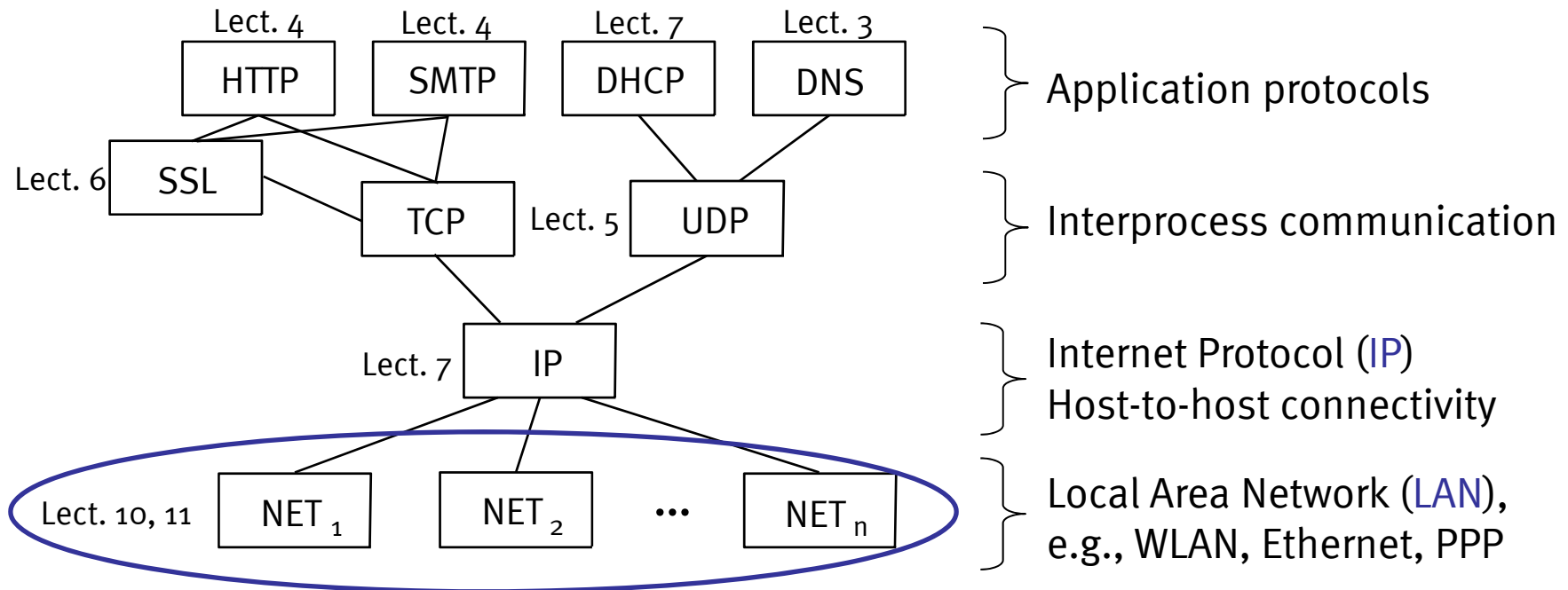




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# Computer Networks, Winter Term 2009/2010

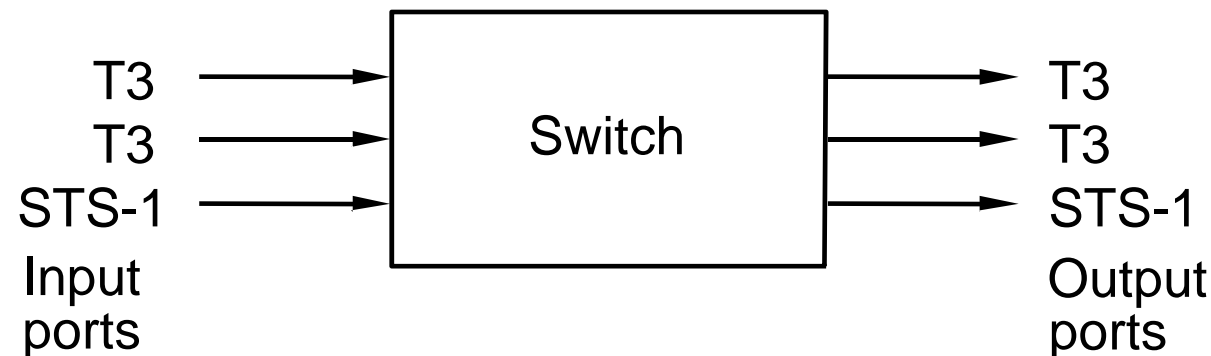
## Switched Networks



- Limitations of directly connected networks
  - Number of attachable hosts restricted
  - Geographic service area cannot grow indefinitely
- New goal
  - Enable communication between hosts that are **not** directly connected
  - Build **extended LANs**
- Solution
  - Use of packet **switches/bridges** (data link layer)
    - Inputs are connected to outputs of finite bandwidth
    - Incoming packets are **forwarded selectively**
    - Problems include contention, congestion
  - (**Hubs** always forward to all outputs; physical layer)

- Switch

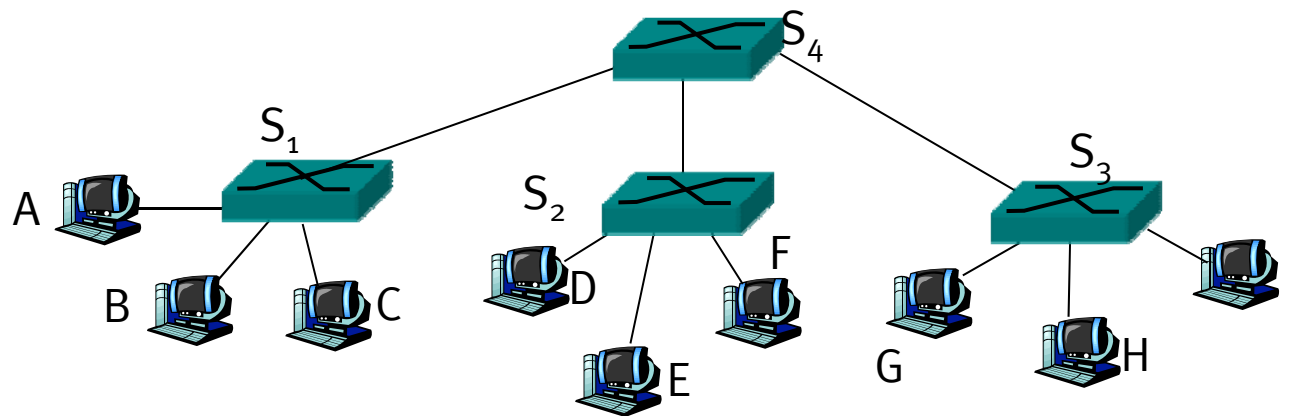
- Store and forward from input port to output port
- Port selected based on address in packet header



- Advantages (recall limitations of direct link networks)

- Cover larger geographic area
- Support larger numbers of hosts (scalable bandwidth)
  - Point-to-point links, full-duplex

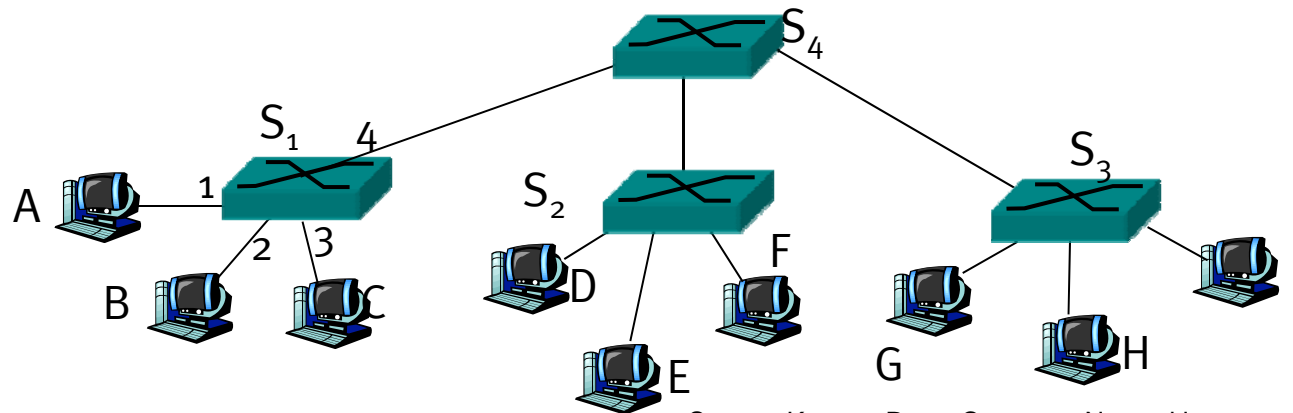
# Switches: Star Topology, Extended LAN



Source: Kurose, Ross: Computer Networking:  
A Top Down Approach (4<sup>th</sup> ed.). Addison-Wesley, 2007.

- Switch inspects header of incoming packet to identify its destination
- Common approaches
  - Datagram or **connectionless** approach
  - Virtual-circuit or **connection-oriented** approach

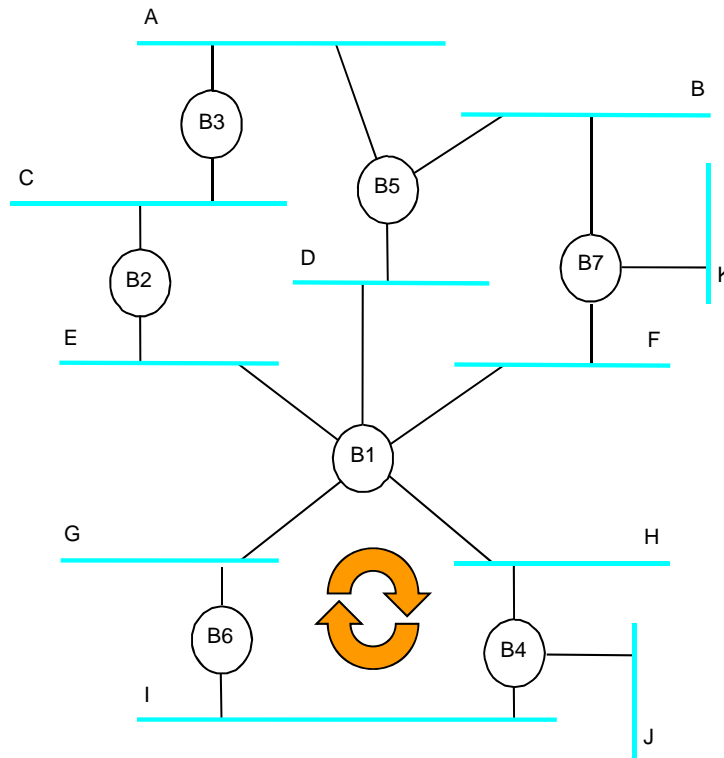
- Do not forward when unnecessary
- Maintain **forwarding table**



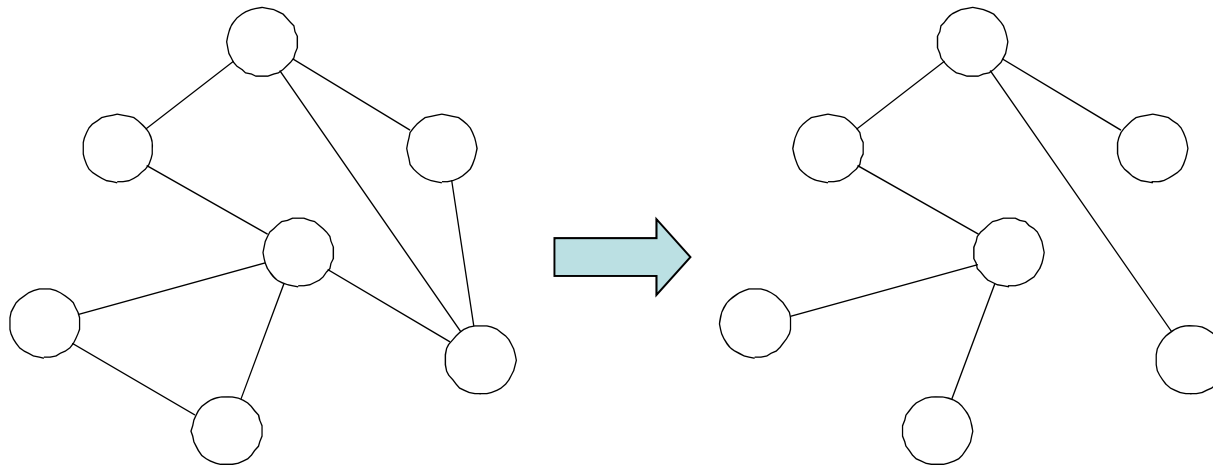
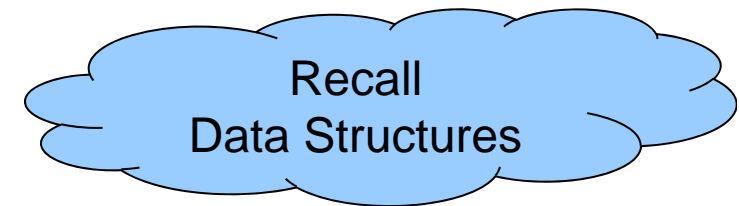
Source: Kurose, Ross: Computer Networking: A Top Down Approach (4<sup>th</sup> ed.). Addison-Wesley, 2007.

Host	Port	TTL
A	1	60
B	2	58
C	3	60
D	4	32
E	4	10
F	4	30
...	4	...

- **Learn** table entries based on source address
- Table is an optimization; need not be complete
- Always forward broadcast frames



- Switches run distributed **spanning tree algorithm**
  - Switches agree on spanning tree for extended LAN
  - Select which switches actively forward
  - IEEE 802.1 specification



- Assumptions of LAN applications may not hold in extended LANs
  - Latency
    - Upper bound known for direct link
    - No upper bound for switched network
  - Congestion
    - Does not exist for direct link
    - Switches have queues that may overflow
  - Reordering of frames
    - Does not exist for direct link
    - Alternative routes may lead to reordering in switched network

- Switch major component in local networks
  - OSI layer 2
  - Store-and-forward
  - Star topology
  - Full-duplex, point-to-point

## Recall: Key Question (Answer throughout the term)

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- What happens “on the wire” when you enter a URI in your browser until you see the page?
  - https://?
  - Addressing, naming?
  - Connection establishment?
  - Routing?
  - Involved heterogeneous LANs and resources?