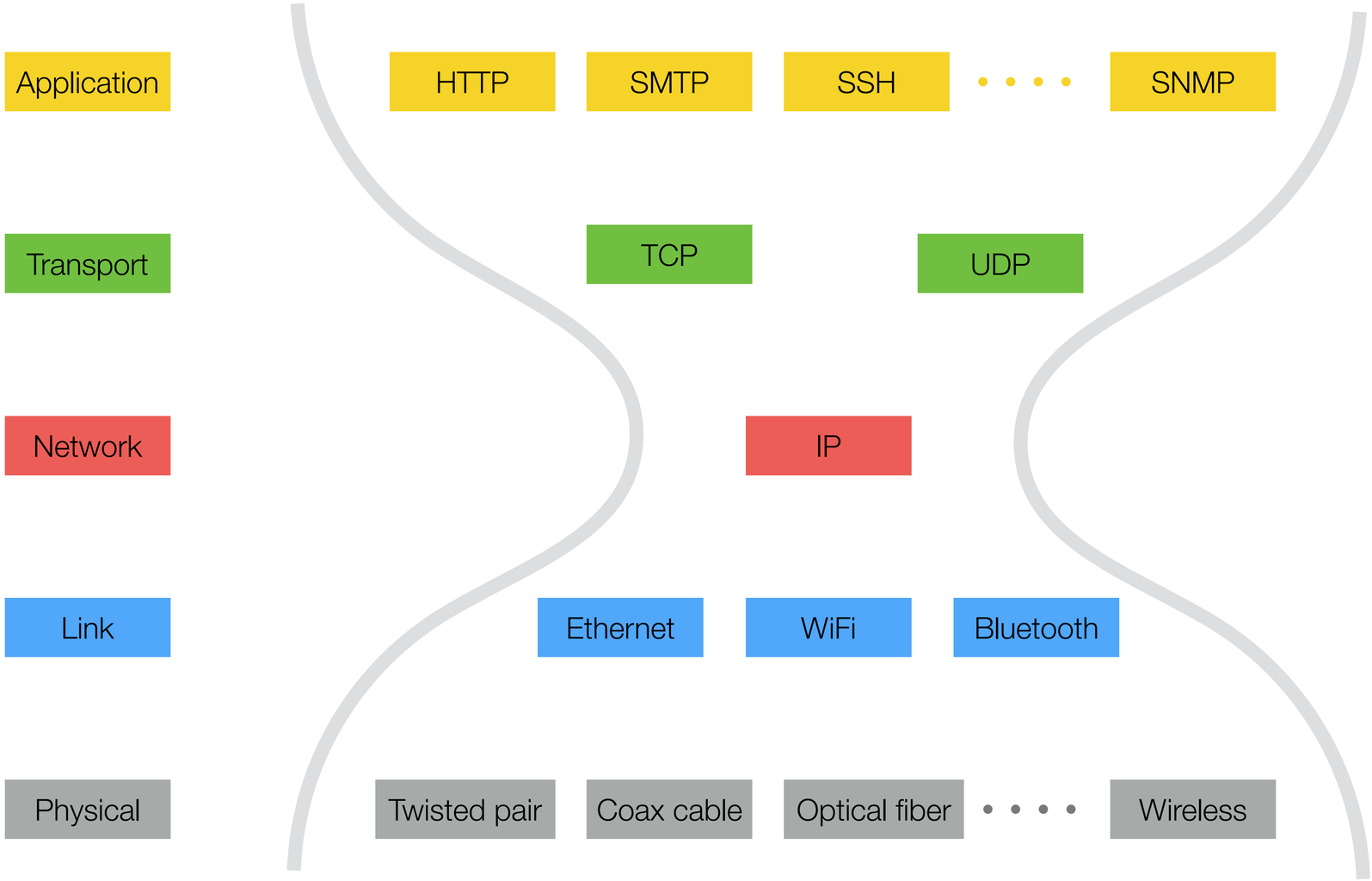
CS 725/825 & IT 725

Lecture 3

Basic Concepts

September 3, 2025

Internet “Hourglass”



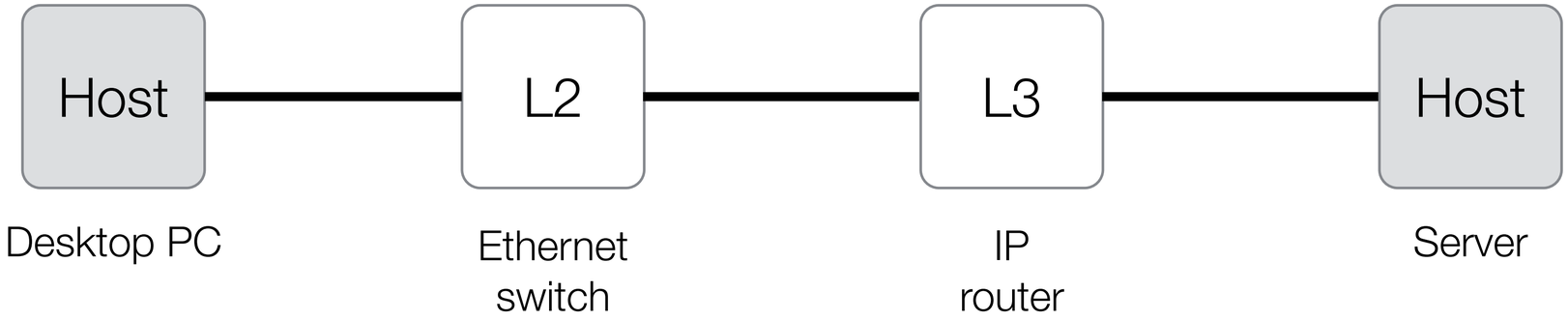
Protocols going forward

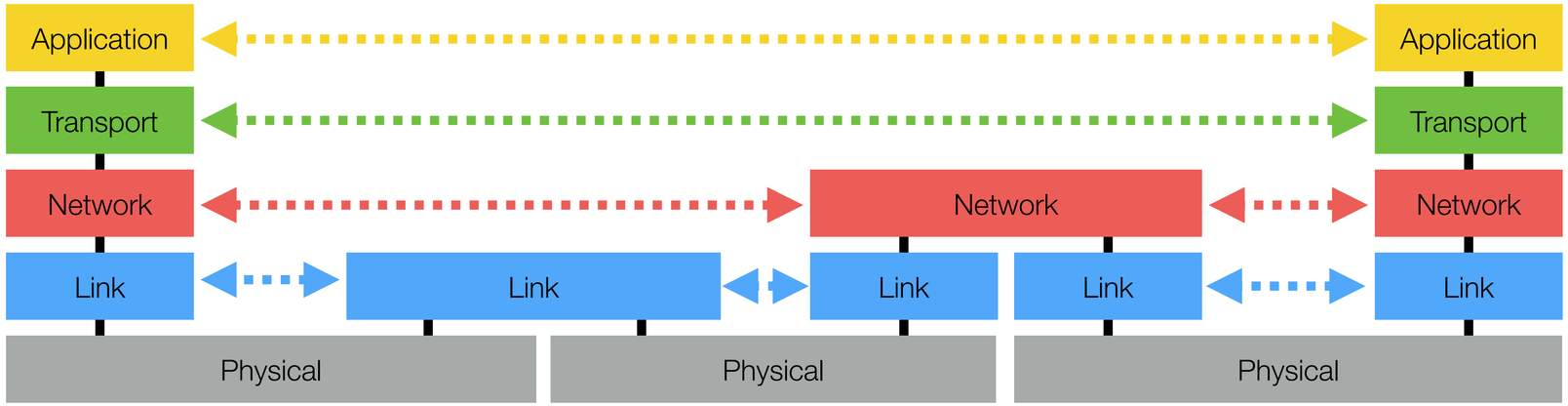
- QUIC and HTTP/3
  - Enhanced HTTP over TLS 1.3 over UDP over IP …
  - Developed by Google and becoming widely deployed
  - Design goal: reduction of transaction latency
  - Implemented in the user space (application)

Common Layer Functions

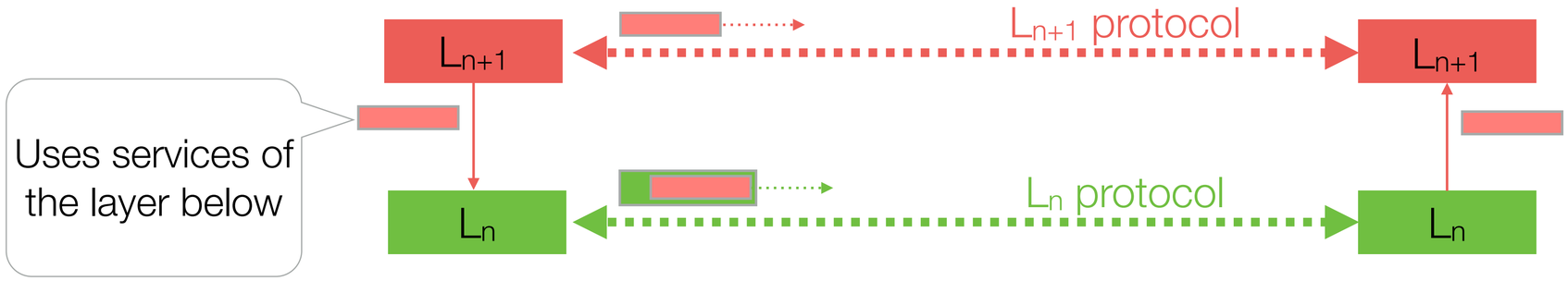
- Addressing
- Error control
  - error detection
  - error correction
- Flow control (traffic management, congestion control)
- Quality of Service (QoS)
- (new) Security

Layers - Example



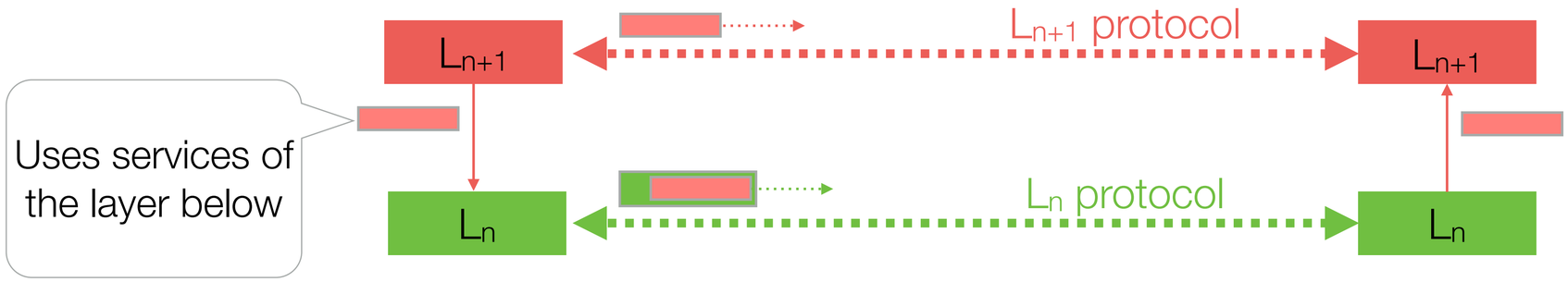


Service of a layer



Service	Connection-oriented	Connectionless
Unreliable		
Reliable		

Examples



Service	Connection-oriented	Connectionless
Unreliable	media stream	UDP
Reliable	TCP	reliable messaging

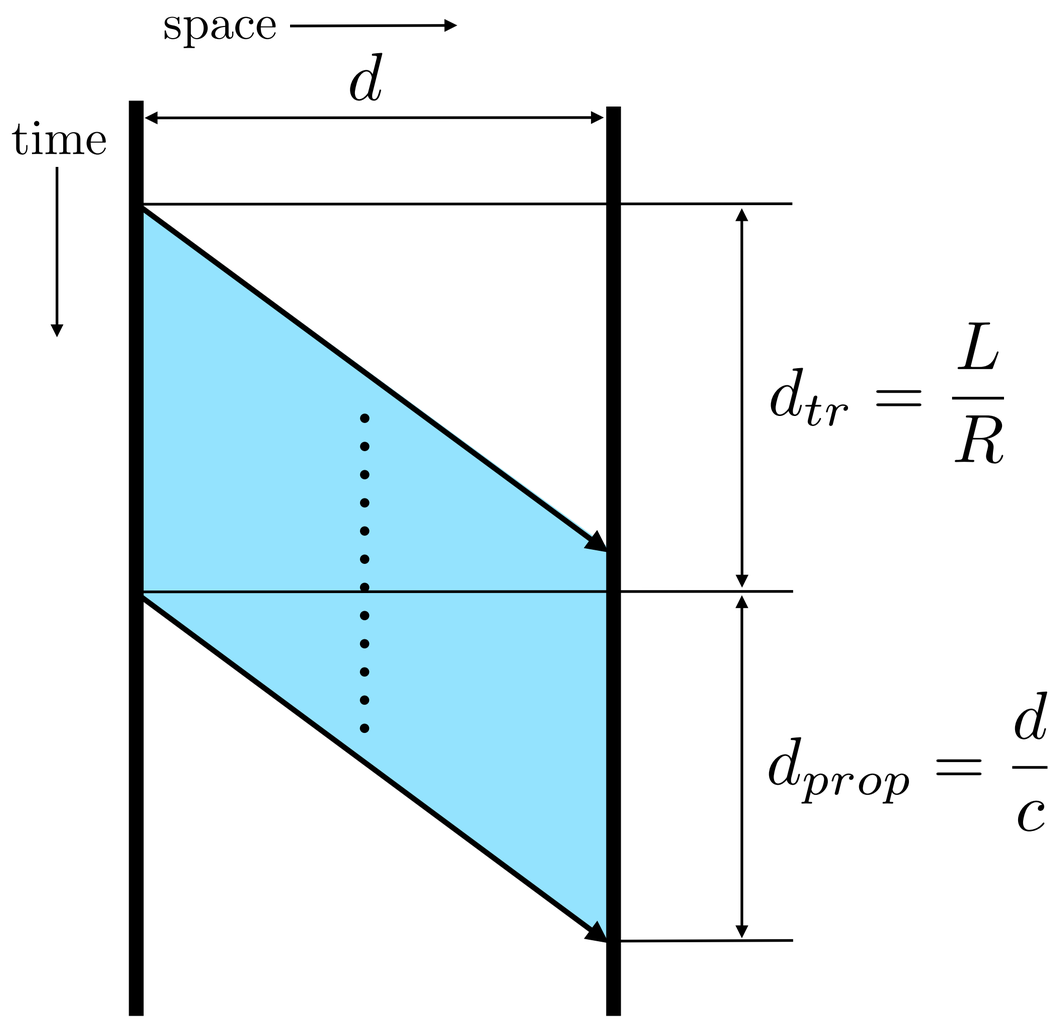
Terminology

- Router (old fashioned: gateway)
  - A network layer device (examines IP addresses)
- Switch, bridge
  - A link layer device (examines MAC addresses)
- Repeater, hub
  - A physical layer device, deals with signals not addresses
- Application layer switches, proxies, gateways
- Deep packet inspection (all of the above)

Performance Measures

- *Throughput* — number of bits/bytes/packets delivered per second
  - *Goodput* — measures “useful” packets/bytes/bits
- *Latency* — time to deliver a packet
  - typically measured from first bit transmission to the last bit reception
  - *RTT* (round-trip-time) — two-way latency
  - *Jitter* — latency variation
- *Packet Loss Rate*

Time-Space Diagram



d_{tr} - time to transmit

d_{prop} - propagation time

L - packet length

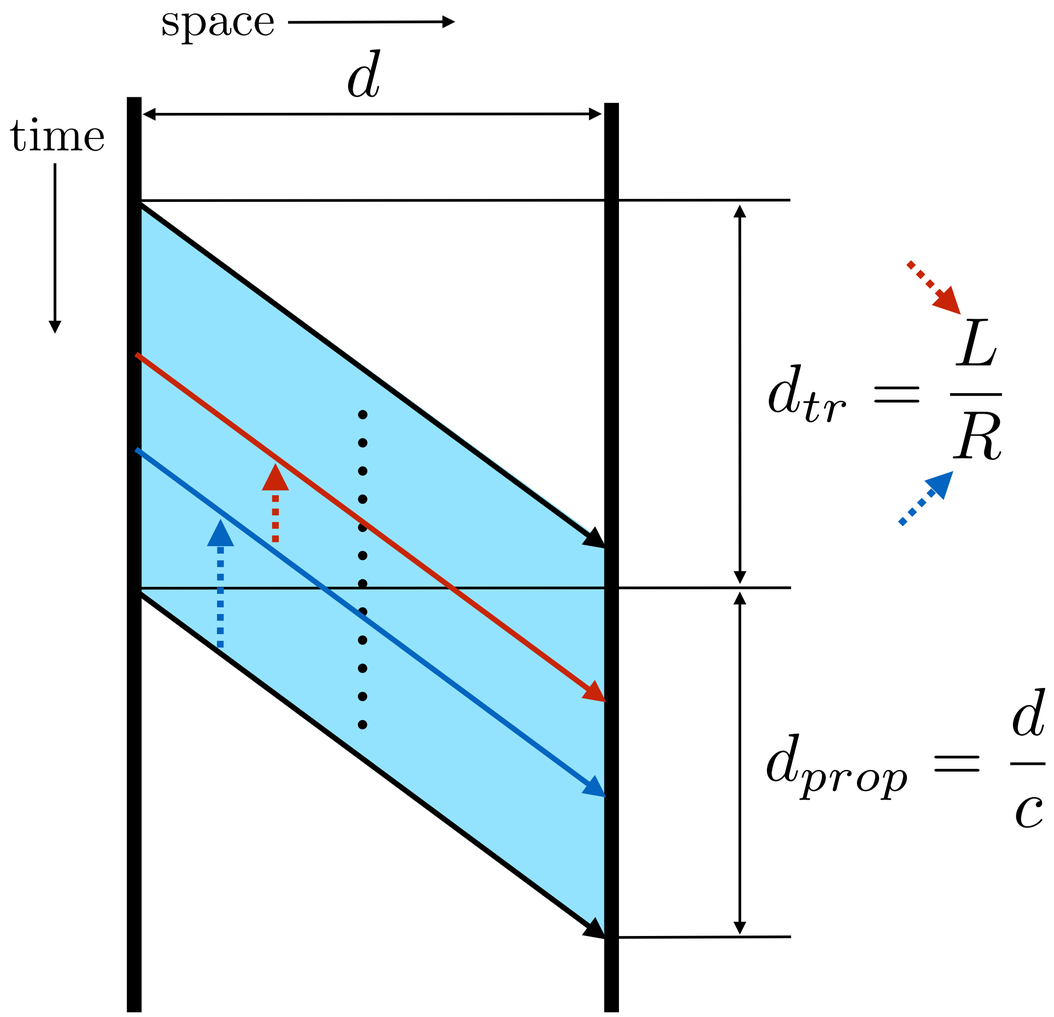
R - transmission rate

d - distance

c - propagation speed

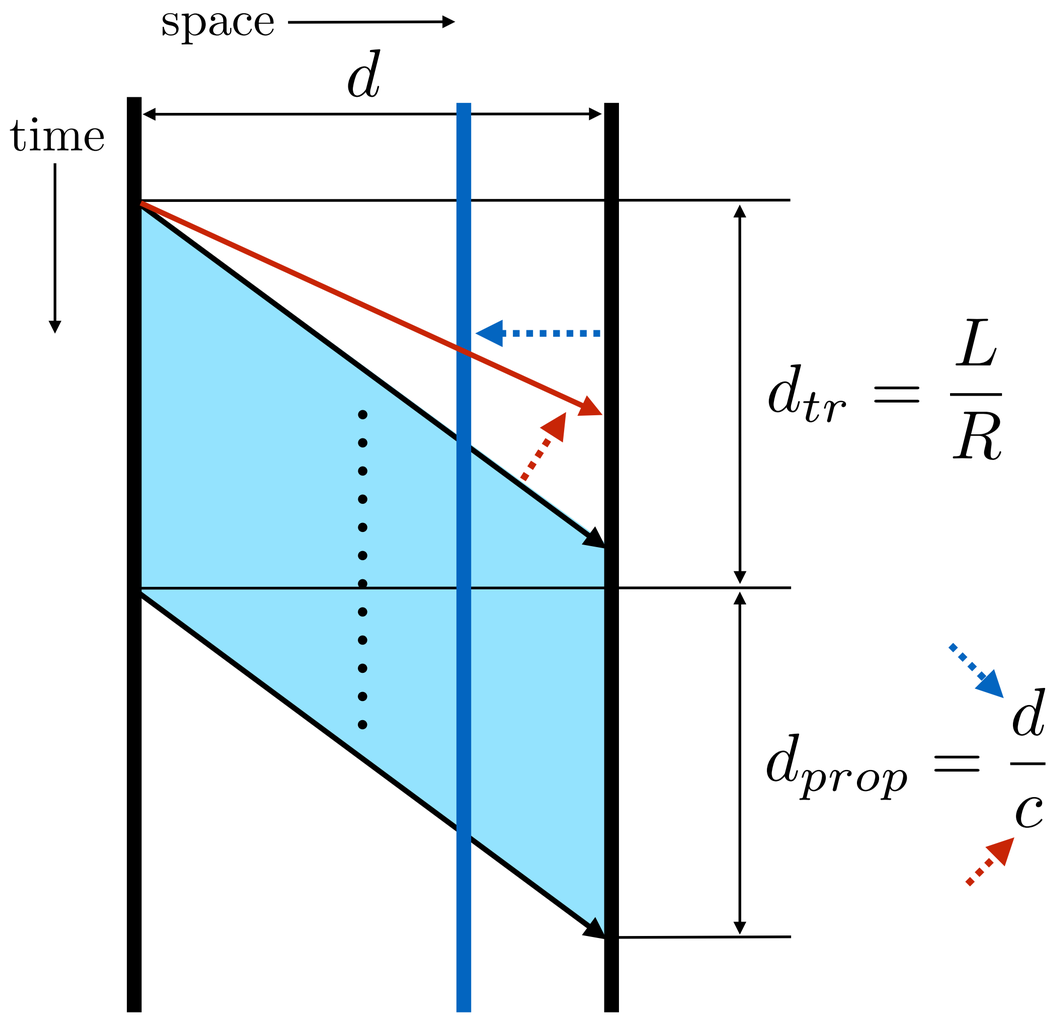
Components of latency

- Transmission delay
  - increase transmission rate (new generations of link/physical layer technologies)
  - decrease the number of bits transmitted (reduced protocol overhead, header compression, payload compression)



Components of latency

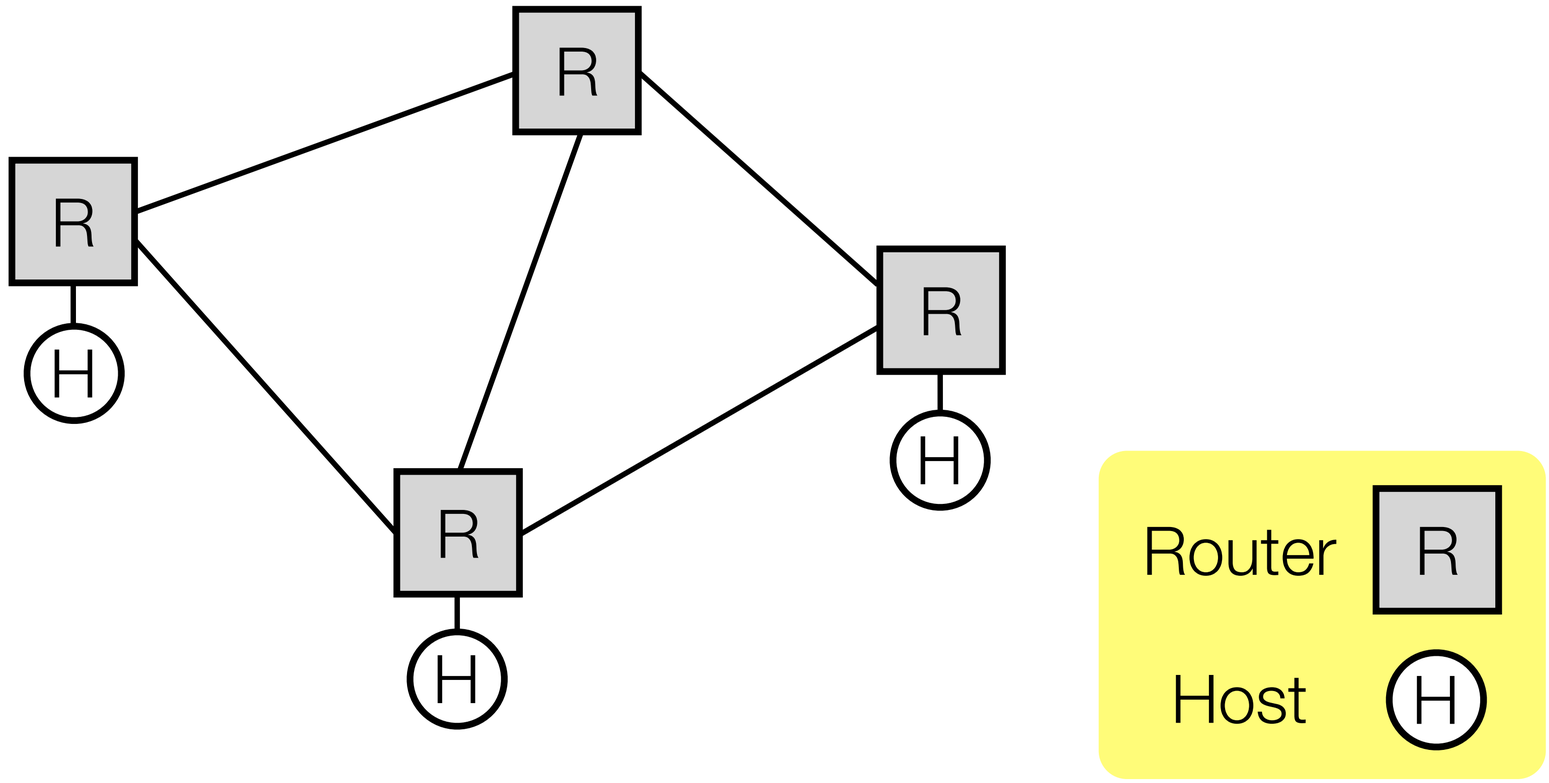
- Propagation delay
  - reduce the distance through more efficient routing
  - faster propagation speed (hollow fibers, wireless transmission)



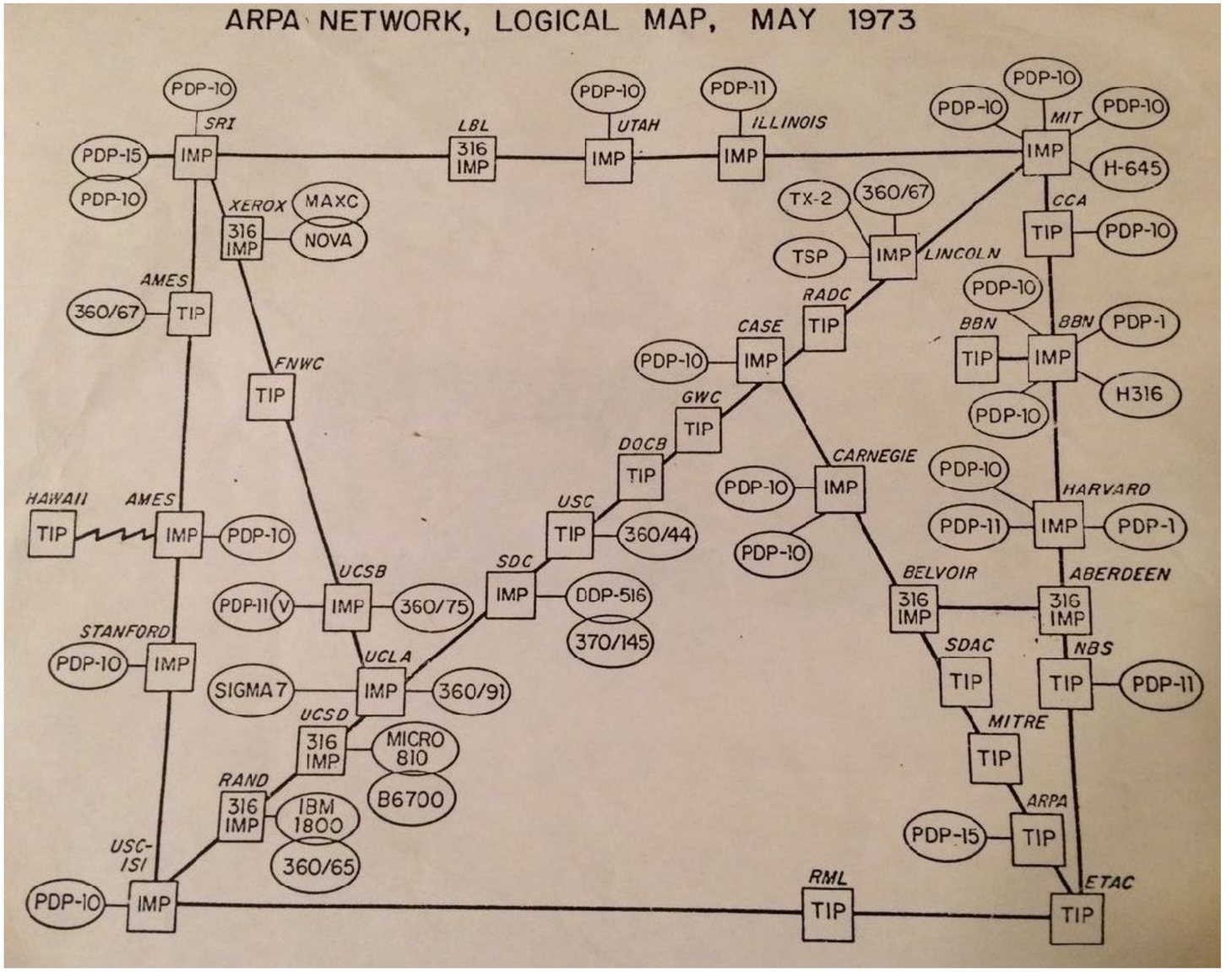
Networking Fundamentals

A bit of history...

- Packet switched networks (70's - 80's)
  - long-distance point to point (leased) lines



ARPANET around 1973



Anatomy of a router/switch