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Welcome to CPSC 441!

Outline

- Introduction to Hub
- Introduction to Switch
- Switch table
- Self-learning
- Hub vs. Switch vs. Router

LAN interconnection

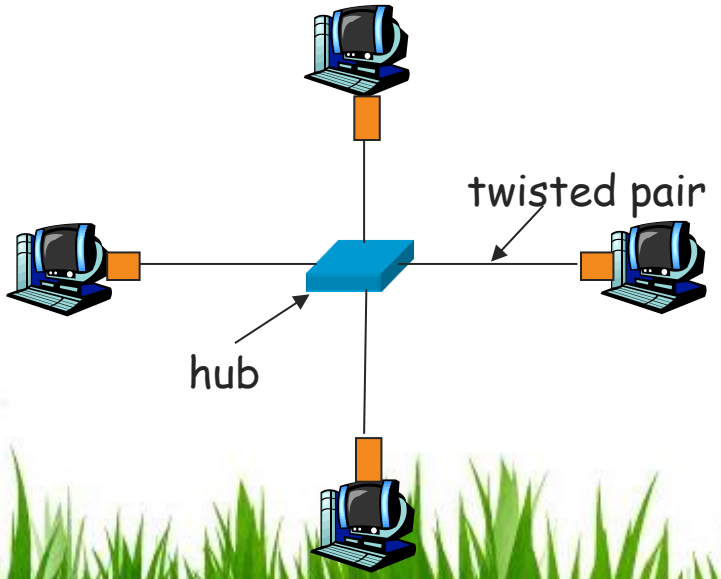
- We need to break down big networks to sub-LANs
  - Limited amount of supportable traffic: on single LAN, all stations must share bandwidth
  - Limited length: 802.3 (Ethernet) specifies maximum cable length. For 10 Mbps:
    - Maximum length of the wire: 2,500 meter
  - Large “collision domain” (can collide with many stations)

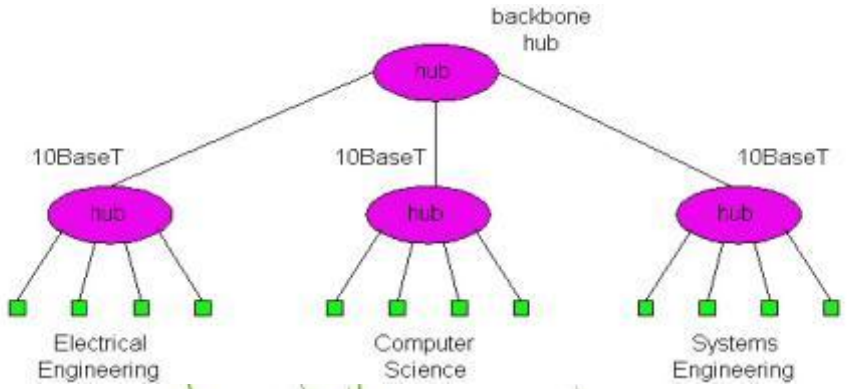
Role of switches/hubs

- Receive incoming link-layer frames/bits and forward them onto outgoing links
- Transparent to host/router: unaware that the frame/bits will be receiving by switches/hubs and then forwarded

HUBS

- **Physical Layer** devices
- Essentially repeaters operating at bit levels: repeat received bits on one interface to all other interfaces
- Hubs can be arranged in a hierarchy (or multi-tier design), with backbone hub at its top
- Each connected LAN referred to as LAN segment





Hubs: Pros

- Hub Advantages:
  - simple, inexpensive device
  - Multi-tier provides graceful degradation: portions of the LAN continue to operate if one hub malfunctions
  - extends maximum distance between node pairs (100m per Hub)

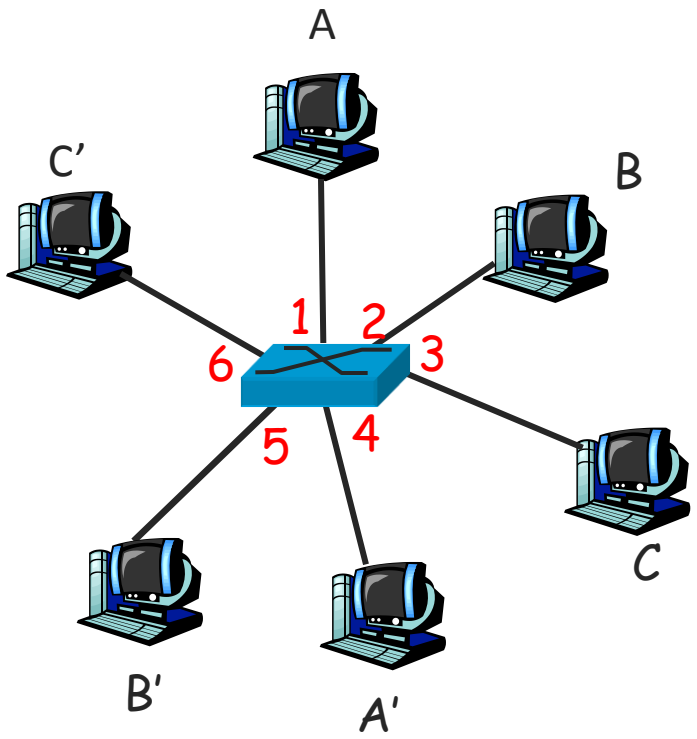
- limitations : Hubs do not isolate collision domains: node may collide with any node residing at any segment in LAN
  - Single collision domain results in no increase in max throughput
  - multi-tier throughput same as single segment throughput
  - Individual LAN restrictions pose limits on number of nodes in same collision domain and on total allowed geographical coverage
  - cannot connect different Ethernet types (e.g., 10BaseT and 100baseT) Why?

Switch

- **Link-layer** devices:
  - store, forward Ethernet frames
  - examine incoming frame's MAC address, selectively forward frame based on its destination. When frame is to be forwarded on segment, bridge uses CSMA/CD to access segment and transmit
- Advantages:
  - Isolates collision domains resulting in higher total max throughput, and does not limit the number of nodes nor geographical coverage
  - Can connect different type Ethernet since it is a store and forward device
  - Transparent: no need for any change to hosts LAN adapters

Switch: allows *multiple* simultaneous transmissions

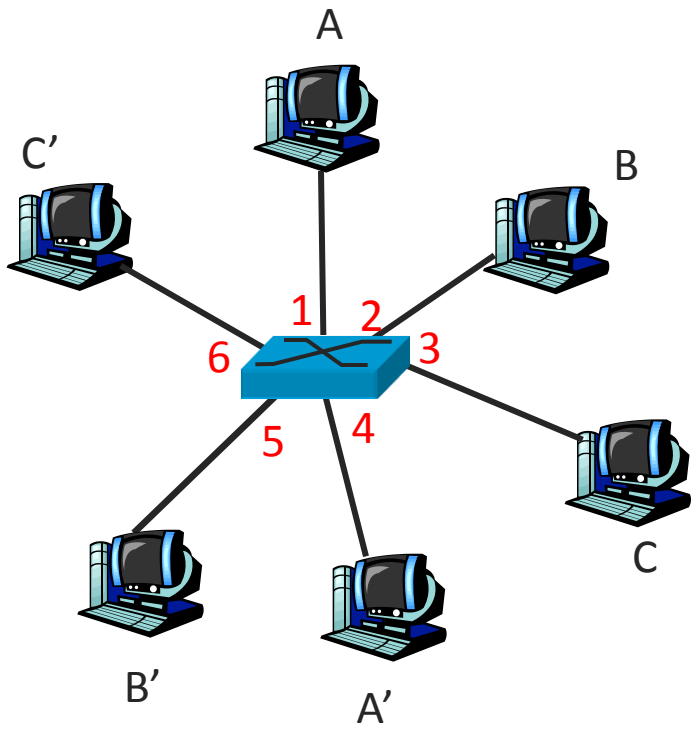
- hosts have dedicated, direct connection to switch
- switches buffer packets
- Ethernet protocol used on *each* incoming link, but no collisions; full duplex
  - each link is its own collision domain
- *switching:* A-to-A' and B-to-B' simultaneously, without collisions
  - not possible with dumb hub



switch with six interfaces (1,2,3,4,5,6)

Switch Table

- *Q:* how does switch know that A' reachable via interface 4, B' reachable via interface 5?
- *A:* each switch has a switch table, each entry:
  - (MAC address of host, interface to reach host, time stamp)
- looks like a routing table!
- *Q:* how are entries created, maintained in switch table?
  - something like a routing protocol?



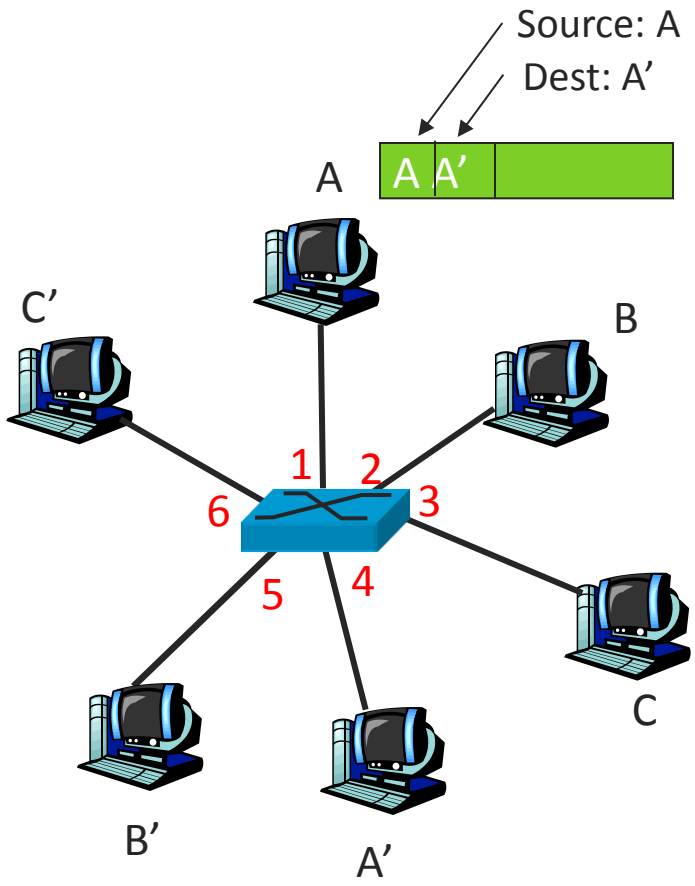
switch with six interfaces (1,2,3,4,5,6)

Switch: self-learning

- switch *learns* which hosts can be reached through which interfaces
  - when frame received, switch "learns" location of sender: incoming LAN segment
  - records sender/location pair in switch table

MAC addr	interface	time
A	1	60

Switch table (initially empty)



Switch: frame filtering/forwarding

When frame received:

1. record link associated with sending host
2. index switch table using MAC dest address
3. **if** entry found for destination
   then {
   if dest on segment from which frame arrived
   then drop the frame
   else forward the frame on interface indicated
   }
   else flood

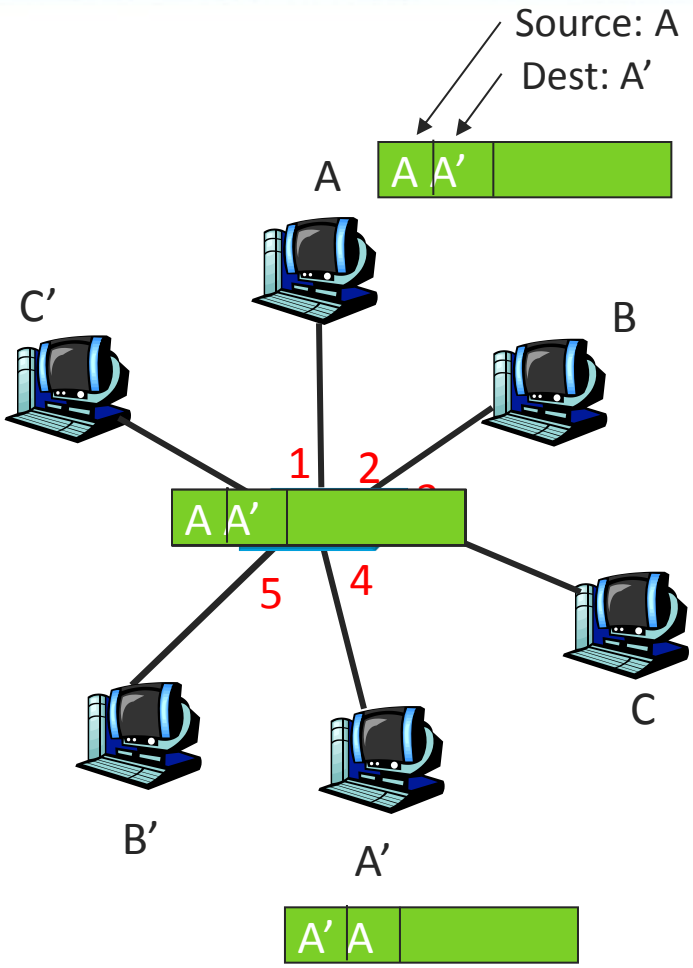
forward on all but the interface on which the frame arrived

Self-learning, forwarding: example

- frame destination unknown: flood
- destination A location known: selective send

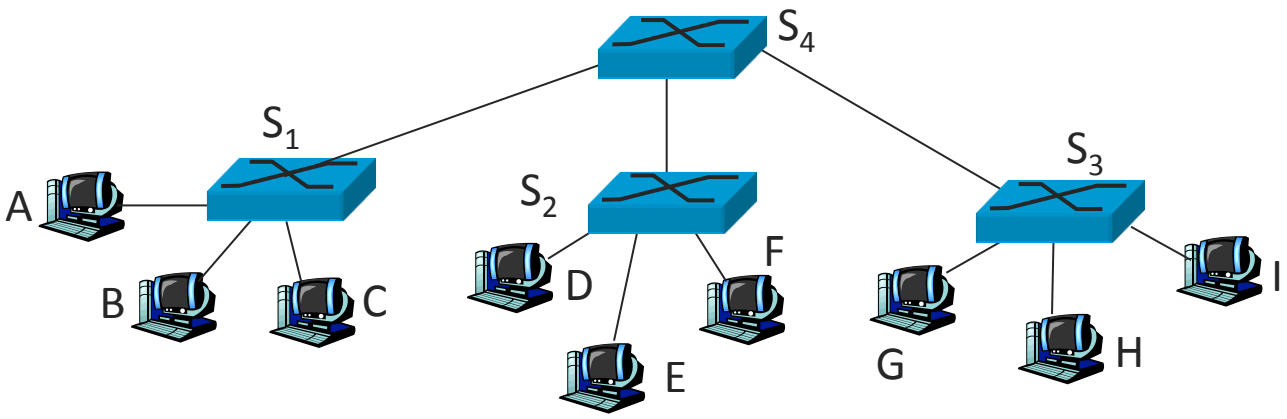
MAC addr	interface	time
A A’	1 4	60 60

Switch table
(initially empty)



Interconnecting switches

- switches can be connected together



- Q: sending from A to F - how does S_1 know to forward frame destined to F via S_4 and S_2?
- A: self learning! (works exactly the same as in single-switch case!)

Resources

- Some useful youtube videos:
- http://www.youtube.com/watch?v=8bPj9KDyUBw
- http://www.youtube.com/watch?v=eLchn1oRNec
- http://www.youtube.com/watch?v=GiyVDpY8Wl0

Thanks for attending!