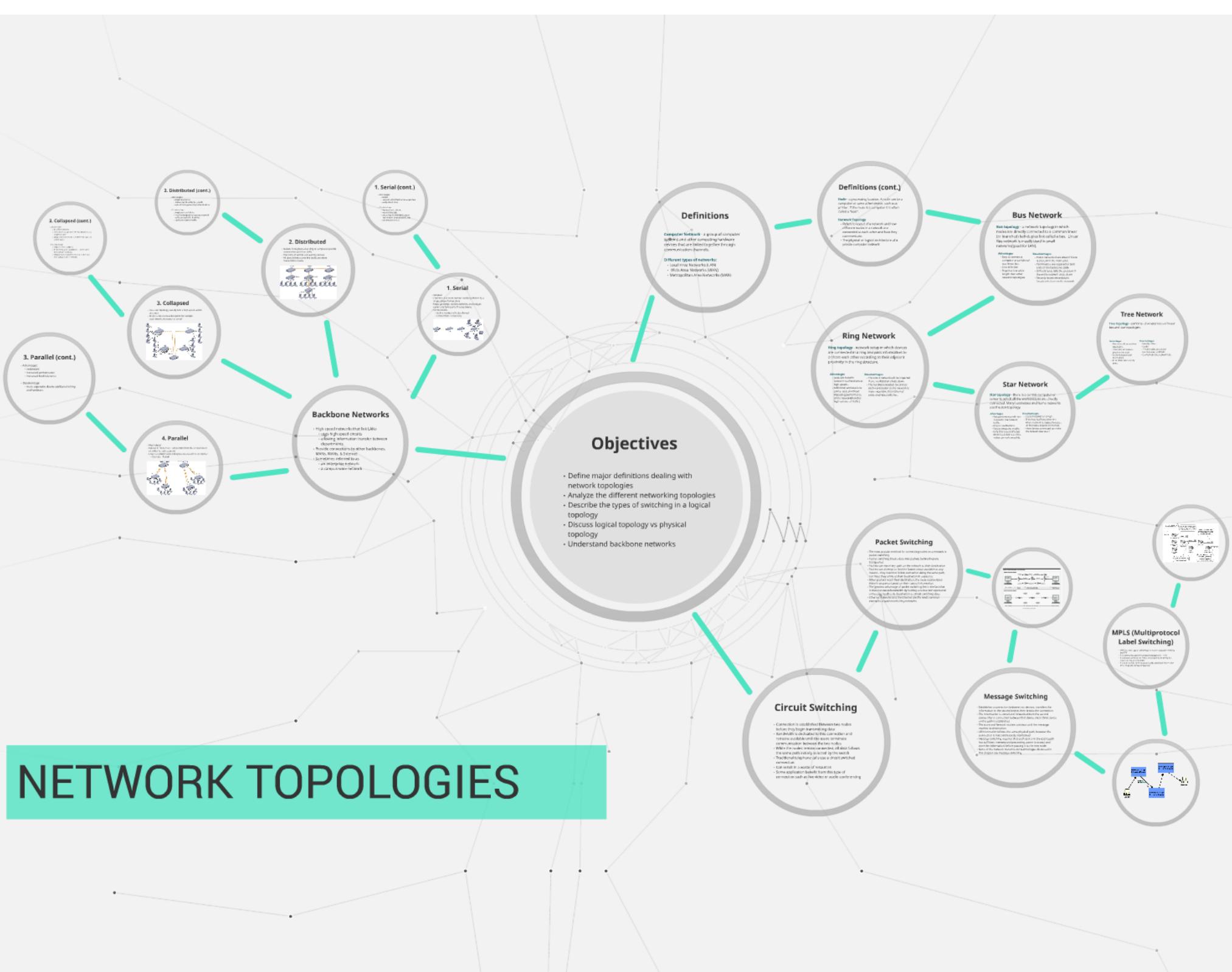


NETWORK TOPOLOGIES

Objectives

- Define major definitions dealing with network topologies
 - Analyze the different networking topologies
 - Describe the types of switching in a logical topology
 - Discuss logical topology vs physical topology
 - Understand backbone networks



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- Define major definitions dealing with network topologies
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Circuit Switching

- Connection is established between two nodes through a circuit switching. This connection is established via switches to the intermediate and remote available until the user terminates the connection.
- While it makes certain connections, all also follow the same path. This is called a permanent virtual connection. Traditional telephone calls use a circuit switched connection.
- Cost efficient in a world of instantaneity.
- Some application benefit from this type of connection such as video conferencing.

Packet Switching

- The main purpose behind packet switching is to handle traffic that is not suitable for circuit switching.
- In packet switching, the data is broken down into small packets. These are then stored in a buffer at the source node and then sent to the destination node.
- They are stored in a buffer at the destination node and then sent to the destination node.
- The main advantage of packet switching is a more efficient utilization of bandwidth. It is also known as store-and-forward switching.

MPLS (Multiprotocol Label Switching)

- MPLS is a technology that uses labels to identify and forward packets across a network.
- It is based on the concept of virtual circuits.
- Labels are placed on the packets and are used to identify the path through which they should travel.
- This allows for faster and more efficient routing.

Message Switching

- Establishes a connection between two devices. Consider the connection between a computer and a printer.
- The information is sent in discrete messages. The message is sent to the intermediate nodes in the network.
- The intermediate nodes store the message and then forward it to the next node.
- This continues until the message reaches its destination.
- Some applications benefit from this type of connection such as video conferencing.

Bus Network

- Bus Topology - a network topology in which all nodes are connected to a single shared bus or backbone.
- Every node on the bus can hear all the traffic on the bus.
- If one node fails, it can affect the entire network.

Tree Network

- Tree Topology - connecting nodes hierarchically.
- A tree network has a central node (root) and multiple branches (children).
- Every node in the tree has a unique path to the root.

Definitions (cont.)

- Computer Network - a group of computer systems and other computing services that are linked together through communication channels.

Different types of network:

- LAN (Local Area Networks) (WANs)

- Wide Area Networks (MANs)

Ring Network

- Ring Topology - network setup in which devices are connected in a ring and each individual is connected to its adjacent neighbors.

Star Network

- Star Topology - this is the most popular setup for which all the workstations are directly connected to the hub or switch.

Backbone Networks

- High speed links that tie LANs together.
- Using intermediate routers to connect them.
- Provide connections to other backbones.
- LANs are interconnected.
- LANs refer to local area networks.
- LANs refer to local area networks.

2. Distributed (cont.)

- All nodes are connected to a central point.
- All nodes are connected to a central point.
- All nodes are connected to a central point.

3. Collapsed

- All nodes are connected to a central point.
- All nodes are connected to a central point.
- All nodes are connected to a central point.

3. Parallel (cont.)

- All nodes are connected to a central point.
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4. Parallel

- All nodes are connected to a central point.
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1. Serial (cont.)

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2. Distributed

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Objectives

- Define major definitions dealing with network topologies
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- Discuss logical topology vs physical topology
- Understand backbone networks

Definitions

Computer Network - a group of computer systems and other computing hardware devices that are linked together through communication channels.

Different types of networks:

- Local Area Networks (LAN)
- Wide Area Networks (WAN)
- Metropolitan Area Networks (MAN)

Definitions (cont.)

Node - a processing location. A node can be a computer or some other device, such as a printer. If the node is a computer it is often called a “host”.

Network Topology

- Refers to layout of a network and how different nodes in a network are connected to each other and how they communicate
- The physical or logical architecture of a private computer network

Bus Network

Bus topology - a network topology in which nodes are directly connected to a common linear (or branched) half-duplex link called a bus. Linear Bus network is mostly used in small networks(good for LAN).

Advantages

- Easy to connect a computer or peripheral to a linear bus.
- Cost effective
- Requires less cable length than other network topologies

Disadvantages

- Entire network shuts down if there is a break in the main cable
- Terminators are required at both ends of the backbone cable
- Difficult to identify the problem if the entire network shuts down
- Security issues since data is broadcasted across the network

Ring Network

- **Ring topology** - network setup in which devices are connected in a ring and pass information to or from each other according to their adjacent proximity in the ring structure.

Advantages

- Data can transfer between workstations at high speeds.
- Additional workstations can be added without impacting performance of the network(handles high volume of traffic)

Disadvantages

- The entire network will be impacted if one workstation shuts down.
- The hardware needed to connect each workstation to the network is more expensive than Ethernet cards and hubs/switches.

Star Network

Star topology - there is a central computer or server to which all the workstations are directly connected. Many businesses and home networks use the star topology.

Advantages

- Fast performance with few nodes and low network traffic.
- Easy to troubleshoot.
- Easy to setup and modify.
- Only that node is affected which has failed rest of the nodes can work smoothly.

Disadvantages

- Cost of installation is high.
- If the hub is affected then the whole network is stopped because all the nodes depend on the hub.
- More devices connected can make the network slow down

Tree Network

Tree topology - combines characteristics of linear bus and star topologies.

Advantages

- Extension of bus and star topologies.
- Expansion of nodes is possible and easy.
- Easily managed and maintained.
- Error detection is easily done.

Disadvantages

- Heavily cabled.
- Costly.
- If more nodes are added maintenance is difficult.
- Central hub fails, network fails.

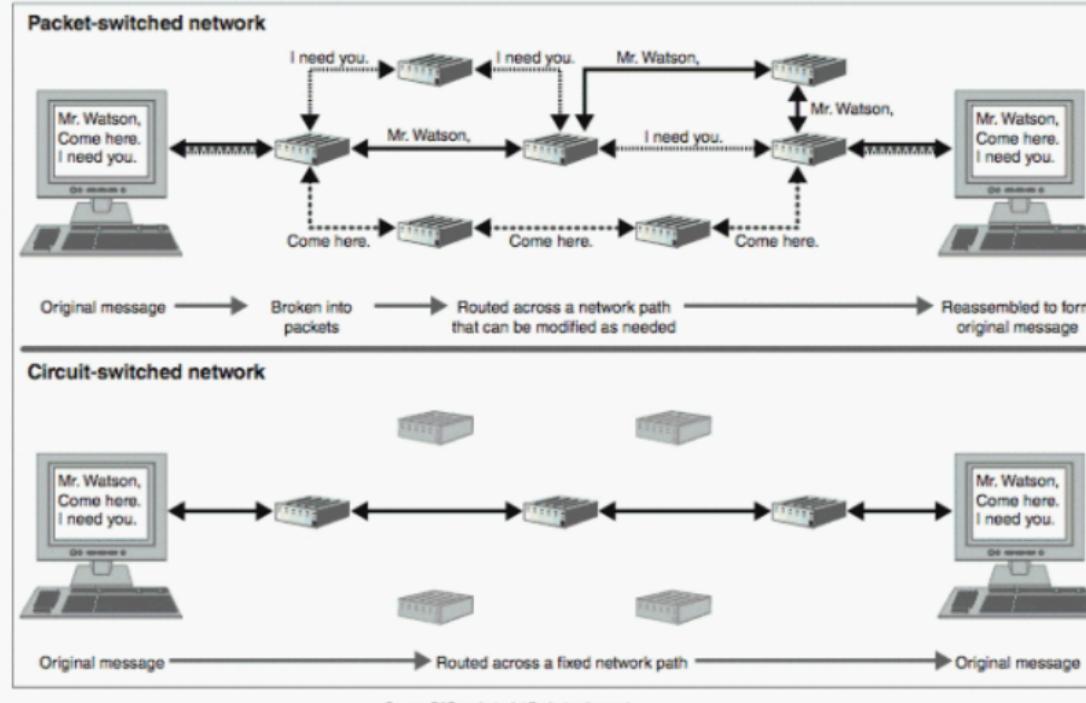
Circuit Switching

- Connection is established between two nodes before they begin transmitting data
- Bandwidth is dedicated to this connection and remains available until the users terminate communication between the two nodes
- While the nodes remain connected, all data follows the same path initially selected by the switch
- Traditional telephone calls use a circuit switched connection
- Can result in a waste of resources
- Some application benefit from this type of connection such as live video or audio conferencing

Packet Switching

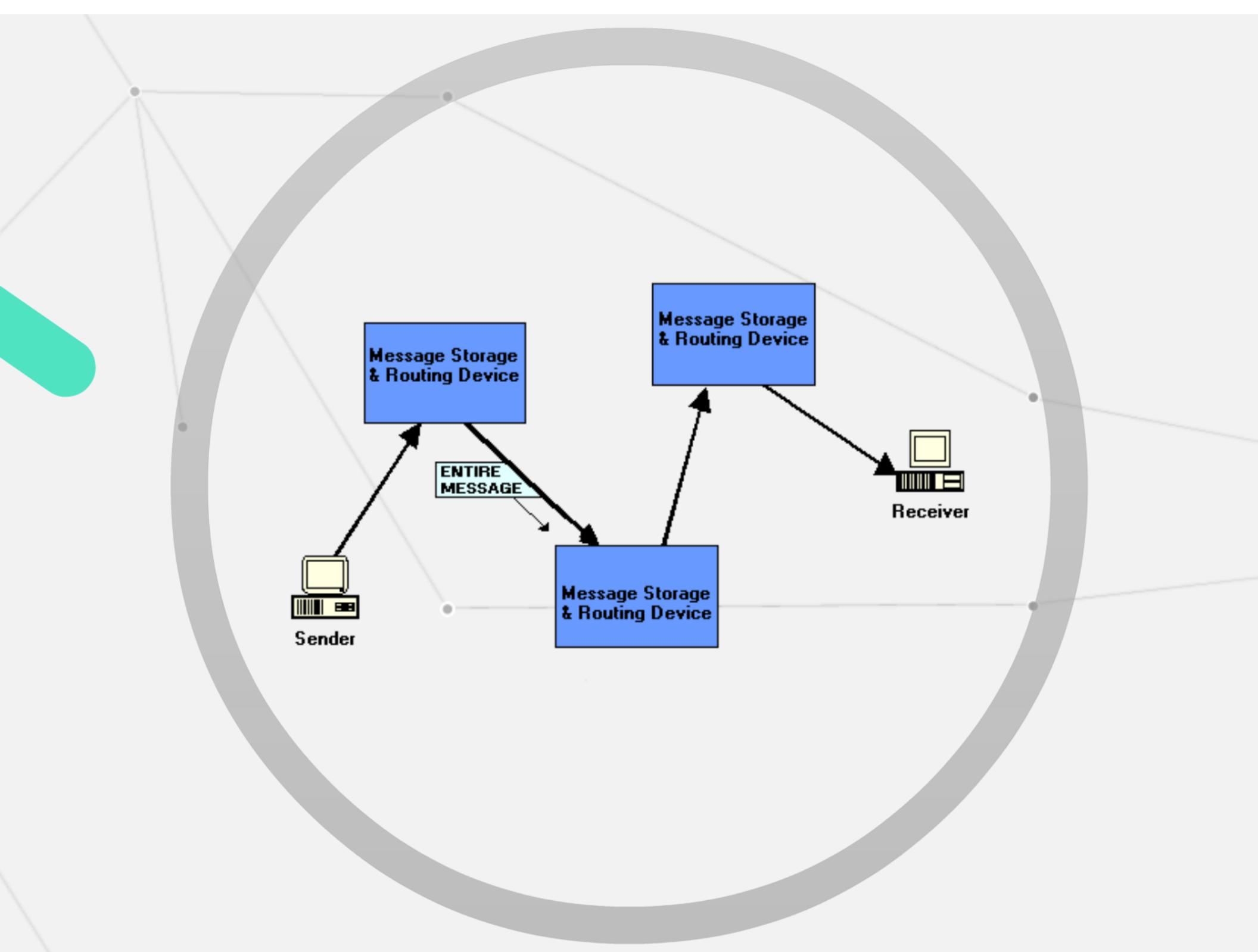
- The most popular method for connecting nodes on a network is packet switching
- Packet switching breaks data into packets before they are transported
- Packets can travel any path on the network to their destination
- Packets can attempt to find the fastest circuit available at any instant – they need not follow each other along the same path, nor must they arrive at their destination in sequence
- When packets reach their destination, the node reassembles them in sequence based on their control information
- The greatest advantage of packet switching lies in the fact that it does not waste bandwidth by holding a connection open until a message reaches its destination as circuit switching does
- Ethernet networks and the Internet are the most common examples of packet switching networks

Figure 1: Packet Switching vs. Circuit Switching



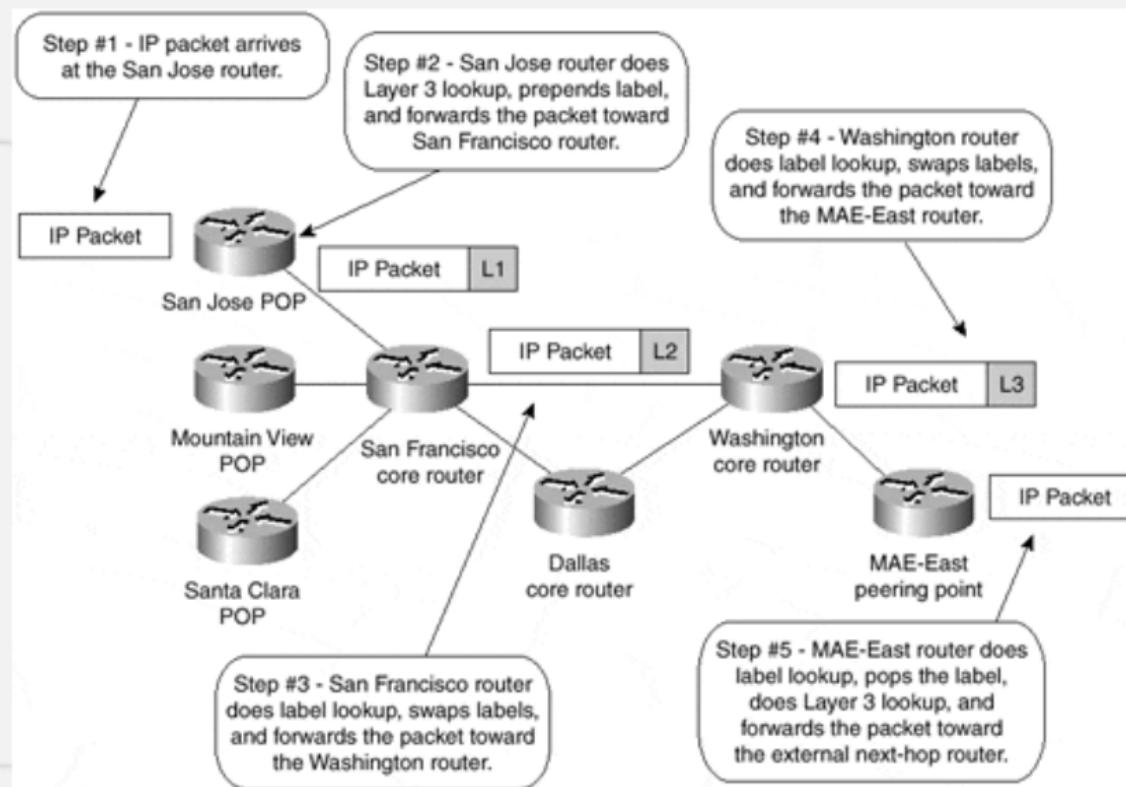
Message Switching

- Establishes a connection between two devices, transfers the information to the second device, then breaks the connection
- The information is stored and forwarded from the second device after a connection between that device and a third device on the path is established
- The store and forward routine continue until the message reaches its destination
- All information follows the same physical path, however the connection is not continuously maintained
- Message switching requires that each device in the data's path has sufficient memory and processing power to accept and store the information before passing it to the next node
- None of the network transmission technologies discussed in this chapter use message switching



MPLS (Multiprotocol Label Switching)

- MPLS is a new type of switching that was introduced in 1999 by the IETF
- It is commonly used with protocols designed for LAN's
- It addresses some of the limitations of packet switching (i.e. faster routing, prioritization)
- It is often called a shim because it adds additional information onto the packet being transported

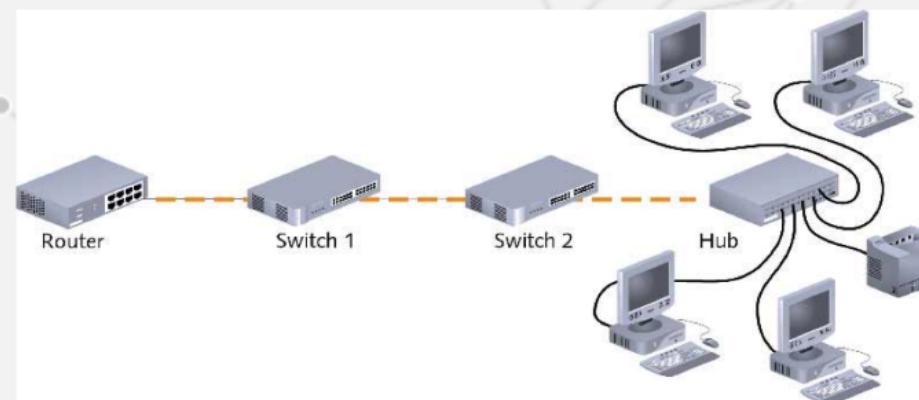


Backbone Networks

- High speed networks that link LANs
 - uses high speed circuits
 - allowing information transfer between departments
- Provide connections to other backbones, MANs, WANs, & Internet
- Sometimes referred to as
 - an enterprise network
 - a campus-wide network

1. Serial

- Simplest
- Connects 2 or more internet working devices by a single daisy-chained cable
- hubs, gateways, routers, switches, and bridges commonly form part of the backbone
- Set Standards
 - Define number of hubs allowed
 - Limited hub connectivity

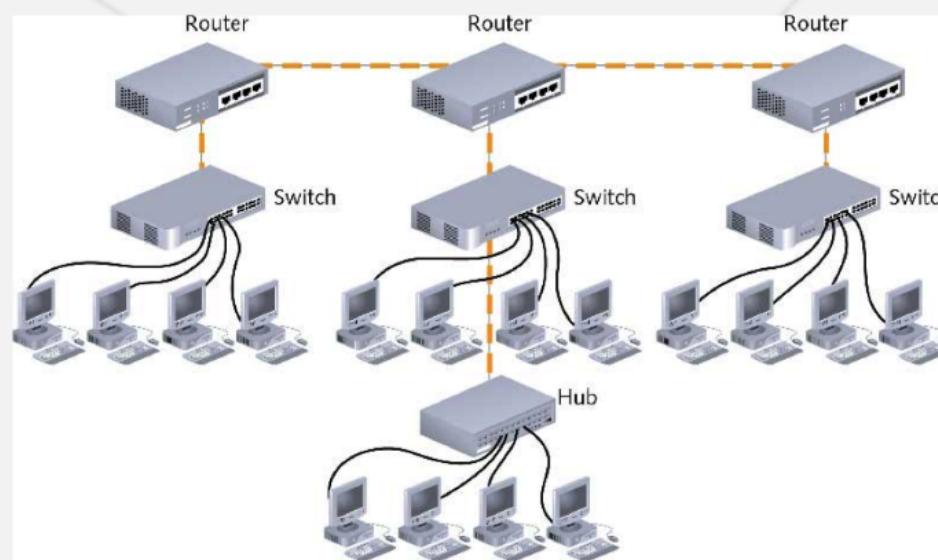


1. Serial (cont.)

- Advantages:
 - simple
 - low-cost LAN infrastructure expansion
 - easily attach hubs
- Disadvantage:
 - not very fault tolerant
 - not very scalable
 - exceeding the standard causes intermittent, unpredictable data
 - transmission errors

2. Distributed

- Snakes throughout a building or campus to provide a connection point for LANs
- Hierarchy of central connectivity devices
- All devices that access this backbone share transmission media

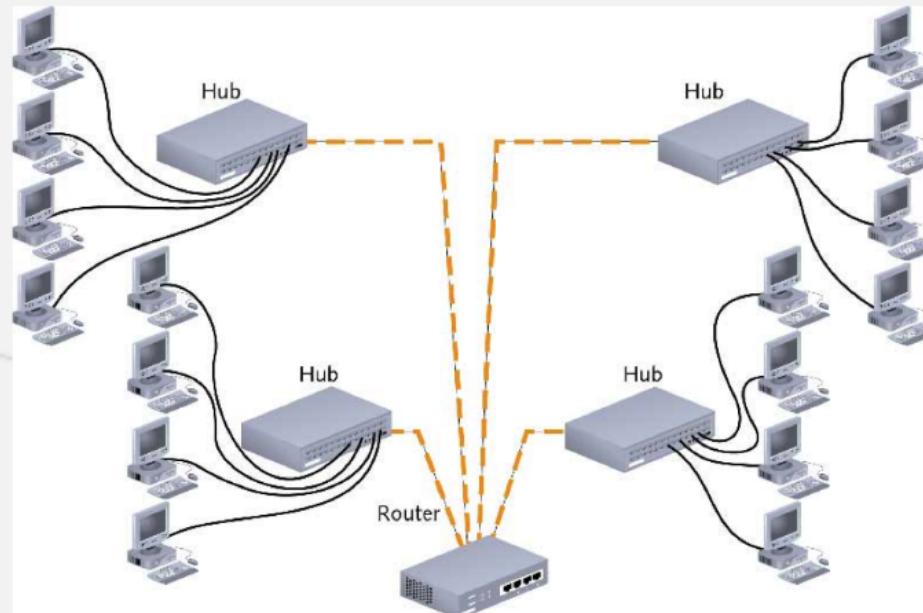


2. Distributed (cont.)

- Advantages:
 - simple expansion
 - limited capital outlay for growth
 - ease of management by network admin
- Disadvantage:
 - single points of failure
 - must be designed to separate network traffic on each LAN from the backbone network traffic

3. Collapsed

- Uses star topology, usually with a high speed switch at center
- Single central connection point for multiple subnetworks via router or switch

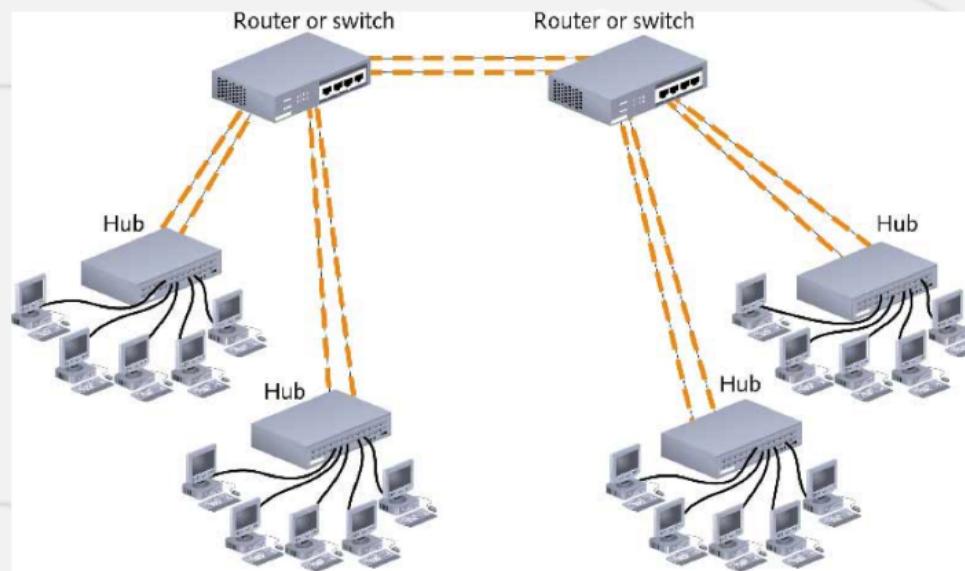


3. Collapsed (cont.)

- Advantages:
 - has fewer devices
 - centrally manage since the backbone is in a single location
 - allows interconnectivity of different types of subnetworks
- Disadvantage:
 - requires extra cabling
 - limited distance capabilities - not feasible for multiple buildings
 - risky because failure in central router can bring down entire network

4. Parallel

- Most robust
- Consist of more than 1 connection from the central router or switch to each segment
- Ensures network connectivity to any area of the enterprise
 - Example - Payroll



3. Parallel (cont.)

- Advantages:
 - redundant
 - increased performance
 - increased fault tolerance
- Disadvantage:
 - more expensive due to additional wiring and hardware

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MPLS (Multiprotocol Label Switching)

- It is a switching technology that uses labels to identify the paths of data packets.
- It is used to improve the performance of packet switching.
- It is based on the concept of virtual circuits.
- It is used to reduce the latency of data transmission.

Bus Network

- Bus Topology - a network topology in which every node is connected to a single shared bus or wire for data transmission. All nodes share the same bus.

Tree Network

- Tree Topology - a network topology where each node has one parent node and multiple child nodes. It is used to represent hierarchical structures.

Definitions (cont.)

- Computer Network - a group of computer systems and other computing devices that are linked together through communication channels.

- Different types of network:
 - LAN (Local Area Networks) (WANs)
 - Metropolitan Area Networks (MANs)

Ring Network

- Ring Topology - network setup in which devices are connected in a ring and information is passed from one device to the next in a clockwise direction.

Star Network

- Star Topology - this is the most popular form of network topology in which all the workstations are connected to a central hub or switch.

Backbone Networks

- High speed links that tie LANs together.
 - Using intermediate routers
 - Provide connections to other backbones
 - Used to connect different areas
 - Are high-speed networks
 - Are backbone networks

1. Serial (cont.)

- Serial:
 - One node at a time can send data
 - Data is transmitted sequentially
 - Data is transmitted sequentially
 - Data is transmitted sequentially

2. Distributed

- Distributed:
 - Many nodes can send data simultaneously
 - Many nodes can receive data simultaneously
 - Many nodes can receive data simultaneously
 - Many nodes can receive data simultaneously

3. Collapsed

- Collapsed:
 - All nodes can send data simultaneously
 - All nodes can receive data simultaneously
 - All nodes can receive data simultaneously
 - All nodes can receive data simultaneously

4. Parallel

- Parallel:
 - Many nodes can send data simultaneously
 - Many nodes can receive data simultaneously
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2. Distributed (cont.)

- Distributed (cont.):
 - Many nodes can send data simultaneously
 - Many nodes can receive data simultaneously
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 - Many nodes can receive data simultaneously

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