

CS 725/825 & IT 725

Lecture 3

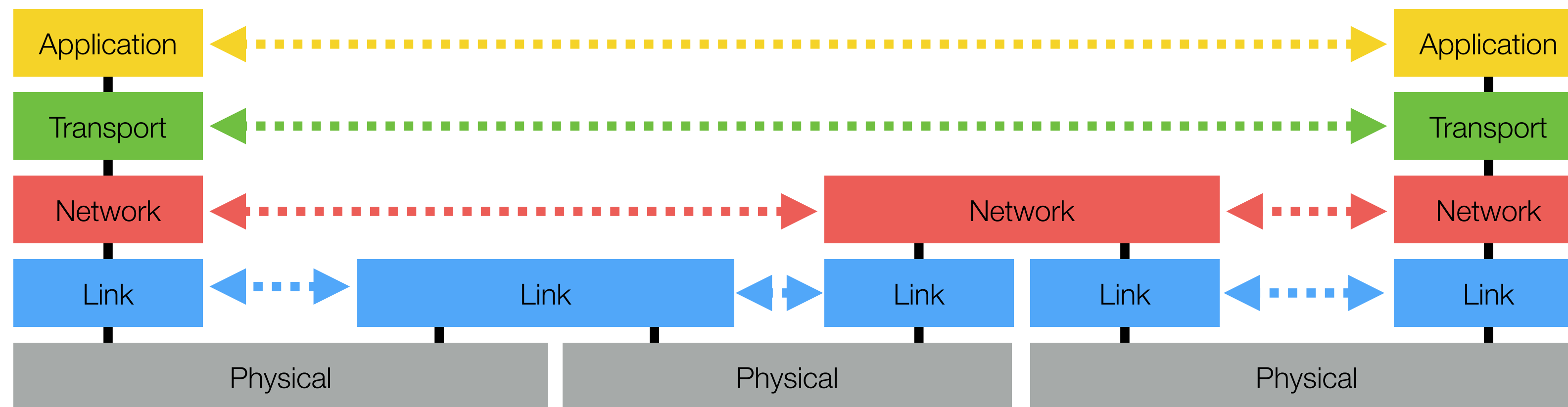
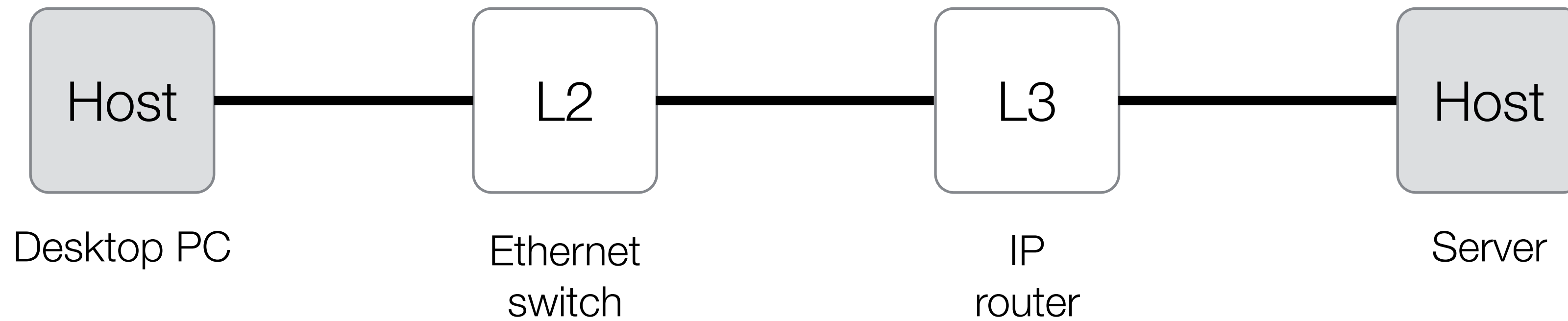
Basic Concepts

September 9, 2026

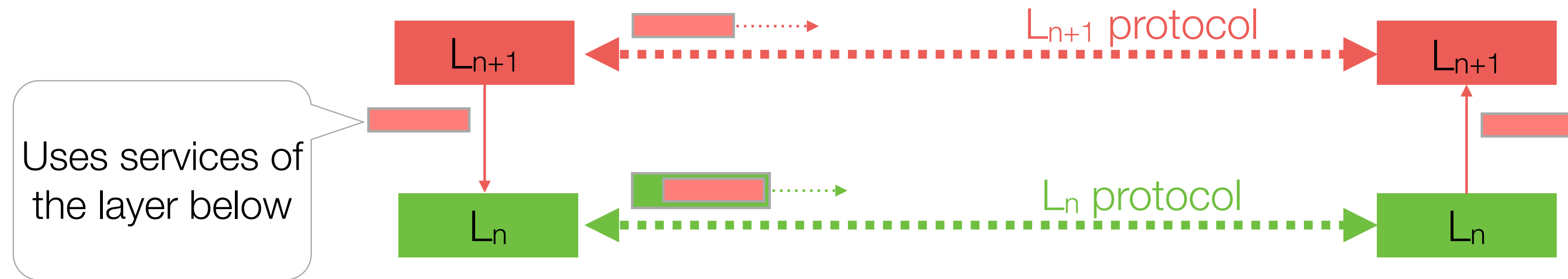
Common Layer Functions

- ▶ Addressing
- ▶ Error control
 - error detection
 - error correction
- ▶ Flow control
- ▶ Congestion control
- ▶ Quality of Service (QoS)
- ▶ (new) Security

Layers - Example

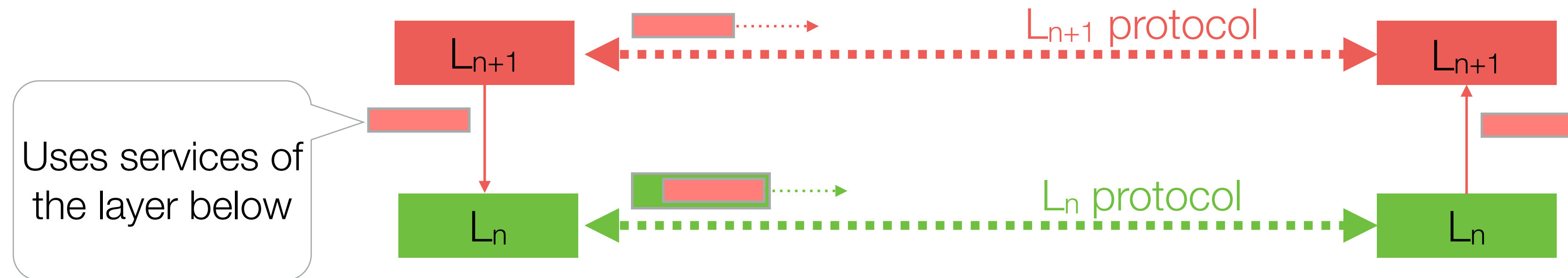


Service of a layer



Service	Connection-oriented	Connectionless
Unreliable		
Reliable		

Examples



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

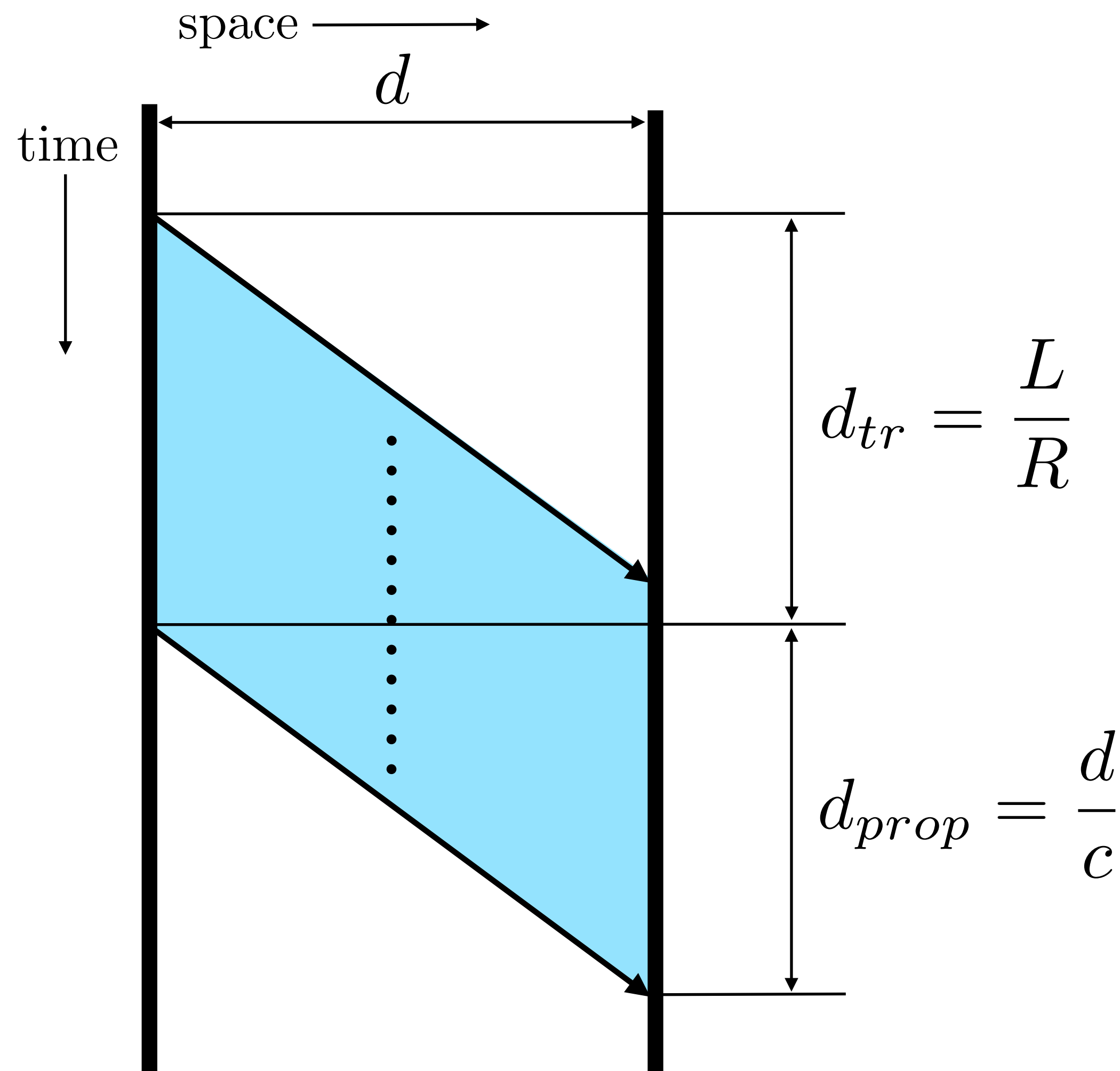
Terminology

- ▶ **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

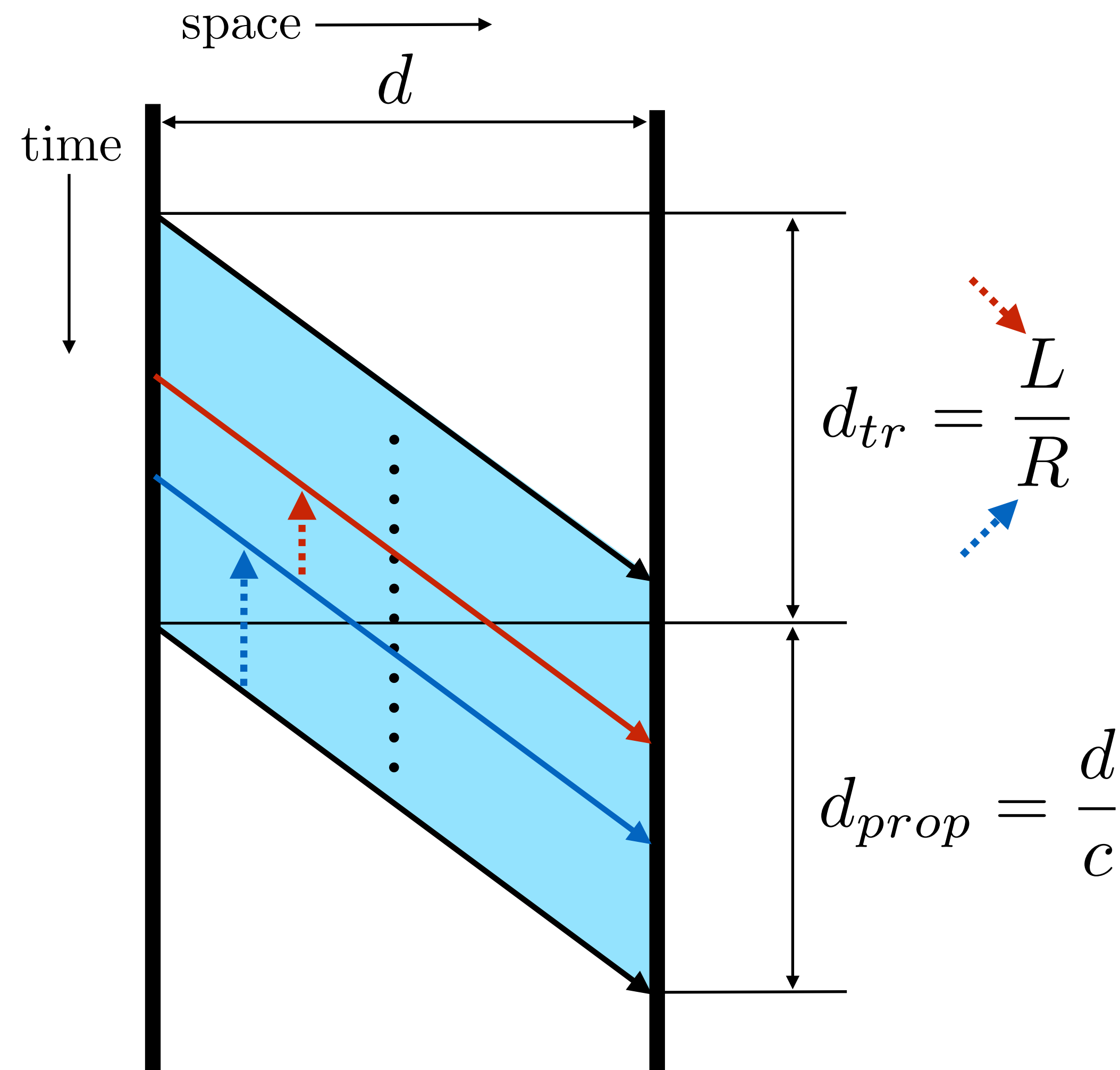
d - distance

c - propagation speed

Components of latency

► Transmission delay

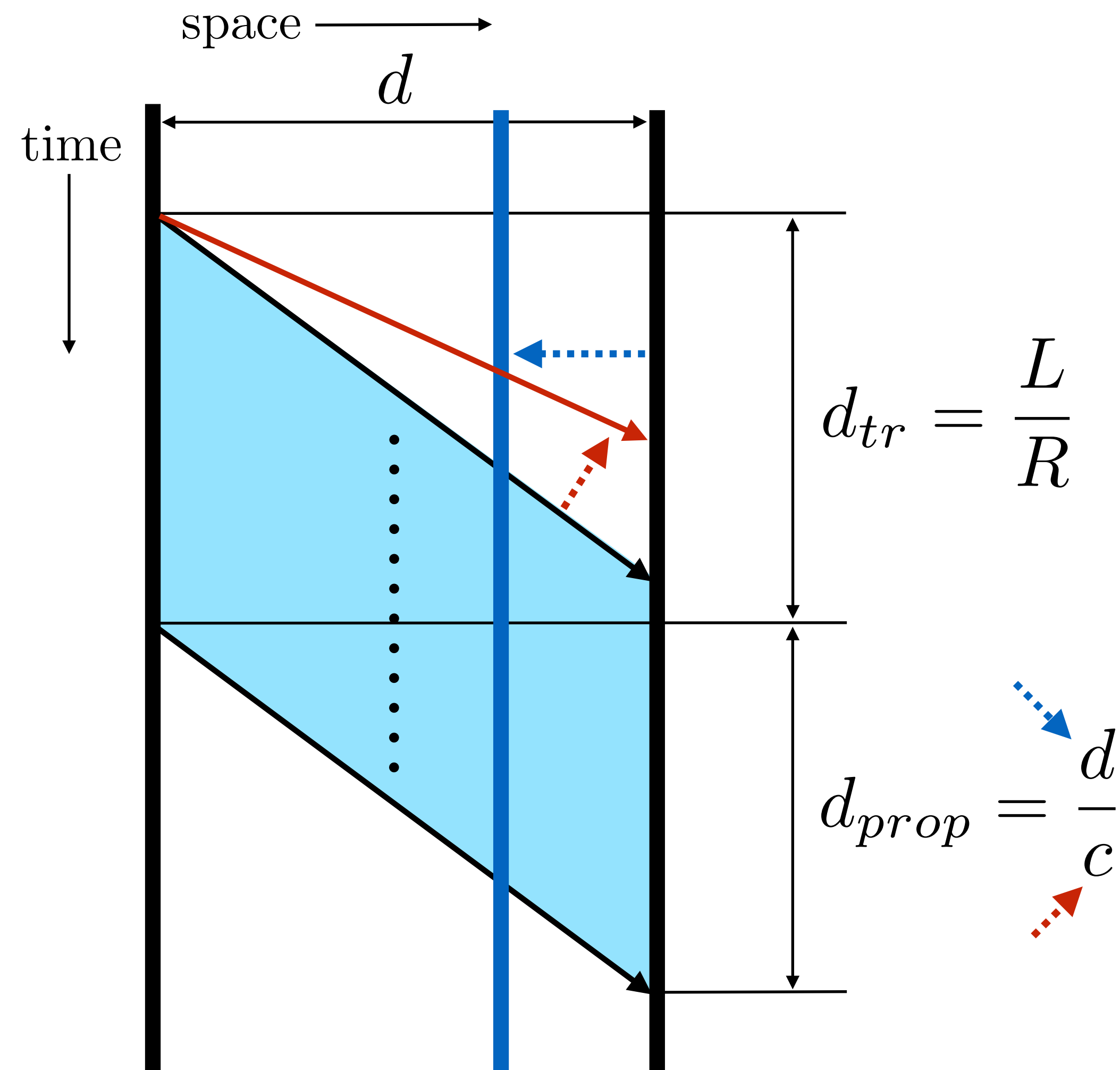
- increase transmission rate (new generations of link/physical layer technologies)
- decrease the number of bits transmitted (reduced protocol overhead, header compression, payload compression)



Components of latency

► Propagation delay

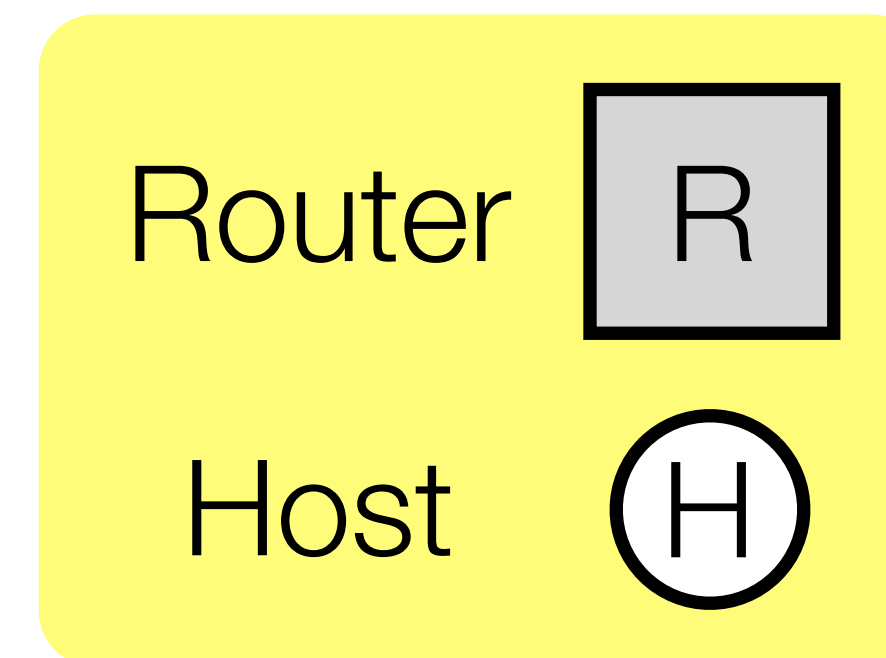
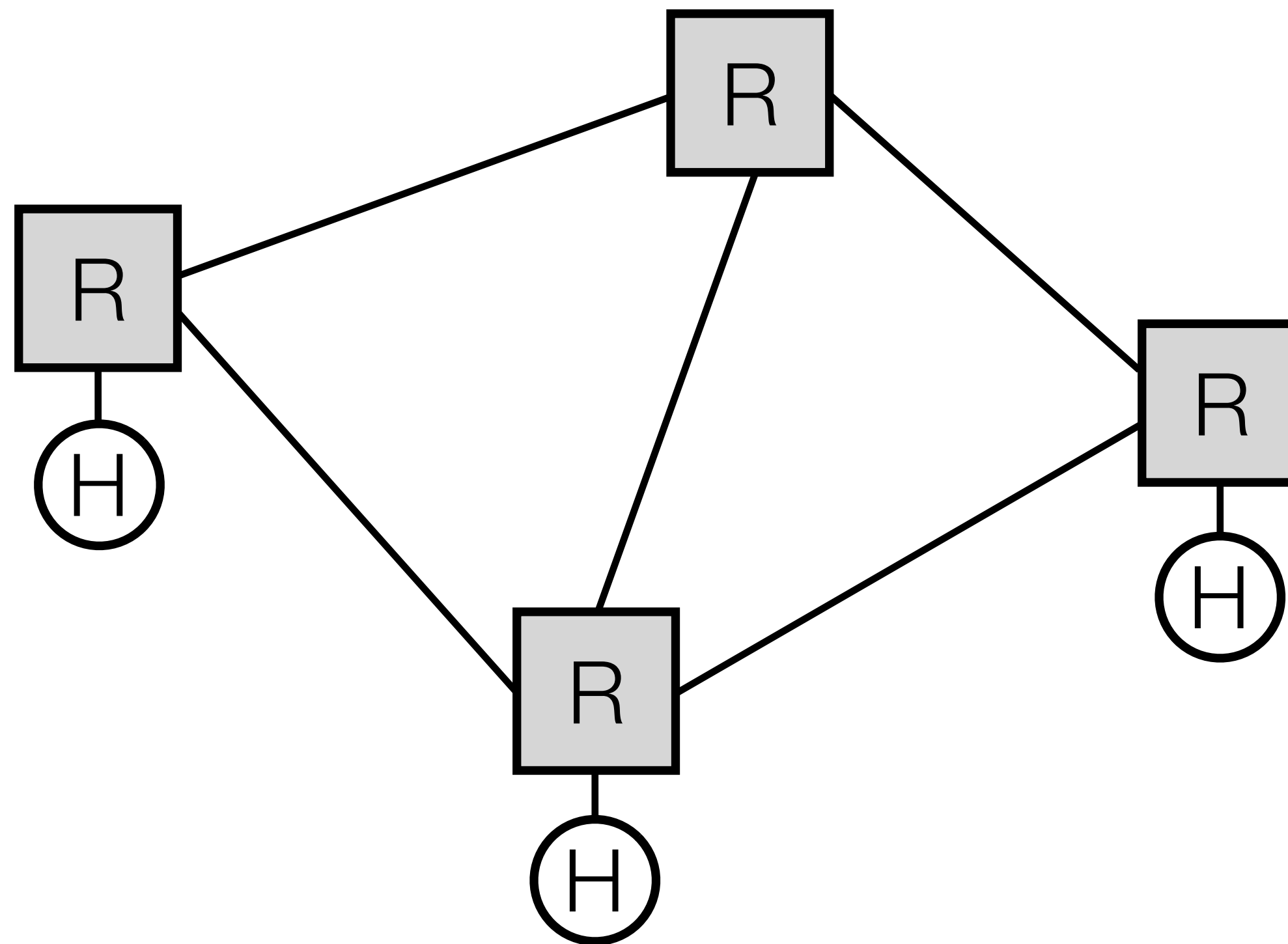
-► — reduce the distance through more efficient routing
-► — faster propagation speed (hollow fibers, wireless transmission)



Networking Fundamentals

A bit of history...

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



ARPANET around 1973

