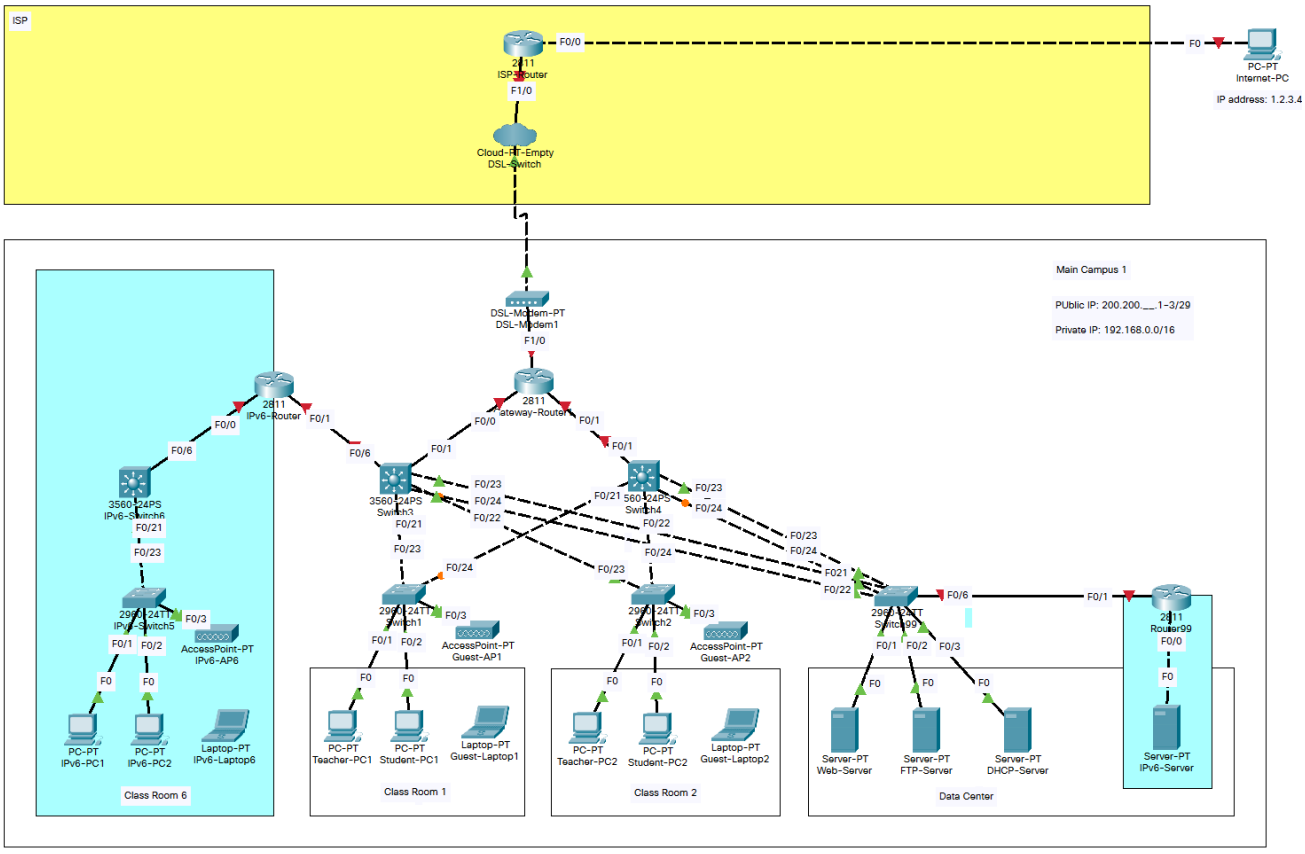
Lab 2. Addressing Technology

SILAN HU|2009853P-I011-0015

Objective

- Understand the Addressing Technologies, including DHCP, NAT and IPv6 transition.

Topology



Address Scheme

Inside:

Host name	Interface	IPv4/IPv6 address	Memo
Switch1	F0/1	N/A	VLAN ID = 11
	F0/2	N/A	VLAN ID = 22
	F0/3	N/A	VLAN ID = 88
	F0/23~24	N/A	VLAN ID = All VLANs (trunk)
Switch2	F0/1	N/A	VLAN ID = 11
	F0/2	N/A	VLAN ID = 22
	F0/3	N/A	VLAN ID = 88
	F0/23~24	N/A	VLAN ID = All VLANs (trunk)
Switch3	F0/1	N/A	VLAN ID = 101
	F0/6	N/A	VLAN ID = 66
	F0/21~24	N/A	VLAN ID = All VLANs (trunk)
	Vlan 11	IPv4: 192.168.11.1/24	SVI
	Vlan 22	IPv4: 192.168.22.1/24	SVI
	Vlan 66	IPv4: 192.168.66.1/24	SVI
	Vlan 88	IPv4: 192.168.88.1/24	SVI
	Vlan 99	IPv4: 192.168.99.2/24	SVI
	Vlan 101	IPv4: 192.168.101.2/24	SVI
Switch4	F0/1	N/A	VLAN ID = 102
	F0/21~24	N/A	VLAN ID = All VLANs (trunk)
	Vlan 11	IPv4: 192.168.11.2/24	SVI
	Vlan 22	IPv4: 192.168.22.2/24	SVI
	Vlan 88	IPv4: 192.168.88.2/24	SVI
	Vlan 99	IPv4: 192.168.99.2/24	SVI
	Vlan 102	IPv4: 192.168.102.2/24	SVI
Switch99	F0/1	N/A	VLAN ID = 99
	F0/2	N/A	VLAN ID = 99
	F0/3	N/A	VLAN ID = 99
	F0/6	N/A	VLAN ID = 99
	F0/21~24	N/A	VLAN ID = All VLANs (trunk)
Gateway-Router1	F0/0	IPv4: 192.168.101.1/24	N/A
	F0/1	IPv4: 192.168.102.1/24	N/A
	F1/0	IPv4: 200.200.200.2/30	N/A
IPv6-Router	F0/0	IPv6: 2001:2345:6789:66::6/64	N/A
	F0/1	IPv4: 192.168.66.6/24	N/A
Router99	F0/0	IPv6: 2001:2345:6789:99::6/64	
	F0/1	IPv4: 192.168.99.6/24	
Teacher-PC1~2	F0	IPv4: 192.168.11.101~199/24	N/A
Student-PC1~2	F0	IPv4: 192.168.22.101~199/24	N/A
Guest-Laptop1~2	F0	IPv4: 192.168.88.101~199/24	N/A
IPv6-PC1~2 IPv6-Laptop		IPv6: 2001:2345:6789:66::?:?:?:?/64	
Web-Server FTP Server DHCP-Server IPv6-Server	F0 F0 F0 F0	IPv4: 192.168.99.101/24 IPv4: 192.168.99.102/24 IPv4: 192.168.99.103/24 IPv6: 2001:2345:6789:99::106/64	N/A

Outside:

ISP-Router	F0/0	IPv4: 1.1.1.1/8	N/A
	F1/0	IPv4: 200.200.200.1/30	N/A
Internet-PC	F0/0	IPv4: 1.2.3.4/8	N/A

Translation:

Addressing Scheme for NAT		
	Public IPv4 addresses	Private IPv4 addresses
Teacher-PC1~2 Student-PC1~2 Guest-PC1~2	200.200.123.1/29	192.168. 11. 0/24 192.168. 22. 0/24 192.168. 88. 0/24
Web-Server FTP Server	200.200.123.2 200.200.123.3	192.168. 99.101/24 192.168. 99.102/24

Part 1 – DHCP.

> Requirement:
> 1.1 Dynamic IP addresses to Teacher-PCs/Student-PCs. (DHCP via Gatway-Router1)
> 1.2 Dynamic IP addresses to Guest-Laptops. (DHCP via DHCP-Server)

Step 1 – DHCP Router

1. configure the DHCP pool on the router (e.g. Gateway-Rotuer1).

Reference 4. DHCP .Q 22 ~24

```
Gatweay-Router1(config)#service dhcp
Gatweay-Router1(config)#ip dhcp pool Teacher-DHCPPool
Gatweay-Router1(dhcp-config)#network 192.168.11.0 255.255.255.0
Gatweay-Router1(dhcp-config)#default-router 192.168.11.254
Gatweay-Router1(dhcp-config)#ip dhcp excluded-address 192.168.11.1 192.168.11.100
Gatweay-Router1(config)#ip dhcp excluded-address 192.168.11.200 192.168.11.255
Gatweay-Router1(config)#ip dhcp pool Student-DHCPPool
Gatweay-Router1(dhcp-config)#network 192.168.22.0 255.255.255.0
Gatweay-Router1(dhcp-config)#default-router 192.168.22.254
Gatweay-Router1(dhcp-config)#ip dhcp excluded-address 192.168.22.1 192.168.22.100
Gatweay-Router1(config)#ip dhcp excluded-address 192.168.22.200 192.168.22.255
```

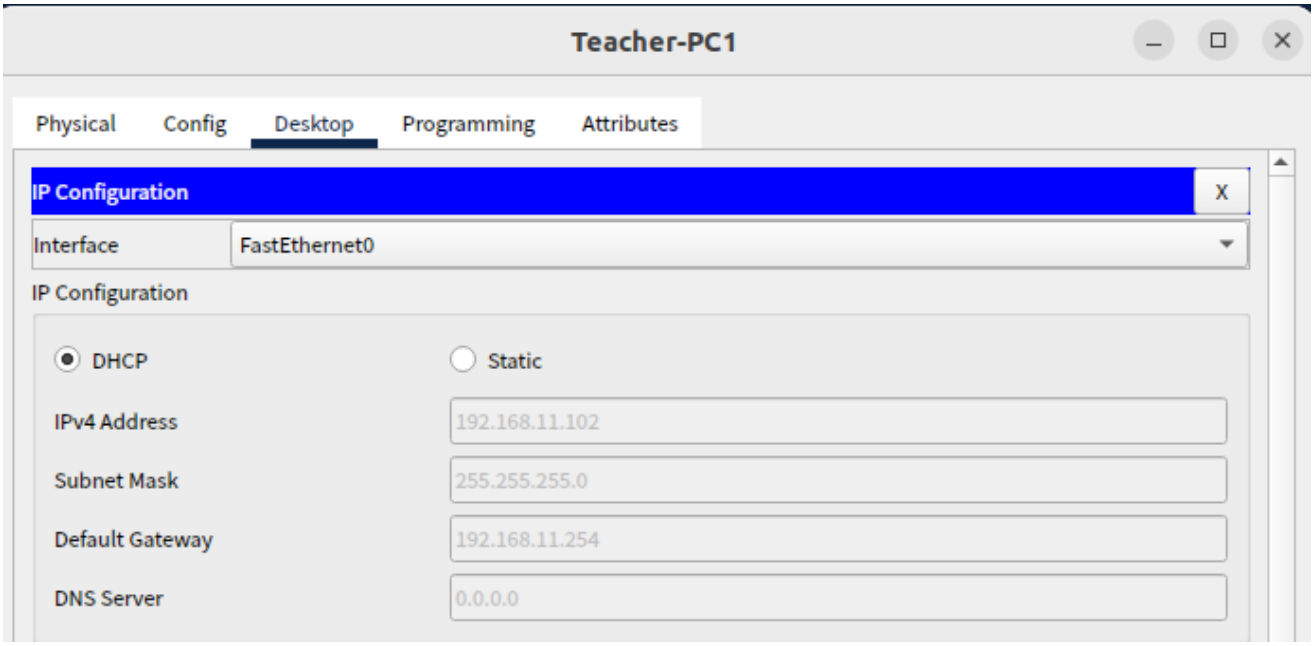
2. configure the DHCP relay from PCs to the router (e.g. Gateway-Rotuer1).

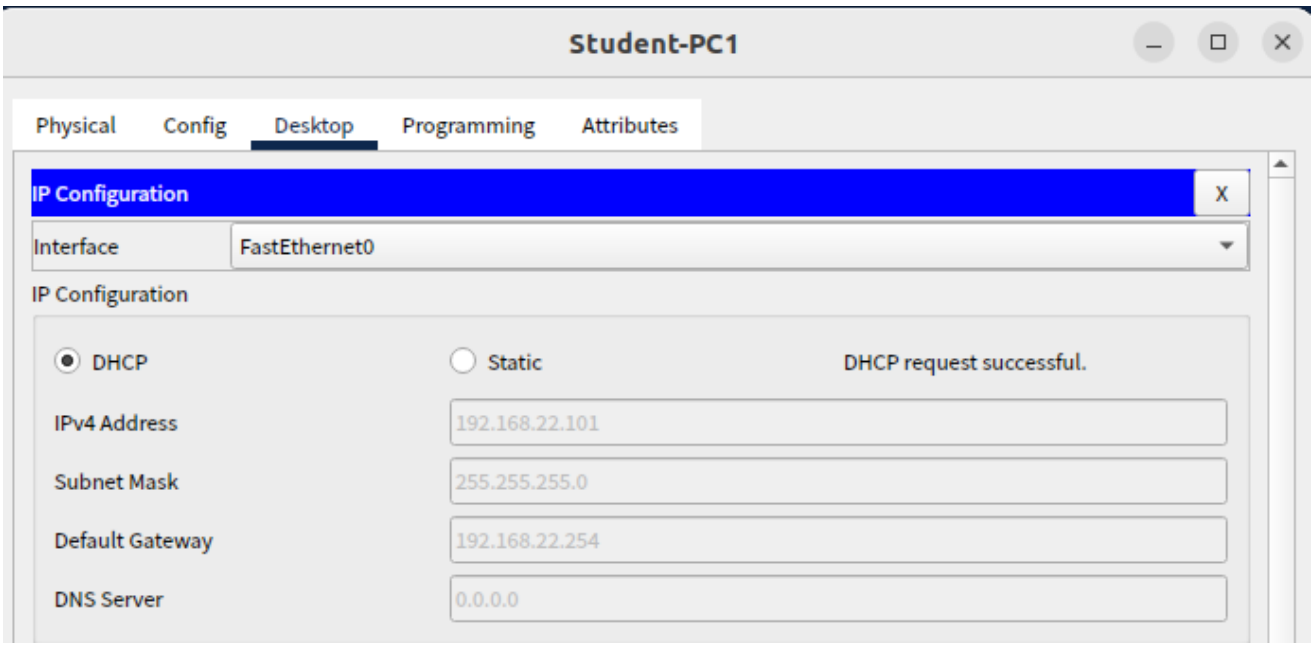
Reference 4.DHCP.Q25;

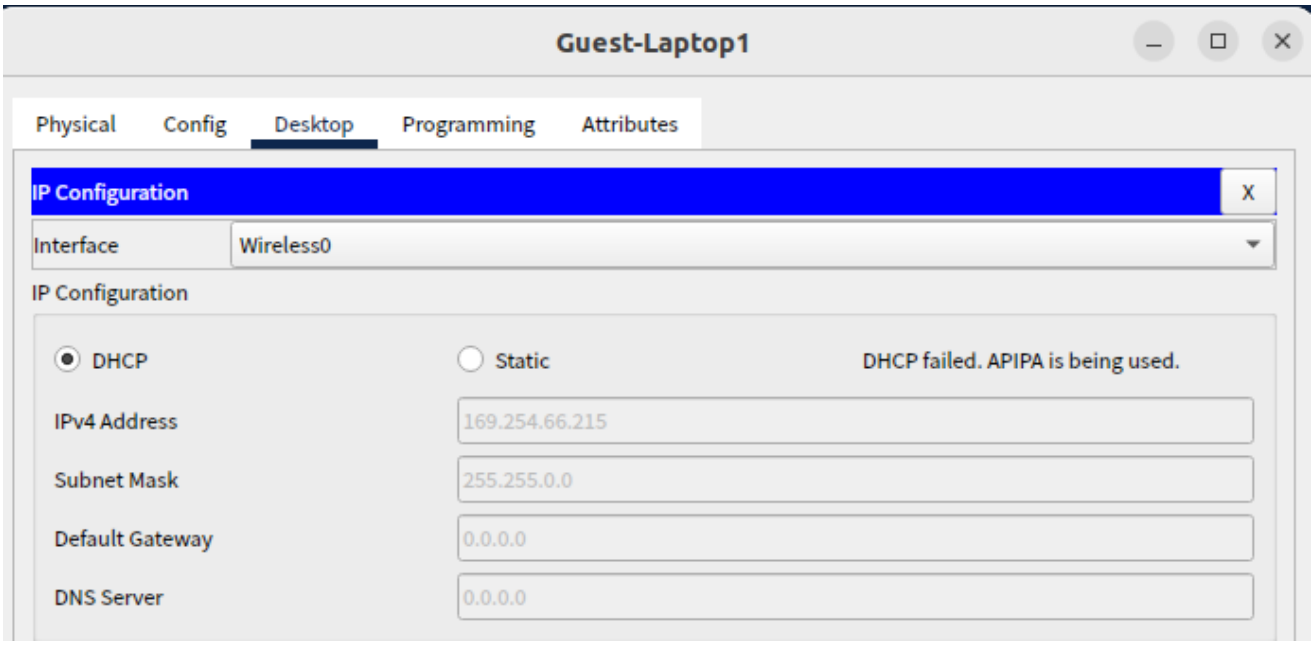
```
Switch3(config)#interface vlan 11
Switch3(config-if)#ip helper-address 192.168.101.1
Switch3(config-if)#interface vlan 22
Switch3(config-if)#ip helper-address 192.168.101.1


Switch4(config)#interface vlan 11
Switch4(config-if)#ip helper-address 192.168.102.1
Switch4(config-if)#interface vlan 22
Switch4(config-if)#ip helper-address 192.168.102.1
```

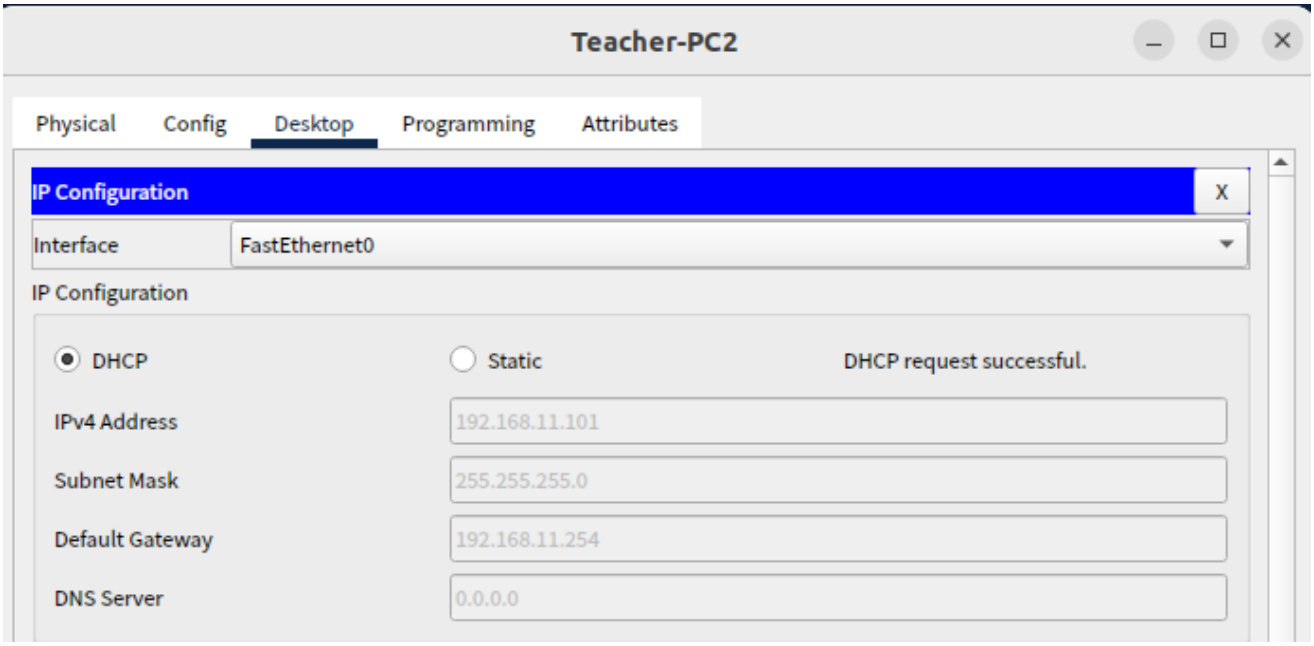
Reference 4.DHCP.Q9,12; Q13,19

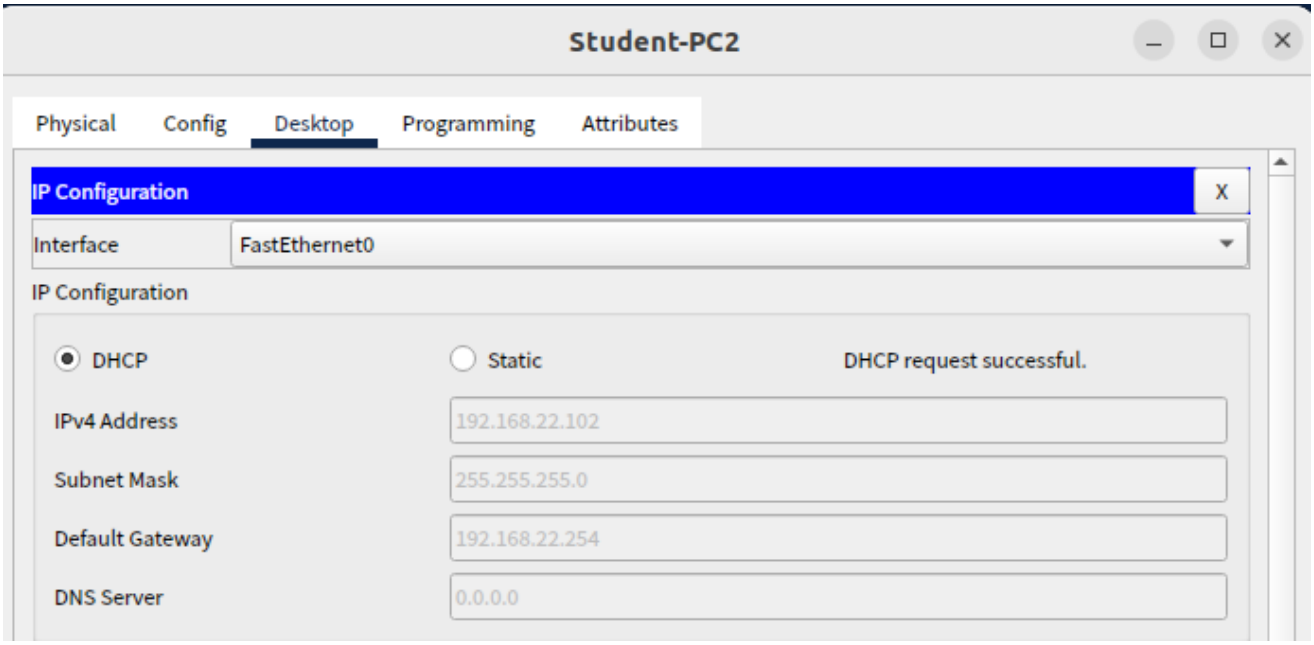
```
Switch3(config)#interface FastEthernet 0/1
Switch3(config-if)#switchport mode access
Switch3(config-if)#switchport access vlan 101
% Access VLAN does not exist. Creating vlan 101
Switch3(config-if)#interface vlan 101
Switch3(config-if)#ip address 192.168.101.2 255.255.255.0
Switch3(config-if)#no shutdown
%LINK-5-CHANGED: Interface Vlan101, changed state to up


Switch4(config)#interface FastEthernet 0/1
Switch4(config-if)#switchport mode access
Switch4(config-if)#switchport access vlan 102
% Access VLAN does not exist. Creating vlan 102
Switch4(config-if)#interface vlan 102
Switch4(config-if)#ip address 192.168.102.2 255.255.255.0
Switch4(config-if)#no shutdown
%LINK-5-CHANGED: Interface Vlan102, changed state to up


Gatweay-Router1(config)#interface FastEthernet 0/0
Gatweay-Router1(config-if)#ip address 192.168.101.1 255.255.255.0
Gatweay-Router1(config-if)#no shutdown
Gatweay-Router1(config-if)#interface FastEthernet 0/1
Gatweay-Router1(config-if)#ip address 192.168.102.1 255.255.255.0
Gatweay-Router1(config-if)#no shutdown
Gatweay-Router1(config-if)#exit
Gatweay-Router1(config)#ip route 192.168.0.0 255.255.0.0 192.168.101.2
Gatweay-Router1(config)#ip route 192.168.99.0 255.255.255.0 192.168.102.2
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
```




Student-PC1
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
DHCP request successful.
IPv4 Address
192.168.22.101
Subnet Mask
255.255.255.0
Default Gateway
192.168.22.254
DNS Server
0.0.0.0


Guest-Laptop1
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
Wireless0
IP Configuration
DHCP
Static
DHCP failed. APIPA is being used.
IPv4 Address
169.254.66.215
Subnet Mask
255.255.0.0
Default Gateway
0.0.0.0
DNS Server
0.0.0.0


Teacher-PC2
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
DHCP request successful.
IPv4 Address
192.168.11.101
Subnet Mask
255.255.255.0
Default Gateway
192.168.11.254
DNS Server
0.0.0.0

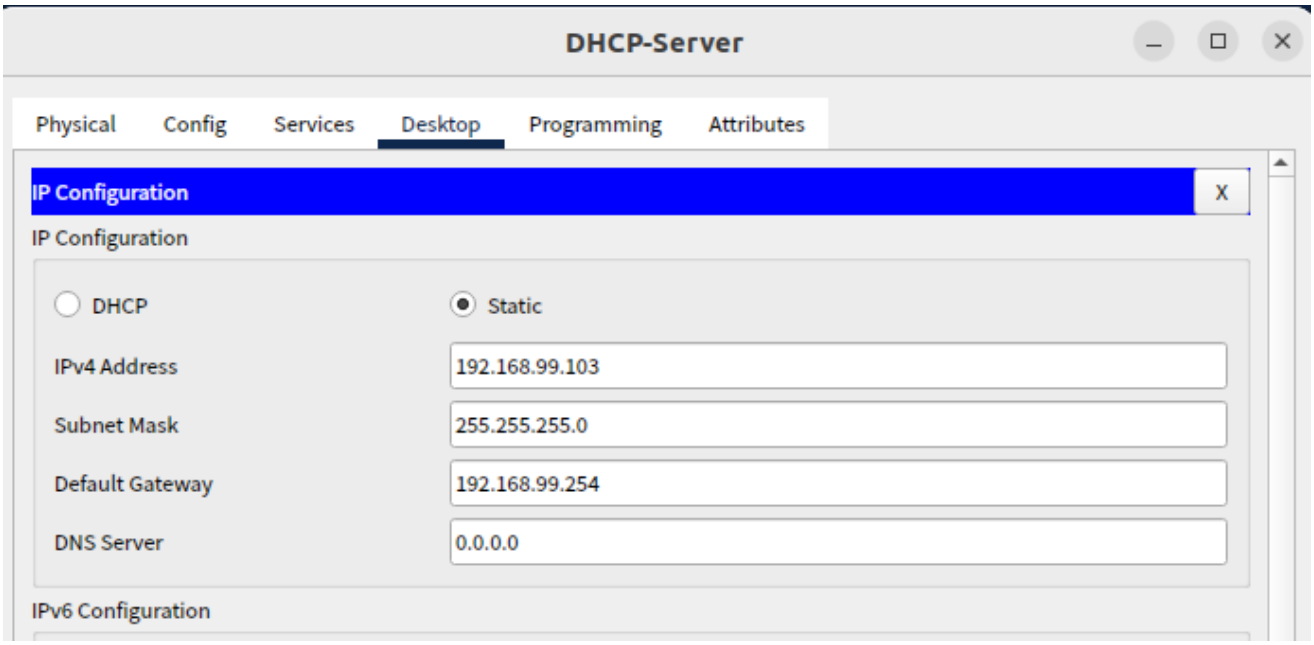



```
Gatweay-Router1#show ip dhcp binding
IP address       Client-ID/              Lease expiration        Type
                 Hardware address
192.168.11.101   0000.0C73.9546           --                     Automatic
192.168.11.102   0005.5E39.9EEA           --                     Automatic
192.168.22.101   0001.4375.E3C1           --                     Automatic
192.168.22.102   00D0.9725.71B8           --                     Automatic
```

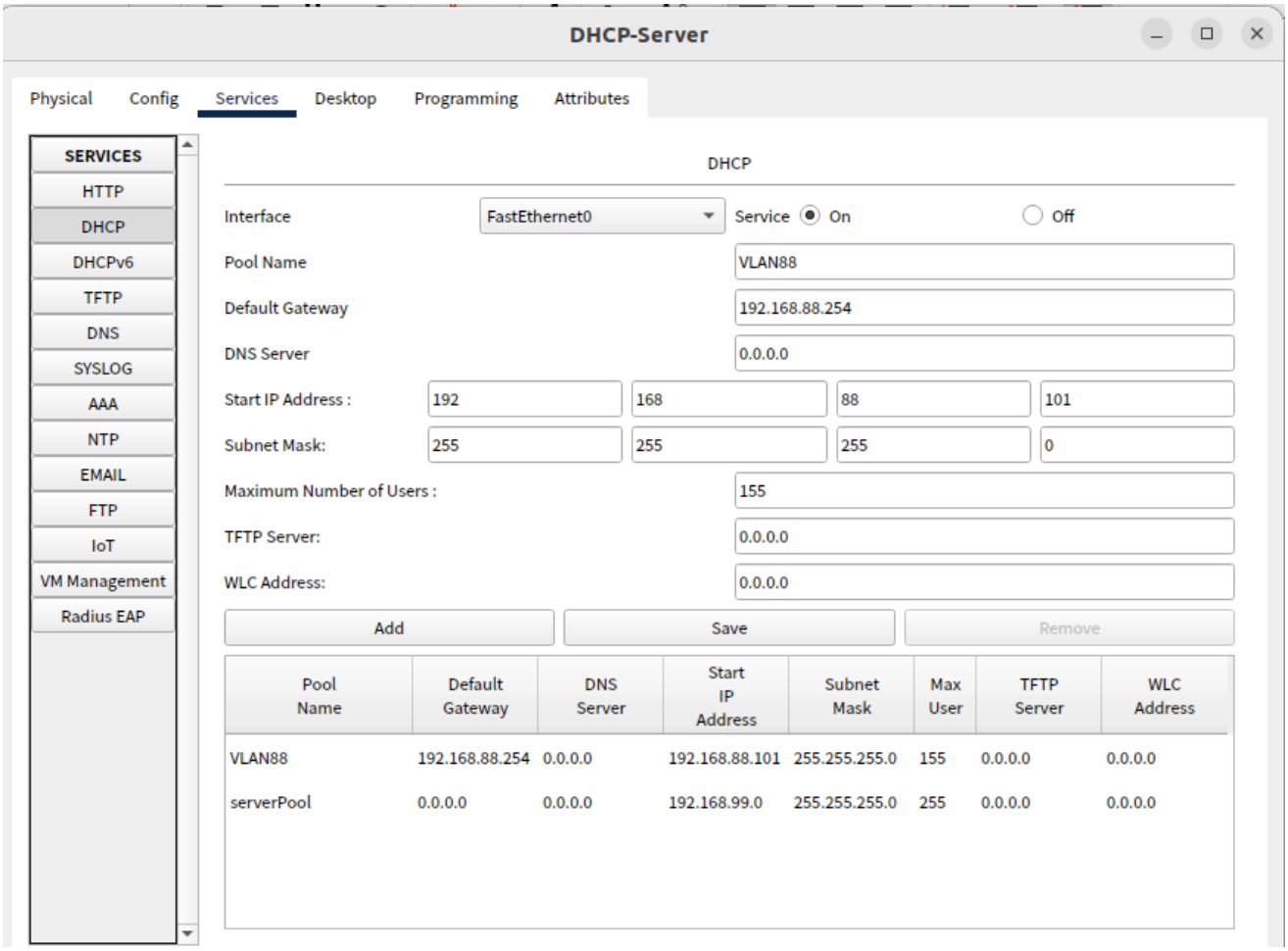
Step 2 – DHCP Server

3. configure the DHCP pool on the server (e.g. DHCP-Server).

- setting the server address



- DHCP service(VLAN88)



- access vlan 99 on Switch99

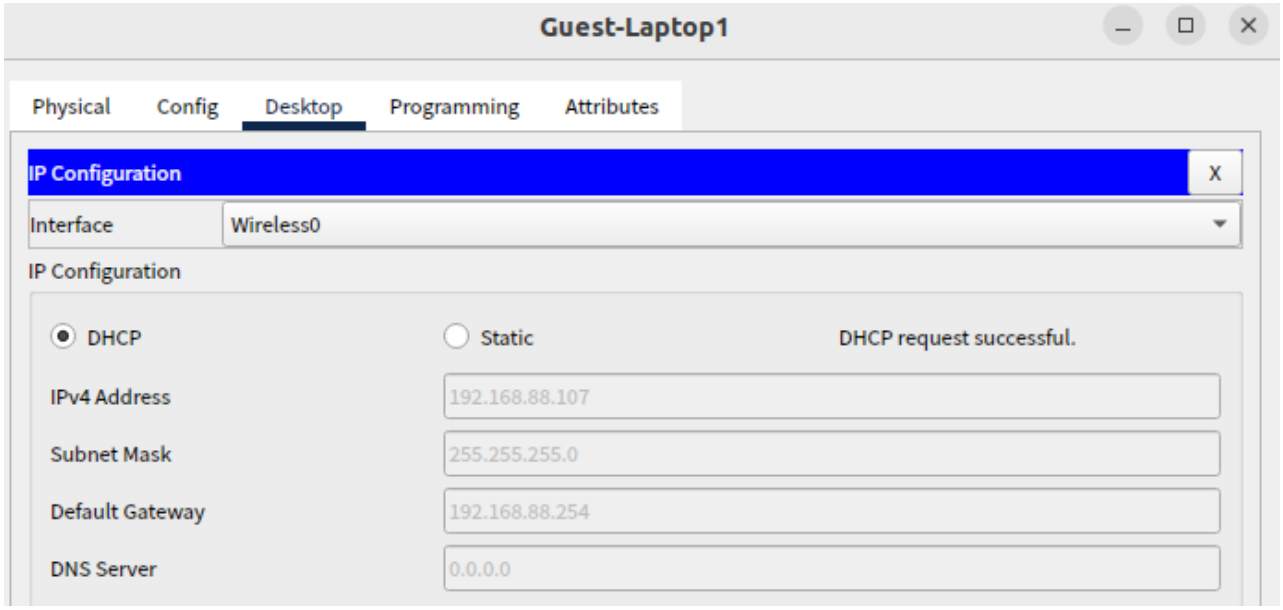
```
Switch99(config)#int FastEthernet 0/3
Switch99(config-if)#switchport mode access
Switch99(config-if)#switchport access vlan 99
```

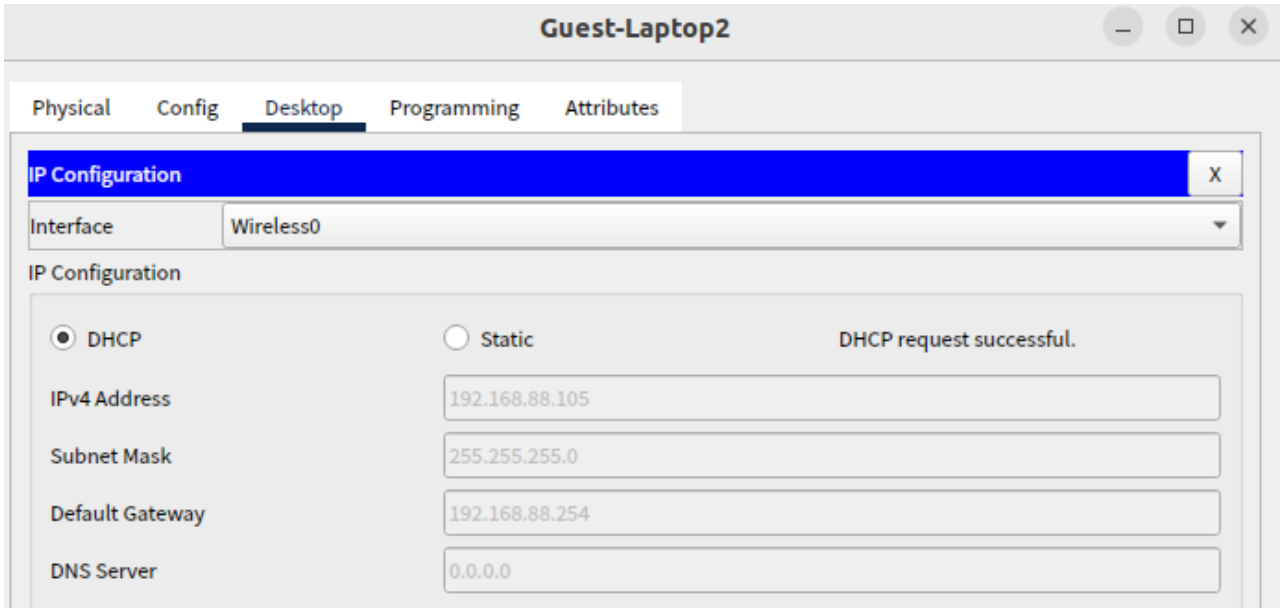
4. configure the DHCP relay from Laptops to the server (e.g. DHCP-Server).

Reference 4.DHCP.Q25

```
Switch3(config)#interface vlan 88
Switch3(config-if)#ip helper-address 192.168.99.103


Switch4(config)#interface vlan 88
Switch4(config-if)#ip helper-address 192.168.99.103
```

- Laptop-anto-config





Part 2 – NAT.

> Requirement:
>
> 2.1 Internet-PC -> Web-Server/FTP-Server. (Static NAT)
> 2.2 Teacher-PCs/Student-PCs/Guest-Laptops -> Internet-PC. (Dynamic NAT)

Step 3 – Static NAT

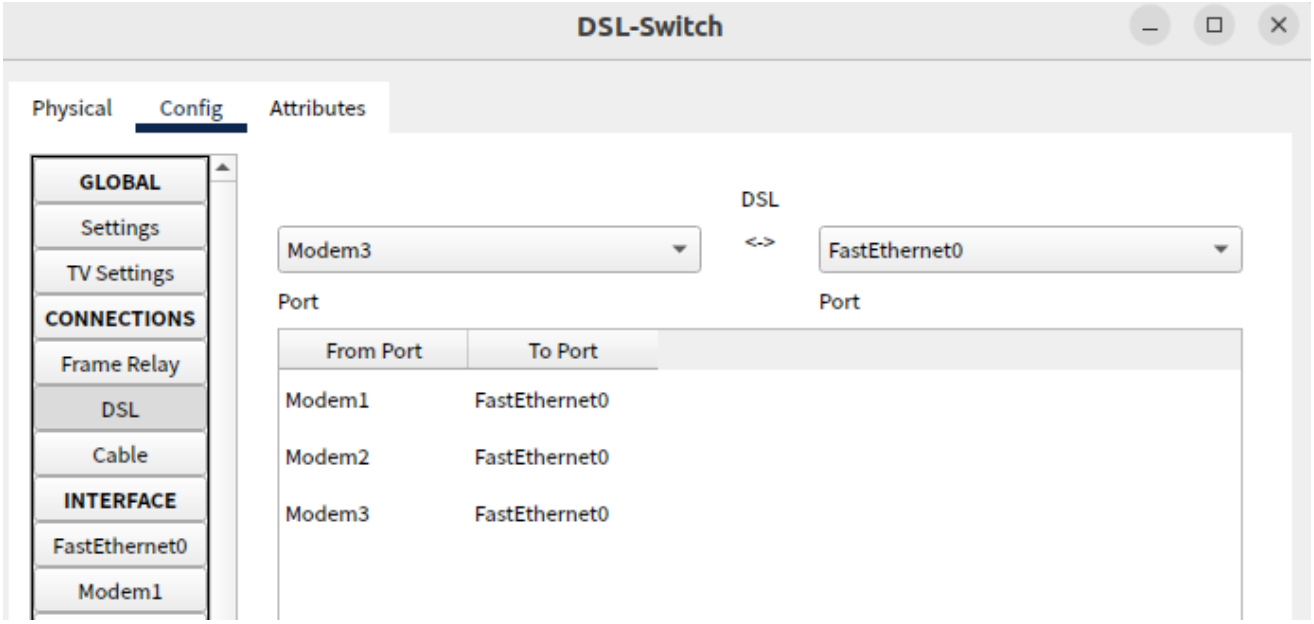
5. configure the static nat for server translation on the border router (Gateway-Router1).

Reference 4.NAT.Q30~31

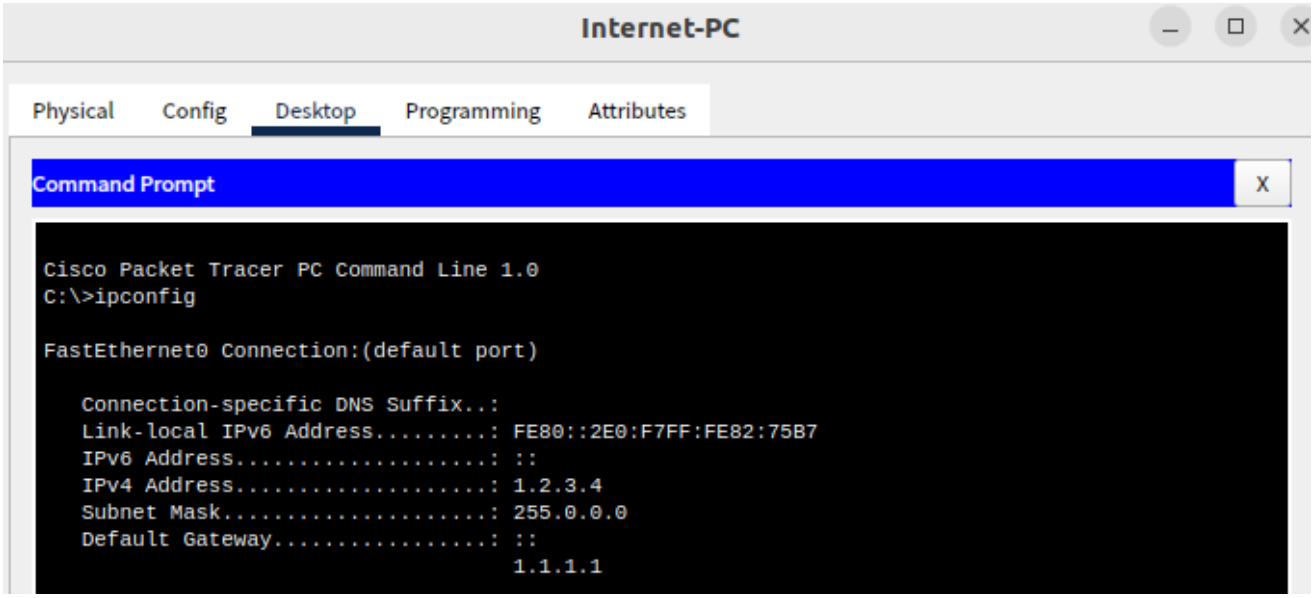
```
Gatweay-Router1(config)#ip nat inside source static 192.168.99.101 200.200.123.2
Gatweay-Router1(config)#ip nat inside source static 192.168.99.102 200.200.123.3
Gatweay-Router1(config)#interface range FastEthernet 0/0-1
Gatweay-Router1(config-if-range)#ip nat inside
Gatweay-Router1(config-if-range)#interface range FastEthernet 1/0
Gatweay-Router1(config-if-range)#ip nat outside
```

6. configure the route from border router (Gateway-Router1) to ISP router.

Reference 4.NAT.Q13,16,17;



Reference 4.NAT.Q18,20,21

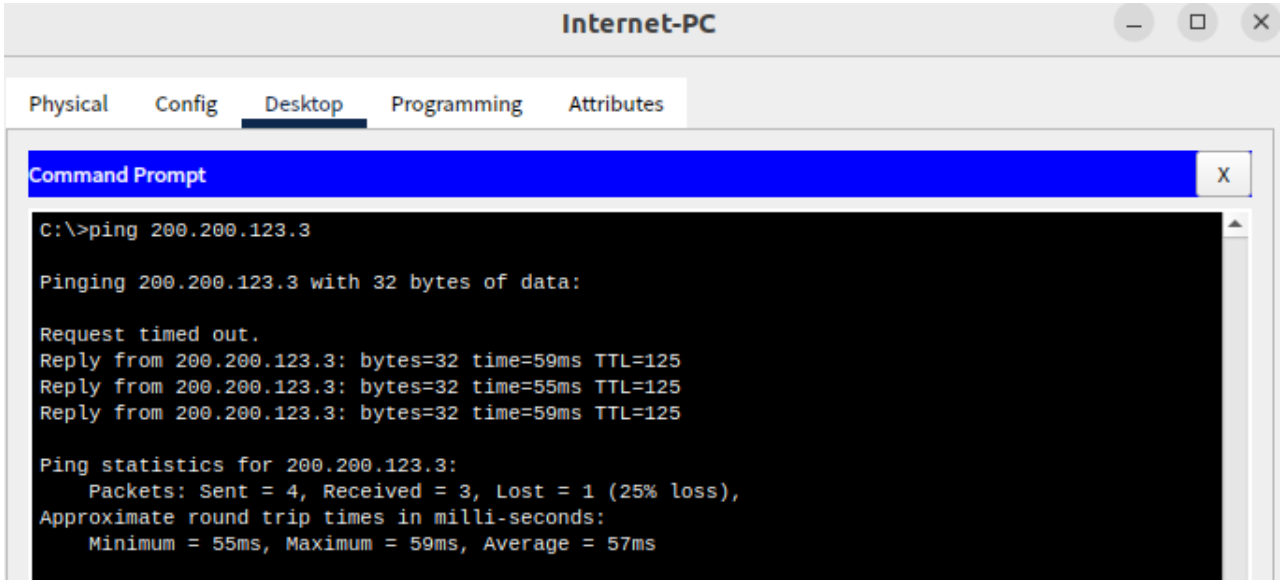



```
Gatweay-Router1(config)#interface f 1/0
Gatweay-Router1(config-if)#ip address 200.200.200.2 255.255.255.252
Gatweay-Router1(config-if)#no shutdown
Gatweay-Router1(config-if)#
%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up
```

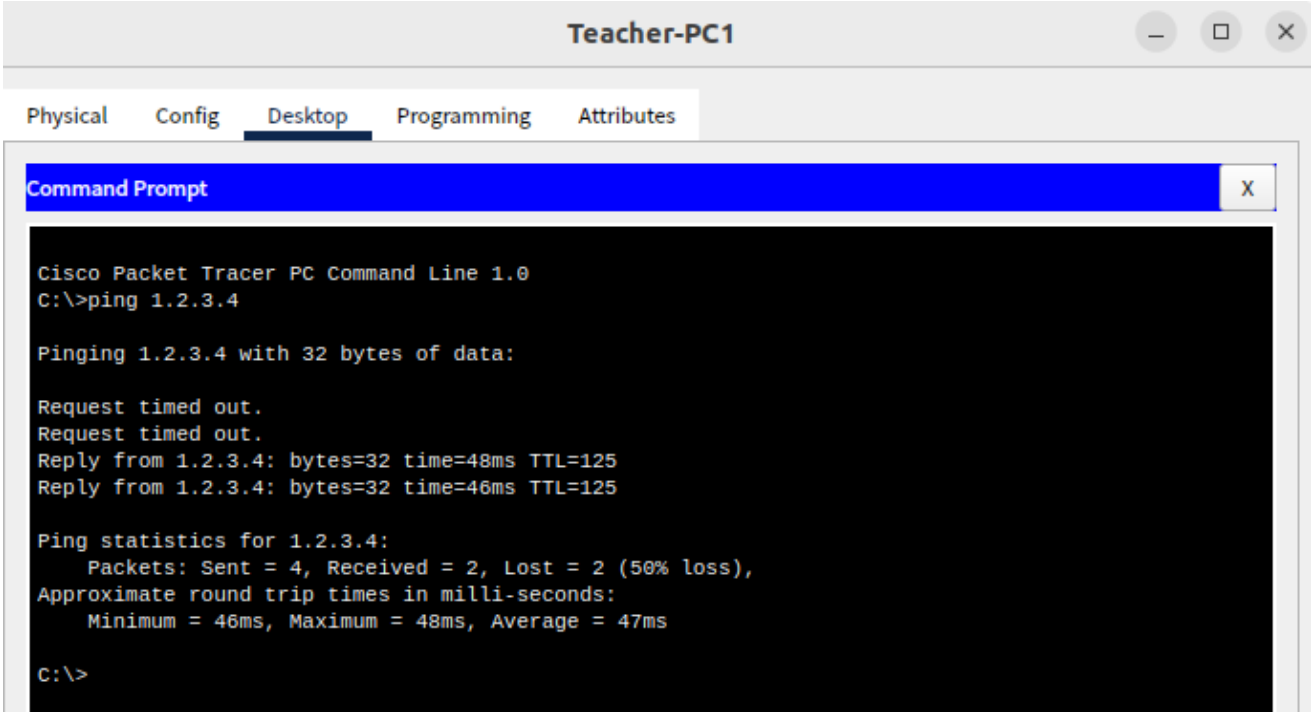
```
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up


ISP-Router(config)#interface f 0/0
ISP-Router(config-if)#ip address 1.1.1.1 255.0.0.0
ISP-Router(config-if)#no shutdown
ISP-Router(config-if)#interface f 1/0
ISP-Router(config-if)#ip address 200.200.200.1 255.255.255.252
ISP-Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
%LINK-5-CHANGED: Interface FastEthernet1/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet1/0, changed state to up
```

```
Switch3(config)#ip route 0.0.0.0 0.0.0.0 192.168.101.1


Switch4(config)#ip route 0.0.0.0 0.0.0.0 192.168.102.1


Gatweay-Router1(config)#ip route 0.0.0.0 0.0.0.0 200.200.200.1


ISP-Router(config)#ip route 200.200.123.0 255.255.255.248 200.200.200.2
```

- **From : Internet-PC to FTP-Server**



- **From : Teacher-PC to Internet-PC**



Step 4 – Dynamic NAT

7. configure the dynamic nat for PC translation on the border router (Gateway-Router1).

Reference 4.NAT.Q37~39

```
Gatweay-Router1(config)#ip access-list standard NAT-List
Gatweay-Router1(config-std-nacl)#permit 192.168.11.0 0.0.0.255
Gatweay-Router1(config-std-nacl)#permit 192.168.22.0 0.0.0.255
Gatweay-Router1(config-std-nacl)#permit 192.168.88.0 0.0.0.255
Gatweay-Router1(config-std-nacl)#exit
Gatweay-Router1(config)#ip nat pool NAT-Pool 200.200.123.1 200.200.123.1 netmask
255.255.255.248
Gatweay-Router1(config)#ip nat inside source list NAT-List pool NAT-Pool overload
```

Part 3 – IPv6 transition.

> Requirement:
> 3.1 IPv6-PC -> IPv6-Server. (Tunneling)
> 3.2 IPv6-PC -> Web-Server/FTP-Server. (NATPT)

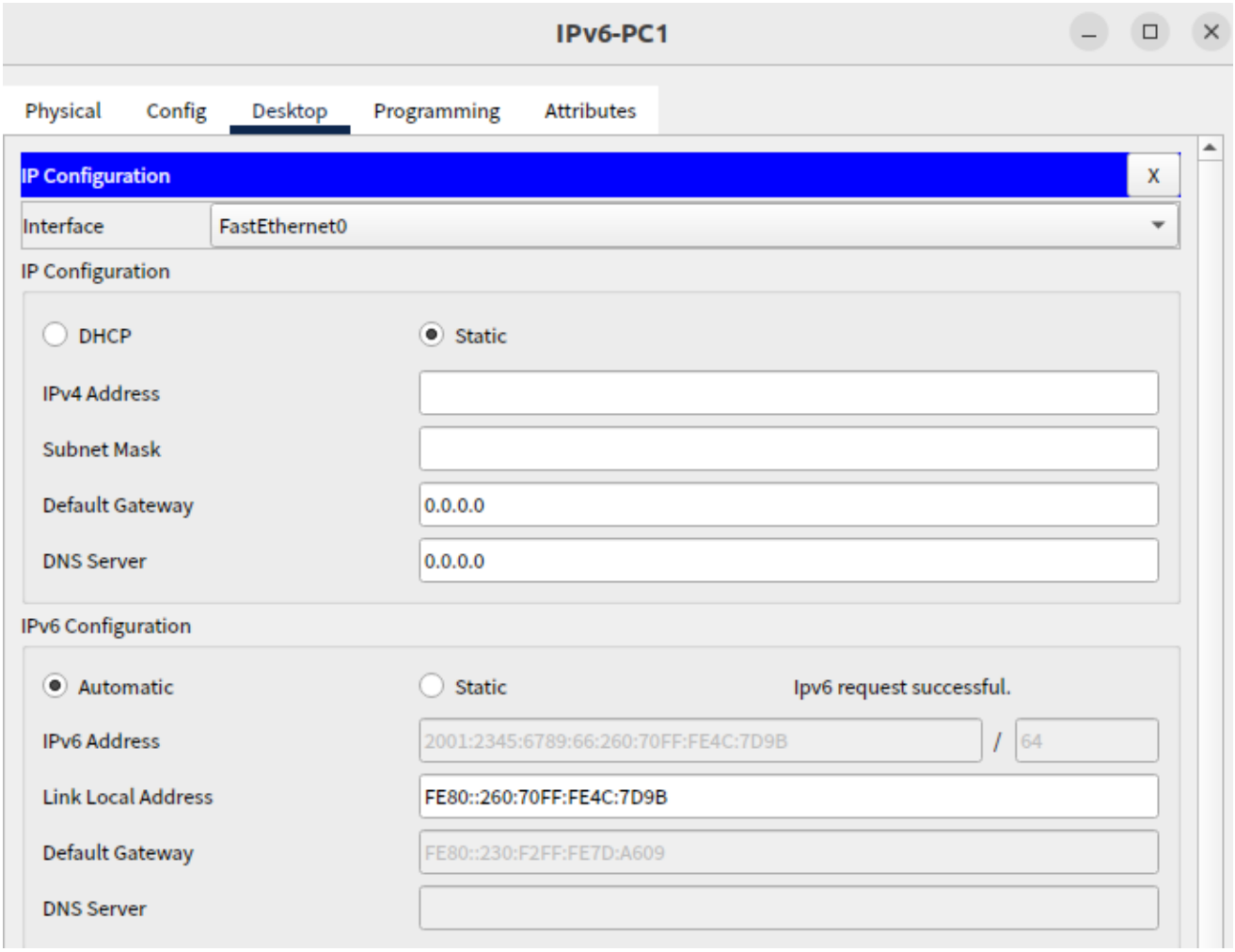
Step 5 – IPv6 tunnel

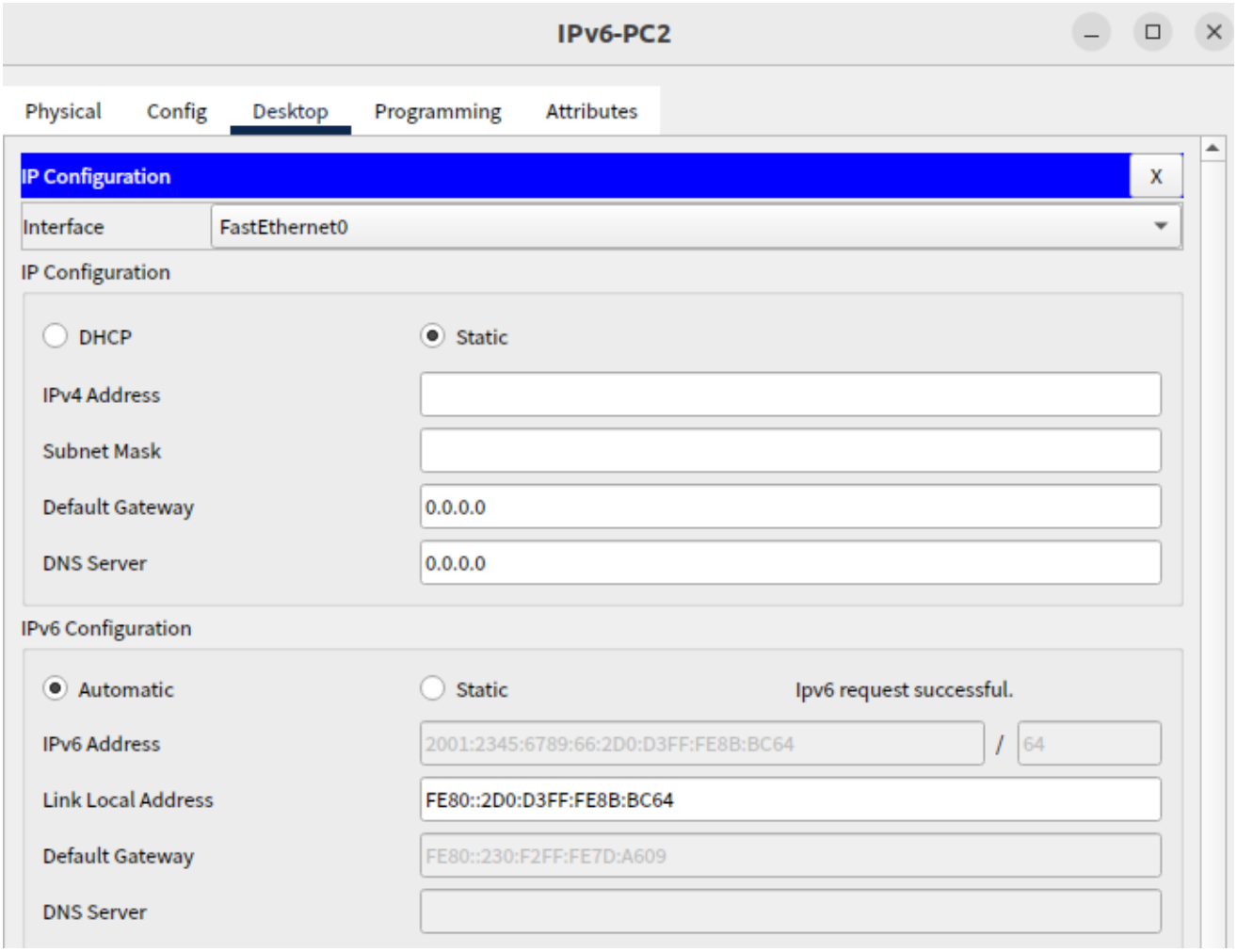
1. configure the ipv6 subnet on the PC site.

- configure IPV6-Router interface

```
IPv6-Router(config)#ipv6 unicast-routing
IPv6-Router(config)#interface f 0/0
IPv6-Router(config-if)#ipv6 address 2001:2345:6789:66::6/64
IPv6-Router(config-if)#no shutdown

IPv6-Router(config-if)#interface f 0/1
IPv6-Router(config-if)#ip address 192.168.66.6 255.255.255.0
IPv6-Router(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
```

- configure each PC





2. configure the ipv6 subnet on the Server site.

```
Router99(config)#ipv6 unicast-routing
Router99(config)#interface f 0/0
Router99(config-if)#ipv6 address 2001:2345:6789:99::6/64
Router99(config-if)#no shutdown

Router99(config-if)#interface f 0/1
Router99(config-if)#ip address 192.168.99.6 255.255.255.0
Router99(config-if)#no shutdown
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up
%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
```

3. configure the ipv4 subnets between the PC site and Server site.

```
Switch3(config)#interface f 0/6
Switch3(config-if)#switchport mode access
Switch3(config-if)#switchport access vlan 66
% Access VLAN does not exist. Creating vlan 66
Switch3(config-if)#
%HSRP-6-STATECHANGE: Vlan99 Grp 99 state Speak -> Standby

Switch3(config)#interface vlan 66
Switch3(config-if)#ip address 192.168.66.1 255.255.255.0
Switch3(config-if)#no shutdown
```

```
Switch3(config-if)#standby 66 ip 192.168.66.254
Switch3(config-if)#standby 66 priority 99
Switch3(config-if)#standby 66 preempt
%LINK-5-CHANGED: Interface Vlan66, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan66, changed state to up


Switch4(config)#interface vlan 66
Switch4(config-if)#ip address 192.168.66.2 255.255.255.0
Switch4(config-if)#no shutdown
Switch4(config-if)#standby 66 ip 192.168.66.254
Switch4(config-if)#standby 66 priority 101
Switch4(config-if)#standby 66 preempt
%LINK-5-CHANGED: Interface Vlan66, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan66, changed state to up
%HSRP-6-STATECHANGE: Vlan66 Grp 66 state Standby -> Active
```

```
Switch99(config)#int f 0/6
Switch99(config-if)#switchport mode access
Switch99(config-if)#switchport access vlan 99
```

4. configure the ipv6 over ipv4 tunnel between the routers of the PC site and Server site.

Reference 4. tunnel

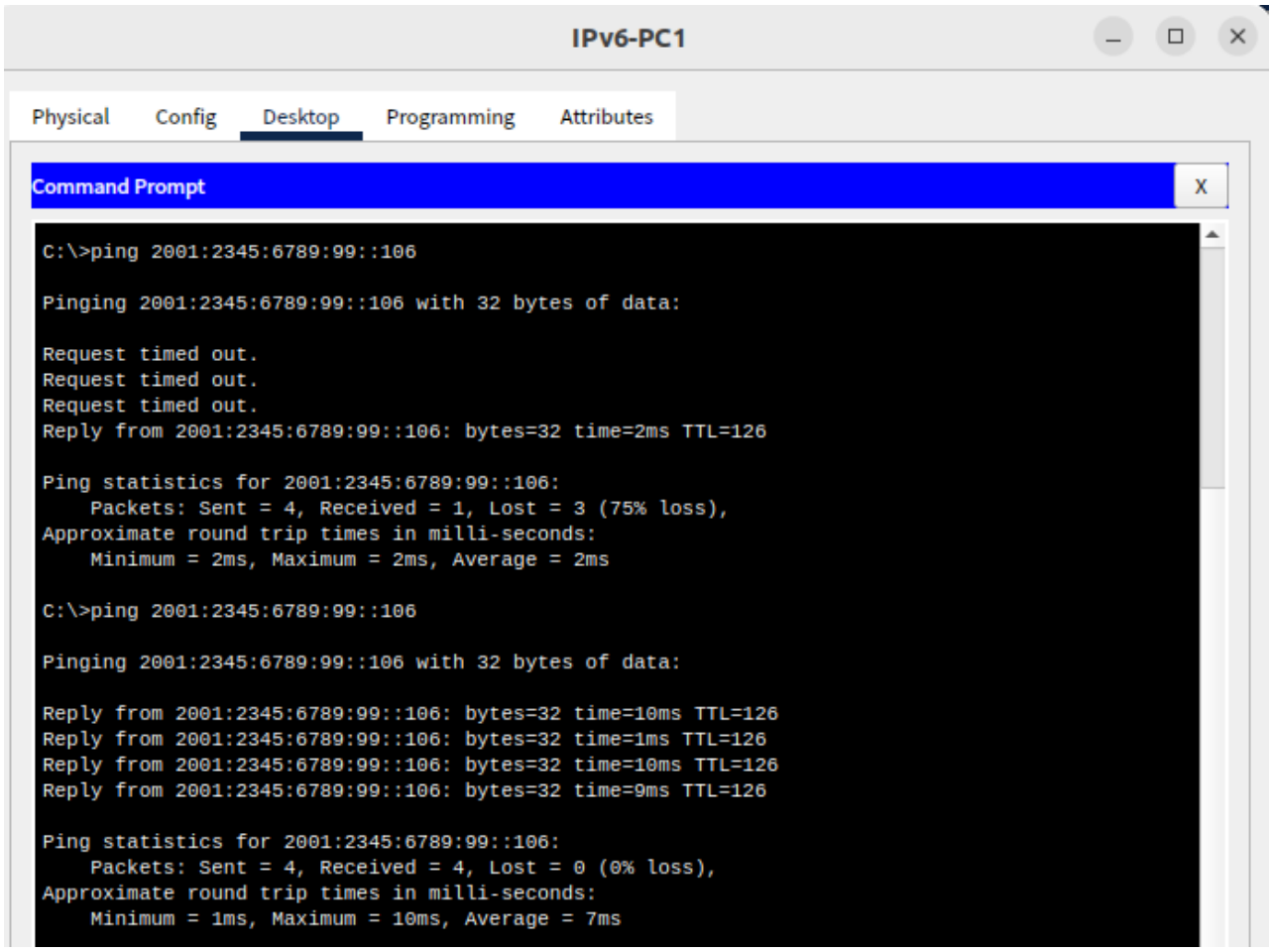
```
IPv6-Router(config-if)#tunnel source f 0/1
IPv6-Router(config-if)#tunnel destination 192.168.99.6
IPv6-Router(config-if)#tunnel mode ipv6ip
IPv6-Router(config-if)#ipv6 address 2001:2345:6789:64::66/64
%LINK-5-CHANGED: Interface Tunnel64, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel64, changed state to up


Router99(config)#interface tunnel 64
Router99(config-if)#tunnel source fastEthernet 0/1
Router99(config-if)#tunnel destination 192.168.66.6
Router99(config-if)#tunnel mode ipv6ip
Router99(config-if)#ipv6 address 2001:2345:6789:64::99/64
%LINK-5-CHANGED: Interface Tunnel64, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel64, changed state to up
```

5. configure the ipv4 route and ipv4 route between the routers of the PC site and Server site.

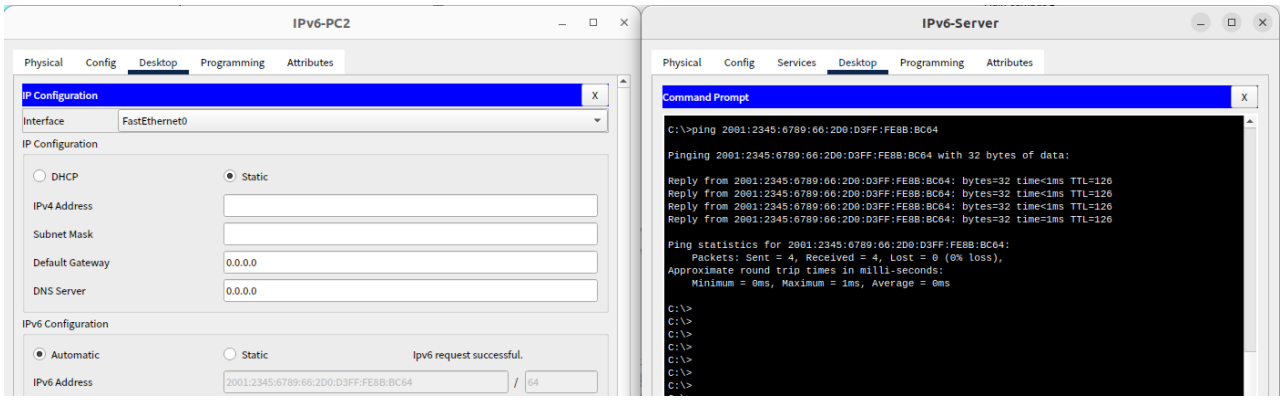
```
IPv6-Router(config)#ip route 192.168.99.0 255.255.255.0 192.168.66.254
IPv6-Router(config)#ipv6 route 2001:2345:6789:99::/64 2001:2345:6789:64::99

Router99(config)#ip route 192.168.66.0 255.255.255.0 192.168.99.254
Router99(config)#ipv6 route 2001:2345:6789:66::/64 2001:2345:6789:64::66
```

6. test the connectivity of the tunnel between the PC site and Server site.

- From IPv6-PC1 to IPv6-Server



- From IPv6-Server to IPv6-PC2



Step 6 – NAT-PT

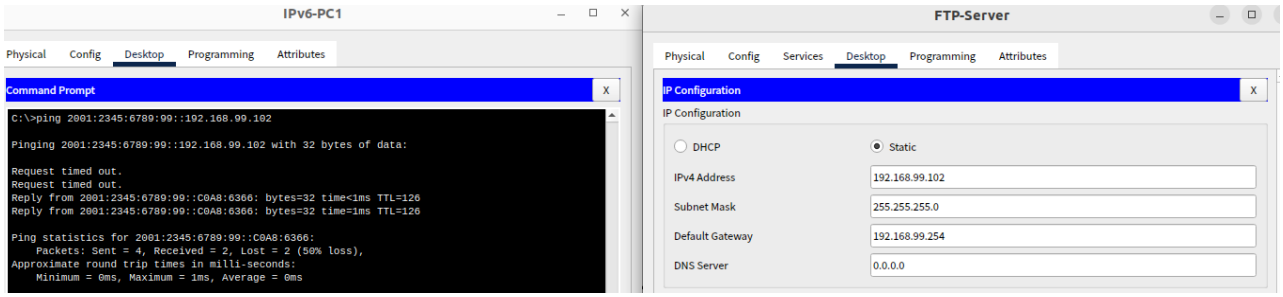
11. configure the nat-pt on IPv6-Router.

Reference 4.natpt. Configuration Examples for NAT-PT for IPv6

```
IPv6-Router(config)#interface f 0/0
IPv6-Router(config-if)#ipv6 nat
IPv6-Router(config)#interface f 0/1
IPv6-Router(config-if)#ipv6 nat
```

```
IPv6-Router(config)#ipv6 access-list v6List
IPv6-Router(config-ipv6-acl)#permit ipv6 2001:2345:6789:66::/64
2001:2345:6789:99::192.168.99.101/128
IPv6-Router(config-ipv6-acl)#permit ipv6 2001:2345:6789:66::/64
2001:2345:6789:99::192.168.99.102/128

IPv6-Router(config-ipv6-acl)#exit

IPv6-Router(config)#ipv6 nat v6v4 pool v4Pool 192.168.66.101 192.168.66.199 prefix-
length 24
IPv6-Router(config)#ipv6 nat v6v4 source list v6List pool v4Pool

IPv6-Router(config)#ipv6 nat prefix 2001:2345:6789:99::/96
IPv6-Router(config)#interface f 0/0
IPv6-Router(config-if)#ipv6 nat prefix 2001:2345:6789:99::/96 v4-mapped v6List
```

- From IPv6-PC1 to FTP-Server




```
IPv6-Router#show ipv6 nat translations
Prot  IPv4 source              IPv6 source
      IPv4 destination         IPv6 destination
---   192.168.66.101           2001:2345:6789:66:260:70FF:FE4C:7D9B
---   ---                      ---

IPv6-Router#show ipv6 nat translations
Prot  IPv4 source              IPv6 source
      IPv4 destination         IPv6 destination
icmp  192.168.66.101,13        2001:2345:6789:66:260:70FF:FE4C:7D9B,13
      192.168.99.102,13        2001:2345:6789:99::C0A8:6366,13

icmp  192.168.66.101,14        2001:2345:6789:66:260:70FF:FE4C:7D9B,14
      192.168.99.102,14        2001:2345:6789:99::C0A8:6366,14

icmp  192.168.66.101,15        2001:2345:6789:66:260:70FF:FE4C:7D9B,15
      192.168.99.102,15        2001:2345:6789:99::C0A8:6366,15

icmp  192.168.66.101,16        2001:2345:6789:66:260:70FF:FE4C:7D9B,16
      192.168.99.102,16        2001:2345:6789:99::C0A8:6366,16

---   192.168.66.101           2001:2345:6789:66:260:70FF:FE4C:7D9B
---   ---                      ---
```