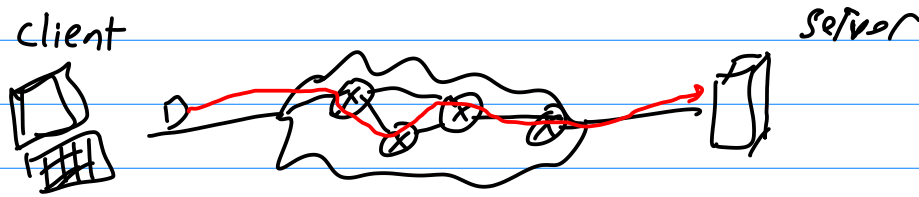
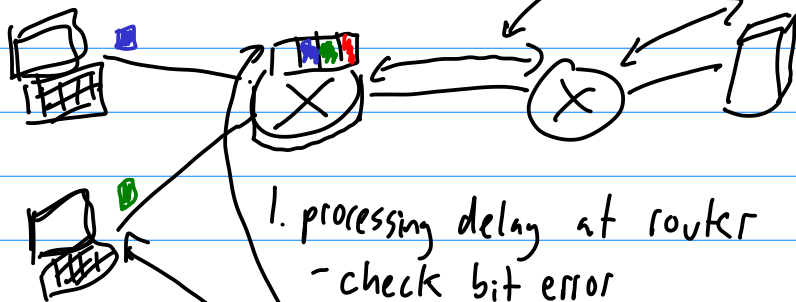


CS 3214 lecture #23 "networking"

Internet = network of networks



Packet Delay: 4 sources



1. processing delay at router
 - check bit error
 - determine output link $< \text{ms}$

2. propagation delay

d : length of phys link

s : propagation speeds

$\frac{d}{s}$ optical fiber
 70% speed of light
 $\sim 2 \times 10^8 \text{ m/sec}$

store + forward
 entire packet

3. queuing delay

L : transmission delay if arrival rate $>$ xmit rate of router

L : packet length (bits) too many packets = drops packets

R : link xmit rate (bps)

$$L/R$$

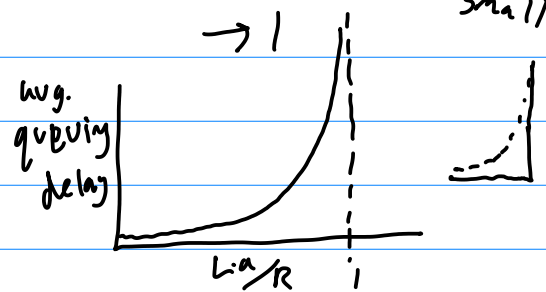
What happens when network gets busy?

R : link b/w (bps)

L : packet lengths (bits)

a : average packet arrival rate

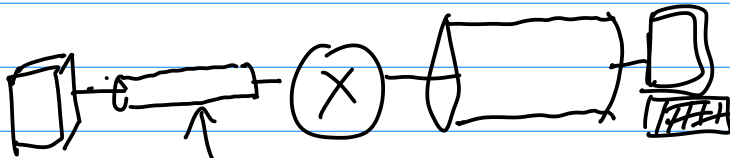
$$\frac{L \cdot a}{R} \sim 0 \quad \text{avg. queuing delay small}$$



Throughput: rate at which bits are being sent from sender to receiver

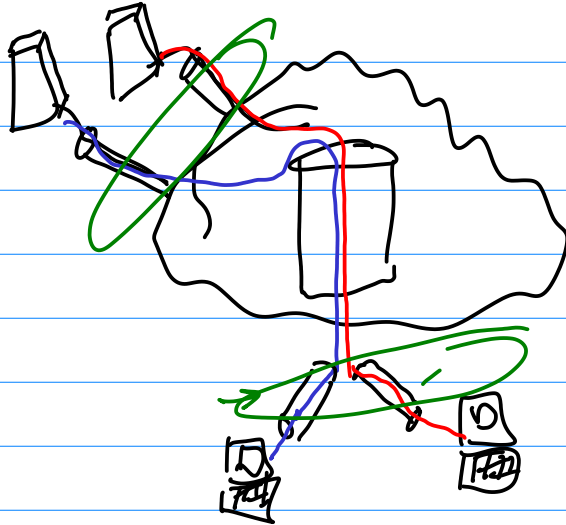
- instantaneous
- average

"width of pipes"



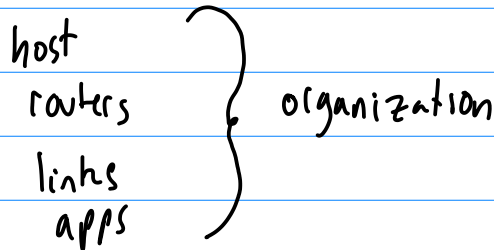
bottleneck limits end-to-end tput

"bottleneck"



"last mile"

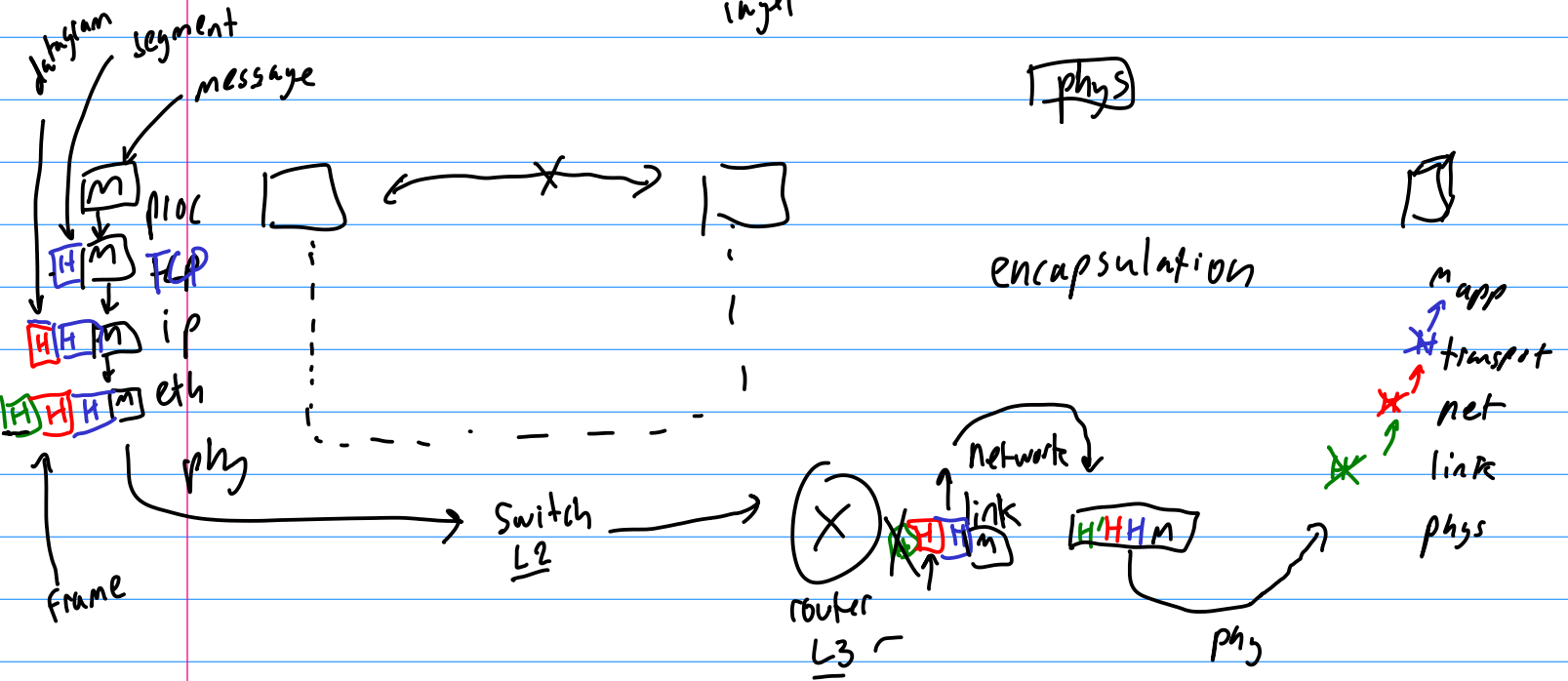
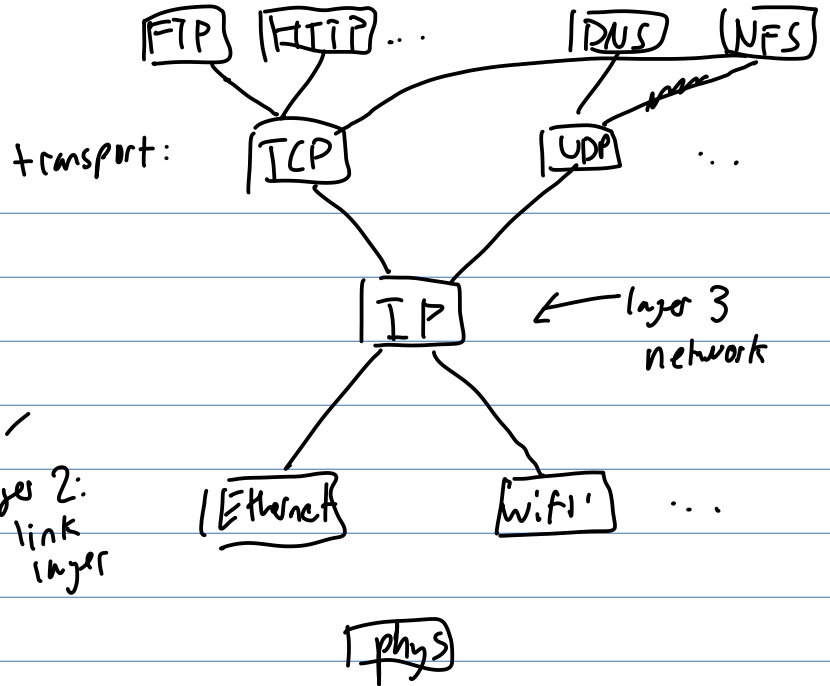
Layering



layers help maintenance / upgrades be independent
 are layers always good? (7) application layer HTTP, FTP
 (presentation session)

OSI/ISO 7-layer transport process to process TCP, UDP
 (3) network IP routing
 (2) link Ethernet, wifi (protocols) switch
 phys "bits on the wire"

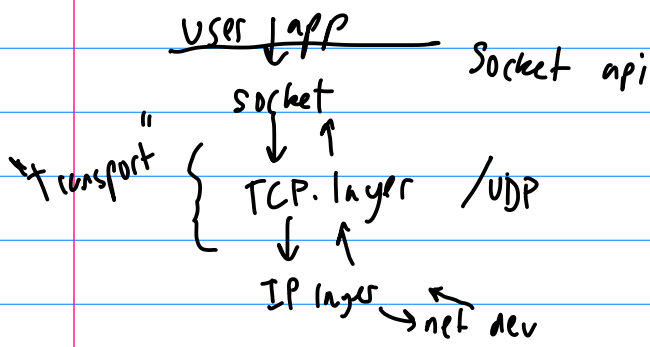
[TCP/IP] hourglass



[[sk_buff]]
 ↖ socket

[Software Defined Net.]
 L2/L3

How does user interact w/ network: sockets
 sockets are fds! ← read(), write(), close()

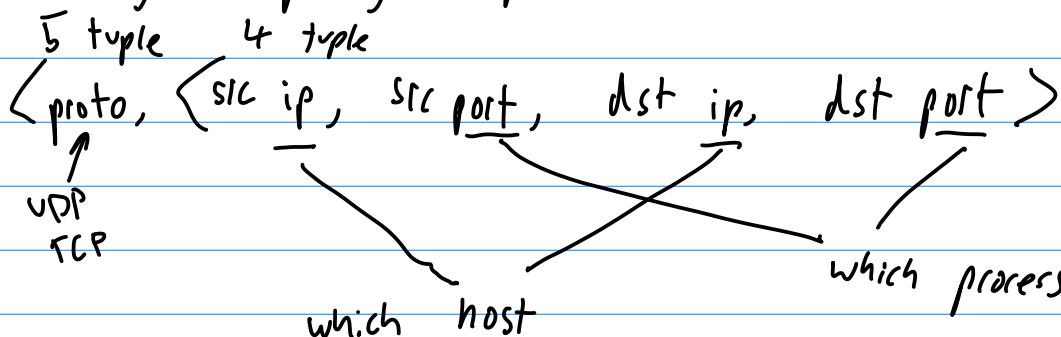


unreliable (best effort)
data transmission

reliable stream

transport layer: UDP/TCP

how do you specify endpoint



OS
port → place
port → proc
port → proc



headers

UDP: RFC 768 (1980)

- simple
- datagram oriented (up to 64k)
- connectionless
- unreliable

IP header

UDP header

