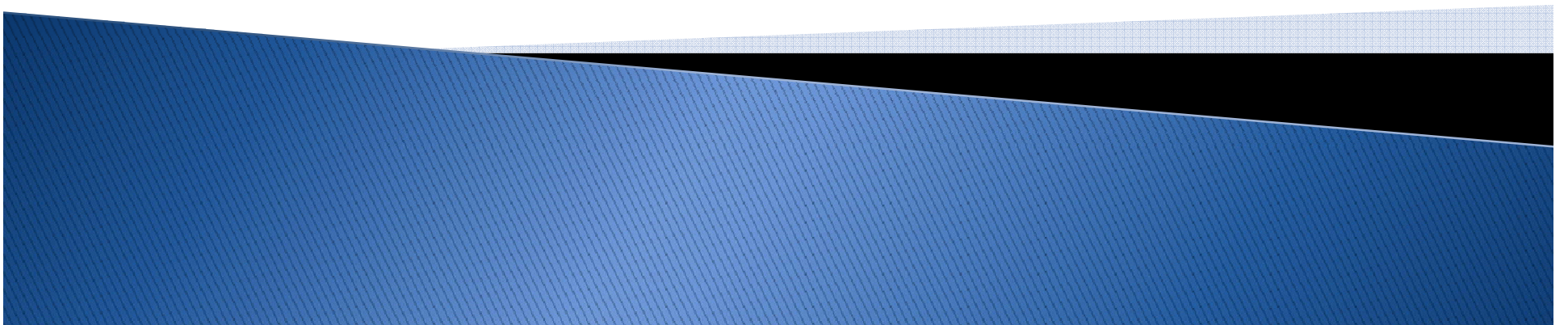



Local Area Networks (LAN)

CBCN4103

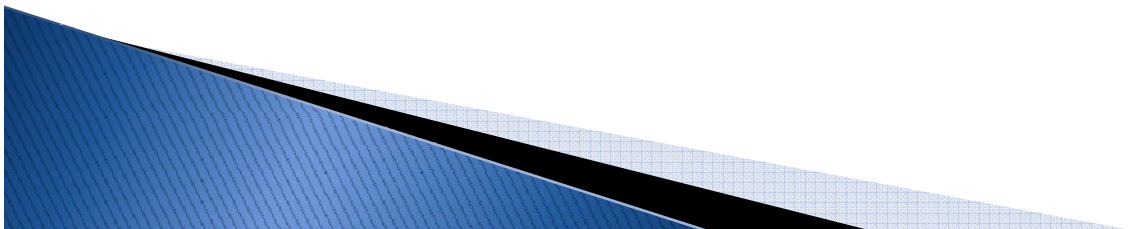


Local Area Network (LAN)

- ▶ A *LAN* is a high-speed data network that covers a relatively small geographic area. It typically connects workstations, personal computers, printers, servers, and other devices. LANs offer computer users many advantages, including shared access to devices and applications, file exchange between connected users, and communication between users via electronic mail and other applications.
 - ▶ Most LANs connect workstations and personal computers. Each **node** (individual computer) in a LAN has its own CPU with which it executes programs, but it is also able to access data and devices anywhere on the LAN.
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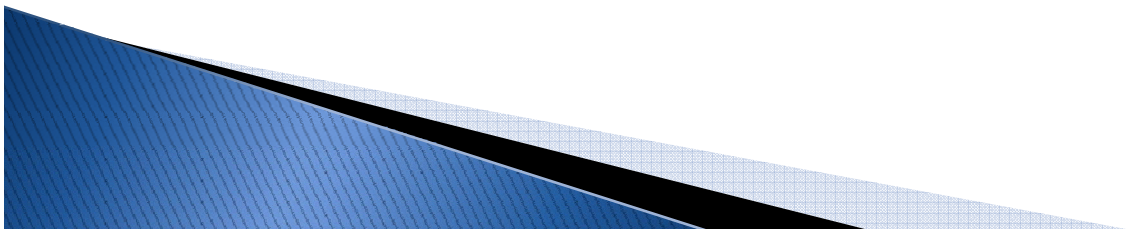
Characteristics that differentiate one LAN from another

- ▶ **Topology:** The geometric arrangement of devices on the network. For example, devices can be arranged in a ring or in a straight line.
- ▶ **Protocols:** The rules and encoding specifications for sending data. The protocols also determine whether the network uses a peer-to-peer or client/server architecture.
- ▶ **Media:** Devices can be connected by twisted-pair wire, coaxial cables, or fiber optic cables. Some networks do without connecting media altogether, communicating instead via radio waves.



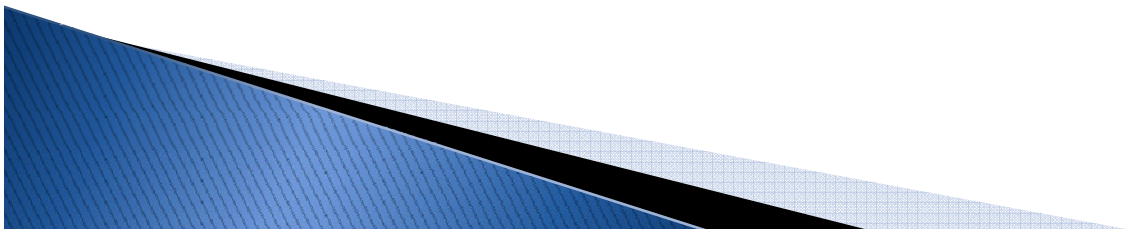
Local Area Networks (cont.)

- ▶ Ethernet is the most popular and dominant LAN technology in use today. Other LAN technology types include Token Ring, Fast Ethernet, Gigabit Ethernet, Fiber Distributed Data Interface (FDDI), Asynchronous Transfer Mode (ATM) and AppleTalk.
- ▶ Ethernet is popular because it strikes a good balance between speed, cost and ease of installation.

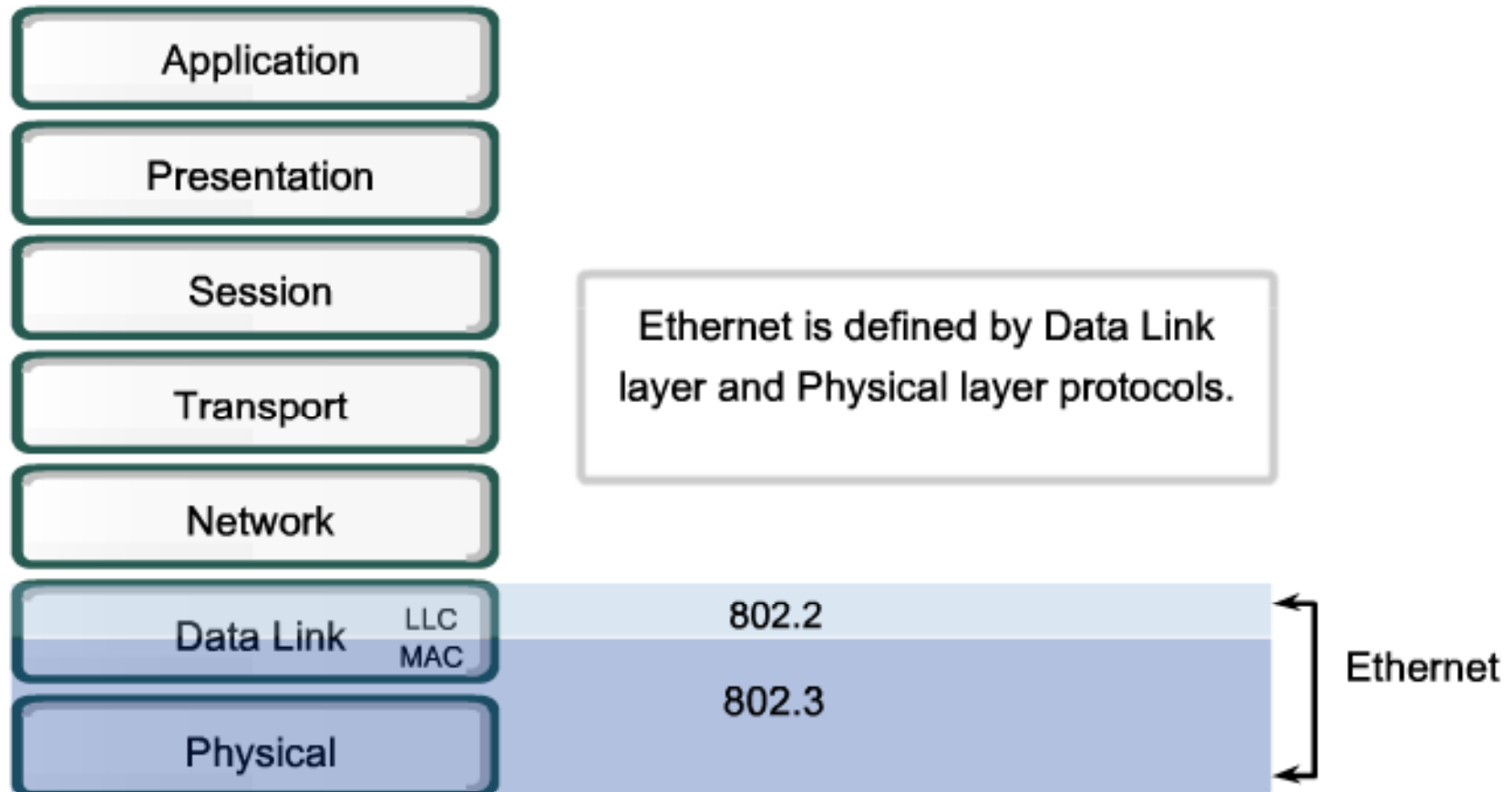


Ethernet

- ▶ Ethernet uses a bus or star topology and supports data transfer rates of **10 Mbps**.
- ▶ Ethernet is standardized as **IEEE 802.3**. For more details on Ethernet family standards refer to Table 2.1 (page 25)
- ▶ Ethernet uses the **Carrier Sense Multiple Access/Collision Detection (CSMA/CD)** access method to handle simultaneous demands.

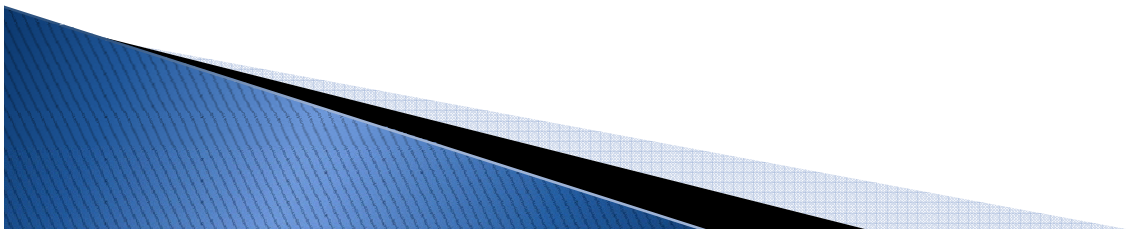


Ethernet (cont.)



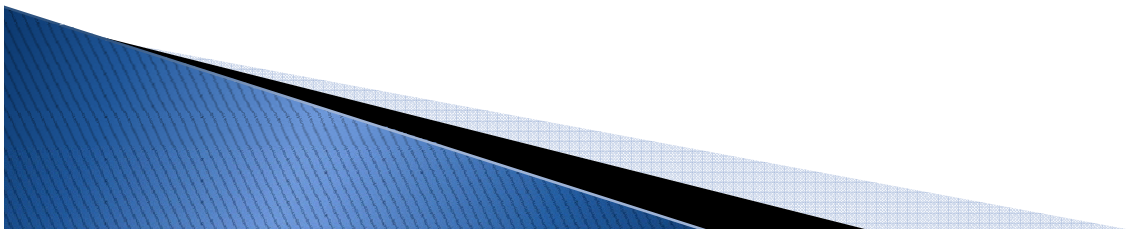
Protocols

- ▶ A protocol or communications protocol is a formal description of message formats and the rules for exchanging those messages.
- ▶ A protocol defines how computers identify one another on a network, the form that the data should take in transit, and how this information is processed once it reaches its final destination.
- ▶ Protocols also define procedures for handling lost or damaged transmissions or "packets."



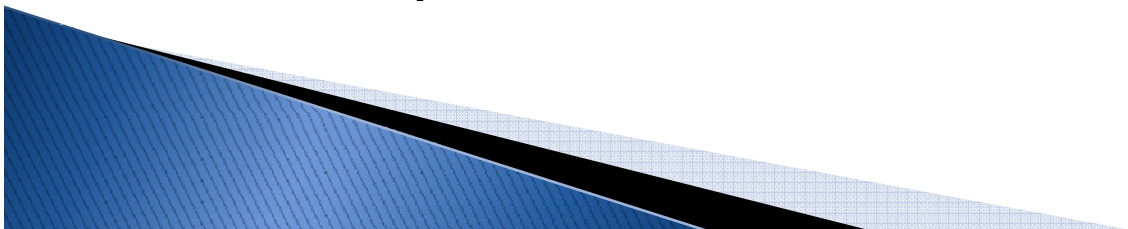
Protocols (cont.)

- ▶ The main network protocols in use today are as follows:
 - TCP/IP (for UNIX, Windows 7, Windows 95 and other platforms)
 - IPX (for Novell NetWare)
 - DECnet (for networking Digital Equipment Corp. computers)
 - AppleTalk (for Macintosh computers), and NetBIOS/NetBEUI (for LAN Manager and Windows NT networks)



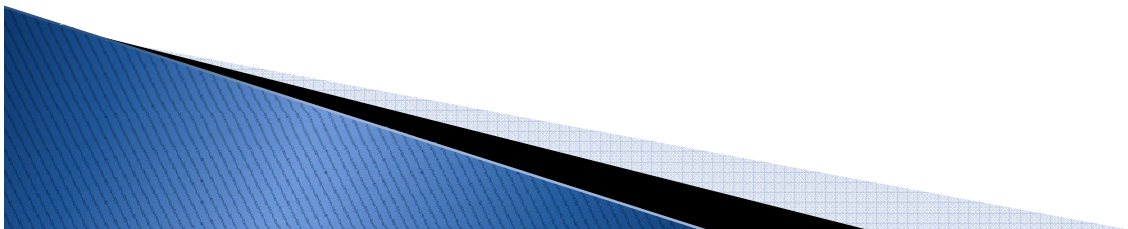
Media

- ▶ There are four major types of media in use today:
 - Thick wire for 10BASE5 networks,
 - Thin coax for 10BASE2 networks,
 - Unshielded twisted pair (UTP) for 10BASE-T networks, and
 - Fiber optic for 10BASE-FL or Fiber-Optic Inter-Repeater Link (FOIRL) networks.
- ▶ The most popular wiring schemes are 10BASE-T and 100BASE-TX, which use unshielded twisted pair (UTP) cable.
- ▶ This is similar to telephone cable and comes in a variety of grades, with each higher grade offering better performance.



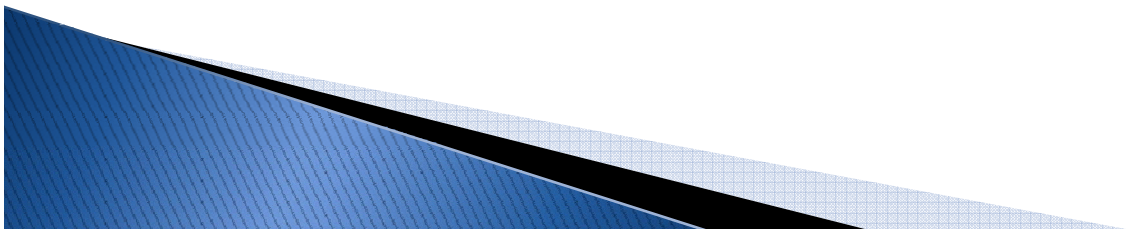
Media (cont.)

- ▶ Category 6 cable (CAT-6) is a cable standard for Gigabit Ethernet and supports up to 10 Gbps speeds
- ▶ Level 5 cable (CAT 5/5e) offering support for transmission rates of up to 100Mbps.
- ▶ Level 4 (CAT 4) and level 3 (CAT 3) cable are less expensive, but cannot support the same data throughput speeds; level 4 cable can support speeds of up to 20 Mbps; level 3 up to 16 Mbps.



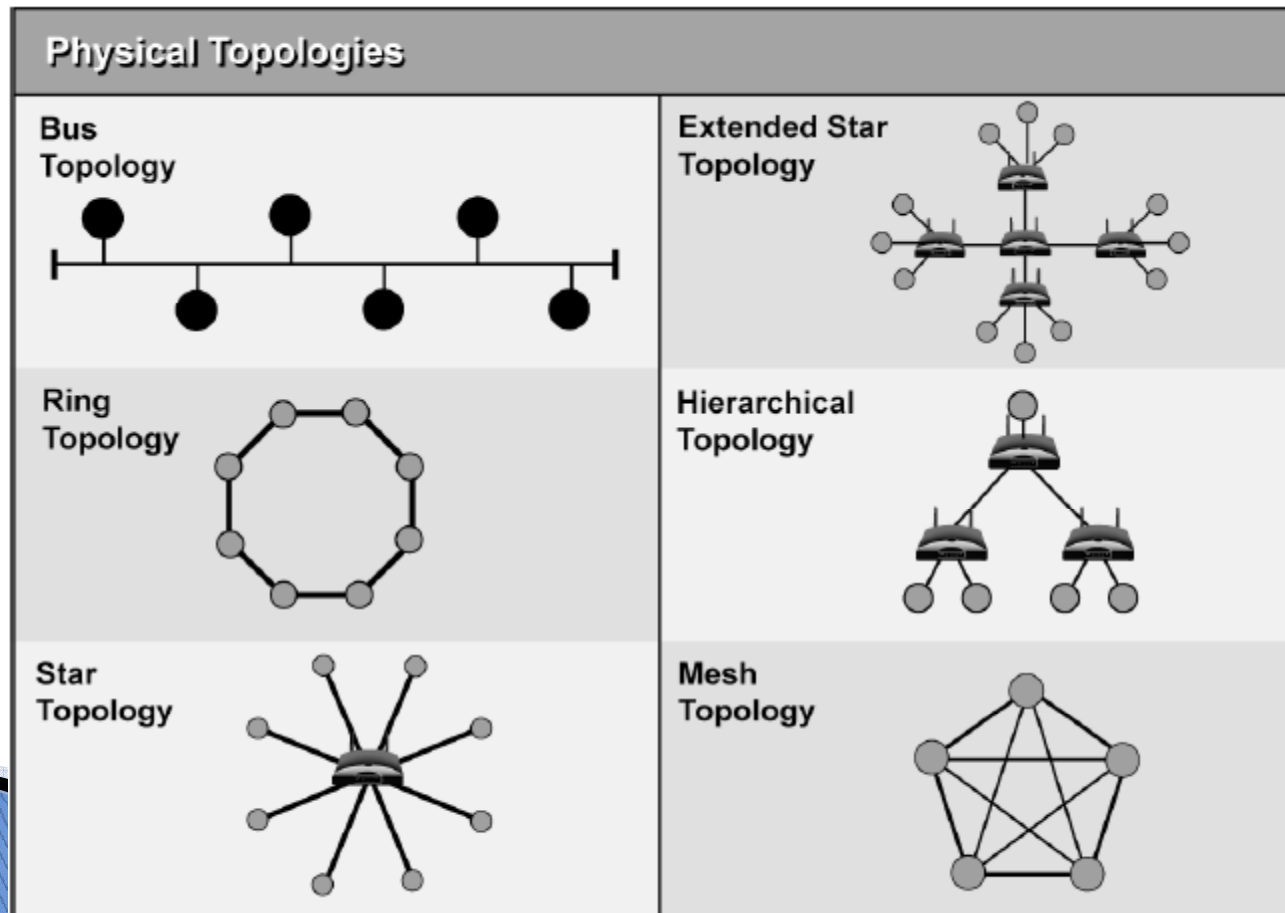
Media (cont.)

- ▶ The 100BASE-T4 standard allows for support of 100 Mbps Ethernet over level 3 cables, but at the expense of adding another pair of wires (4 pair instead of the 2 pair used for 10BASE-T)
- ▶ For specialised applications, fiber-optic, or 10BASE-FL, Ethernet segments are popular. Fiber-optic cable is more expensive, but it is invaluable for situations where electronic emissions and environmental hazards are a concern.



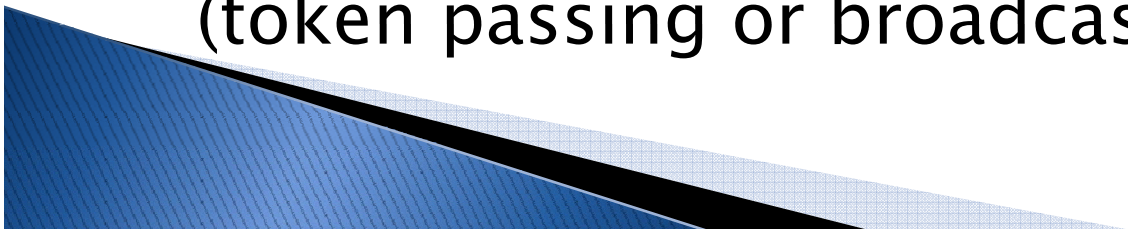
Network Topologies

- ▶ LAN topologies define the manner in which network devices are organized.



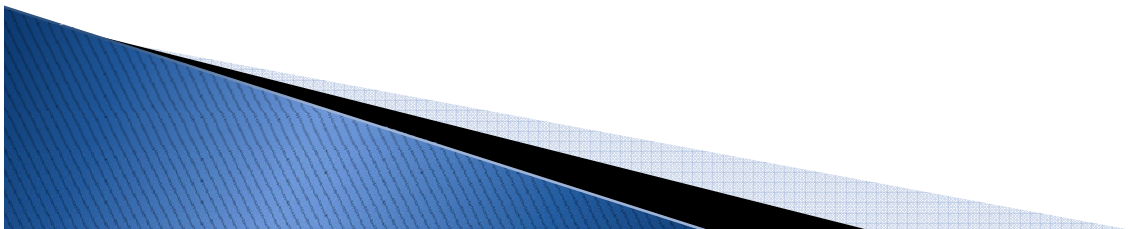
Network Topologies (cont.)

- ▶ The topology of a network is the arrangement or relationship of the network devices and the interconnections between them. Network topologies can be viewed at the physical level and the logical level.
- ▶ The physical topology is an arrangement of the nodes and the physical connections between them. (bus, star, extended star, token bus and token ring)
- ▶ A logical topology is the way a network transfers frames from one node to the next. (token passing or broadcast)



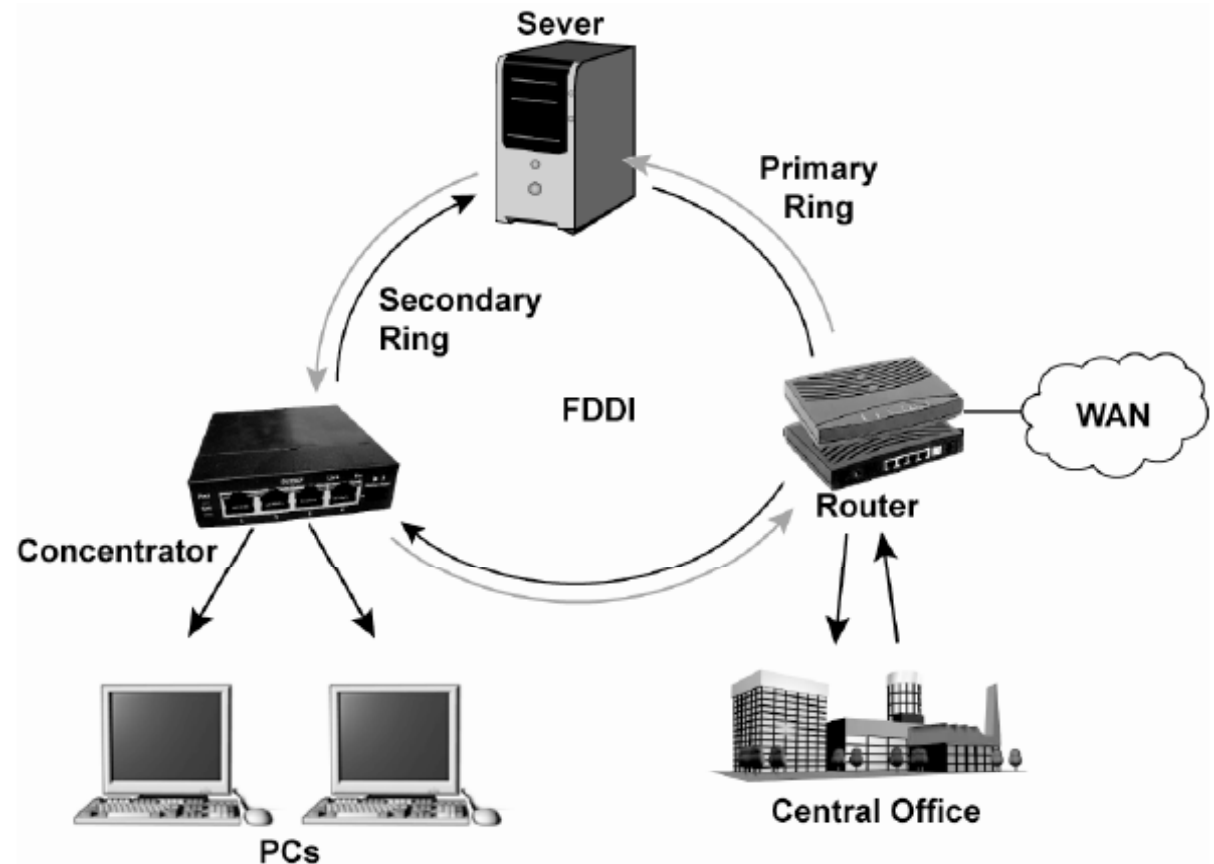
Network Topologies (cont.)

- ▶ In broadcast topology all devices listen to signal or message transmitted by one of the device in the LAN. Only the intended destination node or host will copy and respond to the message.
- ▶ On the other hand in token passing, device takes turn to react. Device that holds the token shall perform the task.



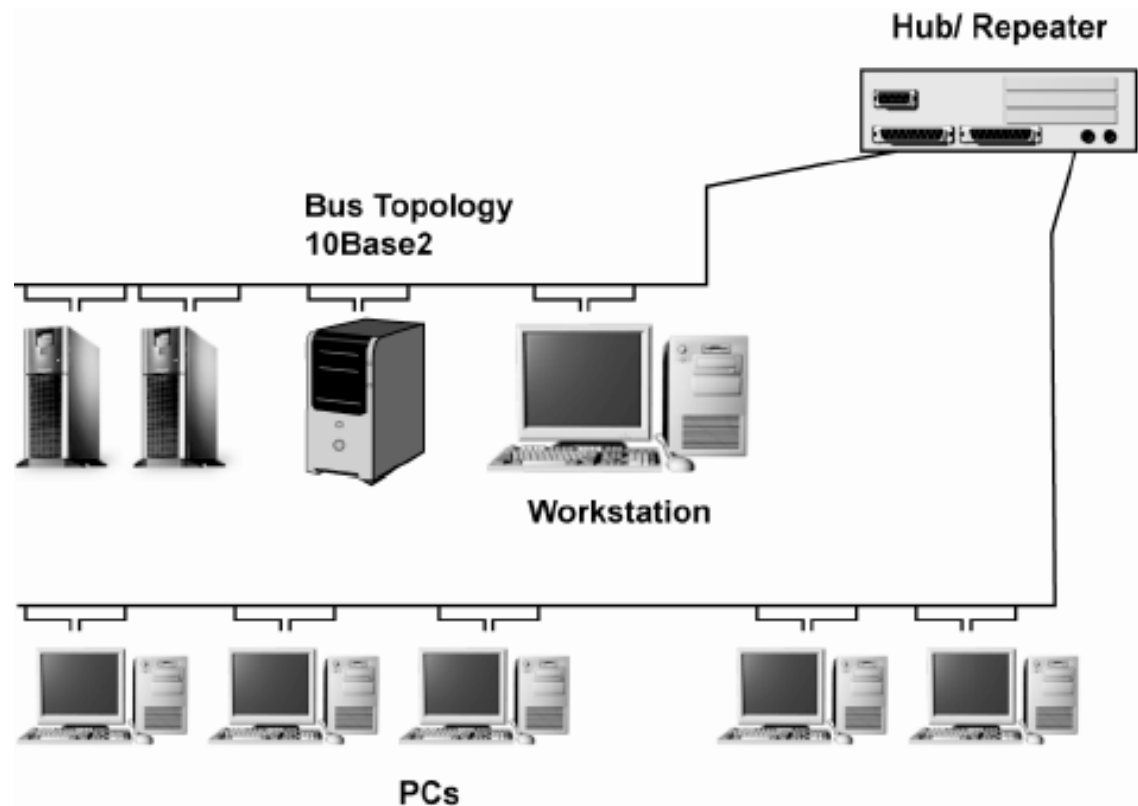
Network Topologies (cont.)

- ▶ Fiber Distributed Data Interface (FDDI) is an example of physical token ring and logical token passing topologies. Token ring has one point of failure, the ring itself. In which case, FDDI has dual ring for redundancy



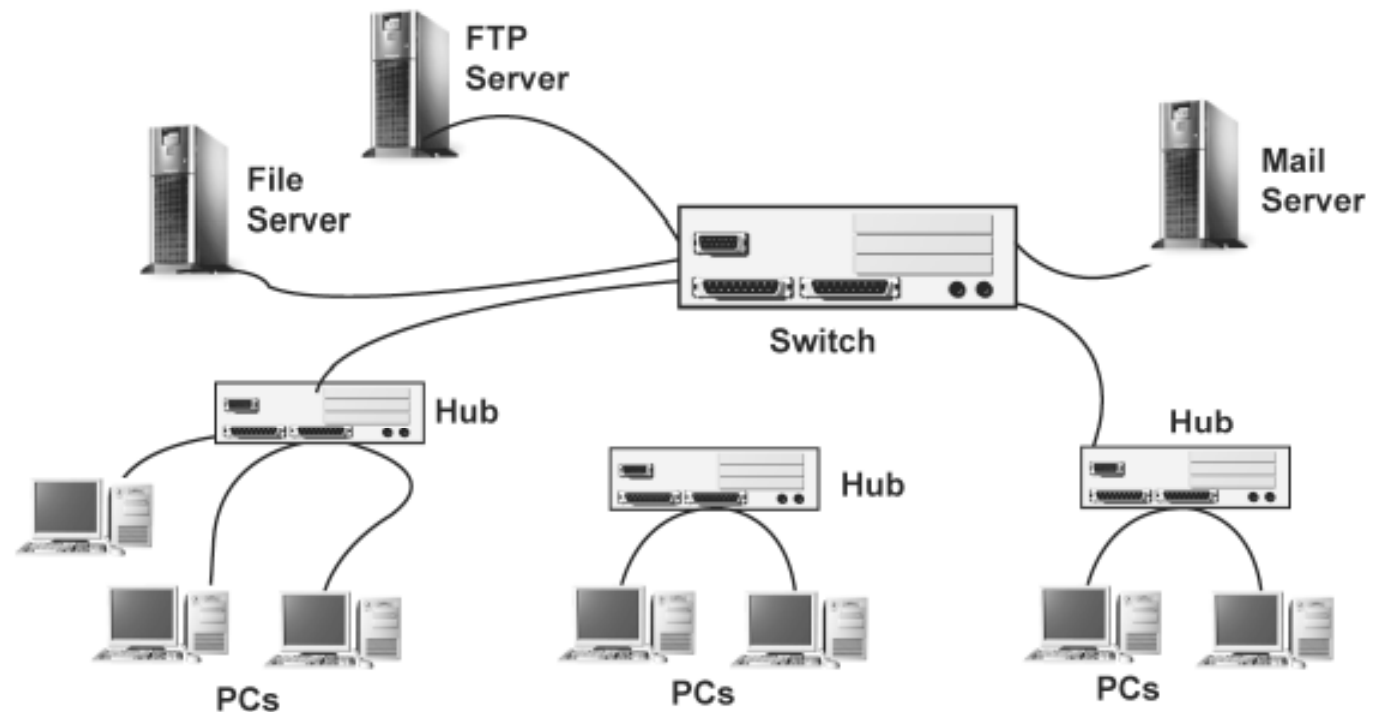
Network Topologies (cont.)

- ▶ A physical **bus topology** consists of nodes linked together in a series with each node connected to a long cable or bus. Many nodes can tap into the bus and begin communication with all other nodes on that cable segment. A break anywhere in the cable will usually cause the entire segment to be inoperable until the break is repaired.

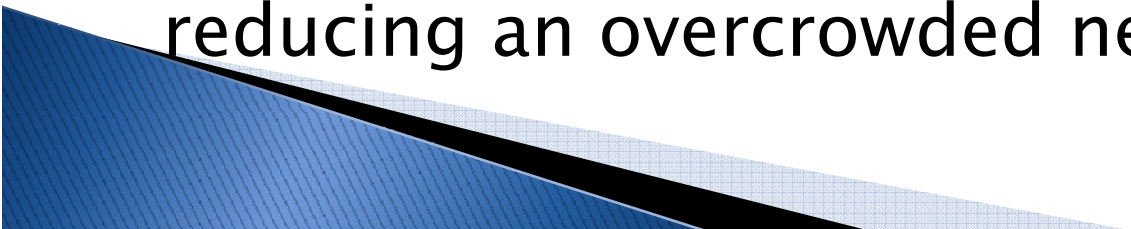


Network Topologies (cont.)

- ▶ 10BASE-T Ethernet and Fast Ethernet use a star topology, in which access is controlled by a central computer. Generally a computer is located at one end of the segment, and the other end is terminated in central location with a hub. Main advantage of star topology is reliability.



Collisions

- ▶ Ethernet is a shared media, so there are rules for sending packets of data to avoid conflicts and protect data integrity. Nodes determine when the network is available for sending packets. It is possible that two nodes at different locations attempt to send data at the same time. When both PCs are transferring a packet to the network at the same time, a collision will happen.
 - ▶ Segmenting the network, where a network is divided into different pieces joined together logically with a bridge or switch, is one way of reducing an overcrowded network.
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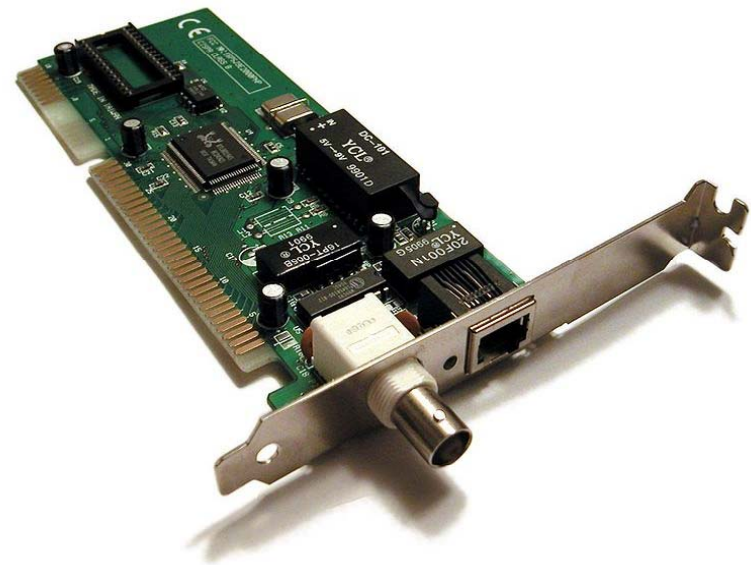
Ethernet Products

- ▶ **Transceivers:** Transceivers are used to connect nodes to the various Ethernet media. Most computers and network interface cards contain a built-in 10BASE-T or 10BASE2 transceiver, allowing them to be connected directly to Ethernet without requiring an external transceiver.



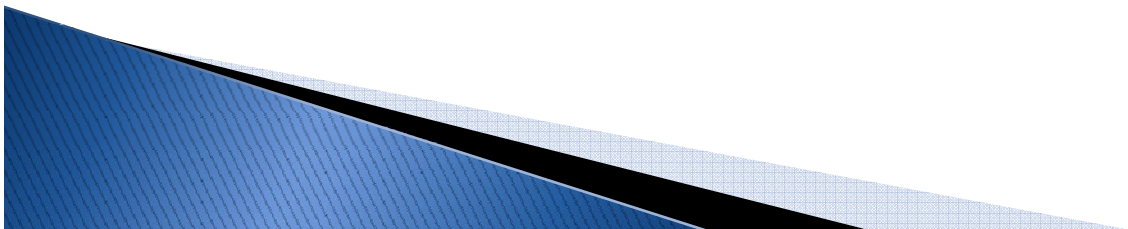
Ethernet Products (cont.)

- ▶ **Network Interface Cards:** Network interface cards, commonly referred to as NICs, are used to connect a PC to a network. The NIC provides a physical connection between the networking cable and the computer's internal bus.



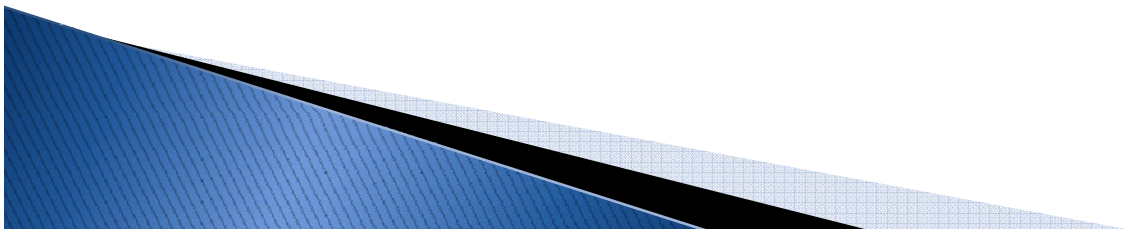
Ethernet Products (cont.)

- ▶ **Hubs/Repeaters:** Hubs/repeaters are used to connect together two or more Ethernet segments of any media type.
- ▶ In larger designs, signal quality begins to deteriorate as segments exceed their maximum length. Hubs provide the signal amplification required to allow a segment to be extended a greater distance. A hub takes any incoming signal and repeats it out all ports.
- ▶ A very important fact to note about hubs is that they only allow users to share Ethernet. A network of hubs/repeaters is termed a "shared Ethernet," meaning that all members of the network are contending for transmission of data onto a single network or collision domain.




Fast Ethernet

- ▶ For Ethernet networks that need higher transmission speeds, the Fast Ethernet standard (IEEE 802.3u) has been established. This standard raises the Ethernet speed limit from 10 Megabits per second (Mbps) to 100 Mbps with only minimal changes to the existing cable structure.
- ▶ There are three types of Fast Ethernet: 100BASE-TX for use with level 5 UTP cable, 100BASE-FX for use with fiber-optic cable, and 100BASE-T4 which utilises an extra two wires for use with level 3 UTP cable.

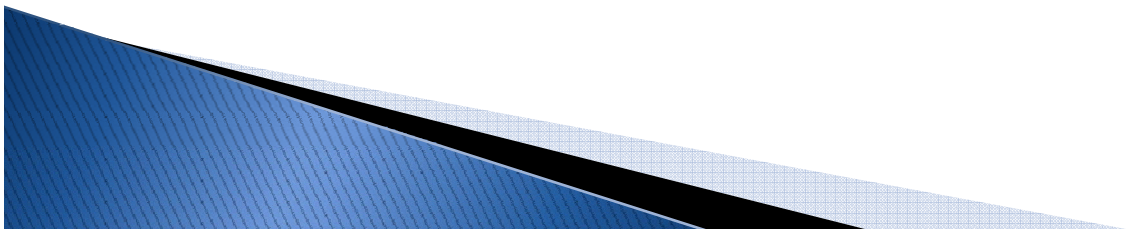


Token Ring

- ▶ Token ring is another form of network configuration which differs from Ethernet in that all messages are transferred in a unidirectional manner along the ring at all times. Data is transmitted in tokens, which are passed along the ring and viewed by each device.
 - ▶ When a device sees a message addressed to it, that device copies the message and then marks that message as being read. As the message makes its way along the ring, it eventually gets back to the sender who now notes that the message was received by the intended device. The sender can then remove the message and free that token for use by others.
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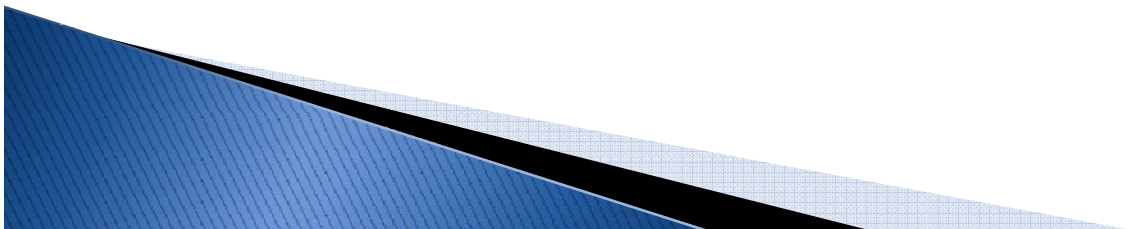
Asynchronous Transfer Mode (ATM)

- ▶ **Asynchronous Transfer Mode** is a cell-based switching technique that uses asynchronous time division multiplexing.
- ▶ ATM is an ITU-T standard for cell relay wherein information for multiple service types, such as voice, video, or data, is conveyed in small, fixed-size cells.
- ▶ Data and information can be prioritized on the basis of time-sensitivity as ATM can accommodate a variety of information formats.



Lan Standards

- ▶ The IEEE defines most of the standards for Ethernet and Token Ring; with ANSI defining standards for FDDI. These specifications match OSI Layer 2 and typically are divided into two parts: the Media Access Control (MAC) and Logical Link Control (LLC) sublayers.



Exercise – 2

- ▶ What is a LAN?
- ▶ What is a segment?
- ▶ What is the difference between a Switch and a Hub?
- ▶ What is a bridge and how does it work?
- ▶ What is the difference between Half duplex and Full duplex?

