

# 网络技术与应用验证性实验四报告

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## 一. 实验内容说明

### 1. 实体环境下互联网组网与路由器配置

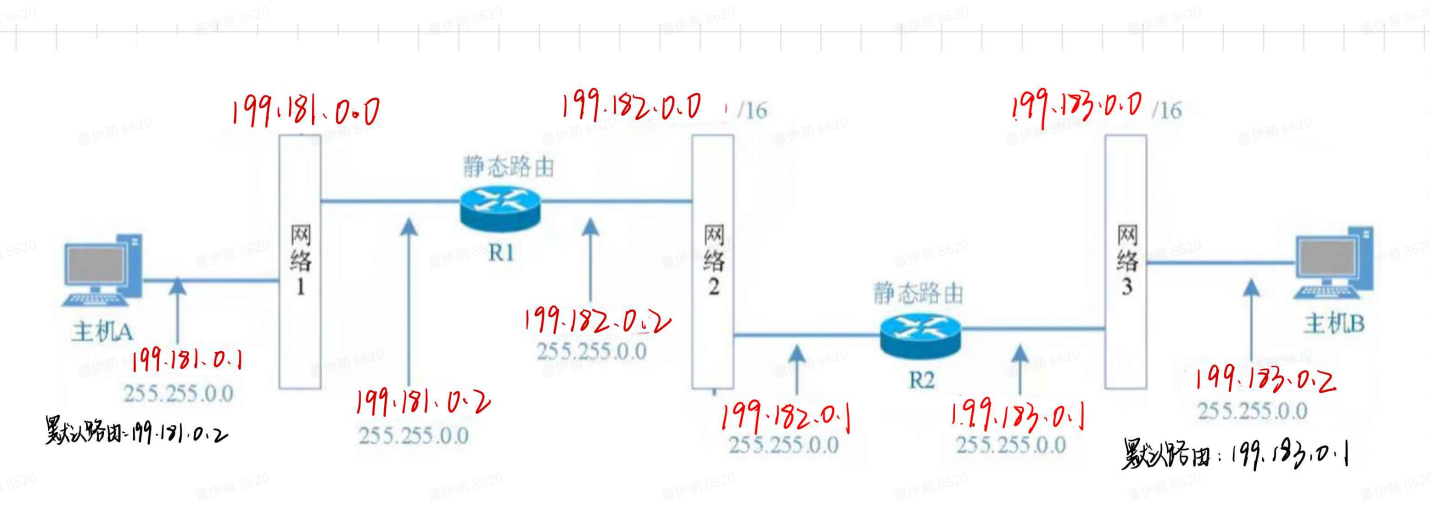
在实体环境下完成互联网组网与路由器配置，要求如下：（1）在机房实验室环境下，通过将局域网划分为不同子网，用多IP主机作为路由器，组建互联网。（2）在命令行方式下，按照静态路由方式，配置路由器和主机，测试互联网的连通性。

### 2. 仿真环境下的互联网组网与路由器配置

在仿真环境下完成互联网组网与路由器配置，要求如下：（1）学习路由器的配置方法和配置命令。（2）参考实体实验，组建由多个路由器组成的互联网。物理网络可以由集线器、交换机构成。（3）按照静态路由方式配置路由器和主机，测试互联网的连通性。（4）利用动态路由方式配置路由器和主机，测试互联网的连通性。（5）在仿真环境的“模拟”方式中观察数据包在互联网中的传递过程，并进行分析。

## 二. 实验准备

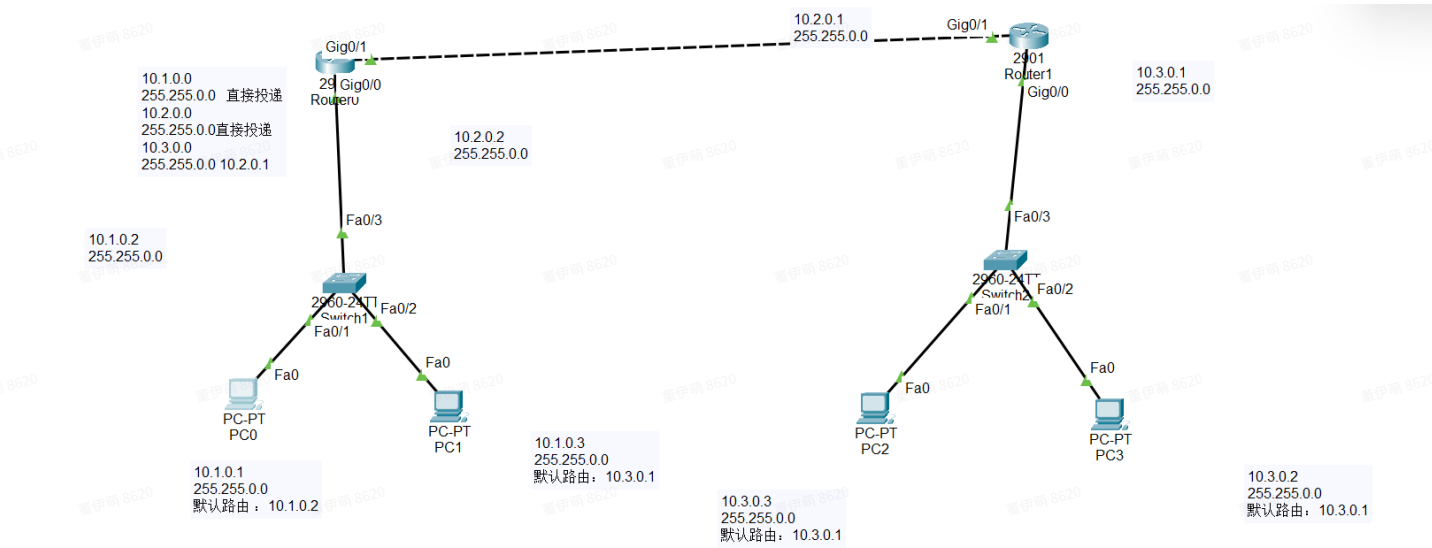
### 1. 真实环境下组网



如上图所示，四台主机分别配置成主机A，静态路由R1，静态路由R2和主机B，具体的IP号和掩码以及默认路由已显示，之后配置时按照此图进行配置。

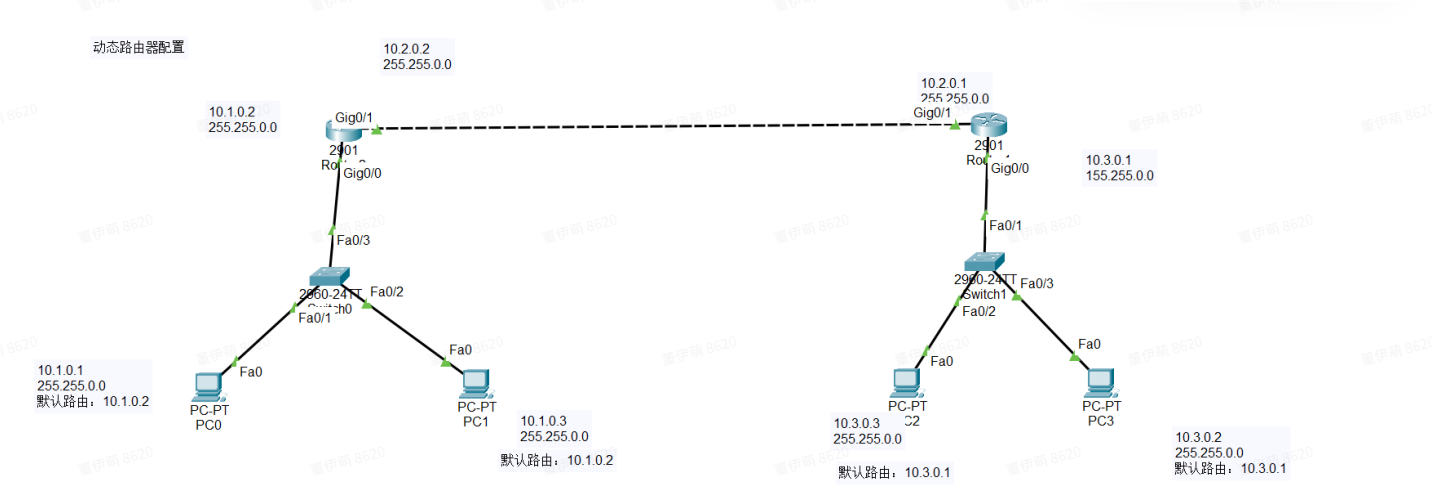
### 2. 仿真环境下网络拓扑图

●静态路由方式：



各设备的IP和掩码如图所示

●动态路由方式：



各设备的IP和掩码如图所示

### 三.实验具体内容

#### 1. 实体环境下互联网组网与路由器配置：

##### (1) 配置主机的 IP 地址和默认路由

按照如上拓扑图给主机 A 和主机 B 设置 IP 地址、子网掩码和默认网关。将默认路由指向各自的路由器。



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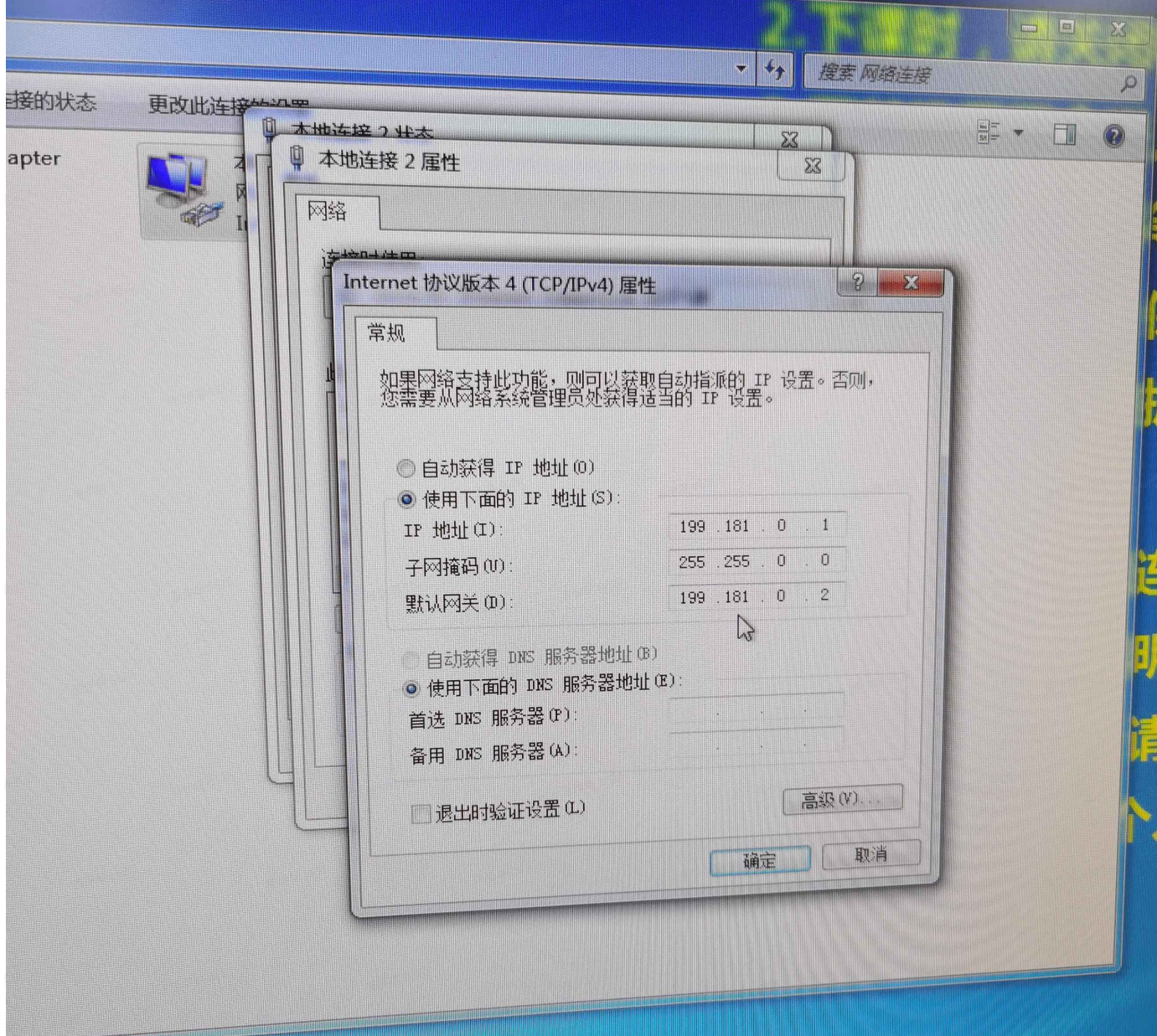
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打开控制面板->网络和共享中心->更改适配器设置->网络状态->属性->Internet协议版本4->属性->进行IP地址配置。



这里展示配置过程中主机A的配置，B的类似，此处不再展示。

## (2) 配置路由设备的 IP 地址

按照上图给静态路由 R1 和 R2 设置 IP 地址，由于路由设备需要连接 2 个或 2 个以上的网络，因此需要设置多个 IP 地址

打开控制面板->网络和共享中心->更改适配器设置->网络状态->属性->Internet 协议版本 4->属性->高级->添加两个 IP 地址

## (3) 配置路由器的静态路由

在命令行程程序中使用如下 route 指令给 R1、R2 增加路由表项

R1: route ADD 199.183.0.0 MASK 255.255.0.0 199.182.0.1

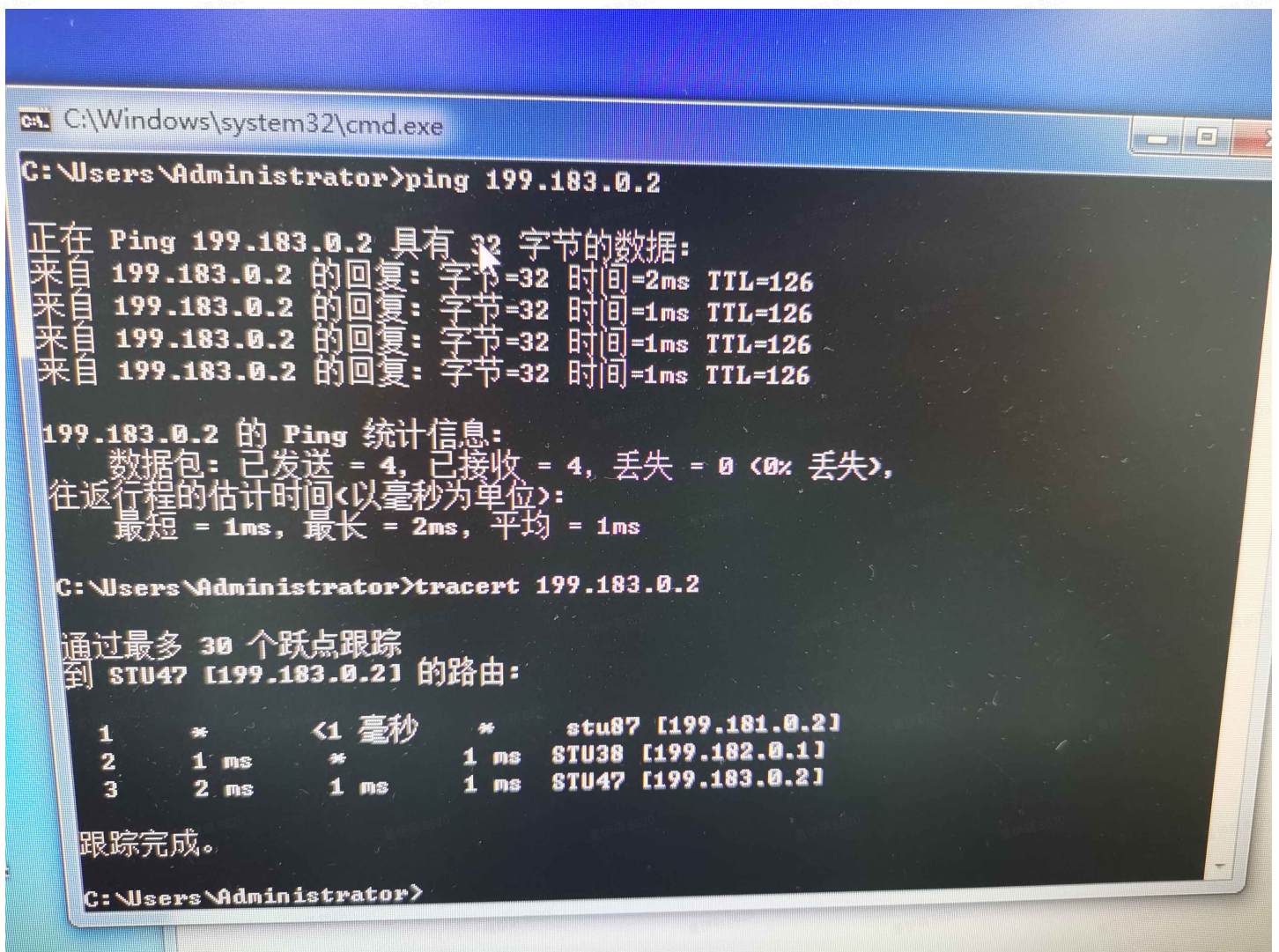
R2: route ADD 199.181.0.0 MASK 255.255.0.0 199.182.0.2

之后利用 route PRINT 查看路由表

## (4) 关闭网络防火墙

## (5) 测试网络连通性

测试网络连通性 用主机 A ping 主机 B 显示成功

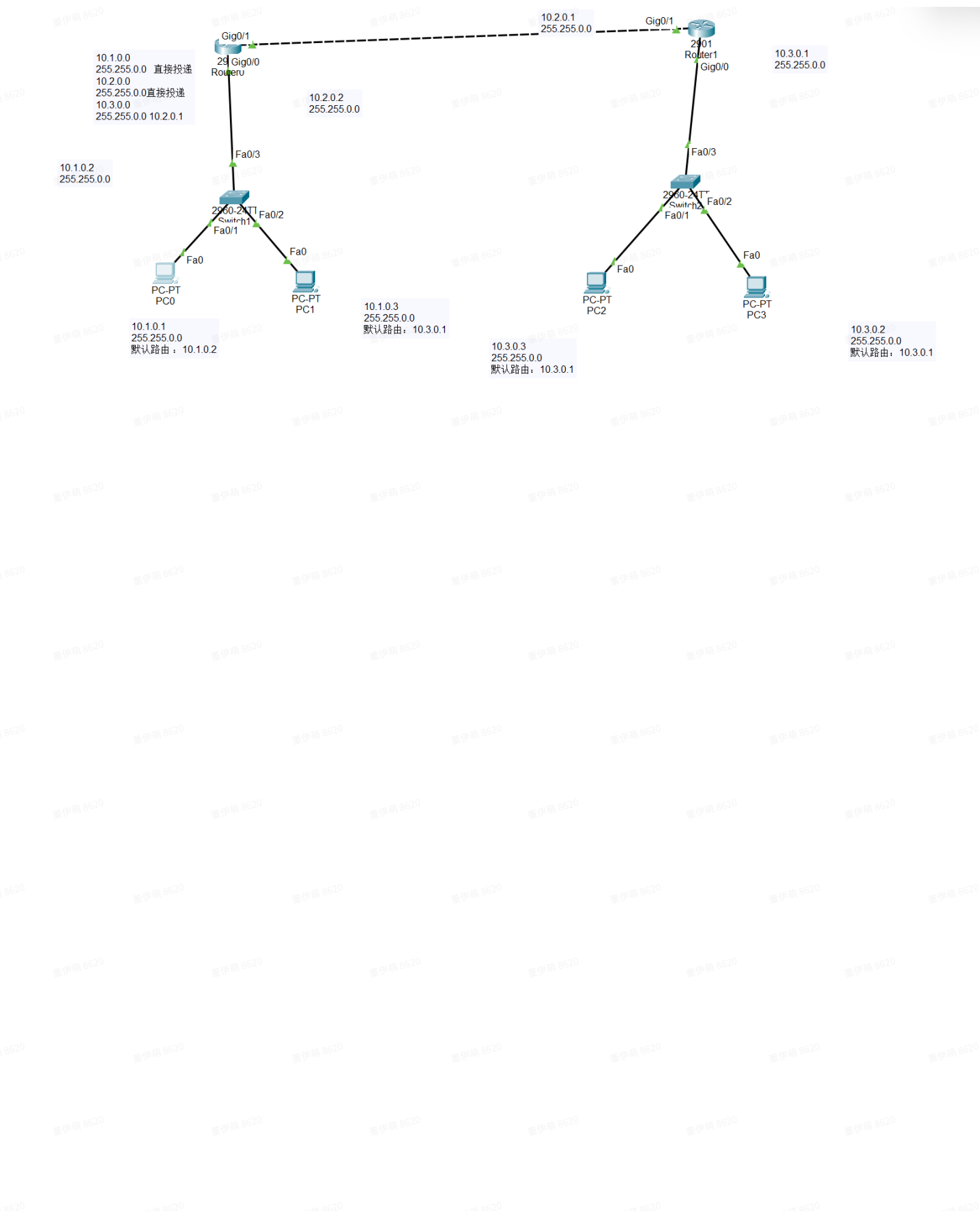


## 2. 仿真环境下的互联网组网与路由器配置：

### (1) 静态路由方式配置路由器和主机

- 配置主机的IP地址和默认路由

按照如上拓扑图给 PC0、PC1、PC2、PC3 设置 IP 地址和默认网关。



## Command Prompt



Cisco Packet Tracer PC Command Line 1.0

C:\>ping

C:\>ping 10.1.0.3

Pinging 10.1.0.3 with 32 bytes of data:

Reply from 10.1.0.3: bytes=32 time<1ms TTL=128

Reply from 10.1.0.3: bytes=32 time<1ms TTL=128

Reply from 10.1.0.3: bytes=32 time<1ms TTL=128

Reply from 10.1.0.3: bytes=32 time<1ms TTL=128

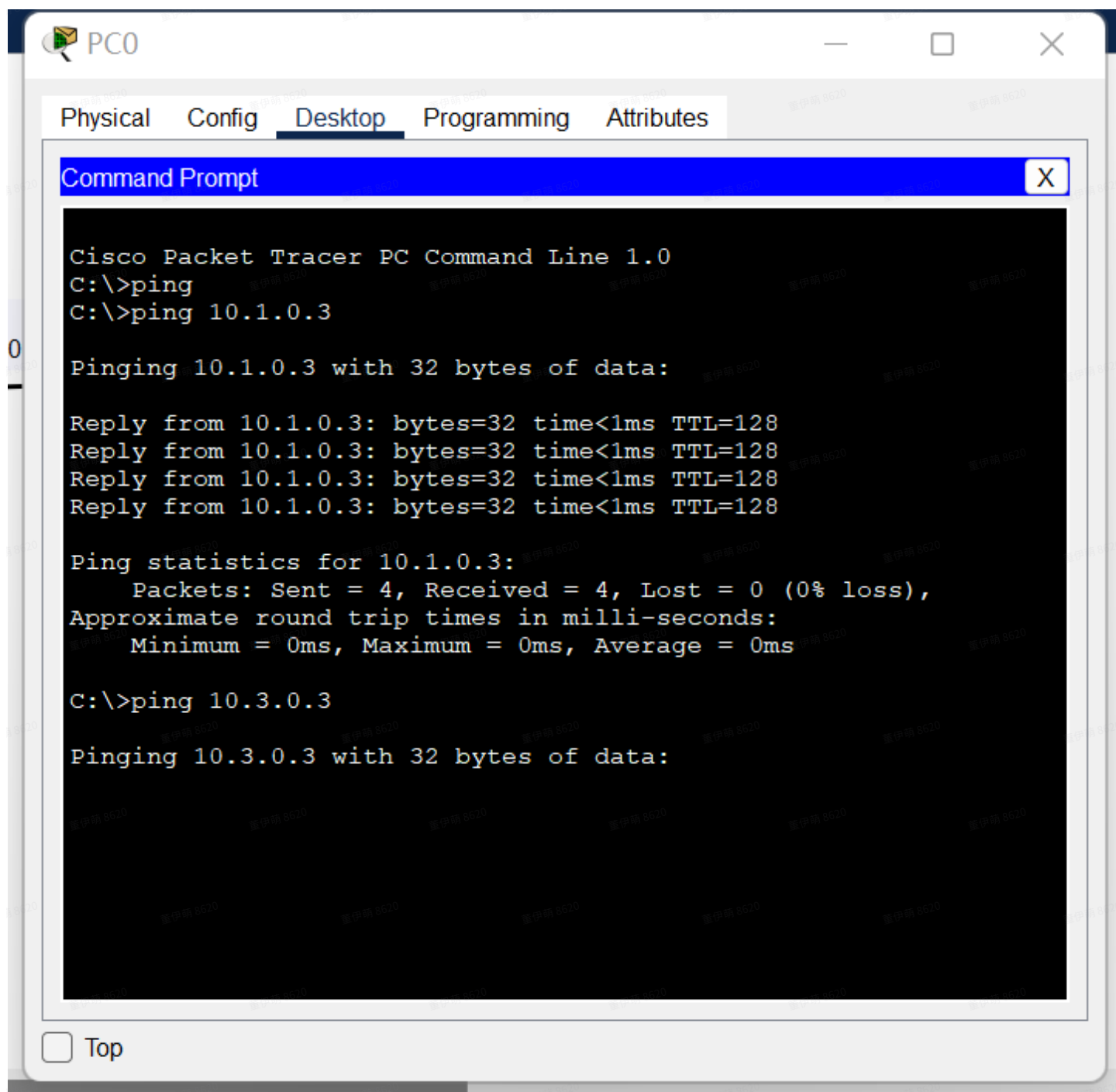
Ping statistics for 10.1.0.3:

Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),

Approximate round trip times in milli-seconds:

Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>



在没有进行路由设备的配置时，只有处于同一交换机下的两台主机才能联通。而跨越交换机的两台主机无法联通。

- 配置路由设备的IP地址

按照上图给静态路由 Router0 和 Router1 设置 IP 地址，由于路由设备需要连接 2 个或 2 个以上的网络，因此需要设置多个 IP 地址。在 CLI 中根据命令进行配置：

Router0:

## IOS Command Line Interface

249856K bytes of ATA System CompactFlash 0 (Read/Write)

Press RETURN to get started!

%LINEPROTO-5-UPDOWN: Line protocol on Interface  
GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface  
GigabitEthernet0/1, changed state to up

Router>enable

Router#config terminal

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

Router(config)#interface gig0/0

Router(config-if)#ip address 10.1.0.2 255.255.0.0

Router(config-if)#no shutdown

Router(config-if)#

Router(config-if)#no shutdown

Router(config-if)#exit

Router(config)#interface gig0/1

Router(config-if)#ip address 10.2.0.2 255.255.0.0

Router(config-if)#no shutdown

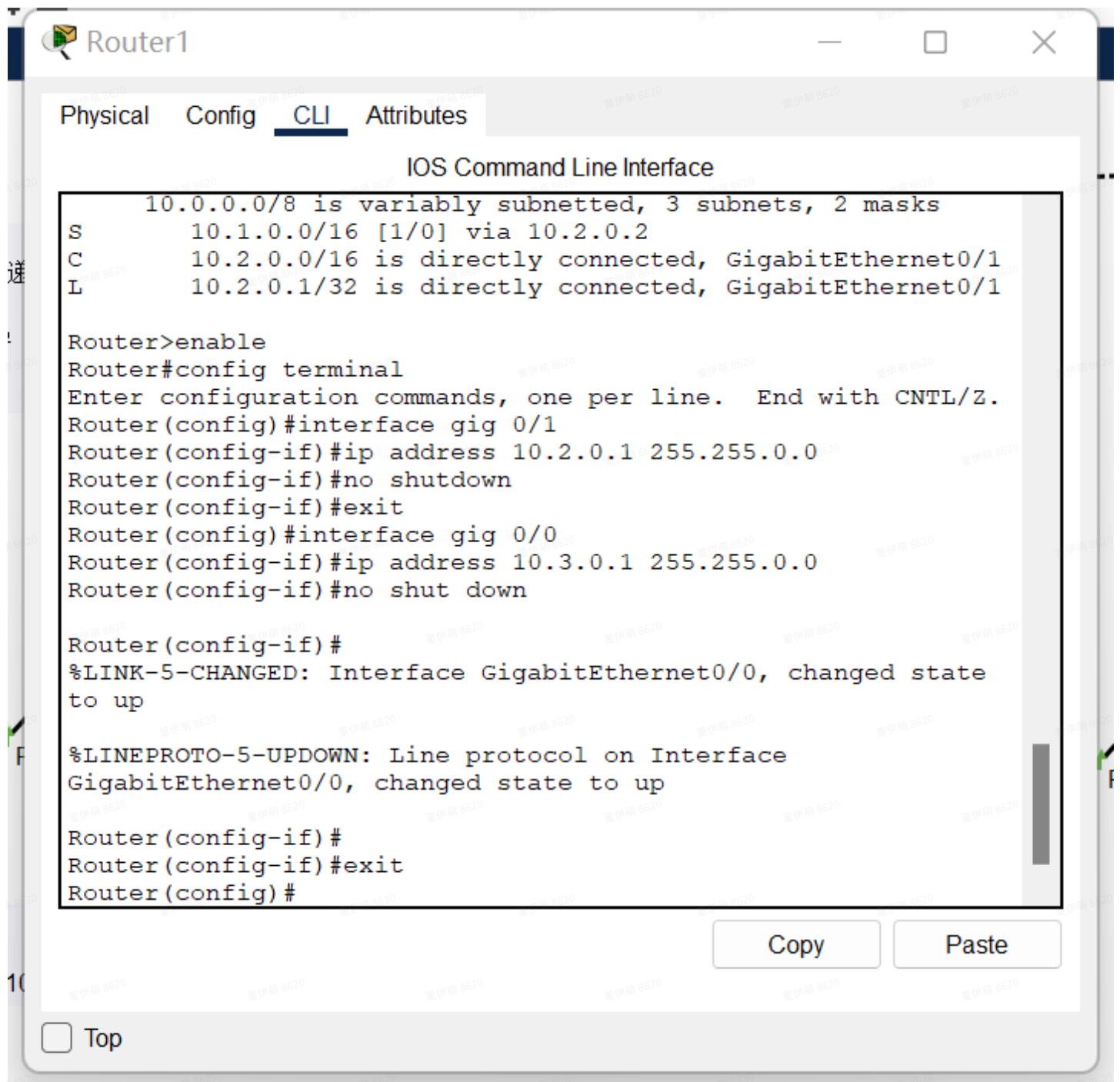
Router(config-if)#exit

Router(config)#

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Router1:





- 配置路由器的静态路由

在全局配置模式下使用如下命令给 Router0、Router1 增加路由表项

R0: ip route 10.3.0.0 255.255.0.0 10.2.0.1

R1: ip route 10.1.0.0 255.255.0.0 10.2.0.2

再退回到特权执行模式，用 show ip route 查看路由表，如下，均添加成功。

R0:



Router0

Physical Config CLI Attributes

## IOS Command Line Interface

```
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#
Router(config)#ip route 10.3.0.0 255.255.0.0 10.2.0.1
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

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

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Router0

PhysicalConfigCLIAttributes

IOS Command Line Interface

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

Gateway of last resort is not set

    10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
C       10.1.0.0/16 is directly connected, GigabitEthernet0/0
L       10.1.0.2/32 is directly connected, GigabitEthernet0/0
C       10.2.0.0/16 is directly connected, GigabitEthernet0/1
L       10.2.0.2/32 is directly connected, GigabitEthernet0/1
S       10.3.0.0/16 [1/0] via 10.2.0.1

Router#
```

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R1:



## IOS Command Line Interface

```
Router(config-if)#ip address 10.3.0.1 255.255.0.0
Router(config-if)#no shut down

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state
to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/0, changed state to up

Router(config-if)#
Router(config-if)#exit
Router(config)#
Router(config)#ip route 10.1.0.0 255.255.0.0 10.2.0.2
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#show ip route
Codes: L - local, C - connected, S - static, 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,
```

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Router1

PhysicalConfigCLIAttributes

IOS Command Line Interface

Router#show ip route

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks

S 10.1.0.0/16 [1/0] via 10.2.0.2

C 10.2.0.0/16 is directly connected, GigabitEthernet0/1

L 10.2.0.1/32 is directly connected, GigabitEthernet0/1

C 10.3.0.0/16 is directly connected, GigabitEthernet0/0

L 10.3.0.1/32 is directly connected, GigabitEthernet0/0

Router#

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- 测试网络连通性

用主机PC0 ping 主机 PC2, PC3, 成功, 则说明网络联通:

```
PC0
Physical Config Desktop Programming Attributes
Command Prompt
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.3.0.3

Pinging 10.3.0.3 with 32 bytes of data:

Reply from 10.3.0.3: bytes=32 time<1ms TTL=126
Reply from 10.3.0.3: bytes=32 time<1ms TTL=126
Reply from 10.3.0.3: bytes=32 time<1ms TTL=126
Reply from 10.3.0.3: bytes=32 time<1ms TTL=126

Ping statistics for 10.3.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
      Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 10.3.0.2

Tracing route to 10.3.0.2 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms   10.1.0.2
  1  0 ms    0 ms    0 ms   10.2.0.1
  2  *        0 ms    0 ms   10.3.0.2

Trace complete.

C:\>
```

```
PC0
Physical Config Desktop Programming Attributes
Command Prompt
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.3.0.3

Pinging 10.3.0.3 with 32 bytes of data:

Reply from 10.3.0.3: bytes=32 time<1ms TTL=126
Reply from 10.3.0.3: bytes=32 time<1ms TTL=126
Reply from 10.3.0.3: bytes=32 time<1ms TTL=126
Reply from 10.3.0.3: bytes=32 time<1ms TTL=126

Ping statistics for 10.3.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
      Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>tracert 10.3.0.2

Tracing route to 10.3.0.2 over a maximum of 30 hops:

  0  0 ms    0 ms    0 ms   10.1.0.2
  1  0 ms    0 ms    0 ms   10.2.0.1
  2  *        0 ms    0 ms   10.3.0.2

Trace complete.

C:\>
```

## (2) 动态路由方式配置路由器和主机

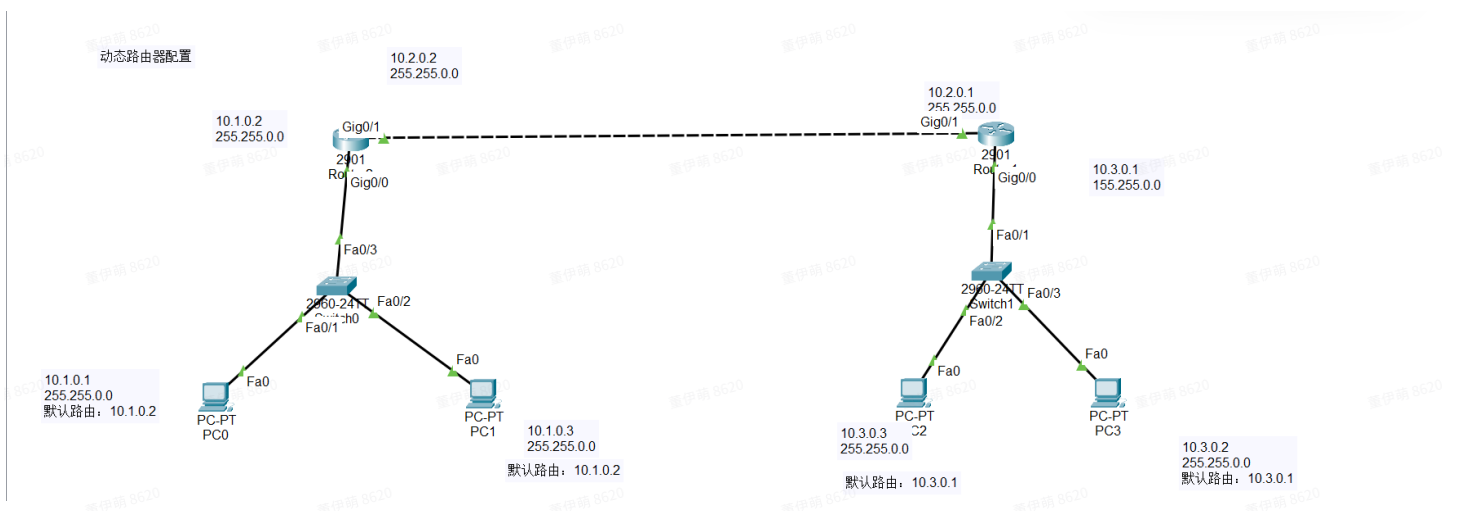
与静态路由不同，动态路由可以通过自身的学习，自动修改和刷新路由表。

在互联网中RIP是一个经常使用的动态路由选择协议，适合在中小型互联网上使用。

- 配置主机的IP地址和默认路由

由于主机PC1、PC2和PC3、PC4分别处于两个物理网中，因此PC1、PC2和PC3、PC4之间的通信需要路由器转发

按照如上拓扑图给 PC0、PC1、PC2、PC3 设置 IP 地址和默认网关。



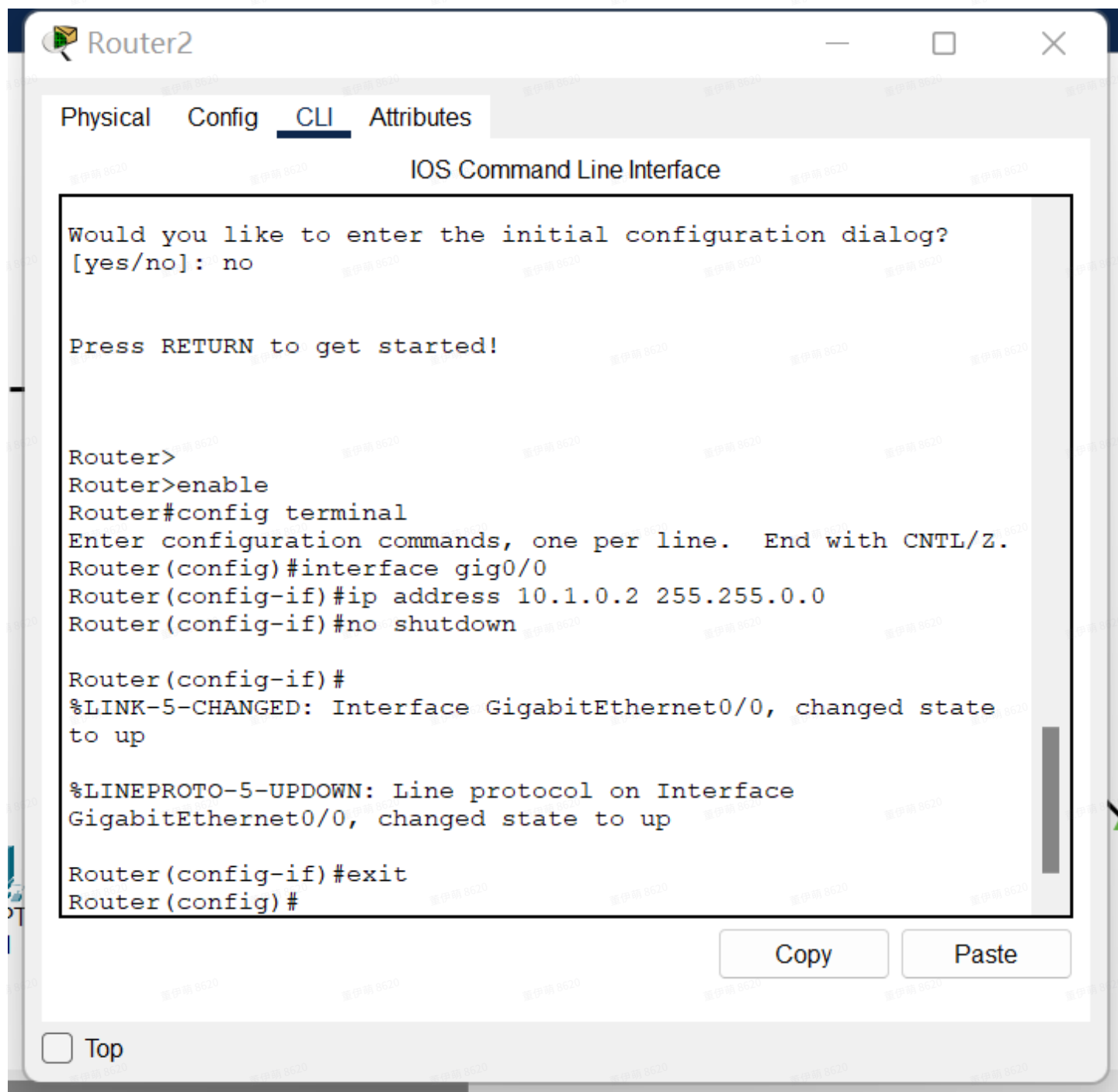
- 配置路由器接口的IP地址

这一部分（在配置路由表步骤前的端口IP分配等）与静态相同

单击需要配置的路由器，在弹出的配置界面选择CLI。使用enable命令进入路由器的特权执行模式，然后使用config terminal进入全局配置模式，通过interface进入特定接口的配置模式。配置路由器的IP



地址的命令为“ip address IP 地址 掩码”，利用命令“no shutdown”保证使用的接口处于激活状态。具体配置命令如下图所示：



## IOS Command Line Interface

```
Router(config-if)#exit
Router(config)#interface gig0/1
Router(config-if)#ip address 10.2.0.2 255.255.0.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state
to up

Router(config-if)#exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/1, changed state to up

Router(config)#
Router(config)#router rip
Router(config-router)#version 2
      ^
% Invalid input detected at '^' marker.

Router(config-router)#version 2
Router(config-router)#network 10.1.0.0
Router(config-router)#network 10.2.0.0
Router(config-router)#exit
Router(config)#
```

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- RIP的配置

RIP的配置需要在全局配置模式下进行。在全局配置模式下运行router rip 命令进入RIP配置模式，利用version2命令通知系统使用的RIP版本为可以处理子网编址的Version2版本。使用network命令说明路由器直接相连的网络，最后使用show ip route命令查看路由器是否获得了正确的路由。

router2:

## IOS Command Line Interface

```
Router(config-if)#exit
Router(config)#interface gig0/1
Router(config-if)#ip address 10.2.0.2 255.255.0.0
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state
to up

Router(config-if)#exit
Router(config)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface
GigabitEthernet0/1, changed state to up

Router(config)#
Router(config)#router rip
Router(config-router)#version 2
      ^
% Invalid input detected at '^' marker.

Router(config-router)#version 2
Router(config-router)#network 10.1.0.0
Router(config-router)#network 10.2.0.0
Router(config-router)#exit
Router(config)#
```

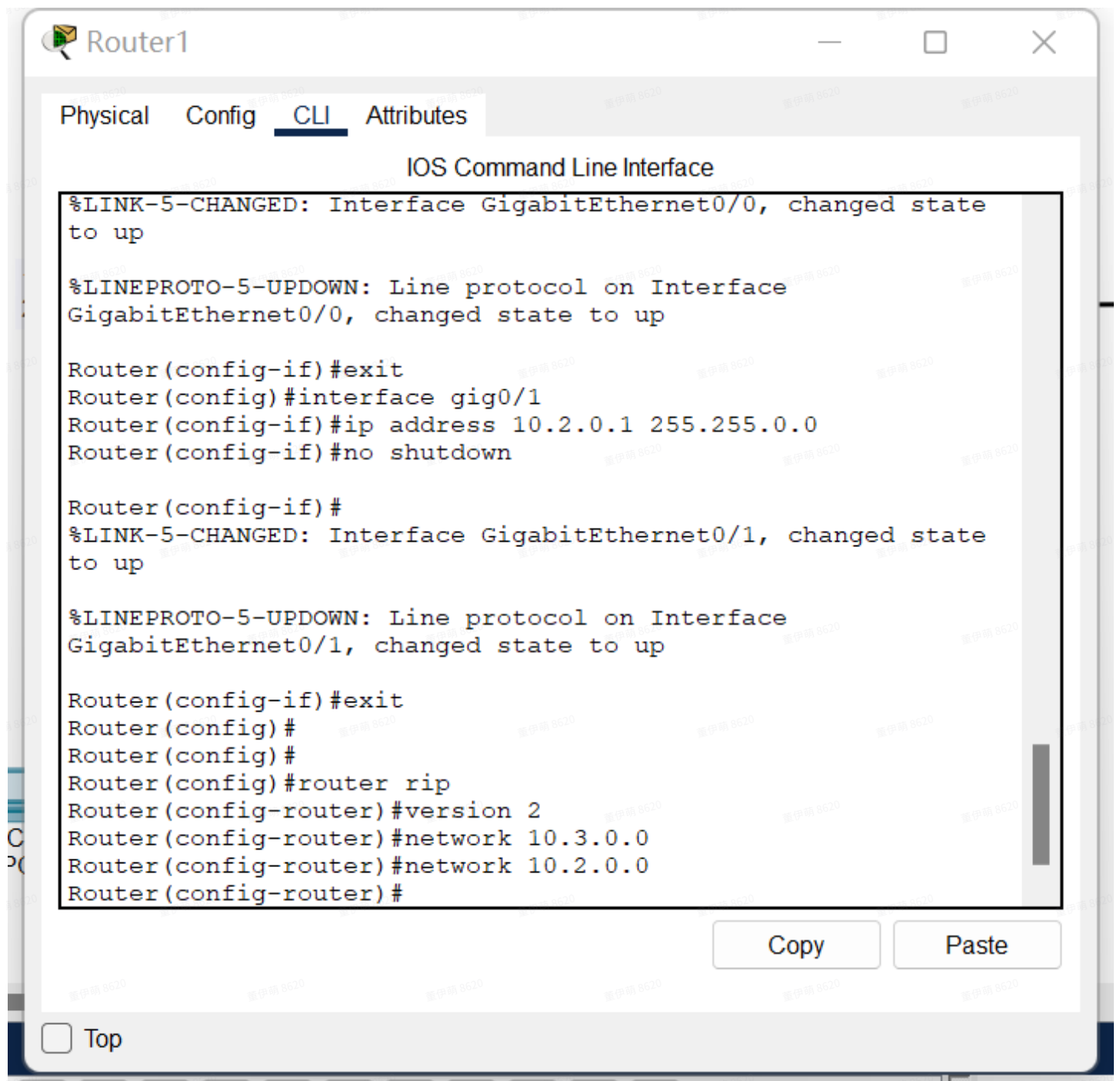
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router1:





查看路由器是否获得了正确的路由：

## IOS Command Line Interface

```
Router(config)#exit
```

```
Router#
```

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

```
Router#
```

```
Router#
```

```
Router#
```

```
Router#show ip route
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
```

```
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
```

```
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
```

```
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
```

```
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
```

```
* - candidate default, U - per-user static route, o - ODR
```

```
P - periodic downloaded static route
```

```
Gateway of last resort is not set
```

```
10.0.0.0/8 is variably subnetted, 5 subnets, 2 masks
```

```
C 10.1.0.0/16 is directly connected, GigabitEthernet0/0
```

```
L 10.1.0.2/32 is directly connected, GigabitEthernet0/0
```

```
C 10.2.0.0/16 is directly connected, GigabitEthernet0/1
```

```
L 10.2.0.2/32 is directly connected, GigabitEthernet0/1
```

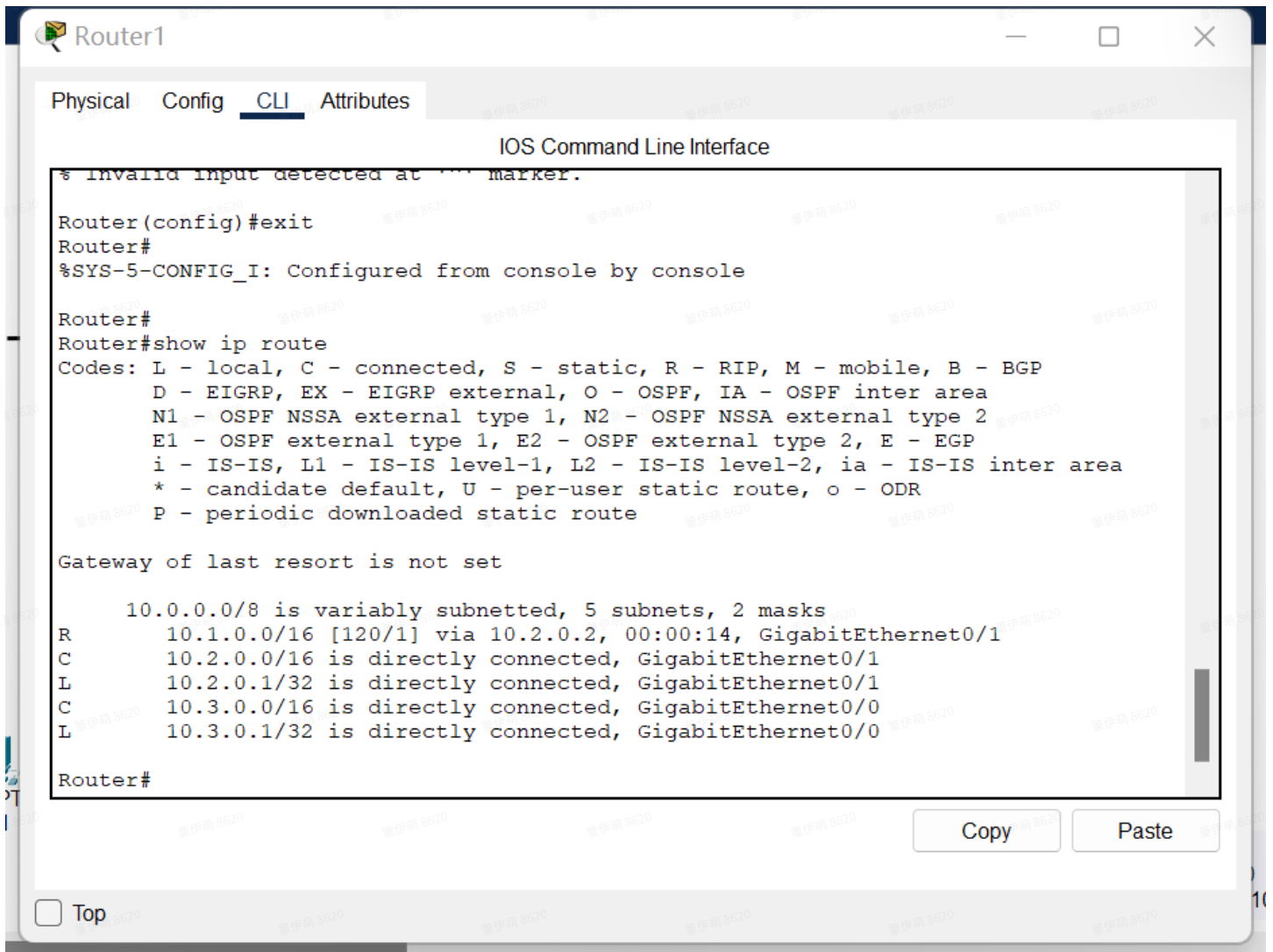
```
R 10.3.0.0/16 [120/1] via 10.2.0.1, 00:00:28, GigabitEthernet0/1
```

```
Router#
```

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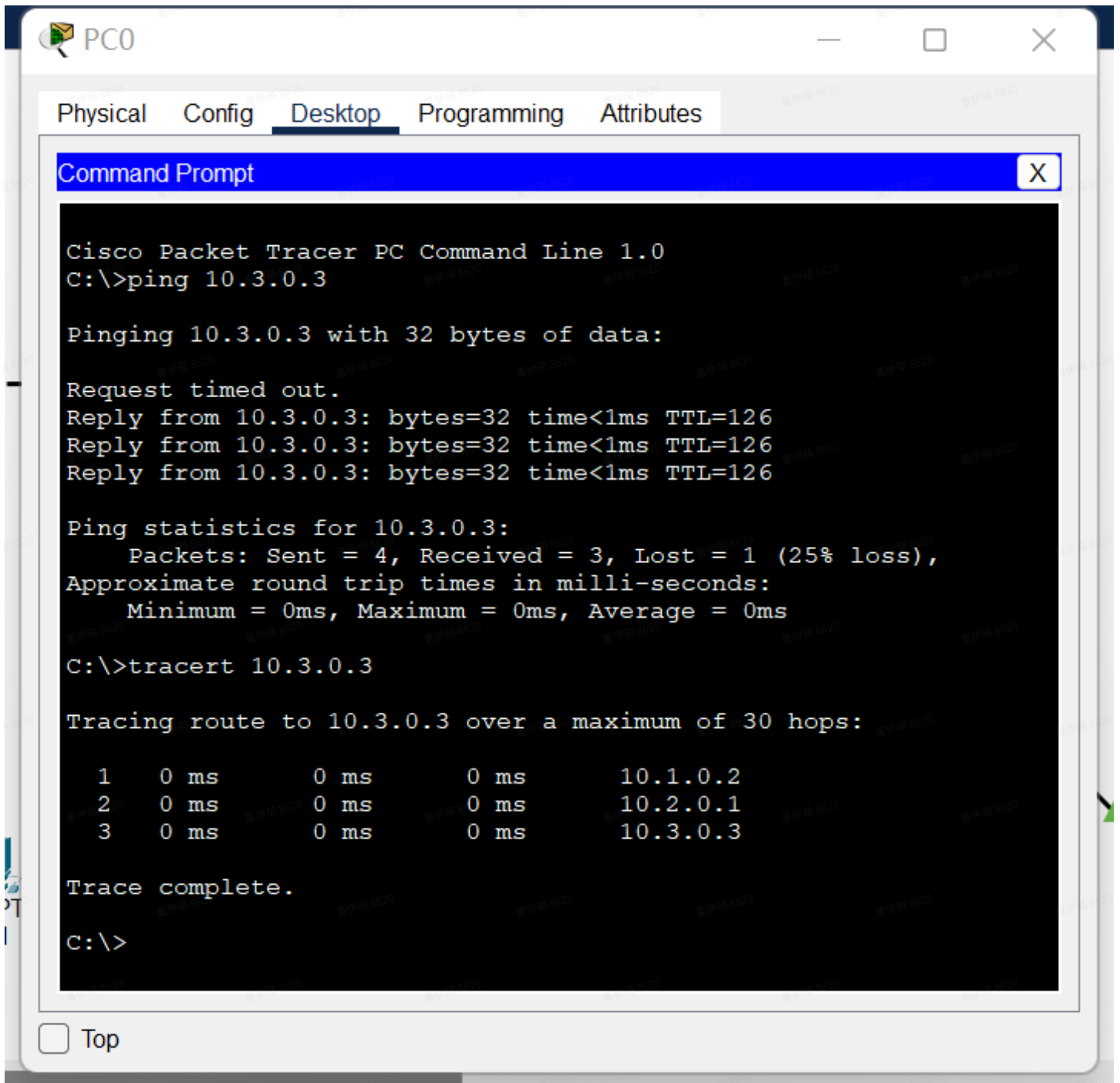
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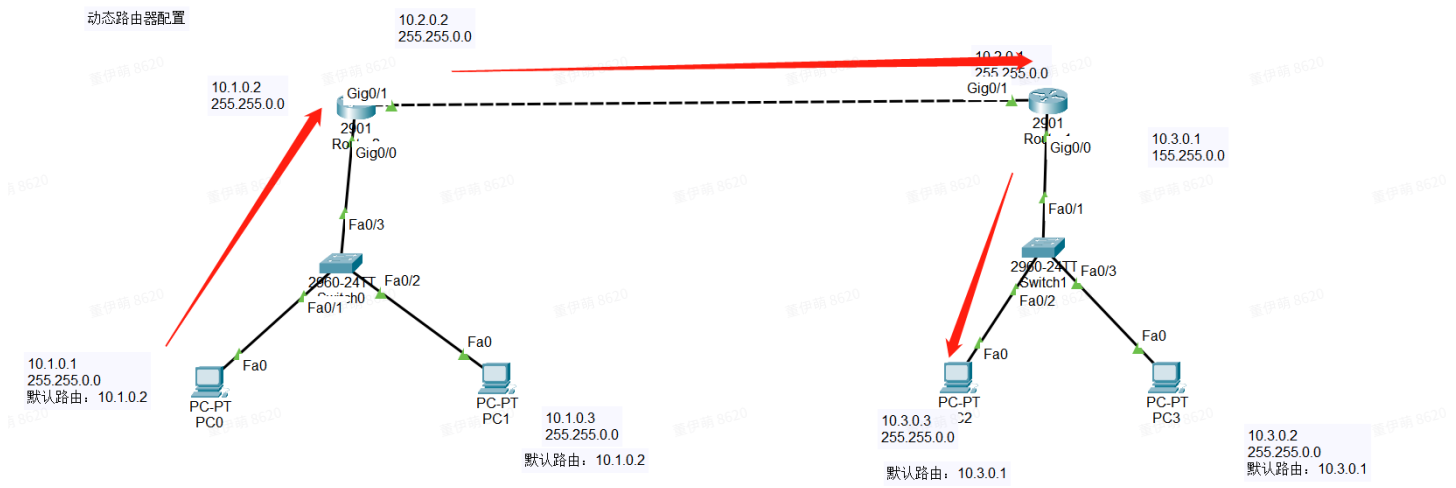
- 测试网络连通性

利用拓扑图中的利用PC0连接PC2，如下图所示，可以连通





并且可以知道选择的路径为由IP地址为10.1.0.2的Router2接口到IP地址为10.2.0.1的Router1接口，最后到达IP地址为10.3.0.3的PC2。



接着观察数据包在互联网中的传递过程，并进行分析：

在配置好的动态路由中点击模拟模式，查看数据包传递过程如下

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	PC0	ICMP
	0.001	PC0	Switch0	ICMP
	0.002	Switch0	Router2	ICMP
	0.003	Router2	Router1	ICMP
	0.004	Router1	Switch1	ICMP
Visible	0.005	Switch1	PC2	ICMP

Reset Simulation ☒ Constant Delay

Captured to: 0.005 s

Play Controls

Event List Filters - Visible Events

ACL Filter, ARP, BGP, Bluetooth, CAPWAP, CDP, DHCP, DHCPv6, DNS, DTP, EAPOL, EIGRP, EIGRPv6, FTP, H.323, HSRP, HSRPv6, HTTP, HTTPS, ICMP, ICMPv6, IPsec, ISAKMP, IoT, IoT TCP, LACP, LLDP, NDP, NETFLOW, NTP, OSPF, OSPFv6, PaGP, POP3, PPP, PPPoE, PTP, RADIUS, REP, RIP, RIPng, RTP, SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP, Telnet, UDP, USB, VTP

Edit Filters Show All/None

可以看到传递路径确实为PC0->router1->router0->PC2

接着查看捕获到的PC3中的数据包，可以看到发送地址为10.1.0.1即PC0的IP地址，接收地址为10.3.0.3即PC3的IP地址

PDU Information at Device: PC2

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: PC2

Source: PC0

Destination: 10.3.0.3

In Layers

Layer7

Layer6

Layer5

Layer4

Layer 3: IP Header Src. IP: 10.1.0.1, Dest. IP: 10.3.0.3 ICMP Message Type: 8

Layer 2: Ethernet II Header 000C.CFAD.7101 >> 0060.7044.3917

Layer 1: Port FastEthernet0

Out Layers

Layer7

Layer6

Layer5

Layer4

Layer 3: IP Header Src. IP: 10.3.0.3, Dest. IP: 10.1.0.1 ICMP Message Type: 0

Layer 2: Ethernet II Header 0060.7044.3917 >> 000C.CFAD.7101

Layer 1: Port(s): FastEthernet0

1. FastEthernet0 receives the frame.

Challenge Me

<< Previous Layer

Next Layer >>

## 四. 总结与反思

本次实验完成了实体环境下的互联网组网与路由器配置，学习了尸体环境下局域网划分子网的方法，以及静态路由配置路由器和主机的方法。在仿真环境下分别完成了静态路由方式和动态路由方式配置路由器和主机的区别，真实的感受到了静态路由和动态路由的不同特点，了解了RIP的配置方法。收获很大！