

网络技术与应用验证性（第六次）实验报告

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一. 实验内容说明

1. 仿真环境下的NAT服务器配置

在仿真环境下完成NAT服务器的配置实验，要求如下：（1）学习路由器的NAT配置过程。（2）组建由NAT连接的内网和外网。（3）测试网络的连通性，观察网络地址映射表。（4）在仿真环境的“模拟”方式中观察IP数据报在互联网中的传递过程，并对IP数据报的地址进行分析。

2. 在仿真环境下完成如下实验

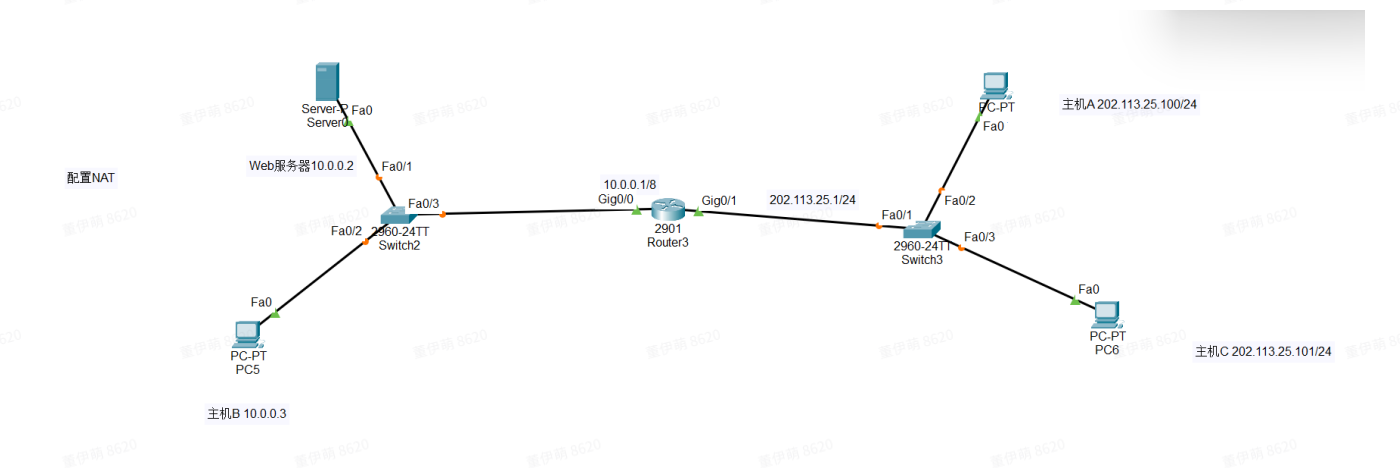
将内部网络中放置一台Web服务器，请设置NAT服务器，使外部主机能够顺利使用该Web服务。

二. 实验准备

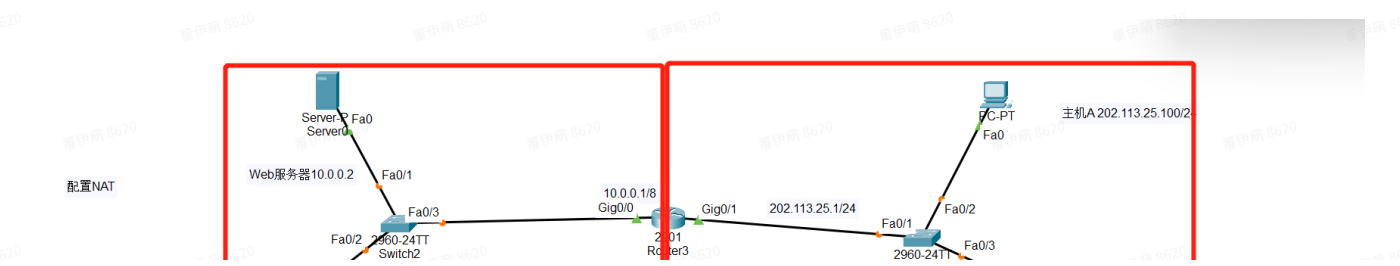
关于NAT：

NAT英文全称是“Network Address Translation”，中文意思是“网络地址转换”，它是一个IETF(Internet Engineering Task Force, Internet工程任务组)标准，允许一个整体机构以一个公用IP（Internet Protocol）地址出现在Internet上。顾名思义，它是一种把内部私有网络地址（IP地址）翻译成合法网络IP地址的技术。

网络拓扑图：



按照上图连接网络，内网和外网的划分如下：



Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface gig0/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#no shutdown

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)#

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Scenario 0

Fire

Last Status

Source

Destination

Router3

Physical Config CLI Attributes

IOS Command Line Interface

```
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)#exit  
Router(config)#  
Router(config)#  
Router(config)#  
Router(config)#  
Router(config)#interface gig0/1  
Router(config-if)#ip address 202.113.25.1 255.255.255.0  
Router(config-if)#no shutdown
```

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

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3. 建立一个记录nat使用的全局ip地址的地址池，使用的命令为 `Ip nat pool myNATPool 202.113.25.1 202.133.25.10 netmask 255.255.255.0`
4. 建立标准访问控制列表，在该列表中的ip地址nat就会进行转换，使用命令为： `access-list 6 permit 10.0.0.0 0.255.255.255`
5. 将使用的地址池与访问的控制列表进行关联，使用的命令为 `Ip nat inside source list 6 pool myNATPool overload`

Router3

Physical Config CLI Attributes

IOS Command Line Interface

```
Router(config)#
Router(config)#
Router(config)#interface gig0/1
Router(config-if)#ip address 202.113.25.1 255.255.255.0
Router(config-if)#no shutdown

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

```
Router(config-if)#exit
Router(config)#ip nat pool myNATPool 202.113.25.1 202.113.25.10 netmask 255.255.255.0
Router(config)#
Router(config)#access-list 6 permit 10.0.0.0 0.255.255.255
Router(config)#
Router(config)#ip nat inside source list 6 pool myNATPool
Router(config)#ip nat inside source list 6 pool myNATPool overload
Router(config)#interface gig0/0
Router(config-if)#ip nat inside
Router(config-if)#exit
Router(config)#interface gig0/1
Router(config-if)#ip nat outside
Router(config-if)#exit
Router(config)#
```

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6. 指定连接内部网络和外部网络的接口，在指定的接口下使用ip nat inside 和 ip nat outside(按照拓扑图所示，左侧为内网，右侧为外网)

Router3

Physical Config CLI Attributes

IOS Command Line Interface

```
Router(config)#
Router(config)#
Router(config)#interface gig0/1
Router(config-if)#ip address 202.113.25.1 255.255.255.0
Router(config-if)#no shutdown

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

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

Router(config-if)#
Router(config-if)#exit
Router(config)#ip nat pool myNATPool 202.113.25.1 202.113.25.10 netmask 255.255.255.0
Router(config)#
Router(config)#access-list 6 permit 10.0.0.0 0.255.255.255
Router(config)#
Router(config)#ip nat inside source list 6 pool myNATPool
Router(config)#ip nat inside source list 6 pool myNATPool overload
Router(config)#interface gig0/0
Router(config-if)#ip nat inside
Router(config-if)#exit
Router(config)#interface gig0/1
Router(config-if)#ip nat outside
Router(config-if)#exit
Router(config)#
```

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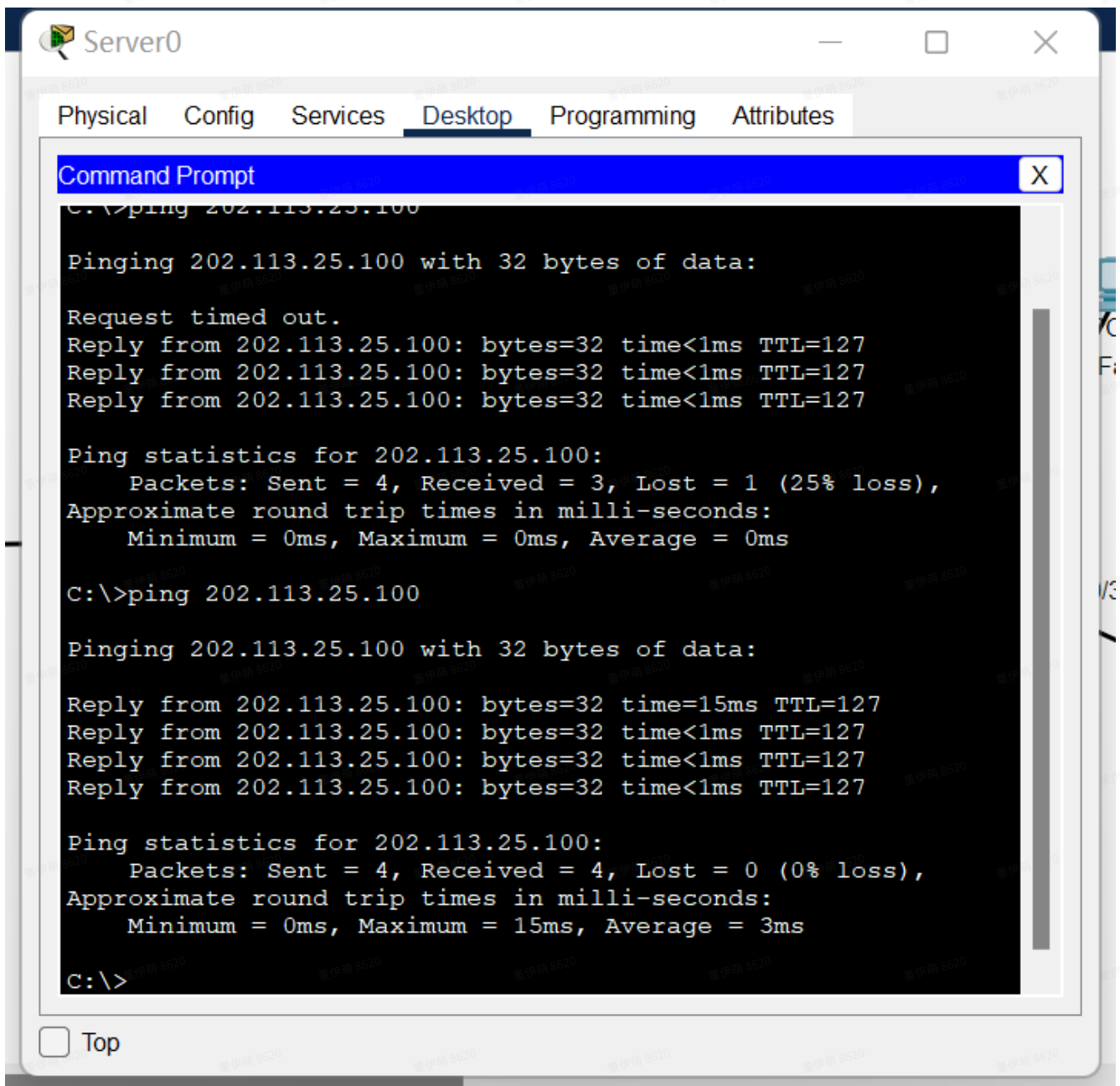
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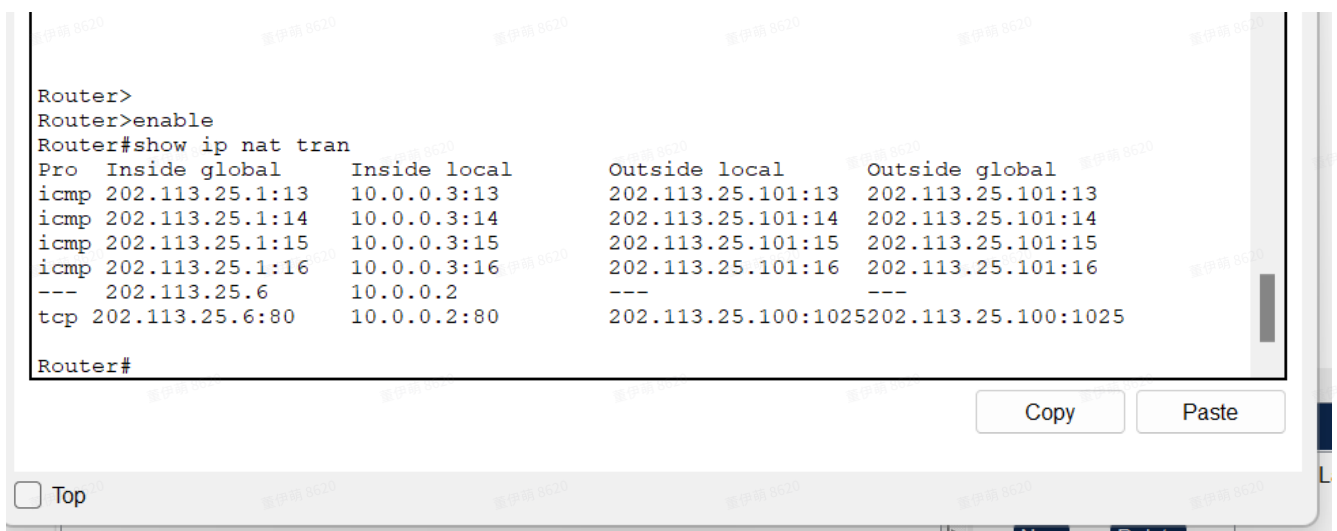
Delete

· 测试网络的连通性，观察网络地址映射表

用主机B连主机C，结果如下图所示：



可以成功连通，网络性能良好，接下来使用命令 `show ip nat statistics` 和 `show ip nat translations` 来查看此时的nat相关配置和网络地址映射表



通过该命令查看到了转换项，查看转发信息，可知PC5的inside global 地址为202.113.25.1

```
Router#show ip nat statistics
Total translations: 1 (1 static, 0 dynamic, 0 extended)
Outside Interfaces: GigabitEthernet0/1
Inside Interfaces: GigabitEthernet0/0
Hits: 7 Misses: 8
Expired translations: 8
Dynamic mappings:
-- Inside Source
access-list 6 pool myNATPool refCount 0
pool myNATPool: netmask 255.255.255.0
start 202.113.25.1 end 202.113.25.10
type generic, total addresses 10 , allocated 0 (0%), misses 0
```

查看NAT统计数据和规则，包括inside和outside接口，以及建立的记录nat使用的全局ip地址的地址池myNATPool的相关信息。

- 在仿真环境的“模拟”方式中观察IP数据报在互联网中的传递过程，并对IP数据报的地址进行分析。

PC5 ping PC6的过程中，通过仿真分析如下：

Simulation Panel

Event List

Vis.	Time(sec)	Last Device	At Device	Type
	0.000	--	PC5	ICMP
	0.001	PC5	Switch2	ICMP
	0.002	Switch2	Router3	ICMP
	0.003	Router3	Switch3	ICMP
	0.004	Switch3	PC4	ICMP
	0.004	Switch3	PC6	ICMP
	0.005	PC6	Switch3	ICMP
	0.006	Switch3	Router3	ICMP
	0.007	Router3	Switch2	ICMP
Visible	0.008	Switch2	PC5	ICMP

Reset Simulation

☒ Constant Delay

Captured to: 0.008 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, PPPoED, PTP, RADIUS, REP, RIP, RIPng, RTP, SCCP, SMTP, SNMP, SSH, STP, SYSLOG, TACACS, TCP, TFTP, Telnet, UDP, USB, VTP

Edit Filters

Show All/None

可以看到数据包传输的路径为PC5->Switch2->Router3->PC6到达目的地后又回送数据包PC6->Router3->Switch2->PC5

在数据的传输过程中，查看数据包的封装，查看信封中的内容，刚开始传输时，即在PC5处，数据包如下：

PDU Information at Device: Switch2

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: Switch2
Source: PC5
Destination: 202.113.25.101

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer3	Layer3
Layer 2: Ethernet II Header 0030.F2CB.28B4 >> 0009.7C81.ED01	Layer 2: Ethernet II Header 0030.F2CB.28B4 >> 0009.7C81.ED01
Layer 1: Port FastEthernet0/2	Layer 1: Port(s): FastEthernet0/3

1. FastEthernet0/2 receives the frame.

[Challenge Me](#) [<< Previous Layer](#) [Next Layer >>](#)

标明了源地址和目的地址，查看数据包传送到路由器时的变化：

PDU Information at Device: Router3

OSI Model Inbound PDU Details Outbound PDU Details

At Device: Router3
Source: PC5
Destination: 202.113.25.101

In Layers	Out Layers
Layer7	Layer7
Layer6	Layer6
Layer5	Layer5
Layer4	Layer4
Layer 3: IP Header Src. IP: 10.0.0.3, Dest. IP: 202.113.25.101 ICMP Message Type: 8	Layer 3: IP Header Src. IP: 202.113.25.1, Dest. IP: 202.113.25.101 ICMP Message Type: 8
Layer 2: Ethernet II Header 0030.F2CB.28B4 >> 0009.7C81.ED01	Layer 2: Ethernet II Header 0009.7C81.ED02 >> 000C.8564.6449
Layer 1: Port GigabitEthernet0/0	Layer 1: Port(s): GigabitEthernet0/1

1. GigabitEthernet0/0 receives the frame.

Challenge Me

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Next Layer >>

可以看到路由器根据NAT转换表在网络层将数据包的源地址由10.0.0.3转换为了202.113.25.1从而后续可以继续传输，下面是最后传送到PC6时的数据包显示

PDU Information at Device: Switch3

OSI Model

Inbound PDU Details

Outbound PDU Details

At Device: Switch3

Source: PC5

Destination: 202.113.25.101

In Layers

Layer7

Layer6

Layer5

Layer4

Layer3

Layer 2: Ethernet II Header

0009 7C81 FD02 >> 000C 8564 6449

Out Layers

Layer7

Layer6

Layer5

Layer4

Layer3

Layer 2: Ethernet II Header

0009 7C81 FD02 >> 000C 8564 6449

0009.7C81.EB02 >> 000C.6504.0449

Layer 1: Port FastEthernet0/1

1. FastEthernet0/1 receives the frame.

Challenge Me

0009.7C81.EB02 >> 000C.6504.0449

**Layer 1: Port(s): FastEthernet0/2
FastEthernet0/3**

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在数据包返回经过路由器时，路由器根据NAT转换表在网络层将数据包的目的地址由202.113.25.1转化成了10.0.0.3从而后续继续传输

PDU Information at Device: Router3

OSI Model
Inbound PDU Details
Outbound PDU Details

At Device: Router3
Source: PC5
Destination: 202.113.25.101

In Layers

Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 202.113.25.101, Dest. IP: 202.113.25.1 ICMP Message Type: 0
Layer 2: Ethernet II Header 000C.8564.6449 >> 0009.7C81.EB02

Out Layers

Layer7
Layer6
Layer5
Layer4
Layer 3: IP Header Src. IP: 202.113.25.101, Dest. IP: 10.0.0.3 ICMP Message Type: 0
Layer 2: Ethernet II Header 0009.7C81.EB01 >> 0030.F2CB.28B4

0004.0443 / 0005.7C01.EB02

Layer 1: Port GigabitEthernet0/1

0005.7C01.EB01 / 0006.1200.2004

Layer 1: Port(s): GigabitEthernet0/0

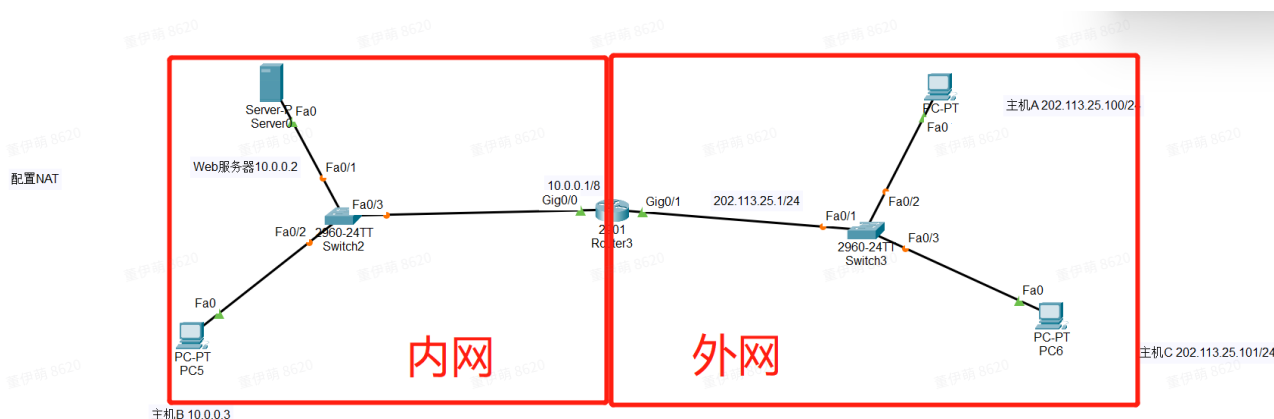
1. GigabitEthernet0/1 receives the frame.

Challenge Me

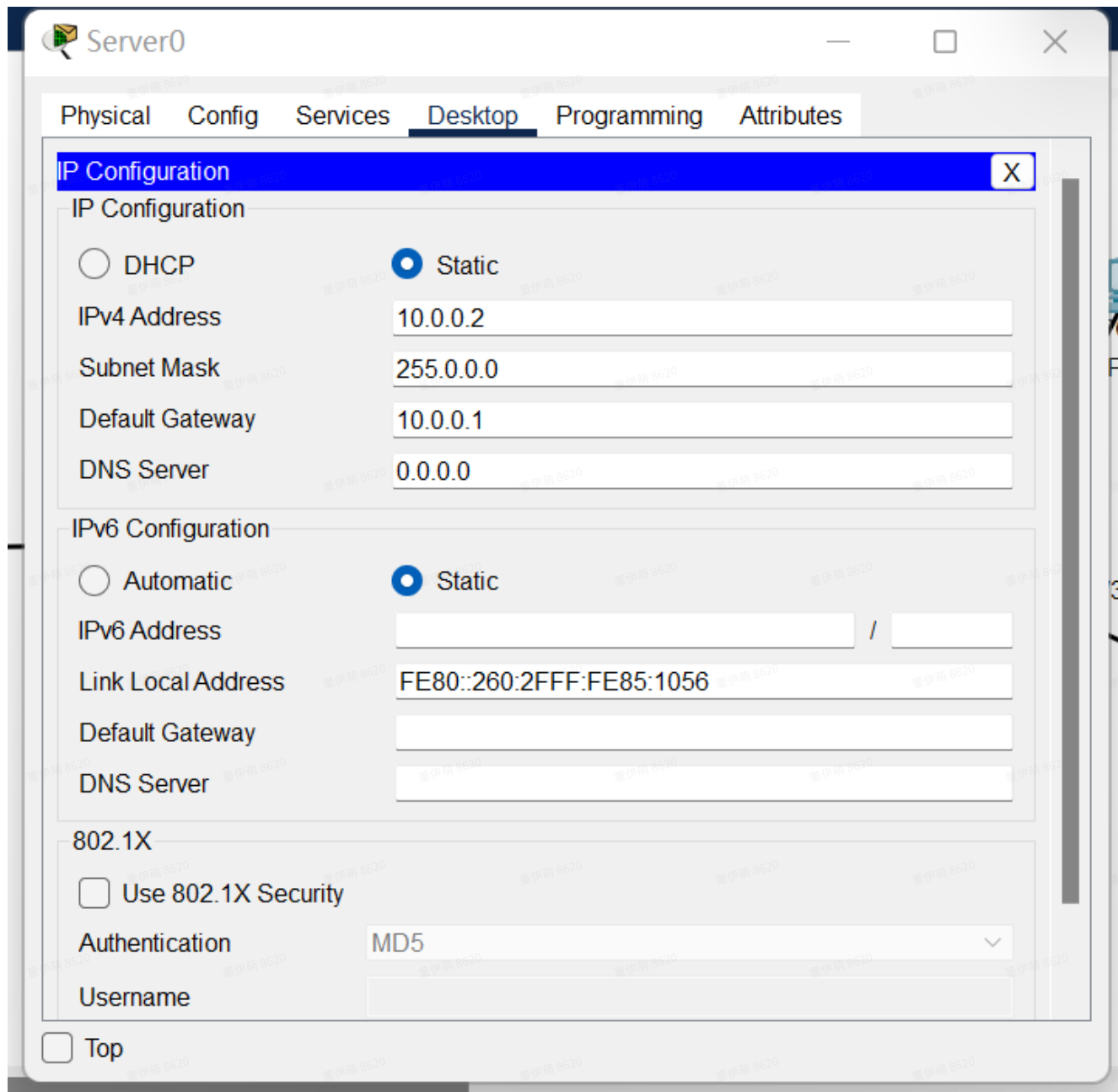
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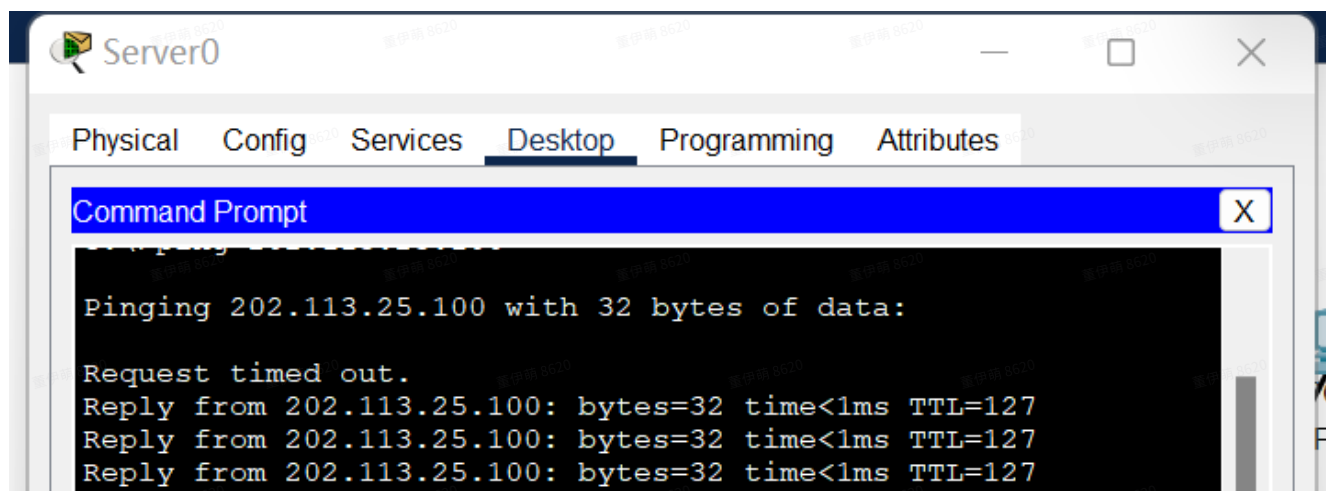
2. 仿真环境下将内部网络中放置一台Web服务器，请设置NAT服务器，使外部主机能够顺利使用该Web服务。



web服务器如该图所示，位于内网中，配置Web服务器的ip地址，NAT服务器的配置上述已经完成无需改动



为了能使外部主机能够顺利使用该Web服务，先用Web服务器pingPC4,然后在服务器的enable模式下输入show ip nat tran获取转换表如下：



```
Ping statistics for 202.113.25.100:
  Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
C:\>ping 202.113.25.100
```

```
Pinging 202.113.25.100 with 32 bytes of data:
```

```
Reply from 202.113.25.100: bytes=32 time=15ms TTL=127
Reply from 202.113.25.100: bytes=32 time<1ms TTL=127
Reply from 202.113.25.100: bytes=32 time<1ms TTL=127
Reply from 202.113.25.100: bytes=32 time<1ms TTL=127
```

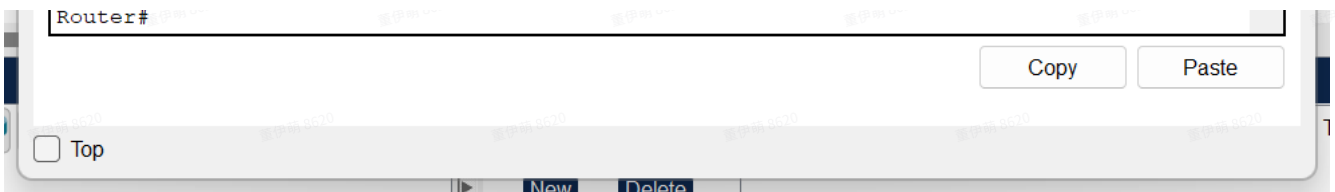
```
Ping statistics for 202.113.25.100:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
  Minimum = 0ms, Maximum = 15ms, Average = 3ms
```

```
C:\>
```

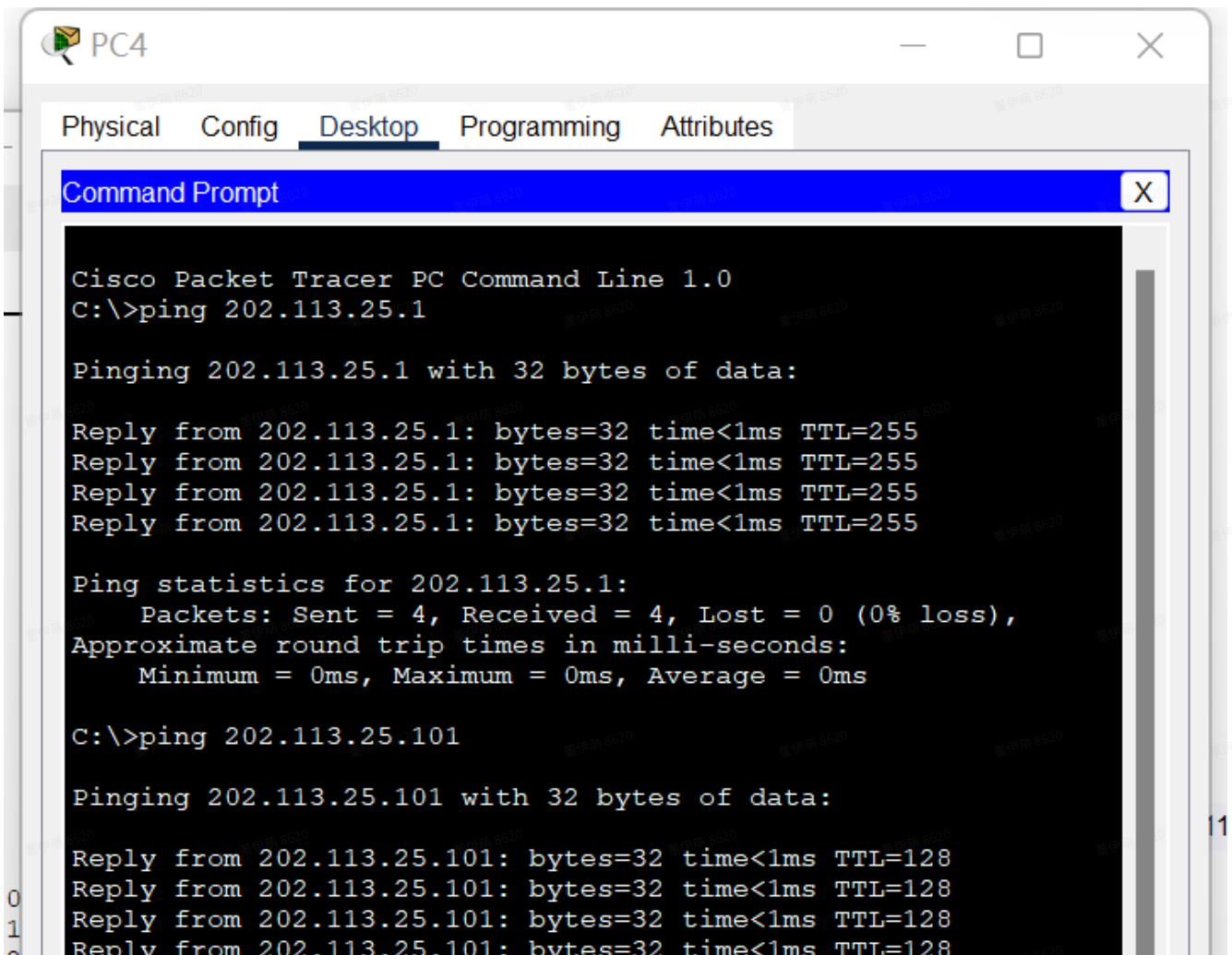
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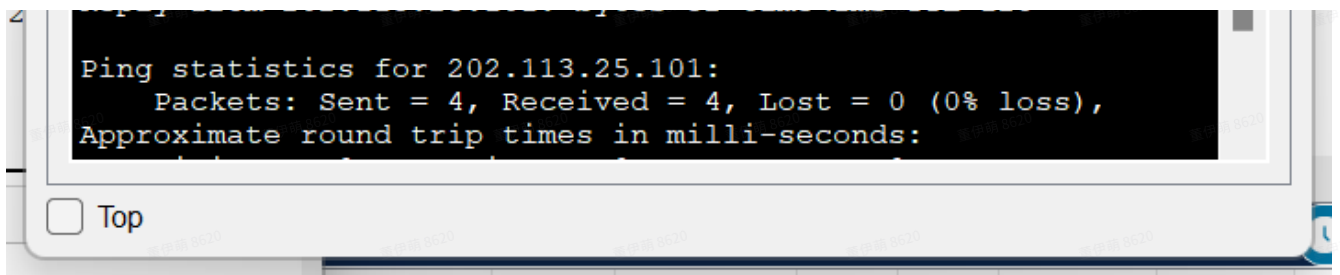
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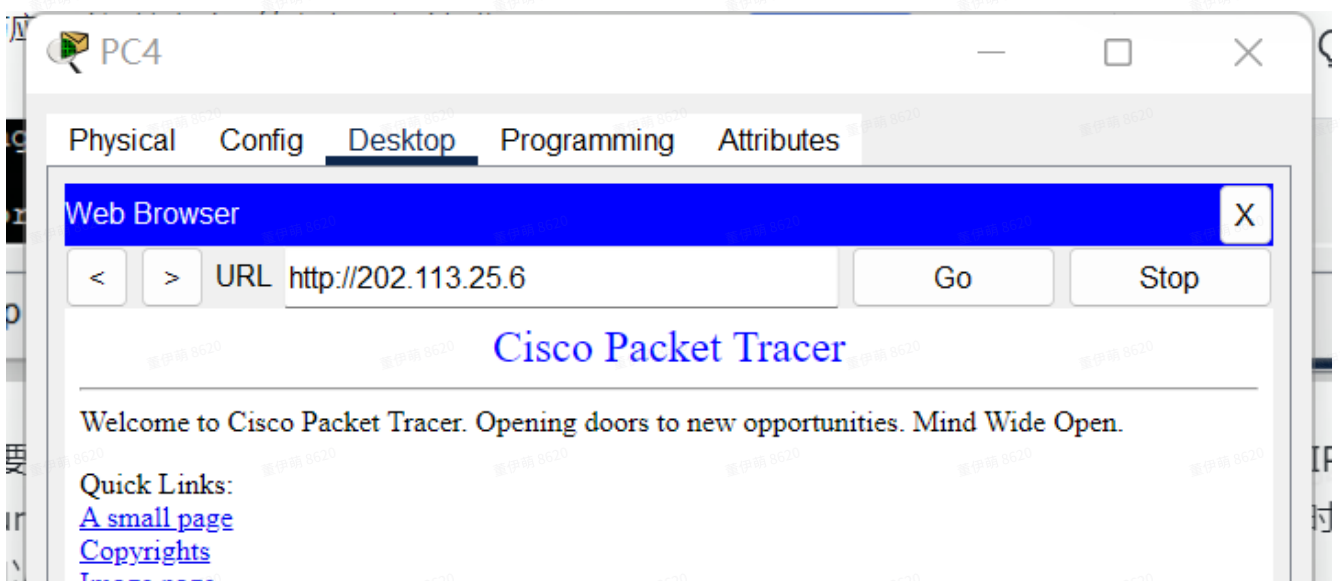


然后根据转换表中的IP地址可以用外部的主机例如PC4pingWeb服务器可以ping通





若主机想要成功访问到内网的WEB服务器，还需要在路由器中配置静态nat转换，使用命令为IP nat inside source static 10.0.0.2 202.113.25.6 ,建立ip 10.0.0.2和202.113.25.6的转换关系，此时外网的PC就可以通过202.113.25.6来访问内网服务器的界面了



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