## LAN topologies

Ethernet

- **introduction**

Note: Many of the lecture slides are based on presentations that accompany
Computer Networking: A Top Down Approach, 6th edition,
by Jim Kurose & Keith Ross, Addison-Wesley, 2013.

A little more about Physical Layer: LAN topologies

- Networks may be classified by *shared medium*
  - Cable
  - Wireless
  - Others …

- Networks may be classified by *topology* (shape)
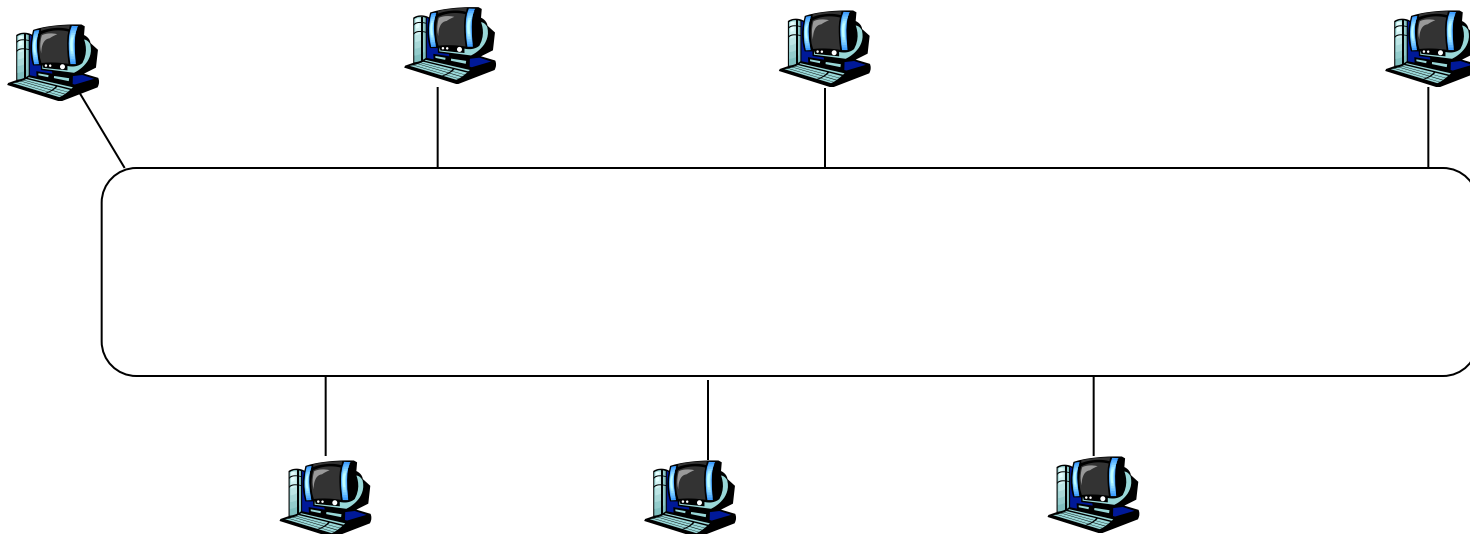 - three most popular:
    - Bus
    - Ring
    - Star

Bus topology

- Each computer has connector to shared cable (medium)
- Uses CSMA/CD MA protocol

Terminator

Terminator
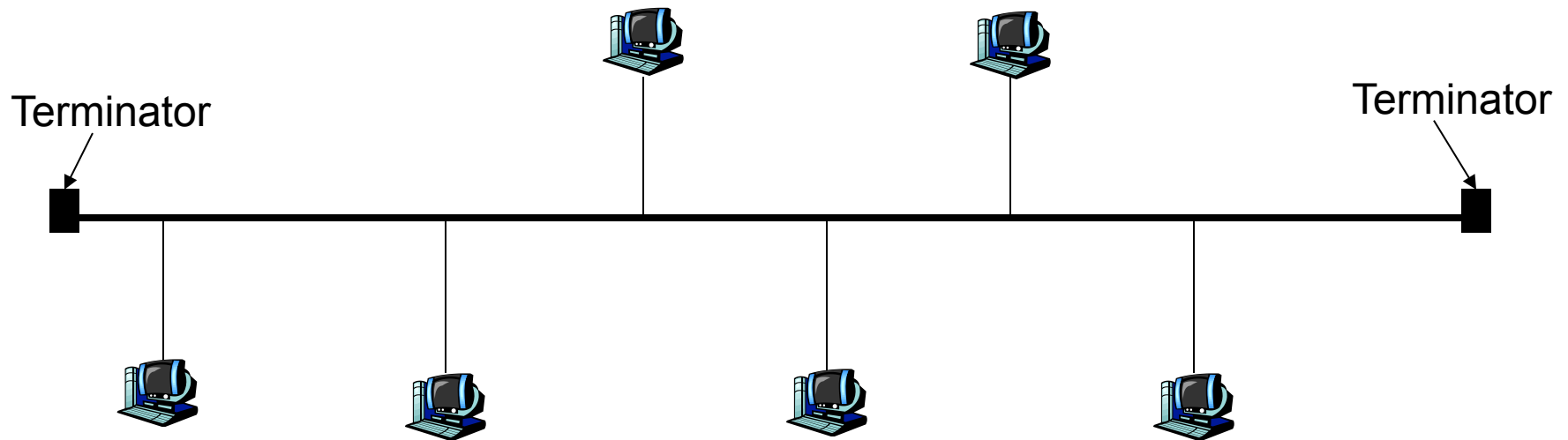
- Computers connected in a closed loop
- First passes data to second, second passes data to third, etc.
  - uses token ring MA protocol
- Refers to logical connections (not physical layout)

Star topology

- All computers attach to a central point:
- "Center" of star is usually a *server* or a *hub*
  - the hub must be programmable (*switch*)
  - server/switch learns connections
  - can service multiple transmissions simultaneously
   - no collisions
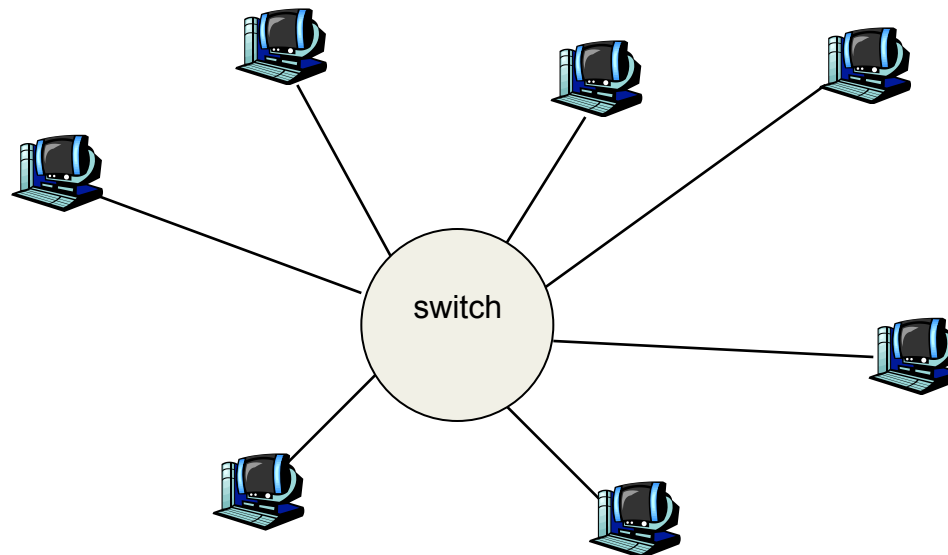
Star topology

- Don't be confused by a diagram.
- "Topology" refers to logical connections (not physical layout)

- A likely diagram of a star-topology LAN:

to the internet
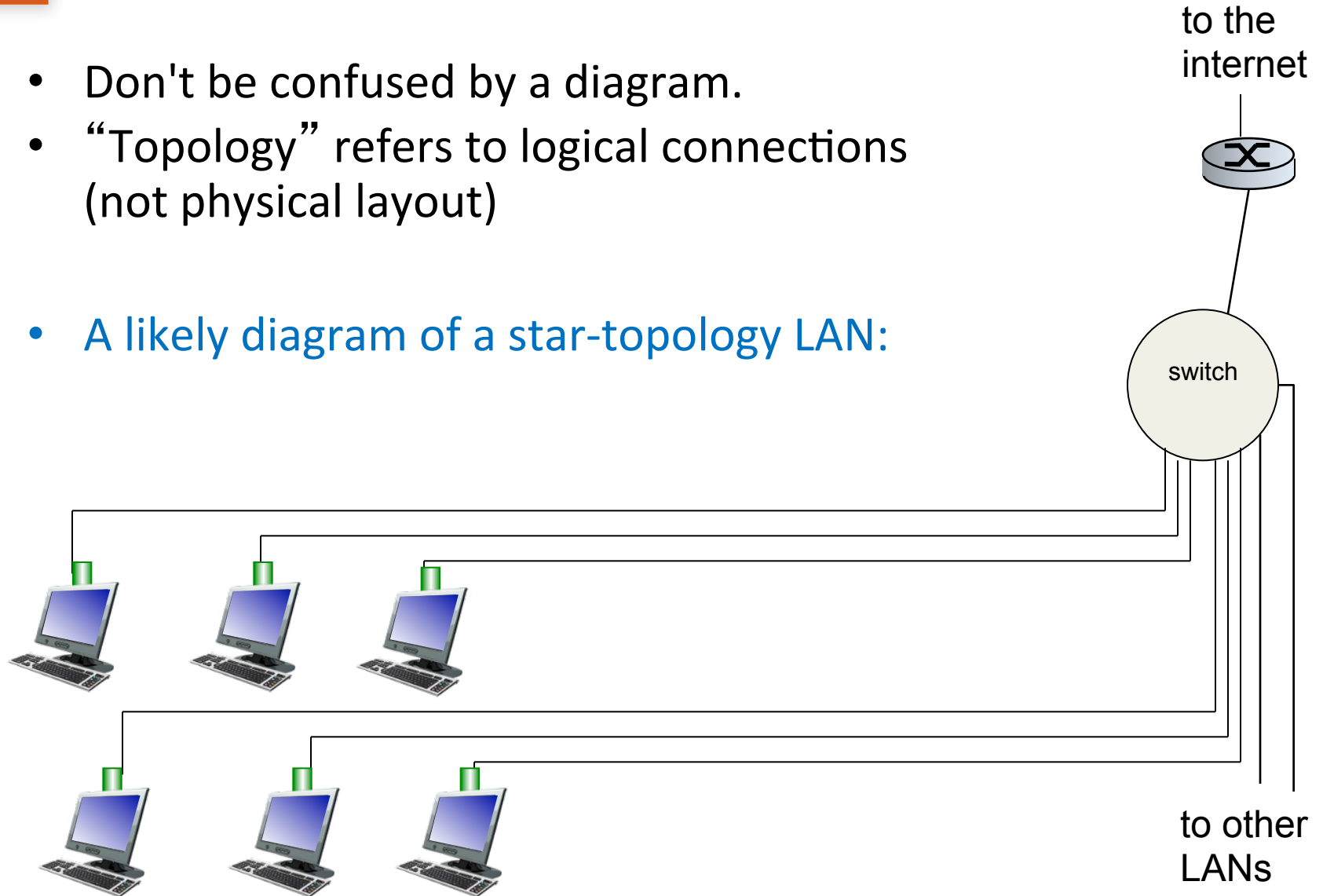
switch

to other LANs

- hosts have dedicated, direct connection to switch
- switches buffer packets
- Ethernet protocol used on *each* incoming link, but no collisions; full duplex
  - each link is its own collision domain
- *switching:* A-to-A' and B-to-B' can transmit simultaneously, without collisions
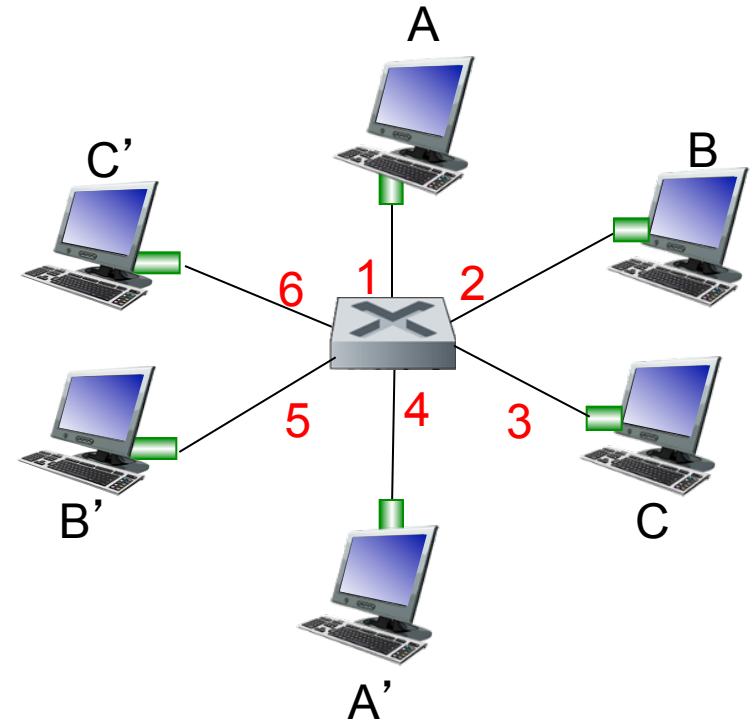
*switch with six interfaces*
(1,2,3,4,5,6)

Example **bus** topology: Ethernet (original)

- Widely used LAN technology
- Standards managed by IEEE
  - defines formats, voltages, cable lengths, etc.
  - See RFC 894
- Uses CSMA/CD protocol
- Uses single coax cable (for the *ether*)
  - Connections to the ether may be unshielded twisted-pair (UTP), etc.
- One Ethernet cable (called a *segment*)
  - Limited to 500 meters in length
  - Minimum separation between connections is 3 meters

  - Limit may be extended with repeaters, bridges, etc.
  - CSMA/CD still requires relatively short *network diameter**
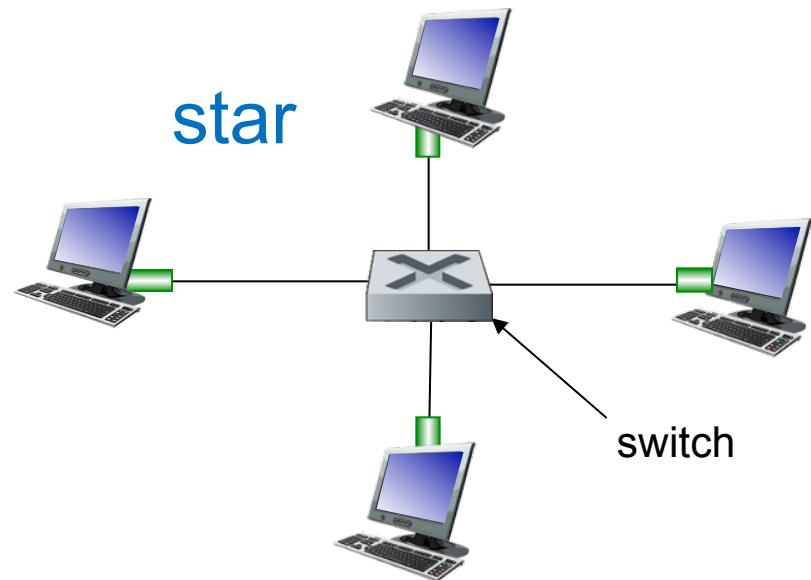   - *maximum distance between any two nodes

Ethernet: physical topology

- **bus**: popular through mid 90s
  - all nodes in same collision domain (can collide with each other)
  - still used in many organizations

- **star**: prevails today
  - active *switch* in center
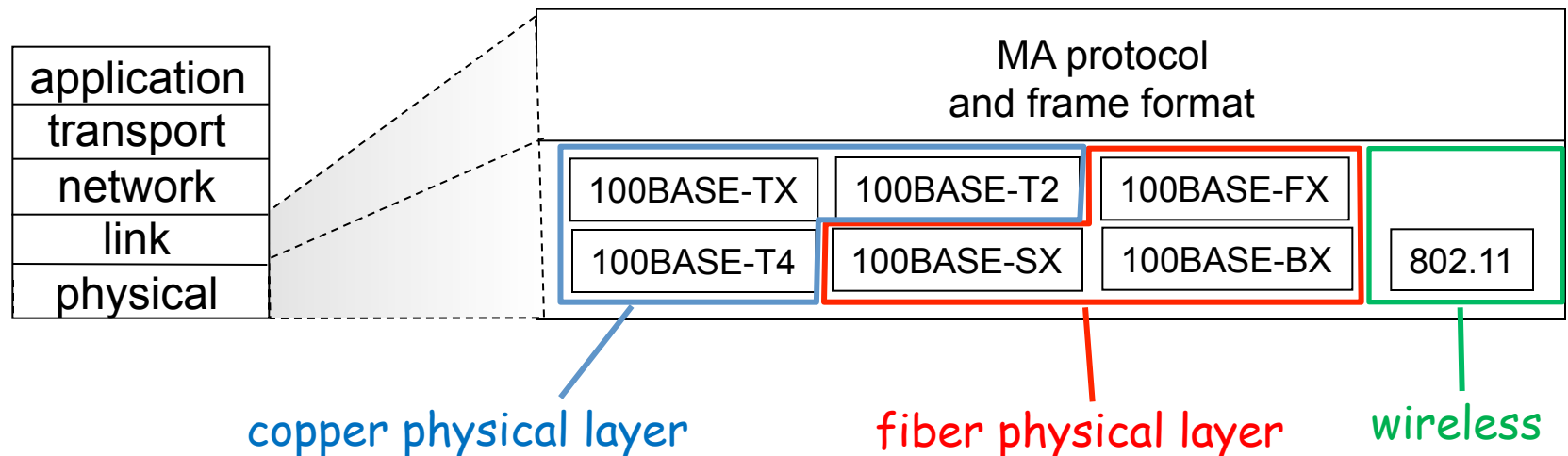 - each "spoke" runs a (separate) Ethernet protocol (nodes do not collide with each other)

bus

star

coaxial cable

switch
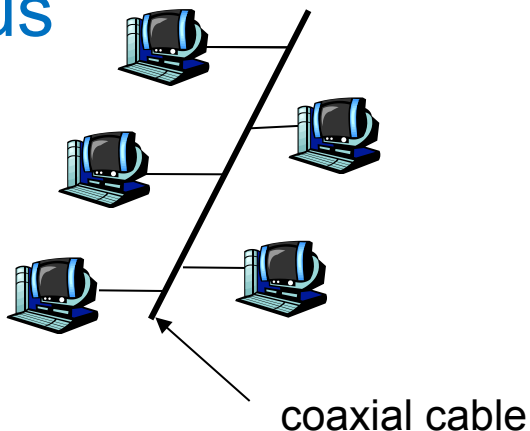
- <u>Many</u> different Ethernet standards
  - common MA protocol (CSMA/CD)and frame format
  - different speeds
    - 10 Mbps, 100 Mbps, 1Gbps, 10G bps
  - different physical layer media
    - cable, fiber, wireless

Ethernet: link layer common standards

- connectionless: no handshaking between sending and receiving NICs

- unreliable: receiving NIC does not send ACKs
  - data in dropped frames is recovered only if sender uses higher layer reliable data transport (e.g., TCP)
  - otherwise dropped data is lost

- sending NIC encapsulates IP datagram (or other network layer protocol packet) in frame

- Ethernet frame format:

- preamble: 8 bytes, used to synchronize receiver/sender clock rates

- addresses: 6 byte destination/source MAC addresses

- type: indicates network layer protocol
  - mostly IP
  - others possible, e.g., Novell IPX, AppleTalk

- payload: complete network-layer datagram

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

- Local area network (LAN) topologies
  - bus, ring, star

- Ethernet
  - Topologies
  - Physical layer media
  - MA protocol (CSMA/CD)
  - Frame format, encapsulation

- Definitions:
  - switch
  - network diameter