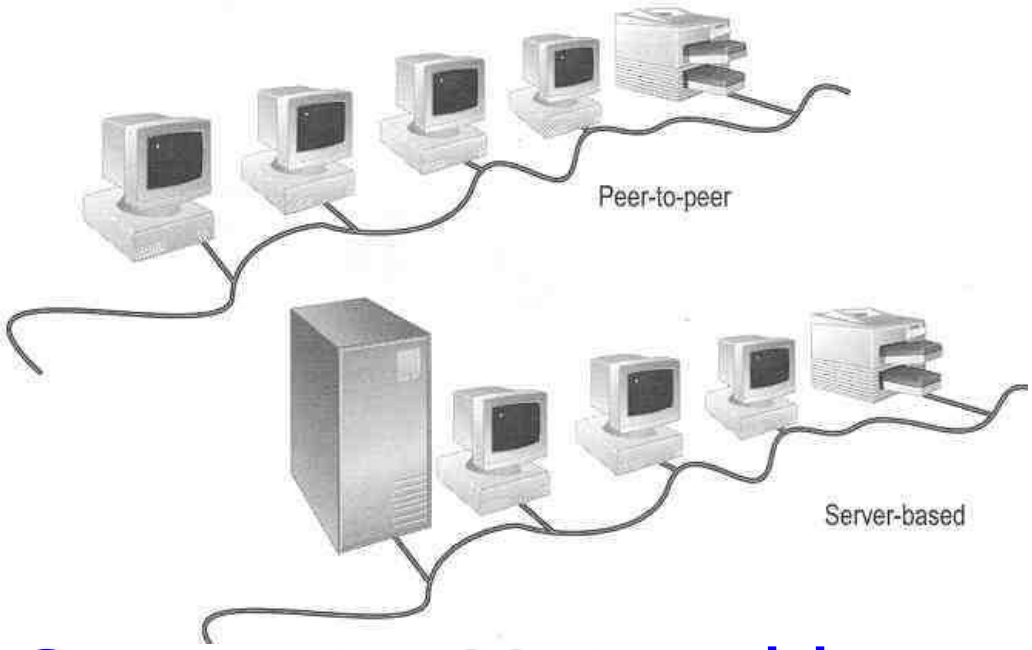


Computer Networking
Lecture 6
Hassan Alamri

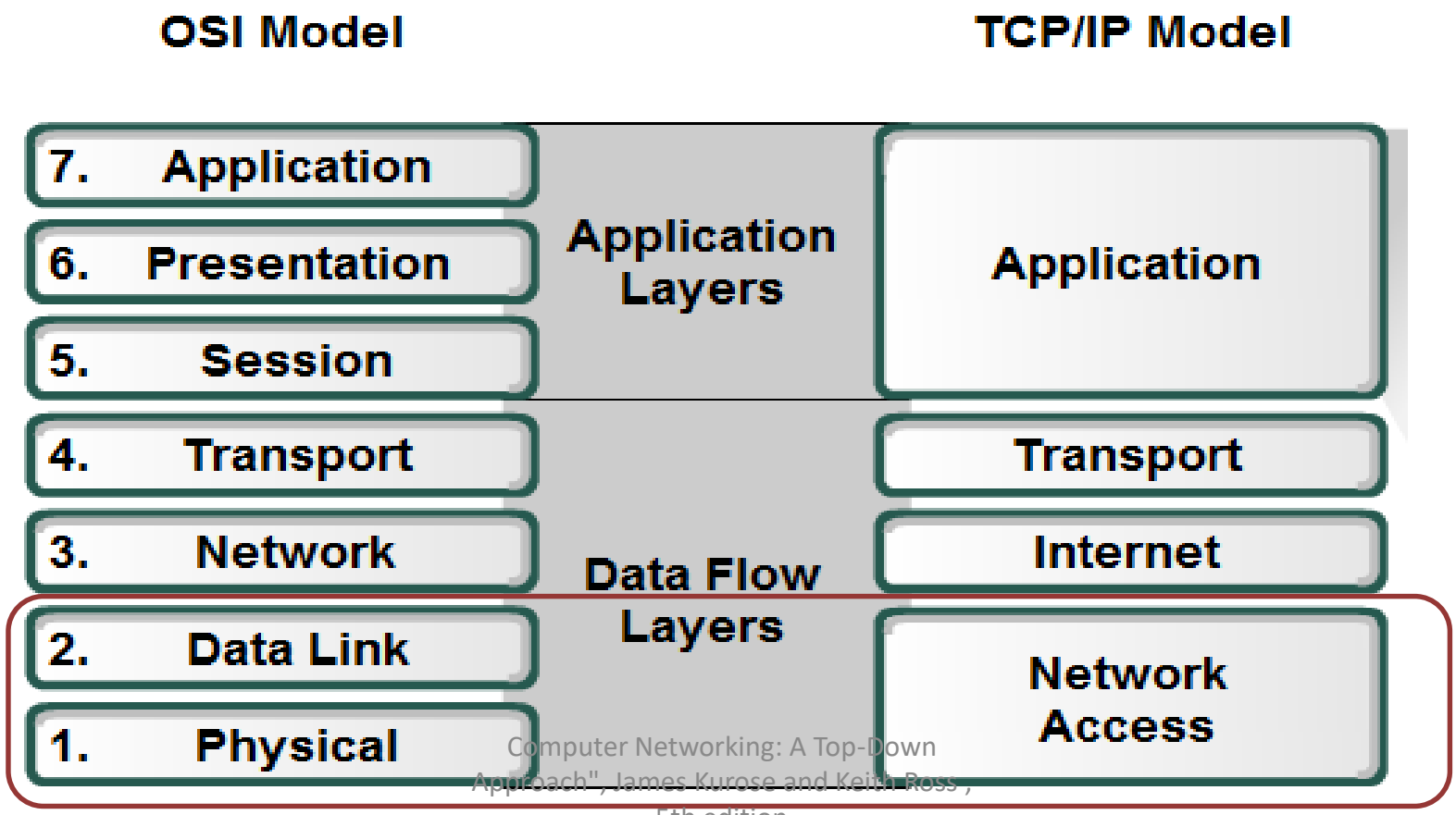
Agenda:

Data link Layer (2)

- Data link Layer principles
- Data link Layer protocols
- Multiple access protocols
- Link layer addressing
- Ethernet
- Switches
- End

Data Link (Layer2)

The data link layer is responsible for moving frames from one hop (node) to the next.



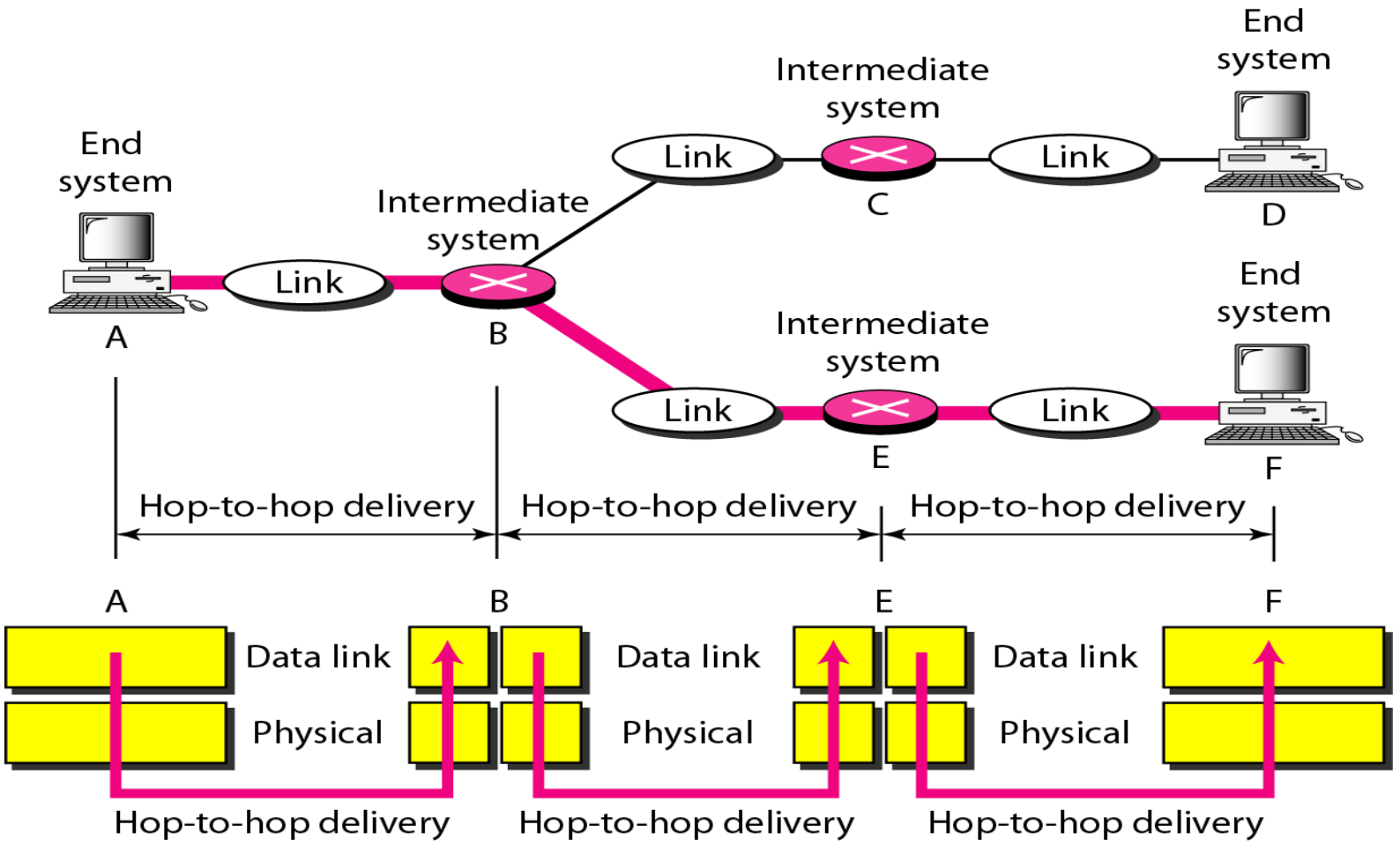
Other Data Link Layer Responsibilities

- **Framing**: The data link layer divides the stream of bits received from the network layer into manageable data units called ***frames***.
- **Physical addressing**. If frames are to be distributed to different systems on the network, the data link layer adds a header to the frame to define the sender and/or receiver of the frame. If the frame is intended for a system outside the sender's network, the receiver address is the address of the device that connects the network to the next one.
- **Data Flow control**. If the rate at which the data are absorbed by the receiver is less than the rate at which data are produced in the sender, the data link layer imposes a flow control mechanism to avoid overwhelming the receiver.

- Error control. The data link layer adds reliability to the physical layer by adding mechanisms to detect and retransmit damaged or lost frames. It also uses a mechanism to recognize duplicate frames. Error control is normally achieved through a trailer added to the end of the frame.
- Access control. When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device has control over the link at any given time.

The data link layer oversees the delivery of the frames between **two systems on the same network (links).**

hop-to-hop (node-to-node) delivery by the data link layer.

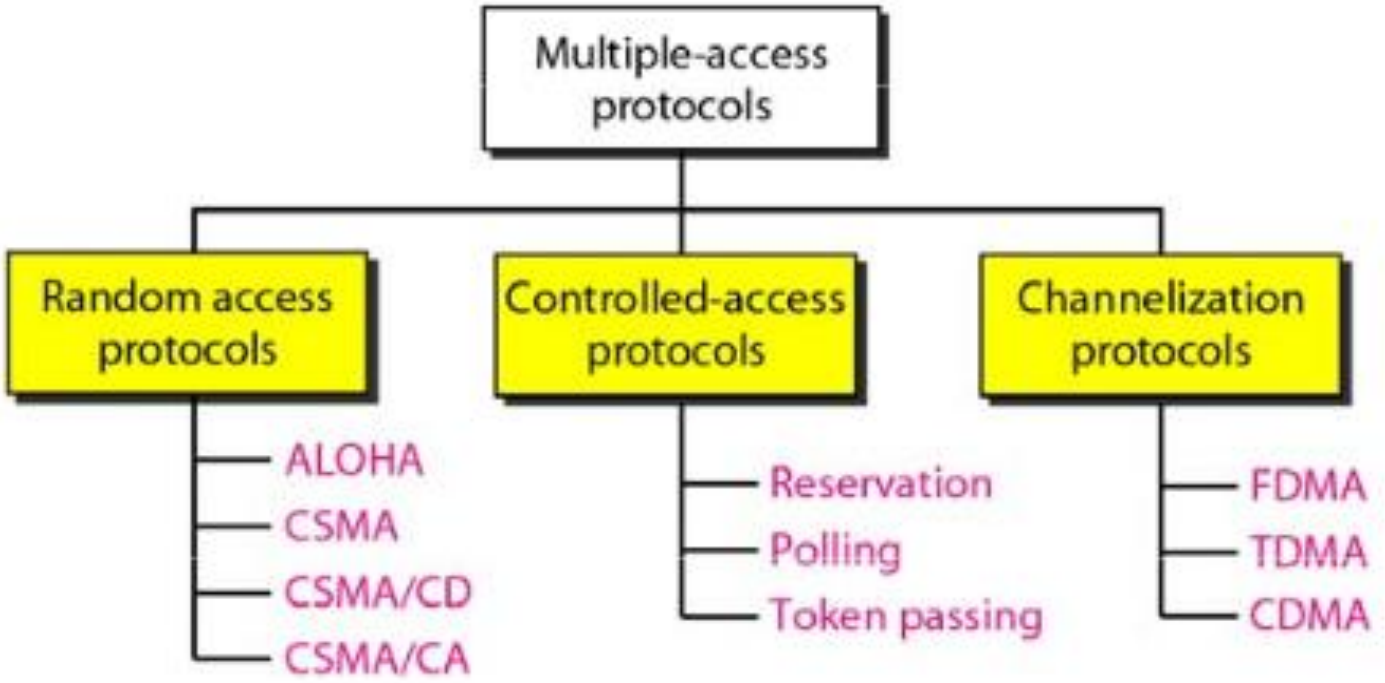


hop-to-hop (node-to-node) delivery by the data link layer.

As the figure shows, communication at the data link layer occurs between two adjacent nodes. To send data from A to F, three partial deliveries are made.
First, the data link layer at A sends a frame to the data link layer at B (a router).
Second, the data link layer at B sends a new frame to the data link layer at E.
Finally, the data link layer at E sends a new frame to the data link layer at F.

Note that the frames that are exchanged between the three nodes have different values in the headers. The frame from A to B has B as the destination address and A as the source address. The frame from B to E has E as the destination address and B as the source address. The frame from E to F has F as the destination address and E as the source address. The values of the trailers can also be different if error checking includes the header of the frame.

Multiple Access Protocols



Carrier Sense Multiple Access

- Invented to minimize collisions and increase the performance
- A station now "follows" the activity of other stations
- Simple rules for a polite human conversation
  - Listen before talking
  - If someone else begins talking at the same time as you, stop talking
- CSMA:
  - A node should not send if another node is already sending → carrier sensing
- CD (collision detection):
  - A node should stop transmission if there is interference → collision detection

Media Access Control (MAC) address

The Media Access Control (MAC) address is a binary number used to uniquely identify computer network adapters.

These numbers (sometimes called "hardware addresses" or "physical addresses") are embedded into the network hardware during the manufacturing process.

Format of a MAC Address

Traditional MAC addresses are 12-digit (6 bytes or 48 bits) hexadecimal numbers. By convention, they are usually written in one of the following three formats:

MM:MM:MM:SS:SS:SS

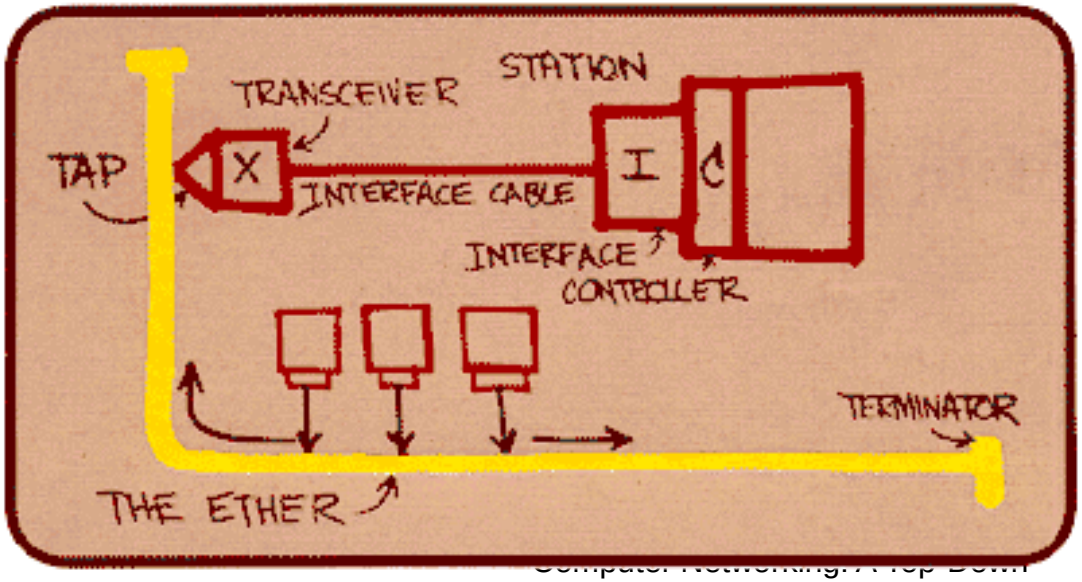
MM-MM-MM-SS-SS-SS

The leftmost 6 digits (24 bits) called a "prefix" is associated with the adapter manufacturer.

Ethernet

"dominant" wired LAN technology:

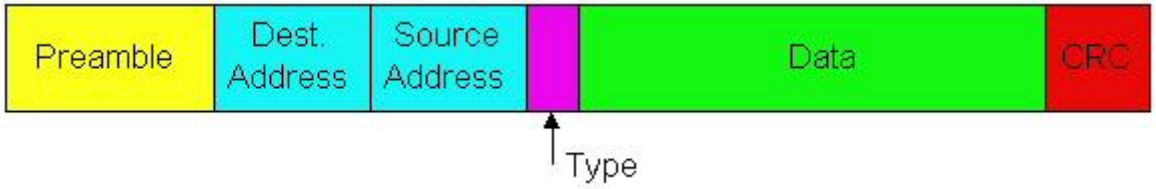
- cheap $ for 100Mbs!
- first widely used LAN technology
- Simpler, cheaper than token LANs and ATM
- Kept up with speed race: 10 Mbps – 10 Gbps



Metcalfe's Ethernet sketch

Ethernet Frame Structure (IEEE 802.3)

Sending adapter encapsulates IP datagram (or other network layer protocol packet) in Ethernet frame



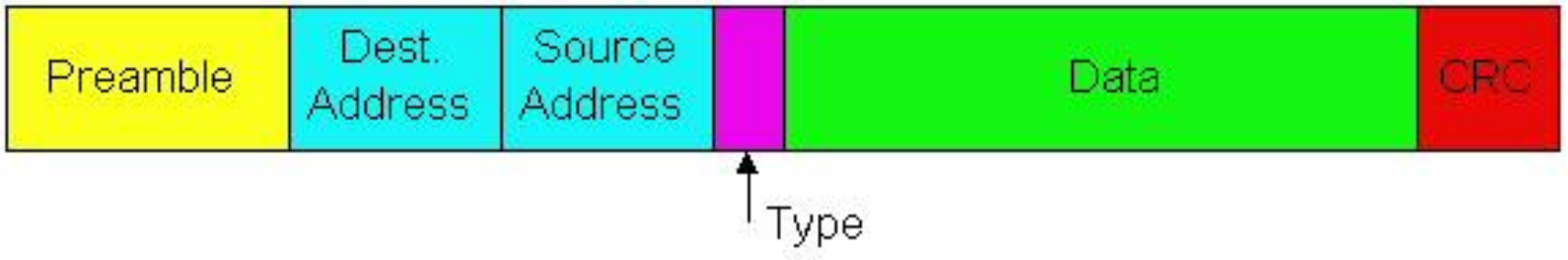
Preamble:

- 7 bytes with pattern 10101010 followed by one byte with pattern 10101011
- used to synchronize receiver, sender clock rates

Ethernet 802.3 header overhead is 26 bytes

Ethernet Frame Structure (more)

- Addresses: 6 bytes
  - if adapter receives frame with matching destination address, or with broadcast address (eg ARP packet), it passes data in frame to net-layer protocol
  - otherwise, adapter discards frame
- Type (2 bytes): indicates the higher layer protocol (mostly IP but others may be supported such as Novell IPX and AppleTalk)
- CRC (4 bytes): checked at receiver, if error is detected, the frame is simply dropped

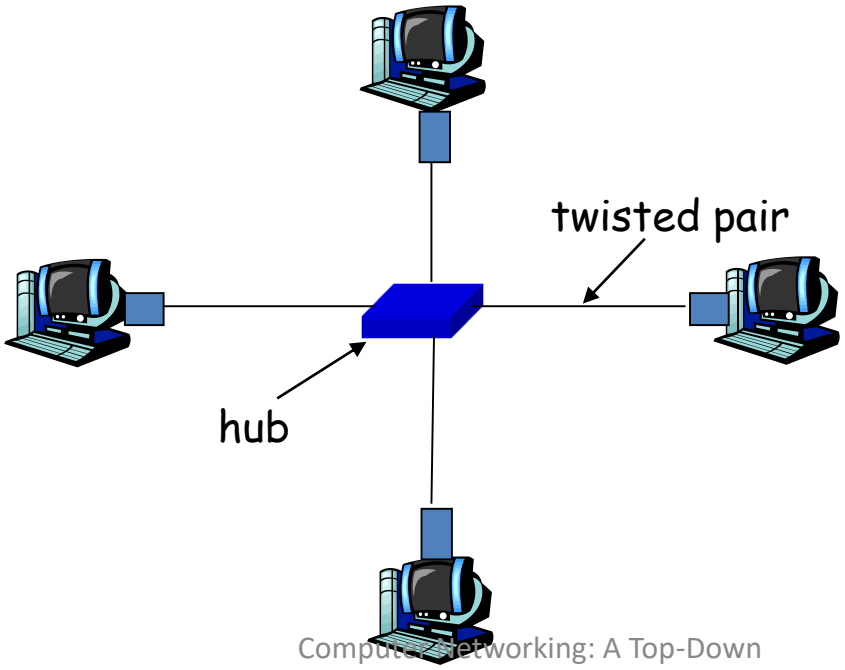


Ethernet uses CSMA/CD

- No slots
- adapter doesn't transmit if it senses that some other adapter is transmitting, that is, carrier sense
- transmitting adapter aborts when it senses that another adapter is transmitting, that is, collision detection
- Before attempting a retransmission, adapter waits a random time, that is, random access

Ethernet Technologies:

- 10BaseT and 100BaseT
  - 10/100 Mbps rate; latter called “fast ethernet”
  - T stands for Twisted Pair
  - Nodes connect to a hub: “star topology”; 100 m max distance between nodes and hub



Reference

- Computer Networking: A Top-Down Approach", James Kurose and Keith Ross , 5th edition