EXPERIMENT 7 – Inter-VLAN Routing

Objective:
To understand the concept of routing between different VLANs in a Local Area Network (LAN) using Router on a stick topology.

Inter-VLAN Routing:

Switches divide broadcast domain through VLANs (Virtual LANs). VLAN is a partitioned broadcast domain from a single broadcast domain. Switch doesn't forward packets across different VLANs by itself. If we want to make these virtual LANs communicate with each other, a concept of Inter VLAN Routing is used.

Inter VLAN routing is a process in which we make different virtual LANs communicate with each other irrespective of where the VLANs are present (on same switch or different switch). Inter VLAN Routing can be achieved through a layer-3 device i.e., Router or a layer-3 Switch. When the Inter VLAN Routing is done through Router it is known as Router on a stick.

Trunk Link and 802.1Q protocol:

A Trunk link can carry multiple VLAN traffic and normally a trunk link is used to connect switches to other switches or to routers. A trunk link is not assigned to a specific VLAN, however, Many VLANs traffic can be transported between switches using a single physical trunk link.

The IEEE 802.1Q protocol interconnects VLANs between multiple switches, routers, and servers. With 802.1Q, a network administrator can define a VLAN topology to span multiple physical devices. Cisco switches support IEEE 802.1Q for FastEthernet and GigabitEthernet interfaces. An 802.1Q trunk link provides VLAN identification by adding a 4-byte tag to an Ethernet Frame as it leaves a trunk port.

Command Syntax:

Following is the command syntax for the creation of new VLAN:

Switch(config)# vlan 10
Switch(config-vlan)# name Admin

Following is the command syntax of access port configuration on Cisco 2960 switch:

Switch(config)# interface FastEthernet 0/1
Switch(config-if)# switchport mode access
Switch(config-if)# switchport access vlan 10

Following is the command syntax of trunk port configuration on Cisco 2960 switch:

Switch(config)# interface FastEthernet 0/3
Switch(config-if)# switchport mode trunk
Switch(config-if)# switchport trunk allowed vlan all

Topology:

Inter-VLAN routing topology consists of one 2960 series switch and two different endpoints connected in two separate VLANs (VLAN 10 and VLAN 20). Switch is also connected to a Cisco 2911 router through a trunk link. The router's interface is divided into 2 sub-interfaces (as there are 2 different VLANs) which will act as a default gateway to their respective VLANs. Then router will perform Inter VLAN Routing and the VLANs will communicate with each other.
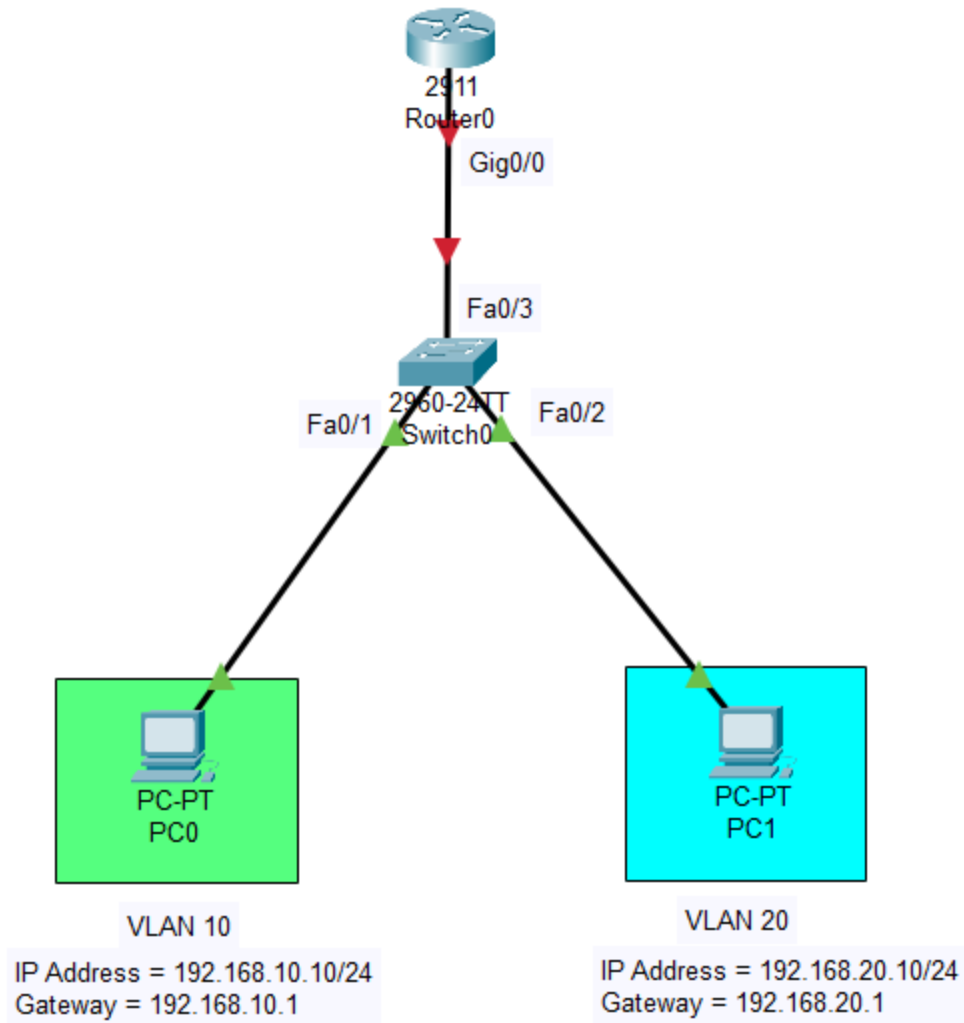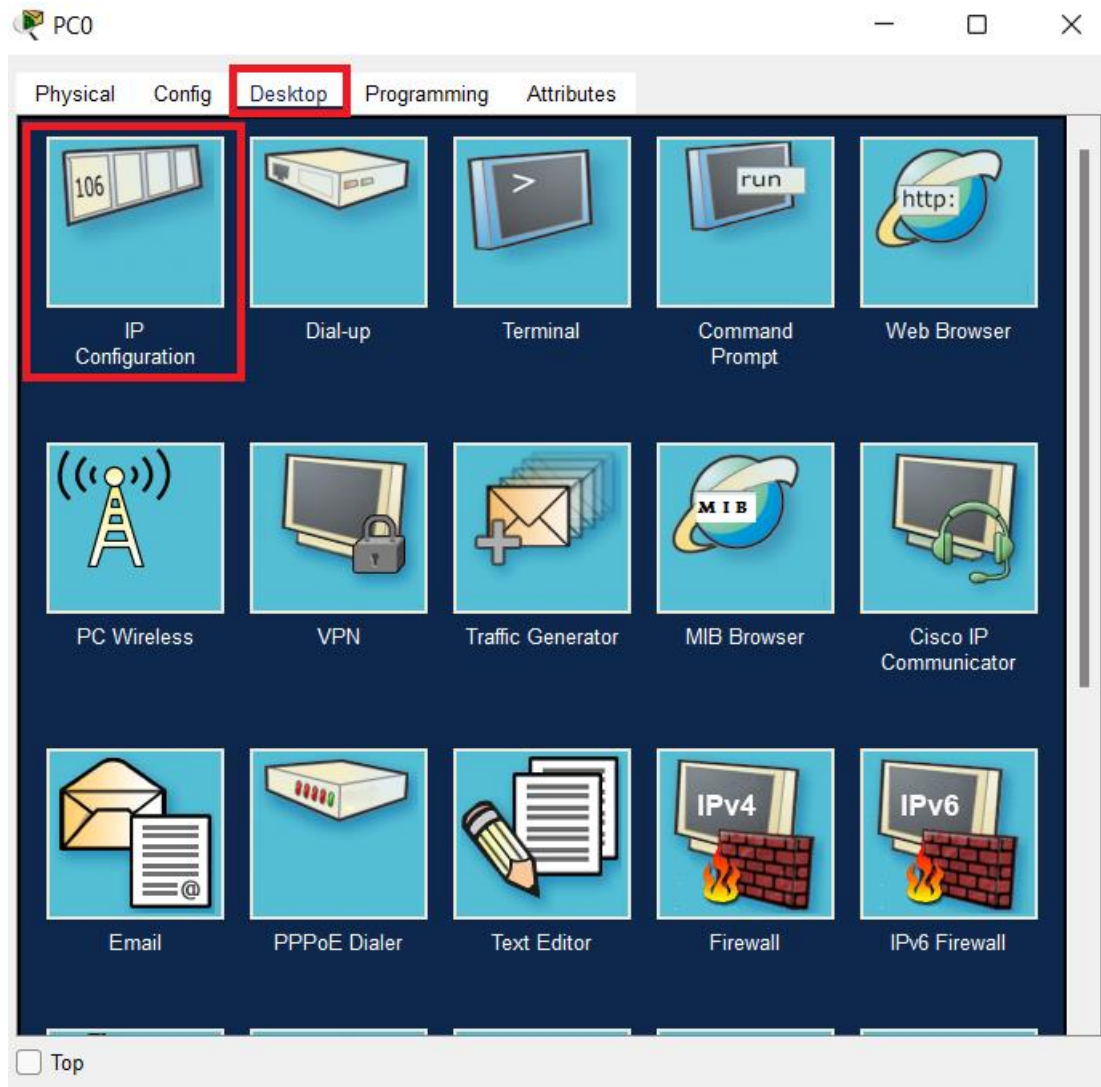

Figure 1 - Inter-VLAN Routing Topology (Router on a stick)

Steps:

Start the IP address assignment on all the endpoints, select the endpoint and click on "Desktop" tab and select "IP configuration" as shown below:

Assign the static IP address, subnet mask and default gateway as shown below:

Repeat the IP address configuration on PC1:

PC1 — □ ✕

Physical Config **Desktop** Programming Attributes

IP Configuration   X

Interface   FastEthernet0   ▼

IP Configuration
  ◯ DHCP   ⦿ Static
  IPv4 Address   192.168.20.10
  Subnet Mask   255.255.255.0
  Default Gateway   192.168.20.1
  DNS Server   0.0.0.0

IPv6 Configuration
  ◯ Automatic   ⦿ Static
  IPv6 Address   /
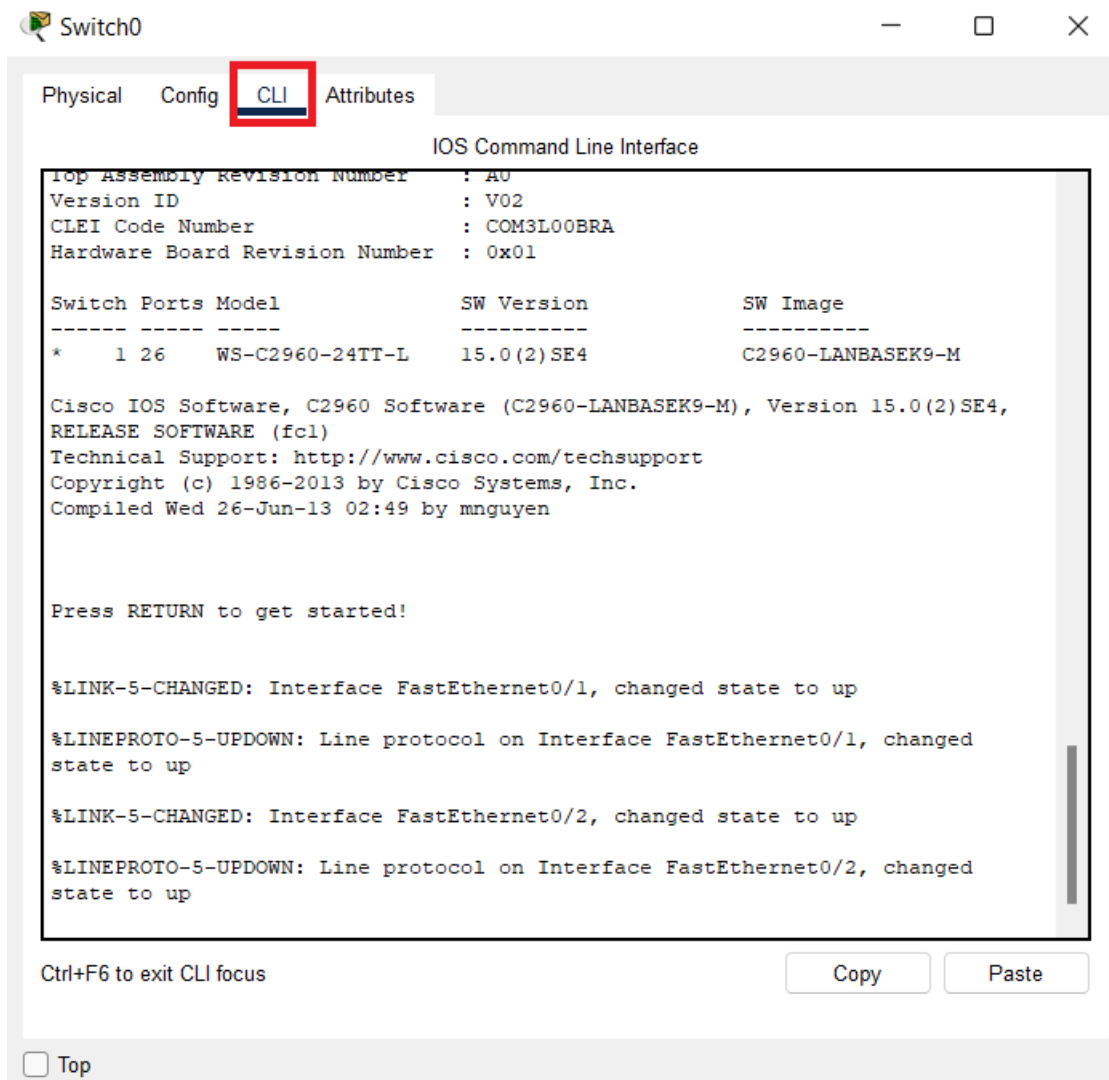 Link Local Address FE80::260:5CFF:FE42:208C
  Default Gateway
  DNS Server

802.1X
  ☐ Use 802.1X Security
  Authentication   MD5   ▼
  Username
  Password

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Select Switch and click on the CLI tab:

Switch0   —   □   ✕

Physical   Config   CLI   Attributes

IOS Command Line Interface

```
Top Assembly Revision Number    : A0
Version ID                      : V02
CLEI Code Number                : COM3L00BRA
Hardware Board Revision Number  : 0x01

Switch Ports Model              SW Version          SW Image
------ ----- -----              ----------          ----------
*    1 26    WS-C2960-24TT-L     15.0(2)SE4          C2960-LANBASEK9-M

Cisco IOS Software, C2960 Software (C2960-LANBASEK9-M), Version 15.0(2)SE4,
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
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Compiled Wed 26-Jun-13 02:49 by mnguyen



Press RETURN to get started!


%LINK-5-CHANGED: Interface FastEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed
state to up

%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed
state to up
```

Ctrl+F6 to exit CLI focus   Copy   Paste

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Create the required VLANs (10 and 20) on the switch. Fa0/1 and Fa0/2 will be assigned to VLAN 10 and VLAN 20 respectively. Trunk port configuration will be applied on Fa0/3:

```
Switch>
Switch>enable
Switch#
Switch#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#interface fastethernet 0/1
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 10
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface fastethernet 0/2
Switch(config-if)#switchport mode access
Switch(config-if)#switchport access vlan 20
Switch(config-if)#exit
Switch(config)#
Switch(config)#interface fastethernet 0/3
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk allowed vlan all
Switch(config-if)#exit
Switch(config)#
Switch(config)#
```

Select the Router and click on CLI tab. Do not enter the initial configuration dialog as shown below:
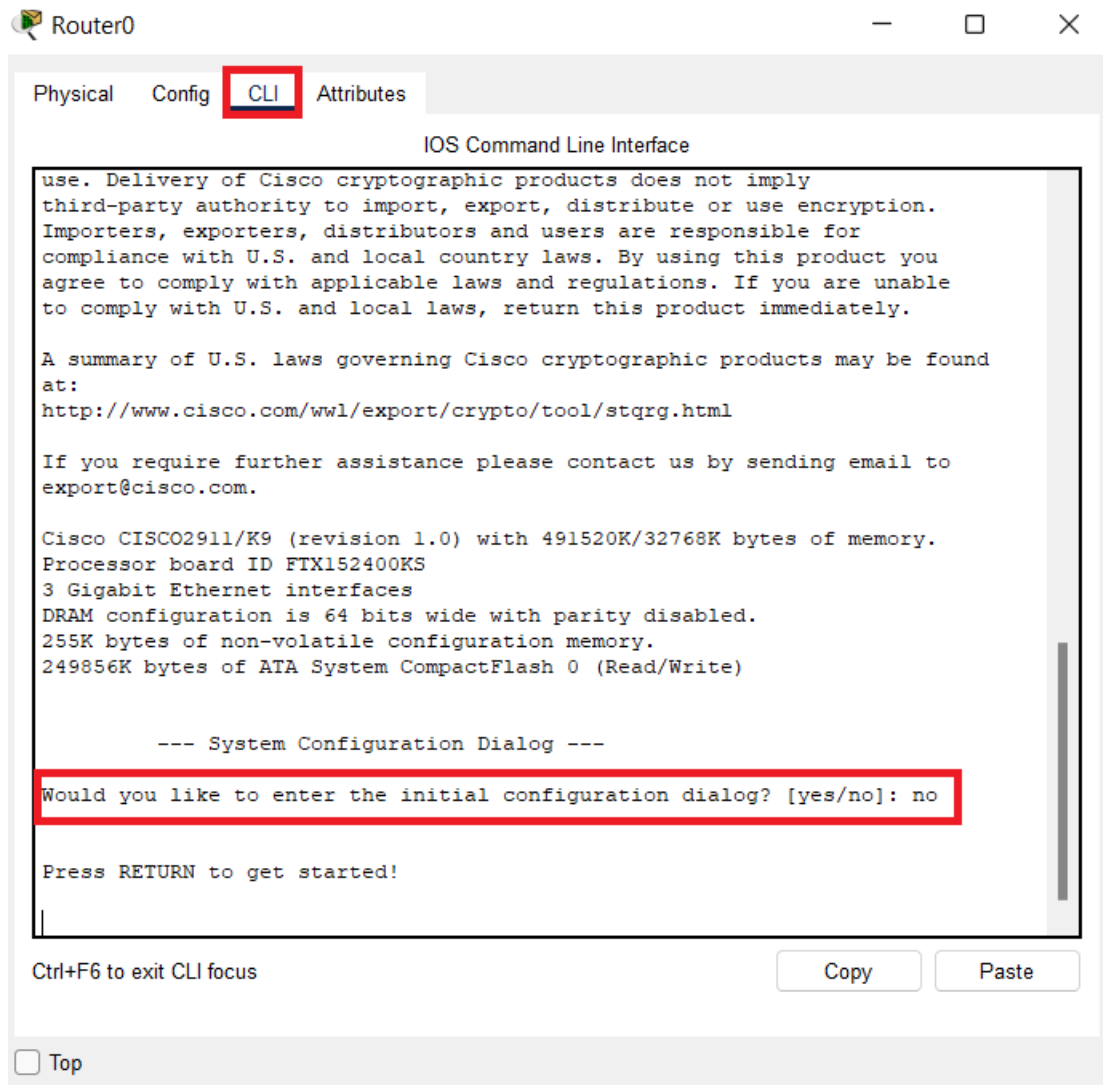
First step in the router configuration is to enable the gig0/0 interface by using "no shutdown" command since all the router ports are in shutdown state by default.

Next we have to create two sub-interfaces for gig0/0 interface and we have to assign IP addresses on these sub-interfaces that will act as default gateway for the respective VLANs.

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#interface gig0/0
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)#exit
Router(config)#
Router(config)#interface gig0/0.10
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.10, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.10,
changed state to up

Router(config-subif)#encapsulation dot1q 10
Router(config-subif)#ip address 192.168.10.1 255.255.255.0
Router(config-subif)#exit
Router(config)#
Router(config)#interface gig0/0.20
Router(config-subif)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0.20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.20,
changed state to up

Router(config-subif)#encapsulation dot1q 20
Router(config-subif)#ip address 192.168.20.1 255.255.255.0
Router(config-subif)#
```
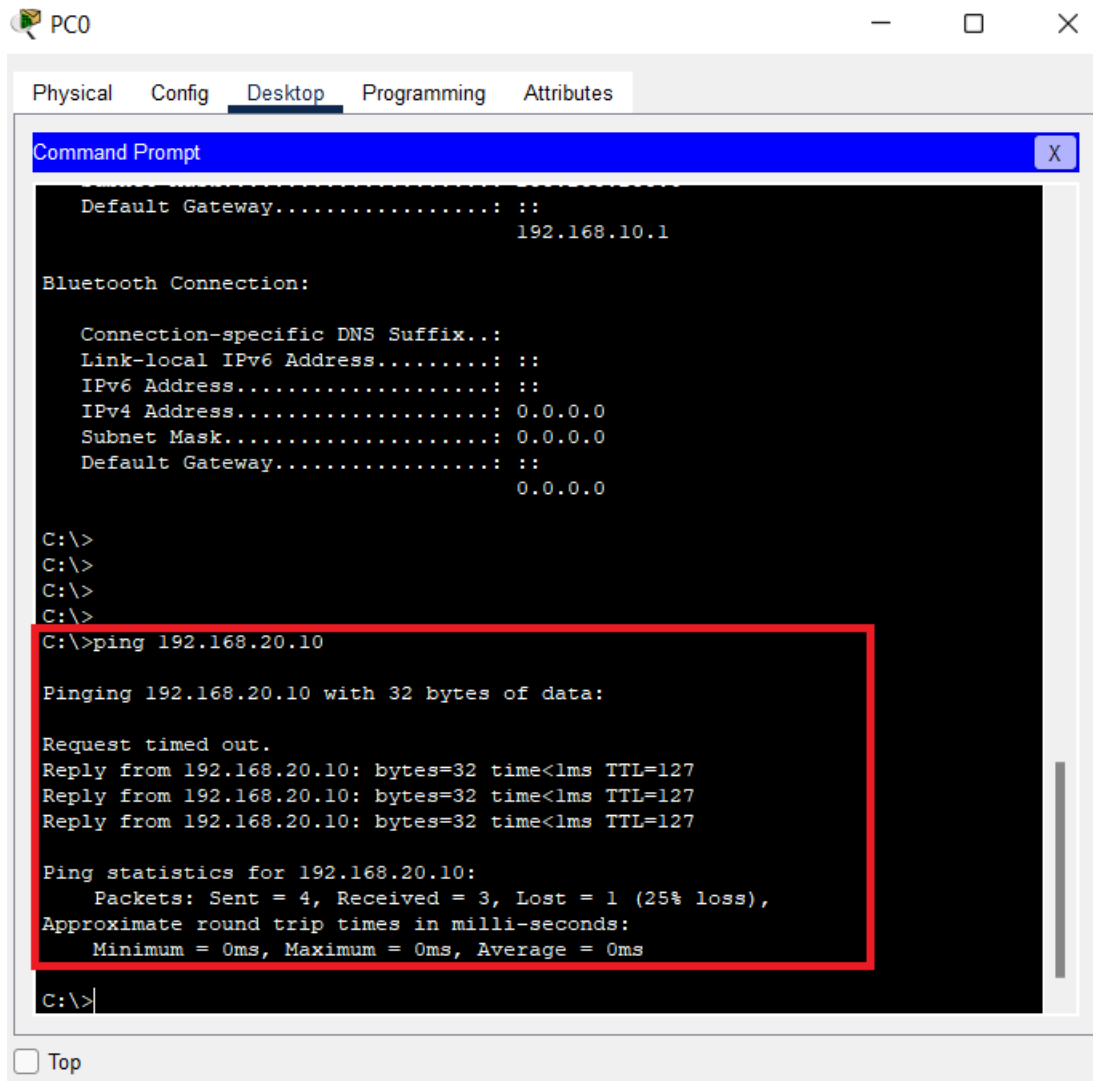
Connectivity check:

Navigate to the command prompt on PC 0 (connected in VLAN 10) to PC 1 (connected in VLAN 11) and verify the network connectivity.

PC0 — □ X

Physical | Config | Desktop | Programming | Attributes

Command Prompt [X]

```
Default Gateway.................: ::
                                 192.168.10.1

Bluetooth Connection:

   Connection-specific DNS Suffix..:
   Link-local IPv6 Address.........: ::
   IPv6 Address....................: ::
   IPv4 Address....................: 0.0.0.0
   Subnet Mask.....................: 0.0.0.0
   Default Gateway.................: ::
                                     0.0.0.0

C:\>
C:\>
C:\>
C:\>
C:\>ping 192.168.20.10

Pinging 192.168.20.10 with 32 bytes of data:

Request timed out.
Reply from 192.168.20.10: bytes=32 time<1ms TTL=127
Reply from 192.168.20.10: bytes=32 time<1ms TTL=127
Reply from 192.168.20.10: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.20.10:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

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