

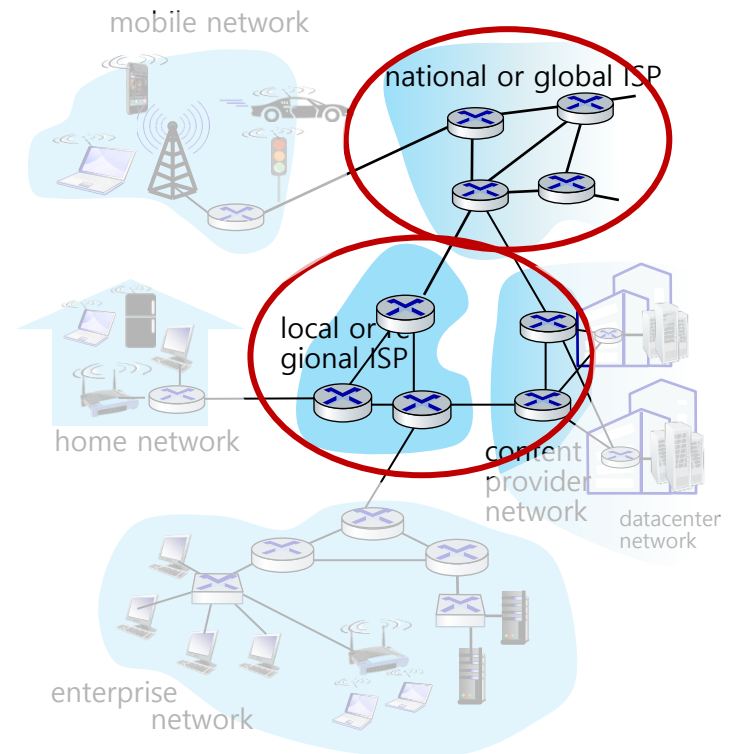
Chapter 1: roadmap

- ◆ What *is* the Internet?
- ◆ What *is* a protocol?
- ◆ Network edge: hosts, access network, physical media
- ◆ **Network core:** packet/circuit switching, internet structure
- ◆ Performance: loss, delay, throughput
- ◆ Security
- ◆ Protocol layers, service models
- ◆ History

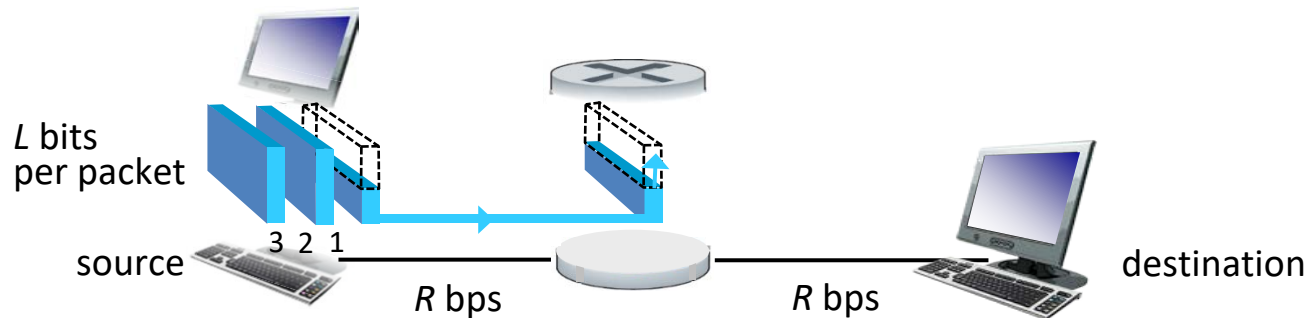


The network core

- ◆ mesh of interconnected routers
- ◆ **packet-switching**: hosts break a pplication-layer messages into *packets*
 - forward packets from one router to the next, across links on path from source to destination
 - each packet transmitted at full link capacity



Packet-switching: store-and-forward

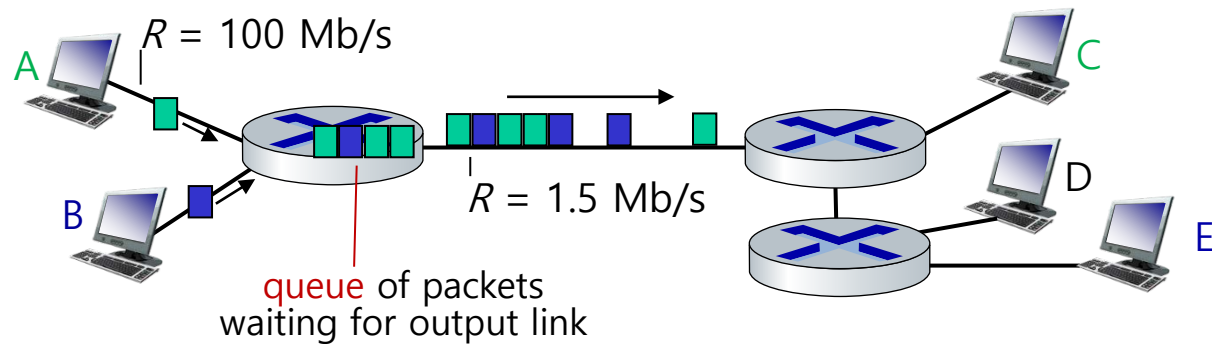


- ◆ **Transmission delay:** takes L/R seconds to transmit (push out) L -bit packet into link at R bps
- ◆ **Store and forward:** entire packet must arrive at router before it can be transmitted on next link
- ◆ **End-end delay:** $2L/R$ (above), assuming zero propagation delay (more on delay shortly)

One-hop numerical example:

- $L = 10$ Kbits
- $R = 100$ Mbps
- one-hop transmission delay = 0.1 msec

Packet-switching: queueing delay, loss



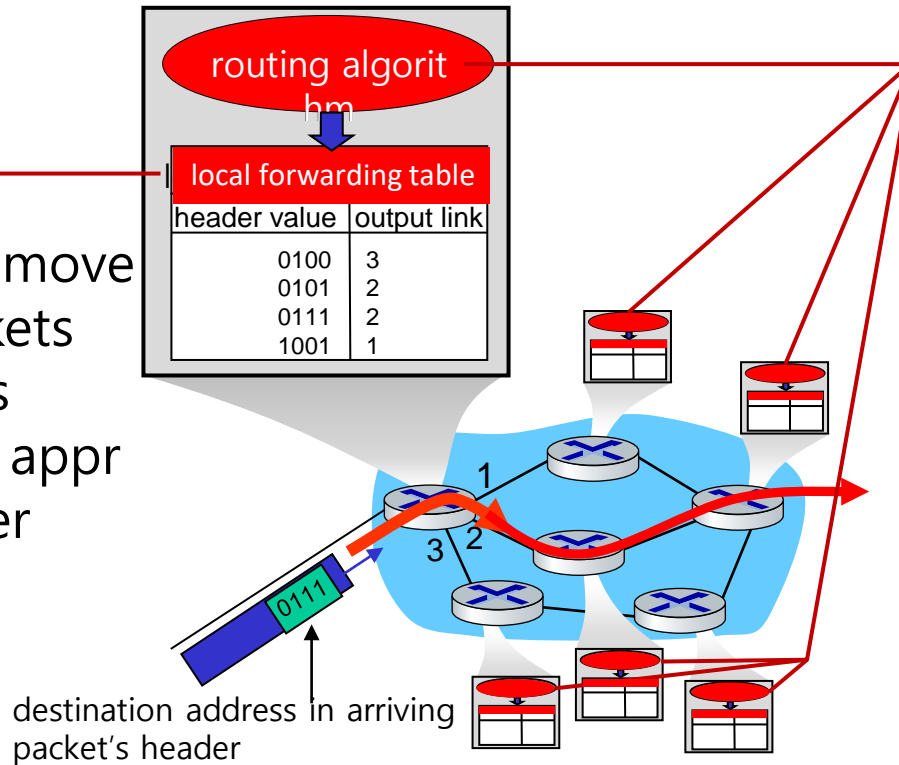
Packet queuing and loss: if arrival rate (in bps) to link exceeds transmission rate (bps) of link for a period of time:

- ◆ packets will queue, waiting to be transmitted on output link
- ◆ packets can be dropped (lost) if memory (buffer) in router fills up

Two key network-core functions

Forwarding:

- ◆ *local* action: move arriving packets from router's input link to appropriate router output link



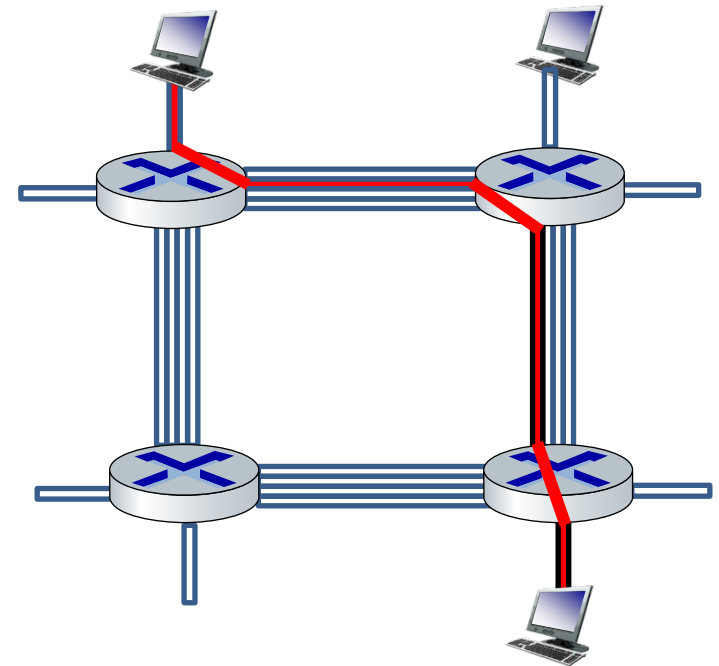
Routing:

- *global* action: determine source-destination paths taken by packets
- routing algorithms

Alternative to packet switching: circuit switching

end-end resources allocated to,
reserved for “call” between source
and destination

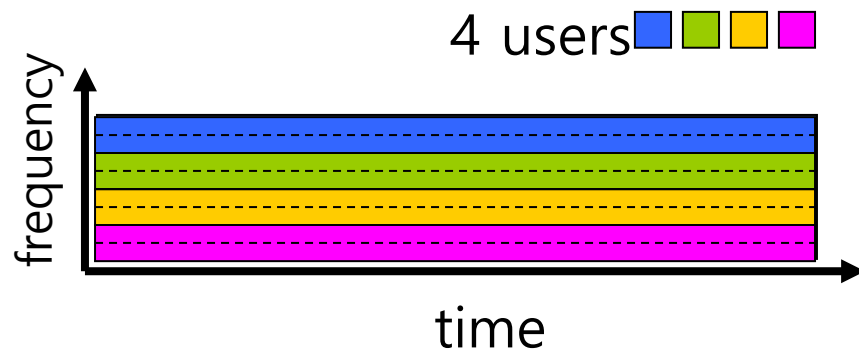
- ◆ in diagram, each link has four circuits.
 - call gets 2nd circuit in top link and 1st circuit in right link.
- ◆ dedicated resources: no sharing
 - circuit-like (guaranteed) performance
- ◆ circuit segment idle if not used by call
(no sharing)
- ◆ commonly used in traditional telephone networks



Circuit switching: FDM and TDM

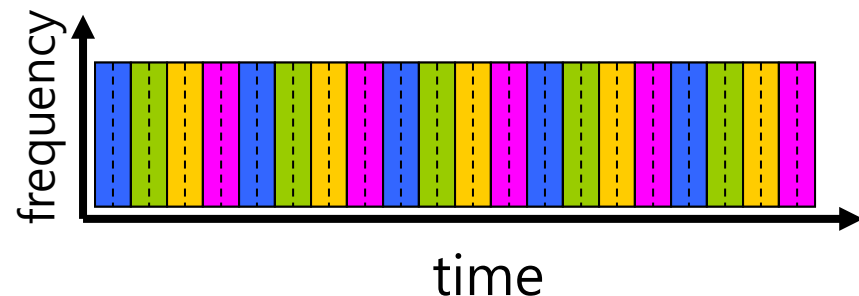
Frequency Division Multiplexing (FDM)

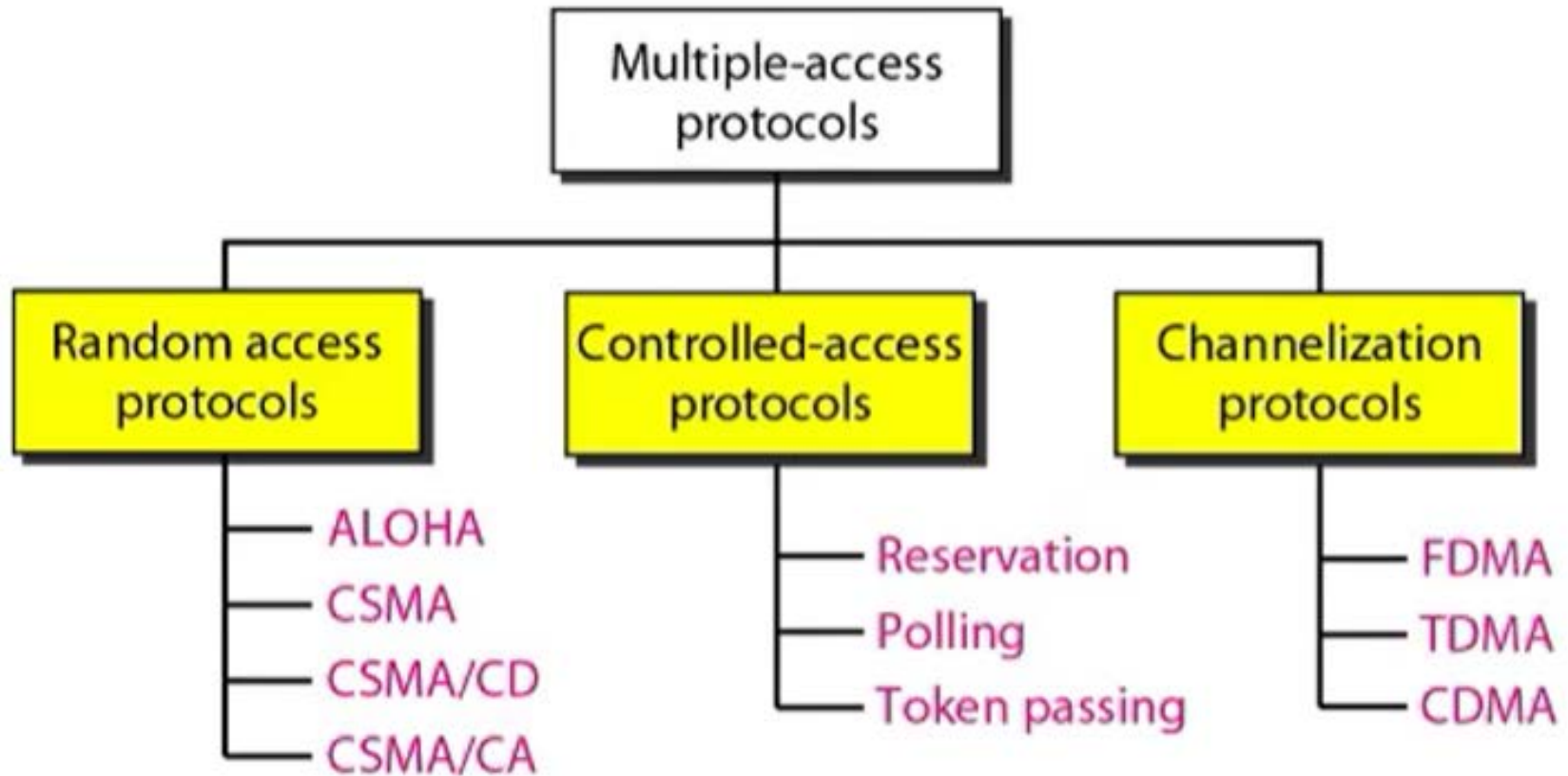
- ◆ optical, electromagnetic frequencies divided into (narrow) frequency bands
- ◆ each call allocated its own band, can transmit at max rate of that narrow band



Time Division Multiplexing (TDM)

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





review

- ◆ Network edge
- ◆ Network core
- ◆ Circuit switching
- ◆ Packet
- ◆ Packet switching
- ◆ Virtual circuit
- ◆ Forwarding
- ◆ Routing
- ◆ Dijkstra's algorithm for network routing
- ◆ Bellman-Ford algorithm
- ◆ Distance vector
- ◆ ATM CVR
- ◆ Internet BE (Best Effort) service model

Announcements

- ◆ 4/10 선거일 강의는 녹화 동영상으로 대체
- ◆ Midterm exam 1은 4/15 또는 17 (수업시간에)
- ◆ Midterm exam 2는 5월 중하순 예정