Overview of Networks

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Based on, and using images from

An Introduction to Computer Networks

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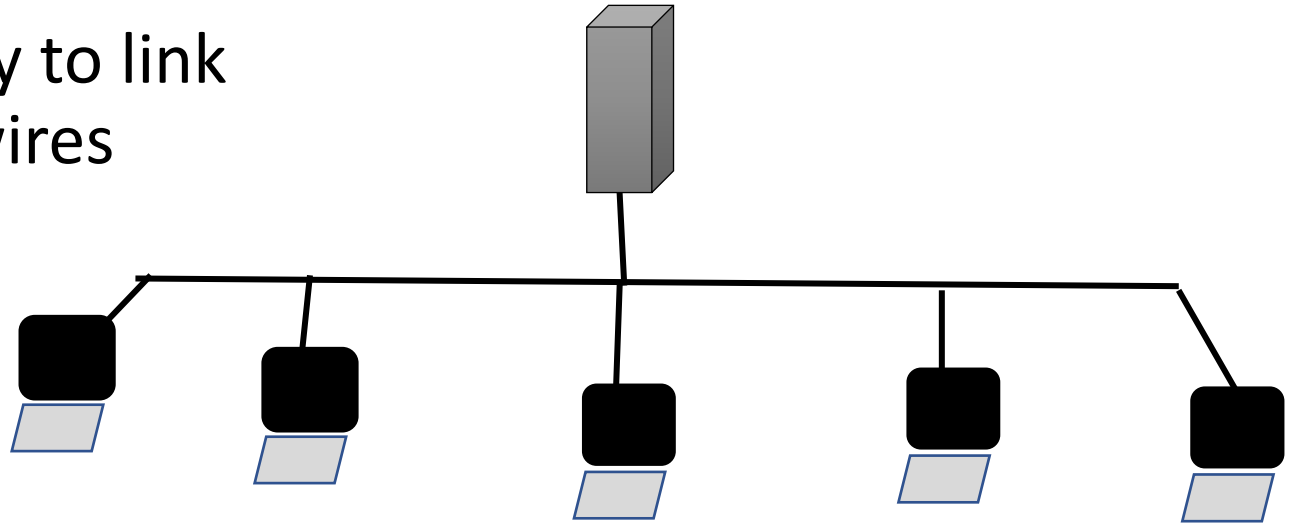
Key Concepts (Vocabulary)

- Layer Model
- Bandwidth
- Packets
- Datagram Forwarding
- Network Topology (Graphs)
- Routing
- Congestion

Client Server

- Client: requests data or service
- Server: provides data or service
- Ethernet: most common way to link computers on a LAN using wires



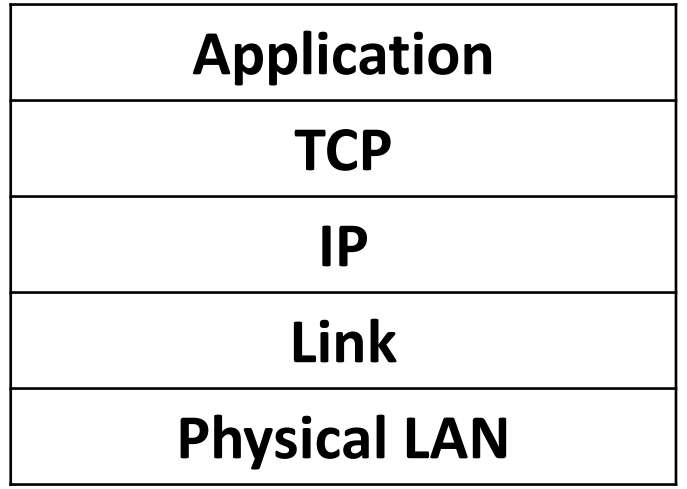
Local area network (LAN)

Layers

- Refers to the various pieces of software and hardware that help data cross the network.
- Refers to information in each **data packet** necessary for it to cross the network, such as the sender's and receiver's addresses.
- Refers to **protocols**: rules for communication that enable orderly transport of data.

5-Layer Model

- **Application**: For example, HTTP, Hypertext Transport Protocol, for web pages, includes encryption/decryption
- **TCP**: Transport Control Protocol ensures all the data packets arrive at Port Number, in correct order, manages session (connect & disconnect)
- **IP**: Internet Protocol ensures that the packets are routed to the correct IP address on a WAN (wide area network) such as the World Wide Web. (IP Address)
- **Logical LAN or Link**: software that routes packets within a local area network (LAN) based on client network card addresses (MAC address)
- **Physical LAN**: wires, routers, access points, network interface cards, wireless channels



Bandwidth

- Rate at which data is transmitted across a network
- Units:
  - Mbps: megabits (10^6) per second
  - Gbps: gigabits (10^9) per second

  For example, a LAN might use 100 Mbps Ethernet.
  A cluster (computers networked together for parallel computation) might have gigabit or 10 gigabit Ethernet.

Packets or Datagrams

- “Modest-sized buffer” of data that will get transmitted over network links
- In addition to the content, the packets contain **headers;** space reserved for address and protocol information.

- Since we are using a layered model, each layer has its own header.
- Sizes of packets and headers is in units of octets (8 bits), i.e. bytes.

Packet name and size by layer

Application
TCP
IP
Link
Physical LAN

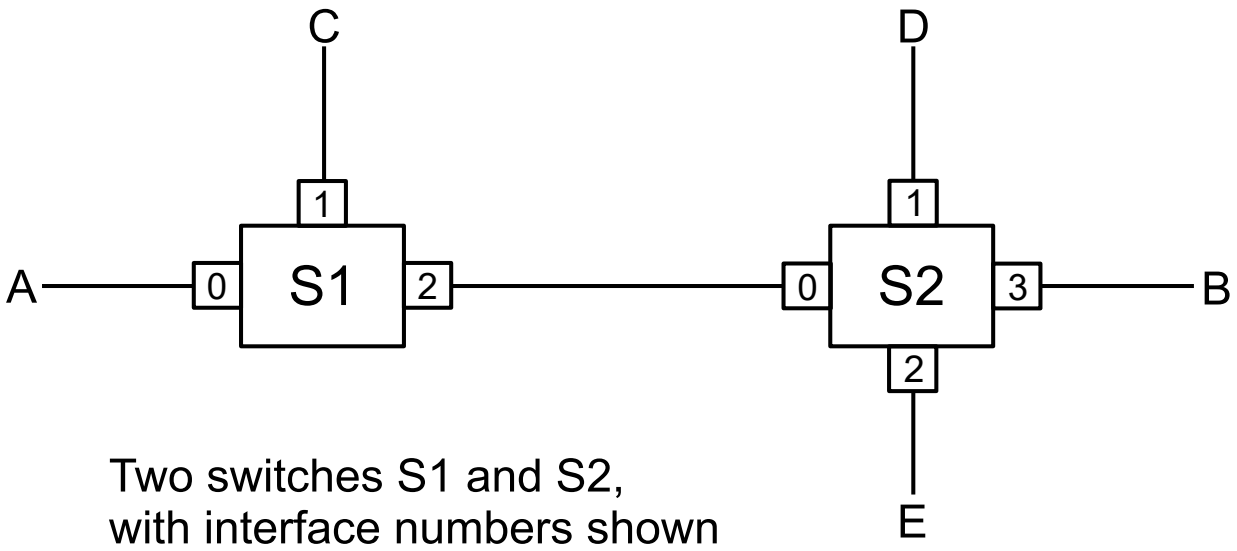
- Link layer: **frame**
  - Maximum size for Ethernet frame: 1518 bytes
- Transport layer (TCP): **segment**

- Typical header sizes
  - Ethernet: 14 bytes
  - IP: 20 bytes
  - TCP: 20 bytes
  - Application: depends on the application!

Much of this course will be studying what is in each header,
and how each protocol uses the header information to handle network traffic.

How Packets Get Where They Need to Go

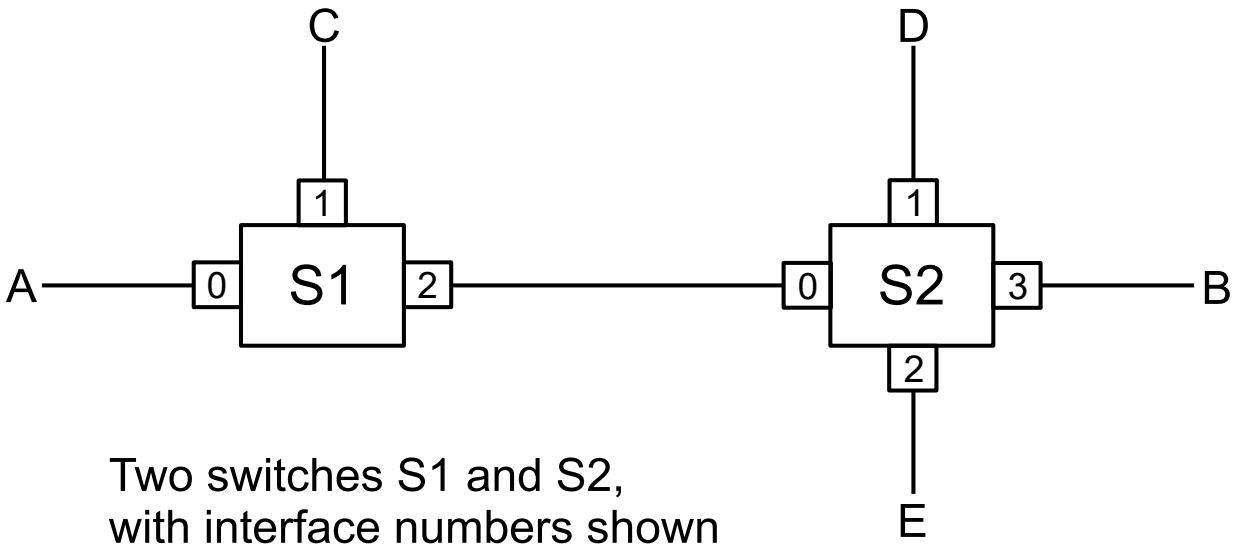
- Attached to the network are routers and/or switches and/or gateways with incoming links and outgoing links (a link is a wire)
- The router will have a routing table to decide which outgoing link the packet should take to get closer to their destination



Two switches S1 and S2,
with interface numbers shown

Routing Tables for S1 and S2

S1	
destination	Next hop
A	0
C	1
B	2
D	2
E	2



Two switches S1 and S2,
with interface numbers shown

S2	
destination	Next hop
A,C	0
D	1
E	2
B	3

How would a packet go from A to E?

Stateless

"To improve robustness of the communication system, gateways are designed to be ***stateless***, forwarding each IP datagram independently of other datagrams. As a result, redundant paths can be exploited to provide ***robust*** service in spite of failures of intervening gateways and networks." RFC 1122

State means data that you save, in a variable or file. The ***stateless*** idea is that the routers don't have to remember anything about packets going by.

Robust means it doesn't fail or crash.

Congestion

- Wired or Wireless, it is a shared medium with many clients and servers
- Congestion: hardware, such as a router can get overwhelmed by too much data
- Algorithms needed to throttle down at times, maintain fairness for everyone, etc.