Experiment 1

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22BCP170

Part A
Class B.Tech CSE 3rd Year **Sub : Computer Network**
Aim: Simulation of Various Networking Topologies
Prerequisite: Nil
Outcome: To impart knowledge of Computer Networking Technology
Theory: ***Star Topology*** All devices are connected to a central hub or switch in a star topology. This arrangement simplifies management and troubleshooting since each device has a dedicated connection to the central point. However, the failure of the central hub can disrupt the entire network, and the performance can be affected by the hub's capacity. ***Bus Topology*** A bus topology involves a single central cable connected to all devices. Data travels along the cable, and each device listens for its specific address. While it's relatively

simple and cost-effective, a cable fault can disrupt the entire network, and performance can degrade as more devices are added.

Mesh Topology

In a mesh topology, every device is connected to every other device, forming a redundant and fault-tolerant network. This architecture ensures high reliability and multiple communication paths, but it can be expensive and complex to implement due to the number of connections required.

Ring Topology

In a ring topology, devices are connected in a closed loop, where data travels in one direction from device to device. Each device receives the data and forwards it to the next. While it's efficient for small networks, a failure in one device or cable can disrupt the entire network until the issue is resolved.

Tree Topology

A tree topology combines characteristics of star and bus topologies. It consists of multiple star-configured networks connected to a central bus or root. This design can accommodate larger networks and offers a good balance between scalability and manageability. Still, failures in the central hub can impact the entire network, similar to a star topology.

Procedure:

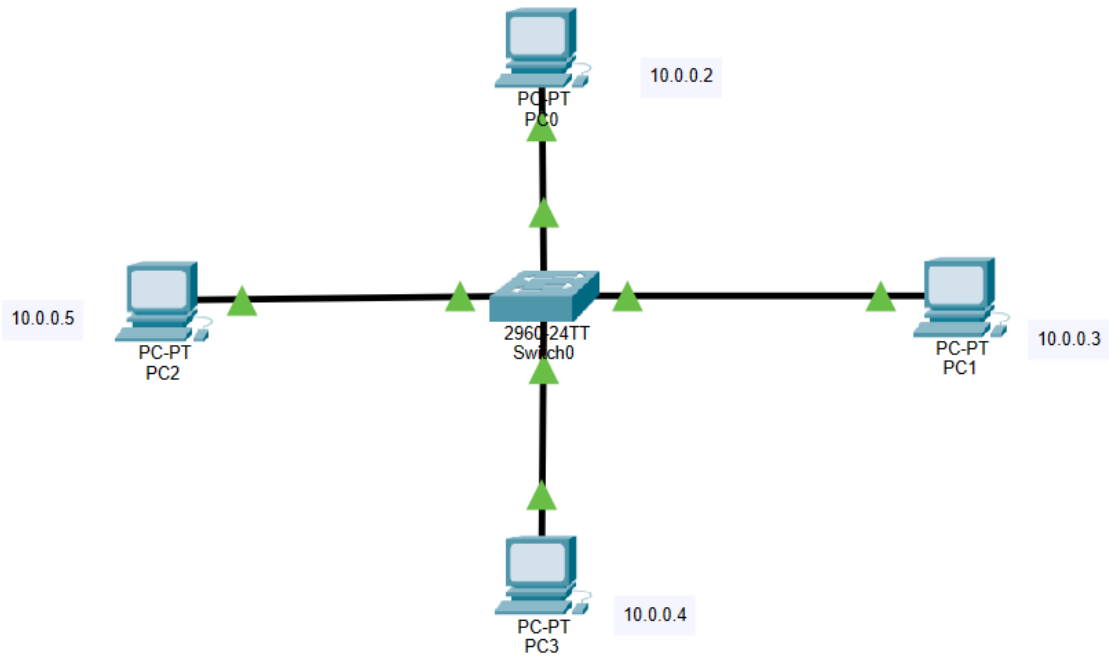
1. Open Cisco Packet Tracer and simulate the topologies of required size.

2. Assign the IP Addresses to the system.
3. Check the connectivity between the devices.

Part B
Steps: 1) **Open Cisco Packet Tracer.** 2) **Add devices:** Add a router. Add PCs or laptops as required by the topology. 3) **Connect devices** Use Copper Straight-Through cables to connect PCs to the router. Connect additional network devices (if any) similarly. 4) **Assign IP addresses:** Set IP addresses for each PC and the router interfaces. Ensure all devices are within the same subnet. 5) **Check connectivity:** Use the ping command from each PC to test connectivity with other devices in the network.

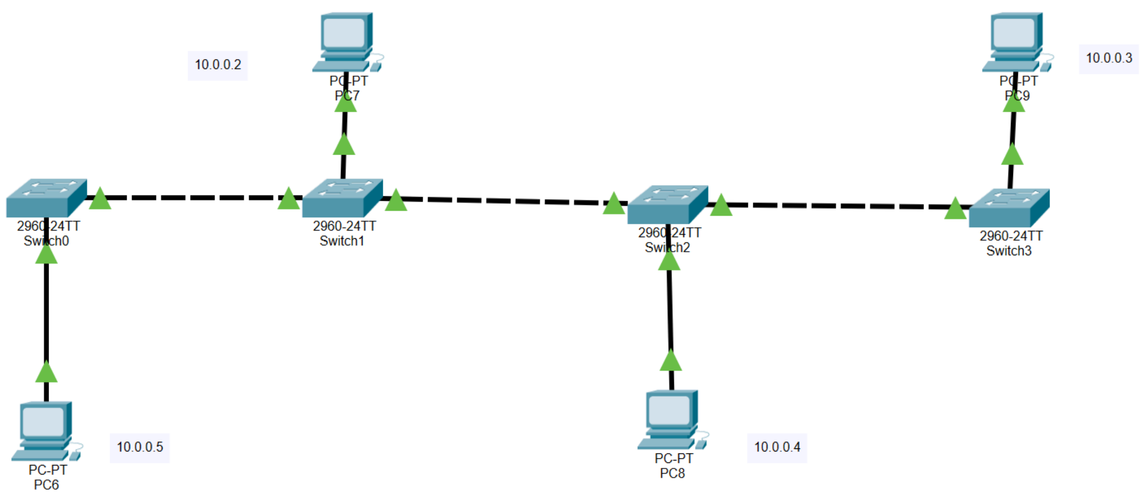
Output:

1) Star Topology



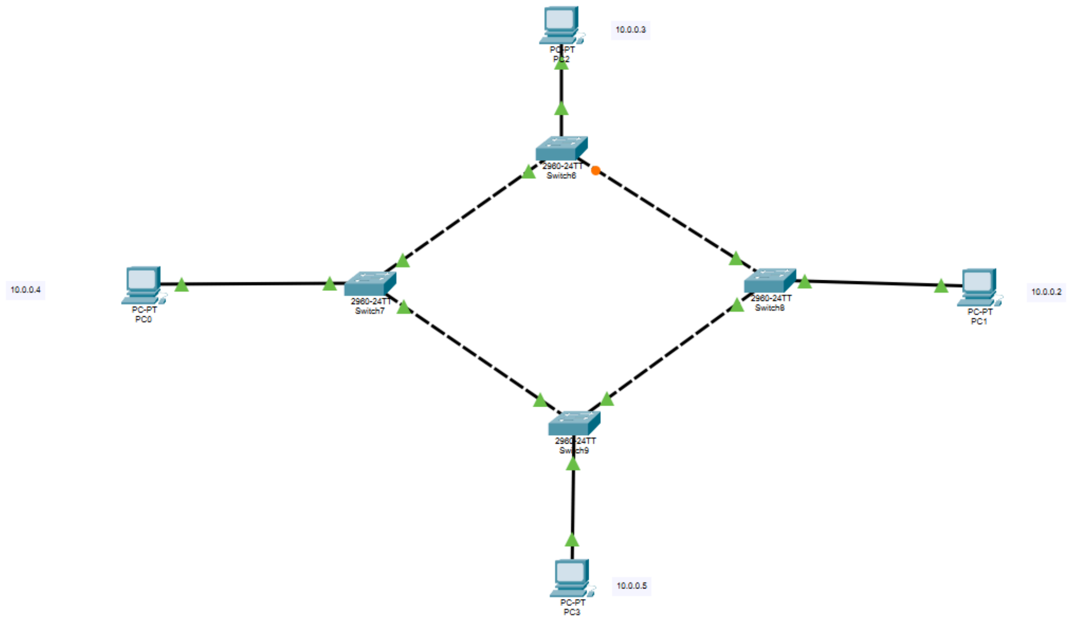
```
Packet Tracer PC Command Line 1.0
C:\>ping 10.0.0.3

Pinging 10.0.0.3 with 32 bytes of data:

Reply from 10.0.0.3: bytes=32 time=28ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 28ms, Average = 7ms

C:\>ping 10.0.0.4

Pinging 10.0.0.4 with 32 bytes of data:

Reply from 10.0.0.4: bytes=32 time<1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

2) Bus Topology



```
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time=2ms TTL=128

Ping statistics for 10.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 2ms, Average = 0ms

C:\>ping 10.0.0.4

Pinging 10.0.0.4 with 32 bytes of data:

Reply from 10.0.0.4: bytes=32 time=1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.0.2

Pinging 10.0.0.2 with 32 bytes of data:

Reply from 10.0.0.2: bytes=32 time<1ms TTL=128
Reply from 10.0.0.2: bytes=32 time<1ms TTL=128
Reply from 10.0.0.2: bytes=32 time=1ms TTL=128
Reply from 10.0.0.2: bytes=32 time=1ms TTL=128

Ping statistics for 10.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

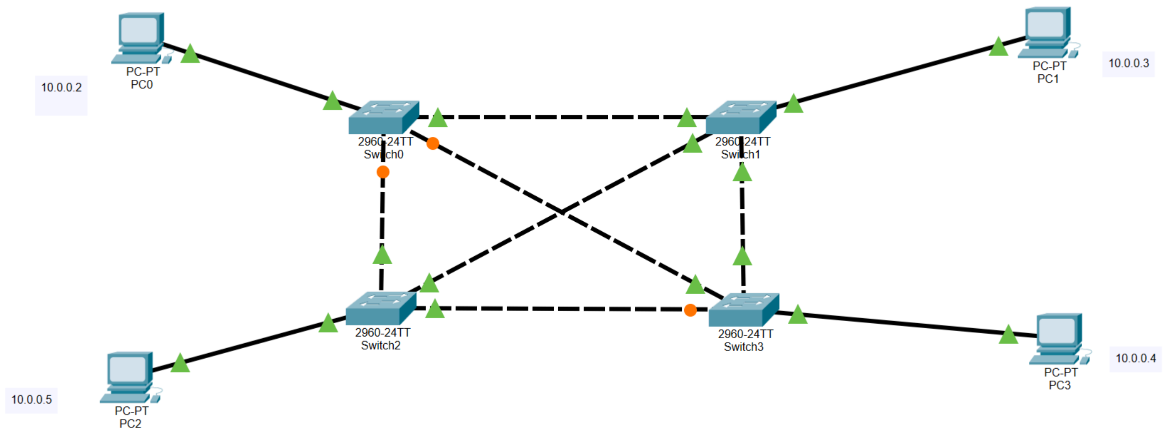
3) Ring Topology



Output:

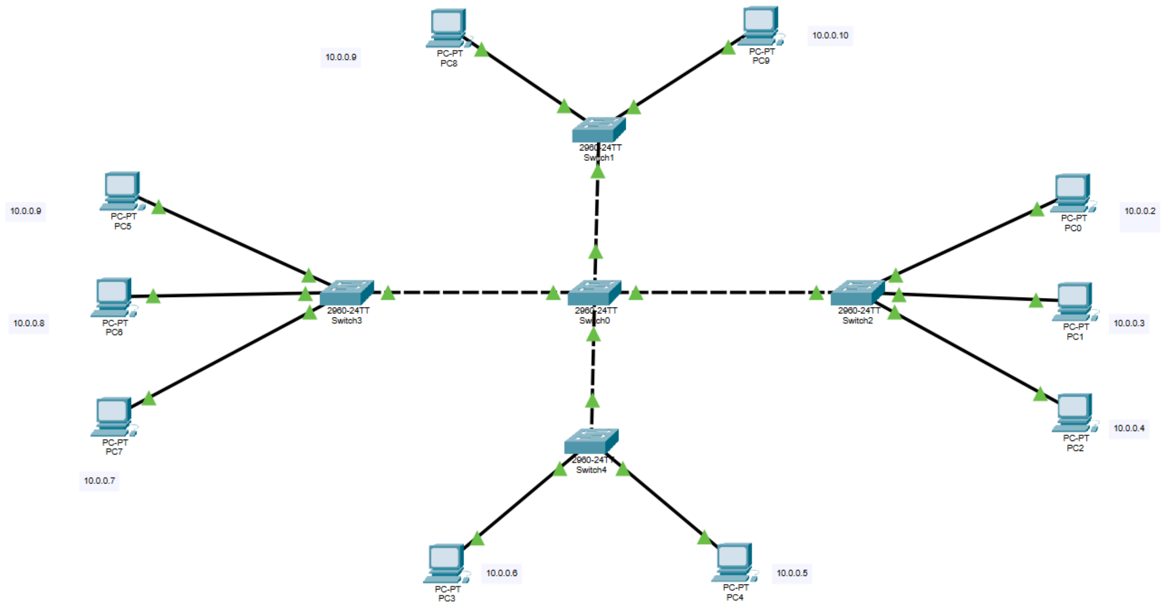
```
Packet Tracer PC Command Line 1.0
C:\>ping 10.0.0.3

Pinging 10.0.0.3 with 32 bytes of data:

Reply from 10.0.0.3: bytes=32 time=4ms TTL=128
Reply from 10.0.0.3: bytes=32 time=4ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time=2ms TTL=128

Ping statistics for 10.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 4ms, Average = 2ms

C:\>ping 10.0.0.4

Pinging 10.0.0.4 with 32 bytes of data:

Reply from 10.0.0.4: bytes=32 time=2ms TTL=128
Reply from 10.0.0.4: bytes=32 time=2ms TTL=128
Reply from 10.0.0.4: bytes=32 time=4ms TTL=128
Reply from 10.0.0.4: bytes=32 time=3ms TTL=128

Ping statistics for 10.0.0.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 4ms, Average = 2ms
```

4) Mesh Topology




```
Pinging 10.0.0.3 with 32 bytes of data:

Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time=1ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128
Reply from 10.0.0.3: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.0.4

Pinging 10.0.0.4 with 32 bytes of data:

Reply from 10.0.0.4: bytes=32 time=1ms TTL=128
Reply from 10.0.0.4: bytes=32 time=1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128
Reply from 10.0.0.4: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.0.5

Pinging 10.0.0.5 with 32 bytes of data:

Reply from 10.0.0.5: bytes=32 time<1ms TTL=128
Reply from 10.0.0.5: bytes=32 time<1ms TTL=128
Reply from 10.0.0.5: bytes=32 time<1ms TTL=128
Reply from 10.0.0.5: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.5:
```

5) Hybrid/Tree Topology




```
C:\>ping 10.0.0.10

Pinging 10.0.0.10 with 32 bytes of data:

Reply from 10.0.0.10: bytes=32 time<1ms TTL=128
Reply from 10.0.0.10: bytes=32 time=1ms TTL=128
Reply from 10.0.0.10: bytes=32 time=1ms TTL=128
Reply from 10.0.0.10: bytes=32 time=1ms TTL=128

Ping statistics for 10.0.0.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 10.0.0.9

Pinging 10.0.0.9 with 32 bytes of data:

Reply from 10.0.0.9: bytes=32 time<1ms TTL=128
Reply from 10.0.0.9: bytes=32 time<1ms TTL=128
Reply from 10.0.0.9: bytes=32 time=1ms TTL=128
Reply from 10.0.0.9: bytes=32 time<1ms TTL=128

Ping statistics for 10.0.0.9:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Observation & Learning:

1) Star Topology

In a star topology, all devices are connected to a central hub or switch. The hub acts as a repeater for data flow.

Advantages:

- **Easy to manage:** Problems can be easily detected and isolated.
- **Scalability:** Adding or removing devices is straightforward.
- **Performance:** Less data collision since each device has a dedicated line to the hub.

Disadvantages:

- **Single point of failure:** If the central hub fails, the entire network is affected.
- **Cost:** Requires more cable length than some other topologies and a hub/switch.

2) Bus Topology

In a star topology, all devices are connected to a central hub or switch. The hub acts as a repeater for data flow.

Advantages:

- **Easy to manage:** Problems can be easily detected and isolated.
- **Scalability:** Adding or removing devices is straightforward.
- **Performance:** Less data collision since each device has a dedicated line to the hub.

Disadvantages:

- **Single point of failure:** If the central hub fails, the entire network is affected.
- **Cost:** Requires more cable length than some other topologies and a hub/switch.

3) Ring Topology

In a ring topology, each device is connected to two other devices, forming a circular data path.

Advantages:

- **Orderly data flow:** Data packets travel in a single direction, reducing collisions.
- **Easy to add devices:** Devices can be easily added with minimal disruption.

Disadvantages:

- **Single point of failure:** A break in the ring (a single cable failure) can disrupt the entire network.
- **Latency:** As the network grows, the data must travel through more devices, increasing latency.

4) Mesh Topology

In a mesh topology, each device is connected to every other device in the network, creating multiple pathways for data.

Advantages:

- **Robustness:** Provides high redundancy; failure of one device doesn't affect the entire network.
- **High reliability:** Multiple paths for data mean it can still reach its destination even if one path fails.

- **Scalability:** Easy to expand without disrupting existing network communications.

Disadvantages:

- **High cost:** Requires a lot of cabling and network interfaces, especially in a fully connected mesh.
- **Complexity:** Difficult to manage and maintain due to the large number of connections.

5) **Hybrid/Tree Topology**

Hybrid topology combines two or more different types of topologies. For example, a large network may use a star-bus topology.

Advantages:

- **Flexible design:** Can be designed to meet the specific needs of the network.
- **Scalability:** Easier to expand as it can incorporate different topologies as needed.

Disadvantages:

- **Complexity:** The combination of multiple topologies can make the network design and maintenance more complex.
- **Cost:** Implementing a hybrid network can be expensive due to the varied hardware requirements.

Conclusion:

This experiment covered the practical implementation and characteristics of various network topologies, including star, bus, ring, mesh, and hybrid, using Cisco Packet Tracer. The hands-on experience provided insight into the advantages and disadvantages of each topology in terms of scalability, fault tolerance, and cost. By configuring devices and testing connectivity, a deeper understanding of network design principles and the importance of proper device setup and IP addressing was developed. This exercise reinforced the critical skills needed for network planning, deployment, and troubleshooting in real-world scenarios.

Questions:

1. Which is the most efficient topology in LAN environment and why?

Star Topology is considered the most efficient topology for a Local Area Network (LAN) environment because:

1) All devices are connected to a central hub or switch making networking, monitoring and troubleshooting easy

2) Start topology is easily scalable. Adding new device to the network is straightforward, simply connect the new device to the central hub without disturbing the network.

3) In star topology, if one of the connected devices fails, the rest of the network remains unaffected.

4) It is easy to implement.

2.How can we test the connectivity between the terminals?

To test the connectivity between terminals (or computers/devices) in a network, you can use the ping command. The ping command is a network utility tool used to check the reachability of a host on an Internet Protocol (IP) network. It also measures the round-trip time for messages sent from the source to the destination.

Syntax: **ping 10.0.0.4**

Output:

- Packets Sent and Received: The output shows the number of packets sent, received, and lost. Ideally, all packets sent should be received, indicating good connectivity.
- Round-Trip Time: This includes the minimum, maximum, and average time (in milliseconds) it took for packets to travel to the destination and back. Lower round-trip times indicate faster connections.
- TTL (Time to Live): This value shows the number of hops (or devices) the packet passed through before reaching its destination.

3.What are the two categories of cable? In what type of connection are they used?

Cables used in networking fall into two primary categories: twisted pair cables and coaxial cables.

Twisted Pair Cables

Twisted pair cables consist of insulated copper wires twisted together. They come in two types: unshielded twisted pair (UTP) and shielded twisted pair (STP). UTP cables are commonly used in Ethernet networks for short to medium distances, providing reliable data transmission. They are widely used in LAN environments, connecting devices like computers, switches, and routers. STP cables offer additional shielding to reduce electromagnetic interference, making them suitable for environments with higher interference levels.

Coaxial Cables

Coaxial cables feature a central conductor surrounded by insulation, a metallic shield, and an outer insulating layer. These cables are often used in cable television (CATV) systems and broadband internet connections. Coaxial cables offer good signal quality over longer distances, making them suitable for applications that require extended reach. However, they are less commonly used within LANs than twisted pair cables due to their bulkier design and more specialised applications.

In summary, twisted pair cables are commonly used for LAN connections within short to medium distances. In contrast, coaxial cables are often employed in longer-distance applications like CATV and broadband connections.