LAB TASK

COMPUTER NETWORKING

TABLE OF CONTENT:

TASK 01

PREPARING ETHERNET CABLE:

Aim:

To prepare Straight-Through and Crossover Ethernet cables using RJ-45 connectors and Crimping Tool for connecting networking devices.

Apparatus / Tools Required:

Tool / Component	Purpose
RJ-45 Connectors	Connector for Ethernet cables
Cat-5e / Cat-6 Cable	Twisted pair cable for data transmission
Crimping Tool	To fix RJ-45 connector to the cable
Cable Stripper / Cutter	To remove outer sheath of cable
Cable Tester (optional)	To test cable continuity

Theory:

Ethernet cables are used to connect computers, switches, routers, etc., in a local area network (LAN).

There are two common types of Ethernet cables:

- **Straight-through cable:** Connects **different devices** (PC to Switch/Router).
- **Crossover cable:** Connects **similar devices** (PC to PC, Switch to Switch).

Color coding follows **TIA/EIA standards**:

- **TIA/EIA 568A**
- **TIA/EIA 568B**

Pin No	T568A Color	T568B Color
1	White/Green	White/Orange
2	Green	Orange
3	White/Orange	White/Green
4	Blue	Blue
5	White/Blue	White/Blue
6	Orange	Green
7	White/Brown	White/Brown
8	Brown	Brown

Procedure:

For Straight-Through Cable:

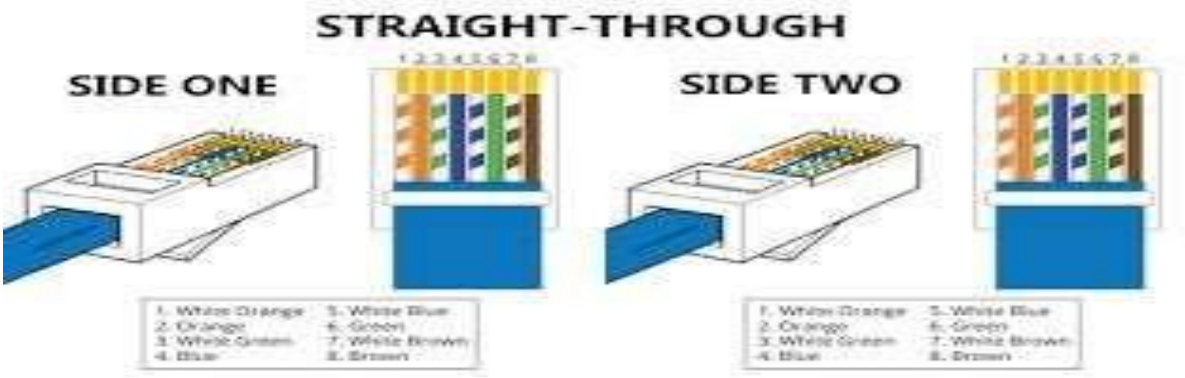
1. Cut a length of Cat-5e/6 cable.
2. Strip about 1 inch of outer jacket from both ends.
3. Untwist the pairs and arrange the wires in **same order** at both ends:
4. Use **T568B on both sides** (commonly used).
5. Trim wires evenly and insert into **RJ-45 connector**.
6. Insert connector into **crimping tool** and crimp it tightly.
7. Repeat for the other end.
8. Use cable tester to verify connectivity.

For Crossover Cable:

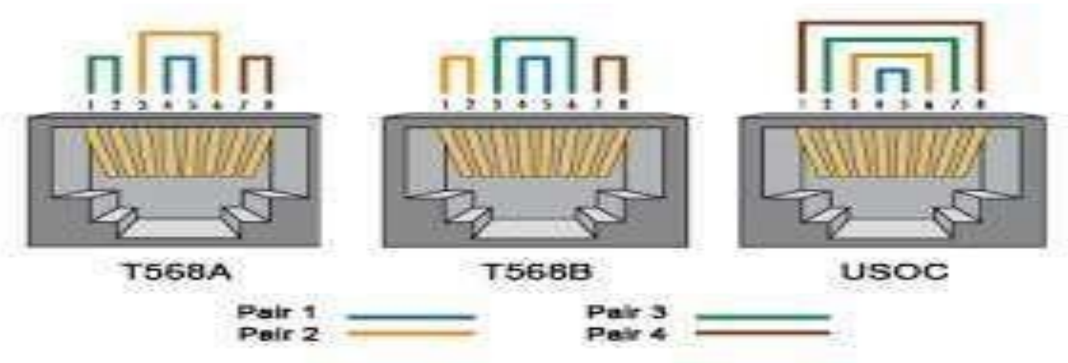
1. Same steps as above.
2. Use **T568A on one end**, **T568B on the other end**.
3. Crimp and test.

Diagrams:

STRAIGHT THROUGH CABLE:



CROSS OVER CABLES:



RJ 45 CABLE:

Observation:

Cable Type	End A Standard	End B Standard	Status
Straight-Through	T568B	T568B	Working ☑
Crossover	T568A	T568B	Working ☑

Result / Conclusion:

The Ethernet cables (Straight-through and Crossover) were successfully prepared using RJ45 connectors and tested for correct pin alignment and connectivity.

TASK 02

UNDERSTANDING NETWORK COMMANDS:

Aim:

To understand and use basic network commands for troubleshooting and analyzing network configuration and connectivity in a computer system.

Apparatus / Tools Required:

Tool/Software	Purpose
Computer (Windows/Linux)	To execute network commands
Command Prompt / Terminal	For entering the commands
Network connectivity	To test live network behavior

Theory:

Network commands help users:

- Check the system's **IP address**
- Test **connectivity to another host**
- View **routing and DNS information**
- Analyze **network adapter configuration**

These commands are widely used for network troubleshooting and configuration analysis.

Commonly Used Network Commands:

1. ipconfig (Windows) / ifconfig (Linux)

- Shows IP address, Subnet Mask, Default Gateway • Use:
- ***ipconfig***

2. ping

- Tests **reachability** of a host on a network • Sends **ICMP Echo Request** and checks replies
- Use:
- ***ping www.google.com***

3. tracert (Windows) / traceroute (Linux)

- Displays **path taken** to reach a destination host • Use:
- ***tracert www.google.com***

4. netstat

- Displays **network connections**, routing tables, interface stats • Use:
- ***netstat -an***

5. nslookup

- Used to obtain **DNS** server information and IP of domain names • Use:
- ***nslookup www.google.com***

6. arp -a

- Shows the **ARP table** (IP ↔ MAC Address) • Use:
- ***arp -a***

Procedure:

1. Open **Command Prompt (Windows)** or **Terminal (Linux)**.
2. Type each command listed above and press Enter.
3. Observe the output carefully.
4. Take note of your IP address, gateway, and DNS server.
5. Try pinging a website and observe response time.
6. Use tracert to see route taken by packets.
7. Record your observations.

Observation Table:

Command	Purpose	Sample Output Data / Status
ipconfig	Shows IP and Gateway	IP: 192.168.1.2
ping	Test connectivity	Replies received ✅
tracert	Shows packet route	10+ hops shown ✅
netstat	Shows active connections	TCP/UDP ports listed
nslookup	Resolves domain to IP	IP of www.google.com shown
arp -a	Displays MAC to IP mapping	ARP entries listed

Result / Conclusion:

The basic network commands were executed successfully. These commands are essential for diagnosing and troubleshooting network problems.

TASK 03

IP ADDRESSING AND SUBNETTING:

Aim:

To understand **IP addressing**, **classful addressing**, and perform **subnetting** to divide an IP network into multiple subnetworks.

Apparatus / Tools Required:

Tool/Software	Purpose
Computer / Notebook	For calculation and simulation
Calculator	For binary & subnet calculation
Packet Tracer (optional)	For visual simulation

Theory:

What is IP Address?

An **IP address** is a 32-bit unique identifier used to identify devices on a network.

Format: xxx.xxx.xxx.xxx (e.g., 192.168.1.1)

- Divided into **Network** and **Host** parts.
- Belongs to different **classes**.

IP Address Classes:

Class	Range	Default Subnet Mask	Use Case
A	1.0.0.0 – 126.255.255.255	255.0.0.0	Large networks
B	128.0.0.0 – 191.255.255.255	255.255.0.0	Medium networks
C	192.0.0.0 – 223.255.255.255	255.255.255.0	Small networks

Note: 127.x.x.x is reserved for loopback.

Subnetting:

Subnetting divides a **larger network** into **smaller subnets**.

- Allows better IP management.
- Helps isolate traffic for better performance and security.

Subnetting Example:

Given IP Address: `192.168.10.0`
Required Subnets: 4
Step 1: Identify IP Class

- 192 → Class C
- Default Mask: `255.255.255.0`

Step 2: Calculate number of bits needed

- 4 subnets → Needs 2 bits ($2^2 = 4$)

Step 3: New Subnet Mask

- Add 2 bits to default mask:

  → New mask = `255.255.255.192` or `/26` **Step**

4: Subnet Ranges:

Subnet	Network Address	First Host	Last Host	Broadcast Address
1	192.168.10.0	192.168.10.1	192.168.10.62	192.168.10.63
2	192.168.10.64	192.168.10.65	192.168.10.126	192.168.10.127
3	192.168.10.128	192.168.10.129	192.168.10.190	192.168.10.191
4	192.168.10.192	192.168.10.193	192.168.10.254	192.168.10.255

Procedure:

1. Identify the class of given IP address.
2. Determine the required number of subnets.
3. Calculate how many bits to borrow from the host portion.
4. Derive the new subnet mask.
5. List all subnet ranges (network address to broadcast).
6. Identify usable IPs (first to last host).
7. Validate with subnetting formula:
   - Total subnets = 2^n (n = bits borrowed)
   - Hosts per subnet = $2^h - 2$ (h = bits left for host)

Observation Table:

Parameter	Value
Given IP Address	192.168.10.0
Class	C
Default Subnet Mask	255.255.255.0 (/24)
Required Subnets	4
Bits Borrowed	2
New Subnet Mask	255.255.255.192 (/26)
Hosts per Subnet	62 usable IPs

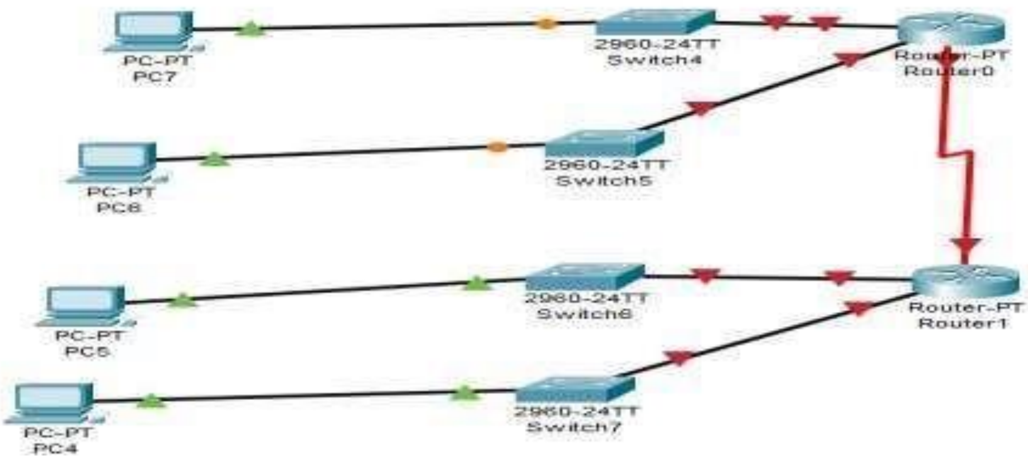
Result / Conclusion:

The IP address `192.168.10.0` was successfully subnetted into 4 subnets using a `/26` subnet mask. Each subnet has 62 usable host addresses.

TASK 04

SUBNETTING SCENARIO:

TOPOLOGY:



ADDRESSING TABLE:

DEVICE	INTERFACE	IP ADDRESS	SUBNETT MASK	DEFAULT GTEWAY
R1	Fa0/0	192.168.1.1	255.255.255.0	N/A
R1	Fa1/0	192.168.2.1	255.255.255.0	N/A
R1	Se2/0	10.10.1.1	255.255.255.0	N/A
R2	Fa0/0	192.168.9.1	255.255.255.0	N/A
R2	Fa1/0	192.168.8.1	255.255.255.0	N/A
R2	Se2/0	10.10.2.1	255.0.0.0	N/A
PC0	Fa0/0	192.168.1.9	255.255.255.0	192.168.1.1
PC1	Fa0/0	192.168.2.2	255.255.255.0	192.168.2.1
PC2	Fa0/0	192.168.9.2	255.255.255.0	192.168.9.1
PC3	Fa0/0	192.168.8.2	255.255.255.0	192.168.8.1

Part 1: Design an IP Addressing Scheme

Step 1: Subnet the 192.168.100.0/24 network into the appropriate number of subnets.

a. Based on the topology, how many subnets are needed?

A- 5

b. How many bits must be borrowed to support the number of subnets in the topology table?

A- 3

c. How many subnets does this create?

A- 8

d. How many usable hosts does this create per subnet?

A- 30

Note: If your answer is less than the 25 hosts required, then you borrowed too many bits.

Step 2: Assign the subnets to the network shown in the topology.

a. Assign Subnet 0 to the LAN connected to the GigabitEthernet 0/0 interface of R1: 192.168.1.1

b. Assign Subnet 1 to the LAN connected to the GigabitEthernet 0/1 interface of R1: 192.168.2.1

c. Assign Subnet 2 to the LAN connected to the GigabitEthernet 0/0 interface of R2: 192.168.9.1

d. Assign Subnet 3 to the LAN connected to the GigabitEthernet 0/1 interface of R2: 192.168.8.1

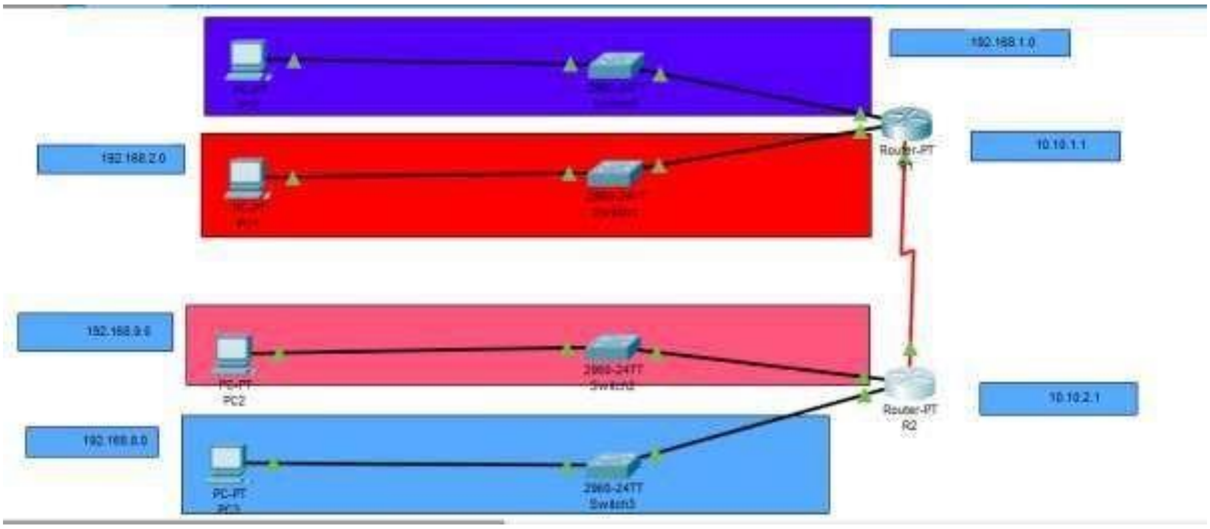
Part 2: Assign IP Addresses to Network Devices and Verify Connectivity

Step 1: Configure IP addressing on R1 LAN interfaces.

Step 2: Configure IP addressing on S3, including the default gateway.

Step 3: Configure IP addressing on PC4, including the default gateway.

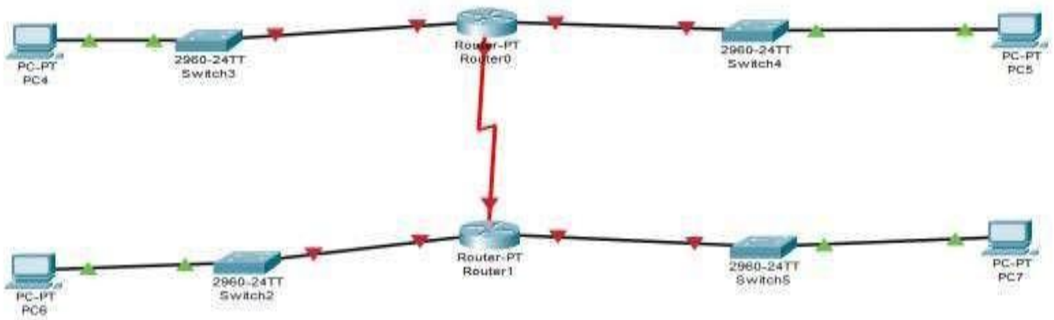
COMPLETE



TASK 05

CONFIGURING STATIC ROUTING:

TOPOLOGY:



ADDRESSING TABLE:

DEVICE	INTERFACE	IP ADDRESS	SUBNETT MASK	DEFAULT GTEWAY
R1	Fa0/0	192.168.12.1	255.255.255.0	N/A
R1	Fa1/0	192.168.22.1	255.255.255.0	N/A
R1	Se2/0	10.10.0.1	255.255.255.0	N/A
R2	Fa0/0	192.168.90.1	255.255.255.0	N/A

R2	Fa1/0	192.168.80.1	255.255.255.0	N/A
R2	Se2/0	10.10.0.1	255.0.0.0	N/A
PC0	Fa0/0	192.168.12.9	255.255.255.0	192.168.12.1
PC1	Fa0/0	192.168.22.2	255.255.255.0	192.168.22.1
PC2	Fa0/0	192.168.90.2	255.255.255.0	192.168.90.1
PC3	Fa0/0	192.168.80.2	255.255.255.0	192.168.80.1

Objectives

Part 1: Examine the Network Requirements
Part 2: Design the VLSM Addressing Scheme

Part 3: Assign IP Addresses to Devices and Verify Connectivity Part 1:

Examine the Network Requirements:

Step 1

Q: How many subnets are needed in the network topology?
A: 5 subnets are needed (Sw1, Sw2, Sw3, Sw4, and the point-to-point link between RemoteSite1 and Remote-Site2).

Step 2

a. Which subnet mask will accommodate the number of IP addresses required for Sw1?
A: /27

How many usable host addresses will this subnet support?
A: 30 usable hosts

b. Which subnet mask will accommodate the number of IP addresses required for Sw2?
A: /27

How many usable host addresses will this subnet support?
A: 30 usable hosts

c. Which subnet mask will accommodate the number of IP addresses required for Sw3?
A: /28

How many usable host addresses will this subnet support?
A: 14 usable hosts

d. Which subnet mask will accommodate the number of IP addresses required for Sw4?
A: /28

How many usable host addresses will this subnet support?
A: 14 usable hosts

e. **Which subnet mask will accommodate the number of IP addresses required for the connection between Remote-Site1 and Remote-Site2?**

A: /30

How many usable host addresses will this subnet support? A:
2 usable hosts

Part 2: Design the VLSM Addressing Scheme

Step 1:Divide the 172.31.103.0/24 network based on the number of hosts per subnet.

a. Use the first subnet to accommodate the largest LAN.
b. Use the second subnet to accommodate the second largest LAN.
c. Use the third subnet to accommodate the third largest LAN.
d. Use the fourth subnet to accommodate the fourth largest LAN.
e. Use the fifth subnet to accommodate the connection between **Remote-Site1** and **Remote-Site2**.

Step 3: Document the addressing scheme.

a. Assign the first usable IP addresses to Remote-Site1 for the two LAN links and the WAN link.

b. Assign the first usable IP addresses to Remote-Site2 for the two LANs links. Assign the last usable IP address for the WAN link.

c. Assign the second usable IP addresses to the switches.

d. Assign the last usable IP addresses to the hosts.

Part 3: Assign IP Addresses to Devices and Verify Connectivity

Most of the IP addressing is already configured on this network. Implement the following steps to complete the addressing configuration.

Step 1: Configure IP addressing on Remote-Site1 LAN interfaces.

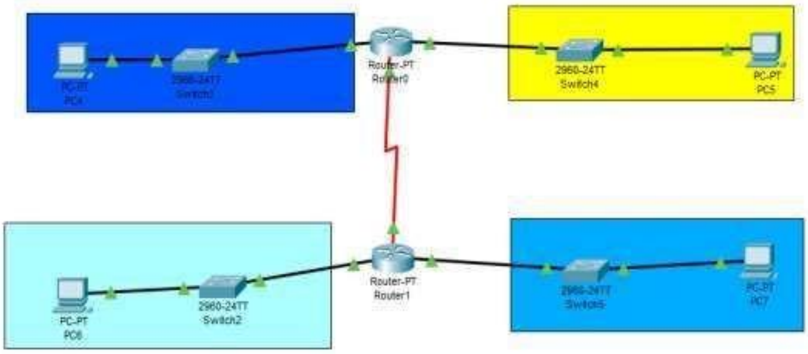
Step 2: Configure IP addressing on Sw3, including the default gateway. Step

3: Configure IP addressing on User-4, including the default gateway.

Step 4: Verify connectivity.

You can only verify connectivity from Remote-Site1, Sw3, and User-4. However, you should be able to ping every IP address listed in the Addressing Table.

COMPLETE


Router-PT
2960-24TT
Switch4
PC-PT
PC5
PC-PT
2960-24TT
Switch2
Router-PT
Router1
PC-PT

Lab Task :06

RIP Configuration in Routers

Objective:

To configure **RIP (Routing Information Protocol)** on two routers and verify that routes are exchanged dynamically between them for successful communication between hosts.

Required Materials:

- 2 Routers (with Serial and Ethernet interfaces)
- 2 Computers (Windows XP)
- 2 Straight-through Ethernet cables
- 1 Crossover Ethernet cable
- 1 Serial cable
- 2 Console cables
- Access to Command Prompt on H1 and H2
- Access to router configuration mode (CLI)

IP Address Table:

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	FastEthernet0/0	192.168.1.1	255.255.255.0	—
R1	Serial0/0/0	10.0.1.2	255.0.0.0	—
R2	Serial0/0/0	10.0.1.1	255.0.0.0	—
R2	FastEthernet0/0	192.168.2.1	255.255.255.0	—
H1	—	192.168.1.2	255.255.255.0	192.168.1.1
H2	—	192.168.2.2	255.255.255.0	192.168.2.1

Procedure / Steps:

Step 1: Build the Network

- Connect routers, switches, and hosts as shown in the topology.
- Use correct cable types for each connection.

Step 2: Configure Hosts

- **Host H1** IP: 172.16.0.2, Mask: 255.255.0.0, Gateway: 172.16.0.1
- **Host H2** IP: 172.18.0.2, Mask: 255.255.0.0, Gateway: 172.18.0.1

Step 3: Configure Routers

```
R1(config)#hostname R1 R1(config)#interface fa0/0
R1(config-if)#ip address 192.168.1.1255.255.255.0
R1(config-if)#no shutdown R1(config)#interface s0/0/0
R1(config-if)#ip address 10.0.1.2 255.0.0.0
R1(config-if)#no shutdown
```

```
R2(config)#hostname R2
R2(config)#interface fa0/0
R2(config-if)#ip address 192.168.2.1 255.255.255.0
R2(config-if)#no shutdown
R2(config)#interface s0/0/0
R2(config-if)#ip address 10.0.1.1 255.0.0.0 R2(config-if)#no shutdown
```

Step 4: Check Initial Routing Table (Before RIP)

- Use: `show ip route`

Q1: What does "C" mean?
C = Directly connected network.

Q2: Is R2's network visible in R1's table? No, because RIP is not configured yet.

Step 5: Configure RIP v2 `R1(config)#router rip`

```
R1(config-router)#version 2
R1(config-router)#network 192.168.1.0
R1(config-router)#network 10.0.1.0

R2(config)#router rip
R2(config-router)#version 2
R2(config-router)#network 192.168.2.0
R2(config-router)#network 10.0.1.0
```

Save configs: `copy running-config startup-config`

Step 6: Verify Routing Tables

On R1: `show ip route`

Q3: What networks are shown? 192.168.1.0, 192.168.2.0, 10.0.1.0

Q4: What does "R" mean?
Learned via RIP

Q5: What does "via 192.168.1.2" mean?
It is the next-hop router IP

Q6: What does “Serial0/0/0” mean?
The interface through which the route is learned

Step 7: Test Connectivity

- From **R1**: `ping 102.168.1.1`
- From **H1**: `ping 192.168.1.2`

Are pings successful?
Yes

Q7: Why are they successful now?

Because RIP exchanged routing info between routers. **Step**

8: Debug RIP

```
debug ip rip
```

Check RIP updates between routers. Then turn off debugging: `undebug`

`all`

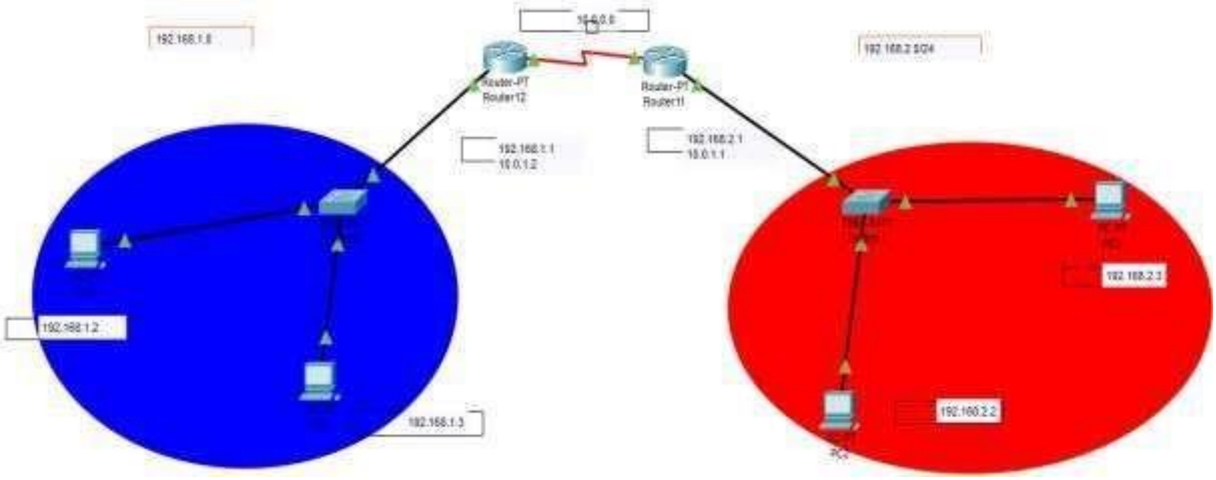
Q8: What interface does R1 send/receive updates on? Serial0/0/0

Q9: Why is metric 1 for 192.168.1.0 and metric 2 for 191.168.2.0?
192.168.1.0 is directly connected; 192.169.2.0 is 1 hop away.

Step 9: Reflection

Q10: What happens if R2's Ethernet goes down?
R1 will remove 192.168.1.0 from its routing table.

Q11: What if R1 runs RIPv1 and R2 runs RIPv2?
They won’t communicate correctly; RIPv1 do esn’t support subnet info or multicasting.


192.168.1.0
10.0.0.0
192.168.2.0/24
Router-PT
Router12
Router-PT
Router11
192.168.1.1
10.0.1.2
192.168.2.1
10.0.1.1
192.168.2.3
192.168.1.2
192.168.2.2
192.168.1.3