6.5 Investigates how the problem of connecting multiple devices into a network is addressed

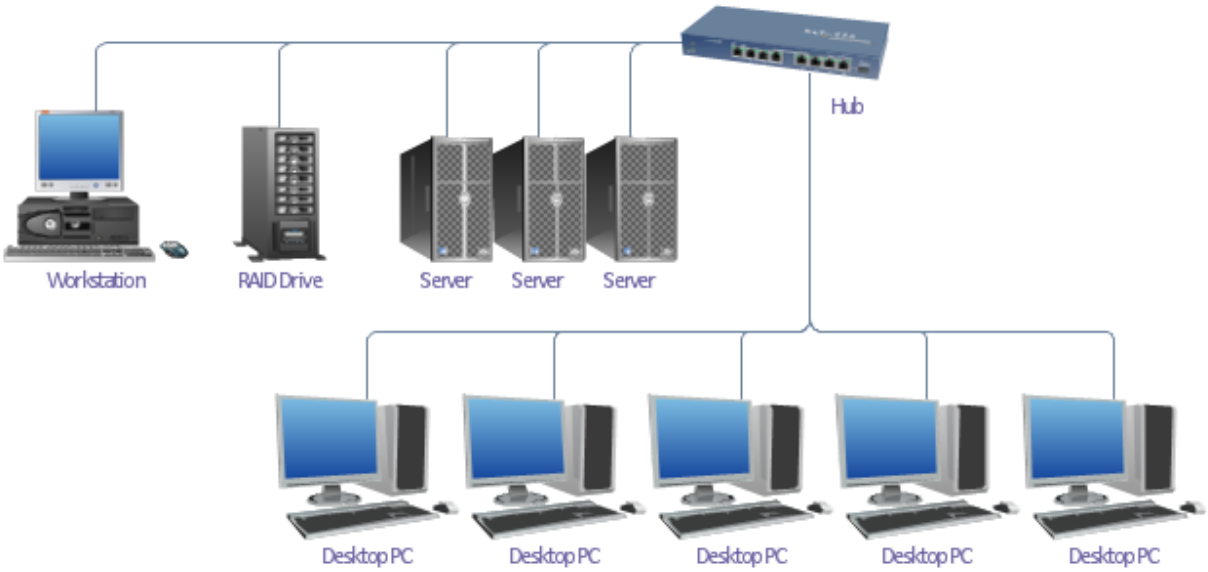
Network Architecture

Network architecture describes **how a network is arranged and how resources are coordinated and shared**. It encompasses a variety of different network specifics, including network topologies and strategies. Network topology describes the physical arrangement of the network. Network strategies define how information and resources are shared.

Topologies

A network can be arranged or configured in several different ways. This arrangement is called the network's topology. The most common topologies are

Bus network—each device is connected to a common cable called a bus or backbone, and all communications travel along this bus.



Advantages of Bus Topology

1. It is easy to set up, handle, and implement.
2. It is best-suited for small networks.
3. It costs very less.

Disadvantages of Bus Topology

1. The cable length is limited. This limits the number of network nodes that can be connected.
2. This network topology can perform well only for a limited number of nodes. When the number of devices connected to the bus increases, the efficiency decreases.
3. It is suitable for networks with low traffic. High traffic increases load on the bus, and the network efficiency drops.
4. It is heavily dependent on the central bus. A fault in the bus leads to network failure.
5. It is not easy to isolate faults in the network nodes.
6. Each device on the network “sees” all the data being transmitted, thus posing a security risk.

Ring network—each device is connected to two other devices, forming a ring. When a message is sent, it is passed around the ring until it reaches the intended destination.

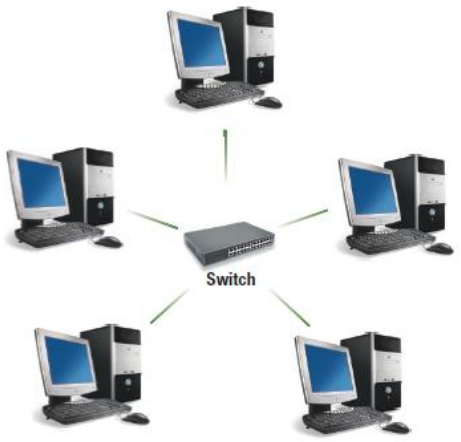
Advantages of Ring Topology

1. The data being transmitted between two nodes passes through all the intermediate nodes. A central server is not required for the management of this topology.
2. The traffic is unidirectional and the data transmission is high-speed.
3. In comparison to a bus, a ring is better at handling load.
4. The adding or removing of network nodes is easy, as the process requires changing only two connections.
5. The configuration makes it easy to identify faults in network nodes.
6. In this topology, each node has the opportunity to transmit data. Thus, it is a very organized network topology.
7. It is less costly than a star topology.

Disadvantages of Ring Topology

1. The failure of a single node in the network can cause the entire network to fail.
2. The movement or changes made to network nodes affect the entire network's performance.
3. Data sent from one node to another has to pass through all the intermediate nodes. This makes the transmission slower in comparison to that in a star topology. The transmission speed drops with an increase in the number of nodes.
4. There is heavy dependency on the wire connecting the network nodes in the ring.

Star network—each device is connected directly to a central network switch. Whenever a node sends a message, it is routed to the switch, which then passes the message along to the intended recipient. The star network is the most widely used network topology today. It is applied to a broad range of applications from small networks in the home to very large networks in major corporations.



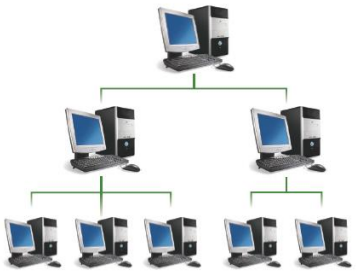
Advantages of Star Topology

1. Due to its centralized nature, the topology offers simplicity of operation.
2. It also achieves isolation of each device in the network.
3. Adding or removing network nodes is easy, and can be done without affecting the entire network.
4. Due to the centralized nature, it is easy to detect faults in the network devices.
5. As the analysis of traffic is easy, the topology poses lesser security risk.
6. Data packets do not have to pass through many nodes, like in the case of a ring network. Thus, with the use of a high-capacity central hub, traffic load can be handled at fairly decent speeds.

Disadvantages of Star Topology

1. Network operation depends on the functioning of the central hub. Hence, central hub failure leads to failure of the entire network.
2. Also, the number of nodes that can be added, depends on the capacity of the central hub.
3. The setup cost is quite high.

Tree network—each device is connected to a central node, either directly or through one or more other devices. The central node is connected to two or more subordinate nodes that in turn are connected to other subordinate nodes, and so forth, forming a treelike structure. This network, also known as a hierarchical network, is often used to share corporate wide data.



Advantages of Tree Topology

1. The tree topology is useful in cases where a star or bus cannot be implemented individually. It is most-suited in networking multiple departments of a university or corporation, where each unit (star segment) functions separately, and is also connected with the main node (root node).
2. The advantages of centralization that are achieved in a star topology are inherited by the individual star segments in a tree network.
3. Each star segment gets a dedicated link from the central bus. Thus, failing of one segment does not affect the rest of the network.
4. Fault identification is easy.
5. The network can be expanded by the addition of secondary nodes. Thus, scalability is achieved.

Disadvantages of Tree Topology

1. As multiple segments are connected to a central bus, the network depends heavily on the bus. Its failure affects the entire network.
2. Owing to its size and complexity, maintenance is not easy and costs are high. Also, configuration is difficult in comparison to that in other topologies.
3. Though it is scalable, the number of nodes that can be added depends on the capacity of the central bus and on the cable type.

Mesh network—this topology is the newest type and does not use a specific physical layout (such as a star or a tree). Rather, the mesh network requires that each node have more than one connection to the other nodes. The resulting pattern forms the appearance of a mesh. If a path between two nodes is somehow disrupted, data can be automatically rerouted around the failure using another path. Wireless technologies are frequently used to build mesh networks.

Advantages of Mesh Topology

1. The arrangement of the network nodes is such that it is possible to transmit data from one node to many other nodes at the same time.
2. The failure of a single node does not cause the entire network to fail as there are alternate paths for data transmission.
3. It can handle heavy traffic, as there are dedicated paths between any two network nodes.
4. Point-to-point contact between every pair of nodes, makes it easy to identify faults.

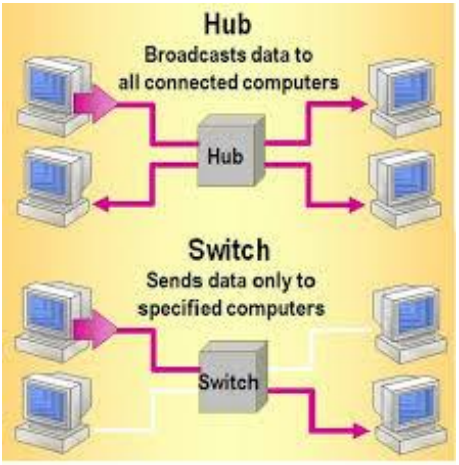
Disadvantages of Mesh Topology

1. The arrangement wherein every network node is connected to every other node of the network, many connections serve no major purpose. This leads to redundancy of many network connections.
2. A lot of cabling is required. Thus, the costs incurred in setup and maintenance are high.
3. Owing to its complexity, the administration of a mesh network is difficult.

Switches and hubs

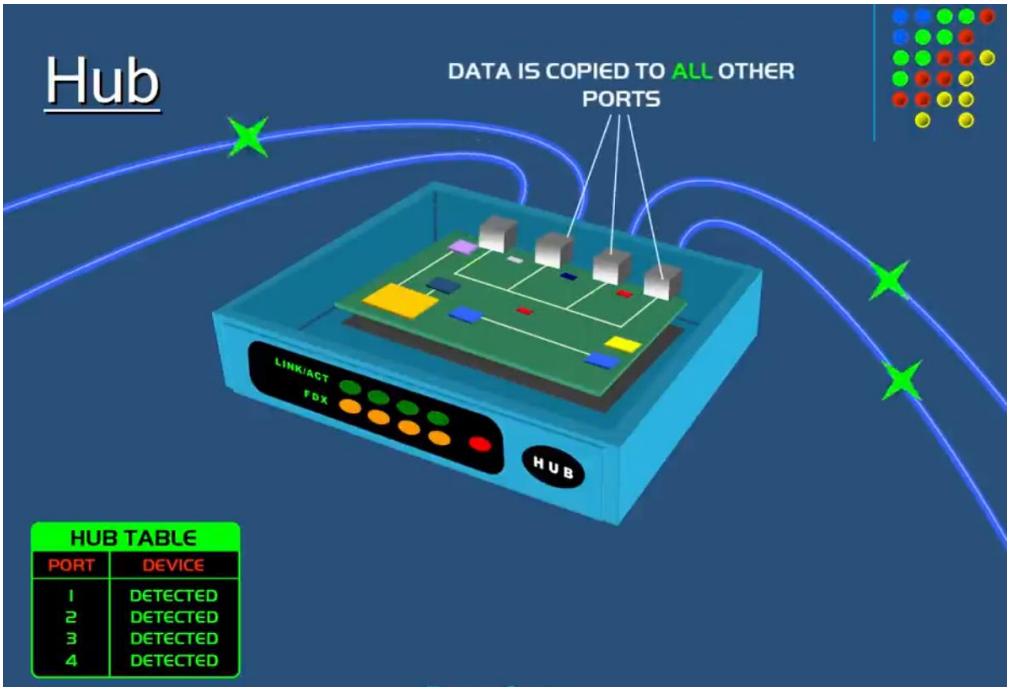
- Hubs and switches are common network devices that function as a common connection point for network devices that make up a network.
- A switch receives data in one of its incoming connections and forwards the data only on the outgoing connection which connects to the destination device.
- A hub receives data in one of its incoming connections and then shall forward the data to all of its outgoing connection.
- In this way a switch is a more intelligent device than a hub.

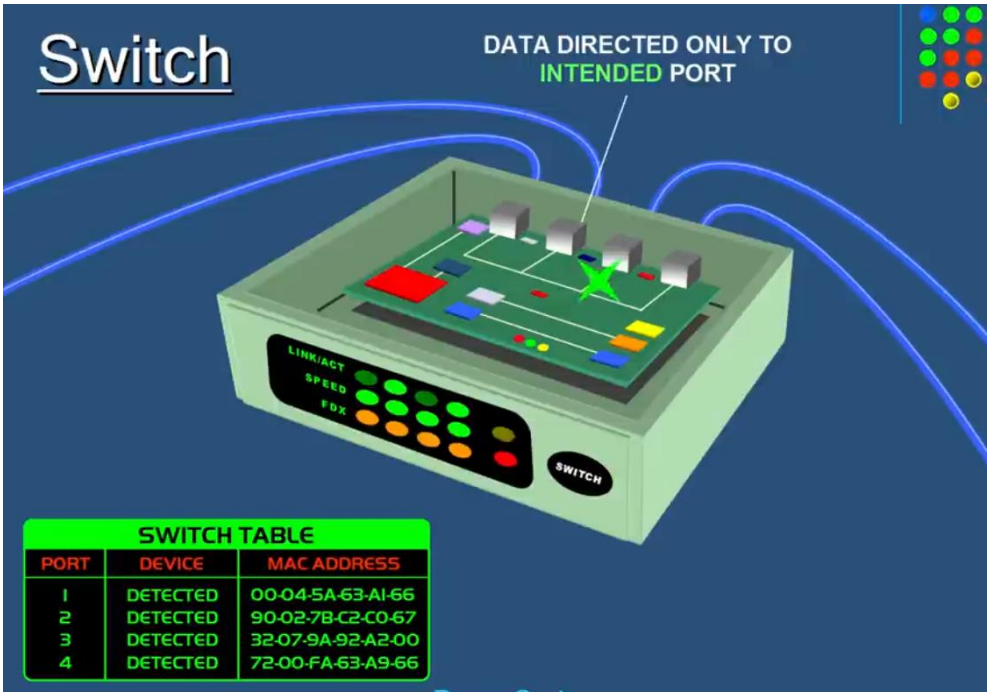


Hub	**Switch**
Layer 1 Network access device	Layer 2 (but there are multilayer) Network access device
Connect end devices together	Connect end devices together
Always half-duplex	Can work on full duplex
No configuration required before use	No configuration required before use
Efficiency decreases as number of hosts increases	Efficiently works with as number of hosts increses

Hub


Hub
DATA IS COPIED TO ALL OTHER PORTS
LINK/ACT
FDX
HUB
HUB TABLE
PORT
DEVICE
1
DETECTED
2
DETECTED
3
DETECTED
4
DETECTED



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