config-if-GigabitEthernet 0/1)#ip address 172.16.1.1 255.255.255.0

RouterA(config-if-GigabitEthernet 0/1)#no shutdown

RouterA(config-if-GigabitEthernet 0/1)#exit

RouterA(config)#interface giga 0/0

RouterA(config-if-GigabitEthernet 0/0)#ip address 172.16.2.1 255.255.255.0

```

RouterA(config-if-GigabitEthernet 0/0)#no shutdown
RouterA(config-if-GigabitEthernet 0/0)#ip address 172.16.2.1 255.255.255.0
RouterA(config-if-GigabitEthernet 0/0)#exit
RouterA(config)#router ospf
RouterA(config-router)#network 172.16.1.0 0.0.0.255 area 0
RouterA(config-router)*Jul  2 16:05:06: %OSPF-5-ADJCHG: Process 1, Nbr
172.16.5.1-GigabitEthernet 0/1 from Down to Init
, HelloReceived.
RouterA(config-router)#network 172.16.2.0 0.0.0.255 area 0
RouterA(config-router)#end
RouterA#*Jul  2 16:05:23: %SYS-5-CONFIG_I: Configured from console by console
*Jul  2 16:05:49: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.5.1-GigabitEthernet
0/1 from Loading to Full, LoadingDone.
*Jul  2 16:06:00: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.2.2-GigabitEthernet
0/0 from Down to Init, HelloReceived.
*Jul  2 16:06:07: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.2.2-GigabitEthernet
0/0 from Loading to Full, LoadingDone.
RouterA#show ip interface brief

```

Interface	Protocol	IP-Address(Pri)	IP-Address(Sec)
Serial 2/0	down	no address	no address
Serial 3/0	down	no address	no address
GigabitEthernet 0/0	up	172.16.2.1/24	no address
GigabitEthernet 0/1	up	172.16.1.1/24	no address

```

RouterA#show ip route
Codes: C - connected, S - static, R - RIP, B - BGP
       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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default
Gateway of last resort is no set
C    172.16.1.0/24 is directly connected, GigabitEthernet 0/1
C    172.16.1.1/32 is local host.
C    172.16.2.0/24 is directly connected, GigabitEthernet 0/0
C    172.16.2.1/32 is local host.
O    172.16.5.0/24 [110/2] via 172.16.1.2, 00:01:26, GigabitEthernet 0/1
RouterA#show ip ospf neighbor
OSPF process 1, 2 Neighbors, 2 is Full:
Neighbor ID    Pri   State                    BFD State  Dead Time   Address

```

```

Interface
  172.16.5.1          1    Full/DR          -          00:00:35
172.16.1.2    GigabitEthernet 0/1
  172.16.2.2          1    Full/BDR          -          00:00:39
172.16.2.2    GigabitEthernet 0/0

```

```
RouterA#show ip ospf interface giga 0/0
```

```
GigabitEthernet 0/0 is up, line protocol is up
```

```
Internet Address 172.16.2.1/24, Ifindex 3, Area 0.0.0.0, MTU 1500
```

```
Matching network config: 172.16.2.0/24
```

```
Process ID 1, Router ID 172.16.2.1, Network Type BROADCAST, Cost: 1
```

```
Transmit Delay is 1 sec, State DR, Priority 1
```

```
Designated Router (ID) 172.16.2.1, Interface Address 172.16.2.1
```

```
Backup Designated Router (ID) 172.16.2.2, Interface Address 172.16.2.2
```

```
Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
```

```
Hello due in 00:00:07
```

```
Neighbor Count is 1, Adjacent neighbor count is 1
```

```
Crypt Sequence Number is 0
```

```
Hello received 13 sent 18, DD received 3 sent 4
```

```
LS-Req received 1 sent 1, LS-Upd received 2 sent 4
```

```
LS-Ack received 2 sent 2, Discarded 0
```

```
RouterA#show running-config
```

```
Building configuration...
```

```
Current configuration : 1758 bytes
```

```
!
```

```
version RGOS 10.4(3b12) Release(151012) (Fri Dec 28 19:23:27 CST 2012 -ngcf67)
```

```
hostname RouterA
```

```
!
```

```
diffserv domain default
```

```
!!!!!!
```

```
vlan 1
```

```
!!
```

```
no service password-encryption
```

```
!!!!!!
```

```
RouterA#
```

设置路由器 B

```
[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the
device, please wait a moment....]
```

```
[Message : Connection is established.Device is RSR20-11-1]
```

```
Ruijie>enable
```

```
Ruijie#configure terminal
```

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

```
Ruijie(config)#hostname RouterB
```

```
RouterB(config)#interface giga 0/0
```

```

RouterB(config-if-GigabitEthernet 0/0)#ip address 172.16.3.1 255.255.255.0
RouterB(config-if-GigabitEthernet 0/0)#no shutdown
RouterB(config-if-GigabitEthernet 0/0)#exit
RouterB(config)#interface giga 0/0
RouterB(config-if-GigabitEthernet 0/0)#ip address 172.16.2.2 255.255.255.0
RouterB(config-if-GigabitEthernet 0/0)#no shutdown
RouterB(config-if-GigabitEthernet 0/0)#exit
RouterB(config)#router ospf
RouterB(config-router)#network 172.16.2.0 0.0.0.255 area 0
RouterB(config-router)#network 172.16.3.0 0.0.0.255 area 0
RouterB(config-router)*Jul  2 16:07:03: %OSPF-5-ADJCHG: Process 1, Nbr
172.16.2.1-GigabitEthernet 0/0 from Down to Init
, HelloReceived.
*Jul  2 16:07:03: %OSPF-5-ADJCHG: Process 1, Nbr 172.16.2.1-GigabitEthernet
0/0 from Loading to Full, LoadingDone.
RouterB(config-router)#end
RouterB*Jul  2 16:07:10: %SYS-5-CONFIG_I: Configured from console by console
RouterB#show ip interface brief

```

Status	Interface	Protocol	IP-Address(Pri)	IP-Address(Sec)
up	Serial 2/0	down	no address	no address
up	Serial 3/0	down	no address	no address
up	GigabitEthernet 0/0	up	172.16.2.2/24	no address
up	GigabitEthernet 0/1	down	no address	no address

```

RouterB#show ip route
Codes: C - connected, S - static, R - RIP, B - BGP
       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
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default
Gateway of last resort is no set
O    172.16.1.0/24 [110/2] via 172.16.2.1, 00:01:22, GigabitEthernet 0/0
C    172.16.2.0/24 is directly connected, GigabitEthernet 0/0
C    172.16.2.2/32 is local host.
O    172.16.5.0/24 [110/3] via 172.16.2.1, 00:01:22, GigabitEthernet 0/0
RouterB#show running-config
Building configuration...
Current configuration : 1720 bytes
!

```



```
version RGOS 10.4(3b12) Release(151012) (Fri Dec 28 19:23:27 CST 2012 -ngcf67)
hostname RouterB
!
diffserv domain default
!!!!!!
vlan 1
!!
no service password-encryption
!!!!!!
RouterB#show running-config
Building configuration...
Current configuration : 1720 bytes
!
version RGOS 10.4(3b12) Release(151012) (Fri Dec 28 19:23:27 CST 2012 -ngcf67)
hostname RouterB
!
diffserv domain default
!!!!!!
vlan 1
!!
no service password-encryption
!!!!!!
RouterB#
```

4. RIP v2 配置

(1) 实验目的

理解 RIP 两个版本之间的区别，掌握如何配置 RIPv2

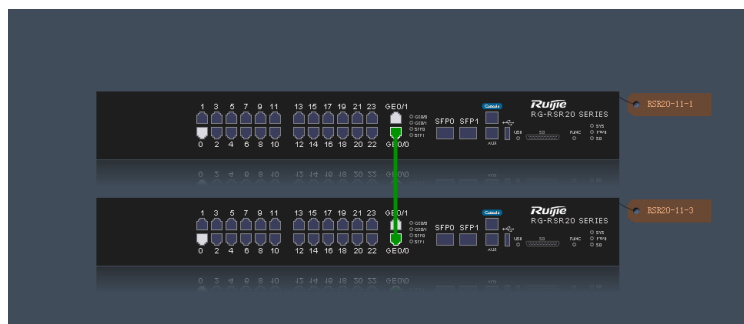
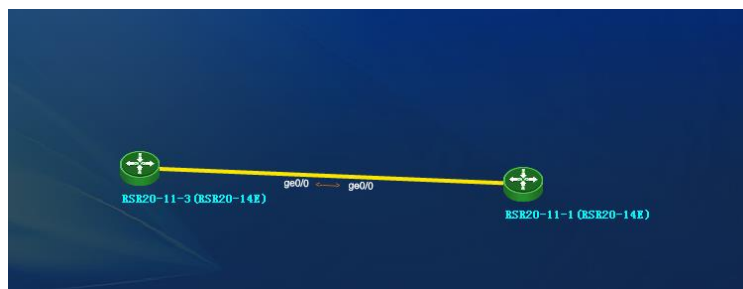
(2) 需求分析

两台路由器通过快速以太网端口连接在一起，每个路由器上设置2个Loopback端口模拟子网，在所有端口运行RIP路由协议，实现所有子网间的互通。

(3) 实验器材

路由器 2 台

(4) 实验拓扑



(5) 实验原理

RIP协议有两个版本RIPv1和RIPv2。

RIPv1属于有类路由协议，不支持VLSM（变长子网掩码），RIPv1是以广播的形式进行路由信息的更新的；更新周期为30秒。

RIPv2属于无类路由协议，支持VLSM（变长子网掩码），RIPv2是以组播的形式进行路由信息的更新的，组播地址是224.0.0.9。RIPv2还支持基于端口的认证，提高网络的安全性。

(6) 实验步骤

配置路由器 A

第一步：配置两台路由器的主机名、接口IP地址

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is RSR20-11-3]

Ruijie#enable

Ruijie#configure terminal

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

Ruijie(config)#hostname RouterA

RouterA(config)#interface giga 0/0

RouterA(config-if-GigabitEthernet 0/0)#ip address 192.168.1.1 255.255.255.0

RouterA(config-if-GigabitEthernet 0/0)#no shutdown

RouterA(config-if-GigabitEthernet 0/0)#exit

RouterA(config)#interface loopback 0

RouterA(config-if-Loopback 0)#*Jul 2 16:20:00: %LINK-3-UPDOWN: Interface Loopback 0, changed state to up.

*Jul 2 16:20:00: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback 0,

changed state to up.

```
RouterA(config-if-Loopback 0)#ip address 172.16.1.1 255.255.255.0
```

```
RouterA(config-if-Loopback 0)#exit
```

```
RouterA(config)#
```

```
RouterA(config)#interface loopback 1
```

```
RouterA(config-if-Loopback 1)#*Jul  2 16:20:34: %LINK-3-UPDOWN: Interface  
Loopback 1, changed state to up.
```

```
*Jul  2 16:20:34: %LINEPROTO-5-UPDOWN: Line protocol on Interface Loopback 1,  
changed state to up.
```

第二步：在两台路由器上启用**RIPv2**，但不关闭自动汇总

```
RouterA(config-if-Loopback 1)#ip address 172.16.2.1 255.255.255.0
```

```
RouterA(config-if-Loopback 1)#exit
```

```
RouterA(config)#router rip
```

```
RouterA(config-router)#network 192.168.1.0
```

```
RouterA(config-router)#network 172.16.1.0
```

```
RouterA(config-router)#version 2
```

```
RouterA(config-router)#exit
```

```
RouterA(config)#exit
```

```
RouterA#*Jul  2 16:26:07: %SYS-5-CONFIG_I: Configured from console by console
```

第三步：查看路由表

```
RouterA#show ip route
```

```
Codes: C - connected, S - static, R - RIP, B - BGP
```

```
       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
```

```
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
```

```
       ia - IS-IS inter area, * - candidate default
```

```
Gateway of last resort is no set
```

```
R    10.0.0.0/8 [120/1] via 192.168.1.2, 00:00:53, GigabitEthernet 0/0
```

```
C    172.16.1.0/24 is directly connected, Loopback 0
```

```
C    172.16.1.1/32 is local host.
```

```
C    172.16.2.0/24 is directly connected, Loopback 1
```

```
C    172.16.2.1/32 is local host.
```

```
C    192.168.1.0/24 is directly connected, GigabitEthernet 0/0
```

```
C    192.168.1.1/32 is local host.
```

```
RouterA#configure terminal
```

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

第四步：关闭自动路由汇总

```
RouterA(config)#router rip
```

```
RouterA(config-router)#no auto-summary
```

```
RouterA(config-router)#end
```

```
RouterA#*Jul  2 16:30:21: %SYS-5-CONFIG_I: Configured from console by console
```

第五步：查看RIP配置信息，路由表

RouterA#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP

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

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set

R 10.0.0.0/8 [120/1] via 192.168.1.2, 00:05:23, GigabitEthernet 0/0

C 172.16.1.0/24 is directly connected, Loopback 0

C 172.16.1.1/32 is local host.

C 172.16.2.0/24 is directly connected, Loopback 1

C 172.16.2.1/32 is local host.

C 192.168.1.0/24 is directly connected, GigabitEthernet 0/0

C 192.168.1.1/32 is local host.

RouterA#show ip rip

Routing Protocol is "rip"

Sending updates every 30 seconds

Invalid after 180 seconds, flushed after 120 seconds

Outgoing update filter list for all interface is: not set

Incoming update filter list for all interface is: not set

Redistribution default metric is 1

Redistributing:

Default version control: send version 2, receive version 2

Interface	Send	Recv
GigabitEthernet 0/0	2	2
Loopback 0	2	2
Loopback 1	2	2

Routing for Networks:

172.16.0.0 255.255.0.0

192.168.1.0 255.255.255.0

Distance: (default is 120)

Graceful-restart disabled

RouterA#show ip rip database

10.0.0.0/8 auto-summary

10.0.0.0/8

[1] via 192.168.1.2 GigabitEthernet 0/0 00:43

10.1.1.0/24

[1] via 192.168.1.2 GigabitEthernet 0/0 00:13

10.2.2.0/24

[1] via 192.168.1.2 GigabitEthernet 0/0 00:13

172.16.0.0/16 auto-summary

```
172.16.1.0/24
    [1] directly connected, Loopback 0
172.16.2.0/24
    [1] directly connected, Loopback 1
192.168.1.0/24    auto-summary
192.168.1.0/24
    [1] directly connected, GigabitEthernet 0/0
RouterA#show ip rip interface
GigabitEthernet 0/0 is up, line protocol is up
  Routing Protocol: RIP
    Receive RIPv2 packets only
    Send RIPv2 packets only
    Receive RIP packet: Enabled
    Send RIP packet: Enabled
    Send RIP supernet routes: Enabled
    Passive interface: Disabled
    Split horizon: Enabled
    Triggered RIP Disabled
    BFD: Disabled
    V2 Broadcast: Disabled
    Multicast register: Registered
    Interface Summary Rip:
      Not Configured
    Authentication mode: TEXT
    IP interface address:
      192.168.1.1/24, next update due in 15 seconds
Loopback 0 is up, line protocol is up
  Routing Protocol: RIP
    Receive RIPv2 packets only
    Send RIPv2 packets only
    Receive RIP packet: Enabled
    Send RIP packet: Enabled
    Send RIP supernet routes: Enabled
    Passive interface: Disabled
    Split horizon: Enabled
    Triggered RIP Disabled
    BFD: Disabled
    V2 Broadcast: Disabled
    Multicast register: Registered
    Interface Summary Rip:
      Not Configured
    Authentication mode: TEXT
    IP interface address:
      172.16.1.1/24, next update due in 23 seconds
```

Loopback 1 is up, line protocol is up

Routing Protocol: RIP

Receive RIPv2 packets only

Send RIPv2 packets only

Receive RIP packet: Enabled

Send RIP packet: Enabled

Send RIP supernet routes: Enabled

Passive interface: Disabled

Split horizon: Enabled

Triggered RIP Disabled

BFD: Disabled

V2 Broadcast: Disabled

Multicast register: Registered

Interface Summary Rip:

Not Configured

Authentication mode: TEXT

IP interface address:

第六步：测试网络连通性

RouterA#ping 10.1.1.1

Sending 5, 100-byte ICMP Echoes to 10.1.1.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/6/10 ms

第七步：用**debug**命令观察路由器接收和发生路由更新的情况

RouterA#ping 10.2.2.1

Sending 5, 100-byte ICMP Echoes to 10.2.2.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/8/10 ms

RouterA#show running-config

Building configuration...

Current configuration : 1841 bytes

!

version RGOS 10.4(3b12) Release(151012) (Fri Dec 28 19:23:27 CST 2012 -ngcf67)

hostname RouterA

!

diffserv domain default

!!!!!!

vlan 1

!!

no service password-encryption

!!!!!!

--More--

配置路由器 B

第一步：配置两台路由器的主机名、接口IP地址

Default version control: send version 2, receive version 2

Interface	Send	Recv
GigabitEthernet 0/0	2	2
Loopback 0	2	2
Loopback 1	2	2

Routing for Networks:

10.0.0.0 255.0.0.0

192.168.1.0 255.255.255.0

Distance: (default is 120)

Graceful-restart disabled

RouterB#show ip rip interface

GigabitEthernet 0/0 is up, line protocol is up

Routing Protocol: RIP

Receive RIPv2 packets only

Send RIPv2 packets only

Receive RIP packet: Enabled

Send RIP packet: Enabled

Send RIP supernet routes: Enabled

Passive interface: Disabled

Split horizon: Enabled

Triggered RIP Disabled

BFD: Disabled

V2 Broadcast: Disabled

Multicast register: Registered

Interface Summary Rip:

Not Configured

Authentication mode: TEXT

IP interface address:

192.168.1.2/24, next update due in 27 seconds

Loopback 0 is up, line protocol is up

Routing Protocol: RIP

Receive RIPv2 packets only

Send RIPv2 packets only

Receive RIP packet: Enabled

Send RIP packet: Enabled

RouterB#ping 172.16.1.1

Sending 5, 100-byte ICMP Echoes to 172.16.1.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 1/8/10 ms

```

RouterB#ping 172.16.2.1
Sending 5, 100-byte ICMP Echoes to 172.16.2.1, timeout is 2 seconds:
 < press Ctrl+C to break >
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/8/10 ms
RouterB#debug ip rip
RouterB#*Jul  2 16:35:11: %7:  [RIP] Update timer expired via interface
GigabitEthernet 0/0[192.168.1.2/24]
*Jul  2 16:35:11: %7:  [RIP] Update timer schedule via interface
GigabitEthernet 0/0[192.168.1.2/24]
*Jul  2 16:35:11: %7:  [RIP] Prepare to send MULTICAST response...
*Jul  2 16:35:11: %7:  [RIP] Building update entries on GigabitEthernet 0/0
*Jul  2 16:35:11: %7:      10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:11: %7:      10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:11: %7:  [RIP] Send packet to 224.0.0.9 Port 520 on
GigabitEthernet 0/0
*Jul  2 16:35:18: %7:  [RIP] Update timer expired via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:35:18: %7:  [RIP] Update timer schedule via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:35:18: %7:  [RIP] Prepare to send MULTICAST response...
*Jul  2 16:35:18: %7:  [RIP] Building update entries on Loopback 0
*Jul  2 16:35:18: %7:      10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:18: %7:      172.16.0.0/16 via 0.0.0.0 metric 16 tag 0
*Jul  2 16:35:18: %7:      172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:35:18: %7:      172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:35:18: %7:      192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:18: %7:  [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 0
*Jul  2 16:35:18: %7:  [RIP] Update timer expired via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:35:18: %7:  [RIP] Update timer schedule via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:35:18: %7:  [RIP] Prepare to send MULTICAST response...
*Jul  2 16:35:18: %7:  [RIP] Building update entries on Loopback 1
*Jul  2 16:35:18: %7:      10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:18: %7:      172.16.0.0/16 via 0.0.0.0 metric 16 tag 0
*Jul  2 16:35:18: %7:      172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:35:18: %7:      172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:35:18: %7:      192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:18: %7:  [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 1
*Jul  2 16:35:22: %7:  [RIP] RIP received packet, sock=32969 src=192.168.1.1
len=44
*Jul  2 16:35:22: %7:  [RIP] Received version 2 response packet on
GigabitEthernet 0/0

```



```

*Jul  2 16:35:22: %7:  [RIP] Cancel peer[192.168.1.1] remove timer
*Jul  2 16:35:22: %7:  [RIP] Peer[192.168.1.1] remove timer shedule...
*Jul  2 16:35:22: %7:  [RIP] Both do not need auth, Auth ok
*Jul  2 16:35:22: %7:      route-entry: family 2 tag 0 ip 172.16.1.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:35:22: %7:      route-entry: family 2 tag 0 ip 172.16.2.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:35:22: %7:  [RIP] [172.16.1.0/24] RIP route update, protocol(4)
*Jul      2  16:35:22: %7:      [RIP]  Old  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul      2  16:35:22: %7:      [RIP]  New  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:35:22: %7:  [RIP] [172.16.1.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:35:22: %7:  [RIP] [172.16.1.0/24] cancel Route timer
*Jul  2 16:35:22: %7:  [RIP] [172.16.1.0/24] route timer schedule...
*Jul  2 16:35:22: %7:  [RIP] [172.16.2.0/24] RIP route update, protocol(4)
*Jul      2  16:35:22: %7:      [RIP]  Old  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul      2  16:35:22: %7:      [RIP]  New  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:35:22: %7:  [RIP] [172.16.2.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:35:22: %7:  [RIP] [172.16.2.0/24] cancel Route timer
*Jul  2 16:35:22: %7:  [RIP] [172.16.2.0/24] route timer schedule...
*Jul  2 16:35:41: %7:  [RIP] Update timer expired via interface GigabitEthernet
0/0[192.168.1.2/24]
*Jul  2 16:35:41: %7:  [RIP] Update timer schedule via interface
GigabitEthernet 0/0[192.168.1.2/24]
*Jul  2 16:35:41: %7:  [RIP] Prepare to send MULTICAST response...
*Jul  2 16:35:41: %7:  [RIP] Building update entries on GigabitEthernet 0/0
*Jul  2 16:35:41: %7:      10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:41: %7:      10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:41: %7:  [RIP] Send packet to 224.0.0.9 Port 520 on
GigabitEthernet 0/0
*Jul  2 16:35:48: %7:  [RIP] Update timer expired via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:35:48: %7:  [RIP] Update timer schedule via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:35:48: %7:  [RIP] Prepare to send MULTICAST response...
*Jul  2 16:35:48: %7:  [RIP] Building update entries on Loopback 0
*Jul  2 16:35:48: %7:      10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:48: %7:      172.16.0.0/16 via 0.0.0.0 metric 16 tag 0
*Jul  2 16:35:48: %7:      172.16.1.0/24 via 0.0.0.0 metric 2 tag 0

```

```

*Jul  2 16:35:48: %7:      172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:35:48: %7:      192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:48: %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 0
*Jul  2 16:35:48: %7: [RIP] Update timer expired via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:35:48: %7: [RIP] Update timer schedule via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:35:48: %7: [RIP] Prepare to send MULTICAST response...
*Jul  2 16:35:48: %7: [RIP] Building update entries on Loopback 1
*Jul  2 16:35:48: %7:      10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:48: %7:      172.16.0.0/16 via 0.0.0.0 metric 16 tag 0
*Jul  2 16:35:48: %7:      172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:35:48: %7:      172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:35:48: %7:      192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:35:48: %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 1
*Jul  2 16:35:52: %7: [RIP] RIP received packet, sock=32969 src=192.168.1.1
len=44
*Jul  2 16:35:52: %7: [RIP] Received version 2 response packet on
GigabitEthernet 0/0
*Jul  2 16:35:52: %7: [RIP] Cancel peer[192.168.1.1] remove timer
*Jul  2 16:35:52: %7: [RIP] Peer[192.168.1.1] remove timer shedule...
*Jul  2 16:35:52: %7: [RIP] Both do not need auth, Auth ok
*Jul  2 16:35:52: %7:      route-entry: family 2 tag 0 ip 172.16.1.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:35:52: %7:      route-entry: family 2 tag 0 ip 172.16.2.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:35:52: %7: [RIP] [172.16.1.0/24] RIP route update, protocol(4)
*Jul  2 16:35:52: %7: [RIP] Old path is: nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:35:52: %7: [RIP] New path is: nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:35:52: %7: [RIP] [172.16.1.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:35:52: %7: [RIP] [172.16.1.0/24] cancel Route timer
*Jul  2 16:35:52: %7: [RIP] [172.16.1.0/24] route timer schedule...
*Jul  2 16:35:52: %7: [RIP] [172.16.2.0/24] RIP route update, protocol(4)
*Jul  2 16:35:52: %7: [RIP] Old path is: nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:35:52: %7: [RIP] New path is: nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:35:52: %7: [RIP] [172.16.2.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:35:52: %7: [RIP] [172.16.2.0/24] cancel Route timer
*Jul  2 16:35:52: %7: [RIP] [172.16.2.0/24] route timer schedule...

```

```

*Jul  2 16:35:52: %7: [RIP] [172.16.0.0/16] route timer expired
*Jul  2 16:35:52: %7: [RIP] [172.16.0.0/16] RIP route removing...
*Jul  2 16:35:52: %7: [RIP] [172.16.0.0/16] ready to add into kernel...
*Jul  2 16:36:11: %7: [RIP] Update timer expired via interface GigabitEthernet
0/0[192.168.1.2/24]
*Jul  2 16:36:11: %7: [RIP] Update timer schedule via interface
GigabitEthernet 0/0[192.168.1.2/24]
*Jul  2 16:36:11: %7: [RIP] Prepare to send MULTICAST response...
*Jul  2 16:36:11: %7: [RIP] Building update entries on GigabitEthernet 0/0
*Jul  2 16:36:11: %7: 10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:11: %7: 10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:11: %7: [RIP] Send packet to 224.0.0.9 Port 520 on
GigabitEthernet 0/0
*Jul  2 16:36:18: %7: [RIP] Update timer expired via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:36:18: %7: [RIP] Update timer schedule via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:36:18: %7: [RIP] Prepare to send MULTICAST response...
*Jul  2 16:36:18: %7: [RIP] Building update entries on Loopback 0
*Jul  2 16:36:18: %7: 10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:18: %7: 172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:18: %7: 172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:18: %7: 192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:18: %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 0
*Jul  2 16:36:18: %7: [RIP] Update timer expired via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:36:18: %7: [RIP] Update timer schedule via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:36:18: %7: [RIP] Prepare to send MULTICAST response...
*Jul  2 16:36:18: %7: [RIP] Building update entries on Loopback 1
*Jul  2 16:36:18: %7: 10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:18: %7: 172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:18: %7: 172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:18: %7: 192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:18: %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 1
*Jul  2 16:36:22: %7: [RIP] RIP received packet, sock=32969 src=192.168.1.1
len=44
*Jul  2 16:36:22: %7: [RIP] Received version 2 response packet on
GigabitEthernet 0/0
*Jul  2 16:36:22: %7: [RIP] Cancel peer[192.168.1.1] remove timer
*Jul  2 16:36:22: %7: [RIP] Peer[192.168.1.1] remove timer shedule...
*Jul  2 16:36:22: %7: [RIP] Both do not need auth, Auth ok
*Jul  2 16:36:22: %7: route-entry: family 2 tag 0 ip 172.16.1.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1

```

```

*Jul  2 16:36:22: %7:      route-entry: family 2 tag 0 ip 172.16.2.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:36:22: %7:  [RIP] [172.16.1.0/24] RIP route update, protocol(4)
*Jul    2  16:36:22:  %7:      [RIP]  Old  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul    2  16:36:22:  %7:      [RIP]  New  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:36:22: %7:  [RIP] [172.16.1.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:36:22: %7:  [RIP] [172.16.1.0/24] cancel Route timer
*Jul  2 16:36:22: %7:  [RIP] [172.16.1.0/24] route timer schedule...
*Jul  2 16:36:22: %7:  [RIP] [172.16.2.0/24] RIP route update, protocol(4)
*Jul    2  16:36:22:  %7:      [RIP]  Old  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul    2  16:36:22:  %7:      [RIP]  New  path  is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:36:22: %7:  [RIP] [172.16.2.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:36:22: %7:  [RIP] [172.16.2.0/24] cancel Route timer
*Jul  2 16:36:22: %7:  [RIP] [172.16.2.0/24] route timer schedule...

```

RouterB#show running-config

Building configuration...

Current configuration : 1835 bytes

!

version RGOS 10.4(3b12) Release(151012) (Fri Dec 28 19:23:27 CST 2012 -ngcf67)

hostname RouterB

!

diffserv domain default

!!!!!!

vlan 1

!!

no service password-encryption

!!!!!!

```

--More-- *Jul  2 16:36:41: %7:  [RIP] Update timer expired via interface
GigabitEthernet 0/0[192.168.1.2/24]

```

```

*Jul    2  16:36:41:  %7:      [RIP]  Update timer schedule via interface
GigabitEthernet 0/0[192.168.1.2/24]

```

```

*Jul  2 16:36:41: %7:  [RIP] Prepare to send MULTICAST response...

```

```

*Jul  2 16:36:41: %7:  [RIP] Building update entries on GigabitEthernet 0/0

```

```

*Jul  2 16:36:41: %7:      10.1.1.0/24 via 0.0.0.0 metric 1 tag 0

```

```

*Jul  2 16:36:41: %7:      10.2.2.0/24 via 0.0.0.0 metric 1 tag 0

```

```

*Jul  2 16:36:41: %7:  [RIP] Send packet to 224.0.0.9 Port 520 on
GigabitEthernet 0/0

```

```

*Jul  2 16:36:48: %7:  [RIP] Update timer expired via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:36:48: %7:  [RIP] Update timer schedule via interface Loopback
0[10.1.1.1/24]
*Jul  2 16:36:48: %7:  [RIP] Prepare to send MULTICAST response...
*Jul  2 16:36:48: %7:  [RIP] Building update entries on Loopback 0
*Jul  2 16:36:48: %7:      10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:48: %7:      172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:48: %7:      172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:48: %7:      192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:48: %7:  [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 0
*Jul  2 16:36:48: %7:  [RIP] Update timer expired via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:36:48: %7:  [RIP] Update timer schedule via interface Loopback
1[10.2.2.1/24]
*Jul  2 16:36:48: %7:  [RIP] Prepare to send MULTICAST response...
*Jul  2 16:36:48: %7:  [RIP] Building update entries on Loopback 1
*Jul  2 16:36:48: %7:      10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:48: %7:      172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:48: %7:      172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul  2 16:36:48: %7:      192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul  2 16:36:48: %7:  [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 1
*Jul  2 16:36:52: %7:  [RIP] RIP received packet, sock=32969 src=192.168.1.1
len=44
*Jul  2 16:36:52: %7:  [RIP] Received version 2 response packet on
GigabitEthernet 0/0
*Jul  2 16:36:52: %7:  [RIP] Cancel peer[192.168.1.1] remove timer
*Jul  2 16:36:52: %7:  [RIP] Peer[192.168.1.1] remove timer shedule...
*Jul  2 16:36:52: %7:  [RIP] Both do not need auth, Auth ok
*Jul  2 16:36:52: %7:      route-entry: family 2 tag 0 ip 172.16.1.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:36:52: %7:      route-entry: family 2 tag 0 ip 172.16.2.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:36:52: %7:  [RIP] [172.16.1.0/24] RIP route update, protocol(4)
*Jul  2 16:36:52: %7:      [RIP] Old path is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:36:52: %7:      [RIP] New path is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:36:52: %7:  [RIP] [172.16.1.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:36:52: %7:  [RIP] [172.16.1.0/24] cancel Route timer
*Jul  2 16:36:52: %7:  [RIP] [172.16.1.0/24] route timer schedule...
*Jul  2 16:36:52: %7:  [RIP] [172.16.2.0/24] RIP route update, protocol(4)
*Jul  2 16:36:52: %7:      [RIP] Old path is:  nhop=192.168.1.1

```

```

routesrc=192.168.1.1 intf=3
*Jul 2 16:36:52: %7: [RIP] New path is: nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul 2 16:36:52: %7: [RIP] [172.16.2.0/24] RIP distance apply from
192.168.1.1!
*Jul 2 16:36:52: %7: [RIP] [172.16.2.0/24] cancel Route timer
*Jul 2 16:36:52: %7: [RIP] [172.16.2.0/24] route timer schedule...
*Jul 2 16:37:11: %7: [RIP] Update timer expired via interface GigabitEthernet
0/0[192.168.1.2/24]
*Jul 2 16:37:11: %7: [RIP] Update timer schedule via interface
GigabitEthernet 0/0[192.168.1.2/24]
*Jul 2 16:37:11: %7: [RIP] Prepare to send MULTICAST response...
*Jul 2 16:37:11: %7: [RIP] Building update entries on GigabitEthernet 0/0
*Jul 2 16:37:11: %7: 10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul 2 16:37:11: %7: 10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul 2 16:37:11: %7: [RIP] Send packet to 224.0.0.9 Port 520 on
GigabitEthernet 0/0
*Jul 2 16:37:18: %7: [RIP] Update timer expired via interface Loopback
0[10.1.1.1/24]
*Jul 2 16:37:18: %7: [RIP] Update timer schedule via interface Loopback
0[10.1.1.1/24]
*Jul 2 16:37:18: %7: [RIP] Prepare to send MULTICAST response...
*Jul 2 16:37:18: %7: [RIP] Building update entries on Loopback 0
*Jul 2 16:37:18: %7: 10.2.2.0/24 via 0.0.0.0 metric 1 tag 0
*Jul 2 16:37:18: %7: 172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul 2 16:37:18: %7: 172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul 2 16:37:18: %7: 192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul 2 16:37:18: %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 0
*Jul 2 16:37:18: %7: [RIP] Update timer expired via interface Loopback
1[10.2.2.1/24]
*Jul 2 16:37:18: %7: [RIP] Update timer schedule via interface Loopback
1[10.2.2.1/24]
*Jul 2 16:37:18: %7: [RIP] Prepare to send MULTICAST response...
*Jul 2 16:37:18: %7: [RIP] Building update entries on Loopback 1
*Jul 2 16:37:18: %7: 10.1.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul 2 16:37:18: %7: 172.16.1.0/24 via 0.0.0.0 metric 2 tag 0
*Jul 2 16:37:18: %7: 172.16.2.0/24 via 0.0.0.0 metric 2 tag 0
*Jul 2 16:37:18: %7: 192.168.1.0/24 via 0.0.0.0 metric 1 tag 0
*Jul 2 16:37:18: %7: [RIP] Send packet to 224.0.0.9 Port 520 on Loopback 1
*Jul 2 16:37:22: %7: [RIP] RIP received packet, sock=32969 src=192.168.1.1
len=44
*Jul 2 16:37:22: %7: [RIP] Received version 2 response packet on
GigabitEthernet 0/0
*Jul 2 16:37:22: %7: [RIP] Cancel peer[192.168.1.1] remove timer

```

```

*Jul  2 16:37:22: %7:  [RIP] Peer[192.168.1.1] remove timer shedule...
*Jul  2 16:37:22: %7:  [RIP] Both do not need auth, Auth ok
*Jul  2 16:37:22: %7:      route-entry: family 2 tag 0 ip 172.16.1.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:37:22: %7:      route-entry: family 2 tag 0 ip 172.16.2.0 mask
255.255.255.0 nhop 0.0.0.0 metric 1
*Jul  2 16:37:22: %7:  [RIP] [172.16.1.0/24] RIP route update, protocol(4)
*Jul    2 16:37:22: %7:      [RIP] Old path is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul    2 16:37:22: %7:      [RIP] New path is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:37:22: %7:  [RIP] [172.16.1.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:37:22: %7:  [RIP] [172.16.1.0/24] cancel Route timer
*Jul  2 16:37:22: %7:  [RIP] [172.16.1.0/24] route timer schedule...
*Jul  2 16:37:22: %7:  [RIP] [172.16.2.0/24] RIP route update, protocol(4)
*Jul    2 16:37:22: %7:      [RIP] Old path is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul    2 16:37:22: %7:      [RIP] New path is:  nhop=192.168.1.1
routesrc=192.168.1.1 intf=3
*Jul  2 16:37:22: %7:  [RIP] [172.16.2.0/24] RIP distance apply from
192.168.1.1!
*Jul  2 16:37:22: %7:  [RIP] [172.16.2.0/24] cancel Route timer
*Jul  2 16:37:22: %7:  [RIP] [172.16.2.0/24] route timer schedule...

```

5. 静态路由配置

(1) 实验目的

理解静态路由的工作原理，掌握如何配置静态路由

(2) 需求分析

两台路由器通过串口以V.35 DCE/DTE电缆连接在一起，每个路由器上设置2个Loopback端口模拟子网，设置静态路由，实现所有子网间的互通。

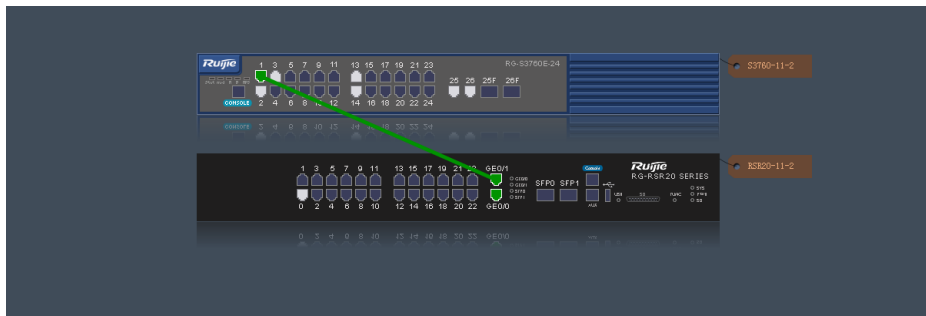
(3) 实验器材

路由器 2 台

V. 35 DCE/DTE 电缆 1 对

(4) 实验拓扑





(5) 实验原理

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。而路由表里就是由一条条的路由信息组成。路由表的产生方式一般有 3 种

(6) 实验步骤

配置路由器 A

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is RSR20-11-1]

Ruijie#hostname R1

% Unknown command.

Ruijie#configure terminal

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

Ruijie(config)#hostname RouterA

RouterA(config)#inter s2/0

RouterA(config-if-Serial 2/0)#ip address 192.168.5.1 255.255.255.0

RouterA(config-if-Serial 2/0)#exit

RouterA(config)#inter gi 0/0

RouterA(config-if-GigabitEthernet 0/0)#ip address 192.168.1.1 255.255.255.0

RouterA(config-if-GigabitEthernet 0/0)#exit

RouterA(config)#inter gi 0/1

RouterA(config-if-GigabitEthernet 0/1)#ip address 192.168.2.1 255.255.255.0

RouterA(config-if-GigabitEthernet 0/1)#exit

RouterA(config)#ip route 196.168.3.0 255.255.255.0 192.168.5.2

RouterA(config)#ip route 196.168.4.0 255.255.255.0 s2/0

RouterA(config)#exit

RouterA#*Jul 2 17:44:38: %SYS-5-CONFIG_I: Configured from console by console

查看路由表和接口配置

RouterA#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP

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
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default
Gateway of last resort is no set
C    192.168.1.0/24 is directly connected, GigabitEthernet 0/0
C    192.168.1.1/32 is local host.
C    192.168.2.0/24 is directly connected, GigabitEthernet 0/1
C    192.168.2.1/32 is local host.
C    192.168.5.0/24 is directly connected, Serial 2/0
C    192.168.5.1/32 is local host.
S    196.168.3.0/24 [1/0] via 192.168.5.2
S    196.168.4.0/24 is directly connected, Serial 2/0
RouterA#show interfaces serial 2/0
Index(dec):1 (hex):1
Serial 2/0 is UP , line protocol is UP
Hardware is SIC-1HS HDLC CONTROLLER Serial
Interface address is: 192.168.5.1/24
  MTU 1500 bytes, BW 2000 Kbit
  Encapsulation protocol is HDLC, loopback not set
  Keepalive interval is 10 sec ,retries 3.
  Carrier delay is 2 sec
  Rxload is 1/255, Txload is 1/255
  Queueing strategy: FIFO
    Output queue 0/40, 0 drops;
    Input queue 0/75, 0 drops
    0 carrier transitions
    V35 DTE cable
    DCD=up DSR=up DTR=up RTS=up CTS=up
  5 minutes input rate 19 bits/sec, 0 packets/sec
  5 minutes output rate 19 bits/sec, 0 packets/sec
    76 packets input, 1824 bytes, 0 no buffer, 0 dropped
    Received 0 broadcasts, 0 runs, 0 giants
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 abort
    76 packets output, 1824 bytes, 0 underruns , 0 dropped
    0 output errors, 0 collisions, 1 interface resets

```

测试网络连通性:

RA ping RB:

RA#ping 196.168.3.1

Sending 5, 100-byte ICMP Echoes to 196.168.3.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 50/56/60 ms

RA#ping 196.168.4.1

Sending 5, 100-byte ICMP Echoes to 196.168.4.1, timeout is 2 seconds:

< press Ctrl+C to break >

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 50/56/60 ms

配置路由器 B

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is RSR20-11-2]

Ruijie>enable

Ruijie#configure terminal

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

Ruijie(config)#hostname RouterA

RouterA(config)#hostname RouterB

RouterB(config)#inter s2/0

RouterB(config-if-Serial 2/0)#ip address 192.168.5.2 255.255.255.0

RouterB(config-if-Serial 2/0)#exit

RouterB(config)#inter gi 0/0

RouterB(config-if-GigabitEthernet 0/0)#ip address 192.168.3.1 255.255.255.0

RouterB(config-if-GigabitEthernet 0/0)#exit

RouterB(config)#inter gi 0/1

RouterB(config-if-GigabitEthernet 0/1)#ip address 192.168.4.1 255.255.255.0

RouterB(config-if-GigabitEthernet 0/1)#exit

RouterB(config)#ip route 196.168.1.0 255.255.255.0 196.168.5.1

RouterB(config)#ip route 196.168.2.0 255.255.255.0 s2/0

RouterB(config)#exit

RouterB#*Jul 2 17:01:28: %SYS-5-CONFIG_I: Configured from console by console
show ip route

Codes: C - connected, S - static, R - RIP, B - BGP

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

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set

C 192.168.3.0/24 is directly connected, GigabitEthernet 0/0

C 192.168.3.1/32 is local host.

C 192.168.4.0/24 is directly connected, GigabitEthernet 0/1

C 192.168.4.1/32 is local host.

```

C    192.168.5.0/24 is directly connected, Serial 2/0
C    192.168.5.2/32 is local host.
S    196.168.2.0/24 is directly connected, Serial 2/0
RouterB#show interfaces serial 2/0
Index(dec):1 (hex):1
Serial 2/0 is UP , line protocol is UP
Hardware is SIC-1HS HDLC CONTROLLER Serial
Interface address is: 192.168.5.2/24
    MTU 1500 bytes, BW 2000 Kbit
    Encapsulation protocol is HDLC, loopback set
    Keepalive interval is 10 sec ,retries 3.
    Carrier delay is 2 sec
    Rxload is 1/255, Txload is 1/255
    Queueing strategy: FIFO
        Output queue 0/40, 0 drops;
        Input queue 0/75, 0 drops
        0 carrier transitions
        V35 DCE cable
        DCD=down DSR=up DTR=up RTS=up CTS=up
    5 minutes input rate 18 bits/sec, 0 packets/sec
    5 minutes output rate 19 bits/sec, 0 packets/sec
    2480 packets input, 59520 bytes, 0 no buffer, 0 dropped
    Received 0 broadcasts, 0 runs, 3 giants
    7 input errors, 0 CRC, 0 frame, 0 overrun, 4 abort
    2512 packets output, 60288 bytes, 0 underruns , 1 dropped
    0 output errors, 0 collisions, 13 interface resets
RouterB#

```

通过 RB ping RA:

```

RB>ping 196.168.1.1
Sending 5, 100-byte ICMP Echoes to 196.168.1.1, timeout is 2 seconds:
< press Ctrl+C to break >
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 50/58/60 ms
RB>ping 196.168.2.1
Sending 5, 100-byte ICMP Echoes to 196.168.2.1, timeout is 2 seconds:
< press Ctrl+C to break >
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 50/56/60 ms

```

6. 跨交换机实现 VLAN;

(1) 实验目的

掌握如何在交换机上划分基于端口的VLAN、如何给VLAN内添加端口，理解跨交换机之间VLAN的特点。

(2) 需求分析

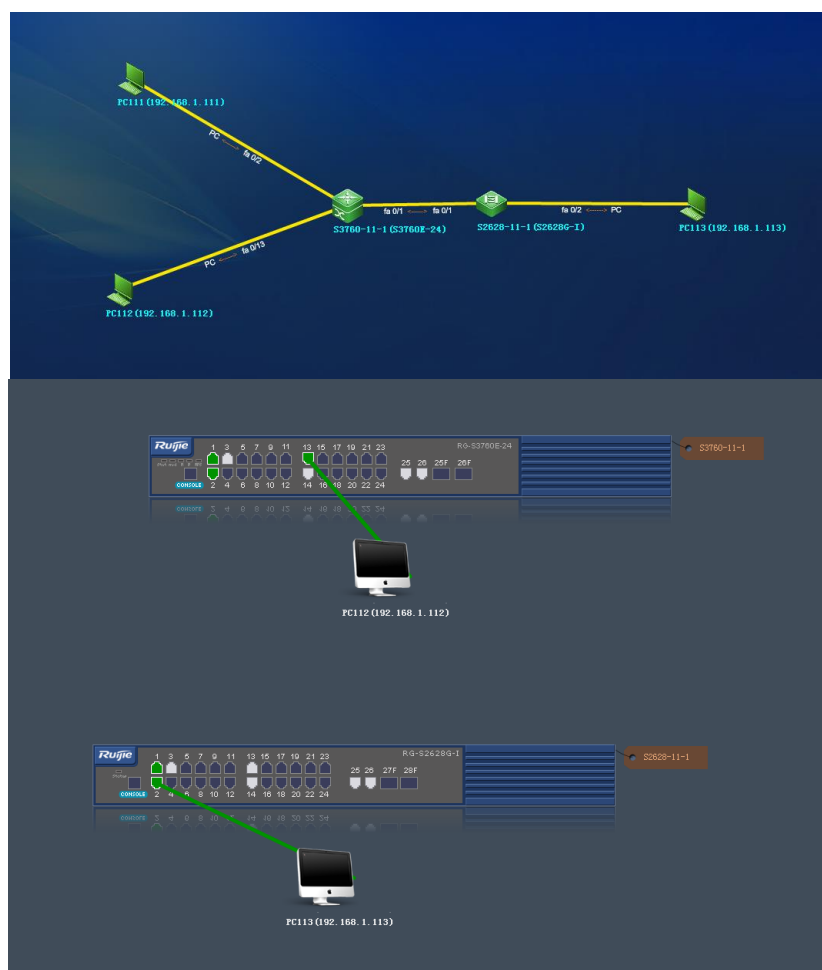
通过划分 Port VLAN 实现交换机的端口隔离，然后使在同一 VLAN 里的计算机系统能跨交换机进行相互通信，而在不同 VLAN 里的计算机系统不能进行相互通信

(3) 实验器材

三层交换机 1 台

二层交换机 1 台

(4) 实验拓扑



(5) 实验原理

VLAN（Virtual Local Area Network，虚拟局域网）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内的主机可以互相直接访问，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内进行传播，不能传输到其他VLAN中。

Port Vlan是实现VLAN的方式之一，Port Vlan是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，主要用于实现跨交换机的相同 VLAN 内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 遵循了 IEEE802.1q 协议的标准。在利用配置了 Tag vlan 的接口进行数据传输时，需要在数据帧内添加 4 个字节的 802.1q 标签信息，用于标识该数据帧属于哪个 VLAN，以便于对端交换机接收到数据帧后进行准确的过滤

(6) 实验步骤

配置交换机 L2-SW

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is S2628-11-1]

Ruijie>enable

Ruijie#configure terminal

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

Ruijie(config)#hostname L2-SW

L2-SW(config)#vlan 10

L2-SW(config-vlan)#name xiaoshou

L2-SW(config-vlan)#vlan 20

L2-SW(config-vlan)#name jishu

L2-SW(config-vlan)#exit

L2-SW(config)#interface range fastEthernet 0/6-10

L2-SW(config-if-range)#switchport mode access

L2-SW(config-if-range)#switchport access vlan 10

L2-SW(config-if-range)#exit

L2-SW(config)#interface fastEthernet 0/1

L2-SW(config-if-FastEthernet 0/1)#switchport mode trunk

L2-SW(config-if-FastEthernet 0/1)#exit

L2-SW(config)#show vlan

VLAN Name	Status	Ports
-----	-----	-----
1 VLAN0001	STATIC	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/11, Fa0/12, Fa0/13 Fa0/14, Fa0/15, Fa0/16, Fa0/17 Fa0/18, Fa0/19, Fa0/20, Fa0/21 Fa0/22, Fa0/23, Fa0/24,

Gi0/25

```
10 xiaoshou          STATIC  Gi0/26, Gi0/27, Gi0/28
                        Fa0/1, Fa0/6, Fa0/7, Fa0/8
                        Fa0/9, Fa0/10
20 jishu              STATIC  Fa0/1
```

L2-SW(config)#exit

L2-SW#*Jul 2 16:35:13: %SYS-5-CONFIG_I: Configured from console by console

L2-SW#show vlan

VLAN Name	Status	Ports
1 VLAN0001	STATIC	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/11, Fa0/12, Fa0/13 Fa0/14, Fa0/15, Fa0/16, Fa0/17 Fa0/18, Fa0/19, Fa0/20, Fa0/21 Fa0/22, Fa0/23, Fa0/24, Gi0/25

```
10 xiaoshou          STATIC  Gi0/26, Gi0/27, Gi0/28
                        Fa0/1, Fa0/6, Fa0/7, Fa0/8
                        Fa0/9, Fa0/10
20 jishu              STATIC  Fa0/1
```

L2-SW#show interfaces fastEthernet 0/1 switchport

Interface	Switchport Mode	Access Native
FastEthernet 0/1	enabled	TRUNK 1 1

Protected VLAN lists

Disabled ALL

L2-SW#

L2-SW CON0 is now available

配置交换机 L3-SW

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is S3760-11-1]

Ruijie>enable

Ruijie#configure terminal

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

Ruijie(config)#hostname L3-SW

L3-SW(config)#vlan 10

L3-SW(config-vlan)#name xiaoshou

```

L3-SW(config-vlan)#vlan 20
L3-SW(config-vlan)#name jishu
L3-SW(config-vlan)#exit
L3-SW(config)#interface range fastEthernet 0/6-10
L3-SW(config-if-range)#switchport mode access
L3-SW(config-if-range)#switchport access vlan 10
L3-SW(config-if-range)#exit
L3-SW(config)#interface range fastEthernet 0/11-15
L3-SW(config-if-range)#switchport mode access
L3-SW(config-if-range)#switchport access vlan 20
L3-SW(config-if-range)#exit
L3-SW(config)#interface fastEthernet 0/1
L3-SW(config-if-FastEthernet 0/1)#switchport mode trunk
L3-SW(config-if-FastEthernet 0/1)#exit
L3-SW(config)#show vlan

```

VLAN Name	Status	Ports
1 VLAN0001	STATIC	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/16, Fa0/17, Fa0/18 Fa0/19, Fa0/20, Fa0/21, Fa0/22 Fa0/23, Fa0/24, Gi0/25, Gi0/26
10 xiaoshou	STATIC	Fa0/1, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/10
20 jishu	STATIC	Fa0/1, Fa0/11, Fa0/12, Fa0/13 Fa0/14, Fa0/15

```

L3-SW(config)#show interfaces fastEthernet 0/1 switchport

```

Interface	Switchport	Mode	Access	Native	Protected	VLAN
FastEthernet 0/1	enabled	TRUNK	1	1	Disabled	ALL

```

L3-SW(config)#
L3-SW CON0 is now available

```

```

Press RETURN to get started
*Jul 2 16:57:06: %SYS-5-CONFIG_I: Configured from console by console
Press RETURN to get started

```

实验验证配置

PC3 和 PC1 都属于 VLAN 10，它们的 IP 地址都在 C 类网络 172.168.10.0/24 内，PC2 属于 VLAN 20，它的 IP 地址在 C 类网络 196.168.20.0/24 内，可以看到从 PC3 是可以 ping

通 PC1 的，而从 PC3 是不能 ping 通 PC2 的。

从 PC3 可以 ping 通 PC1

```
C:\Users\Administrator>ping 172.168.10.1
```

正在 Ping 172.168.10.1 具有 32 字节的数据:

来自 172.168.10.1 的回复: 字节=32 时间<1ms TTL=64

来自 172.168.10.1 的回复: 字节=32 时间<1ms TTL=64

来自 172.168.10.1 的回复: 字节=32 时间<1ms TTL=64

来自 172.168.10.1 的回复: 字节=32 时间<1ms TTL=64

172.168.10.1 的 Ping 统计信息:

数据包: 已发送= 4, 已接收= 4, 丢失= 0 (0% 丢失),

往返行程的估计时间(以毫秒为单位):

最短= 0ms, 最长= 0ms, 平均= 0ms

从 PC3 不能 ping 通 PC2

```
C:\Users\Administrator>ping 172.168.20.1
```

正在 Ping 196.168.20.1 具有 32 字节的数据:

请求超时。

来自 196.168.20.1 的回复: 无法访问目标主机。

来自 196.168.20.1 的回复: 无法访问目标主机。

来自 196.168.20.1 的回复: 无法访问目标主机。

196.168.20.1 的 Ping 统计信息:

数据包: 已发送= 4, 已接收= 3, 丢失= 1 (25% 丢失)

7. 利用单臂路由实现 VLAN 间路由

(1) 实验目的

掌握如何在路由器端口上划分子接口、封装 Dot1Q (IEEE 802.1Q) 协议，实现 VLAN 间的路由

(2) 需求分析

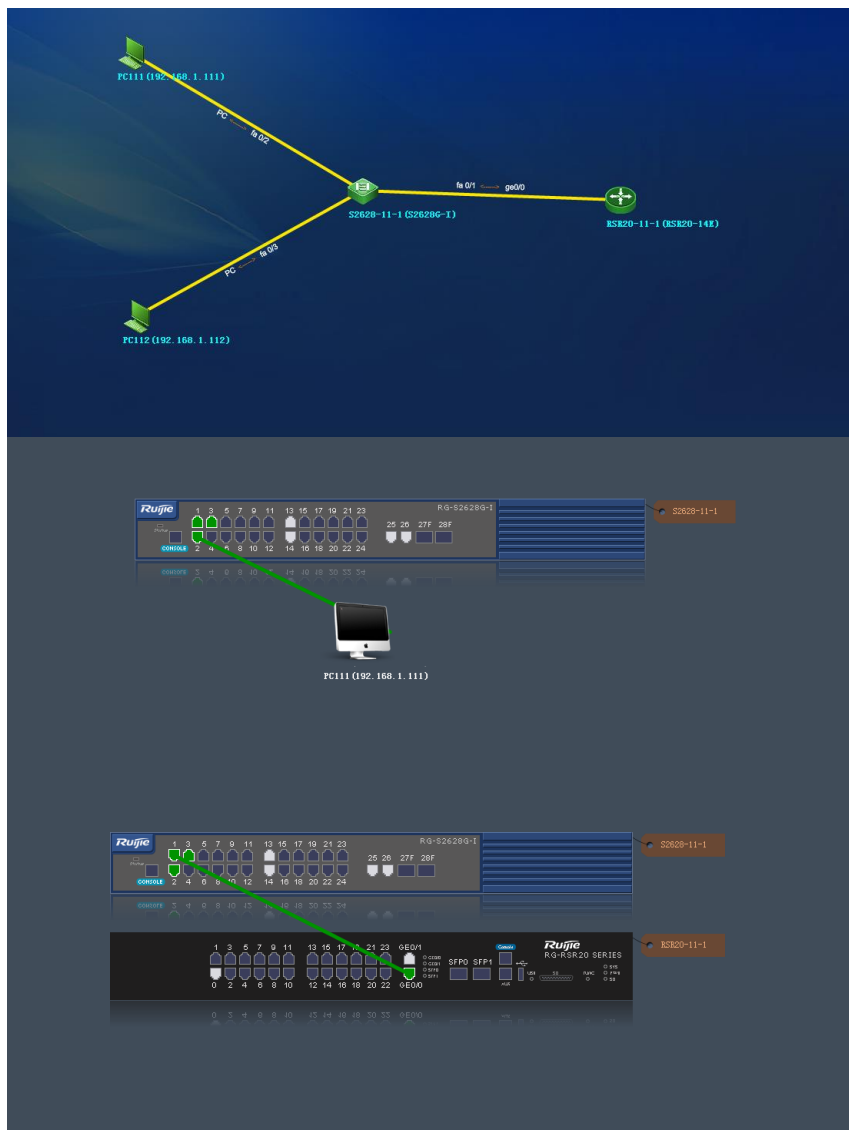
需要在交换机上配置 VLAN，然后在路由器连接交换机的端口上划分子接口，给相应的 VLAN 设置 IP 地址，以实现 VLAN 间的路由

(3) 实验器材

路由器 1 台

二层交换机 1 台

(4) 实验拓扑



(5) 实验原理

在交换网络中，通过VLAN对一个物理网络进行了逻辑划分，不同的VLAN之间是无法直接访问的，必须通过三层的路由设备进行连接。一般利用路由器或三层交换机来实现不同VLAN之间的互相访问。

将路由器和交换机相连，使用IEEE 802.1Q来启动一个路由器上的子接口成为干道模式，就可以利用路由器来实现VLAN之间的通信。

路由器可以从某一个VLAN接收数据包并且将这个数据包转发到另外的一个VLAN，要实施VLAN间的路由，必须在一个路由器的物理接口上启用子接口，也就是将以太网物理接口划分为多个逻辑的、可编址的接口，并配置成干道模式，每个VLAN对应一个这种接口，这样路由器就能够知道如何到达这些互联的VLAN

(6) 实验步骤

实验路由器设置

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is RSR20-11-1]

Ruijie#configure terminal

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

Ruijie(config)#hostname Router

Router(config)#interface giga 0/0

Router(config-if-GigabitEthernet 0/0)#no ip address

Router(config-if-GigabitEthernet 0/0)#no shutdown

Router(config-if-GigabitEthernet 0/0)#exit

Router(config)#interface giga 0/0.10

Router(config-if-GigabitEthernet 0/0.10)#encapsulation dot1Q 10

Router(config-if-GigabitEthernet 0/0.10)#\$. 168. 10. 1 255. 255. 255. 0

Router(config-if-GigabitEthernet 0/0.10)#ip address 192. 168. 10. 1
255. 255. 255. 0

Router(config-if-GigabitEthernet 0/0.10)#exit

Router(config)#interface giga 0/0.20

Router(config-if-GigabitEthernet 0/0.20)#encapsulation dot1Q 20

Router(config-if-GigabitEthernet 0/0.20)#ip address 192. 168. 20. 1
255. 255. 255. 0

Router(config-if-GigabitEthernet 0/0.20)#end

Router##Jul 2 18:06:56: %SYS-5-CONFIG_I: Configured from console by console

Router#show ip route

Codes: C - connected, S - static, R - RIP, B - BGP

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

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

ia - IS-IS inter area, * - candidate default

Gateway of last resort is no set

C 192.168.10.0/24 is directly connected, GigabitEthernet 0/0.10

C 192.168.10.1/32 is local host.

C 192.168.20.0/24 is directly connected, GigabitEthernet 0/0.20

C 192.168.20.1/32 is local host.

Router#show running-config

Building configuration...

Current configuration : 1791 bytes

!

version RGOS 10.4(3b12) Release(151012) (Fri Dec 28 19:23:27 CST 2012 -ngcf67)

hostname Router

!

diffserv domain default

!!!!!!

```

vlan 1
!!
no service password-encryption
!!!!
--More--

```

实验交换机设置

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is S2628-11-1]

Ruijie>enable

Ruijie#configure terminal

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

Ruijie(config)#hostname L2-SW

L2-SW(config)#vlan 10

L2-SW(config-vlan)#name xiaoshou

L2-SW(config-vlan)#vlan 20

L2-SW(config-vlan)#name jishu

L2-SW(config-vlan)#exit

L2-SW(config)#interface range fastEthernet 0/6-10

L2-SW(config-if-range)#switchport mode access

L2-SW(config-if-range)#switchport access VLAN 10

L2-SW(config-if-range)#exit

L2-SW(config)#interface range fastEthernet 0/11-15

L2-SW(config-if-range)#switchport mode access

L2-SW(config-if-range)#switchport access vlan 20

L2-SW(config-if-range)#exit

L2-SW(config)#interface fastEthernet 0/1

L2-SW(config-if-FastEthernet 0/1)#switchport mode trunk

L2-SW(config-if-FastEthernet 0/1)#end

L2-SW##Jul 2 17:33:47: %SYS-5-CONFIG_I: Configured from console by console

L2-SW#show vlan

VLAN Name	Status	Ports
-----	-----	-----
1 VLAN0001	STATIC	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/16, Fa0/17, Fa0/18 Fa0/19, Fa0/20, Fa0/21, Fa0/22 Fa0/23, Fa0/24, Gi0/25, Gi0/26 Gi0/27, Gi0/28
10 xiaoshou	STATIC	Fa0/1, Fa0/6, Fa0/7, Fa0/8

```

                Fa0/9, Fa0/10
20 jishu                STATIC    Fa0/1, Fa0/11, Fa0/12, Fa0/13
                                Fa0/14, Fa0/15

L2-SW#show interfaces fastEthernet 0/1 switchport
Interface                Switchport Mode          Access Native
Protected VLAN lists
-----
FastEthernet 0/1                enabled    TRUNK          1          1
Disabled ALL
L2-SW#show running-config
Building configuration...
Current configuration : 1629 bytes
!
version RGOS 10.4(3b16) Release(151126) (Mon Dec 31 01:20:24 CST 2012 -ngcf64)
hostname L2-SW
!!!
redundancy
  auto-sync time-period 3600
  auto-sync standard
  switchover timeout 4000
!!!!!!!
nfpp
--More--

```

The screenshot shows a Windows command prompt window with the command 'ipconfig' entered. The output displays network configuration for three adapters: Ethernet adapter Local Area Connection, Wireless LAN adapter Wireless Network Connection, and three Tunnel adapters (isatap). Each adapter's configuration includes its DNS suffix, IPv6 address, IPv4 address, subnet mask, and default gateway. The Ethernet adapter Local Area Connection 2 is also listed but has no configuration details shown.

```

C:\Users\Administrator>ipconfig

Windows IP 配置

以太网适配器 本地连接:

    连接特定的 DNS 后缀 . . . . . : 
    本地连接 IPv6 地址. . . . . : fe80::22:770:b97d:17a8%11
    IPv4 地址 . . . . . : 192.168.1.113
    子网掩码 . . . . . : 255.255.255.0
    默认网关. . . . . : 192.168.1.1

无线局域网适配器 无线网络连接:

    媒体状态 . . . . . : 媒体已断开
    连接特定的 DNS 后缀 . . . . . : 

以太网适配器 本地连接 2:

    连接特定的 DNS 后缀 . . . . . : 
    本地连接 IPv6 地址. . . . . : fe80::c994:3f5b:24df:19ea%12
    IPv4 地址 . . . . . : 172.16.1.111
    子网掩码 . . . . . : 255.255.255.0
    默认网关. . . . . : 172.16.1.0

隧道适配器 isatap.{ADB18BEC-B082-4DB6-9A3D-F3985435D686}:

    媒体状态 . . . . . : 媒体已断开
    连接特定的 DNS 后缀 . . . . . : 

隧道适配器 isatap.{BDE7110B-466D-4D76-9119-BE08C69A2D0E}:

    媒体状态 . . . . . : 媒体已断开
    连接特定的 DNS 后缀 . . . . . : 

隧道适配器 isatap.{FE47BE2D-5E7D-4B6B-A920-F5EC509F1471}:

    媒体状态 . . . . . : 媒体已断开
    连接特定的 DNS 后缀 . . . . . : 

```

8. 广域网协议的封装

(1) 实验目的

掌握广域网协议的封装类型和封装方法

(2) 需求分析

查看路由器广域网接口支持的数据链路层协议，并进行正确的封装

(3) 实验器材

路由器 2 台

(4) 实验拓扑



(5) 实验原理

常见广域网专线技术有，DDN专线、PSTN/ISDN专线、帧中继专线、X.25专线等。数据链路层提供各种专线技术的协议，主要有PPP、HDLC、X.25、Frame-relay以及ATM等。

(6) 实验步骤

路由器 RA 设置

```
[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]
```

```
[Message : Connection is established.Device is RSR20-11-1]
```

```
Ruijie#enable
```

```
Ruijie#configure terminal
```

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

```
Ruijie(config)#hostname RouterA
```

```
RouterA(config)#inter s2/0
```

```
RouterA(config-if-Serial 2/0)#ip address 196.168.2.2 255.255.255.0
```

```
RouterA(config-if-Serial 2/0)#exit
```

```
RouterA(config)#
```

```
RouterA(config)#
```

```
RouterA(config)#
```

```
RouterA(config)#inter s2/0
```

```
RouterA(config-if-Serial 2/0)#encapsulation hdlc
```

```
RouterA(config-if-Serial 2/0)#exit
```

```
RouterA(config)#show inter s2/0
```

```
Index(dec):1 (hex):1
```

```
Serial 2/0 is UP , line protocol is UP
```

```

Hardware is SIC-1HS HDLC CONTROLLER Serial
Interface address is: 196.168.2.2/24
MTU 1500 bytes, BW 2000 Kbit
Encapsulation protocol is HDLC, loopback not set
Keepalive interval is 10 sec ,retries 3.
Carrier delay is 2 sec
Rxload is 1/255, Txload is 1/255
Queueing strategy: FIFO
  Output queue 0/40, 0 drops;
  Input queue 0/75, 0 drops
  0 carrier transitions
  V35 DTE cable
  DCD=up DSR=up DTR=up RTS=up CTS=up
5 minutes input rate 16 bits/sec, 0 packets/sec
5 minutes output rate 19 bits/sec, 0 packets/sec
  126 packets input, 3024 bytes, 0 no buffer, 0 dropped
  Received 0 broadcasts, 0 runts, 0 giants
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 abort
  125 packets output, 3000 bytes, 0 underruns , 0 dropped
  0 output errors, 0 collisions, 0 interface resets
RouterA(config)#
RouterA(config)#
RouterA(config)#
RouterA(config)#
RouterA(config)#
RouterA(config)#
RouterA(config)#inter s2/0
RouterA(config-if-Serial 2/0)#encapsulation ppp
RouterA(config-if-Serial 2/0)#*Jul  2 19:10:36: %LINEPROTO-5-UPDOWN: Line
protocol on Interface Serial 2/0, changed stat
e to down.
RouterA(config-if-Serial 2/0)#encapsulation ppp
RouterA(config-if-Serial 2/0)#exit
RouterA(config)#show inter s2/0
Index(dec):1 (hex):1
Serial 2/0 is UP , line protocol is DOWN
Hardware is SIC-1HS HDLC CONTROLLER Serial
Interface address is: 196.168.2.2/24
MTU 1500 bytes, BW 2000 Kbit
Encapsulation protocol is PPP, loopback not set
Keepalive interval is 10 sec ,retries 10.
Carrier delay is 2 sec
Rxload is 1/255, Txload is 1/255
LCP Termsent

```

```

Closed: ipcp
Queueing strategy: FIFO
  Output queue 0/40, 0 drops;
  Input queue 0/75, 0 drops
  0 carrier transitions
  V35 DTE cable
  DCD=up DSR=up DTR=up RTS=up CTS=up
  5 minutes input rate 16 bits/sec, 0 packets/sec
  5 minutes output rate 45 bits/sec, 0 packets/sec
    190 packets input, 4560 bytes, 0 no buffer, 0 dropped
    Received 0 broadcasts, 0 runts, 0 giants
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 abort
    260 packets output, 5460 bytes, 0 underruns , 0 dropped
    0 output errors, 0 collisions, 7 interface resets
RouterA(config)#
RouterA(config)#
RouterA(config)#
RouterA(config)**Jul  2 19:15:39: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial 2/0, changed state to up.

```

路由器 RB 设置

```

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the
device, please wait a moment....]
[Message : Connection is established.Device is RSR20-11-2]
Ruijie>enable
Ruijie#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#hostname RouterB
RouterB(config)#inter s2/0
RouterB(config-if-Serial 2/0)#ip address 192.168.1.2 255.255.255.0
RouterB(config-if-Serial 2/0)#exit
RouterB(config)#
RouterB(config)#
RouterB(config)#
RouterB(config)#
RouterB(config)#inter s2/0
RouterB(config-if-Serial 2/0)#encapsulation hdlc
RouterB(config-if-Serial 2/0)#exit
RouterB(config)#show inter s2/0
Index(dec):1 (hex):1
Serial 2/0 is UP , line protocol is UP
Hardware is SIC-1HS HDLC CONTROLLER Serial
Interface address is: 192.168.1.2/24
  MTU 1500 bytes, BW 2000 Kbit

```



```

Encapsulation protocol is HDLC, loopback set
Keepalive interval is 10 sec ,retries 3.
Carrier delay is 2 sec
Rxload is 1/255, Txload is 1/255
Queueing strategy: FIFO
  Output queue 0/40, 0 drops;
  Input queue 0/75, 0 drops
  0 carrier transitions
  V35 DCE cable
  DCD=down DSR=up DTR=up RTS=up CTS=up
5 minutes input rate 19 bits/sec, 0 packets/sec
5 minutes output rate 19 bits/sec, 0 packets/sec
  417 packets input, 10008 bytes, 0 no buffer, 0 dropped
  Received 0 broadcasts, 0 runts, 1 giants
  2 input errors, 0 CRC, 0 frame, 0 overrun, 1 abort
  425 packets output, 10200 bytes, 0 underruns , 0 dropped
  0 output errors, 0 collisions, 3 interface resets
RouterB(config)#
RouterB(config)#
RouterB(config)#
RouterB(config)*Jul  2 18:27:44: %LINEPROTO-5-UPDOWN: Line protocol on
Interface Serial 2/0, changed state to down.
RouterB(config)#
RouterB(config)#
RouterB(config)#
RouterB(config)#inter s2/0
RouterB(config-if-Serial 2/0)#encapsulation ppp
RouterB(config-if-Serial 2/0)*Jul  2 18:32:16: %LINEPROTO-5-UPDOWN: Line
protocol on Interface Serial 2/0, changed stat
e to up.
RouterB(config-if-Serial 2/0)#encapsulation ppp
RouterB(config-if-Serial 2/0)#exit
RouterB(config)#show inter s2/0
Index(dec):1 (hex):1
Serial 2/0 is UP , line protocol is UP
Hardware is SIC-1HS HDLC CONTROLLER Serial
Interface address is: 192.168.1.2/24
  MTU 1500 bytes, BW 2000 Kbit
  Encapsulation protocol is PPP, loopback set
  Keepalive interval is 10 sec ,retries 10.
  Carrier delay is 2 sec
  Rxload is 1/255, Txload is 1/255
  LCP Open
  Open: ipcp

```

```
Queueing strategy: FIFO
Output queue 0/40, 0 drops;
Input queue 0/75, 0 drops
0 carrier transitions
V35 DCE cable
DCD=down DSR=up DTR=up RTS=up CTS=up
5 minutes input rate 41 bits/sec, 0 packets/sec
5 minutes output rate 24 bits/sec, 0 packets/sec
569 packets input, 12664 bytes, 0 no buffer, 0 dropped
Received 0 broadcasts, 0 runts, 1 giants
2 input errors, 0 CRC, 0 frame, 0 overrun, 1 abort
495 packets output, 11800 bytes, 0 underruns , 0 dropped
0 output errors, 0 collisions, 13 interface resets
RouterB(config)#
RouterB(config)#
RouterB(config)#
RouterB(config)#
```

9. IPv6

(1) 实验目的

掌握IPv6静态邻居配置

(2) 需求分析

需求1: 应用IPv6后, 能够自己指定设备的邻居。

分析 1: 需要在设备上作相应的配置, 指定设备的邻居

(3) 实验器材

双协议栈交换机 1台

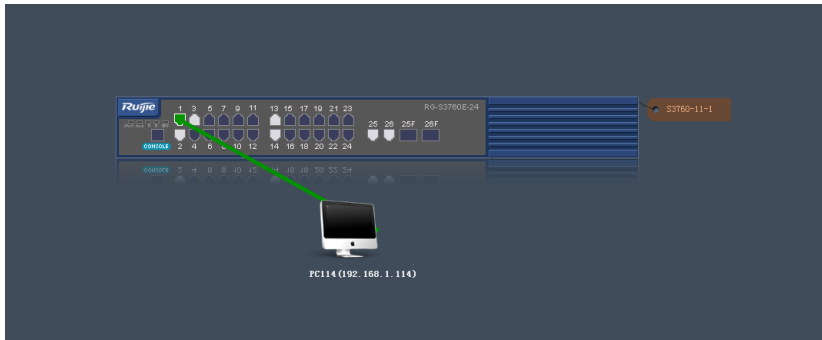
IPv6 PC 1台

配置线 1条

双绞线 1条

(4) 实验拓扑





(5) 实验步骤

第一步：配置交换机相应端口。

[Message : Hello, welcome to use LIMP Telnet Proxy.Prepare connecting to the device, please wait a moment....]

[Message : Connection is established.Device is S3760-11-1]

Ruijie#enable

Ruijie#config

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

Ruijie(config)#interface vlan 1

Ruijie(config-if-VLAN 1)#ipv6 address 1::1/64

Ruijie(config-if-VLAN 1)#no shutdown

Ruijie(config-if-VLAN 1)#ipv6 enable

Ruijie(config-if-VLAN 1)#no ipv6 nd suppress-ra

Ruijie(config-if-VLAN 1)#exit

Ruijie(config)#ipv6 neighbor 1::2 vlan 1 0017.3107.03b1

Ruijie(config)#exit

Ruijie**Jul 3 09:19:23: %SYS-5-CONFIG_I: Configured from console by console

第二步：查看交换机端口配置

Ruijie#show interface vlan 1

Index(dec):4097 (hex):1001

VLAN 1 is UP , line protocol is UP

Hardware is VLAN, address is 1414.4b5c.7399 (bia 1414.4b5c.7399)

Interface address is: no ip address

ARP type: ARPA, ARP Timeout: 3600 seconds

MTU 1500 bytes, BW 1000000 Kbit

Encapsulation protocol is Ethernet-II, loopback not set

Keepalive interval is 10 sec , set

Carrier delay is 2 sec

Rxload is 1/255, Txload is 1/255

第三步：验证交换邻居配置

Ruijie#show ipv6 neighbors verbose 1::2

IPv6 Address	Linklayer Addr	Interface
1::2	0017.3107.03b1	VLAN 1

State: REACH/H Age: - asked: 0

Ruijie#

实验二、互联网的模拟

一、课程设计的目的与要求

1. 结合实验环境，提出模拟网络互联需求，设计并完成组网，要求尽最大可能利用实验资源。

1.1 网络物理拓扑结构设计及 IP 地址分配；

1.2 网络逻辑拓扑结构设计；

2. 网络设备配置实现

按步骤（1）所设计的网络拓扑进行设备连接并配置。配置内容包括路由选择协议 OSPF 配置，VLAN 划分等，并进行测试。

二、设计正文

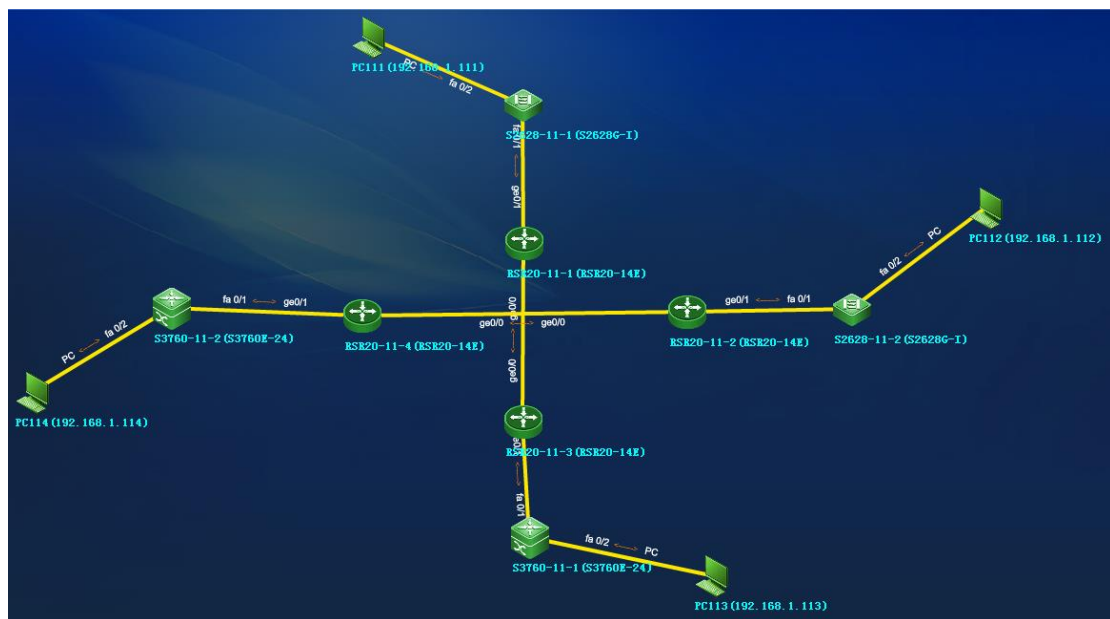
1. 实验设备

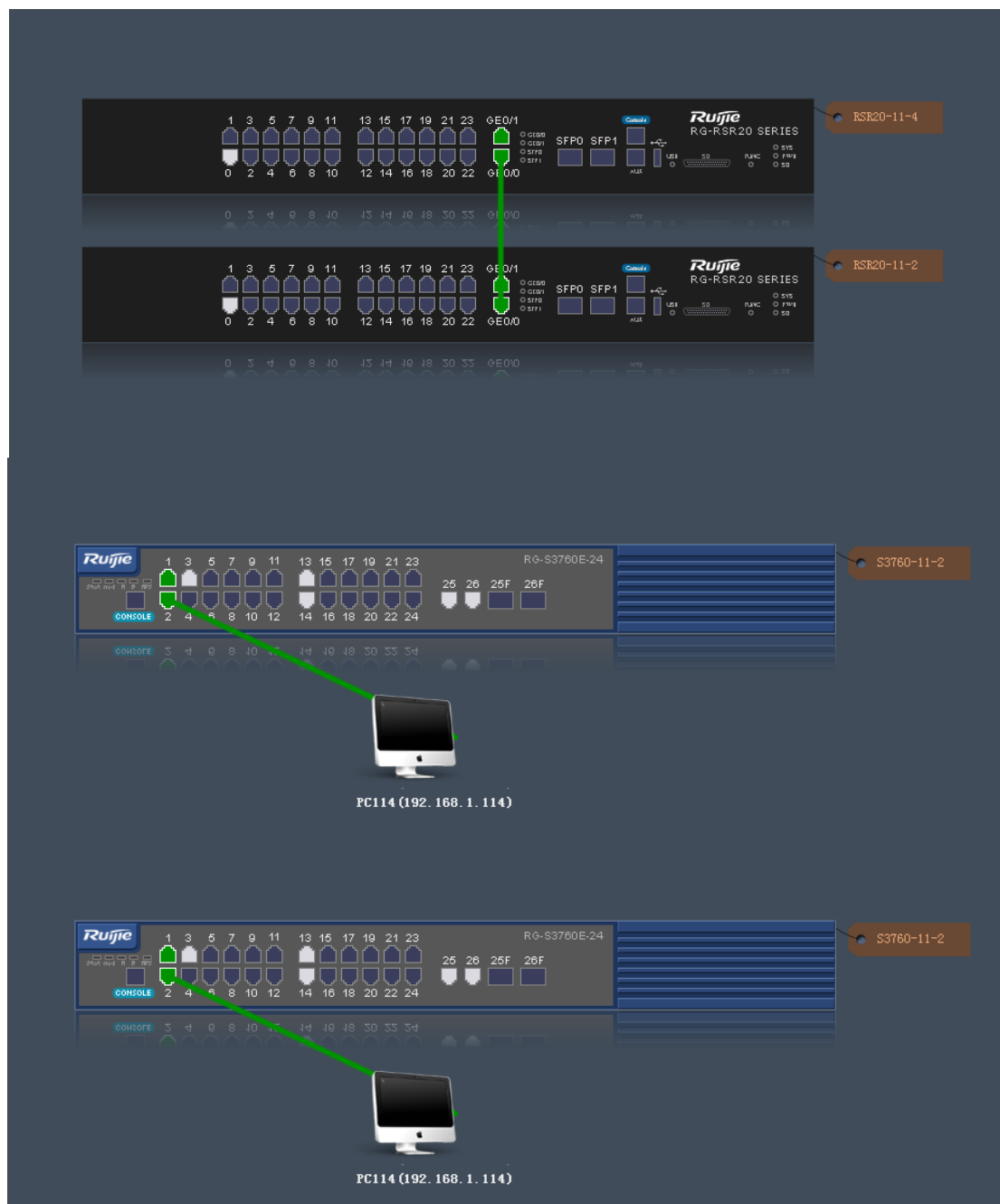
主机 4 台

交换机 4 台

路由器 4 台

2. 实验拓扑





3. 实验内容

第一步：主机网卡设置

主机 1		主机 2	
IPv4 地址	196. 168. 1. 2	IPv4 地址	196. 168. 2. 2
IPv4 子网掩码	255. 255. 255. 0	IPv4 子网掩码	255. 255. 255. 0
IPv4 默认网关	196. 168. 1. 1	IPv4 默认网关	196. 168. 2. 1
主机 3		主机 4	
IPv4 地址	196. 168. 3. 2	IPv4 地址	196. 168. 4. 2
IPv4 子网掩码	255. 255. 255. 0	IPv4 子网掩码	255. 255. 255. 0
IPv4 默认网关	196. 168. 3. 1	IPv4 默认网关	196. 168. 4. 1

第二步：路由器配置

路由器 1 配置

[Message : Hello, welcome to use LIMP Telnet Proxy. Prepare connecting to the device, please wait a moment....]

[Message : Connection is established. Device is RSR20-11-1]

Ruijie>enable

Ruijie#conf t

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

Ruijie(config)#interface Serial 2/0

Ruijie(config-if-Serial 2/0)#encapsulation HDLC

Ruijie(config-if-Serial 2/0)#ip address 196.168.5.1 255.255.255.0

Ruijie(config-if-Serial 2/0)#shutdown

Ruijie(config-if-Serial 2/0)#*Jul 2 19:51:32: %LINK-5-CHANGED: Interface Serial 2/0, changed state to administratively down.

*Jul 2 19:51:32: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial 2/0, changed state to down.

Ruijie(config-if-Serial 2/0)#exit

Ruijie(config)#interface Serial 3/0

Ruijie(config-if-Serial 3/0)#encapsulation HDLC

Ruijie(config-if-Serial 3/0)#ip address 196.168.8.2 255.255.255.0

Ruijie(config-if-Serial 3/0)#shutdown

Ruijie(config-if-Serial 3/0)#*Jul 2 19:54:21: %LINK-5-CHANGED: Interface Serial 3/0, changed state to administratively down.

*Jul 2 19:54:21: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial 3/0, changed state to down.

Ruijie(config-if-Serial 3/0)#exit

Ruijie(config)#interface Giga 0/0

Ruijie(config-if-GigabitEthernet 0/0)#ip address 196.168.9.1 255.255.255.0

Ruijie(config-if-GigabitEthernet 0/0)#duplex auto

Ruijie(config-if-GigabitEthernet 0/0)#speed auto

Ruijie(config-if-GigabitEthernet 0/0)#exit

Ruijie(config)#interface Giga 0/1

Ruijie(config-if-GigabitEthernet 0/1)#ip address 196.168.1.1 255.255.255.0

Ruijie(config-if-GigabitEthernet 0/1)#duplex auto

Ruijie(config-if-GigabitEthernet 0/1)#speed auto

Ruijie(config-if-GigabitEthernet 0/1)#exit

Ruijie(config)#router ospf 1

Ruijie(config-router)#network 196.168.1.0 0.0.0.255 area 0

Ruijie(config-router)#network 196.168.5.0 0.0.0.255 area 0

Ruijie(config-router)#network 196.168.8.0 0.0.0.255 area 0

Ruijie(config-router)#network 196.168.9.0 0.0.0.255 area 0

Ruijie(config-router)#

```
Ruijie(config-router)#
Ruijie(config-router)#
Ruijie CON0 is now available
Press RETURN to get started
*Jul  2 20:15:24: %SYS-5-CONFIG_I: Configured from console by console
*Jul  2 20:27:12: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to
down.
*Jul  2 20:27:12: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/0, changed state to down.
*Jul  2 20:27:12: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
down.
*Jul  2 20:27:12: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to down.
*Jul  2 20:27:22: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to
up.
*Jul  2 20:27:22: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/0, changed state to up.
*Jul  2 20:27:22: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
up.
*Jul  2 20:27:22: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to up.
*Jul  2 20:29:57: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to
down.
*Jul  2 20:29:57: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/0, changed state to down.
*Jul  2 20:29:57: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
down.
*Jul  2 20:29:57: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to down.
*Jul  2 20:30:09: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to
up.
*Jul  2 20:30:09: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/0, changed state to up.
*Jul  2 20:30:09: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
up.
*Jul  2 20:30:09: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to up.
```

路由器 2 配置

```
[Message : Hello, welcome to use LIMP Telnet Proxy. Prepare connecting to the device,
please wait a moment....]
```

```
[Message : Connection is established.Device is RSR20-11-2]
```

```
Ruijie>enable
```

```
Ruijie#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Ruijie(config)#hostname RouterB
RouterB(config)#interface Serial 2/0
RouterB(config-if-Serial 2/0)#encapsulation HDLC
RouterB(config-if-Serial 2/0)#ip address 196.168.5.2 255.255.255.0
RouterB(config-if-Serial 2/0)#clock rate 64000
RouterB(config-if-Serial 2/0)#exit
RouterB(config)#interface Serial 3/0
RouterB(config-if-Serial 3/0)#encapsulation HDLC
RouterB(config-if-Serial 3/0)#ip address 196.168.6.1 255.255.255.0
RouterB(config-if-Serial 3/0)#clock rate 64000
RouterB(config-if-Serial 3/0)#shutdown
RouterB(config-if-Serial 3/0)**Jul  2 19:25:40: %LINK-5-CHANGED: Interface Serial
3/0, changed state to administratively
down.
*Jul  2 19:25:40: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial 3/0,
changed state to down.
RouterB(config-if-Serial 3/0)#exit
RouterB(config)#interface Giga 0/0
RouterB(config-if-GigabitEthernet 0/0)#ip address 196.168.10.2 255.255.255.0
RouterB(config-if-GigabitEthernet 0/0)#duplex auto
RouterB(config-if-GigabitEthernet 0/0)#speed auto
RouterB(config-if-GigabitEthernet 0/0)#exit
RouterB(config)#interface Giga 0/1
RouterB(config-if-GigabitEthernet 0/1)#ip address 196.168.2.1 255.255.255.0
RouterB(config-if-GigabitEthernet 0/1)#duplex auto
RouterB(config-if-GigabitEthernet 0/1)#speed auto
RouterB(config-if-GigabitEthernet 0/1)#exit
RouterB(config)#router ospf 1
RouterB(config-router)#network 192.168.2.0 0.0.0.255 area 0
RouterB(config-router)#network 192.168.5.0 0.0.0.255 area 0
RouterB(config-router)#network 192.168.6.0 0.0.0.255 area 0
RouterB(config-router)#network 192.168.10.0 0.0.0.255 area 0
RouterB(config-router)#
RouterB CON0 is now available
Press RETURN to get started
*Jul  2 19:40:41: %SYS-5-CONFIG_I: Configured from console by console
*Jul  2 19:43:48: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to
down.
*Jul  2 19:43:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/0, changed state to down.
*Jul  2 19:43:48: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
down.
```


*Jul 2 19:43:48: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet 0/1, changed state to down.
*Jul 2 19:43:58: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to up.
*Jul 2 19:43:58: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet 0/1, changed state to up.
*Jul 2 19:44:00: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to up.
*Jul 2 19:44:00: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet 0/0, changed state to up.
*Jul 2 19:46:33: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to down.
*Jul 2 19:46:33: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet 0/0, changed state to down.
*Jul 2 19:46:34: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to down.
*Jul 2 19:46:34: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet 0/1, changed state to down.
*Jul 2 19:46:43: %LINK-3-UPDOWN: Interface GigabitEthernet 0/0, changed state to up.
*Jul 2 19:46:43: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet 0/0, changed state to up.
*Jul 2 19:46:43: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to up.
*Jul 2 19:46:43: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet 0/1, changed state to up.

路由器 3 配置

[Message : Hello, welcome to use LIMP Telnet Proxy. Prepare connecting to the device, please wait a moment....]

[Message : Connection is established. Device is RSR20-11-3]

Ruijie>enable

Ruijie#conf t

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

Ruijie(config)#hostname RouterC

RouterC(config)#interface Serial 2/0

RouterC(config-if-Serial 2/0)#encapsulation HDLC

RouterC(config-if-Serial 2/0)#ip address 196.168.6.2 255.255.255.0

RouterC(config-if-Serial 2/0)#exit

RouterC(config)#interface Serial 3/0

RouterC(config-if-Serial 3/0)#encapsulation HDLC

RouterC(config-if-Serial 3/0)#ip address 196.168.7.1 255.255.255.0

RouterC(config-if-Serial 3/0)#exit

RouterC(config)#interface Giga 0/0

```

RouterC(config-if-GigabitEthernet 0/0)#ip address 196.168.9.2 255.255.255.0
RouterC(config-if-GigabitEthernet 0/0)#duplex auto
RouterC(config-if-GigabitEthernet 0/0)#speed auto
RouterC(config-if-GigabitEthernet 0/0)#shutdown
RouterC(config-if-GigabitEthernet 0/0)#ex*Jul  2 20:19:02: %LINK-5-CHANGED:
Interface GigabitEthernet 0/0, changed state
to administratively down.
*Jul  2 20:19:02: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/0, changed state to down.
it
RouterC(config)#interface Giga 0/1
RouterC(config-if-GigabitEthernet 0/1)#ip address 196.168.3.1 255.255.255.0
RouterC(config-if-GigabitEthernet 0/1)#duplex auto
RouterC(config-if-GigabitEthernet 0/1)#speed auto
RouterC(config-if-GigabitEthernet 0/1)#exit
RouterC(config)#router ospf 1
RouterC(config-router)#network 196.168.3.0 0.0.0.255 area 0
RouterC(config-router)#network 196.168.6.0 0.0.0.255 area 0
RouterC(config-router)#network 196.168.7.0 0.0.0.255 area 0
RouterC(config-router)#network 196.168.9.0 0.0.0.255 area 0
RouterC(config-router)*Jul  2 20:26:19: %LINK-3-UPDOWN: Interface
GigabitEthernet 0/1, changed state to down.
*Jul  2 20:26:19: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to down.
*Jul  2 20:26:27: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
up.
*Jul  2 20:26:27: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to up.
*Jul  2 20:29:04: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
down.
*Jul  2 20:29:04: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to down.
*Jul  2 20:29:13: %LINK-3-UPDOWN: Interface GigabitEthernet 0/1, changed state to
up.
*Jul  2 20:29:13: %LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet
0/1, changed state to up.
RouterC CON0 is now available
Press RETURN to get started
*Jul  2 20:31:33: %SYS-5-CONFIG_I: Configured from console by console
*Jul  2 20:36:22: %OSPF-5-ADJCHG: Process 1, Nbr 196.168.10.1-Serial 3/0 from Down
to Init, HelloReceived.
*Jul  2 20:36:26: %OSPF-5-ADJCHG: Process 1, Nbr 196.168.10.1-Serial 3/0 from
Loading to Full, LoadingDone.

```

路由器 4 配置

```
[Message : Hello, welcome to use LIMP Telnet Proxy. Prepare connecting to the device,
please wait a moment....]
[Message : Connection is established. Device is RSR20-11-4]
Ruijie>enable
Ruijie#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Ruijie(config)#hostname RouterD
RouterD(config)#interface serial 2/0
RouterD(config-if-Serial 2/0)#encapsulation HDLC
RouterD(config-if-Serial 2/0)#ip address 196.168.7.2 255.255.255.0
RouterD(config-if-Serial 2/0)#clock rate 64000
RouterD(config-if-Serial 2/0)#exit
RouterD(config)#interface serial 3/0
RouterD(config-if-Serial 3/0)#encapsulation HDLC
RouterD(config-if-Serial 3/0)#ip address 196.168.8.1 255.255.255.0
RouterD(config-if-Serial 3/0)#clock rate 64000
RouterD(config-if-Serial 3/0)#shutdown
RouterD(config-if-Serial 3/0)#i*Jul 2 19:53:37: %LINK-5-CHANGED: Interface
Serial 3/0, changed state to administrativel
y down.
RouterD(config-if-Serial 3/0)#exit
RouterD(config)#interface Giga 0/0
RouterD(config-if-GigabitEthernet 0/0)#ip address 196.168.10.1 255.255.255.0
RouterD(config-if-GigabitEthernet 0/0)#duplex auto
RouterD(config-if-GigabitEthernet 0/0)#speed auto
RouterD(config-if-GigabitEthernet 0/0)#exit
RouterD(config)#interface Giga 0/1
RouterD(config-if-GigabitEthernet 0/1)#ip address 196.168.4.1 255.255.255.0
RouterD(config-if-GigabitEthernet 0/1)#duplex auto
RouterD(config-if-GigabitEthernet 0/1)#speed auto
RouterD(config-if-GigabitEthernet 0/1)#exit
RouterD(config)#router ospf 1
RouterD(config-router)#network 196.168.4.0 0.0.0.255 area 0
RouterD(config-router)#network 196.168.7.0 0.0.0.255 area 0
RouterD(config-router)#network 196.168.7*Jul 2 19:56:58: %OSPF-5-ADJCHG: Process
1, Nbr 196.168.7.1-Serial 2/0 from Dow
n to Init, HelloReceived.
*Jul 2 19:56:59: %OSPF-5-ADJCHG: Process 1, Nbr 196.168.7.1-Serial 2/0 from
Loading to Full, LoadingDone.
RouterD(config-router)#network 196.168.8.0 0.0.0.255 area 0
RouterD(config-router)#network 196.168.10.0 0.0.0.255 area 0
RouterD(config-router)#
RouterD CON0 is now available
```

Press RETURN to get started

*Jul 2 20:07:48: %SYS-5-CONFIG_I: Configured from console by console

第三步:验证测试

路由表、主机 1 ping 主机 3 及追踪

R1 的路由表:

```
C 196.168.1.0/24 is directly connected, GigabitEthernet 0/1
C 196.168.1.1/32 is local host.
O 196.168.2.0/24 [110/51] via 196.168.5.2, 00:17:26, Serial 2/0
O 196.168.3.0/24 [110/2] via 196.168.9.2, 00:17:06, GigabitEthernet 0/0
O 196.168.4.0/24 [110/51] via 196.168.8.1, 00:17:15, Serial 3/0
C 196.168.5.0/24 is directly connected, Serial 2/0
C 196.168.5.1/32 is local host.
O 196.168.6.0/24 [110/51] via 196.168.9.2, 00:17:06, GigabitEthernet 0/0
O 196.168.7.0/24 [110/51] via 196.168.9.2, 00:17:06, GigabitEthernet 0/0
C 196.168.8.0/24 is directly connected, Serial 3/0
C 196.168.8.2/32 is local host.
C 196.168.9.0/24 is directly connected, GigabitEthernet 0/0
C 196.168.9.1/32 is local host.
O 196.168.10.0/24 [110/51] via 196.168.5.2, 00:17:26, Serial 2/0
[110/51] via 196.168.8.1, 00:17:15, Serial 3/0
```

R2 的路由表:

```
O 196.168.1.0/24 [110/51] via 196.168.5.1, 00:17:50, Serial 2/0
C 196.168.2.0/24 is directly connected, GigabitEthernet 0/1
C 196.168.2.1/32 is local host.
O 196.168.3.0/24 [110/51] via 196.168.6.2, 00:21:36, Serial 3/0
O 196.168.4.0/24 [110/2] via 196.168.10.1, 00:20:55, GigabitEthernet 0/0
C 196.168.5.0/24 is directly connected, Serial 2/0
C 196.168.5.2/32 is local host.
C 196.168.6.0/24 is directly connected, Serial 3/0
C 196.168.6.1/32 is local host.
O 196.168.7.0/24 [110/51] via 196.168.10.1, 00:20:55, GigabitEthernet 0/0
O 196.168.8.0/24 [110/51] via 196.168.10.1, 00:20:55, GigabitEthernet 0/0
O 196.168.9.0/24 [110/51] via 196.168.6.2, 00:20:09, Serial 3/0
[110/51] via 196.168.5.1, 00:17:31, Serial 2/0
C 196.168.10.0/24 is directly connected, GigabitEthernet 0/0
C 196.168.10.2/32 is local host.
```

R3 的路由表:

```
O 196.168.1.0/24 [110/2] via 196.168.9.1, 00:09:04, GigabitEthernet 0/0
O 196.168.2.0/24 [110/51] via 196.168.6.1, 00:13:10, Serial 2/0
C 196.168.3.0/24 is directly connected, GigabitEthernet 0/1
C 196.168.3.1/32 is local host.
O 196.168.4.0/24 [110/51] via 196.168.7.2, 00:12:17, Serial 3/0
O 196.168.5.0/24 [110/51] via 196.168.9.1, 00:09:04, GigabitEthernet 0/0
```

C 196.168.6.0/24 is directly connected, Serial 2/0
C 196.168.6.2/32 is local host.
C 196.168.7.0/24 is directly connected, Serial 3/0
C 196.168.7.1/32 is local host.
O 196.168.8.0/24 [110/51] via 196.168.9.1, 00:09:04, GigabitEthernet 0/0
C 196.168.9.0/24 is directly connected, GigabitEthernet 0/0
C 196.168.9.2/32 is local host.
O 196.168.10.0/24 [110/51] via 196.168.6.1, 00:13:10, Serial 2/0
[110/51] via 196.168.7.2, 00:12:17, Serial 3/0

R4 的路由表:

O 196.168.1.0/24 [110/51] via 196.168.8.2, 00:17:46, Serial 3/0
O 196.168.2.0/24 [110/2] via 196.168.10.2, 00:21:03, GigabitEthernet 0/0
O 196.168.3.0/24 [110/51] via 196.168.7.1, 00:20:53, Serial 2/0
C 196.168.4.0/24 is directly connected, GigabitEthernet 0/1
C 196.168.4.1/32 is local host.
O 196.168.5.0/24 [110/51] via 196.168.10.2, 00:21:03, GigabitEthernet 0/0
O 196.168.6.0/24 [110/51] via 196.168.10.2, 00:21:03, GigabitEthernet 0/0
C 196.168.7.0/24 is directly connected, Serial 2/0
C 196.168.7.2/32 is local host.
C 196.168.8.0/24 is directly connected, Serial 3/0
C 196.168.8.1/32 is local host.
O 196.168.9.0/24 [110/51] via 196.168.7.1, 00:20:24, Serial 2/0
[110/51] via 196.168.8.2, 00:17:46, Serial 3/0
C 196.168.10.0/24 is directly connected, GigabitEthernet 0/0
C 196.168.10.1/32 is local host.

主机 1 ping 主机 3:

C:\Users\Administrator>ping 196.168.3.2

正在 Ping 196.168.3.2 具有 32 字节的数据:

来自 196.168.3.2 的回复: 字节=32 时间=13ms TTL=62

来自 196.168.3.2 的回复: 字节=32 时间<1ms TTL=62

来自 196.168.3.2 的回复: 字节=32 时间<1ms TTL=62

来自 196.168.3.2 的回复: 字节=32 时间<1ms TTL=62

196.168.3.2 的 Ping 统计信息:

数据包: 已发送= 4, 已接收= 4, 丢失= 0 (0% 丢失),

往返行程的估计时间(以毫秒为单位):

最短= 0ms, 最长= 13ms, 平均= 3ms

追踪:

C:\Users\Administrator>tracert 196.168.3.2

通过最多 30 个跃点跟踪

到 WORKGROUP [196.168.3.2] 的路由:

1 <1 毫秒<1 毫秒<1 毫秒 196.168.1.1

2 <1 毫秒<1 毫秒<1 毫秒 196.168.9.2

3 <1 毫秒<1 毫秒<1 毫秒 WORKGROUP [196.168.3.2]

跟踪完成。

实验三、基于模拟互联网的网络协议分析

一、课程设计的目的与要求

在上面设计并实现的网络环境下，利用 arp、ping、tracert 等命令、浏览器和 IIS、wireshark 等截获所配置环境下的 C/S 端数据包，分类保存相关数据包文件，完成如下协议分析：

- 1.以太网数据链路层帧格式分析；
- 2.网络层分片；ICMP 协议分析；
- 3.ARP 地址解析协议分析；
- 4.TCP 传输控制协议分析；（三次握手、数据传输、四次挥手）
- 5.FTP 协议分析；HTTP 协议分析。

二、设计正文

1. 实验设备

主机 4 台

交换机 4 台

路由器 4 台

2. 实验拓扑



3. 实验内容

3.1，以太网数据帧格式分析

目的地址：6 个字节的物理地址，标识帧的接收结点。

源地址：6 个字节的源物理地址，标识帧的发送结点。

帧类型/长度 (TYPE/LEN)：该字段的值大于或等于 0x0600 时，表示上层数据使用的协议类型。例如 0x0806 表示 ARP 请求或应答，0x0600 表示 IP 协议。该字段的值小于 0x0600 时表示以太网用户数据的长度字段，上层携带 LLC PDU。

数据字段：这是一个可变长度字段，用于携带上层传下来的数据。

帧校验FCS：以太网采用32 位CRC 冗余校验。校验范围是目的地址、源地址、长度/类型、数据字段。

当以太网数据帧的长度/类型字段的值小于0x0600 时，说明数据字段携带的是LLCPDU。

三种LLC 帧的控制位。

3.2网络层分片；ICMP 协议分析

```
0000 14 14 4b 31 e2 8f 14 cf 92 e3 2e 9d 08 00 45 00
0010 00 3c 20 64 00 00 40 01 ce 08 c4 a8 02 02 c4 a8
0020 01 02 00 00 54 d2 00 01 00 89 61 62 63 64 65 66
0030 67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 74 75 76
0040 77 61 62 63 64 65 66 67 68 69
```

分析：该网络层分片的目的MAC地址为14 14 4b 31 e2 8f，源MAC 地址：14 cf 92 e3 2e 9d。网络层分片的长度为08 00，类型是IP类型，版本号4，代表Ipv4，首部长度（5）为20字节，服务类型00，区分服务普通。数据帧总长度为60字节，总长度003c，标识：20 64，标志为0x00，不允许分片，片偏0，生存时间40，ICMP协议，首部检验和为ce 08，源IP 地址c4 a8 02 02，即196.168.2.2，目的IP 地址 c4 a8 01 02，即196.168.1.2，类型00 回显应答报文，代码00，检验和54 d2，标识符00 01，序号00 89，回答报文重复：61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 74 75 76 77 61 62 63 64 65 66 67 68 69

3.3ARP 地址解析协议分析

```
0000 14 cf 92 e3 2e 9d 14 14 4b 31 e2 8f 08 06 00 01
0010 08 00 06 04 00 02 14 14 4b 31 e2 8f c4 a8 02 01
0020 14 cf 92 e3 2e 9d c4 a8 02 02 00 00 00 00 00 00
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

分析：目的地址为14 cf 92 e3 2e 9d，源地址为14 14 4b 31 e2 8f，类型为08 06，硬件类型00 01，表示以太网，协议类型08 00，表示IP地址，硬件长度06，MAC,6个字节，协议长度04，对于IP地址，长度是4个字节，操作码00 02，表示ARP应答，发送方MAC14 14 4b 31 e2 8f，发送方IPc4 a8 02 01，196.168.2.1，目标MAC14 cf 92 e3 2e 9d，目的IPc4 a8 02 02，196.168.2.2

3.4 TCP 传输控制协议分析：（三次握手、数据传输、四次挥手） 第一次握手

```
0000 14 14 4b 31 e2 8f 14 cf 92 e3 2e 9d 08 00 45 00
0010 00 34 24 17 40 00 40 06 8a 58 c4 a8 02 02 c4 a8
0020 01 02 12 8d 00 15 71 8d b4 e8 00 00 00 00 80 02
0030 20 00 89 a9 00 00 02 04 05 b4 01 03 03 02 01 01
0040 04 02
```

分析：目的MAC 地址14 14 4b 31 e2 8f 单播，源MAC 地址14 cf 92 e3 2e 9d长度08,类型00 即 IP，版本号4代表 IPv4，首部长度5 即20 字节，服务类型/区分服务 00 表示普通，总长度52 字节，标识24 17，标志4不允许分片，片偏移0x40，生存时间40 4*16=64 跳，协议06 为TCP协议，首部检验和8a 58，源IP 地址c4 a8 02 02 196.168.2.2，目的IP 地址c4 a8 01 02 196.168.1.2，源端口12 目的端口00 15，序号71 8d b4 e8，确认号00 00 00 00，片偏移8 标志位：0 02，窗口 20 00，检验和 89 a9，紧急指针00 00，选项类型 02 MSS，本选项长度 04，MSS 05 b4，选项类型 01 NoP 选项类型 03 Win，本选项长度 03，移位值S 02 选项类型：04 SACKP，本选项长度：02

第二次握手

```
0000 14 cf 92 e3 2e 9d 14 14 4b 31 e2 8f 08 00 45 00
0010 00 34 23 9c 40 00 3e 06 8c d3 c4 a8 01 02 c4 a8
0020 02 02 00 15 12 8d 28 4e bb 2e 71 8d b4 e9 80 12
0030 20 00 a6 15 00 00 02 04 05 b4 01 03 03 08 01 01
0040 04 02
```

分析：目的MAC 地址 14 cf 92 e3 2e 9d 单播，源MAC 地址 14 14 4b 31 e2 8f，长度/类型 08 00 IP，版本号 4 即IPv4，首部长度 5*4=20 字节，服务类型/区分服务 00 表示普通，总长度 00 34 3*16+4=52 字节，标识 23 9c $2*4096+3*256+9*16+12=9116$ ，标志 4 0x40=01000000 不允许分片，片偏移 0x40 0x00 的低13 位，生存时间 3e，协议 06 TCP，首部检验和 8c d3 源IP 地址 c4 a8 01 02 196.168.1.2，目的IP 地址 c4 a8 02 02 196.168.2.2，源端口 00 15 0x0015=16+5=21 熟知端口，目的端口 12 8d，登记端口序号 28 4e bb 2e，确认号 71 8d b4 e9，片偏移 8 8*4=32 字节，标志位 0 12，窗口 20 00，检验和 a6 15，紧急指针 00 00，选项类型 02 MSS，本选项长度 04，MSS 05 b4，选项类型 01 NoP，选项类型 03 WinS，选项类型 03 WinS，本选项长度 08，选项类型 01 NoP，选项类型 01 NoP，本选项长度 04，移位值 02

第三次握手

```
0000 14 14 4b 31 e2 8f 14 cf 92 e3 2e 9d 08 00 45 00
0010 00 28 24 18 40 00 40 06 8a 63 c4 a8 02 02 c4 a8
0020 01 02 12 8d 00 15 71 8d b4 e9 28 4e bb 2f 50 10
0030 40 29 c6 bf 00 00
```

数据传输：

```
0000 14 cf 92 e3 2e 9d 14 14 4b 31 e2 8f 08 00 45 00
0010 00 3d 23 9f 40 00 3e 06 8c c7 c4 a8 01 02 c4 a8
0020 02 02 00 15 12 8d 28 4e bb 92 71 8d b5 05 50 18
0030 01 00 eb 3e 00 00 32 33 30 20 55 73 65 72 20 6c
0040 6f 67 67 65 64 20 69 6e 2e 0d 0a
```

分析：目的MAC 地址 14cf 92e3 2e9d 单播 网关，源MAC 地址 1414 4b31 e28f，长度/类型 0800/IP，版本号 4 表示IPV4，首部长度 5 表示5x4 字节=20 字节0x0E-0x21，服务类型/区分服务 00 表示普通，总长度 003d 表示3x16+13=61 字节0x0xE-0x42，标识 0x239f 表示 $2x4096+3x256+9x16+15x1=9119$ ，标志（3 位0/DF/MF） 0x40=010 0 0000 不允许分片，片偏移（13 位） 0x40 0x00 的低13 位0，生存时间 3e 表示 $3x256+14=782$ 跳，协议 06 表示 TCP，首部检验和 8cc7，源IP 地址 c4a8 0102，目的IP 地址 c4a8 0202，源端口 0x0015=16+5=21 表示熟知端口，目的端口 0x128d=1x4096+2x256+8x16+13x1=4749 表示登记端口，序号 284e bb92，确认号 0x718d b505，数据偏移（4 位，实际是首部长度）单位4 字节5x4 字节=20 字节0x22-0x42，标志位 018 表示SYN=0，ACK=1 确认号有效，连接请求报文，窗口（2 字节） 0100 接收窗口，检验和（2 字节） eb3e，紧急指针（2 字节） 0000 表示URG=0 所以无效

第一次挥手：

```
0000 14 14 4b 31 e2 8f 14 cf 92 e3 2e 9d 08 00 45 00
0010 00 28 24 23 40 00 40 06 8a 58 c4 a8 02 02 c4 a8
0020 01 02 12 8d 00 15 71 8d b5 2c 28 4e bc 31 50 11
```


0030 3f e8 c5 ba 00 00

目的MAC 地址 1414 4b31 e28f 单播: 网关, 源MAC 地址 14cf 92e3 2e9d, 长度/类型 0800/IP, 版本号 4 表示IPv4, 首部长度 5 表示5x4 字节=20 字节0x0E-0x21, 服务类型/区分服务 00 表示普通, 总长度 0028 表示2x16+8=40 字节0x0E-0x42, 标识 0x2423 表示2x4096+4x256+2x16+3x1=9251, 标志 (3 位0/DF/MF) 0x40=010 0 0000 不允许分片, 片偏移 (13 位) 0x40 0x00 的低13 位0, 生存时间 40 表示4x16=64 跳, 协议 06 表示TCP, 首部检验和 8a58, 源IP 地址 c4a8 0202, 目的IP 地址 c4a8 0102, 源端口 0x128d=1x4096+2x256+8x16+13x1=4749 表示登记端口, 目的端口 0x0015=16+5=21 表示熟知端口, 序号 0x718d b52c, 确认号 284e bc31, 数据偏移 (4 位, 实际是首部长度) 单位4 字节5x4 字节=20 字节0x22-0x42, 标志位 011 表示SYN=0, ACK=1 确认号有效, 连接请求报文, 窗口 (2 字节) 3fe8 接收窗口, 检验和 (2 字节) c5ba, 紧急指针 (2 字节) 0000 表示URG=0 所以无效

第二次挥手:

0000 14 cf 92 e3 2e 9d 14 14 4b 31 e2 8f 08 00 45 00
0010 00 28 23 a7 40 00 3e 06 8c d4 c4 a8 01 02 c4 a8
0020 02 02 00 15 12 8d 28 4e bc 31 71 8d b5 2d 50 10
0030 01 00 04 a3 00 00 00 00 00 00 00 00 00 00

第三次挥手:

0000 14 cf 92 e3 2e 9d 14 14 4b 31 e2 8f 08 00 45 00
0010 00 28 23 a8 40 00 3e 06 8c d3 c4 a8 01 02 c4 a8
0020 02 02 00 15 12 8d 28 4e bc 31 71 8d b5 2d 50 11
0030 01 00 04 a2 00 00 00 00 00 00 00 00 00 00

第四次挥手:

0000 14 14 4b 31 e2 8f 14 cf 92 e3 2e 9d 08 00 45 00
0010 00 28 24 24 40 00 40 06 8a 57 c4 a8 02 02 c4 a8
0020 01 02 12 8d 00 15 71 8d b5 2d 28 4e bc 32 50 10
0030 3f e8 c5 b9 00 00

目的MAC 地址 1414 4b31 e28f 单播: 网关, 源MAC 地址 14cf 92e3 2e9d, 长度/类型 0800/IP, 版本号 4 表示IPv4, 首部长度 5 表示5x4 字节=20 字节0x0E-0x21, 服务类型/区分服务 00 表示普通, 总长度 0028 表示2x16+8=40 字节0x0E-0x42, 标识 0x2424 表示2x4096+4x256+2x16+4x1=9252, 标志 (3 位0/DF/MF) 0x40=010 0 0000 不允许分片, 片偏移 (13 位) 0x40 0x00 的低13 位0, 生存时间 40 表示4x256=1024 跳, 协议 06 表示TCP, 首部检验和 8a57, 源IP 地址 c4a8 0202, 目的IP 地址: c4a8 0102, 源端口 0x128d=1x4096+2x256+8x16+13x1=4749 表示登记端口, 目的端口 0x0015=16+5=21 表示熟知端口, 序号 0x718d b52d, 确认号 284e bc32, 数据偏移 (4 位, 实际是首部长度) 单位4 字节5x4 字节=20 字节0x22-0x42, 标志位 010 表示SYN=0, ACK=1 确认号有效, 连接请求报文, 窗口 (2 字节) 3fe8 接收窗口, 检验和 (2 字节) c5b9, 紧急指针 (2 字节) 0000 表示URG=0 所以无效

3.5 FTP 协议分析: HTTP 协议分析

FTP协议分析:

0000 14 14 4b 31 e2 8f 14 cf 92 e3 2e 9d 08 00 45 00
0010 00 2d 21 a1 40 00 40 06 8c d5 c4 a8 02 02 c4 a8

0020 01 02 12 5a 00 15 41 62 36 6a 67 63 e8 4c 50 18
0030 3f fc 6b 26 00 00 50 57 44 0d 0a

目的MAC 地址 1414 4b31 e28f 单播 网关, 源MAC 地址 14cf 92e3 2e9d, 长度/类型 0800/IP, 版本号 4 表示IPv4, 首部长度 5 表示5x4 字节=20 字节0x0E-0x21, 服务类型/区分服务 00 表示普通, 总长度 002d 表示2x16+13=45 字节0x0E-0x42, 标识 0x21a1 标志 (3 位0/DF/MF) 0x40=010 0 0000 不允许分片, 片偏移 (13 位) 0x40 0x00 的低13 位0, 生存时间 40 表示4x256=1024 跳, 协议 06 表示TCP, 首部检验和, 8cd5, 源IP 地址 c4a8 0202 , 目的IP 地址 c4a8 0102 , 源端口 0x125a=1x4096+2x256+5x16+10=4698 表示登记端口, 目的端口 0x0015=1x16+5=21 表示熟知端口, 序号 4162 366a, 确认号 0x6763 e84c, 数据偏移 (4 位, 实际是首部长度) 单位4 字节5x4 字节=20 字节0x22-0x42, 标志位 018 表示SYN=0, ACK=1 确认号有效, 连接请求报文, 窗口 (2 字节) 3ffc 接收窗口, 检验和 (2 字节) 6b26, 紧急指针 (2 字节) 0000 表示URG=0 所以无效

HTTP协议分析:

0000 14 14 4b 31 e2 8f 14 cf 92 e3 2e 9d 08 00 45 00
0010 02 0b 29 0b 40 00 3e 06 86 b9 c4 0a 01 0a c4 0a
0020 02 0a 27 40 00 50 64 10 b8 35 74 34 44 d8 50 18
0030 40 29 f3 9a 00 00 47 45 54 20 2f 20 48 54 54 50
0040 2f 31 2e 31 0d 0a 41 63 63 65 70 74 3a 20 69 6d

目的MAC 地址 14 14 4b 31 e2 8f, 源MAC 地址 14 cf 92 e3 2e 9d, 长度/类型 08 00 , IP, 版本号 4 , IPv4, 首部长度 5 , 5x4 字节=20 字节, 服务类型/区分服务 00 , 普通, 总长度 02 0b , 0x020b=2*256+11=523, 标识 29 0b , 0x290b=2*4096+9*256+11=10507, 标志 4 , 0x40=01000000 不允许分片, 片偏移: 0x40 0x00 的低13 位, 生存时间 3e , 3*16+14=62 跳, 协议 06 ,TCP, 首部检验和 86 b9, 源IP 地址 c4 0a 01 0a , .196.168.1.10, 目的IP 地址 c4 0a 02 0a , 196.168.2.10, 源端口 27 40 , 0x2740=2*4096+7*256+4*16=10048 登记端口, 目的端口 00 50 , 0x0050=5*16=80 熟知端口, 序号 64 10 b8 35, 确认号 74 34 44 d8, 数据偏移 5 , 5*4=20 字节, 标志位: 0 18, 窗口 40 29, 检验和 f3 9a, 紧急指针 00 00

三、课程设计总结或结论

经过本次计算机网络课程设计实验, 对课本上的知识有了更深的理解, 将所学运用到了实践中, 在实验过程中, 遇到了一些问题, 经过再次详细阅读课本和上课的笔记, 以及和其他组同学一起讨论, 最终解决了问题。本次实验设计还存在一些未解决的问题, 比如有一台主机在多次尝试中仍不能连接到搭建的网络, 这些问题值得我们在课下在今后的工作中继续去探究。

感谢老师对于本次实验的指导, 感谢小组中的各位队友。