

PROJECT 1:

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

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

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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 62	10.10.10.1 61
SW2_Branch	SW2-Branch-Odulaja	Ajoke1311@	Ajoke1311@	Ayobami / Ajoke1311@	10.10.10.1 63	10.10.10.1 61
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
Reply from 10.10.10.33: bytes=32 time<1ms TTL=255
Reply from 10.10.10.33: bytes=32 time<1ms TTL=255
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
Reply from 10.10.10.65: bytes=32 time<1ms TTL=255
Reply from 10.10.10.65: bytes=32 time<1ms TTL=255
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
Reply from 10.10.10.34: bytes=32 time<1ms TTL=127
Reply from 10.10.10.34: bytes=32 time<1ms TTL=127
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
```

Top

Step 2: Verify HQ ↔ Branch WAN Link

On HQ Router

HQ Router

Physical Config CLI Attributes

```
[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:

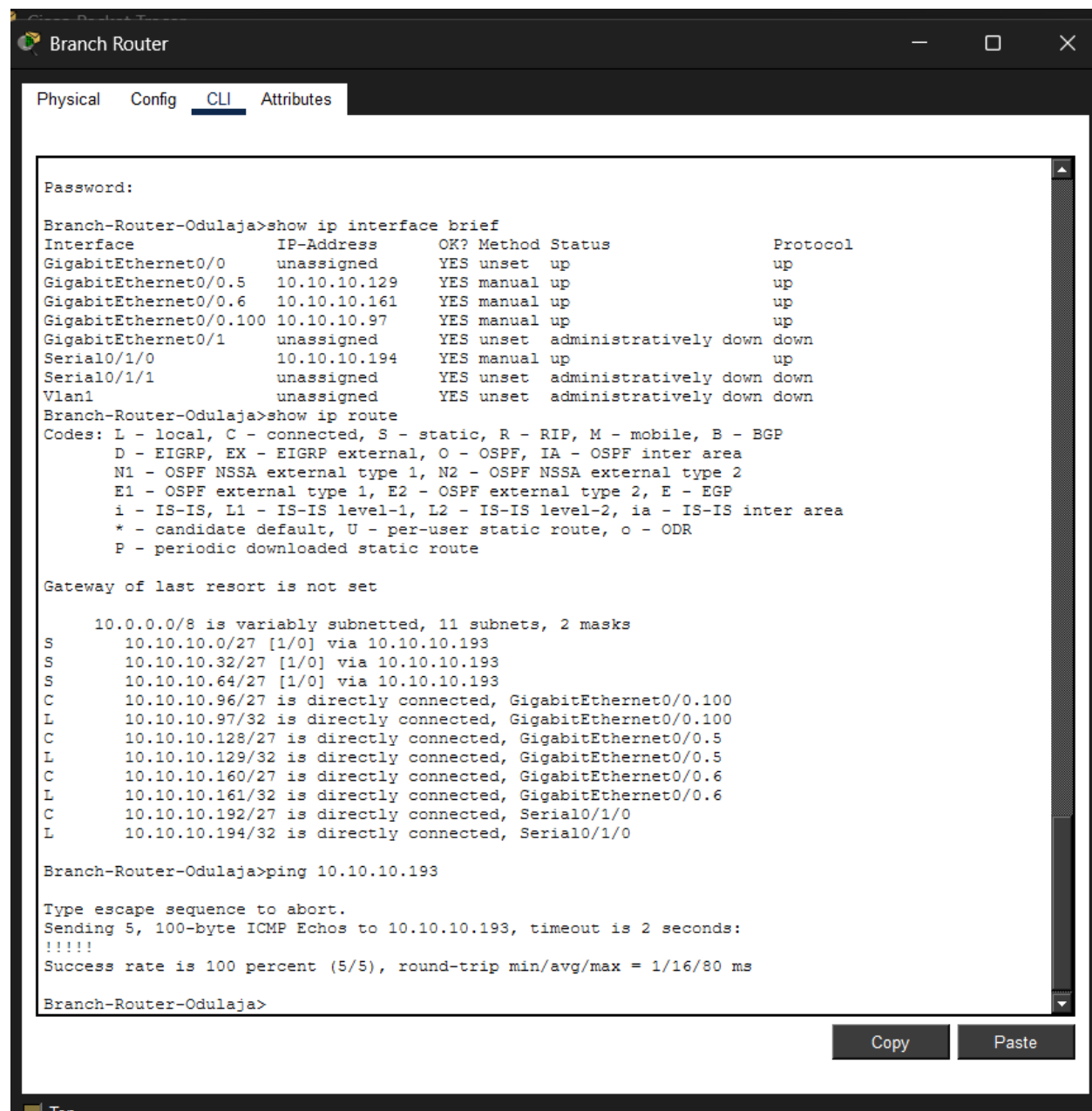
HQ-Router-Odulaja>ping 10.10.10.194

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>
```

Copy Paste

On Branch Router:



The screenshot shows a terminal window titled "Branch Router" with tabs for Physical, Config, CLI, and Attributes. The CLI tab is active, displaying the output of several commands. The first command is "show ip interface brief", which lists the status of various interfaces. The second command is "show ip route", which displays the routing table. The third command is "ping 10.10.10.193", which shows the results of a ping test.

```
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

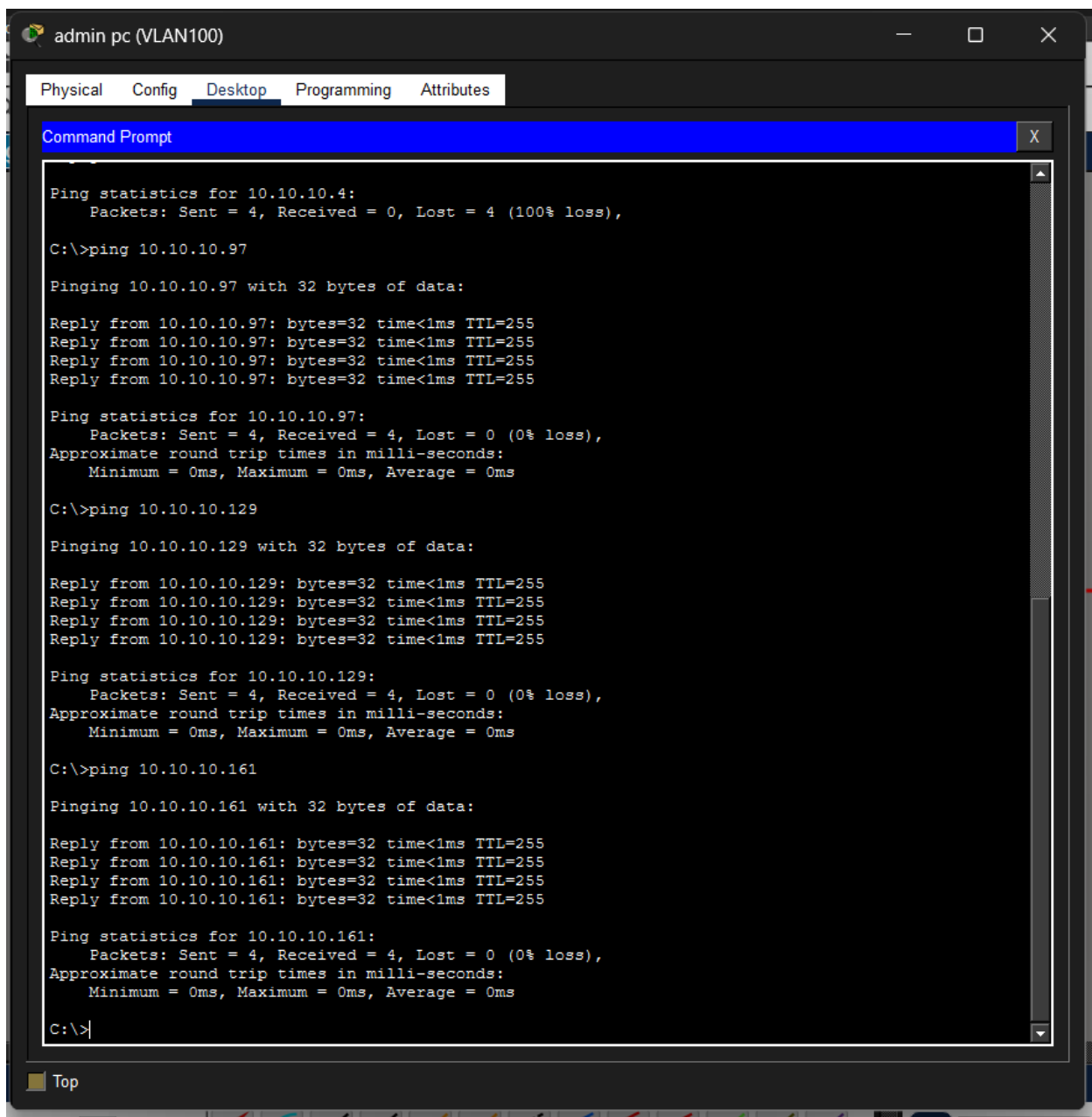
Branch-Router-Odulaja>
```

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

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 Packet Tracer console window titled 'admin pc (VLAN100)'. The window has tabs for 'Physical', 'Config', 'Desktop', 'Programming', and 'Attributes', with 'Desktop' selected. Inside the console, a 'Command Prompt' window is open, displaying the following text:

```
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
Reply from 10.10.10.97: bytes=32 time<1ms TTL=255
Reply from 10.10.10.97: bytes=32 time<1ms TTL=255
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
Reply from 10.10.10.129: bytes=32 time<1ms TTL=255
Reply from 10.10.10.129: bytes=32 time<1ms TTL=255
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
Reply from 10.10.10.161: bytes=32 time<1ms TTL=255
Reply from 10.10.10.161: bytes=32 time<1ms TTL=255
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:\>|
```

At the bottom of the console window, there is a 'Top' button and a toolbar with various drawing tools.

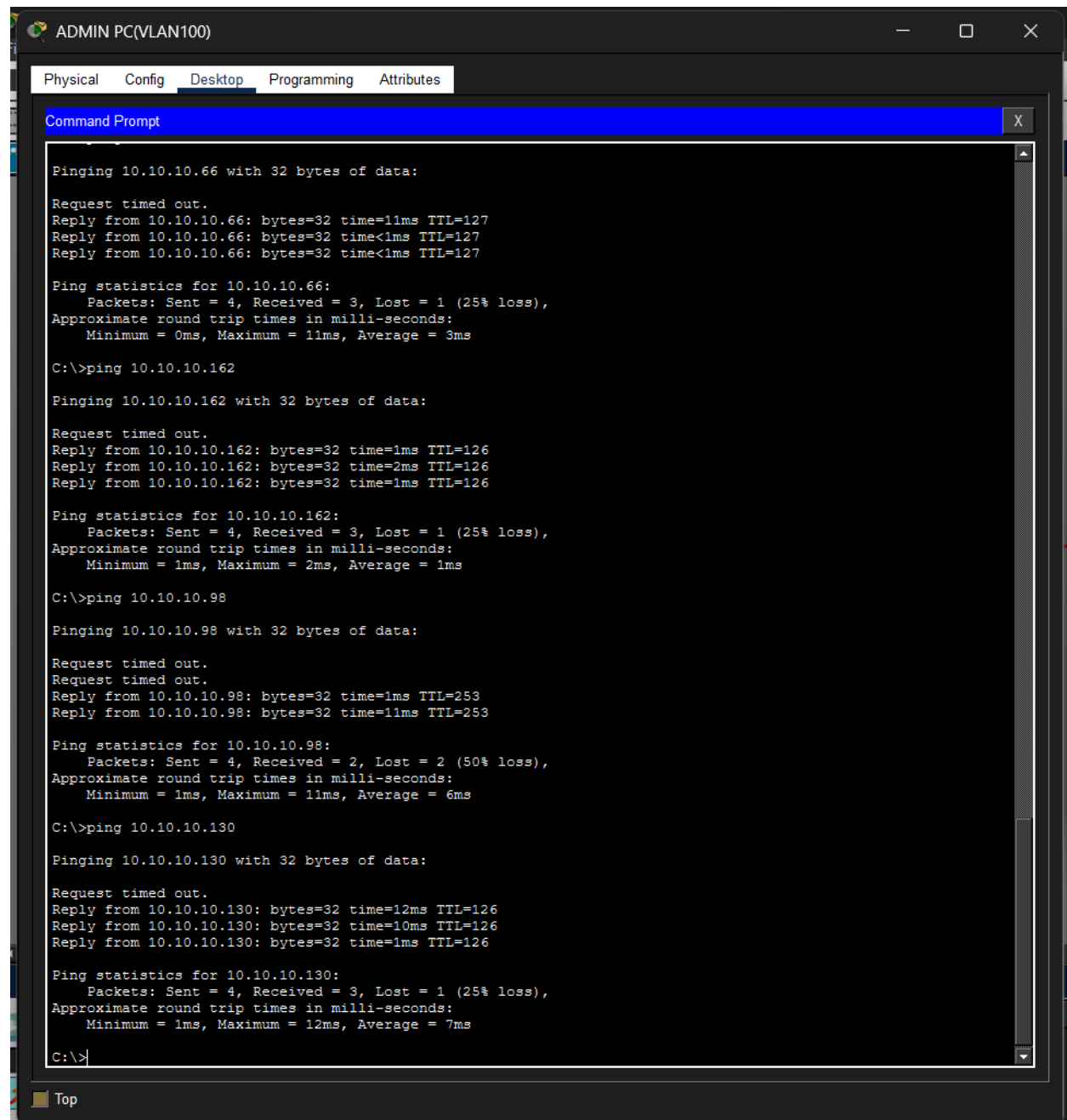
Step 4: Verify HQ ↔ Branch Inter-VLAN Routing:

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:



```
ADMIN PC(VLAN100)
Physical Config Desktop Programming Attributes
Command Prompt
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

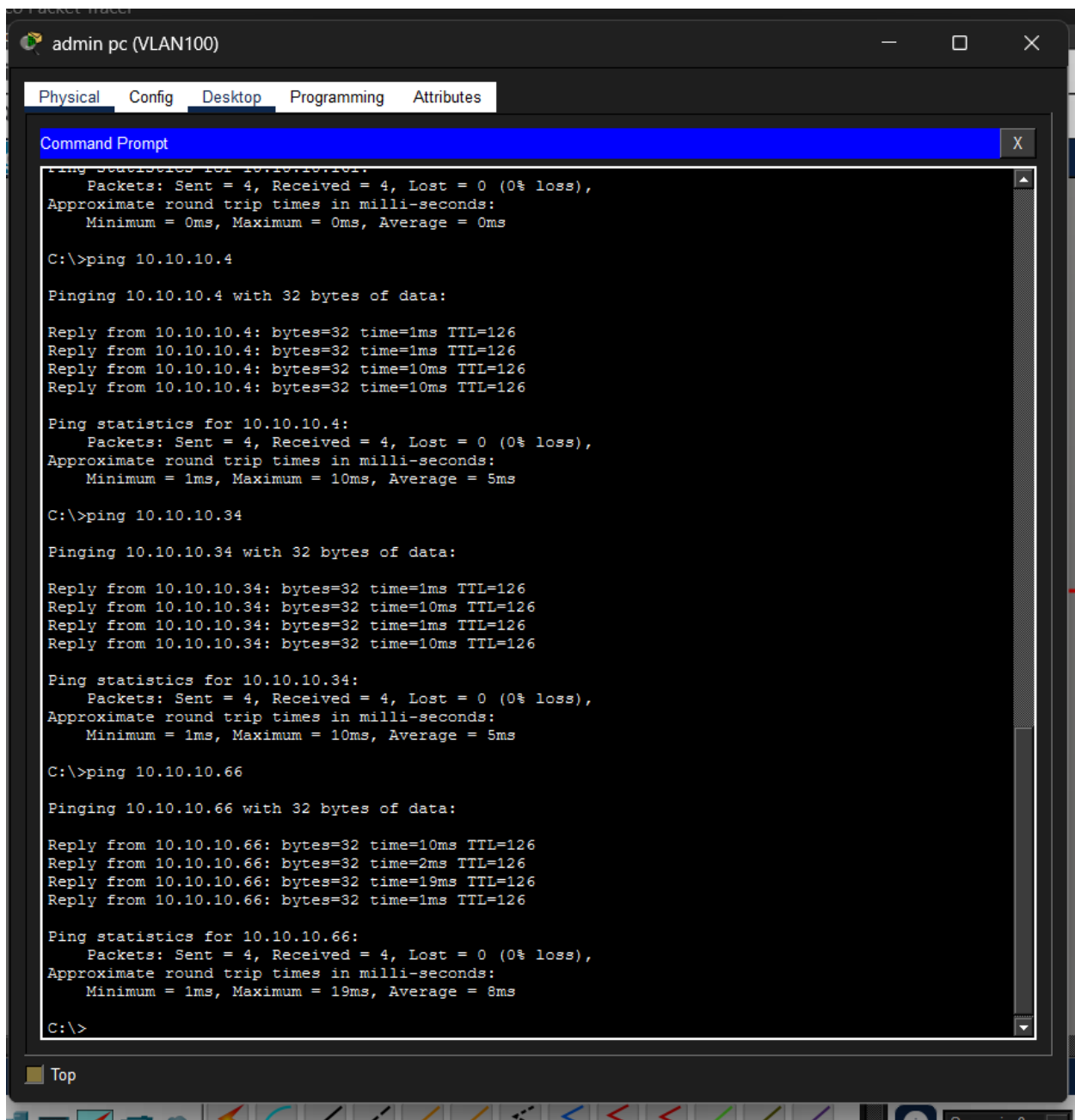
Ping statistics for 10.10.10.130:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 12ms, Average = 7ms

C:\>
```

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:



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%

