COMPUTER NETWORKS

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COMPUTER NETWORKS

Unit – 5 Link Layer and LAN Roadmap

- Introduction
- Error detection, correction
- Multiple access protocols
- LANs
  - Addressing, ARP
  - Ethernet
  - Switches
- A day in the life of a web request
- Physical layer
- Wireless LANs: IEEE 802.11

COMPUTER NETWORKS

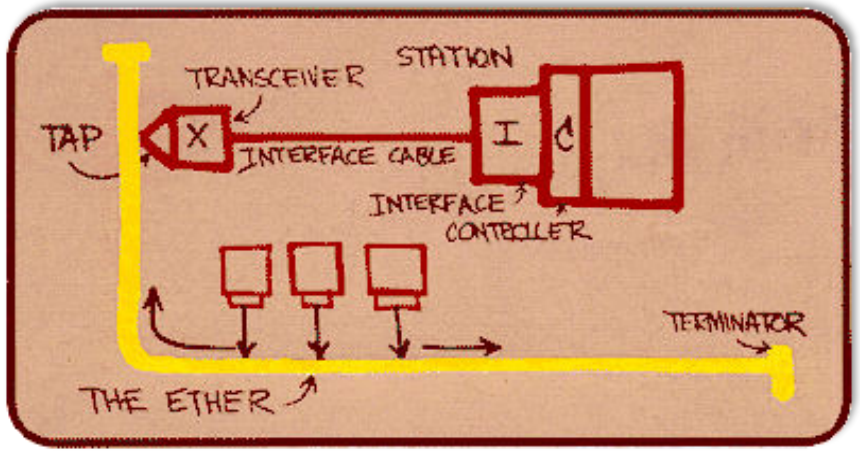
Class 50 : Ethernet : Learning Objectives

- Physical Topology
- Frame Structure

Ethernet

"Dominant" wired LAN technology:

- First widely used LAN technology
- Simpler, cheap
- Kept up with speed race: 10 Mbps – 400 Gbps
- Single chip, multiple speeds (e.g., Broadcom BCM5761)



Metcalfe's Ethernet sketch

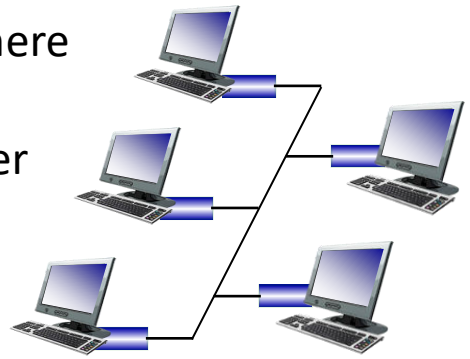
https://www.uspto.gov/learning-and-resources/journeys-innovation/audio-stories/defying-doubters

Ethernet : Physical Topology

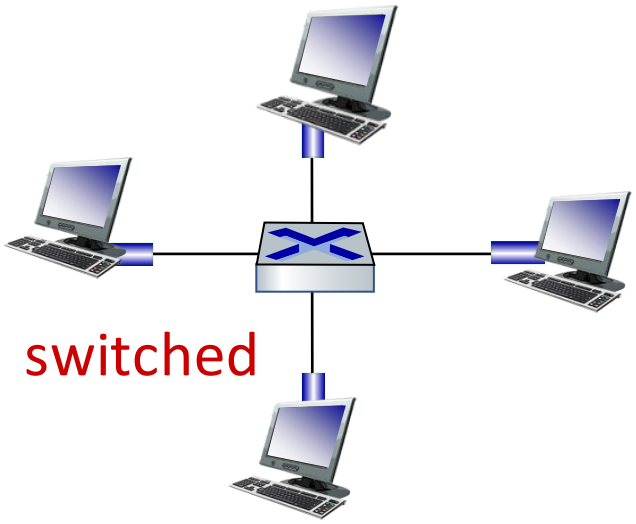
- Bus: popular through mid 90s
  - all nodes in same collision domain (can collide with each other)
- Switched: prevails today
  - active link-layer 2 *switch* in center
  - each "spoke" runs a (separate) Ethernet protocol (nodes do not collide with each other)

Traditional Ethernet
- Nodes connected with coax
- Long "runs" of wire everywhere
- CSMA/CD protocol

Hub acts as a broadcast repeater
Shorted cable "runs", Useful for 100 Mbps
– CSMA/CD protocol
– Easy to add/remove users
– Easy to localize faults
– Cheap cabling (twisted pair, 10baseT)



bus: coaxial cable



switched

Easy to increase data rate (e.g., Gbit Ethernet)
- Nodes transmit when they want
- Switch queues the packets and transmits to destination
- Typical switch capacity of 20-40 ports
- Each node can now transmit at the full rate of 10/100/Gbps
- Modularity: Switches can be connected to each ther using high rate ports

Ethernet Frame Structure

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

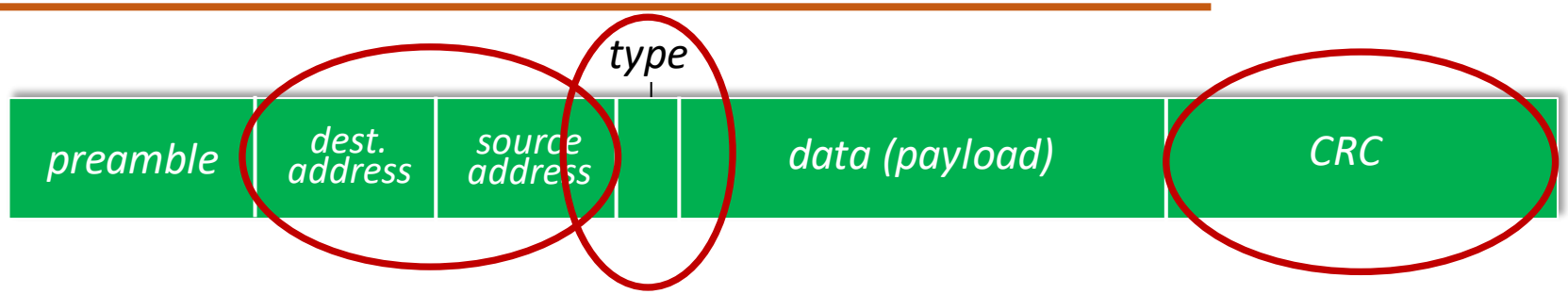
Preamble:

- Used to synchronize receiver, sender clock rates
- 7 bytes of 10101010 followed by one byte of 10101011

Data:

- 46 to 1,500 bytes
- Min-46

Ethernet Frame Structure (more)



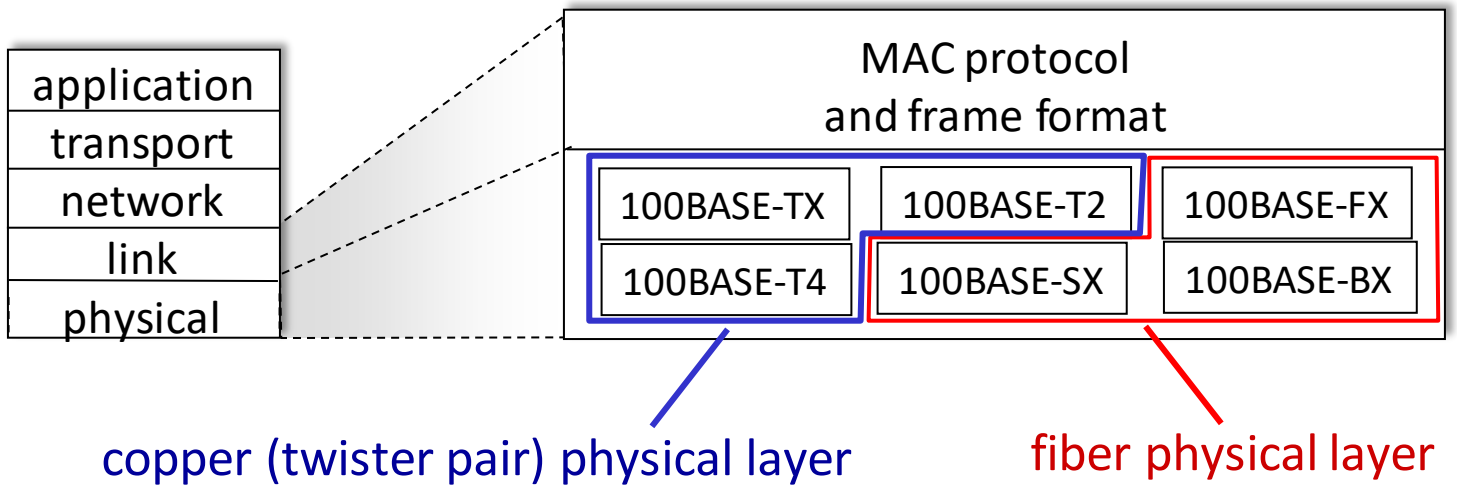
- Addresses: 6 byte source, destination MAC addresses
  - if adapter receives frame with matching destination address, or with broadcast address (e.g., ARP packet), it passes data in frame to network layer protocol
  - otherwise, adapter discards frame
- Type: indicates higher layer protocol
  - mostly IP but others possible, e.g., Novell IPX, AppleTalk
  - used to demultiplex up at receiver
- CRC: cyclic redundancy check at receiver
  - error detected: frame is dropped

Ethernet : Unreliable Connectionless

- Connectionless: no handshaking between sending and receiving NICs
- Unreliable: receiving NIC doesn't send ACKs or NAKs to sending NIC
  - data in dropped frames recovered only if initial sender uses higher layer rdt (e.g., TCP), otherwise dropped data lost
- Ethernet's MAC protocol: unslotted CSMA/CD with binary backoff

802.3 Ethernet Standards: Link and Physical Layers

- *Many* different Ethernet standards
  - Common MAC protocol and frame format
  - Different speeds: 2 Mbps, 10 Mbps, 100 Mbps, 1Gbps, 10 Gbps, 40 Gbps
  - Different physical layer media: fiber, cable



802.3 Ethernet Standards: Link and Physical Layers

Gigabit Ethernet is an extension of Ethernet standards

- Data rate- 40,000 Mbps, 40 Gigabit Ethernet
- Fully compatible with the huge installed base of Ethernet equipment.
- Standard - IEEE 802.3z, does the following:
  - Uses the standard Ethernet frame format
  - Backward compatible with 10BASE-T and 100BASE-T technologies.
  - Allows for point-to-point links as well as shared broadcast channels
    - Point-to-point links use switches
    - Broadcast channels use hubs
    - Hubs-*buffered distributors*.
    - Uses CSMA/CD for shared broadcast channels.
    - In order to have acceptable efficiency, the maximum distance between nodes must be severely restricted.
    - Allows full-duplex operation at 40 Gbps in both directions for point-to-point channels.

THANK YOU

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