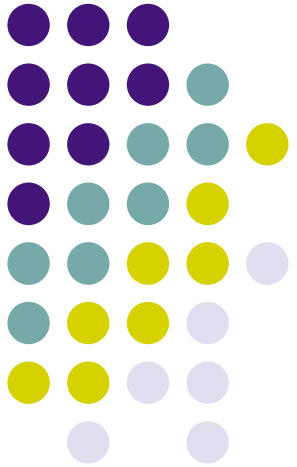
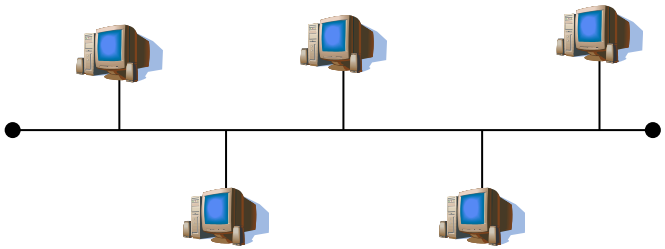
Lecture 5
LAN: Local Area Network

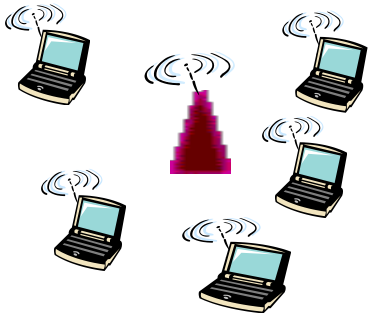
Reading: 4.3 Computer Networks, Tanenbaum



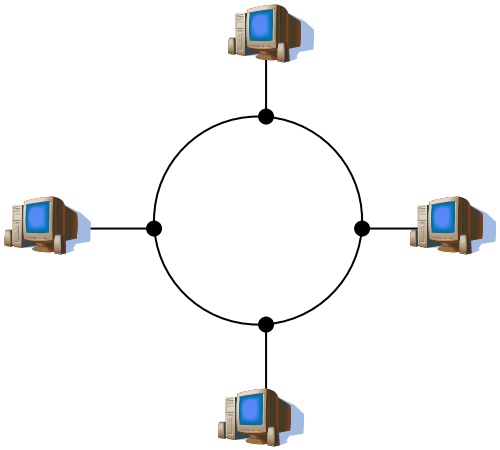
LAN topology



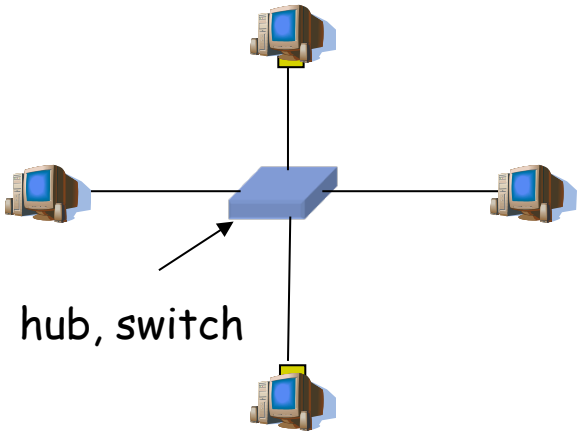
Traditional bus topo



WLAN

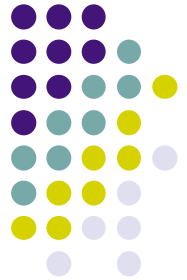


Ring



Star

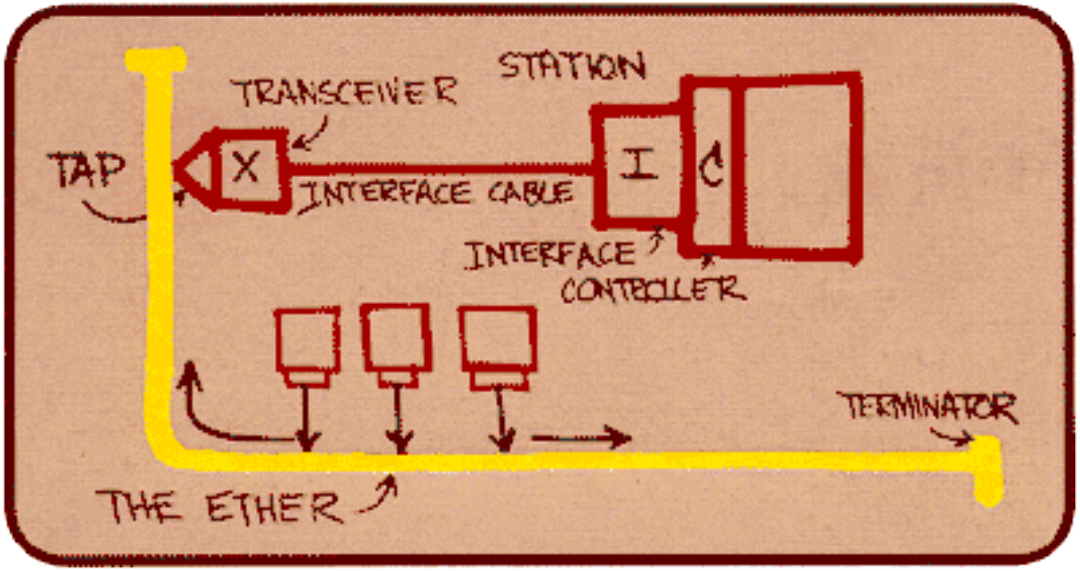
LAN Standards



- IEEE 802 contains many standards for LAN technology.
  - 802.3: Ethernet
  - 802.4: Token bus
  - 802.5: Token ring
  - 802.11 a/b/g/n: Wireless LAN (Wifi)
  - 802.16: WiMax.

Ethernet LAN

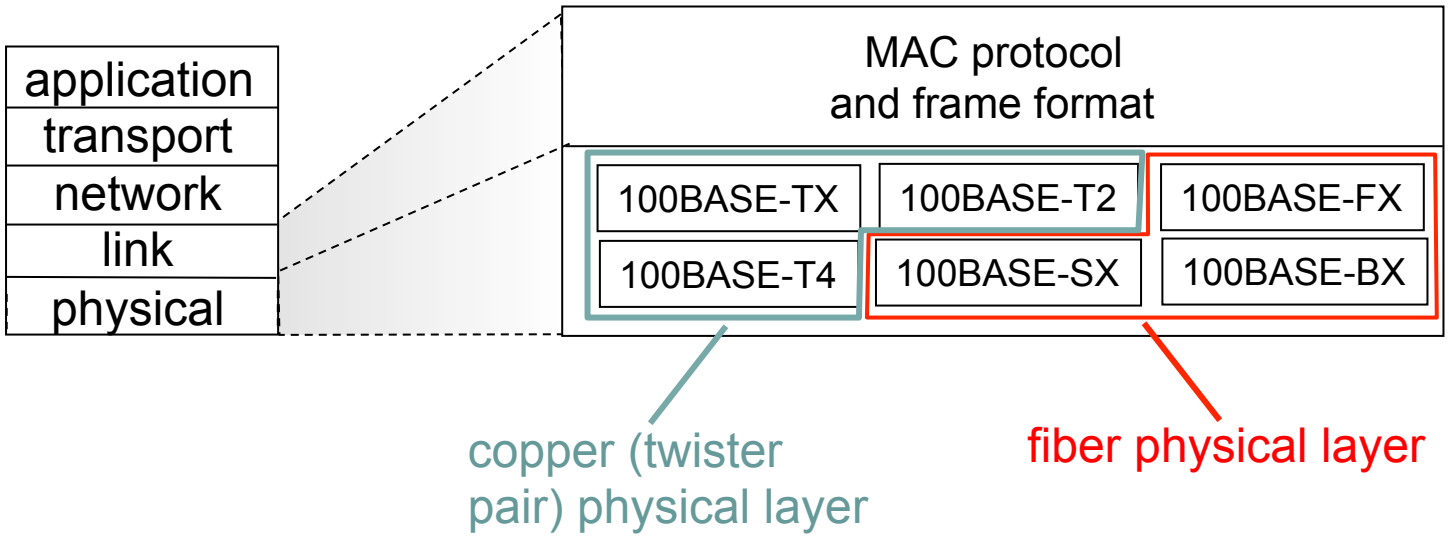
- Layer 2 technology for communication in LAN, invented in 1976
- Standardized in IEEE 802.3
- Ethernet LAN could have different speeds: 3 Mbps – 10 Gbps
  - Ethernet: 10BaseT, 10Base2…



Metcalfe's Ethernet sketch

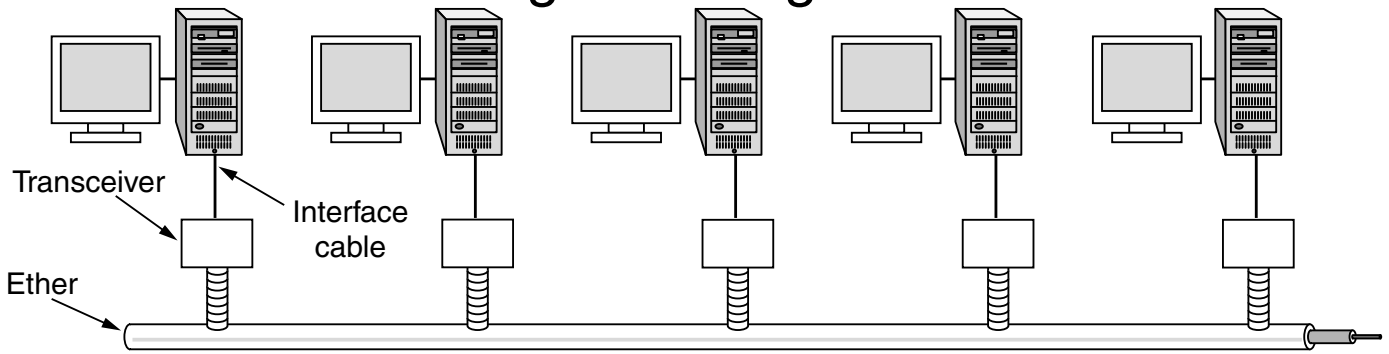
IEEE 802.3 and Ethernet Standards

- Datalink & Physical Layers
- Datalink= LLC + MAC
- MAC: CSMA/CD in classical Ethernet
- Several type of Ethernet
  - Same MAC and frame structure
  - Different rate: 2 Mbps, 10 Mbps, 100 Mbps, 1Gbps, 10G bps
  - Different cable: Optical fiber, coaxial, twisted pair



Classical Ethernet

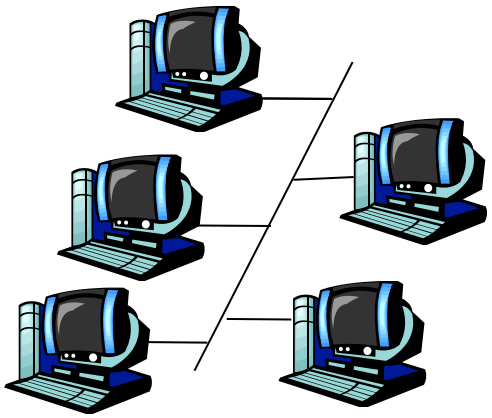
- Bus topology was popular in the past
- All nodes share the same communication medium. Could used a central hub for connecting nodes.
- Use CSMA/CD for media access control.
- Use Manchester encoding at Physical layer
- Use coaxial cable
- Thick Ethernet: Max segment length 500m without converter
- Thin Ethernet: Max segment length 185m without converter



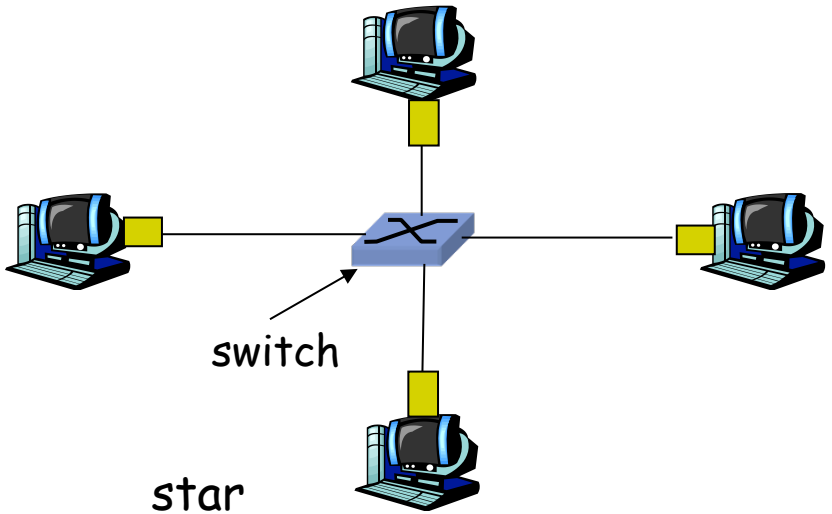
Ref: Computer Network, Tanenbaum

Switched Ethernet

- Switched Ethernet (nowdays):
  - Star topology,
  - Use a central switch Ethernet
  - The switch outputs a frame only to the port linking to the destination ➔ independent connection for each pair of two nodes
  - No collision
  - No media access control is needed.

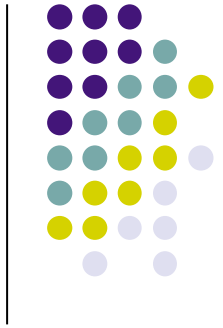


bus: coaxial cable



star

Classical Ethernet



- Ethernet frame

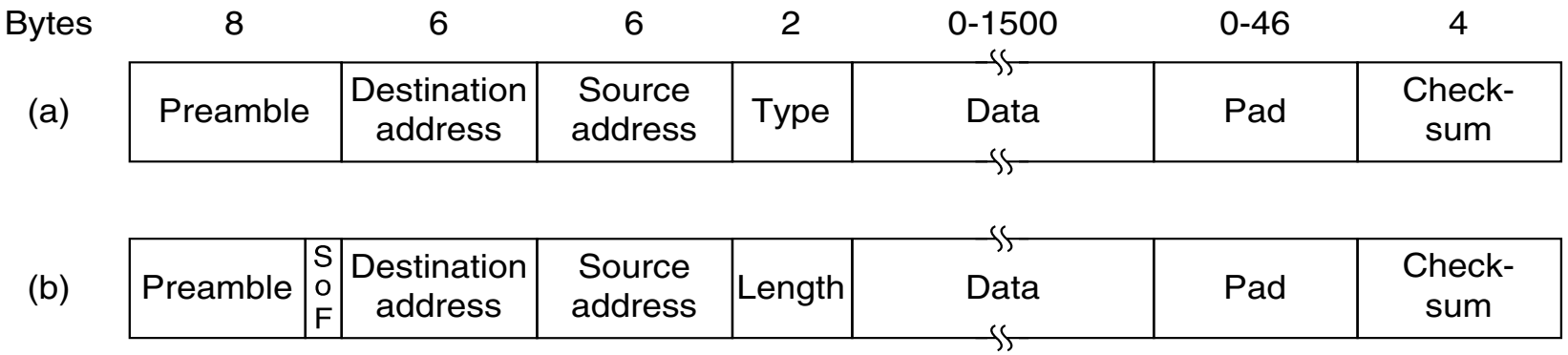
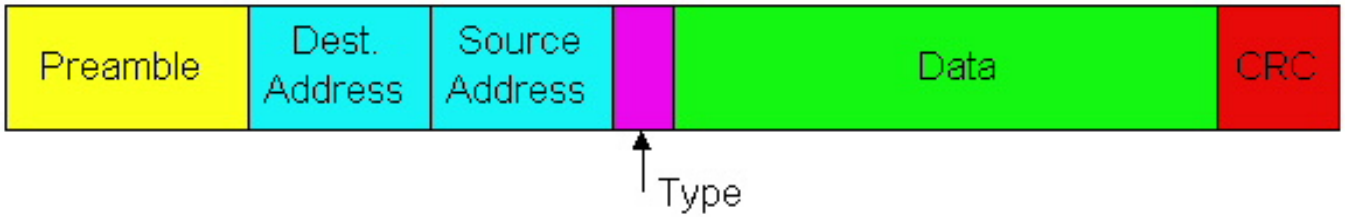


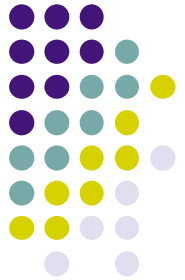
Figure 4-14. Frame formats. (a) Ethernet (DIX). (b) IEEE 802.3.

Structure of Ethernet frame



- Preamble: Marking the starting of a frame
- Address: Physical addresses of source and destination
  - 6 bytes
- Type: Uppper layer protocol (IP, Novell IPX, AppleTalk, …)
- Checksum: Error detection code. CRC??

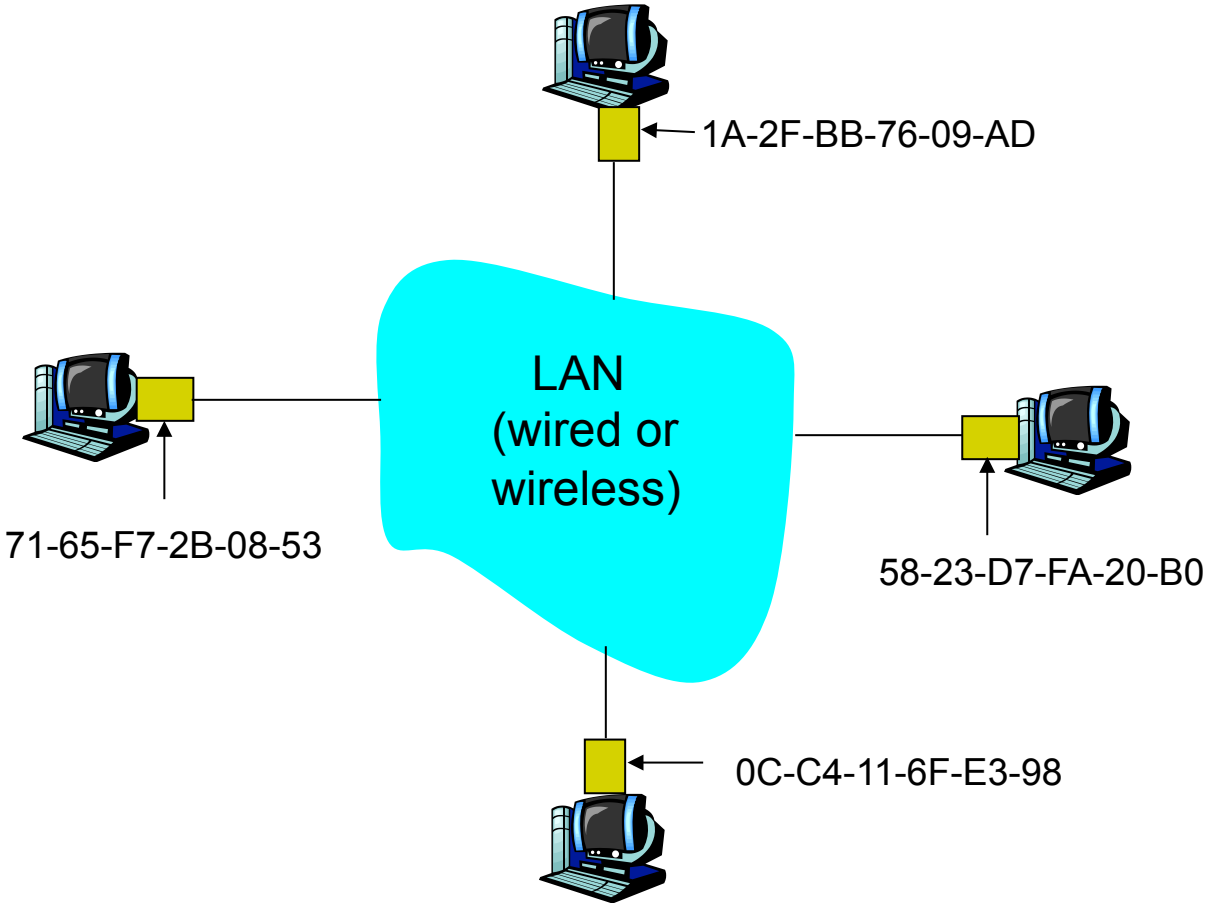
MAC address and ARP



- IP Address :
  - 32-bit
  - Used in Network layer
- MAC address:
  - Used in Data link layer
  - 48 bit

ARP and MAC address

Each network adapter has a MAC address

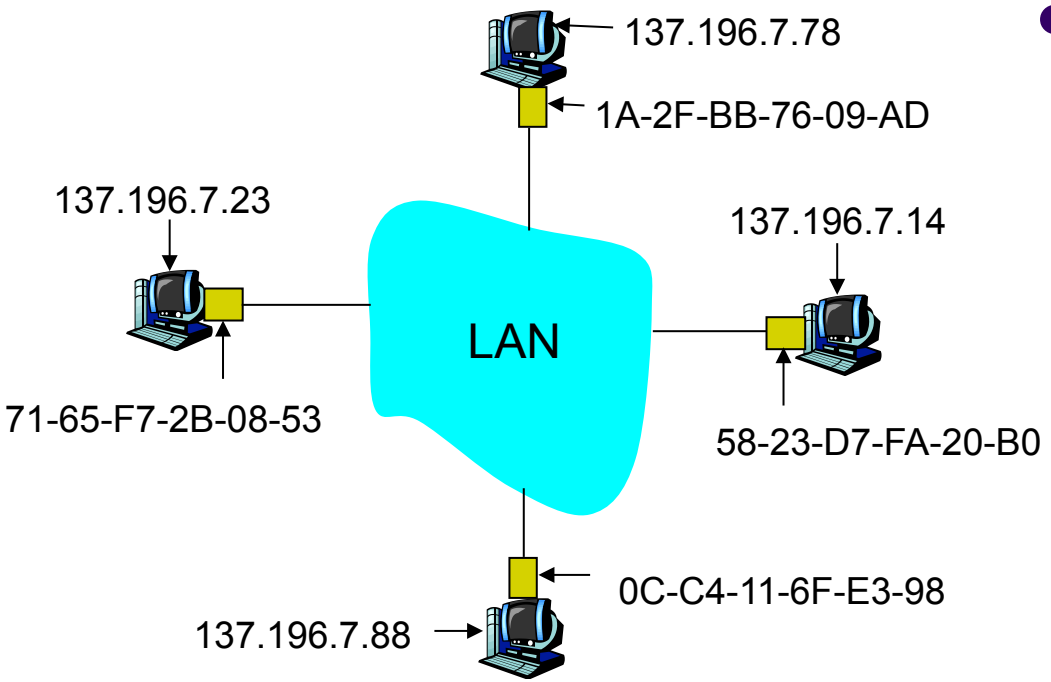


Broadcast address =
FF-FF-FF-FF-FF-FF

= adapter

ARP: Address Resolution Protocol

Question: Identify MAC address from an IP address



- Each network node (host, router) has an ARP table
- ARP table: contain mapping IP/MAC of some nodes

< IP address; MAC address; TTL>

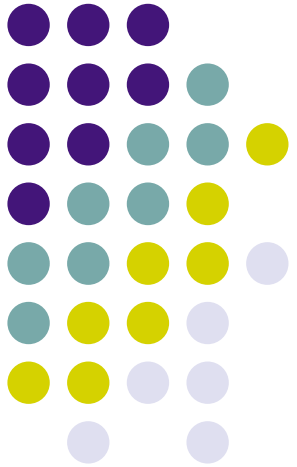
  - TTL (Time To Live): ~20 min.

ARP : Work on a network segment

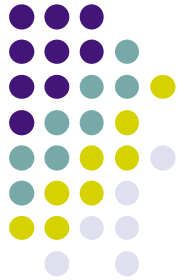
- A wants to send data to B on datalink layer but do not know MAC of B
- A broadcast an ARP package stating the IP address of B
- B receives the package with is address and reply to A with MAC of B
- A saves the MAC address of B

LAN (cont.)

Hub, Switch, Bridge



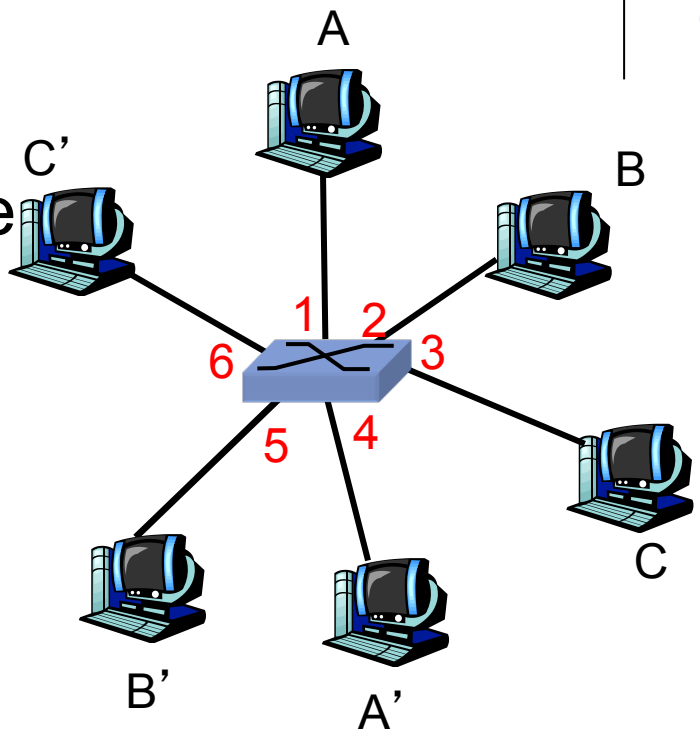
Devices of LAN



- Hub, bridge and switch
  - All are LAN devices with many ports
- Hub:
  - Receive the signal from one port (amplify) and forward to the remaining ports
  - Do not offer services of datalink layer
- Bridge
  - More intelligent than hub
  - Can store and forward data (Ethernet frame)
  - Bridge breaks the network into two collision domains.

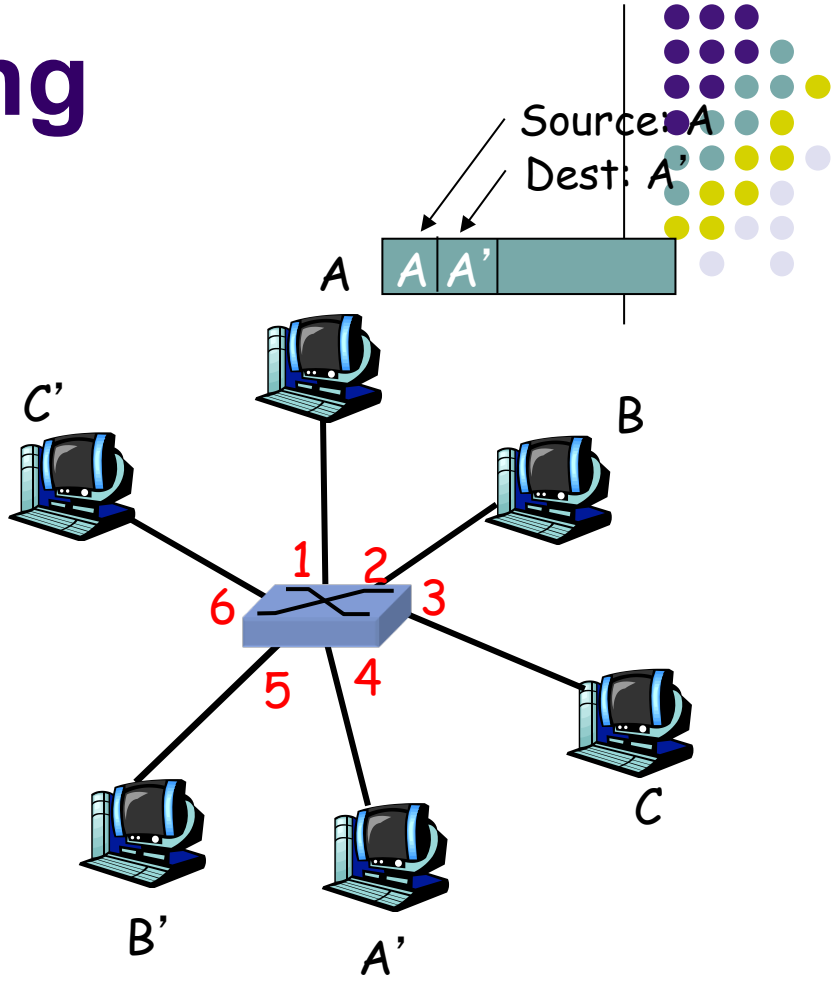
Switch

- Allows multiple node pairs sending data in the same time
  - E.g. A-to-A’ and B-to-B ‘ without collision
  - Each link is an independant collision domain
- Switch has a table of MAC addresses showing which node connects to which port
  - (MAC address of host, port index, TTL)



Switch: Self learning mechanism

- Switch learns the MAC address of all hosts connected to the switch
- Forwarding table



MAC addr	interface	TTL
A	1	60

Switch: forwarding mechanism

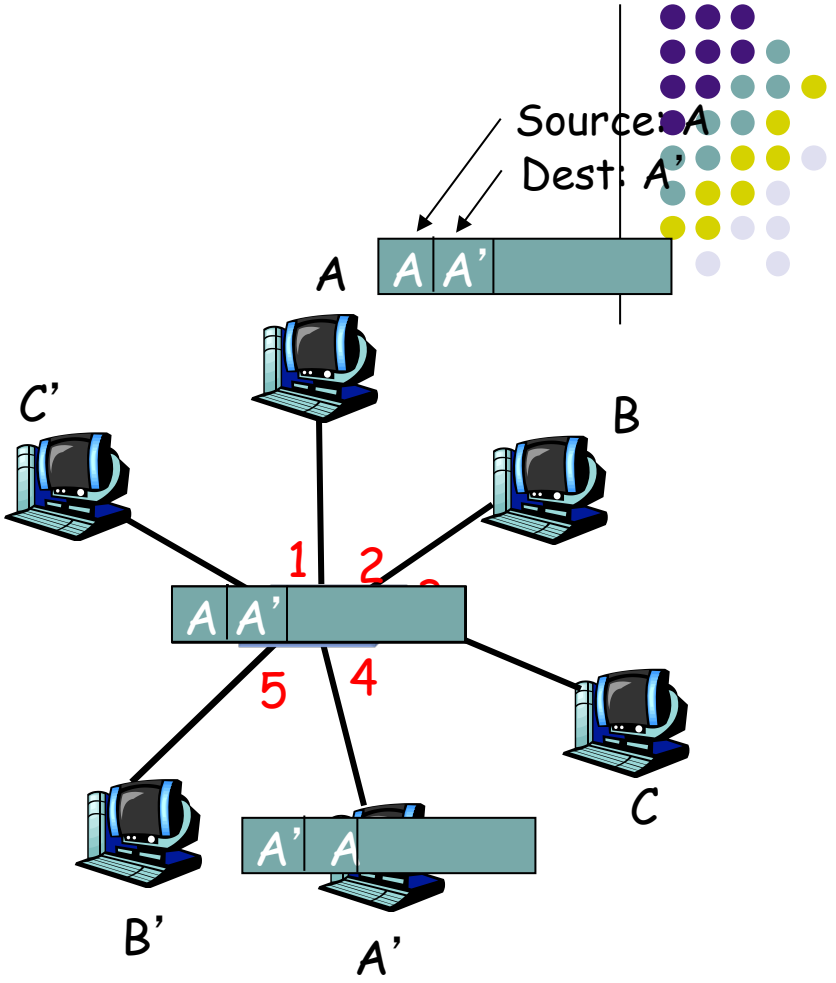
When receiving a fram

1. The incomming port and MAC associated is learnt
2. Looking for outgoing port based on destination MAC and forwarding table
3. **if** outgoing port is found
   then {
   if incomming port== outgoing port
   then destroy the frame
   else forward the frame to outgoing port
   }
   else broacast the frame

Ex:

- Outgoing port unknown: *Broadcast*
- Know A:

Direct transfering

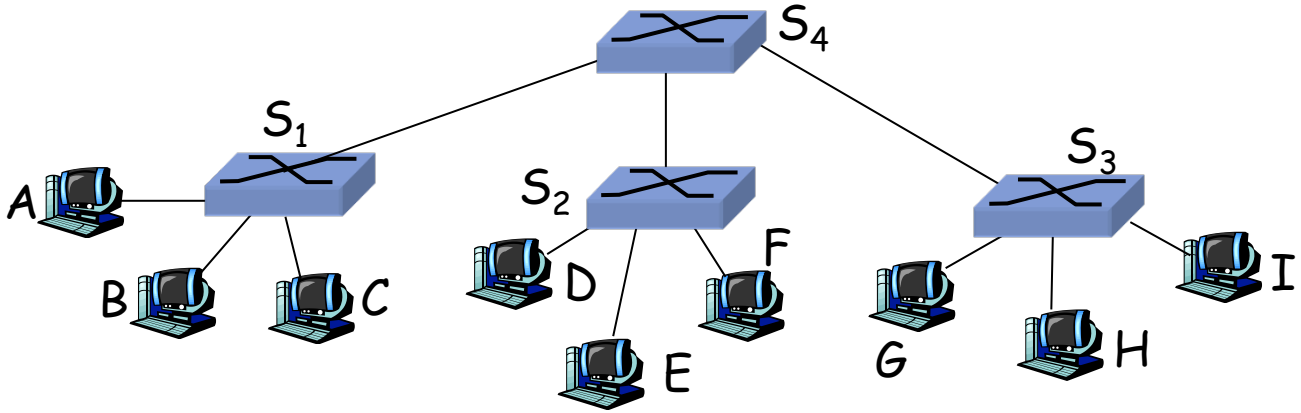


MAC addr	interface	TTL
A	1	60
A'	4	60

Forwarding table (empty initially)

Connecting switch in cascade

- Switches could be connected to eachother



- Switches in cascade uses also self learning mechanism

A typical LAN