# Chapter 6
The Link Layer and LANs

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Thanks and enjoy! JFK/KWR
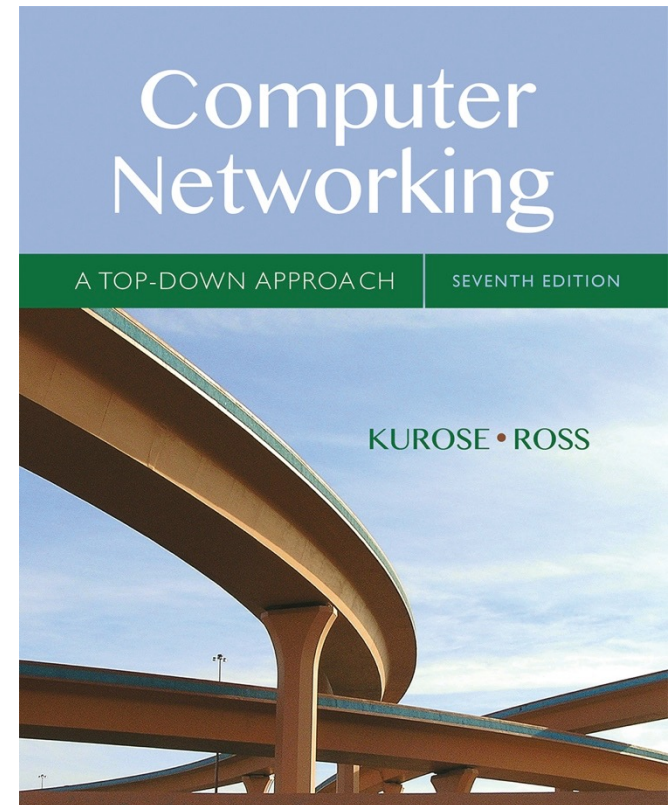
Computer Networking: A Top Down Approach

7th edition
Jim Kurose, Keith Ross
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Minor modifications made to original slides by Nathan Bowman

Network Layer

Link layer, LANs: outline

6.1 introduction, services

6.2 error detection, correction

6.3 multiple access protocols

6.4 LANs
- addressing, ARP
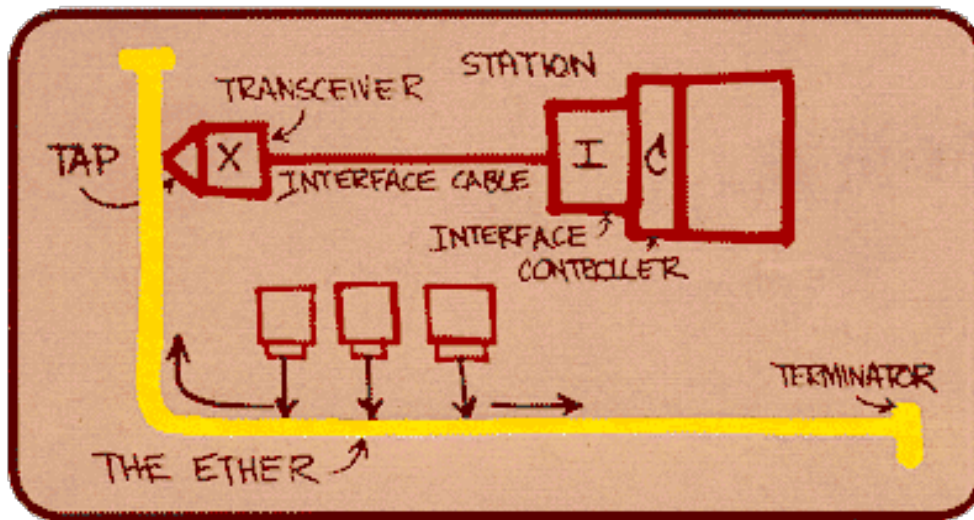- Ethernet
- switches
- VLANS

6.5 link virtualization: MPLS

6.6 data center networking

6.7 a day in the life of a web request
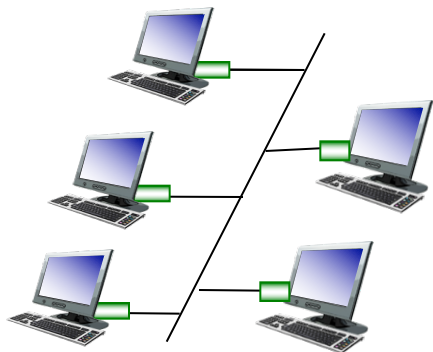
Ethernet

"dominant" wired LAN technology:

- first widely used LAN technology
- remains dominant technology because
  - simpler, cheap
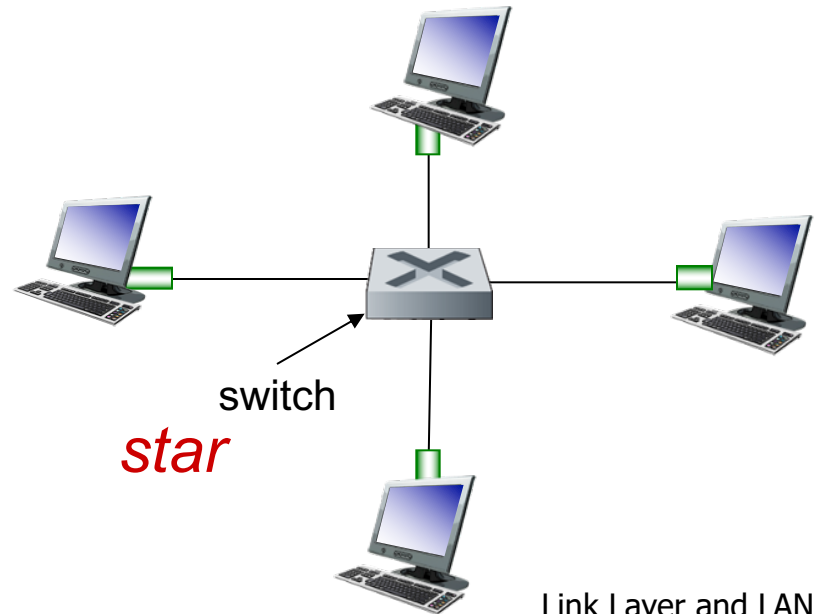 - kept up with speed race: 10 Mbps – 10 Gbps

Metcalfe's Ethernet sketch

Ethernet: physical topology

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

bus: coaxial cable

switch

star

Ethernet frame structure

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

| preamble | dest. address | source address | *type* | data (payload) | CRC |

preamble:

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

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)
- *CRC:* cyclic redundancy check at receiver
  - error detected: frame is dropped

type

preamble	dest. address	source address		data (payload)	CRC

Ethernet frame structure (more)

- You may notice that preamble and CRC do not show up in Wireshark – these are generally handled before data is passed to libraries used by Wireshark

type

preamble	dest. address	source address		data (payload)	CRC

Ethernet: unreliable, connectionless

- *connectionless:* no handshaking between sending and receiving NICs

- *unreliable:* receiving NIC doesn't send acks or nacks 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 & 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

| application |
| transport |
| network |
| link |
| physical |

MAC protocol
and frame format

| 100BASE-TX | 100BASE-T2 | 100BASE-FX |
| 100BASE-T4 | 100BASE-SX | 100BASE-BX |

copper (twister pair) physical layer

fiber physical layer