厦門大學

信息学院软件工程系

《计算机网络》实验报告

题　　　目　实验四　CISCO IOS 路由器基本配置

班　　　级　　　软件工程 2019 级 1 班

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实验时间　　　2021 年 4 月 16 日

2021 年 4 月 16 日

填写说明

1、本文件为 Word 模板文件，建议使用 Microsoft Word 2019 打开，在可填写的区域中如实填写；

2、填表时，勿破坏排版，勿修改字体字号，打印成 PDF 文件提交；

3、文件总大小尽量控制在 1MB 以下，勿超过 5MB；

4、应将材料清单上传在代码托管平台上；

5、在学期最后一节课前按要求打包发送至 cni21@qq.com。

1 实验目的

（1）通过完成实验，理解网络层和路由的基本原理。掌握路由器配置网络和组网的方法；

（2）掌握 IP 协议、IP 地址配置和路由的概念；

（3）掌握 IP 协议和路由的基本原理；

（5）了解在模拟器下根据教程配置网络的方法。

2 实验环境

操作系统 Windows10；

实验软件：Router eSIM v1.1 模拟器；

CCNA Network Visualizer 6.0；

思科模拟器 Packet Tracer 7.0。

3 实验结果

3.1 使用 Router eSIM v1.1 模拟器来模拟路由器的配置环境

（1）为路由器取名

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with END.
Router(config)#hostname lab_A
lab_A(config)#banner motd#
```

（2）在路由器内建立一个 IP 地址的映射表

```
lab_A(config)#banner motd #enter text message. end with the character '#' #
lab_A(config)#ip host lab_A 192.5.5.1 205.7.5.1 201.100.11.1
lab_A(config)#ip host lab_B 219.17.100.1 199.6.13.1 201.100.11.2
lab_A(config)#ip host lab_C 223.8.151.1 204.204.7.1 199.6.13.2
lab_A(config)#ip host lab_D 210.93.105.1 204.204.7.2
lab_A(config)#ip host lab_E 210.93.105.2
lab_A(config)#_
```

（3）对各个端口进行配置

```
lab_A(config)#int eth 0
lab_A(config-if)#ip address 192.5.5.1 255.255.255.0
lab_A(config-if)#int eth 1
lab_A(config-if)#ip address 205.7.5.1 255.255.255.0
lab_A(config-if)#int serial 0
lab_A(config-if)#ip address 201.100.11.1 255.255.255.0
lab_A(config-if)#no shutdown
lab_A(config-if)#clock rate 56000
lab_A(config-if)#int eth 0
lab_A(config-if)#no shutdown
lab_A(config-if)#int eth 1
lab_A(config-if)#no shutdown
lab_A(config-if)#end
```

（4）配置使能口令和使能密码（以 123 和 12345 为例）

```
lab_A(config)#enable password 123
lab_A(config)#enable secret 12345
```

（5）路由器 telnet 远程登录设置

```
lab_A(config)#line vty 0
lab_A(config-line)#login
lab_A(config-line)#password 123
```

（6）控制台端口密码

```
Lab_A(config)#line console 0
Lab_A(config-line)#login
Lab_A(config-line)#password 123
Lab_A(config-line)#_
```

（7）查看串口配置情况

```
lab_A#show interface serial 0
Serial0 is up, line protocol is up
   Internet address is 201.100.11.1/24
   Hardware is HD64570
   MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
      reliability 255/255, txload 1/255, rxload 1/255
   Encapsulation HDLC, loopback not set
   Keepalive set (10 sec)
   Last input never, output never, output hang never
   Last clearing of "show interface" counters never
   Input queue: 0/75/0 (size/max/drops); Total output drops: 0
   Queueing strategy: weighted fair
   Output queue: 0/1000/64/0 (size/max total/threshold/drops)
      Conversations  0/0/256 (active/max active/max total)
      Reserved Conversations 0/0 (allocated/max allocated)
   5 minute input rate 0 bits/sec, 0 packets/sec
   5 minute output rate 0 bits/sec, 0 packets/sec
      0 packets input, 0 bytes, 0 no buffer
      Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
      0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
      0 packets output, 0 bytes, 0 underruns
      0 output errors, 0 collisions, 1 interface resets
```
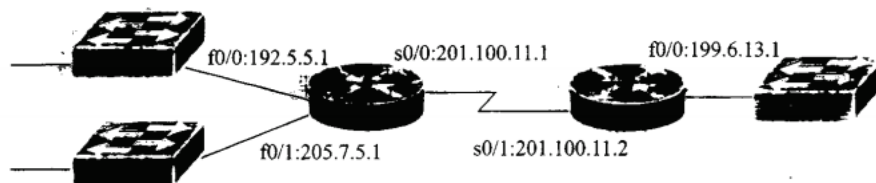
3.2 使用 CCNA Network Visualizer 6.0 配置静态路由
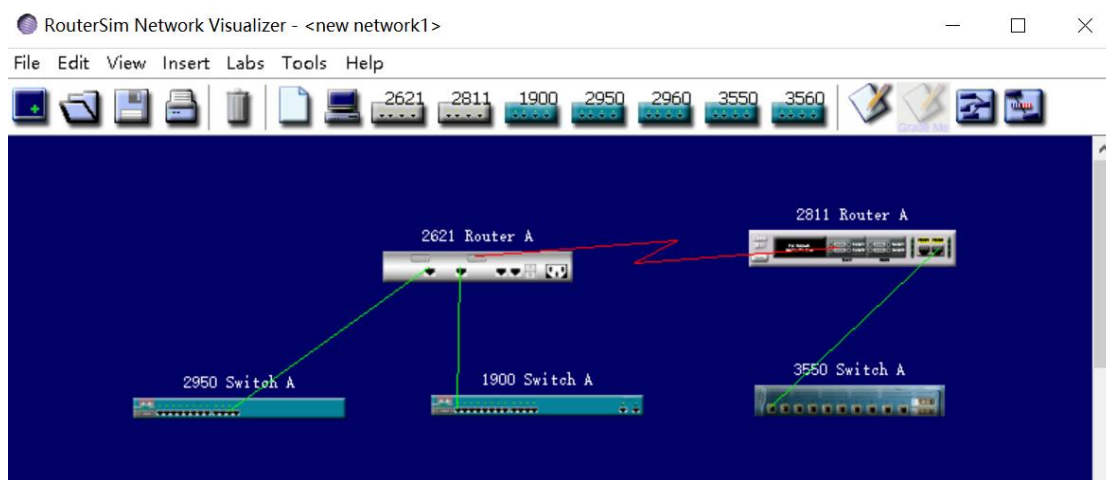
（1）拓扑图

图 5.34　实验用网络拓扑图

（2）配置路由器 routerA 各个端口的 IP 地址

```
Router>enable
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z
Router(config)#int f0/0
Router(config-if)#ip address 192.5.5.1 255.255.255.0
Router(config-if)#no shutdown
12:03:16 %LINK-3-UPDOWN:  Interface FastEthernet0/0, changed state to up
12:03:16 %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#int f0/1
Router(config-if)#ip addr 205.7.5.1 255.255.255.0
Router(config-if)#no shutdown
12:04:11 %LINK-3-UPDOWN:  Interface FastEthernet0/1, changed state to up
12:04:11 %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Router(config-if)#int s0/0
Router(config-if)#ip addr 201.100.11.1 255.255.255.0
Router(config-if)#clock rate 56000
Router(config-if)#no shutdown
12:05:07 %LINK-3-UPDOWN:  Interface Serial0/0, changed state to up
12:05:07 %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0, changed state to up

Router(config-if)#exit
Router(config)#hostname routeA
routeA(config)#exit
routeA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR, P - periodic downloaded static route
       T - traffic engineered route

Gateway of last resort is not set
C    201.100.11.0/24 is directly connected, Serial0/0
C    205.7.5.0/24 is directly connected, FastEthernet0/1
C    192.5.5.0/24 is directly connected, FastEthernet0/0
routeA#
```

3

（3）routerB 的路由表

```
routerB#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR, P - periodic downloaded static route
       T - traffic engineered route

Gateway of last resort is not set
C    201.200.11.0/24 is directly connected, Serial0/1/0
C    199.6.13.0/24 is directly connected, FastEthernet0/0
```

（4）在 routerA 上，ping 命令测试到 routerB 的直连网络 199.6.13.1 是否连通

```
routeA>ping 199.6.13.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 199.6.13.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5), round-trip min/avg/max = 0/0/0 ms
routeA>
```

"success rate is 0 oercent"表明 ping 不通，需要配置静态路由或动态路由。

（5）配置静态路由

```
routeA(config)#ip route 199.6.13.0 255.255.255.0 201.100.11.2
routeA(config)#exit
routeA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR, P - periodic downloaded static route
       T - traffic engineered route

Gateway of last resort is not set
C    205.7.5.0/24 is directly connected, FastEthernet0/1
C    201.100.11.0/24 is directly connected, Serial0/0
C    192.5.5.0/24 is directly connected, FastEthernet0/0
S    199.6.13.0 [1/0] via 201.100.11.2
```

（6）配置默认路由

```
routeA>enable
routeA#config t
Enter configuration commands, one per line.  End with CNTL/Z
routeA(config)#ip classless
routeA(config)#ip route 0.0.0.0 0.0.0.0 201.100.11.2
routeA(config)#exit
routeA#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR, P - periodic downloaded static route
       T - traffic engineered route

Gateway of last resort is 201.100.11.2 to network 0.0.0.0
C    205.7.5.0/24 is directly connected, FastEthernet0/1
S*   0.0.0.0 [1/0] via 201.100.11.2
C    201.100.11.0/24 is directly connected, Serial0/0
C    192.5.5.0/24 is directly connected, FastEthernet0/0
S    199.6.13.0 [1/0] via 201.100.11.2
```

3.3 使用 CCNA Network Visualizer 6.0 配置动态路由

（1）配置 RIP

```
Lab_A(config)#router rip
Lab_A(config-router)#network 10.1.1.1
```

（2）检查路由器 A 中的路由表

```
Lab_A#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate defaul
       U - per-user static route, o - ODR

Gateway of last resort is not set

C    201.100.11.0    /24 is directly connected, Serial0
R    219.17.100.0    /24 [120/1] via 201.100.11.2, 00:00:04, Serial0
C    192.5.5.0       /24 is directly connected, Ethernet0
R    199.6.13.0      /24 [120/1] via 201.100.11.2, 00:00:04, Serial0
C    205.7.5.0       /24 is directly connected, Ethernet1
```
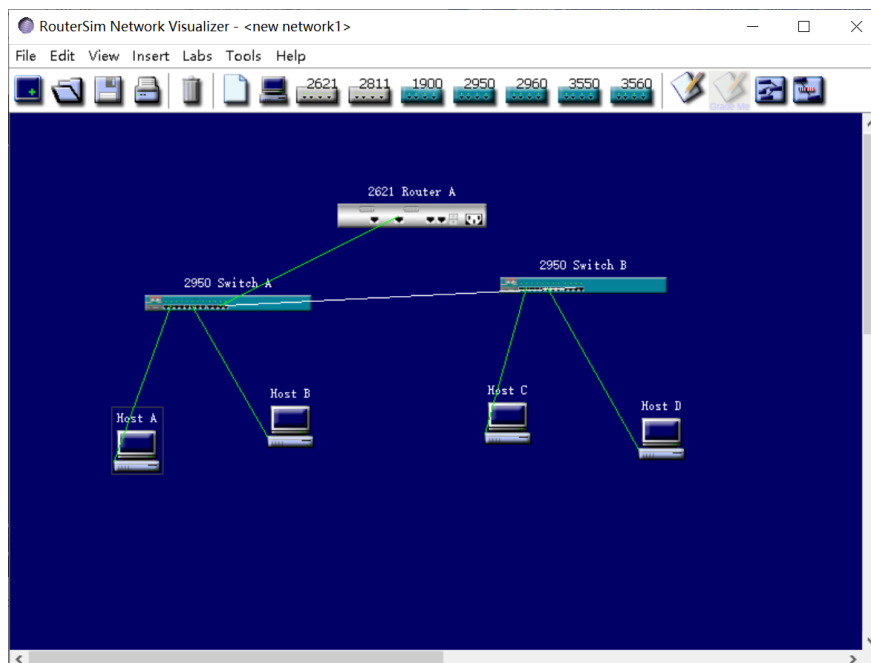
3.4 使用 CCNA Network Visualizer 6.0 配置交换机端口的 VLAN

实现 VLAN 跨越多个交换机及不同 VLAN 之间的通信：

实验拓扑图：

（1）配置 VTP

```
switch#config t
Enter configuration commands, one per line.  End with CNTL/Z
switch(config)#hostname 2950A
2950A(config)#vtp domain Test
Changing VTP domain name from NULL to Test
2950A(config)#vtp mode ?
  client      Set the device to client mode.
  server      Set the device to server mode.
  transparent  Set the device to transparent mode.

2950A(config)#vtp mode server
Device mode already VTP SERVER.
2950A(config)#exit
2950A#show vtp status
VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 64
Number of existing VLANs        : 5
VTP Operating Mode              : Server
VTP Domain Name                 : Test
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x70 0x01 0xF2 0x72 0x97 0xA1 0x35 0xEB
Configuration last modified by: 0.0.0.0 at 11-29-93 20:39:24
Local updater ID is 0.0.0.0 on interface V11 (lowest numbered VLAN interface
found)
2950A#
```

（2）启动 Trunk

【1】在 2950A 设置 Trunk 端口

```
2950A#config t
Enter configuration commands, one per line.  End with CNTL/Z
2950A(config)#interface fa0/12
2950A(config-if)#switchport mode ?
  access   Set trunking mode to ACCESS unconditionally
  dynamic  Set trunking mode to dynamically negotiate access or trunk mode
  trunk    Set trunking mode to TRUNK unconditionally

2950A(config-if)#switchport mode trunk
2950A(config-if)#interface fa0/11
2950A(config-if)#switchport mode trunk
2950A(config-if)#exit
```

【2】在 2950B 设置 Trunk 端口

```
switch>en
switch#config t
Enter configuration commands, one per line.  End with CNTL/Z
switch(config)#hostname 2950B
2950B(config)#interace fa0/12
                      ^
% Invalid input detected at '^' marker.
2950B(config)#interface fa0/12
2950B(config-if)#switchport mode trunk
2950B(config-if)#exit
```

（3）创建 VLAN

```
2950A#vlan database
2950A(vlan)#vlan 2 name vlan2
VLAN 2 added:
      Name: vlan2
2950A(vlan)#vlan 3 name vlan3
VLAN 3 added:
      Name: vlan3
2950A(vlan)#exit
APPLY completed.
Exiting....
```

（4）分配端口到 VLAN

【1】将 2950A 的端口加入 VLAN

```
2950A#config t
Enter configuration commands, one per line.  End with CNTL/Z
2950A(config)#interface f0/2
2950A(config-if)#switchport access vlan 2
2950A(config-if)#switchport mode access
2950A(config-if)#interface f0/6
2950A(config-if)#switchport access vlan 3
2950A(config-if)#switchport mode access
2950A(config-if)#
```

【2】用 show vlan 验证

```
VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    Fa0/1, Fa0/3, Fa0/4, Fa0/5
                                                Fa0/7, Fa0/8, Fa0/9, Fa0/10
2    vlan2                            active    Fa0/2
3    vlan3                            active    Fa0/6
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Transl Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
2    enet  100002     1500  -      -      -        -    -        0      0
3    enet  100003     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0
```

【3】设置 2950B 为 VTP CLIENT 模式

```
2950B(config)#vtp domain Test
Changing VTP domain name from NULL to Test
2950B(config)#vtp mode client
Setting device to VTP CLIENT mode.
```

【4】将 2950B 的端口加入 vlan

```
2950B(config)#interface f0/2
2950B(config-if)#switchport access vlan 2
2950B(config-if)#switchport mode access
2950B(config-if)#interface f0/6
2950B(config-if)#switchport access vlan 3
2950B(config-if)#switchport mode access
```

（5）配置 VLAN 之间的路由

```
Router>en
Router#config t
Enter configuration commands, one per line.  End with CNTL/Z
Router(config)#hostname R2600
R2600(config)#interfacef0/0
                        ^
% Invalid input detected at '^' marker.
R2600(config)#interface f0/0
R2600(config-if)#no ip address
R2600(config-if)#no shut
09:33:56 %LINK-3-UPDOWN:  Interface FastEthernet0/0, changed state to up
09:33:56 %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

R2600(config-if)#interface f0/0.1
R2600(config-subif)#encapsulation dot1q 1
R2600(config-subif)#ip address 172.16.10.1 255.255.255.0
R2600(config-subif)#encapsulation dot1q 2
R2600(config-subif)#interface f0/0.1
R2600(config-subif)#encapsulation dot1q 1
R2600(config-subif)#ip address 172.16.10.1 255.255.255.0
R2600(config-subif)#interface f0/0.2
R2600(config-subif)#encapsulation dot1q 2
R2600(config-subif)#ip address 172.16.20.1 255.255.255.0
R2600(config-subif)#interface f0/0.3
R2600(config-subif)#encapsulation dot1q 3
R2600(config-subif)#ip address 172.16.30.1 255.255.255.0
R2600(config-subif)#exit
R2600(config)#
```

（6）配置主机 HostA、HostB、Hosta、Hostb

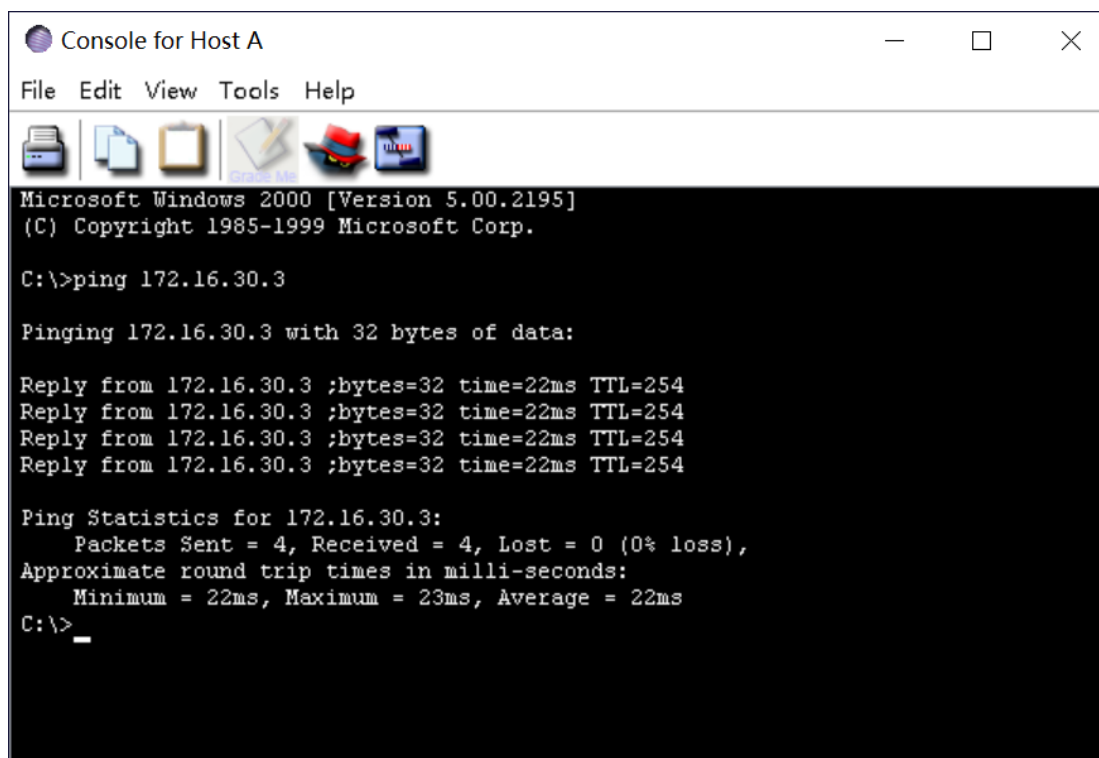（7）验证连通性

在 Host A 上 ping 172.16.20.1 成功

```
C:\>ping 172.16.20.1

Pinging 172.16.20.1 with 32 bytes of data:

Reply from 172.16.20.1 ;bytes=32 time=22ms TTL=254
Reply from 172.16.20.1 ;bytes=32 time=22ms TTL=254
Reply from 172.16.20.1 ;bytes=32 time=22ms TTL=254
Reply from 172.16.20.1 ;bytes=32 time=22ms TTL=254

Ping Statistics for 172.16.20.1:
    Packets Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 22ms, Maximum = 23ms, Average = 22ms
```

在 HostA 上 ping HostB 成功

```
Console for Host A                                    —   □   ×

File  Edit  View  Tools  Help

Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-1999 Microsoft Corp.

C:\>ping 172.16.30.3

Pinging 172.16.30.3 with 32 bytes of data:

Reply from 172.16.30.3 ;bytes=32 time=22ms TTL=254
Reply from 172.16.30.3 ;bytes=32 time=22ms TTL=254
Reply from 172.16.30.3 ;bytes=32 time=22ms TTL=254
Reply from 172.16.30.3 ;bytes=32 time=22ms TTL=254

Ping Statistics for 172.16.30.3:
    Packets Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 22ms, Maximum = 23ms, Average = 22ms
C:\>
```

3.5 使用思科模拟器 Packet Tracer 7.0 配置静态路由，配置各种网络设备组网的综合实验。

命令与 CCNA Network Visualizer 6.0 相同，只是接线方面更加详细。

4 实验代码

本次实验的代码已上传于以下代码仓库：

https://github.com/ikekeer/ComputerNetwork/tree/main/E4_4218

5 实验总结

（1）深入了解路由器的原理：

路由：跨越从源主机到目标主机的一个互联网络来转发数据包的过程，即根据路由表为 IP 包选择路径的过程。

路由表：路由器中维护的路由条目的集合，路由器根据路由表做路径选择。

本次实验中用到的条目：C 直连网段；S 静态路由；S* 默认路由；R 动态路由

（2）路由和交换机的区别：

路由工作在网络层，根据"路由表"转发数据，路由选择、路由转发。

交换机工作在数据链路层，根据"MAC 地址表"转发数据，由硬件转发。

（3）掌握路由器的设置方法：

首先了解路由器的配置模式，路由器的配置都必须先在普通模式进入超级用户模式，然后再进入全局配置模式。

a. 配置静态路由的步骤：

[1] 连线：一般同类产品交叉线，异类产品直通线

[2] 为路由器各个端口配置 IP 地址并启动端口：

    ip address ＜IP 地址＞ ＜子网掩码＞

[3] 设置静态路由表

[4] 测试连通性

[5] 设置静态路由表.

b. 配置动态路由

[1] 启动 RIP 路由：router rip ;

[2] 配置 RIP 的路由 的子网地址：network <子网地址>

c. 配置交换机端口的 VLAN

[1] 核心和分支交换机都配置 VTP

[2] 核心和分支交换机都设置中继 trunk

[3] 在服务器，即核心交换机上设置创建 VLAN

[4] 将分支交换机端口划入 VLAN

[5] 核心交换机配置第三层交换机

[6] 配置各交换机的管理地址

[7] 连接测试

d.服务器和终端的配置

[1] 连线；[2] 为服务器和终端配置 IP；[3] 测试连通性。