

PROJECT 1:

FINAL LAB REPORT — Interconnecting Two Sites Using VLANs, Routers, and Static Routing

****Student Name:**** Ayobami Odulaja

****Project Title:**** Interconnecting HQ and Branch Offices Using VLANs and Static Routing

****Institution:**** Willis College — Cybersecurity Diploma Program

****Date:**** November 03, 2025

1. Introduction

This project demonstrates the configuration of a small enterprise network interconnecting two offices — Headquarters (HQ) and Branch — using Cisco routers and switches in Packet Tracer. The design implements VLAN segmentation, Router-on-a-Stick Inter-VLAN routing, secure SSH remote management, and static routing between sites over a WAN link.

2. Network Topology Overview

Devices Used:

- 2 × Cisco 1941 Routers (HQ & Branch)
- 4 × Cisco 2960-24TT Switches (2 per site)
- 6 × PCs (3 in HQ, 3 in Branch)

Topology Summary:

- HQ and Branch connected via Serial WAN link (10.10.10.193 /30)
- VLANs created for Management, Sales/Departments, and Marketing
- Trunking configured between switches and routers
- SSH configured for secure access to all devices

3. IP Addressing & VLAN Schema

Location	VLAN Name	VLAN ID	Subnet Address	1st Usable	Last Usable	Gateway
HQ	MGMT	100	10.10.10.0	10.10.10.1	10.10.10.30	10.10.10.1
HQ	Sales	2	10.10.10.32	10.10.10.33	10.10.10.62	10.10.10.33
HQ	Marketing	3	10.10.10.64	10.10.10.65	10.10.10.94	10.10.10.65
Branch	MGMT	100	10.10.10.160	10.10.10.161	10.10.10.190	10.10.10.161
Branch	Dept1	5	10.10.10.96	10.10.10.97	10.10.10.126	10.10.10.97
Branch	Dept2	6	10.10.10.128	10.10.10.129	10.10.10.158	10.10.10.129
WAN	Inter-Router	-	10.10.10.192	10.10.10.193	10.10.10.194	-

4. Device Security Configuration

Device	Hostname	Console Pass	Enable Pass	SSH User / Pass	SVI IP	Default GW
SW1_HQ	SW1-HQ-Odulaja	Ajoke1311@	Ajoke1311@	Ayobami / Ajoke1311@	10.10.10.2	10.10.10.1
SW2_HQ	SW2-HQ-Odulaja	Ajoke1311@	Ajoke1311@	Ayobami / Ajoke1311@	10.10.10.3	10.10.10.1
Router_HQ	HQ-Router-Odulaja	Ajoke1311@	Ajoke1311@	Ayobami / Ajoke1311@	-	-
SW1_Branch	SW1-Branch-Odulaja	Ajoke1311@	Ajoke1311@	Ayobami / Ajoke1311@	10.10.10.1	10.10.10.1
SW2_Branch	SW2-Branch-Odulaja	Ajoke1311@	Ajoke1311@	Ayobami / Ajoke1311@	10.10.10.1	10.10.10.1
Router_Branch	Branch-Router-Odulaja	Ajoke1311@	Ajoke1311@	Ayobami / Ajoke1311@	-	-

5. Key Configurations

Sample configurations for both routers:

HQ Router Configuration:

```
interface g0/0.2
  encapsulation dot1Q 2
  ip address 10.10.10.33 255.255.255.224
!
interface g0/0.3
  encapsulation dot1Q 3
  ip address 10.10.10.65 255.255.255.224
!
interface g0/0.100
  encapsulation dot1Q 100
  ip address 10.10.10.1 255.255.255.224
!
interface s1/0
  ip address 10.10.10.193 255.255.255.252
  no shutdown
!
ip route 10.10.10.96 255.255.255.224 10.10.10.194
ip route 10.10.10.128 255.255.255.224 10.10.10.194
ip route 10.10.10.160 255.255.255.224 10.10.10.194
```

Branch Router Configuration:

```
interface g0/0.5
  encapsulation dot1Q 5
  ip address 10.10.10.97 255.255.255.224
!
interface g0/0.6
  encapsulation dot1Q 6
  ip address 10.10.10.129 255.255.255.224
!
interface g0/0.100
  encapsulation dot1Q 100
```

```
ip address 10.10.10.161 255.255.255.224
!
interface s1/0
ip address 10.10.10.194 255.255.255.252
no shutdown
!
ip route 10.10.10.0 255.255.255.224 10.10.10.193
ip route 10.10.10.32 255.255.255.224 10.10.10.193
ip route 10.10.10.64 255.255.255.224 10.10.10.193
```

6. Verification Results

All ping tests between HQ and Branch PCs were successful, confirming full end-to-end communication.

Trunk ports were verified using 'show interfaces trunk', and routing tables confirmed with 'show ip route'.

SSH and console access tested with configured credentials.

7. Conclusion

The network design meets all requirements: VLAN segmentation, inter-VLAN routing, static routing, and secure management. All devices were configured successfully and verified through connectivity tests.

PROJECT SOLUTION.

Step 1: Verify Intra-HQ Connectivity,

From Admin PC:

ping 10.10.10.1 ← its gateway

ping 10.10.10.33 ← Sales gateway

ping 10.10.10.65 ← Marketing gateway

ADMIN PC(VLAN100)

Physical Config Desktop Programming Attributes

Command Prompt

```
C:\>
C:\>ping 10.10.10.1

Pinging 10.10.10.1 with 32 bytes of data:
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time<1ms TTL=255
Reply from 10.10.10.1: bytes=32 time=1ms TTL=255

Ping statistics for 10.10.10.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.10.10.33

Pinging 10.10.10.33 with 32 bytes of data:
Reply from 10.10.10.33: bytes=32 time<1ms TTL=255

Ping statistics for 10.10.10.33:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.10.10.65

Pinging 10.10.10.65 with 32 bytes of data:
Reply from 10.10.10.65: bytes=32 time<1ms TTL=255

Ping statistics for 10.10.10.65:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

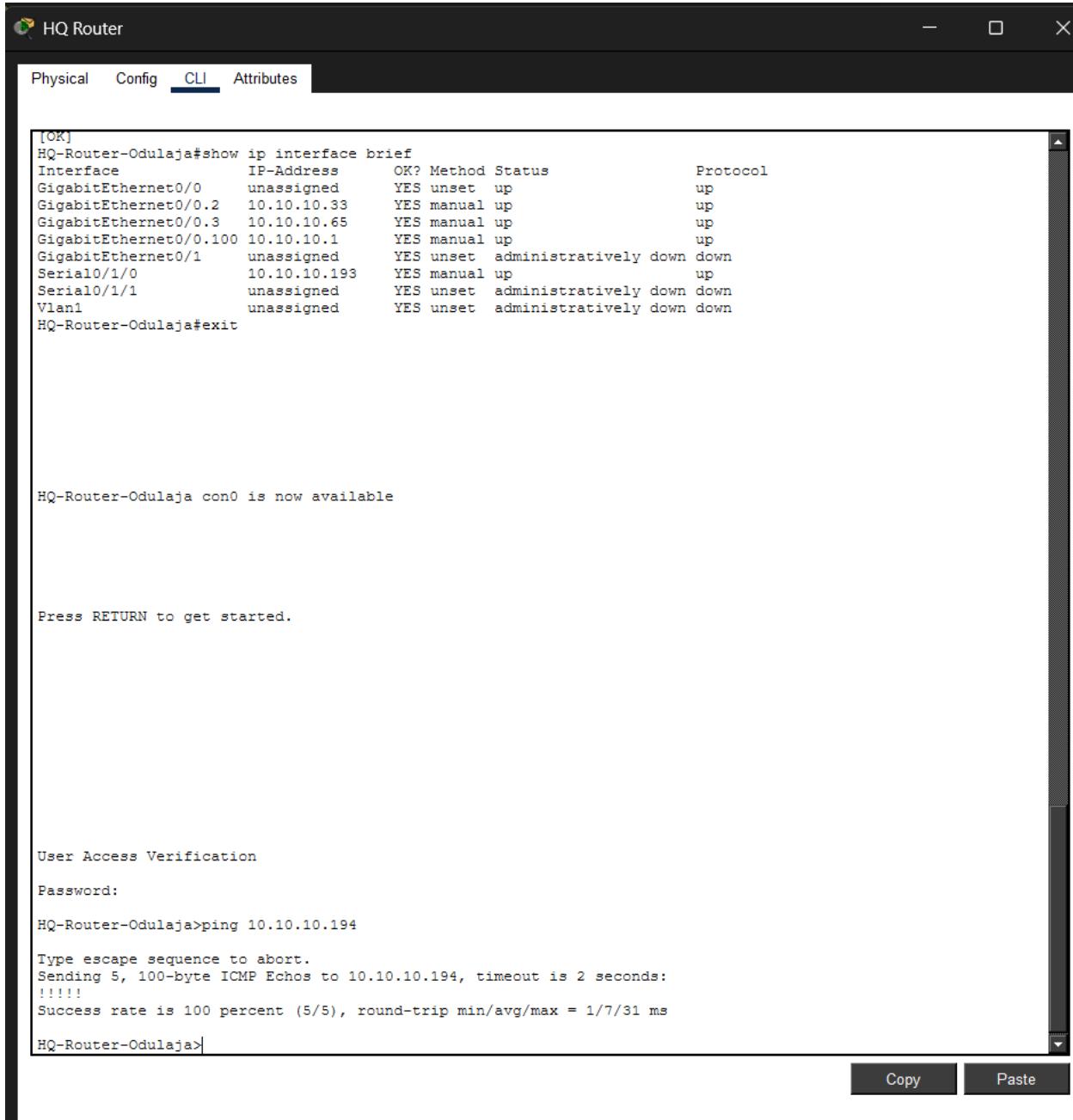
C:\>ping 10.10.10.34

Pinging 10.10.10.34 with 32 bytes of data:
Reply from 10.10.10.34: bytes=32 time<1ms TTL=127

Ping statistics for 10.10.10.34:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

Step 2: Verify HQ ↔ Branch WAN Link

On HQ Router



The screenshot shows a terminal window titled "HQ Router". The tab bar at the top has "Physical", "Config", "CLI" (which is selected), and "Attributes". The main pane displays the following text:

```
[OK]
HQ-Router-Odulaja#show ip interface brief
Interface          IP-Address      OK? Method Status        Protocol
GigabitEthernet0/0  unassigned      YES unset up           up
GigabitEthernet0/0.2 10.10.10.33   YES manual up         up
GigabitEthernet0/0.3 10.10.10.65   YES manual up         up
GigabitEthernet0/0.100 10.10.10.1   YES manual up         up
GigabitEthernet0/1    unassigned      YES unset administratively down down
Serial0/1/0          10.10.10.193  YES manual up         up
Serial0/1/1          unassigned      YES unset administratively down down
Vlan1               unassigned      YES unset administratively down down
HQ-Router-Odulaja#exit

HQ-Router-Odulaja con0 is now available

Press RETURN to get started.

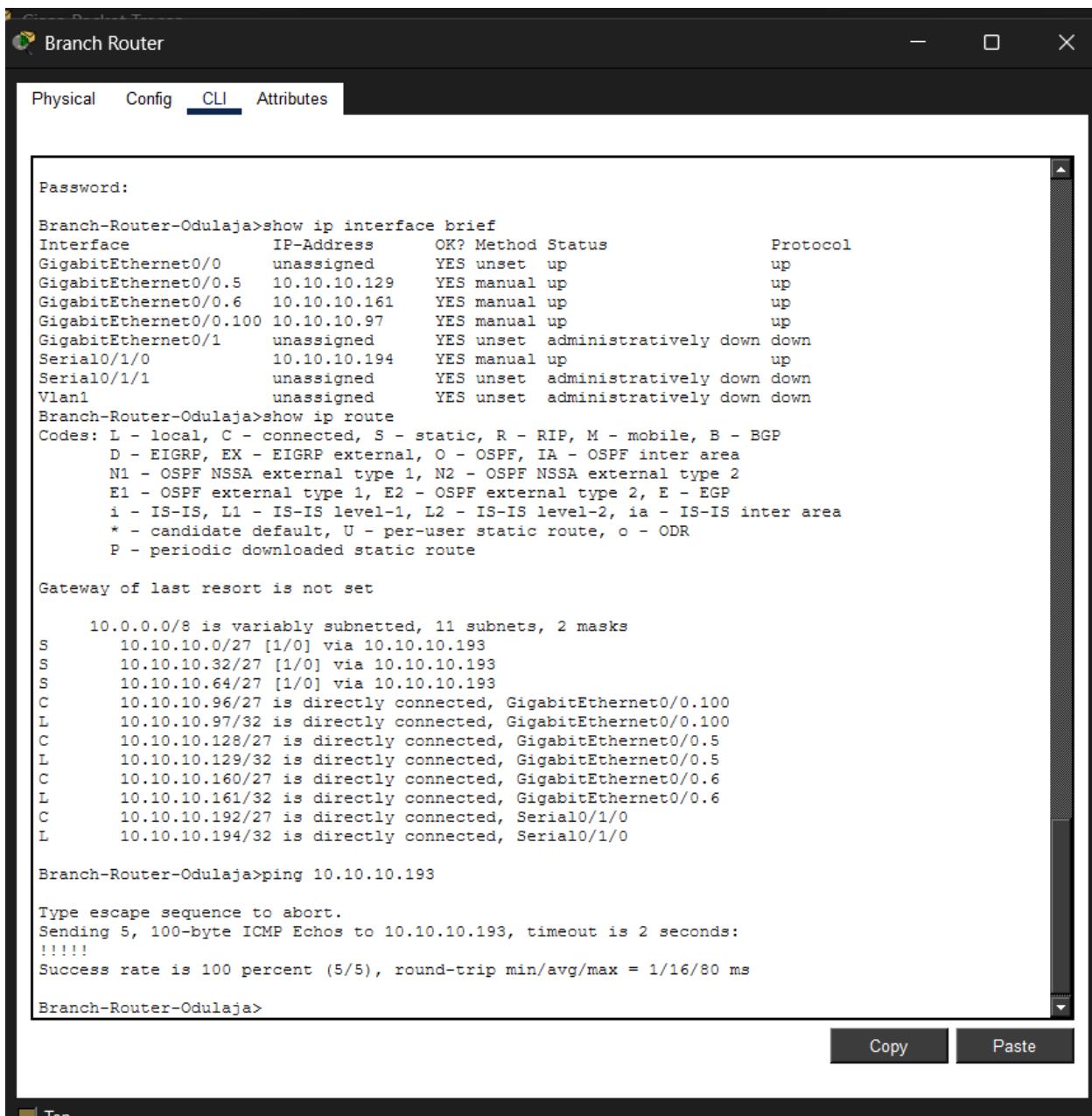
User Access Verification

Password:
HQ-Router-Odulaja>ping 10.10.10.194

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.10.10.194, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/7/31 ms
HQ-Router-Odulaja>
```

At the bottom right of the terminal window are two buttons: "Copy" and "Paste".

On Branch Router:



The screenshot shows a software interface for managing network routers. At the top, there are tabs for "Physical", "Config", "CLI" (which is underlined, indicating it is the active tab), and "Attributes". Below the tabs is a password field labeled "Password:" followed by a redacted password. The main area contains the following CLI session output:

```
Branch-Router-Odulaja>show ip interface brief
Interface          IP-Address      OK? Method Status      Protocol
GigabitEthernet0/0  unassigned     YES unset up        up
GigabitEthernet0/0.5 10.10.10.129  YES manual up       up
GigabitEthernet0/0.6 10.10.10.161  YES manual up       up
GigabitEthernet0/0.100 10.10.10.97  YES manual up       up
GigabitEthernet0/1   unassigned     YES unset administratively down down
Serial0/1/0          10.10.10.194 YES manual up       up
Serial0/1/1          unassigned     YES unset administratively down down
Vlan1               unassigned     YES unset administratively down down

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

Gateway of last resort is not set

  10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
S    10.10.10.0/27 [1/0] via 10.10.10.193
S    10.10.10.32/27 [1/0] via 10.10.10.193
S    10.10.10.64/27 [1/0] via 10.10.10.193
C    10.10.10.96/27 is directly connected, GigabitEthernet0/0.100
L    10.10.10.97/32 is directly connected, GigabitEthernet0/0.100
C    10.10.10.128/27 is directly connected, GigabitEthernet0/0.5
L    10.10.10.129/32 is directly connected, GigabitEthernet0/0.5
C    10.10.10.160/27 is directly connected, GigabitEthernet0/0.6
L    10.10.10.161/32 is directly connected, GigabitEthernet0/0.6
C    10.10.10.192/27 is directly connected, Serial0/1/0
L    10.10.10.194/32 is directly connected, Serial0/1/0

Branch-Router-Odulaja>ping 10.10.10.193
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.10.10.193, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/16/80 ms

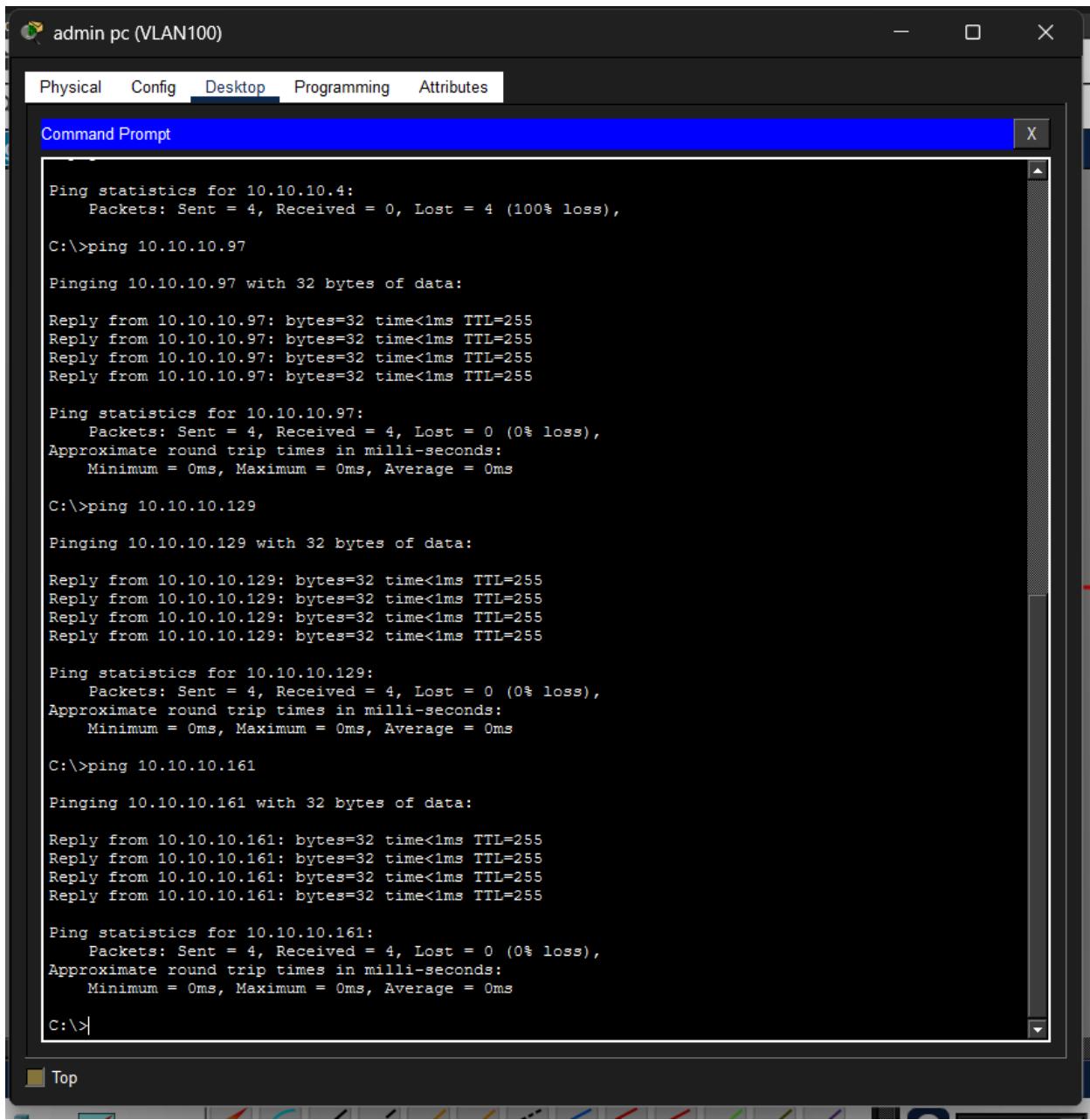
Branch-Router-Odulaja>
```

At the bottom right of the CLI window, there are "Copy" and "Paste" buttons. A small "Top" button is located at the very bottom left.

Step 3: Verify Inter-Branch VLANs:

VLAN	Description	Subinterface	Gateway	Example PC
5	Dept 1	G0/0.5	10.10.10.97	10.10.10.98
6	Dept 2	G0/0.6	10.10.10.129	10.10.10.130
100	Admin	G0/0.100	10.10.10.161	10.10.10.162

From Branch Admin PC



The screenshot shows a Cisco Network Assistant interface titled "admin pc (VLAN100)". A tab bar at the top includes "Physical", "Config", "Desktop", "Programming", and "Attributes", with "Attributes" being the active tab. Below the tabs is a "Command Prompt" window with a blue header bar containing the title. The main area of the window displays the output of several ping commands:

```
Ping statistics for 10.10.10.4:  
  Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),  
  
C:\>ping 10.10.10.97  
  
Pinging 10.10.10.97 with 32 bytes of data:  
  
Reply from 10.10.10.97: bytes=32 time<1ms TTL=255  
  
Ping statistics for 10.10.10.97:  
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
    Minimum = 0ms, Maximum = 0ms, Average = 0ms  
  
C:\>ping 10.10.10.129  
  
Pinging 10.10.10.129 with 32 bytes of data:  
  
Reply from 10.10.10.129: bytes=32 time<1ms TTL=255  
  
Ping statistics for 10.10.10.129:  
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
    Minimum = 0ms, Maximum = 0ms, Average = 0ms  
  
C:\>ping 10.10.10.161  
  
Pinging 10.10.10.161 with 32 bytes of data:  
  
Reply from 10.10.10.161: bytes=32 time<1ms TTL=255  
  
Ping statistics for 10.10.10.161:  
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
    Minimum = 0ms, Maximum = 0ms, Average = 0ms  
  
C:\>
```

A toolbar at the bottom of the window includes icons for "Top", "New", "Open", "Save", "Print", "Copy", "Paste", "Delete", "Find", "Replace", "Select All", "Properties", and "Help".

Step 4: Verify HQ ↔ Branch Inter-VLAN Routing:

ping 10.10.10.162 ← Branch Admin PC

ping 10.10.10.98 ← Branch Dept 1 PC

ping 10.10.10.130 ← Branch Dept 2 PC

From HQ Admin PC:

The screenshot shows a Windows Command Prompt window titled "ADMIN PC(VLAN100)". The window has tabs at the top: Physical, Config, Desktop, Programming, and Attributes. The "Desktop" tab is selected. Below the tabs is a blue header bar with the text "Command Prompt" and a close button "X". The main area of the window displays the output of several ping commands:

```
Pinging 10.10.10.66 with 32 bytes of data:  
Request timed out.  
Reply from 10.10.10.66: bytes=32 time=11ms TTL=127  
Reply from 10.10.10.66: bytes=32 time<1ms TTL=127  
Reply from 10.10.10.66: bytes=32 time<1ms TTL=127  
  
Ping statistics for 10.10.10.66:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 0ms, Maximum = 11ms, Average = 3ms  
  
C:\>ping 10.10.10.162  
  
Pinging 10.10.10.162 with 32 bytes of data:  
  
Request timed out.  
Reply from 10.10.10.162: bytes=32 time=1ms TTL=126  
Reply from 10.10.10.162: bytes=32 time=2ms TTL=126  
Reply from 10.10.10.162: bytes=32 time=1ms TTL=126  
  
Ping statistics for 10.10.10.162:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 1ms, Maximum = 2ms, Average = 1ms  
  
C:\>ping 10.10.10.98  
  
Pinging 10.10.10.98 with 32 bytes of data:  
  
Request timed out.  
Request timed out.  
Reply from 10.10.10.98: bytes=32 time=1ms TTL=253  
Reply from 10.10.10.98: bytes=32 time=11ms TTL=253  
  
Ping statistics for 10.10.10.98:  
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 1ms, Maximum = 11ms, Average = 6ms  
  
C:\>ping 10.10.10.130  
  
Pinging 10.10.10.130 with 32 bytes of data:  
  
Request timed out.  
Reply from 10.10.10.130: bytes=32 time=12ms TTL=126  
Reply from 10.10.10.130: bytes=32 time=10ms TTL=126  
Reply from 10.10.10.130: bytes=32 time=1ms TTL=126  
  
Ping statistics for 10.10.10.130:  
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
    Approximate round trip times in milli-seconds:  
        Minimum = 1ms, Maximum = 12ms, Average = 7ms  
  
C:\>
```

At the bottom left of the window, there is a "Top" button.

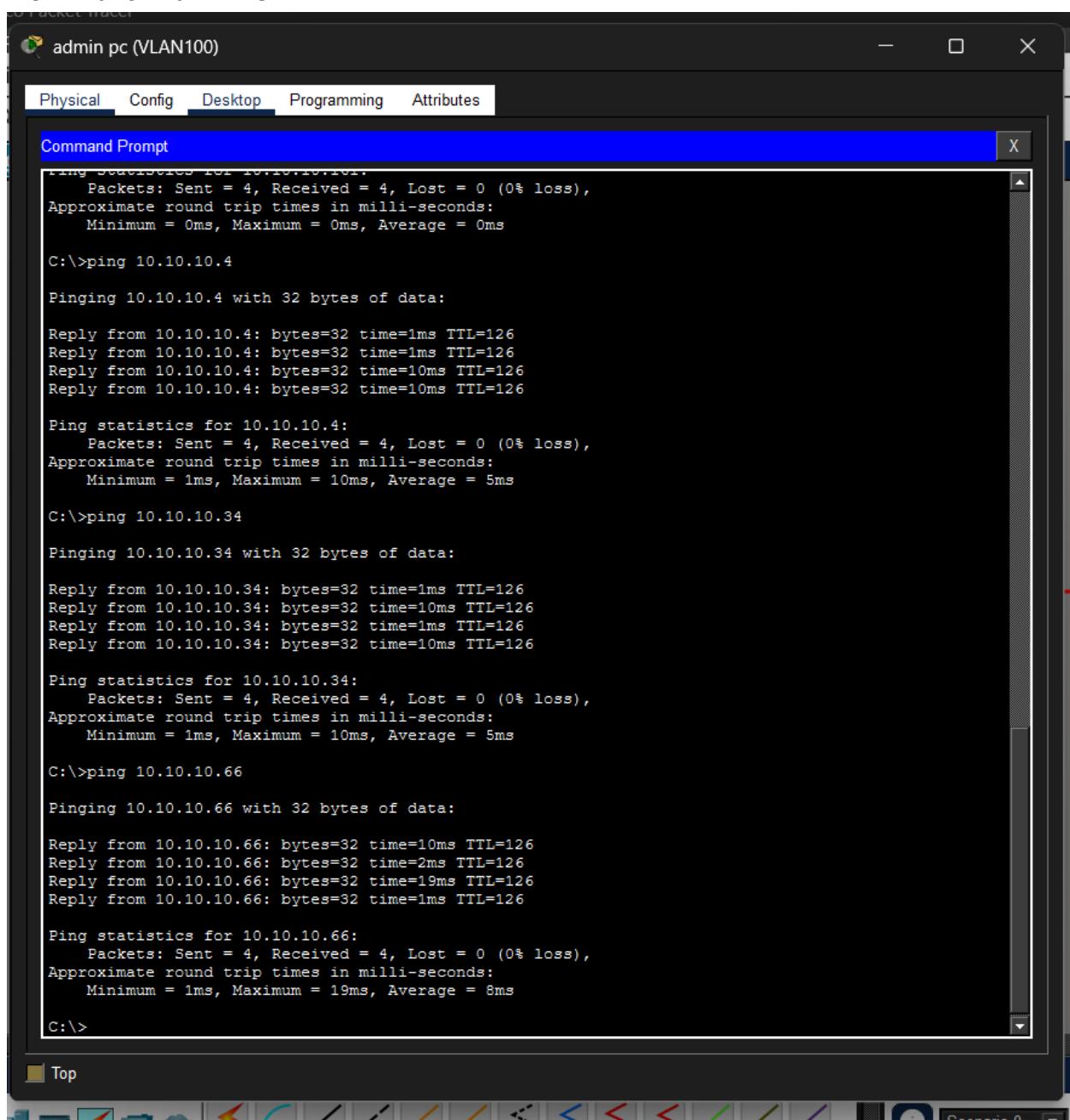
From Branch Admin PC:

ping 10.10.10.4 ← HQ Admin PC

ping 10.10.10.34 ← HQ Sales PC

ping 10.10.10.66 ← HQ Marketing PC

From Branch Admin PC:



The screenshot shows a Windows application window titled "admin pc (VLAN100)" with a tab bar at the top labeled "Physical", "Config", "Desktop", "Programming", and "Attributes". The "Attributes" tab is selected. Below the tab bar is a blue header bar with the text "Command Prompt" and a close button "X". The main area of the window is a terminal-like interface displaying the output of several ping commands. The output is as follows:

```
Ping statistics for 10.10.10.101:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>ping 10.10.10.4

Pinging 10.10.10.4 with 32 bytes of data:

Reply from 10.10.10.4: bytes=32 time=1ms TTL=126
Reply from 10.10.10.4: bytes=32 time=1ms TTL=126
Reply from 10.10.10.4: bytes=32 time=10ms TTL=126
Reply from 10.10.10.4: bytes=32 time=10ms TTL=126

Ping statistics for 10.10.10.4:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 5ms

C:\>ping 10.10.10.34

Pinging 10.10.10.34 with 32 bytes of data:

Reply from 10.10.10.34: bytes=32 time=1ms TTL=126
Reply from 10.10.10.34: bytes=32 time=10ms TTL=126
Reply from 10.10.10.34: bytes=32 time=1ms TTL=126
Reply from 10.10.10.34: bytes=32 time=10ms TTL=126

Ping statistics for 10.10.10.34:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 5ms

C:\>ping 10.10.10.66

Pinging 10.10.10.66 with 32 bytes of data:

Reply from 10.10.10.66: bytes=32 time=10ms TTL=126
Reply from 10.10.10.66: bytes=32 time=2ms TTL=126
Reply from 10.10.10.66: bytes=32 time=19ms TTL=126
Reply from 10.10.10.66: bytes=32 time=1ms TTL=126

Ping statistics for 10.10.10.66:
  Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
  Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 19ms, Average = 8ms

C:\>
```

At the bottom of the window, there is a toolbar with various icons and a status bar on the right side.

Part 2 — Theory / Design & Configuration Answers

1) What network address was assigned?

Answer:

10.10.10.0/24 (Base Network)

2) How many bits were borrowed from the host portion to create 7 subnets?

Answer:

You need at least **3 bits** (since $2^3 = 8 \geq 7$).

3) What is the prefix length and subnet mask for these subnets?

Answer:

Prefix length: /27

Subnet mask: 255.255.255.224

Each subnet contains **32 IP addresses** (30 usable hosts).

4) How many usable addresses are in each subnet?

Answer:

30 usable addresses per subnet (2 addresses are reserved for network + broadcast).

Pka @ 100%

