

CS322 Introduction

Security

Inter-layer comm.
terms + def.

OSI

Protocols

Web Sockets

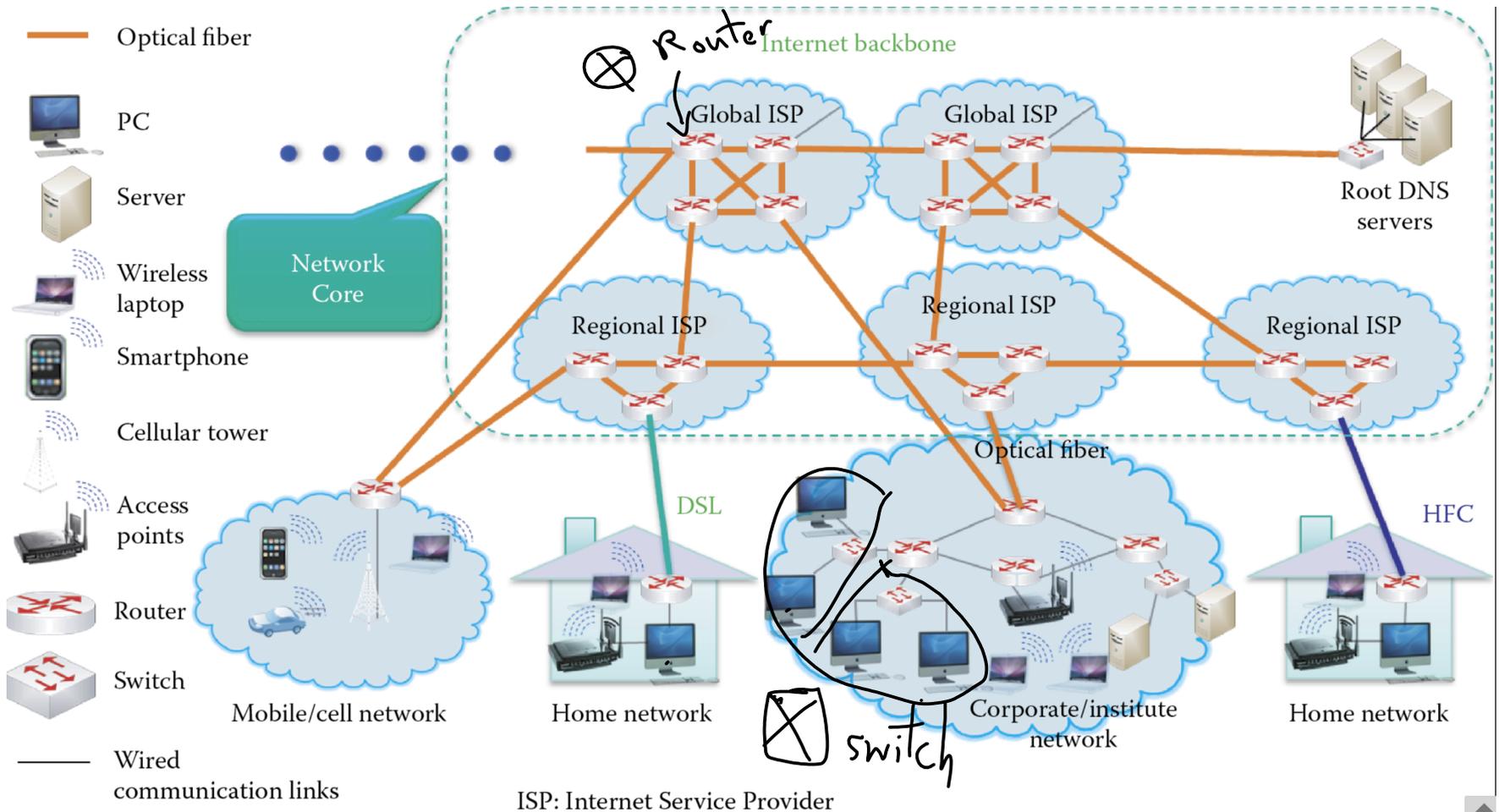
Streaming protocols
(live)

Error Correction

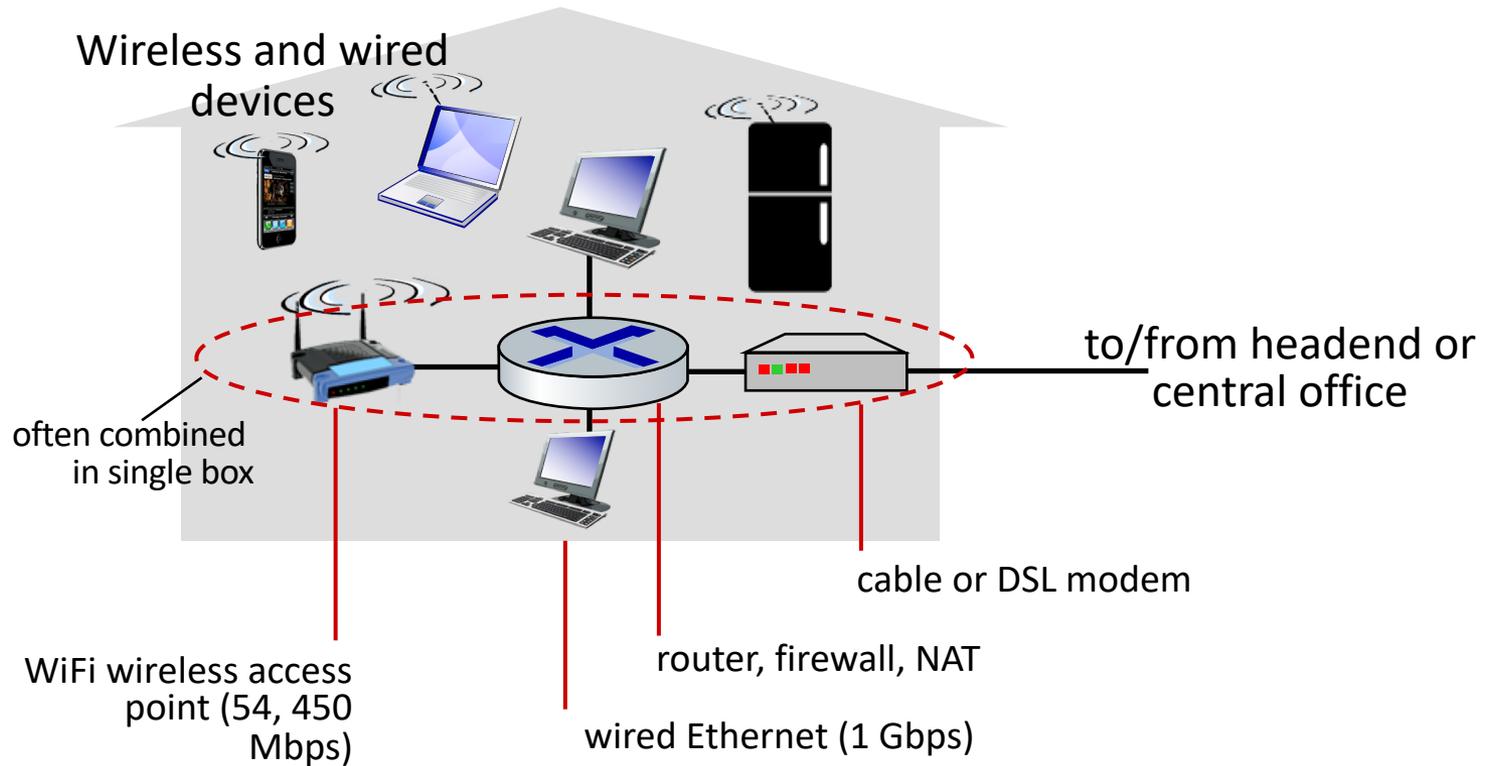
SSL/Cert.

Wireshark

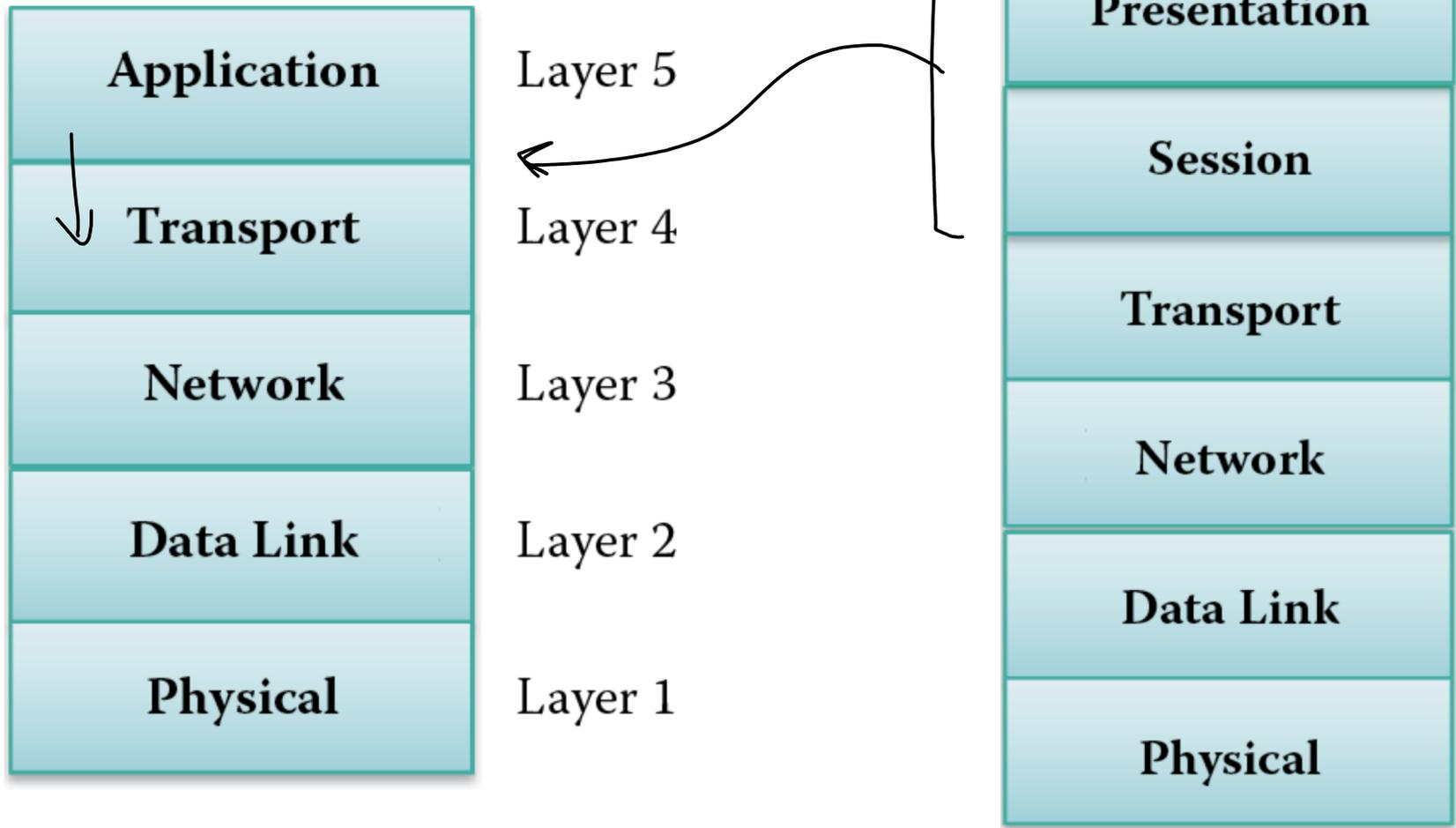
The Network



Access networks: home networks

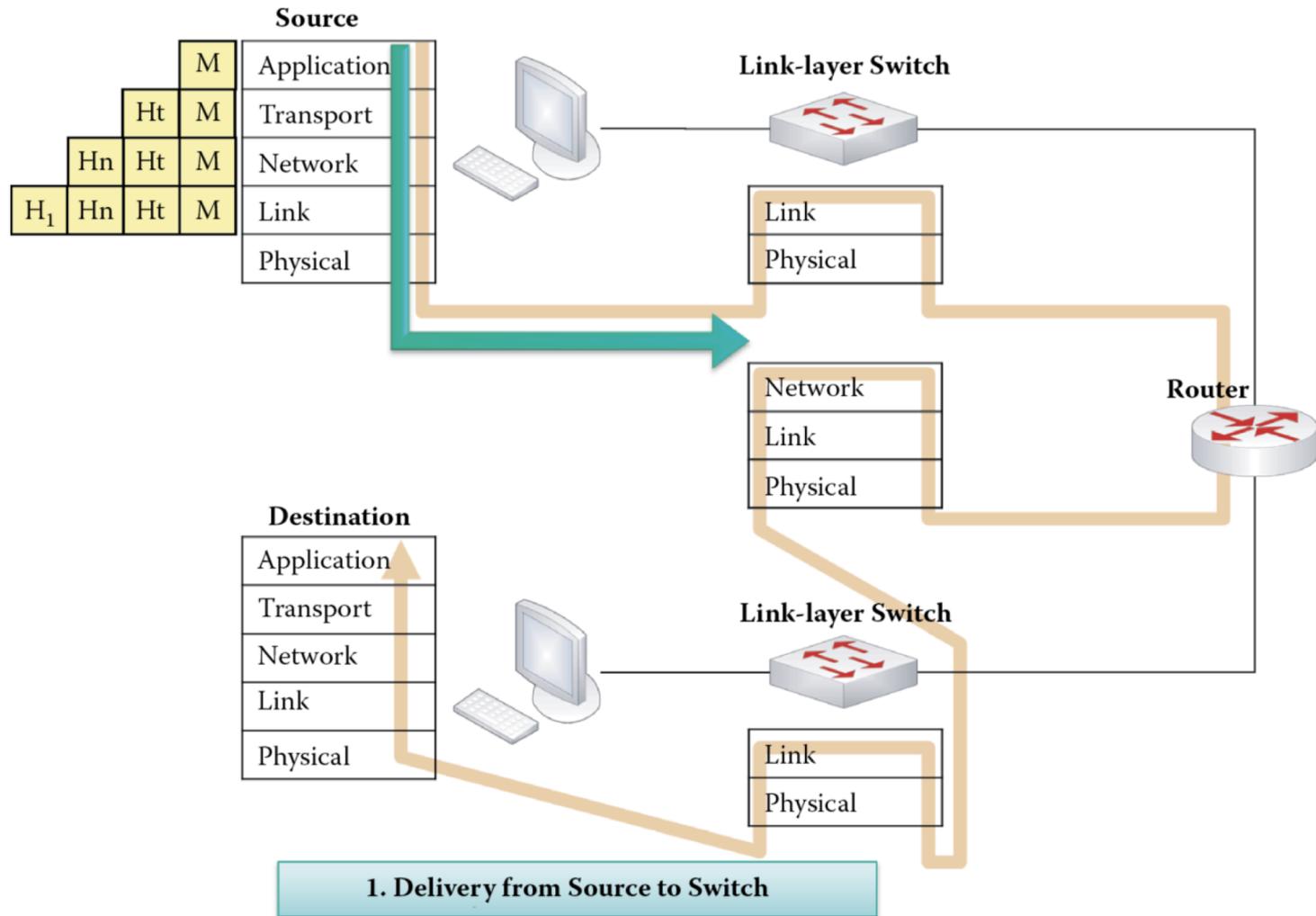


Internet Stacks

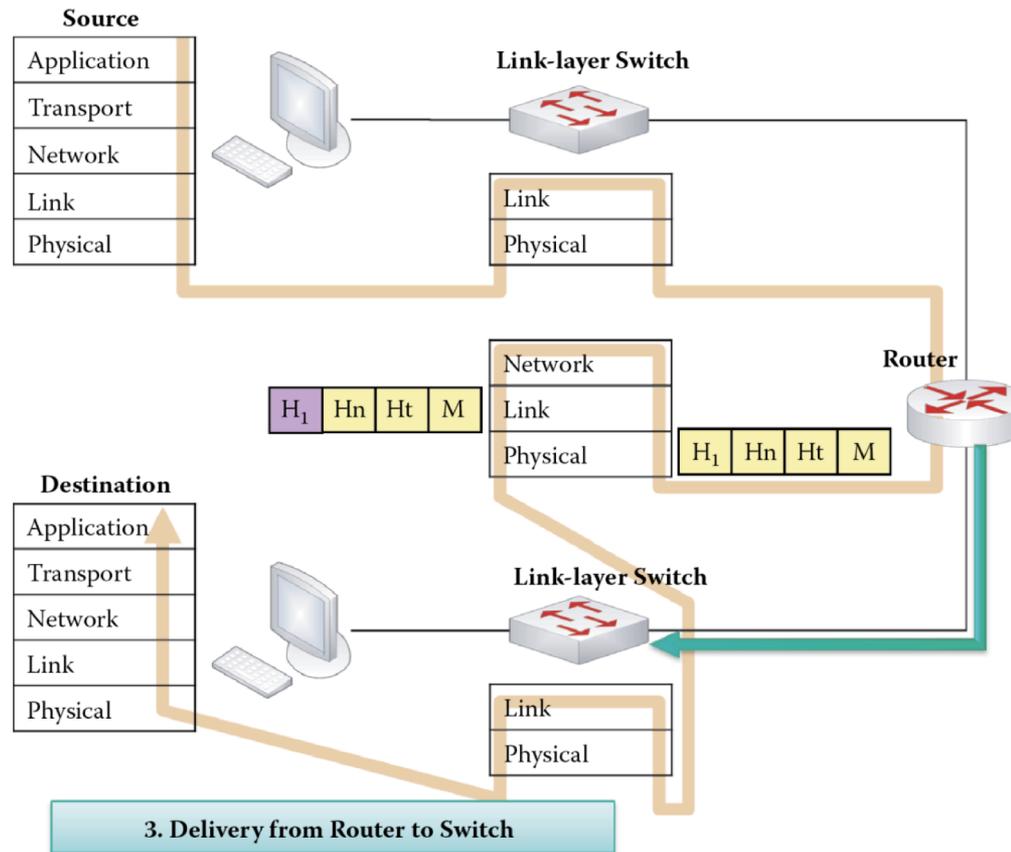


OSI

Layered Operation



Messages



Addresses



Layer 5

Layer 4

Layer 3

Layer 2

Layer 1

Port Numbers (16 bit)

IP Addresses (32, 128 bits)

MAC Addresses (48 bits)

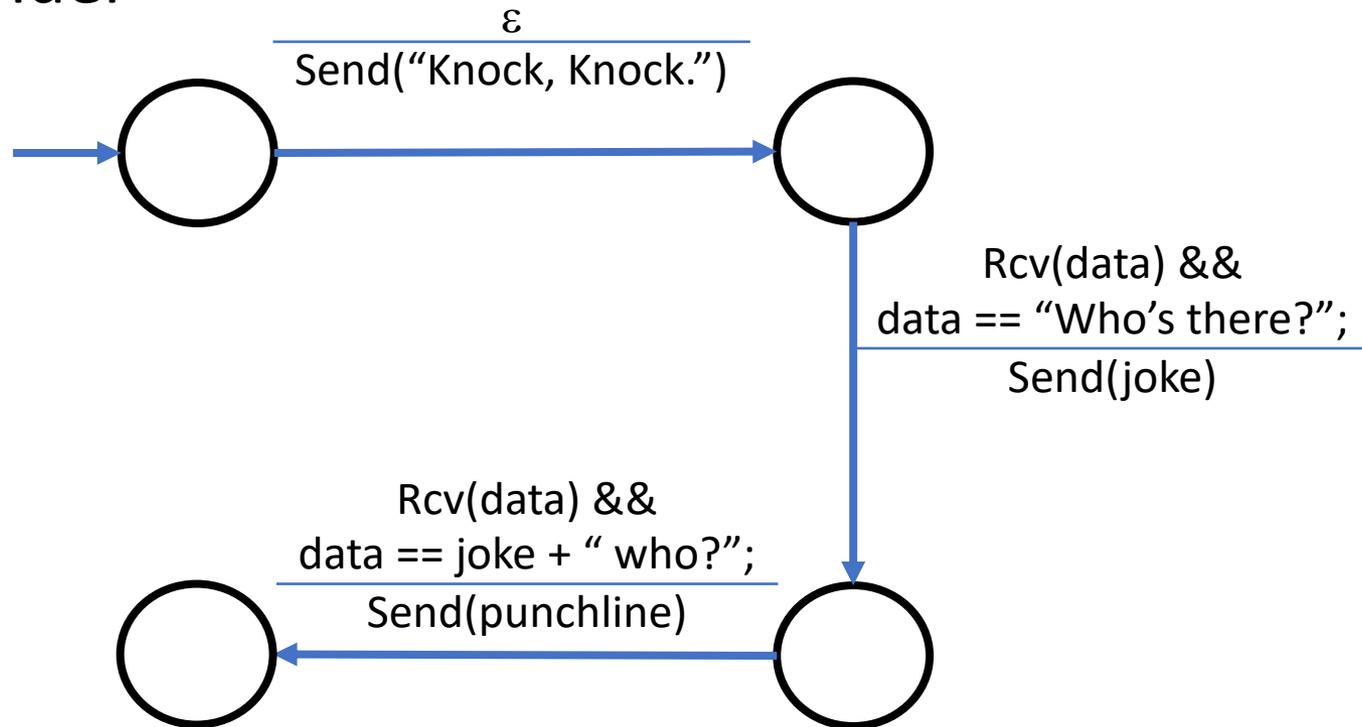
based on network

unique to device

Protocols

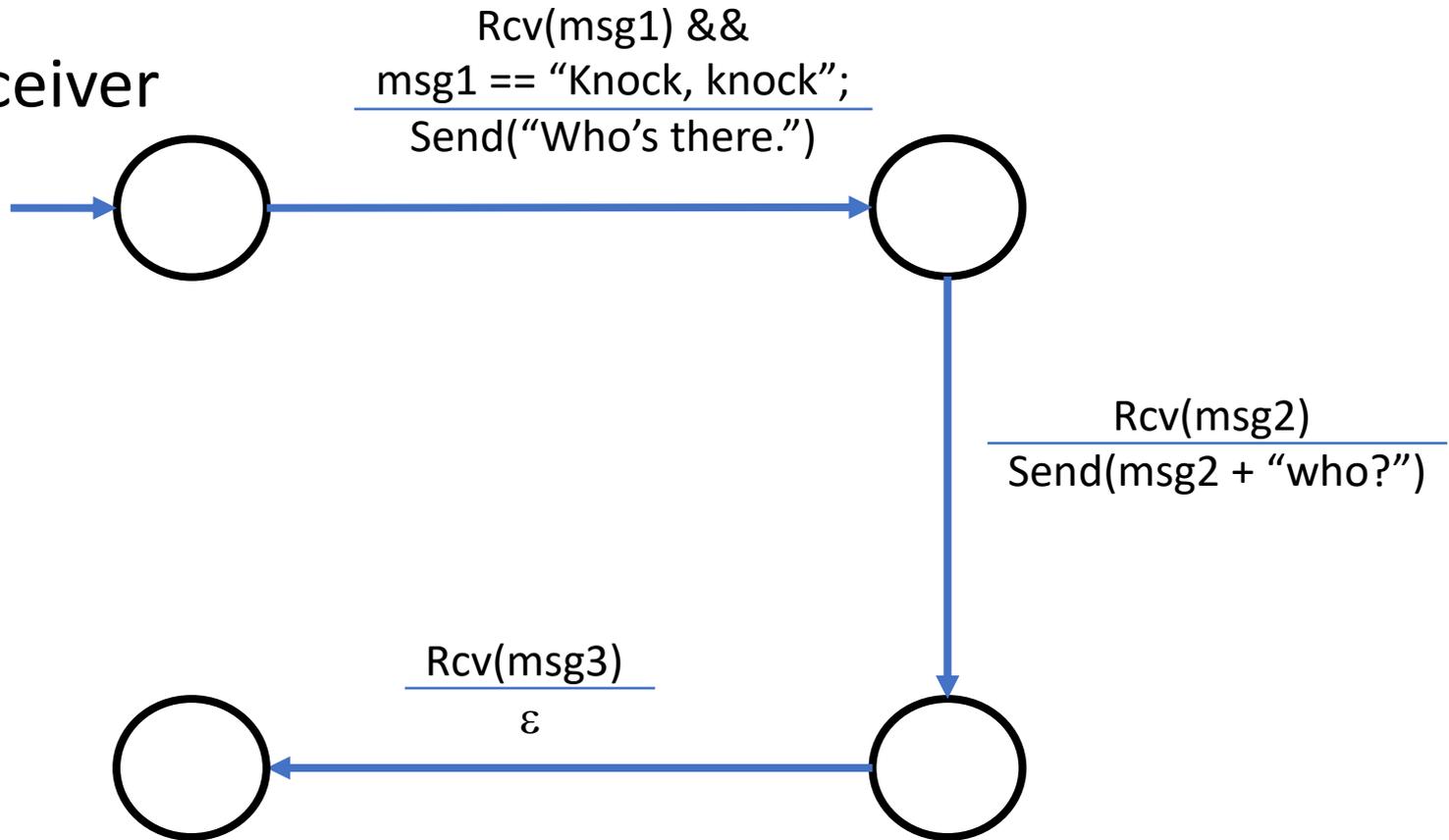
Event
Action

- Sender

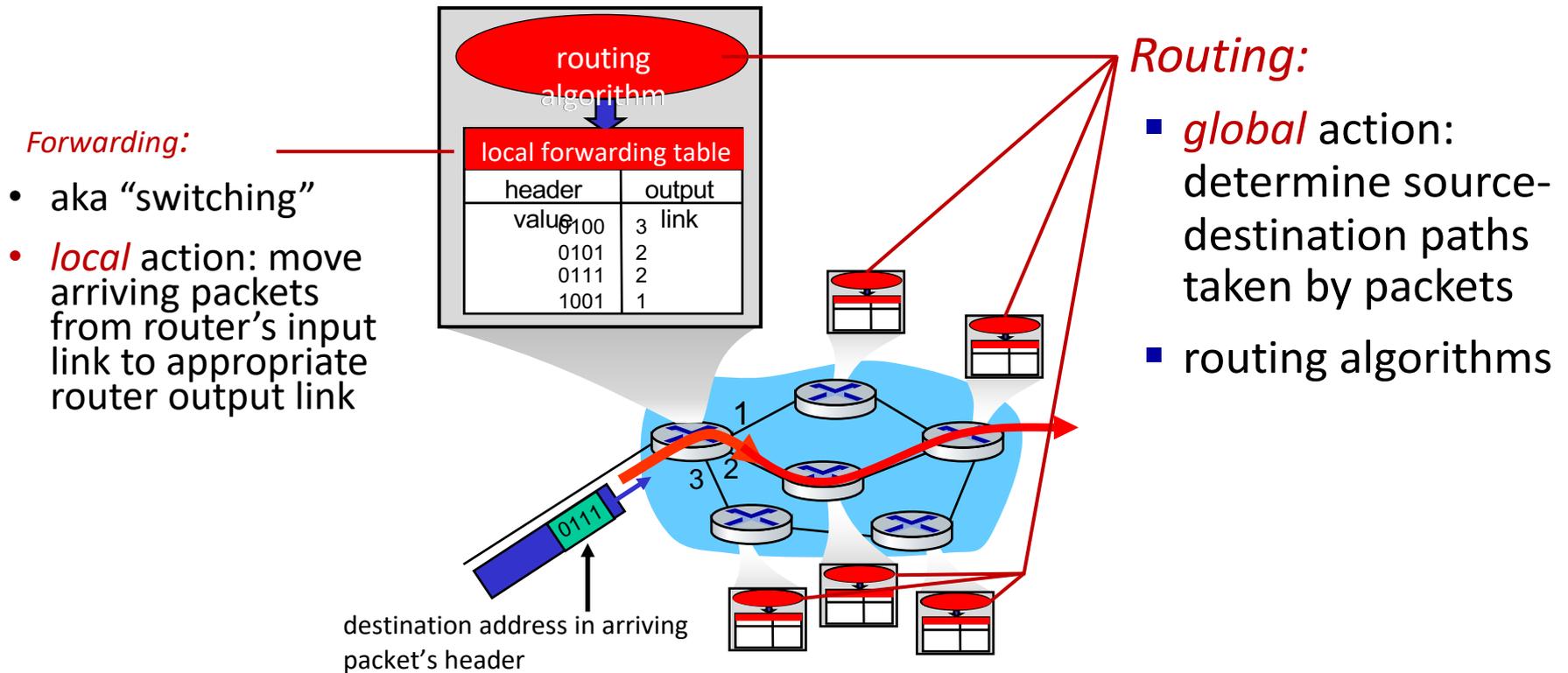


Protocols

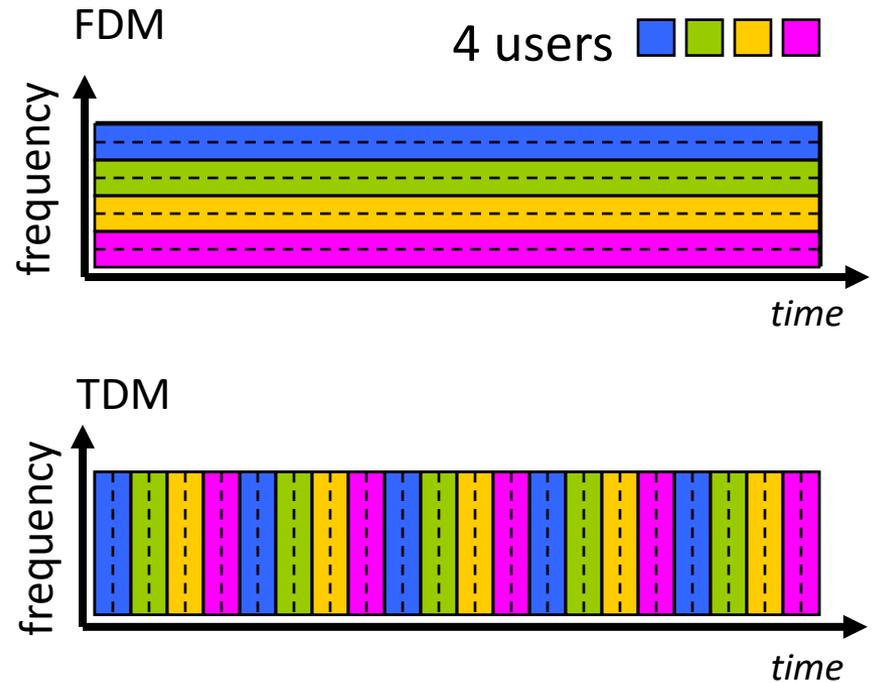
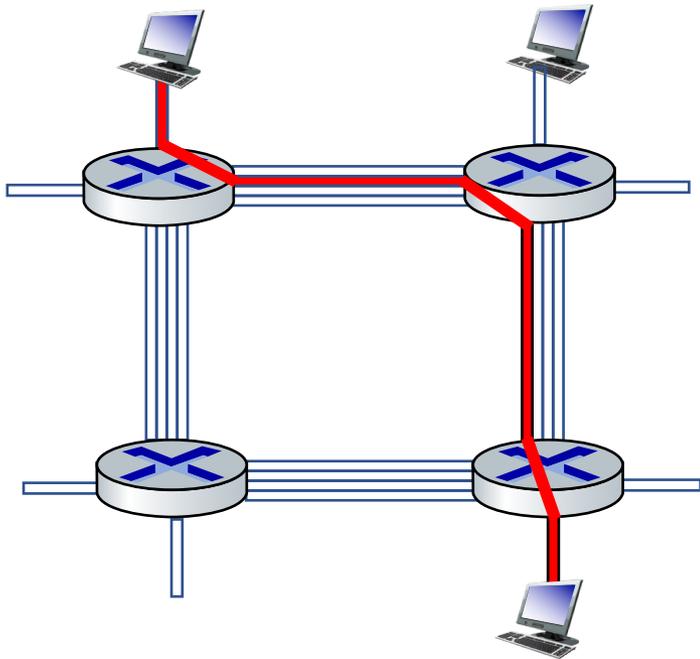
- Receiver



Two key network-core functions



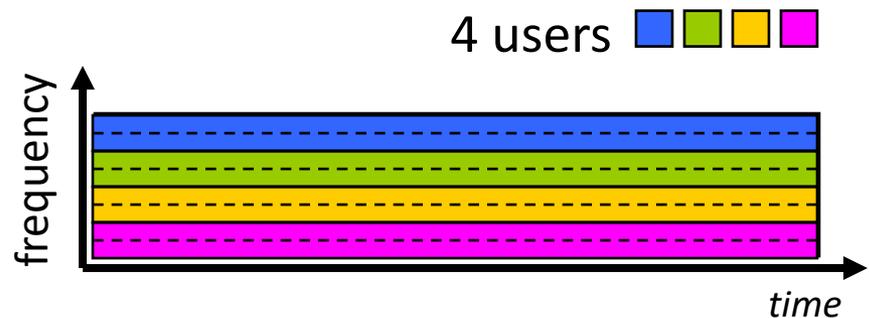
Packet v. circuit switching



Circuit switching: FDM and TDM

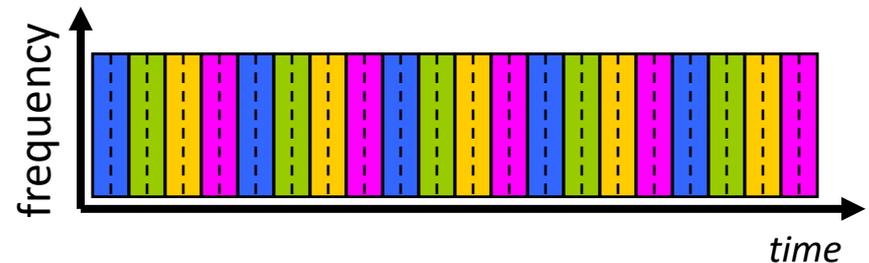
frequency Division Multiplexing (FDM)

- optical, electromagnetic frequencies divided into (narrow) frequency bands
 - each call allocated its own band, can transmit at max rate of that narrow band

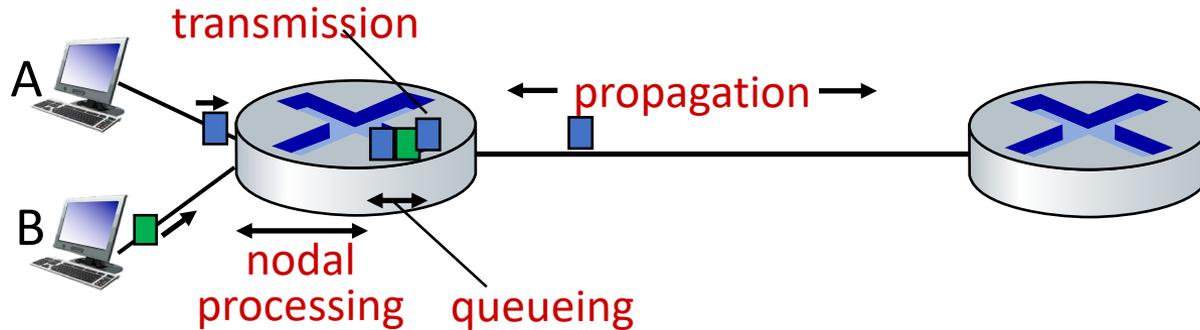


Time Division Multiplexing (TDM)

- time divided into slots
- each call allocated periodic slot(s), can transmit at maximum rate of (wider) frequency band (only) during its time slot(s)



Packet delay: four sources



$$d_{\text{nodal}} = d_{\text{proc}} + d_{\text{queue}} + d_{\text{trans}} + d_{\text{prop}}$$

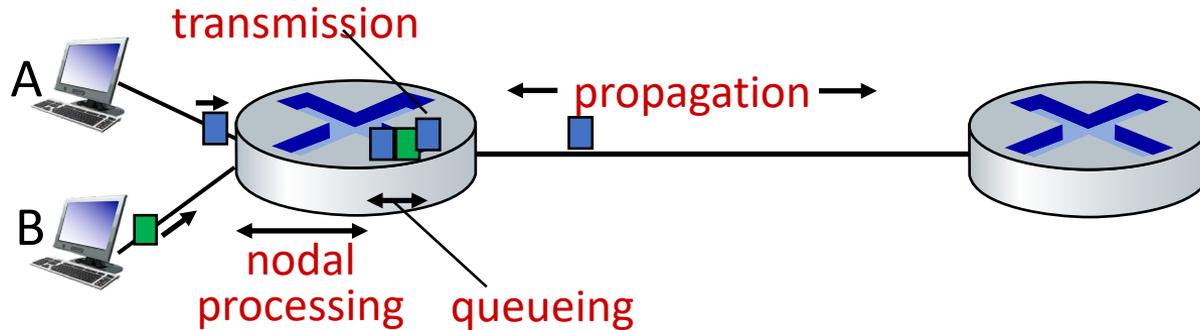
d_{proc} : nodal processing

- check bit errors
- determine output link
- typically < microseconds

d_{queue} : queueing delay

- time waiting at output link for transmission
- depends on congestion level of router

Packet delay: four sources



$$d_{\text{nodal}} = d_{\text{proc}} + d_{\text{queue}} + d_{\text{trans}} + d_{\text{prop}}$$

d_{trans} : transmission delay:

- L : packet length (bits)
- R : link transmission rate (bps)

$$d_{\text{trans}} = L/R$$

d_{prop} : propagation delay:

- d : length of physical link
- s : propagation speed ($\sim 2 \times 10^8$ m/sec)

$$d_{\text{prop}} = d/s$$

d_{trans} and d_{prop}
very different

TCP v UDP (Transport Services)

Transmission Control Protocol

- Reliable
- Connection Oriented
- Flow Control
- Congestion Control

User Datagram Protocol

- Connectionless
- Best Effort