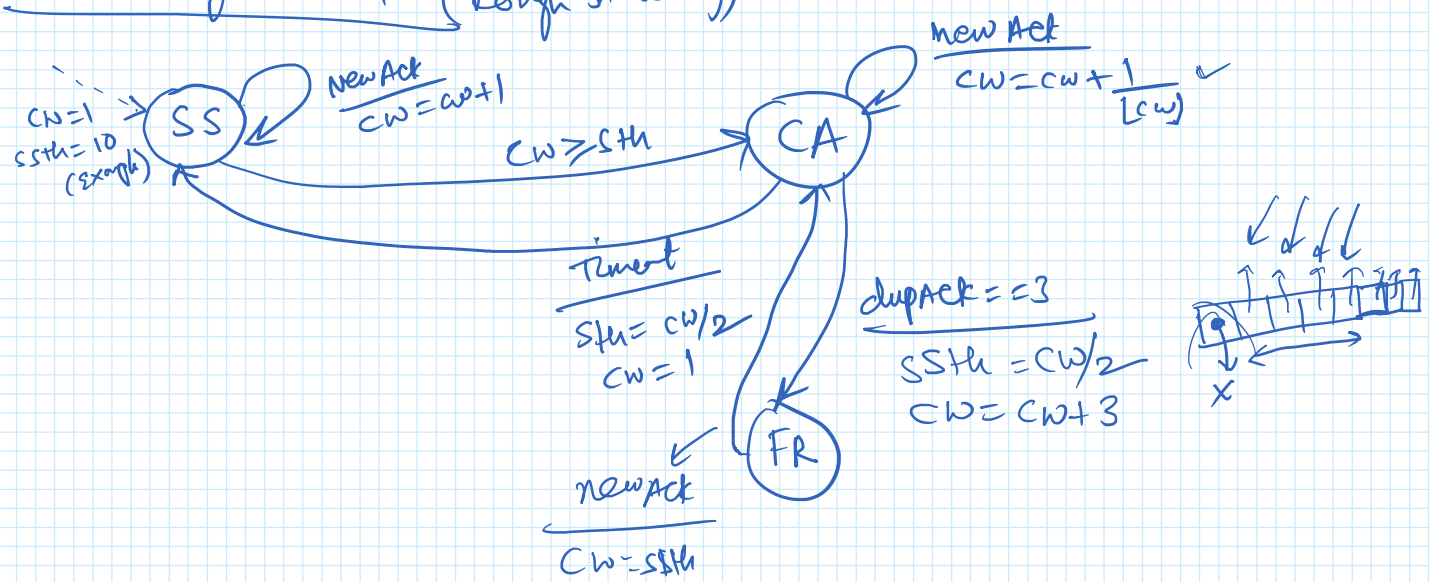
Lecture 16

08 October 2021 17:03

- Recap → TCP Congestion Control
- TCP Throughput ✓
- TCP Fairness ? ✓
- Network Layer → Forwarding
  - → Routing
  - → connection / connectionless n/w Layer
  - → Forwarding implementation

TCP Cong. Control (Rough Sketch)



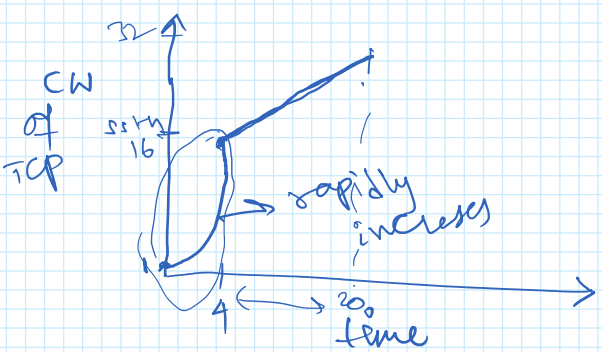
TCP Throughput

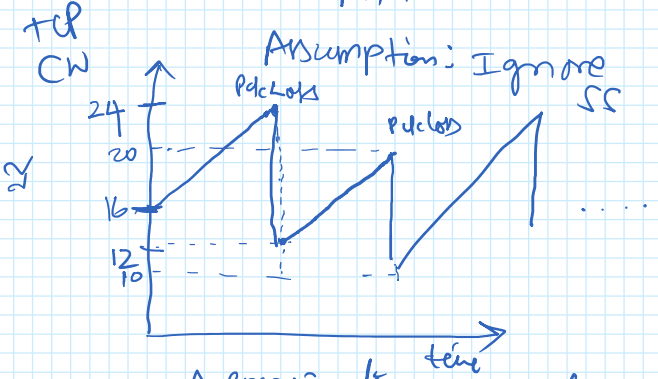
(bytes)

CW = W

Throughput ≈ W bytes / RTT

$= \frac{W}{RTT}$ bytes/sec.



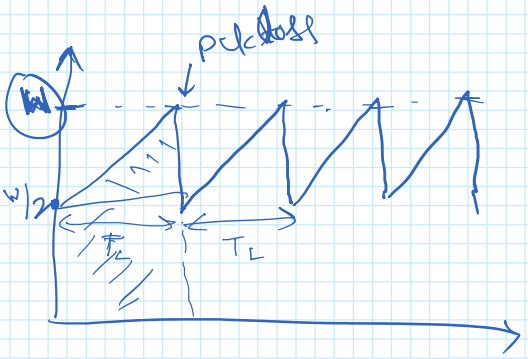


Approximate CW as fn of

time

Approximately cw as fn of time

{ Additive Increase, Multiplicative Decrease (AIMD)



(Ideal TCP cw evolution)

W → window size just before pkt loss

Avg. Throughput

= (Avg. window size) bytes/RTT

Avg. window size

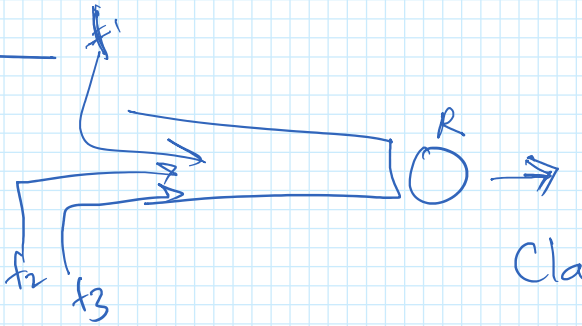
Avg win size $= \frac{\frac{W}{2}T_L + \frac{1}{2}T_L W/2}{T_L} = 3W/4$

$\Downarrow$

Throughput $= \frac{3W}{4RT}$ bytes/sec

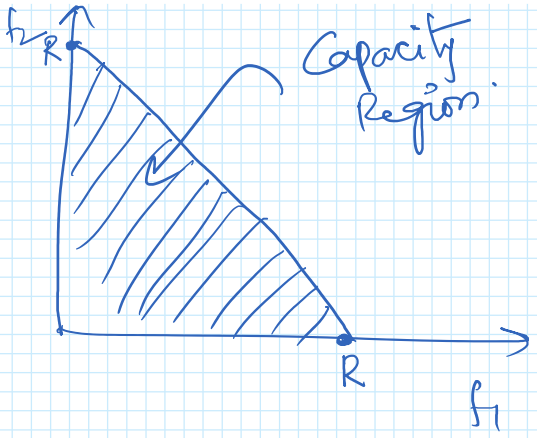
Fairness of TCP

$f_1 + f_2 + f_3 \le R$



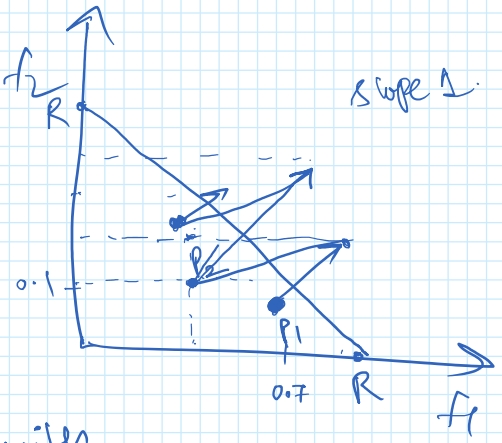
Claim $f_i \simeq R/3$

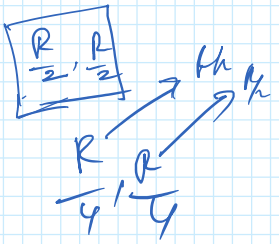
Two flow Scenario

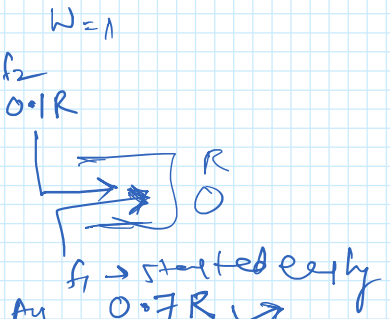


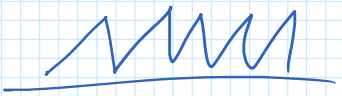
$f_1 + f_2 \leq R$

Why Nash
avg $f_1 = f_2 = R/2$







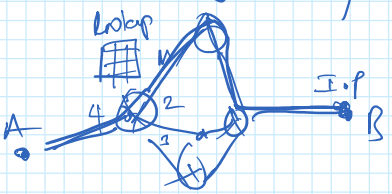


Done with Transport layer.

Network Layer

N/W Edge → Application, Transport (end hosts)

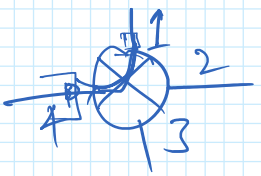
N/W Core → Routers. (N/W layer)



N/W Layer → Routing (Centralized decision) → Formulating Lookup Table
→ Forwarding (Implement Lookup)

Lookup table

IPA	1
IPB	2
IPC	3

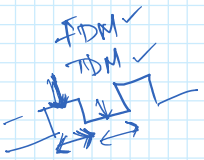


Third functionality → Connection setup

Analogy to
UDP → connectionless
TCP → Connection

① Reserve Router resources

(Virtual circuit) A → B ① Reserve Router resources
↳ Buffer ✓
↳ Bandwidth ✓

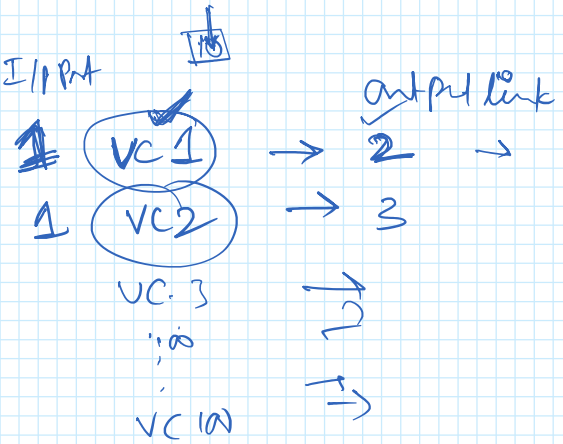


maintain state variables

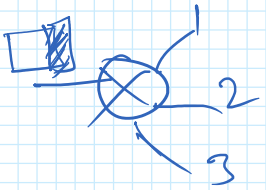
② Decide a fixed path

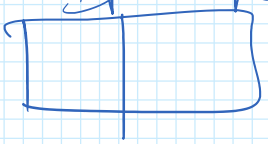
Connection-less
(Datagram N/W) → Best-effort service

32 bit



Datagram (connection-less N/W)





N/W Service → In-order ✓
→ Min. B/W ✓
→ Congestion ✓
feedback

Transport layer.
↓
Security

N/W
→ Reliable ✓
Carrier ✓

Forwarding

— Billions of IP addresses