Lab 1.LANs Technology

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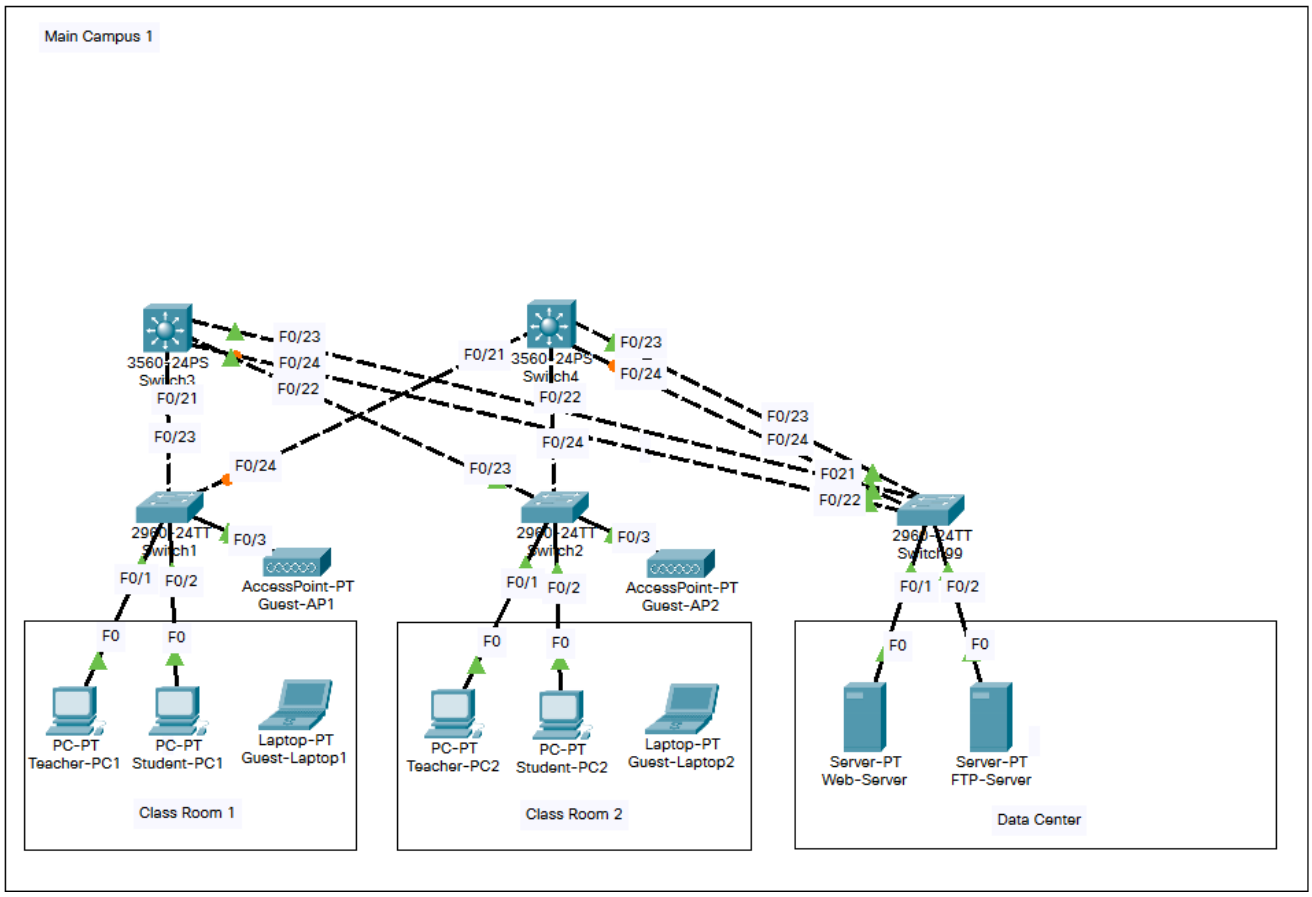
Objective

- Understand the LANs Technologies, including switched LANs, virtual LANs and wireless LANs.

Topology



Address Scheme

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			
	F0/21~24	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 88	IPv4: 192.168.88.1/24	SVI
	Vlan 99	IPv4: 192.168.99.1/24	SVI
Switch4			
	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
Switch99	F0/1	N/A	VLAN ID = 99
	F0/2	N/A	VLAN ID = 99
	F0/3	N/A	VLAN ID = 99
	F0/21~24	N/A	VLAN ID = All VLANs (trunk)
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
Web-Server FTP Server	F0 F0	IPv4: 192.168.99.101/24 IPv4: 192.168.99.102/24	N/A

Part 1 – Switched LANs.

Step 5 – STP

10. configure the root switch of the spanning-tree protocol for each vlan.

Reference 1.Q27-Q28

```
Switch3(config)#spanning-tree vlan 11 priority 4096
Switch3(config)#spanning-tree vlan 22 priority 4096
Switch3(config)#spanning-tree vlan 88 priority 4096
Switch3(config)#spanning-tree vlan 99 priority 8192


Switch4(config)#spanning-tree vlan 11 priority 8192
Switch4(config)#spanning-tree vlan 22 priority 8192
Switch4(config)#spanning-tree vlan 88 priority 8192
Switch4(config)#spanning-tree vlan 99 priority 4096
```

```
Switch1#show spanning-tree vlan 11
VLAN0011
  Spanning tree enabled protocol ieee
  Root ID    Priority    4107
             Address     000B.BE7B.8A54
             Cost        19
             Port        23(FastEthernet0/23)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32779  (priority 32768 sys-id-ext 11)
             Address     000A.F382.ABD5
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Fa0/23           Root FWD 19        128.23   P2p
Fa0/24           Altn BLK 19        128.24   P2p
Switch1#show spanning-tree vlan 22
VLAN0022
  Spanning tree enabled protocol ieee
  Root ID    Priority    4118
             Address     000B.BE7B.8A54
             Cost        19
             Port        23(FastEthernet0/23)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32790  (priority 32768 sys-id-ext 22)
             Address     000A.F382.ABD5
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/23           Root FWD 19        128.23   P2p
Fa0/24           Altn BLK 19        128.24   P2p
Switch1#show spanning-tree vlan 88
VLAN0088
  Spanning tree enabled protocol ieee
  Root ID    Priority    4184
             Address     000B.BE7B.8A54
             Cost        19
             Port        23(FastEthernet0/23)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32856  (priority 32768 sys-id-ext 88)
             Address     000A.F382.ABD5
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/3            Desg FWD 19        128.3    Shr
Fa0/23           Root FWD 19        128.23   P2p
Fa0/24           Altn BLK 19        128.24   P2p
Switch1#show spanning-tree vlan 99
VLAN0099
  Spanning tree enabled protocol ieee
  Root ID    Priority    4195
             Address     0010.1135.5876
```

```
             Cost        19
             Port        24(FastEthernet0/24)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32867  (priority 32768 sys-id-ext 99)
             Address     000A.F382.ABD5
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/23           Altn BLK 19        128.23   P2p
Fa0/24           Root FWD 19        128.24   P2p


Switch3#show spanning-tree vlan 11
VLAN0011
  Spanning tree enabled protocol ieee
  Root ID    Priority    4107
             Address     000B.BE7B.8A54
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    4107  (priority 4096 sys-id-ext 11)
             Address     000B.BE7B.8A54
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po3              Desg FWD 9         128.27   Shr
Switch3#show spanning-tree vlan 22
VLAN0022
  Spanning tree enabled protocol ieee
  Root ID    Priority    4118
             Address     000B.BE7B.8A54
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    4118  (priority 4096 sys-id-ext 22)
             Address     000B.BE7B.8A54
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po3              Desg FWD 9         128.27   Shr
Switch3#show spanning-tree vlan 88
VLAN0088
  Spanning tree enabled protocol ieee
  Root ID    Priority    4184
             Address     000B.BE7B.8A54
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    4184  (priority 4096 sys-id-ext 88)
             Address     000B.BE7B.8A54
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
```

```
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po3              Desg FWD 9         128.27   Shr
Switch3#show spanning-tree vlan 99
VLAN0099
  Spanning tree enabled protocol ieee
  Root ID    Priority    4195
             Address     0010.1135.5876
             Cost        18
             Port        27(Port-channel3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    8291  (priority 8192 sys-id-ext 99)
             Address     000B.BE7B.8A54
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po3              Root FWD 9         128.27   Shr


Switch4#show spanning-tree vlan 11
VLAN0011
  Spanning tree enabled protocol ieee
  Root ID    Priority    4107
             Address     000B.BE7B.8A54
             Cost        18
             Port        27(Port-channel4)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    8203  (priority 8192 sys-id-ext 11)
             Address     0010.1135.5876
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po4              Root FWD 9         128.27   Shr
Switch4#show spanning-tree vlan 22
VLAN0022
  Spanning tree enabled protocol ieee
  Root ID    Priority    4118
             Address     000B.BE7B.8A54
             Cost        18
             Port        27(Port-channel4)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    8214  (priority 8192 sys-id-ext 22)
             Address     0010.1135.5876
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po4              Root FWD 9         128.27   Shr
Switch4#show spanning-tree vlan 88
```

```
VLAN0088
  Spanning tree enabled protocol ieee
  Root ID    Priority    4184
             Address     000B.BE7B.8A54
             Cost        18
             Port        27(Port-channel4)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    8280  (priority 8192 sys-id-ext 88)
             Address     0010.1135.5876
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po4              Root FWD 9         128.27   Shr
Switch4#show spanning-tree vlan 99
VLAN0099
  Spanning tree enabled protocol ieee
  Root ID    Priority    4195
             Address     0010.1135.5876
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    4195  (priority 4096 sys-id-ext 99)
             Address     0010.1135.5876
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/21           Desg FWD 19        128.21   P2p
Fa0/22           Desg FWD 19        128.22   P2p
Po4              Desg FWD 9         128.27   Shr


Switch99#show spanning-tree vlan 11
VLAN0011
  Spanning tree enabled protocol ieee
  Root ID    Priority    4107
             Address     000B.BE7B.8A54
             Cost        9
             Port        27(Port-channel3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32779  (priority 32768 sys-id-ext 11)
             Address     0000.0C9D.951B
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po3              Root FWD 9         128.27   Shr
Po4              Desg FWD 9         128.28   Shr
Switch99#show spanning-tree vlan 22
VLAN0022
  Spanning tree enabled protocol ieee
  Root ID    Priority    4118
             Address     000B.BE7B.8A54
             Cost        9
             Port        27(Port-channel3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
```

```
  Bridge ID  Priority    32790  (priority 32768 sys-id-ext 22)
             Address     0000.0C9D.951B
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po3              Root FWD 9         128.27   Shr
Po4              Desg FWD 9         128.28   Shr
Switch99#show spanning-tree vlan 88
VLAN0088
  Spanning tree enabled protocol ieee
  Root ID    Priority    4184
             Address     000B.BE7B.8A54
             Cost        9
             Port        27(Port-channel3)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32856  (priority 32768 sys-id-ext 88)
             Address     0000.0C9D.951B
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Po3              Root FWD 9         128.27   Shr
Po4              Desg FWD 9         128.28   Shr
Switch99#show spanning-tree vlan 99
VLAN0099
  Spanning tree enabled protocol ieee
  Root ID    Priority    4195
             Address     0010.1135.5876
             Cost        9
             Port        28(Port-channel4)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
  Bridge ID  Priority    32867  (priority 32768 sys-id-ext 99)
             Address     0000.0C9D.951B
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/1            Desg FWD 19        128.1    P2p
Fa0/2            Desg FWD 19        128.2    P2p
Po3              Desg FWD 9         128.27   Shr
Po4              Root FWD 9         128.28   Shr
```

Part 2 – Virtual LANs.

Step 1 – VTP

1. install the vtp on all switches and configure the trunk ports between switches.

Reference 2.Q5~Q6

```
Switch1(config)#vtp version 2
Switch1(config)#vtp domain must
Changing VTP domain name from NULL to must
Switch1(config)#vtp mode server
Device mode already VTP SERVER.
Switch1(config)#interface range FastEthernet 0/23-24
Switch1(config-if-range)#switchport trunk native vlan 1
Switch1(config-if-range)#switchport mode trunk
Switch1(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up
Switch1#show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 255
Number of existing VLANs        : 5
VTP Operating Mode              : Server
VTP Domain Name                 : must
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Enabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x60 0x59 0x49 0x60 0x35 0xAA 0x84 0x9C
Configuration last modified by 0.0.0.0 at 3-1-93 00:01:32
Local updater ID is 0.0.0.0 (no valid interface found)


Switch2(config)#interface range FastEthernet 0/23-24
Switch2(config-if-range)#switchport trunk native vlan 1
Switch2(config-if-range)#switchport mode trunk
Switch2(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up
Switch2(config-if-range)#


Switch3(config)#interface range FastEthernet 0/21-24
Switch3(config-if-range)#switchport trunk encapsulation dot1q
Switch3(config-if-range)#switchport trunk native vlan 1
Switch3(config-if-range)#switchport mode trunk
Switch3(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up
Switch3(config-if-range)#
```

```
Switch4(config)#interface range FastEthernet 0/21-24
Switch4(config-if-range)#switchport trunk encapsulation dot1q
Switch4(config-if-range)#switchport trunk native vlan 1
Switch4(config-if-range)#switchport mode trunk
Switch4(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up
Switch4(config-if-range)#


Switch99(config)#interface range FastEthernet 0/21-24
Switch99(config-if-range)#switchport trunk native vlan 1
Switch99(config-if-range)#switchport mode trunk
```

Step 2 – VLAN

2. create the new vlans on all switches. (**4 vlans for teachers, students, guests and servers.**)

Reference 2.Q11

```
Switch1(config)#vlan 11
Switch1(config-vlan)#name Teacher_VLAN_11
Switch1(config-vlan)#vlan 22
Switch1(config-vlan)#name Student_VLAN_22
Switch1(config-vlan)#vlan 88
Switch1(config-vlan)#name Wireless_VLAN_88
Switch1(config-vlan)#vlan 99
Switch1(config-vlan)#name Server_VLAN_99


Switch2(config)#vlan 11
Switch2(config-vlan)#name Teacher_VLAN_11
Switch2(config-vlan)#vlan 22
Switch2(config-vlan)#name Student_VLAN_22
Switch2(config-vlan)#vlan 88
Switch2(config-vlan)#name Wireless_VLAN_88
Switch2(config-vlan)#vlan 99
Switch2(config-vlan)#name Server_VLAN_99


Switch3(config)#vlan 11
Switch3(config-vlan)#name Teacher_VLAN_11
Switch3(config-vlan)#vlan 22
Switch3(config-vlan)#name Student_VLAN_22
Switch3(config-vlan)#vlan 88
Switch3(config-vlan)#name Wireless_VLAN_88
Switch3(config-vlan)#vlan 99
Switch3(config-vlan)#name Server_VLAN_99
```

```
Switch4(config)#vlan 11
Switch4(config-vlan)#name Teacher_VLAN_11
Switch4(config-vlan)#vlan 22
Switch4(config-vlan)#name Student_VLAN_22
Switch4(config-vlan)#vlan 88
Switch4(config-vlan)#name Wireless_VLAN_88
Switch4(config-vlan)#vlan 99
Switch4(config-vlan)#name Server_VLAN_99


Switch99(config)#vlan 11
Switch99(config-vlan)#name Teacher_VLAN_11
Switch99(config-vlan)#vlan 22
Switch99(config-vlan)#name Student_VLAN_22
Switch99(config-vlan)#vlan 88
Switch99(config-vlan)#name Wireless_VLAN_88
Switch99(config-vlan)#vlan 99
Switch99(config-vlan)#name Server_VLAN_99
```

3. assign the access ports to the new vlans on all access switches (Switch1, Switch2, Switch99)

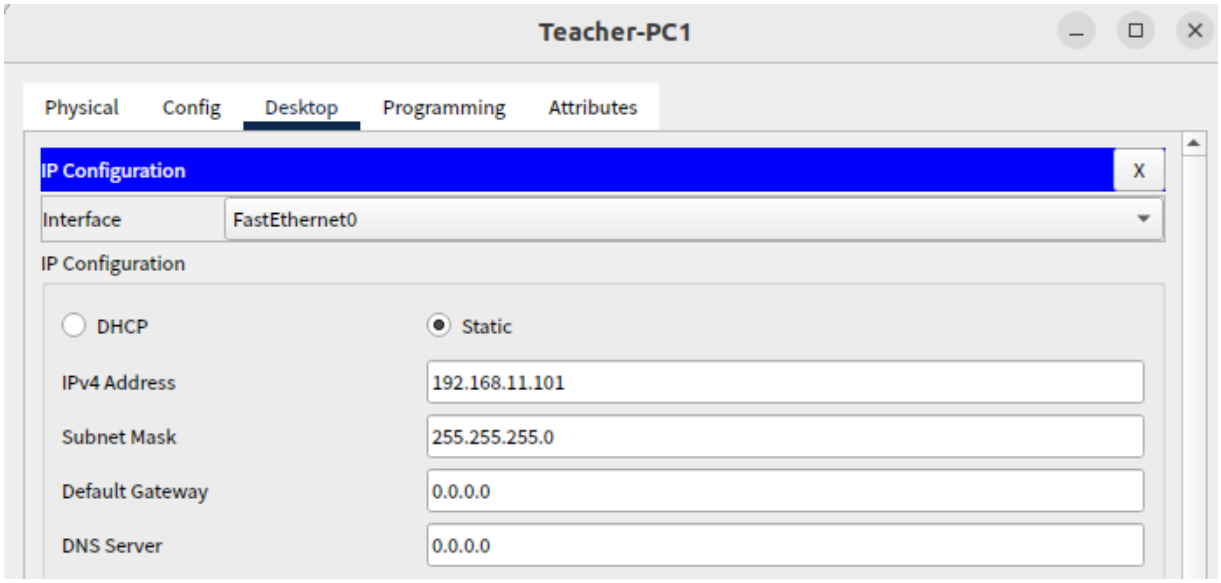
Reference 2.Q18

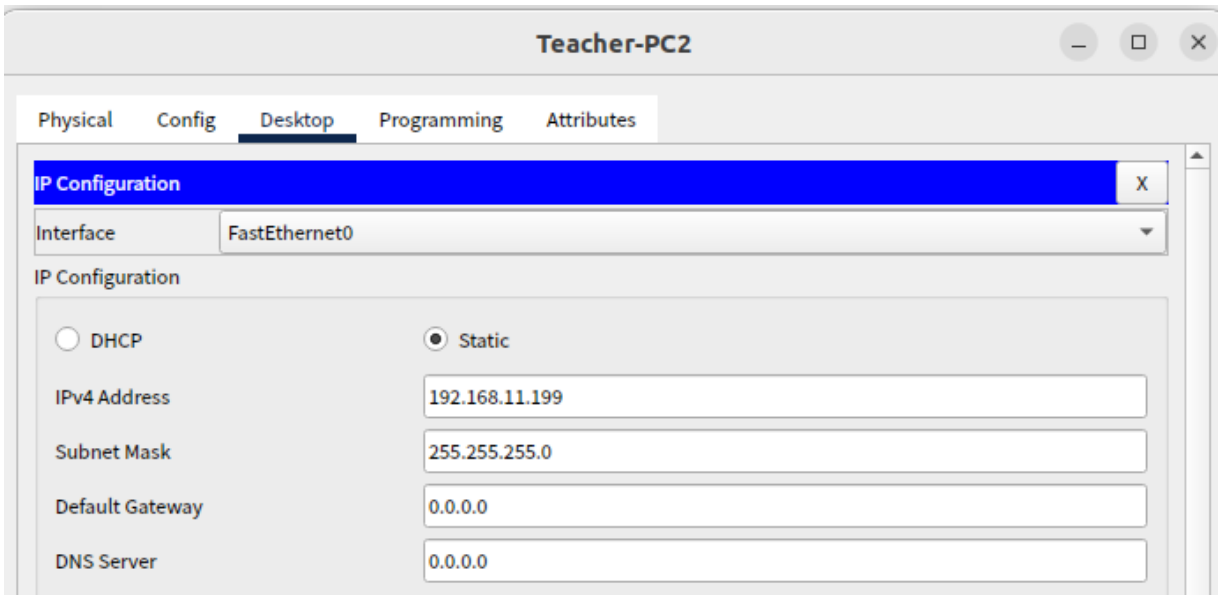
```
Switch1(config)#interface FastEthernet 0/1
Switch1(config-if)#switchport mode access
Switch1(config-if)#switchport access vlan 11
Switch1(config-if)#interface FastEthernet 0/2
Switch1(config-if)#switchport mode access
Switch1(config-if)#switchport access vlan 22
Switch1(config-if)#interface FastEthernet 0/3
Switch1(config-if)#switchport mode access
Switch1(config-if)#switchport access vlan 88
Switch1#show vlan
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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, Gig0/1
                                                 Gig0/2
11   Teacher_VLAN_11                   active    Fa0/1
22   Student_VLAN_22                   active    Fa0/2
88   Wireless_VLAN_88                  active    Fa0/3
99   Server_VLAN_99                    active
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 Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
```

```
1    enet  100001     1500  -      -      -        -    -        0      0
11   enet  100011     1500  -      -      -        -    -        0      0


Switch2(config)#interface FastEthernet 0/1
Switch2(config-if)#switchport mode access
Switch2(config-if)#switchport access vlan 11
Switch2(config-if)#interface FastEthernet 0/2
Switch2(config-if)#switchport mode access
Switch2(config-if)#switchport access vlan 22
Switch2(config-if)#interface FastEthernet 0/3
Switch2(config-if)#switchport mode access
Switch2(config-if)#switchport access vlan 88
Switch2#show vlan
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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, Gig0/1
                                                 Gig0/2
11   Teacher_VLAN_11                   active    Fa0/1
22   Student_VLAN_22                   active    Fa0/2
88   Wireless_VLAN_88                  active    Fa0/3
99   Server_VLAN_99                    active
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 Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
11   enet  100011     1500  -      -      -        -    -        0      0


Switch99(config)#interface FastEthernet 0/1
Switch99(config-if)#switchport mode access
Switch99(config-if)#switchport access vlan 99
Switch99(config-if)#interface FastEthernet 0/2
Switch99(config-if)#switchport mode access
Switch99(config-if)#switchport access vlan 99
Switch99(config-if)#interface FastEthernet 0/3
Switch99(config-if)#switchport mode access
Switch99(config-if)#switchport access vlan 99
Switch99#show vlan
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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, Gig0/1, Gig0/2
11   Teacher_VLAN_11                   active
22   Student_VLAN_22                   active
88   Wireless_VLAN_88                  active
99   Server_VLAN_99                    active    Fa0/1, Fa0/2, Fa0/3
```

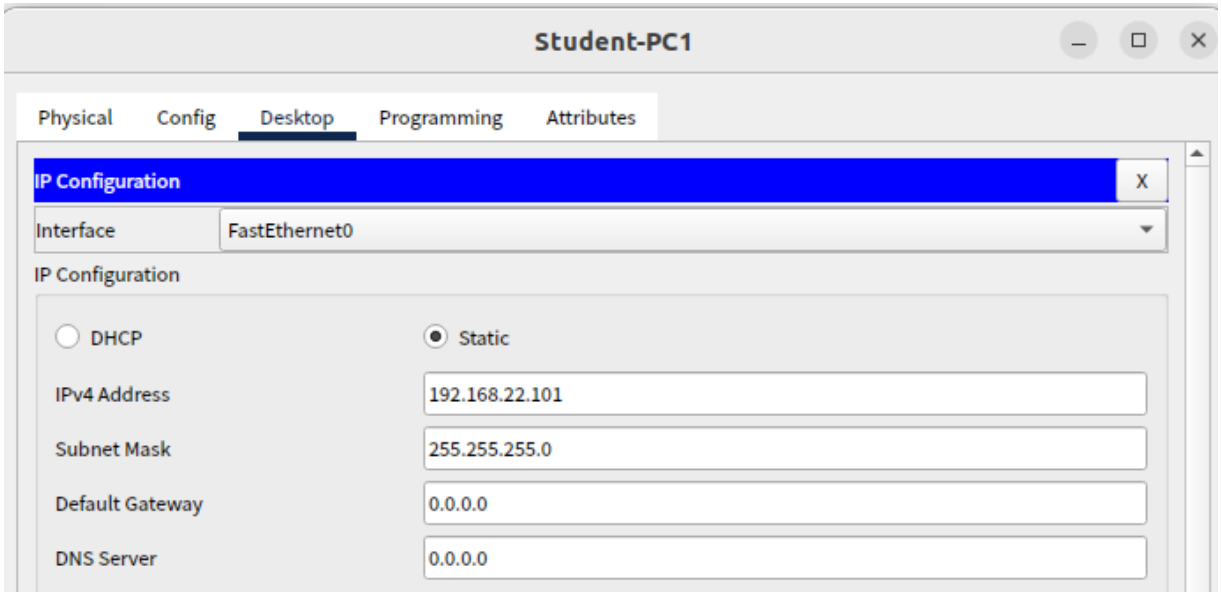
```
1002 fddi-default                     active
1003 token-ring-default               active
1004 fddinet-default                  active
1005 trnet-default                    active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
11   enet  100011     1500  -      -      -        -    -        0      0
22   enet  100022     1500  -      -      -        -    -        0      0
```

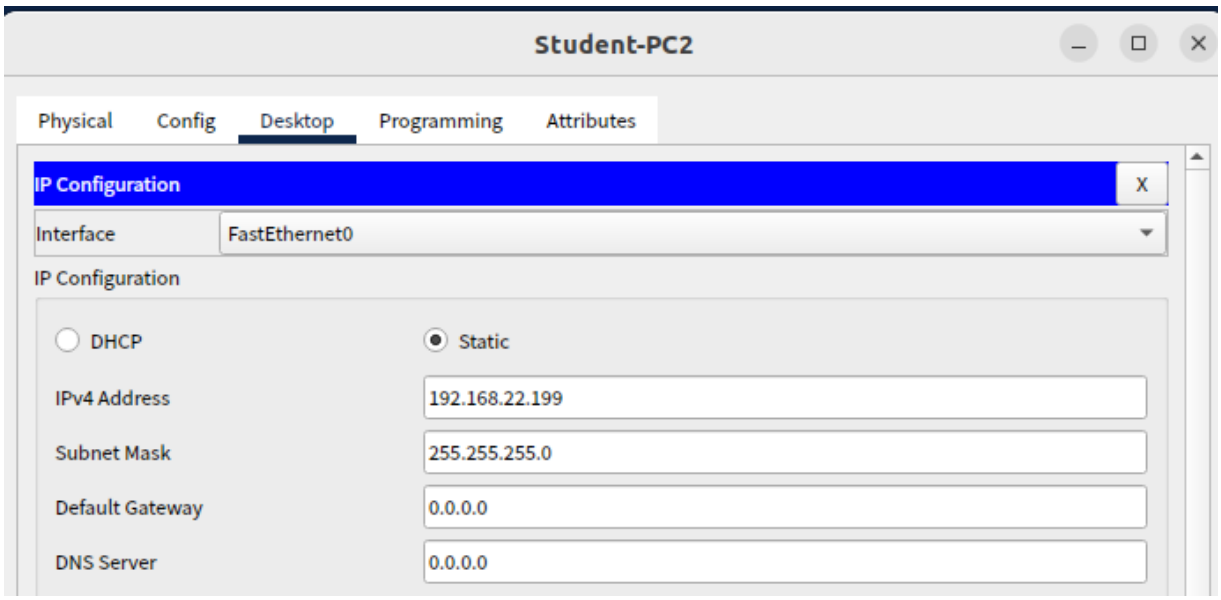
4. configure the ip address on all PCs and servers, and then test the connectivity of intra-vlan communication.

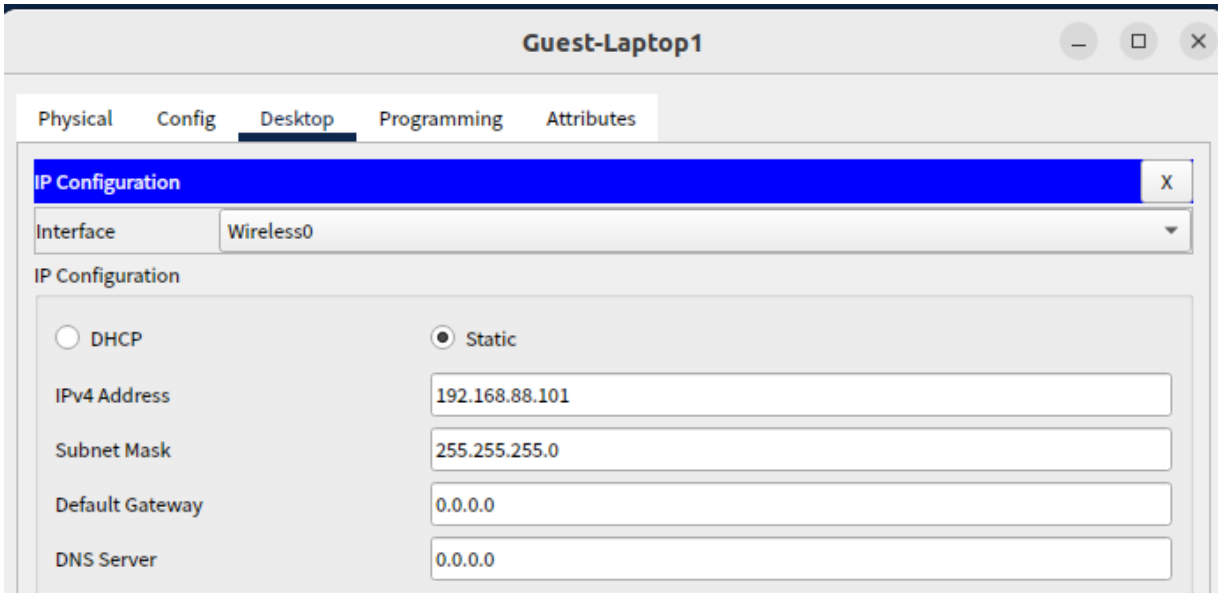
- **configure the ip address on all PCs and servers**
  - Teacher-PC1
    - 

  - Teacher-PC2
    - 

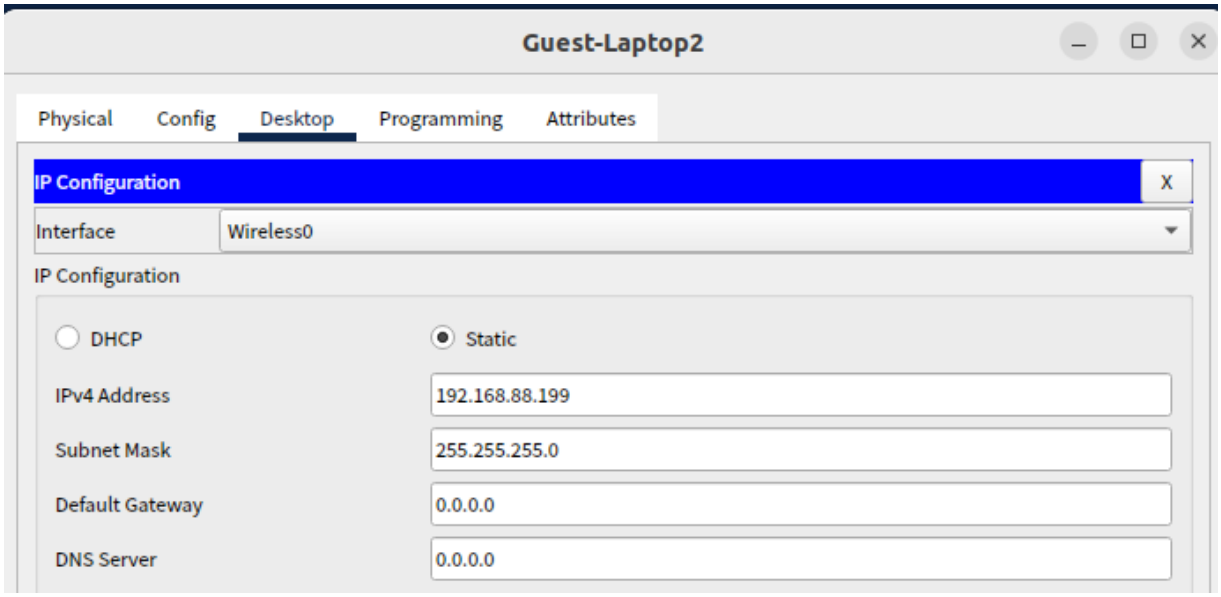
  - Student-PC1

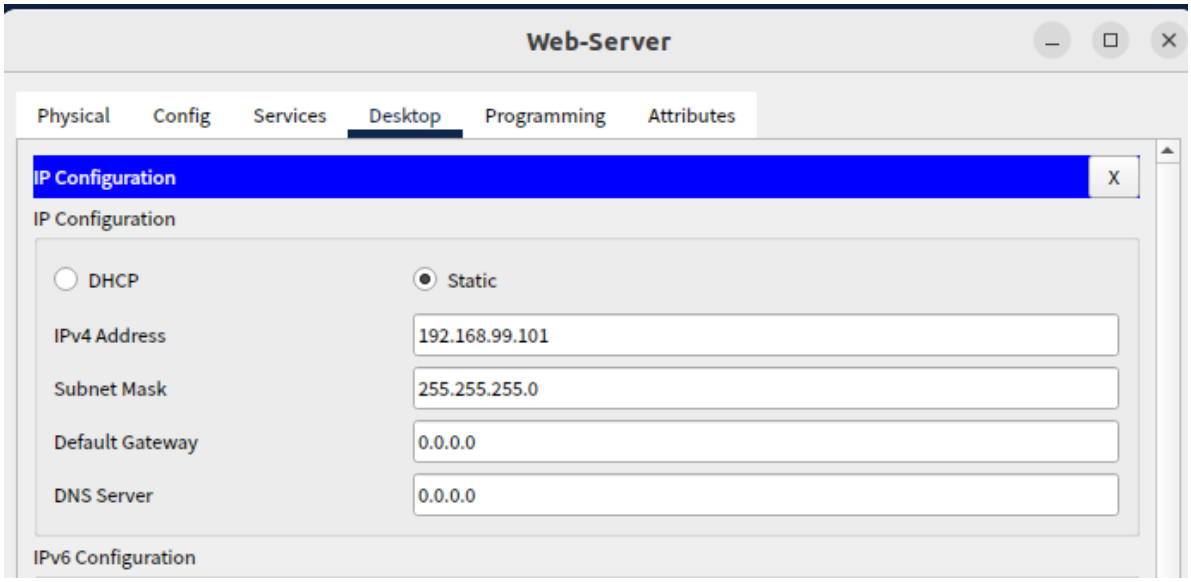
- 

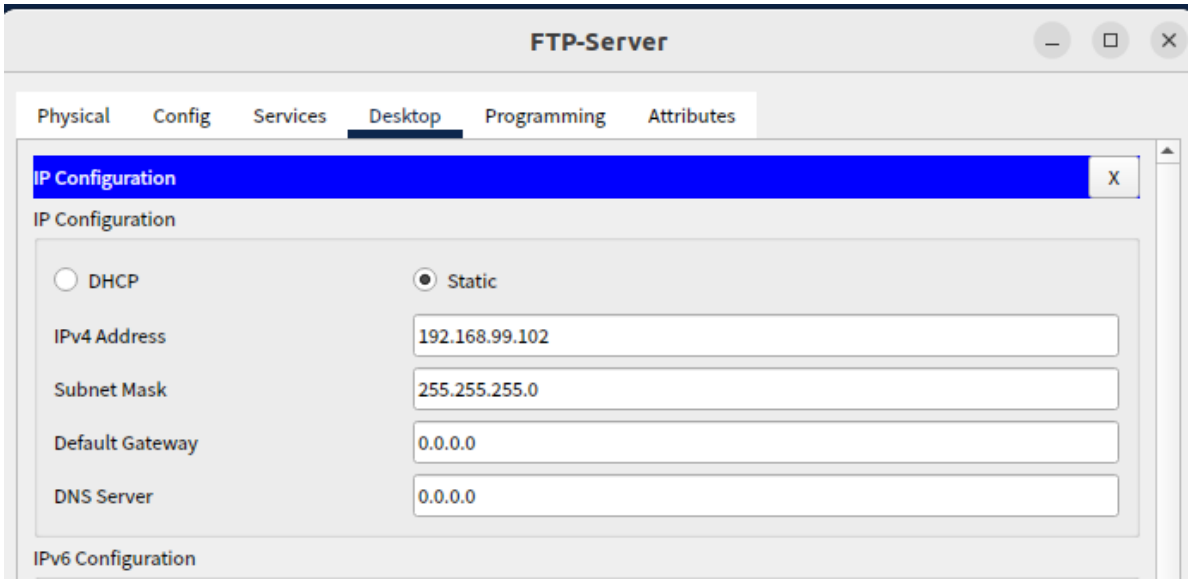
- Student-PC2
  - 

- Guest-Laptop1
  - 

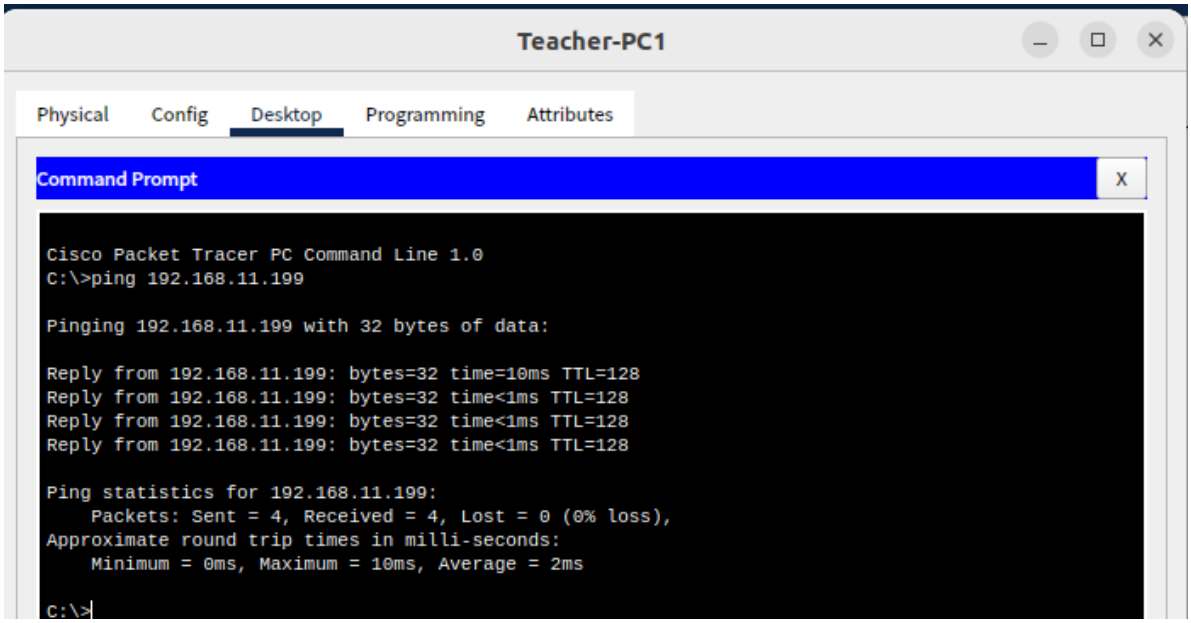
- Guest-Laptop2
  -



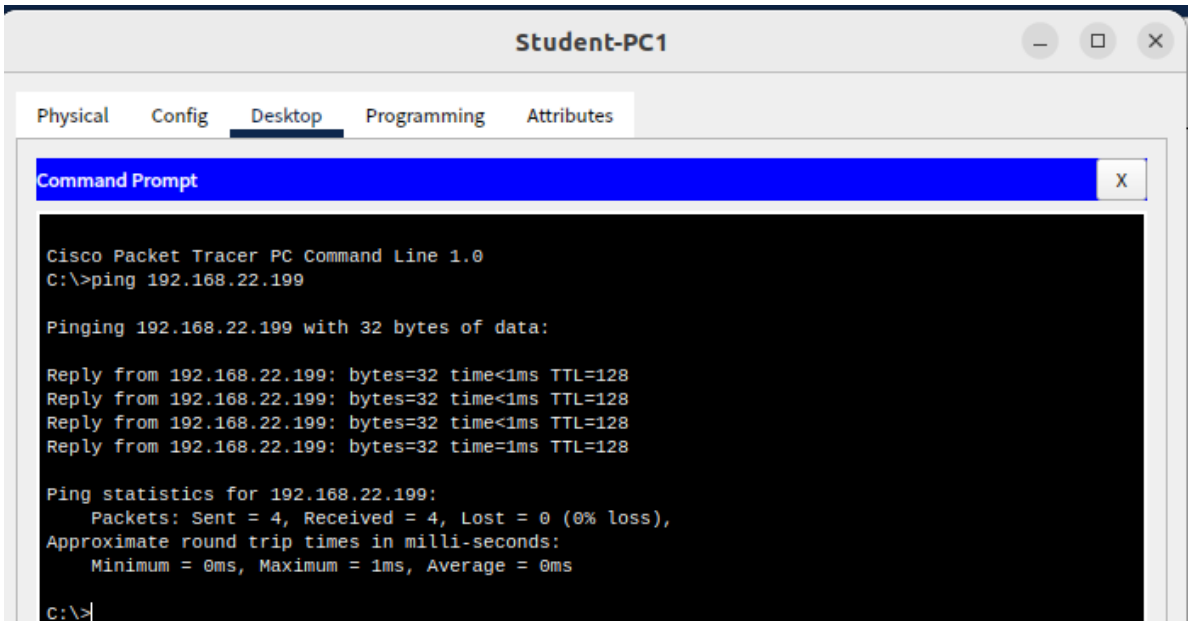
- Web-Server
  - 

- FTP-Server
  - 

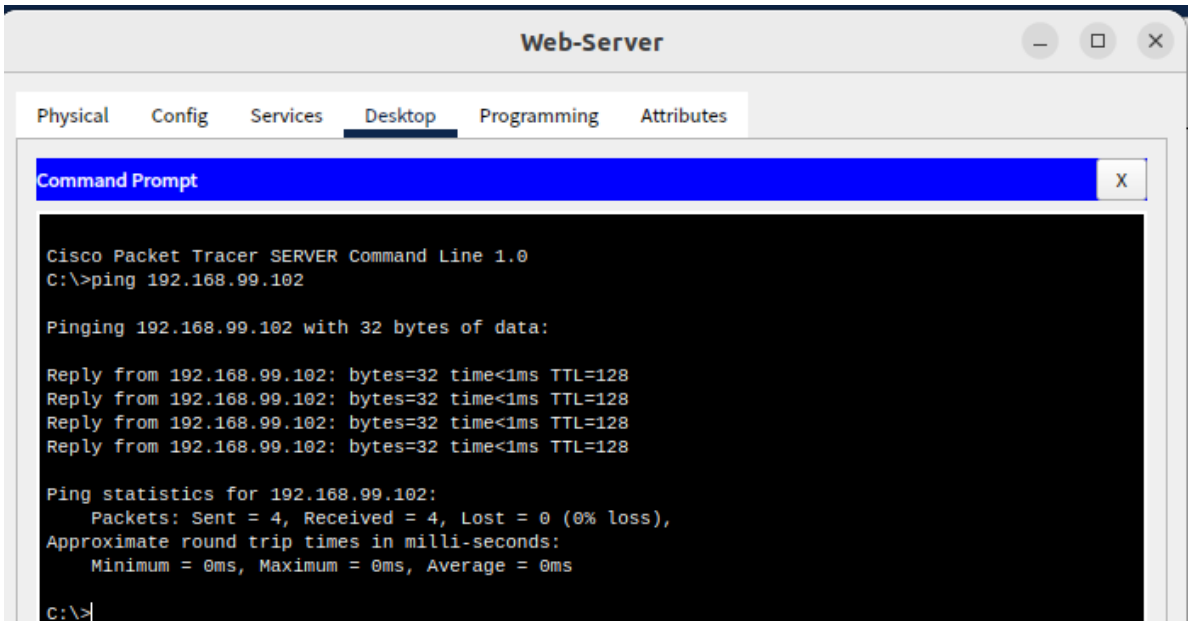
- test the connectivity of intra-vlan communication
  - Vlan 11

- 

- Vlan 22

- 

- Vlan 99

- 

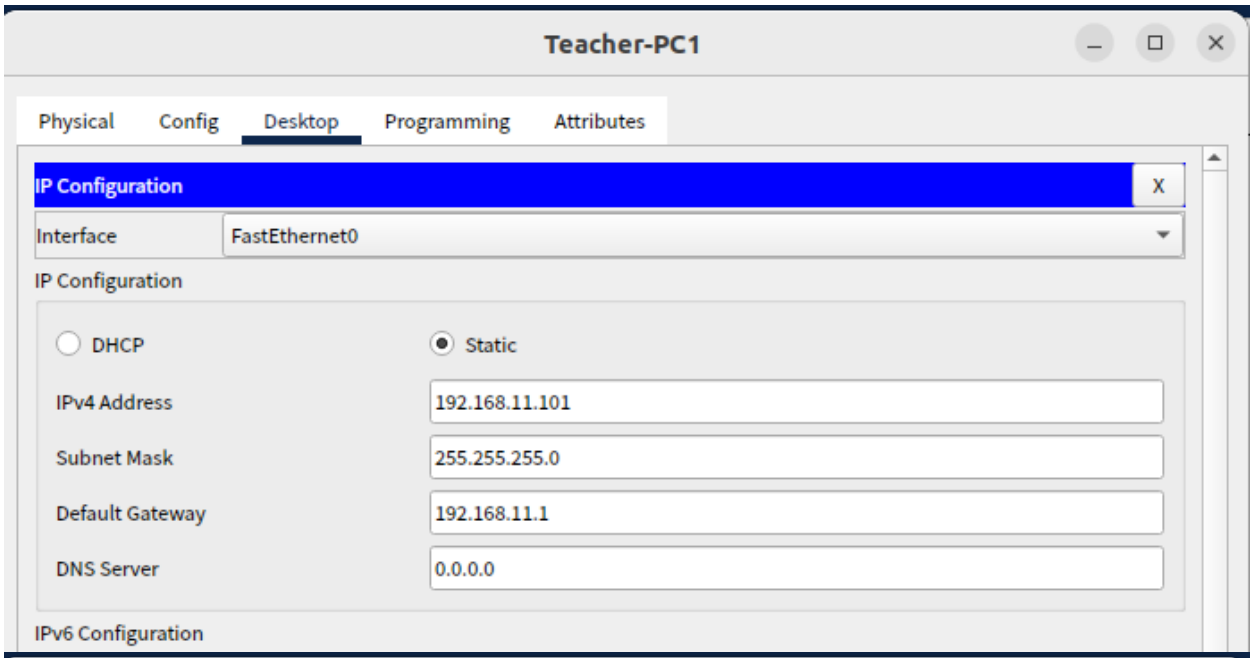
5. enable the routing process, and configure the gateway of each vlan in the distribution switches (Switch3, Switch4).

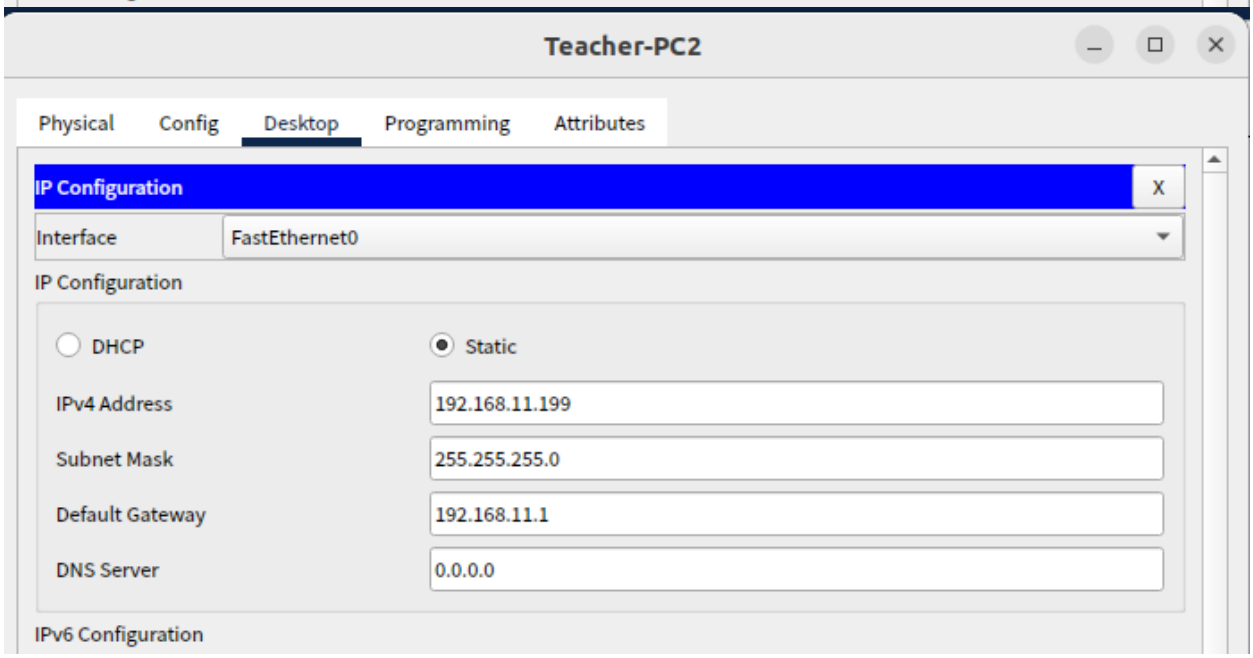
Reference 2.Q25-Q26

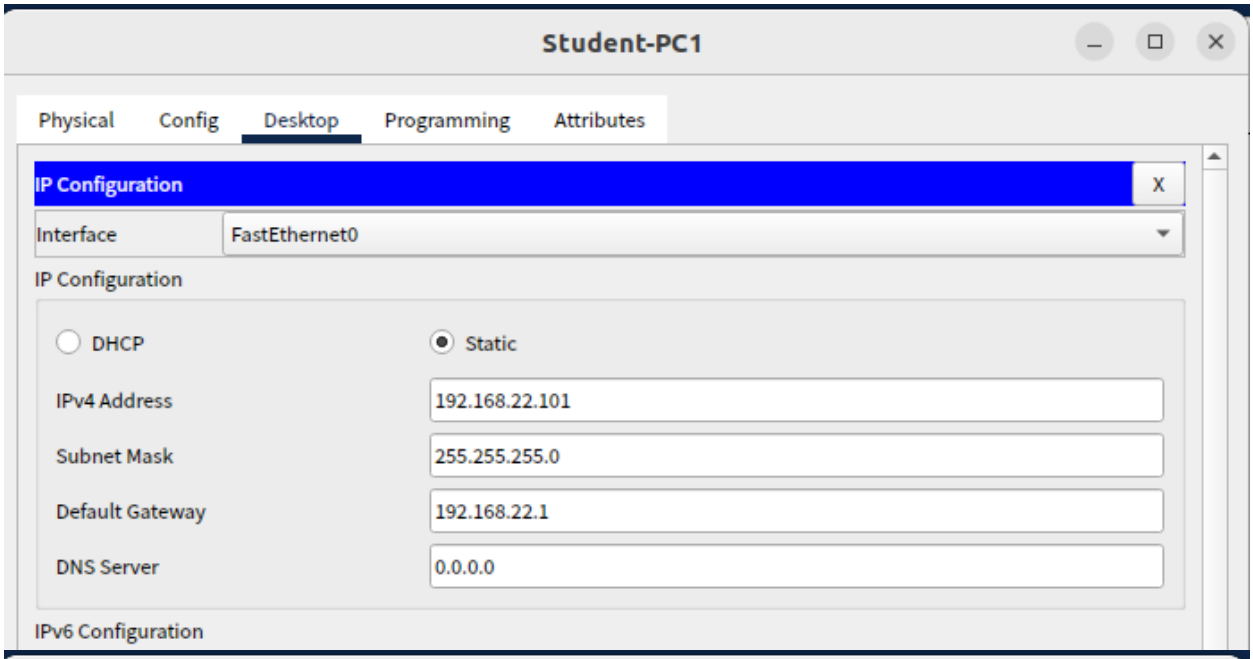
```
Switch3(config)#interface vlan 11
Switch3(config-if)#ip address 192.168.11.1 255.255.255.0
Switch3(config-if)#no shutdown
Switch3(config-if)#interface vlan 22
Switch3(config-if)#ip address 192.168.22.1 255.255.255.0
Switch3(config-if)#no shutdown
Switch3(config-if)#interface vlan 88
Switch3(config-if)#ip address 192.168.88.1 255.255.255.0
Switch3(config-if)#no shutdown
Switch3(config-if)#interface vlan 99
Switch3(config-if)#ip address 192.168.99.1 255.255.255.0
Switch3(config-if)#no shutdown
%LINK-5-CHANGED: Interface Vlan11, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan11, changed state to up
%LINK-5-CHANGED: Interface Vlan22, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan22, changed state to up
%LINK-5-CHANGED: Interface Vlan88, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan88, changed state to up
%LINK-5-CHANGED: Interface Vlan99, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up
Switch3(config-if)#


Switch4(config)#interface vlan 11
Switch4(config-if)#ip address 192.168.11.2 255.255.255.0
Switch4(config-if)#no shutdown
Switch4(config-if)#interface vlan 22
Switch4(config-if)#ip address 192.168.22.2 255.255.255.0
Switch4(config-if)#no shutdown
Switch4(config-if)#interface vlan 88
Switch4(config-if)#ip address 192.168.88.2 255.255.255.0
Switch4(config-if)#no shutdown
Switch4(config-if)#interface vlan 99
Switch4(config-if)#ip address 192.168.99.2 255.255.255.0
Switch4(config-if)#no shutdown
%LINK-5-CHANGED: Interface Vlan11, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan11, changed state to up
%LINK-5-CHANGED: Interface Vlan22, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan22, changed state to up
%LINK-5-CHANGED: Interface Vlan88, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan88, changed state to up
%LINK-5-CHANGED: Interface Vlan99, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan99, changed state to up
Switch4(config-if)#
```

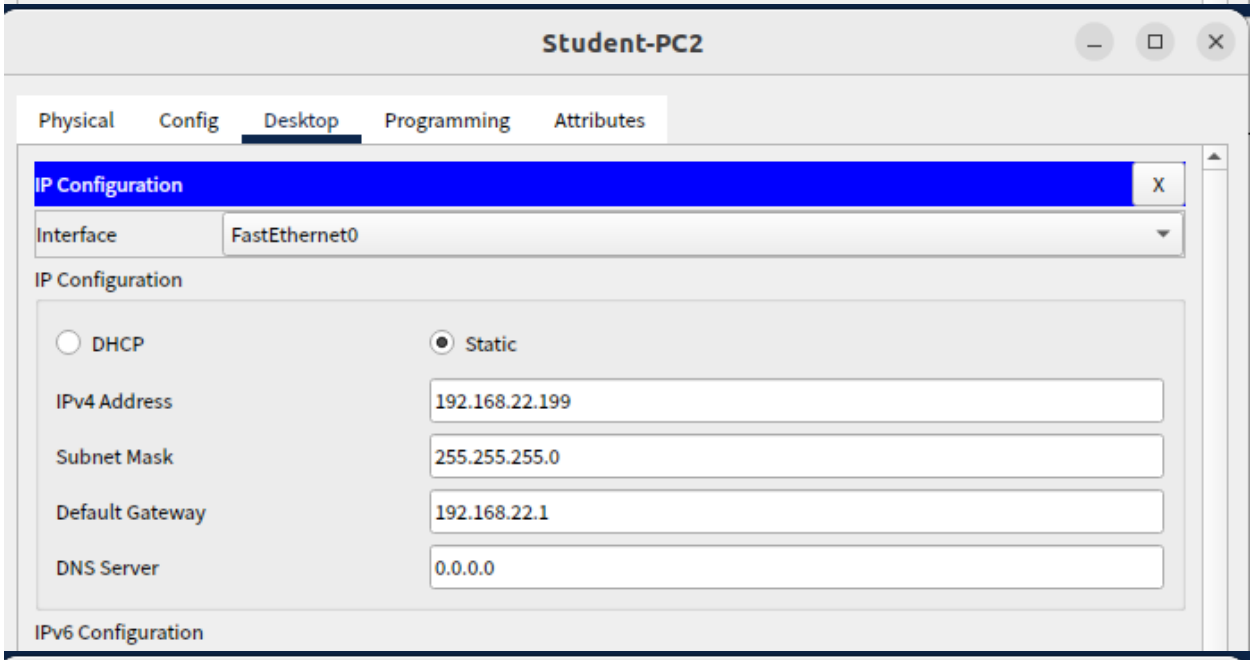
6. configure the gateway on all PCs and servers, and test the connectivity of inter-vlan communication.

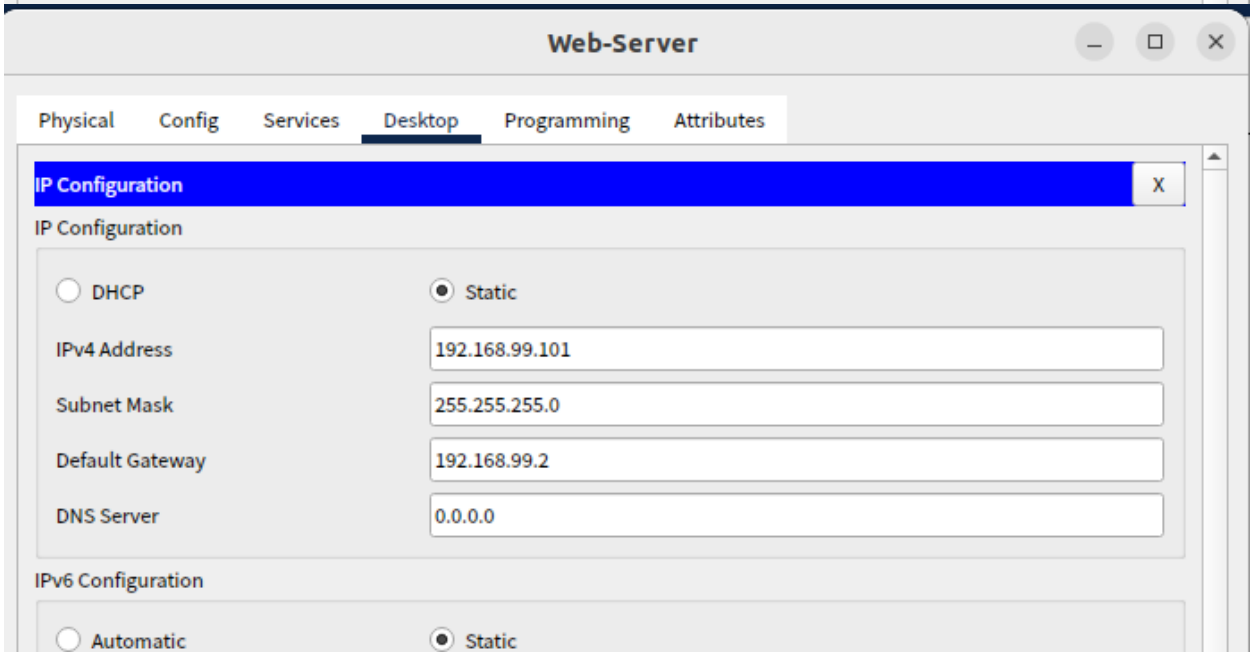
- configure the gateway on all PCs and servers

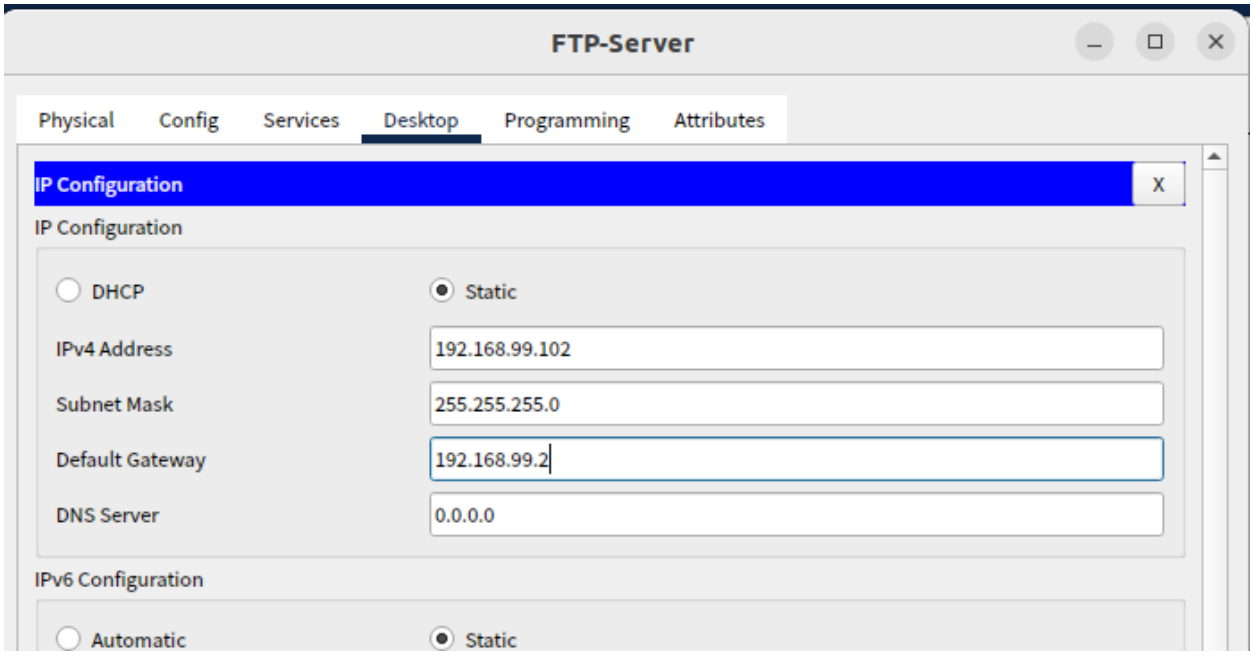


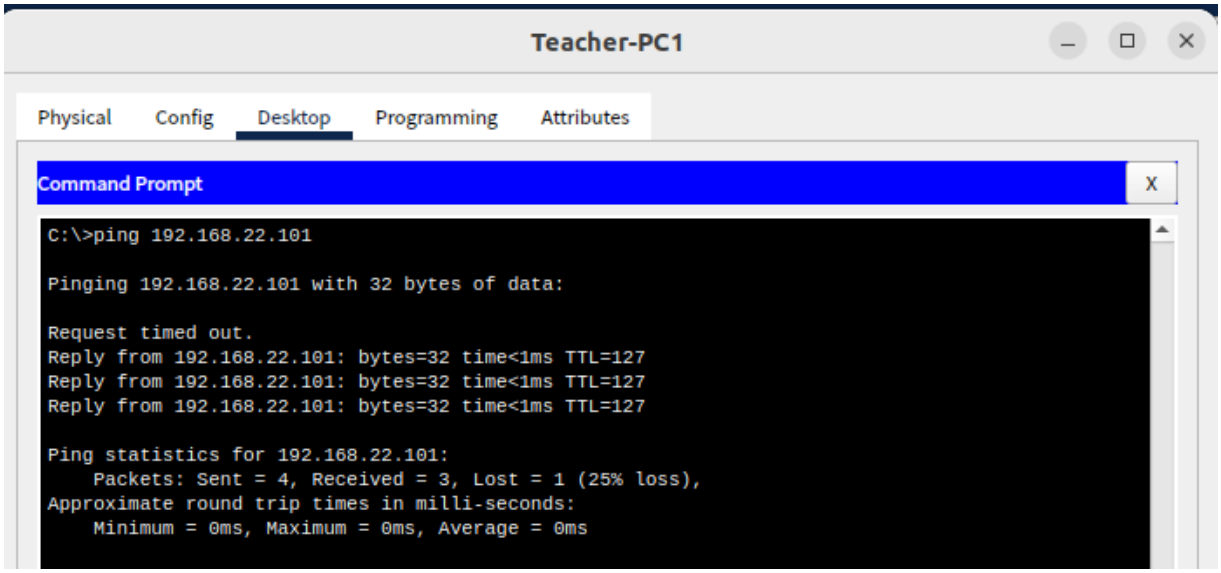


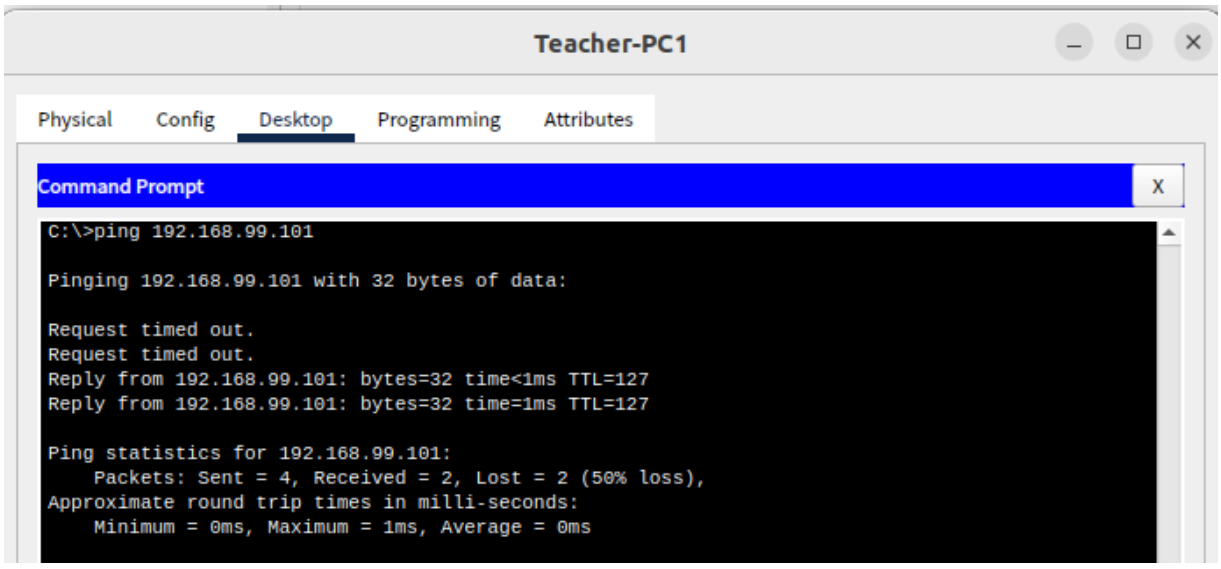

Student-PC1
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.22.101
Subnet Mask
255.255.255.0
Default Gateway
192.168.22.1
DNS Server
0.0.0.0
IPv6 Configuration


Student-PC2
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.22.199
Subnet Mask
255.255.255.0
Default Gateway
192.168.22.1
DNS Server
0.0.0.0
IPv6 Configuration

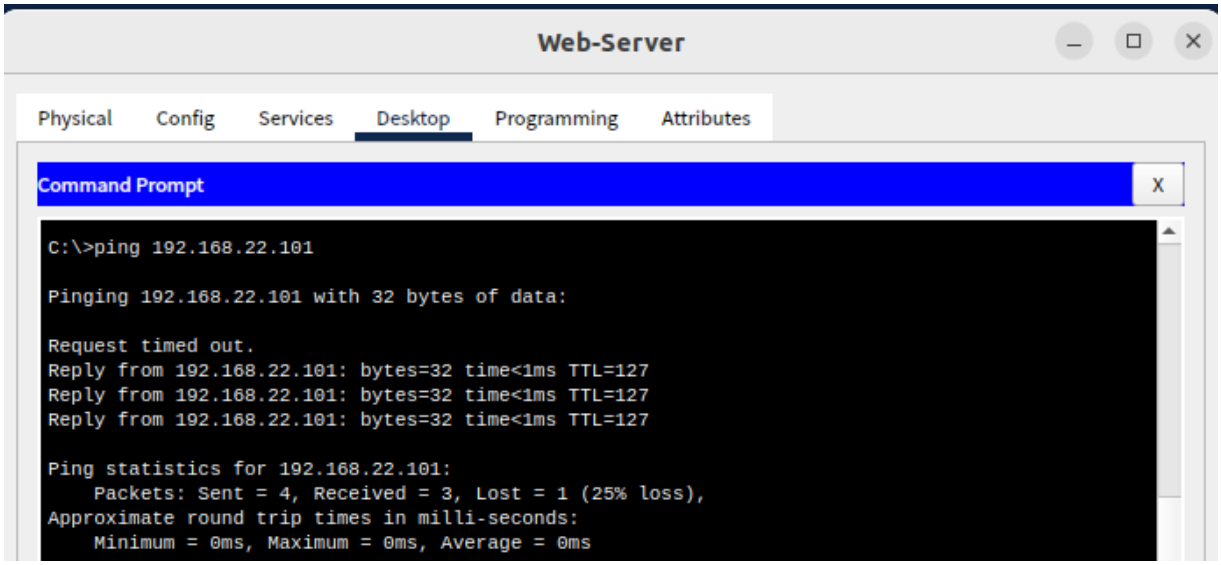

Web-Server
Physical
Config
Services
Desktop
Programming
Attributes
IP Configuration
X
IP Configuration
DHCP
Static
IPv4 Address
192.168.99.101
Subnet Mask
255.255.255.0
Default Gateway
192.168.99.2
DNS Server
0.0.0.0
IPv6 Configuration
Automatic
Static

- 

- test the connectivity of inter-vlan communication
  - vlan 11 -> vlan 22[Teacher-PC1->Student-PC1]
    - 

  - vlan 11 -> vlan 99[Teacher-PC1->Web-Server]
    - 

  - vlan 99 -> vlan 22[Web-Server->Student-PC1]



Step 3 – Link Aggregation

7. configure the ether-channel on the interfaces that connected to switches.

(interfaces between Switch3 and Switch99; interfaces between Switch4 and Switch99)

Reference 2.Q30

```
Switch3(config)#interface range FastEthernet 0/23-24
Switch3(config-if-range)#channel-protocol lacp
Switch3(config-if-range)#channel-group 3 mode active
Switch3(config-if-range)#
Creating a port-channel interface Port-channel 3
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up
Switch3(config-if-range)#
Switch3#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port
Number of channel-groups in use: 1
Number of aggregators:           1
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
3      Po3(SU)           LACP   Fa0/23(P) Fa0/24(P)


Switch4(config)#interface range FastEthernet 0/23-24
Switch4(config-if-range)#channel-protocol lacp
```

```
Switch4(config-if-range)#channel-group 4 mode active
Switch4(config-if-range)#
Creating a port-channel interface Port-channel 4
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up
Switch4(config-if-range)#
Switch4#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port
Number of channel-groups in use: 1
Number of aggregators:           1
Group  Port-channel  Protocol    Ports
------+-------------+-----------+-----------------------------------------------
4      Po4(SU)           LACP   Fa0/23(P) Fa0/24(P)


Switch99(config)#interface range FastEthernet 0/21-22
Switch99(config-if-range)#channel-protocol lacp
Switch99(config-if-range)#channel-group 3 mode active
Switch99(config-if-range)#interface range FastEthernet 0/23-24
Switch99(config-if-range)#channel-protocol lacp
Switch99(config-if-range)#channel-group 4 mode active
Creating a port-channel interface Port-channel 3
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/21, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/22, changed state to up
%LINK-5-CHANGED: Interface Port-channel3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel3, changed state to up
Switch99(config-if-range)#
Creating a port-channel interface Port-channel 4
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/23, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to down
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/24, changed state to up
%LINK-5-CHANGED: Interface Port-channel4, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface Port-channel4, changed state to up
Switch99(config-if-range)#
Switch99#show etherchannel summary
Flags:  D - down        P - in port-channel
        I - stand-alone s - suspended
        H - Hot-standby (LACP only)
        R - Layer3      S - Layer2
        U - in use      f - failed to allocate aggregator
        u - unsuitable for bundling
        w - waiting to be aggregated
        d - default port
Number of channel-groups in use: 2
Number of aggregators:           2
Group  Port-channel  Protocol    Ports
```

```
------+-------------+-----------+--------------------------------------------
3      Po3(SU)           LACP   Fa0/21(P) Fa0/22(P)
4      Po4(SU)           LACP   Fa0/23(P) Fa0/24(P)
```

Step 4 – Redundant Gateway

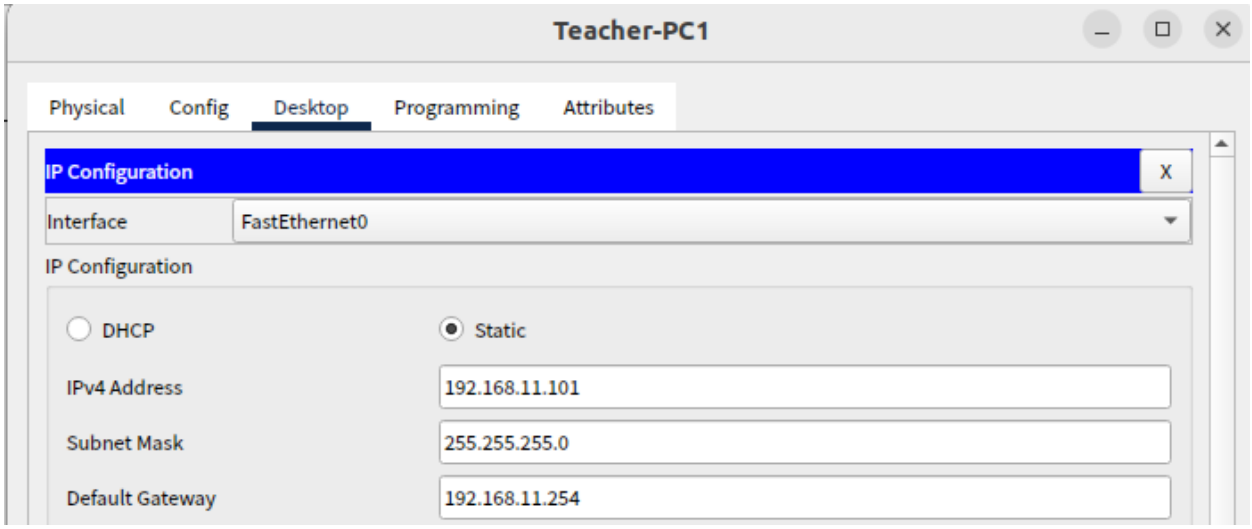
8. configure the active gateway and standby gateway for each vlan on the distribution switches (Switch3, Switch4).

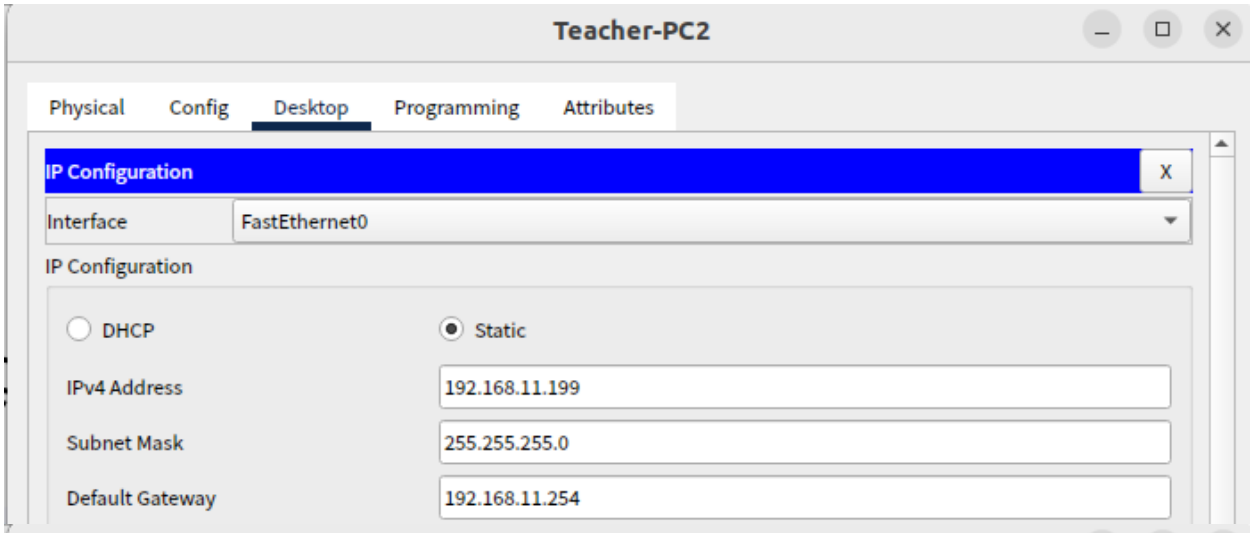
Reference 2.Q35

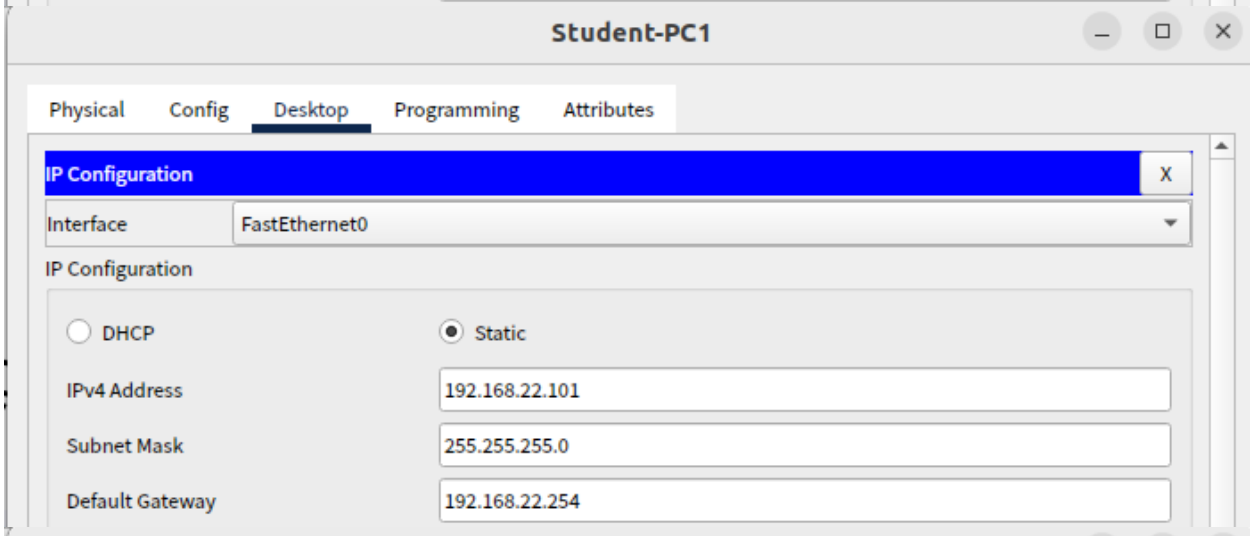
```
Switch3(config)#interface vlan 11
Switch3(config-if)#standby 11 ip 192.168.11.254
Switch3(config-if)#standby 11 priority 101
Switch3(config-if)#standby 11 preempt
Switch3(config-if)#interface vlan 22
Switch3(config-if)#standby 22 ip 192.168.22.254
Switch3(config-if)#standby 22 priority 101
Switch3(config-if)#standby 22 preempt
Switch3(config-if)#interface vlan 88
Switch3(config-if)#standby 88 ip 192.168.88.254
Switch3(config-if)#standby 88 priority 101
Switch3(config-if)#standby 88 preempt
Switch3(config-if)#interface vlan 99
Switch3(config-if)#standby 99 ip 192.168.99.254
Switch3(config-if)#standby 99 priority 99
Switch3(config-if)#standby 99 preempt
Switch3(config-if)#
%HSRP-6-STATECHANGE: Vlan11 Grp 11 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan11 Grp 11 state Standby -> Active
%HSRP-6-STATECHANGE: Vlan99 Grp 99 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan99 Grp 99 state Standby -> Active
%HSRP-6-STATECHANGE: Vlan88 Grp 88 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan88 Grp 88 state Standby -> Active
%HSRP-6-STATECHANGE: Vlan22 Grp 22 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan22 Grp 22 state Standby -> Active
Switch3(config-if)#
Switch3#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Vl11        11   101 P Active   local           192.168.11.2    192.168.11.254
Vl22        22   101 P Active   local           192.168.22.2    192.168.22.254
Vl88        88   101 P Active   local           192.168.88.2    192.168.88.254
Vl99        99   99  P Standby  192.168.99.2    local           192.168.99.254
Switch3#


Switch4(config)#interface vlan 11
Switch4(config-if)#standby 11 ip 192.168.11.254
```

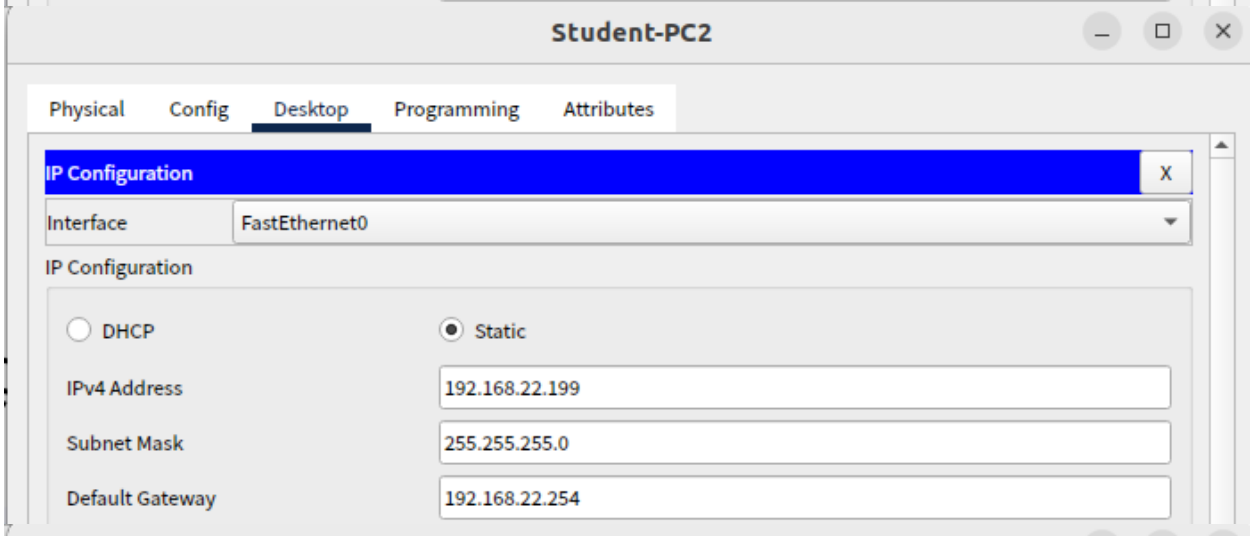
```
Switch4(config-if)#standby 11 priority 99
Switch4(config-if)#standby 11 preempt
Switch4(config-if)#interface vlan 22
Switch4(config-if)#standby 22 ip 192.168.22.254
Switch4(config-if)#standby 22 priority 99
Switch4(config-if)#standby 22 preempt
Switch4(config-if)#interface vlan 88
Switch4(config-if)#standby 88 ip 192.168.88.254
Switch4(config-if)#standby 88 priority 99
Switch4(config-if)#standby 88 preempt
Switch4(config-if)#interface vlan 99
Switch4(config-if)#standby 99 ip 192.168.99.254
Switch4(config-if)#standby 99 priority 101
Switch4(config-if)#standby 99 preempt
Switch4(config-if)#
%HSRP-6-STATECHANGE: Vlan99 Grp 99 state Standby -> Active
%HSRP-6-STATECHANGE: Vlan22 Grp 22 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan11 Grp 11 state Speak -> Standby
%HSRP-6-STATECHANGE: Vlan88 Grp 88 state Speak -> Standby
Switch4#show standby brief
                     P indicates configured to preempt.
                     |
Interface   Grp  Pri P State    Active          Standby         Virtual IP
Vl11        11   99  P Standby  192.168.11.1    local           192.168.11.254
Vl22        22   99  P Standby  192.168.22.1    local           192.168.22.254
Vl88        88   99  P Standby  192.168.88.1    local           192.168.88.254
Vl99        99   101 P Active   local           192.168.99.2    192.168.99.254
```

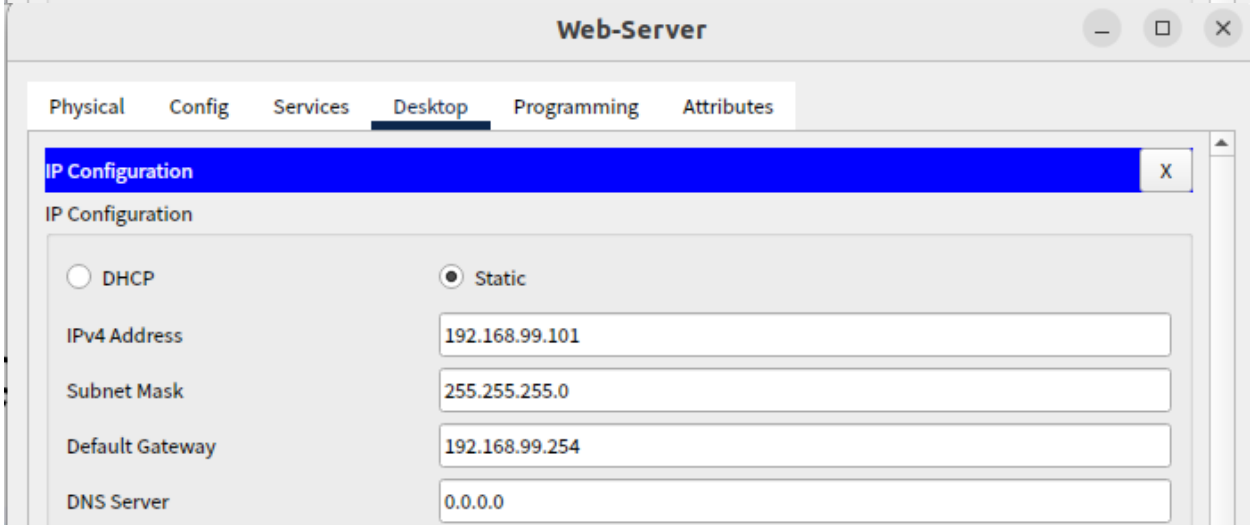
9. configure the virtual gateway on all PCs and servers, and trace the path between the PCs/servers and the active gateway.

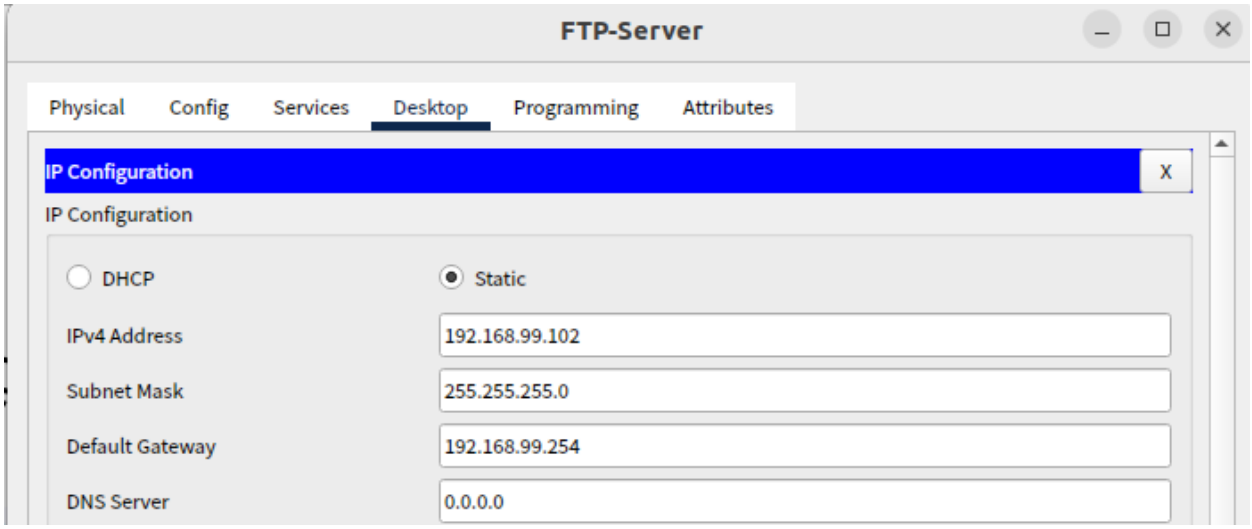
- configure the virtual gateway on all PCs and servers
- 


Teacher-PC2
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.11.199
Subnet Mask
255.255.255.0
Default Gateway
192.168.11.254

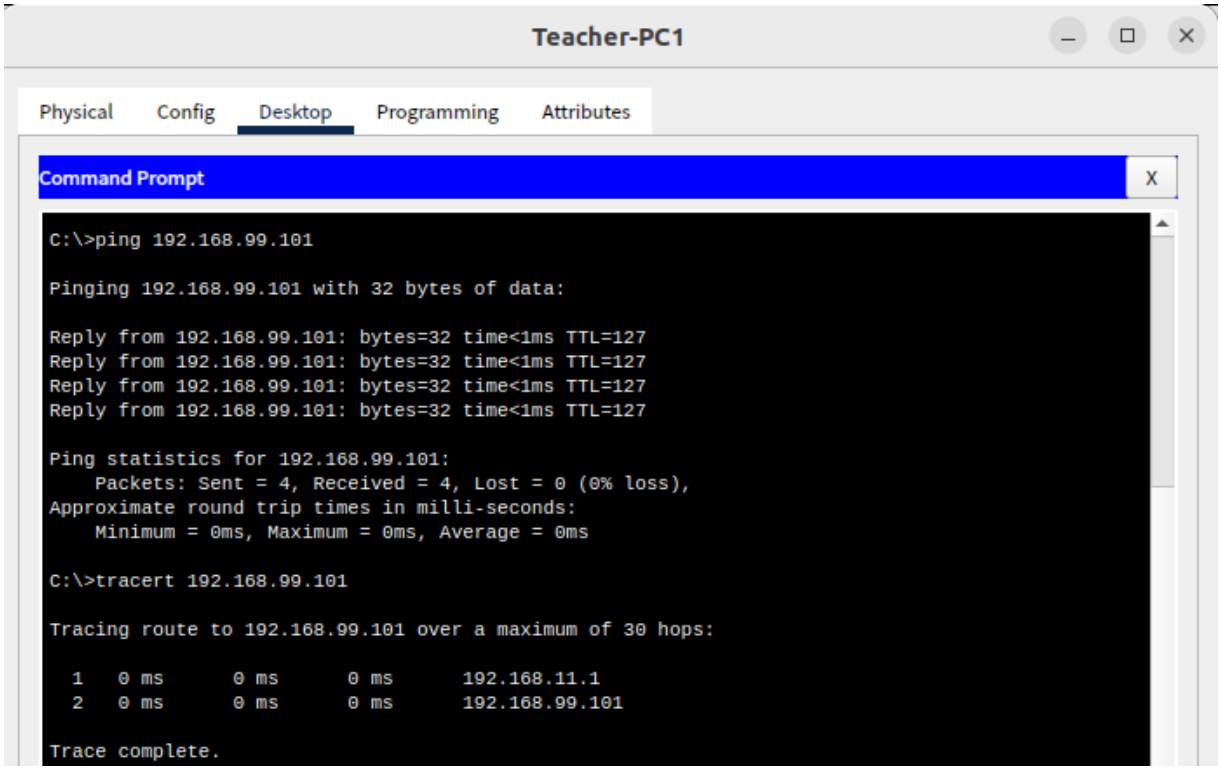

Student-PC1
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.22.101
Subnet Mask
255.255.255.0
Default Gateway
192.168.22.254


Student-PC2
Physical
Config
Desktop
Programming
Attributes
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IPv4 Address
192.168.22.199
Subnet Mask
255.255.255.0
Default Gateway
192.168.22.254


Web-Server
Physical
Config
Services
Desktop
Programming
Attributes
IP Configuration
X
IP Configuration
DHCP
Static
IPv4 Address
192.168.99.101
Subnet Mask
255.255.255.0
Default Gateway
192.168.99.254
DNS Server
0.0.0.0

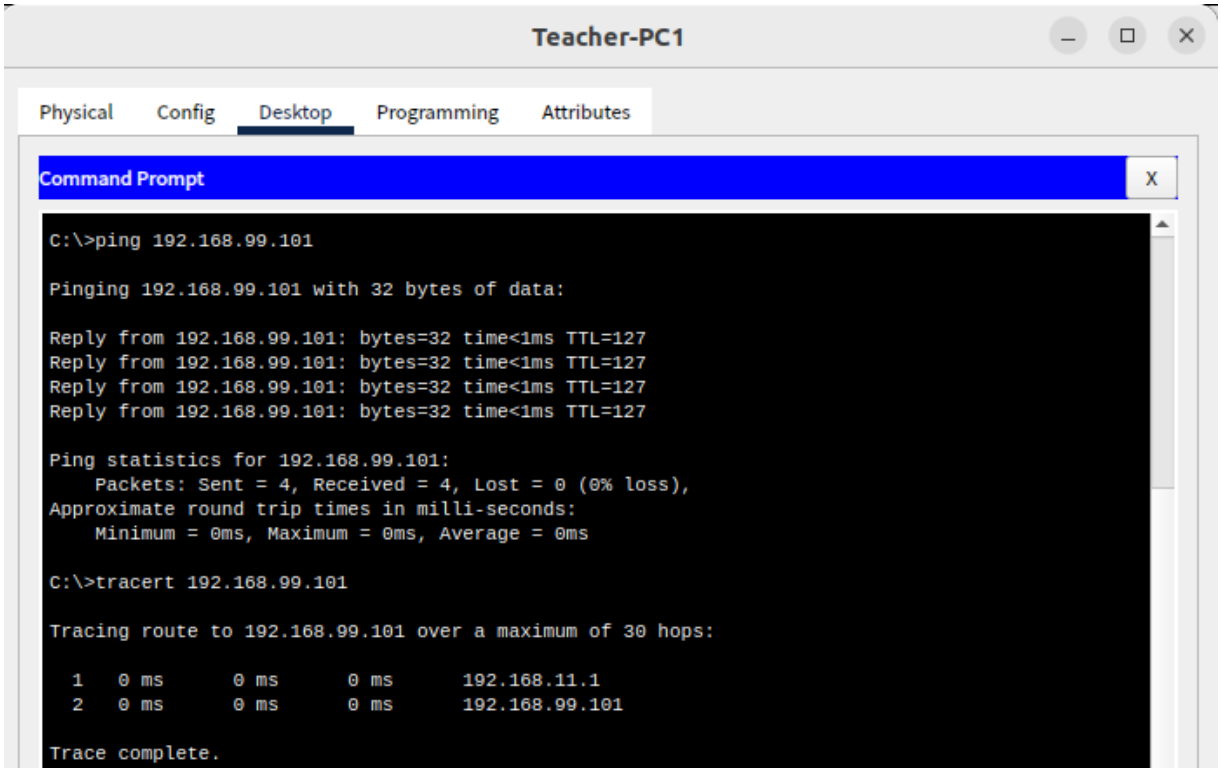


- trace the path between the PCs/servers and the active gateway
  - vlan 11 -> vlan 99[Teacher-PC1->Web-Server]

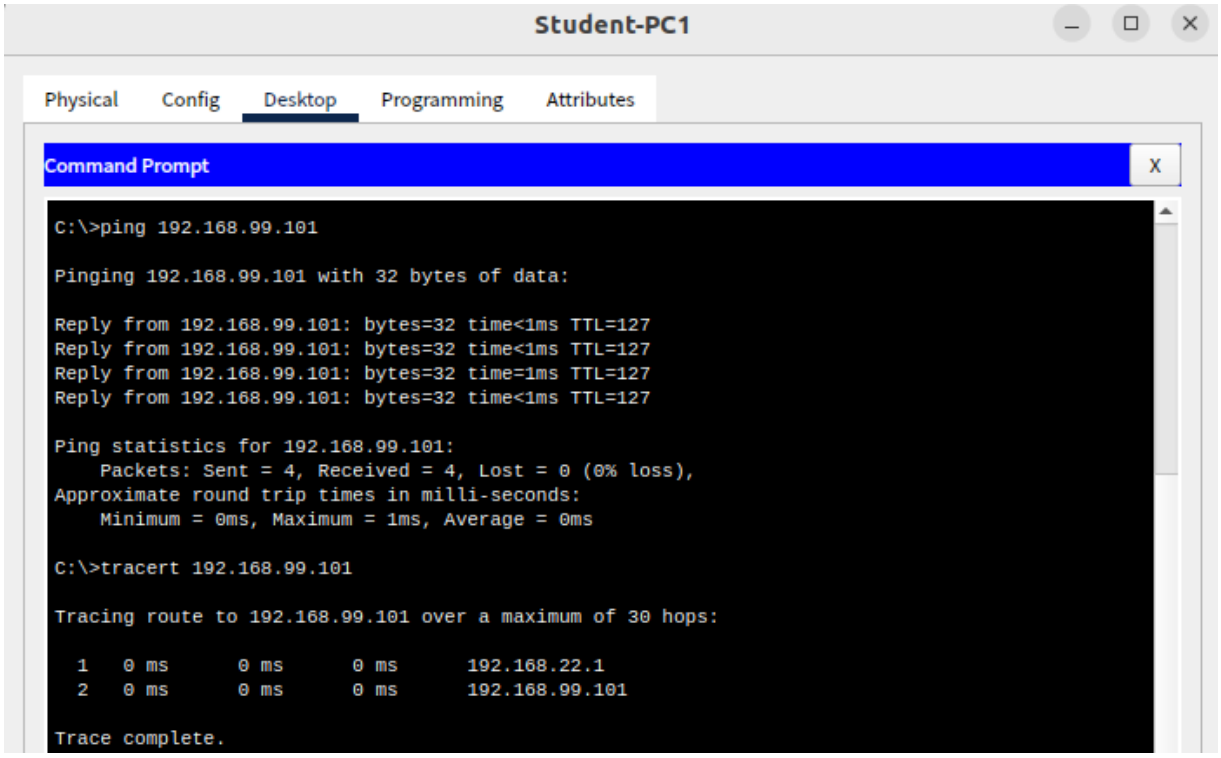



```
C:\>tracert 192.168.99.101
Tracing route to 192.168.99.101 over a maximum of 30 hops:
  1    0 ms      0 ms      0 ms      192.168.11.1
  2    0 ms      0 ms      0 ms      192.168.99.101
Trace complete.
```

  - vlan 11 -> vlan 22[Teacher-PC2->Student-PC1]

- 


```
C:\>tracert 192.168.22.101
Tracing route to 192.168.22.101 over a maximum of 30 hops:
  1    0 ms       0 ms       0 ms       192.168.11.1
  2    0 ms       0 ms       0 ms       192.168.22.101
Trace complete.
```

- vlan 22 -> vlan 99[Student-PC1->Web-Server]
- 

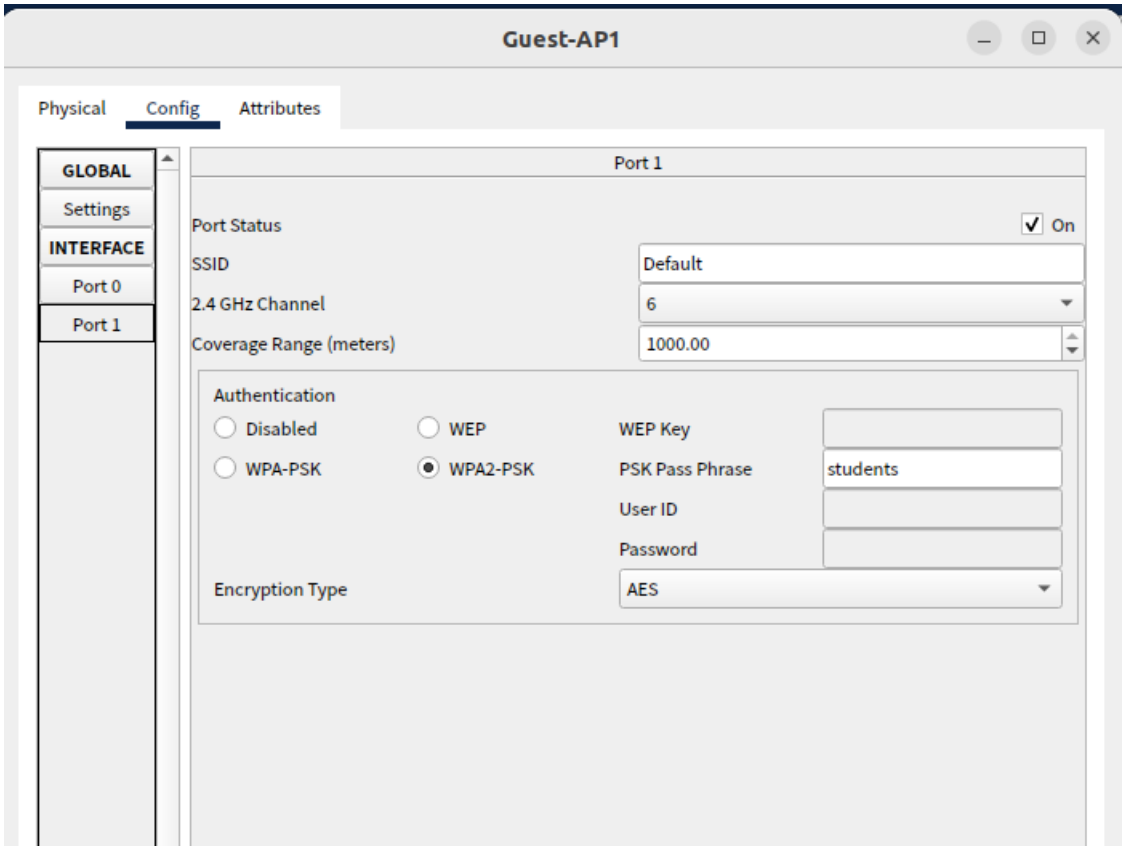

```
C:\>tracert 192.168.99.101
Tracing route to 192.168.99.101 over a maximum of 30 hops:
  1    0 ms       0 ms       0 ms       192.168.22.1
  2    0 ms       0 ms       0 ms       192.168.99.101
Trace complete.
```

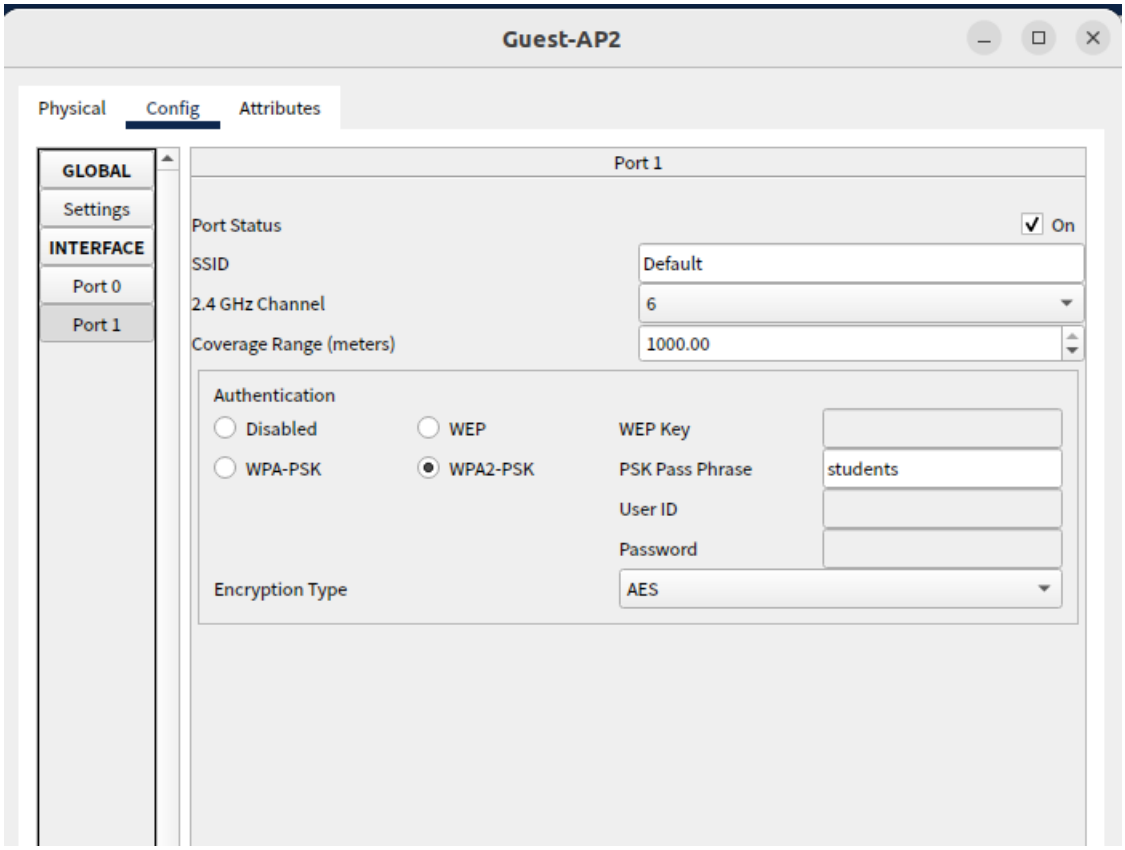
Part 3 – Wireless LANs.

Step 6 – Wireless AP

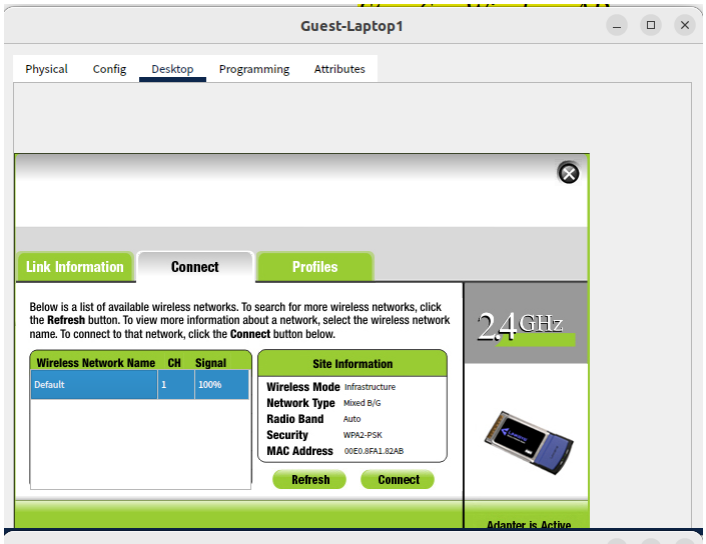
11. configure the wireless access point using WPA2 PSK.

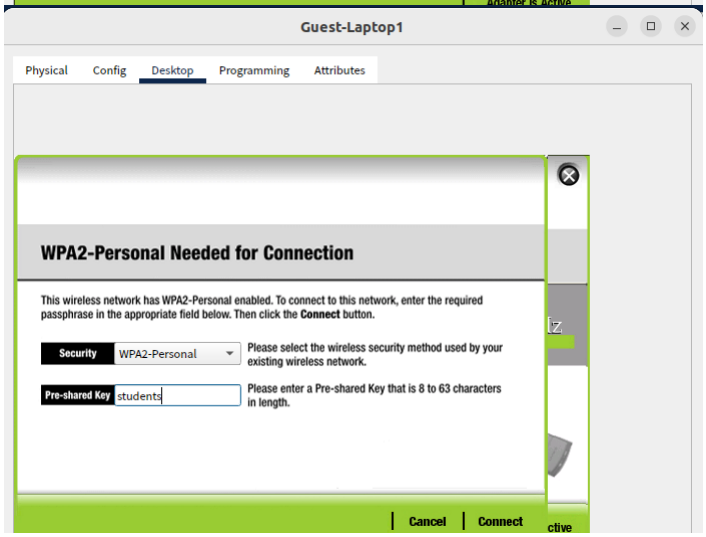
Reference 3.Q22-Q27

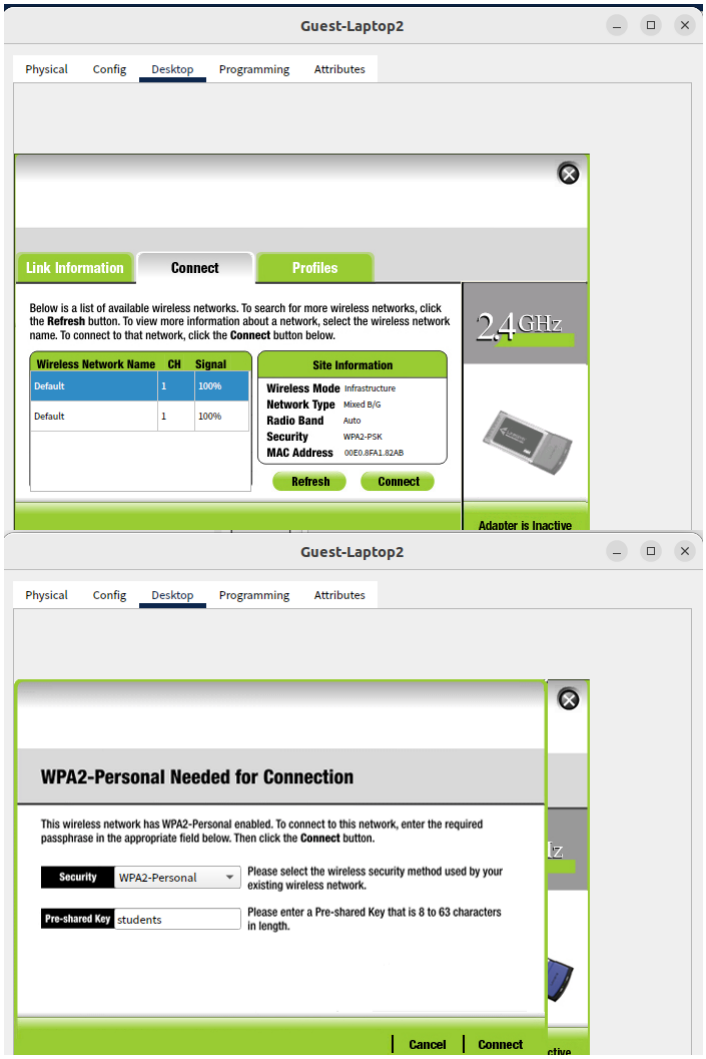
- 

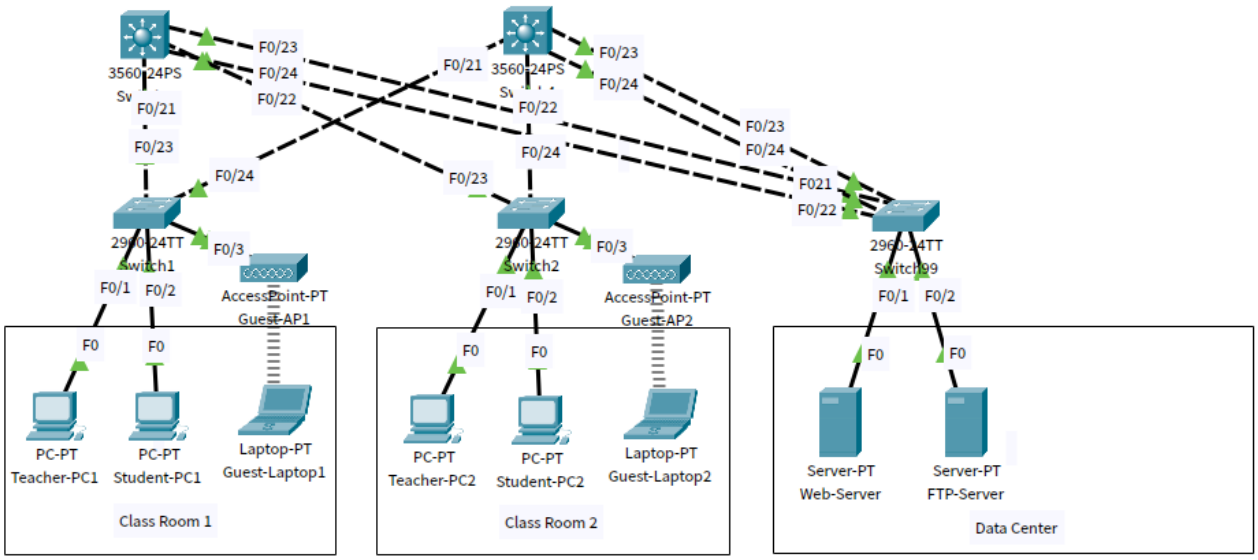


12. connect the wireless clients to the access point.



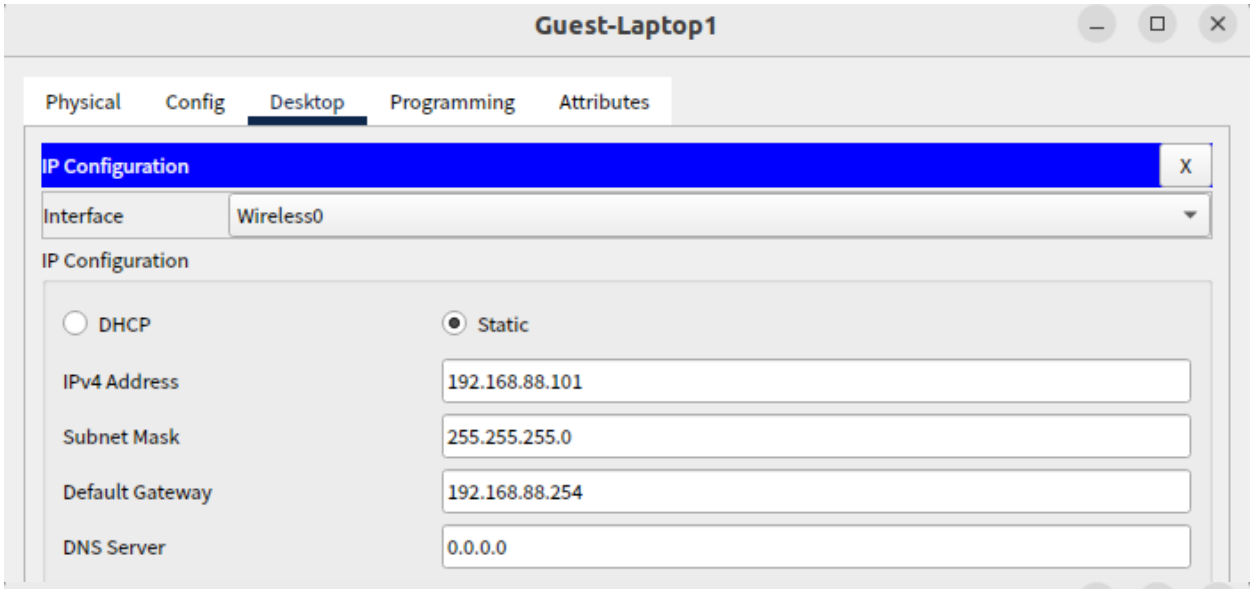


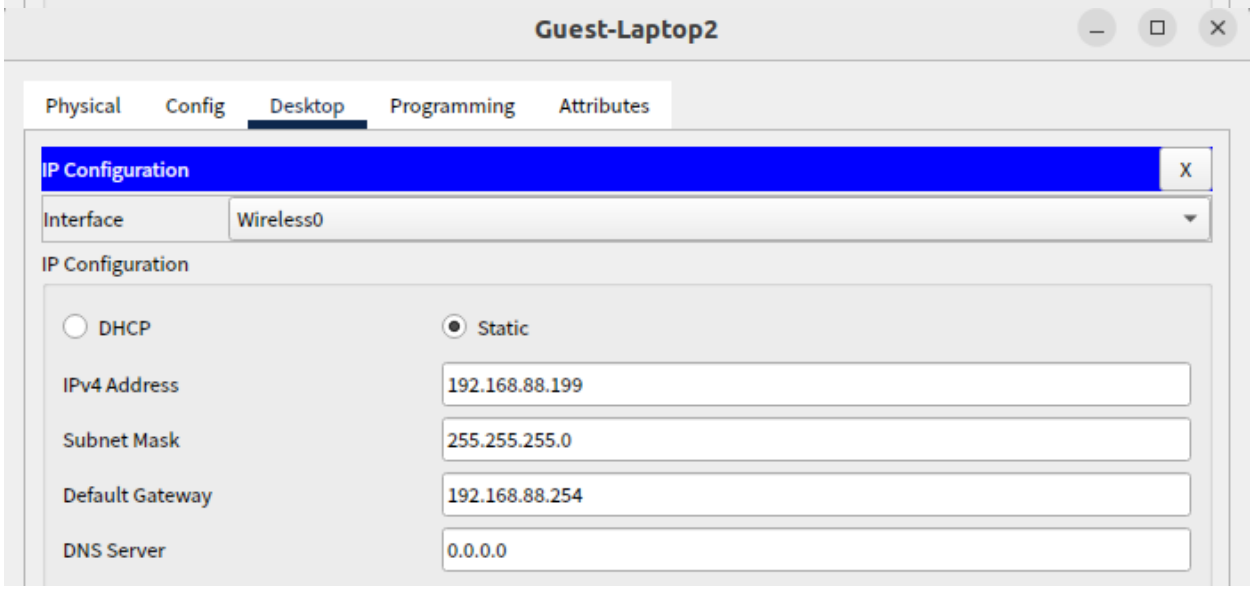
- 

- 

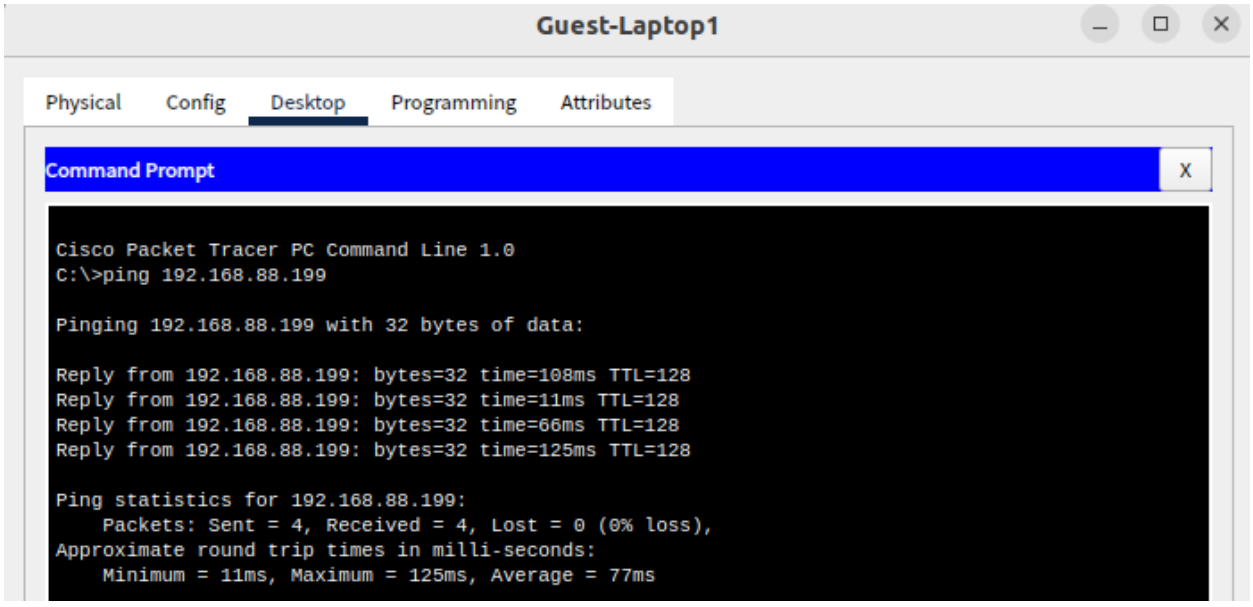
13. configure the ip address and gateway on all laptops, and then test the connectivity of wireless connection.

- configure the ip address and gateway on all laptops

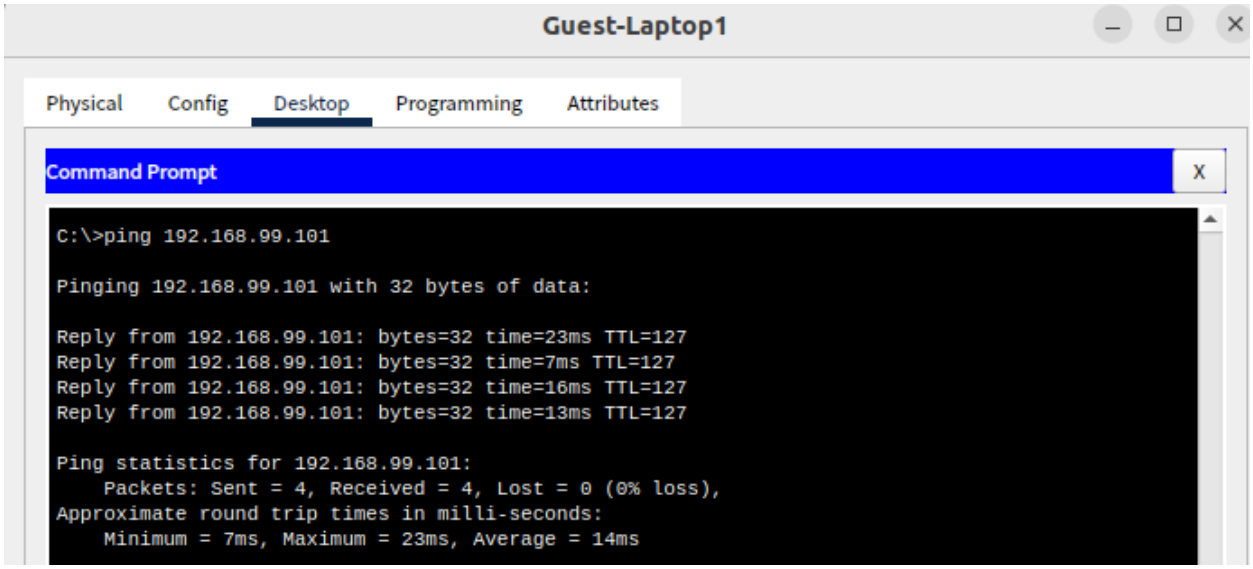
- 

- 

- test the connectivity of wireless connection
  - Guest-Laptop1->Guest-Laptop2



  - Guest-Laptop1->Web-Server


Guest-Laptop1
Physical
Config
Desktop
Programming
Attributes
Command Prompt
X
C:\>ping 192.168.99.101
Pinging 192.168.99.101 with 32 bytes of data:
Reply from 192.168.99.101: bytes=32 time=23ms TTL=127
Reply from 192.168.99.101: bytes=32 time=7ms TTL=127
Reply from 192.168.99.101: bytes=32 time=16ms TTL=127
Reply from 192.168.99.101: bytes=32 time=13ms TTL=127
Ping statistics for 192.168.99.101:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 7ms, Maximum = 23ms, Average = 14ms