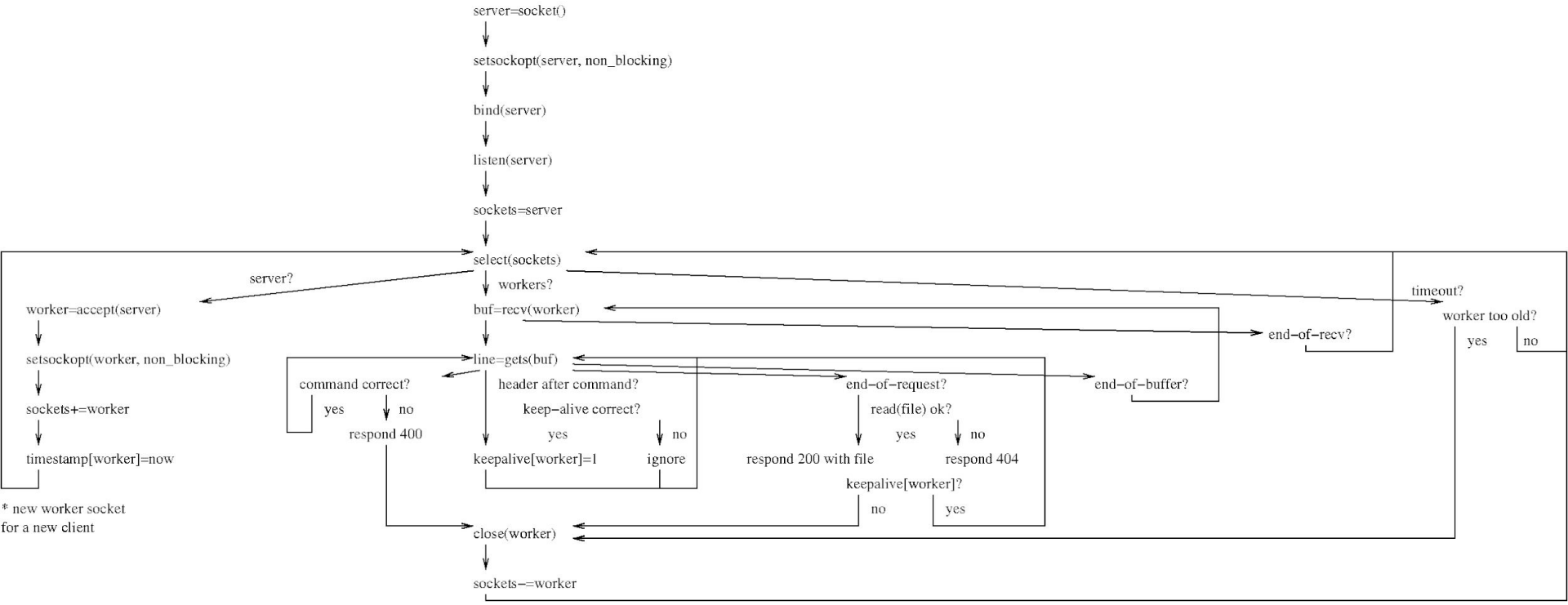
Our course reps

- Thanks to our diverse student volunteers!
  - B03: Chris Brandt (CS, EE, ITadmin, etc)
  - B04: Jennifer Cheng (CS+Stats)
  - B05: Emily Sluis (SEng, CSc110/1/5TA)
  - B06: Owen Thurston (CS, remote in Korea)
  - their uvic email address on connex
- AAA: Aggregate, Amplify and Anonymize
  - **we will e-meet them this Thursday**
  - we do welcome student feedback directly too

*** P3 extended to Monday, Nov 30, 5pm through connex. Today and tomorrow's "lab" hours dedicated to P3 as well**

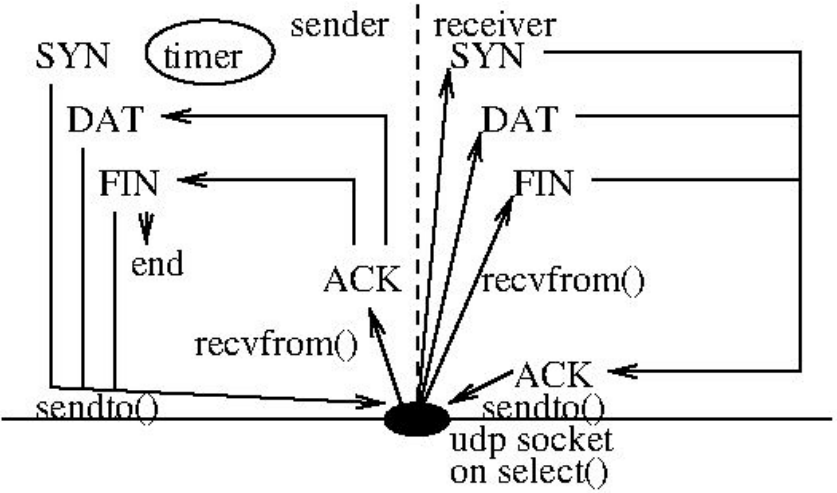
One *possible* P1 flow chart

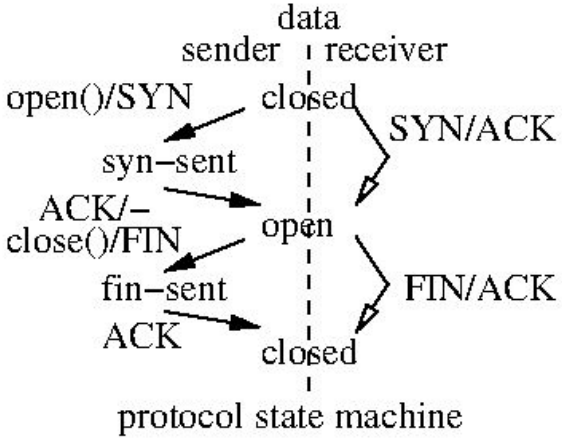


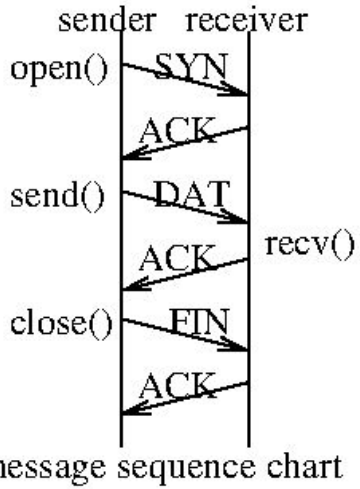
* python socket() with select() https://pymotw.com/2/select/

* python readline() or readlines()

One *possible* P2 flow chart







sender pseudo code in open state

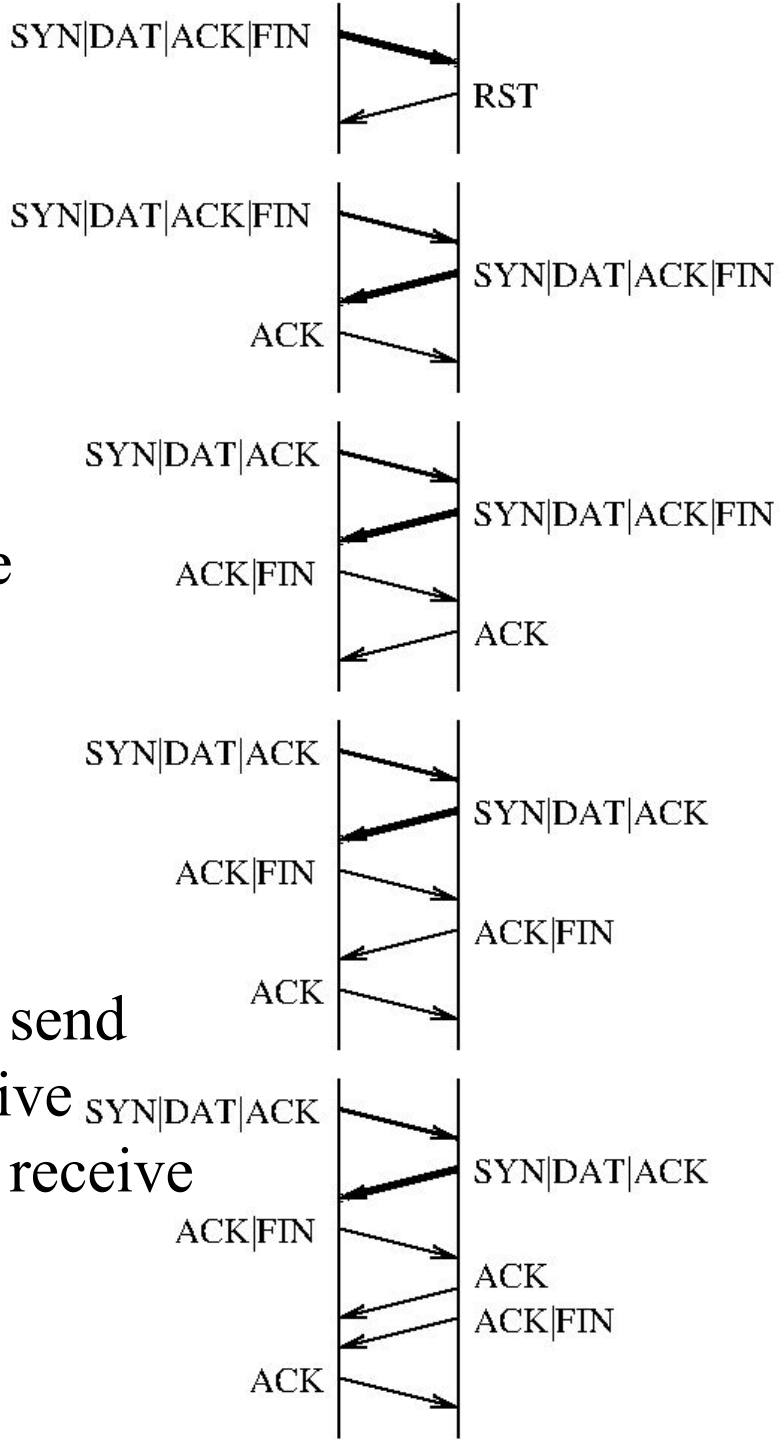
```
forever{
   on application write:
      packetize into packets
      send per receiver's window
      setup timer if not running
      update send_next

   on receiving ACK:
      cancel timer if covered
      setup timer if still unacked packets
      resend the oldest if enough dupacks
      send more if allowed by window

   on sender timeout:
      resend the oldest packet
      setup timer properly
}
```

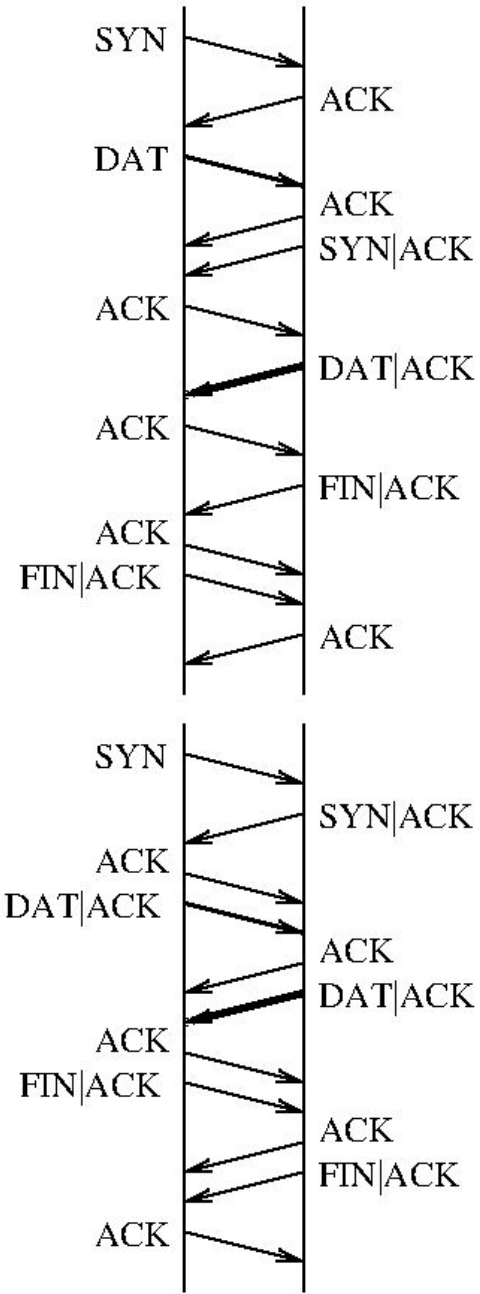
receiver pseudo code in open state

```
forever{
   on receiving DAT:
      below acked?
         drop
      beyond acked+window?
         send RST; exit
      out of order?
         buffer or drop
      in order?
         buffer and update ackno
      enough in−order data?
         write to file
      update window size
      send ACK
}
```

Possible P3 interactions

- non-exhaustive
  - nor complete
- so you need a
  - **protocol state machine**
- Be considerate
  - on what you send
- Be accommodative
  - on what you receive





Computer Networks

Media Access Control

Jianping Pan
Fall 2020

Review

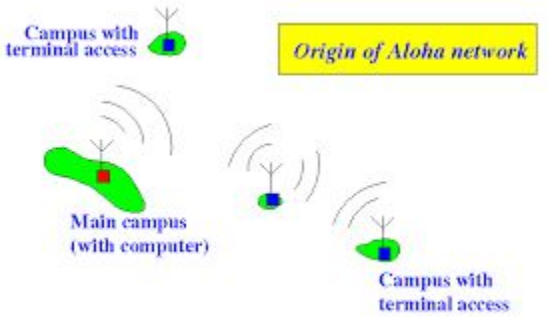
- Link layer mechanisms
  - frame control
  - error control
  - flow control
- Link layer protocols
  - HDLC, SLIP, PPP
- What if there are multiple transmitters?
  - media access control

Types of links

- Point-to-point link
  - dedicated medium for a pair of transceivers
  - e.g., PPP, switched Ethernet
- Broadcast link
  - shared medium by multiple nodes
  - e.g., traditional Ethernet, 802.11
  - collision by concurrent transmission

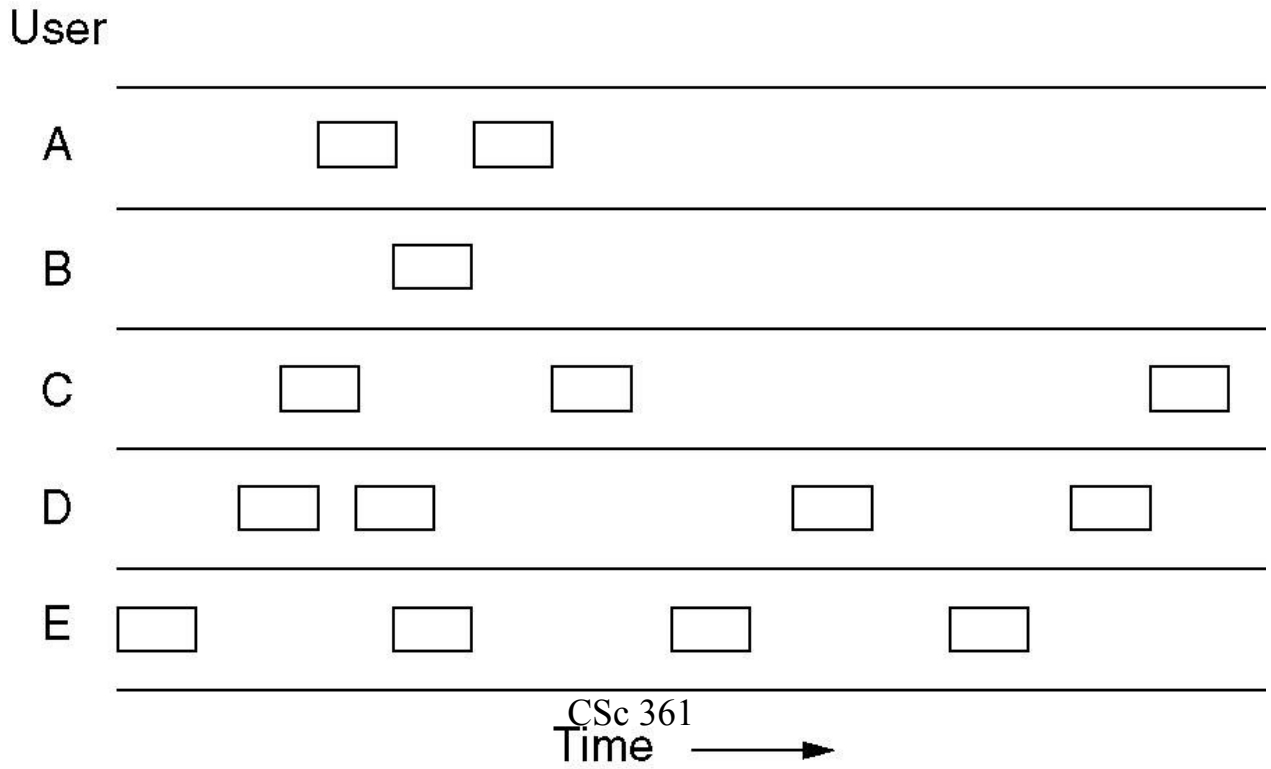
Media access control

- Deterministic allocation
  - frequency division multiple access (FDMA)
  - time division multiple access (TDMA)
  - code division multiple access (CDMA)
- Contention-based
  - ALOHA
  - CSMA
  - CSMA/CD
  - CSMA/CA



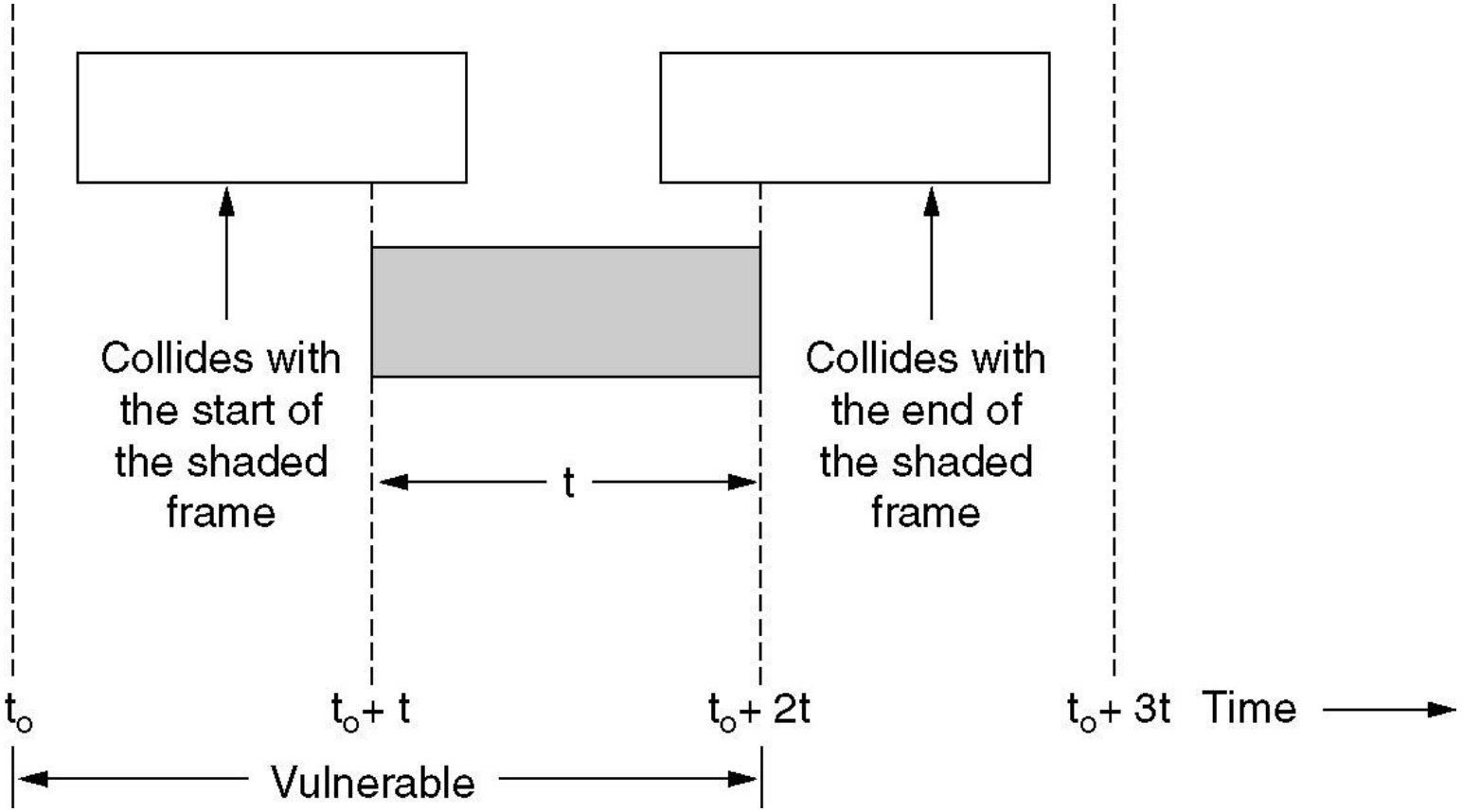
Pure Aloha

- Transmission at any time
  - if collision, random back-off



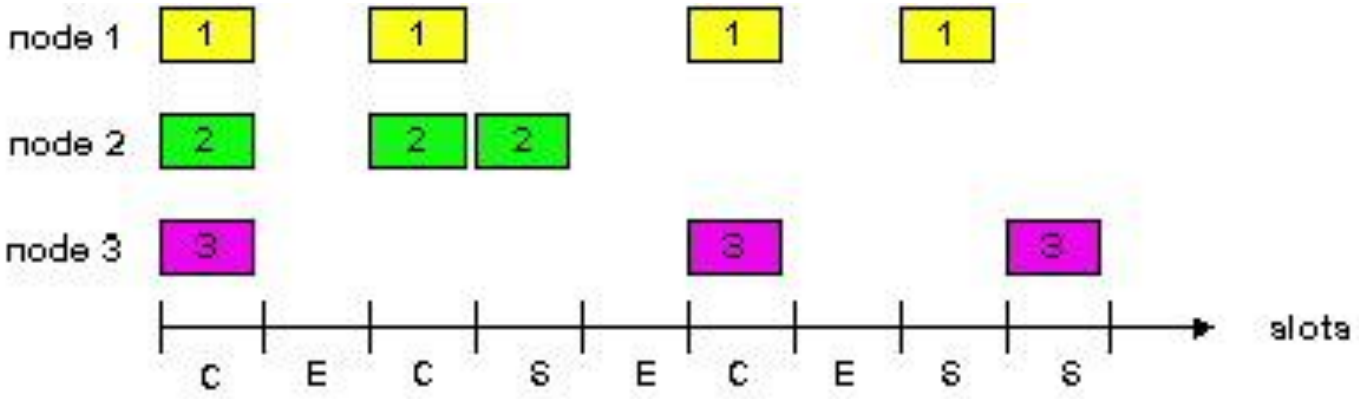
ALOHA: Additive Links On-line Hawaii Area

Pure Aloha: vulnerable period



Slotted Aloha

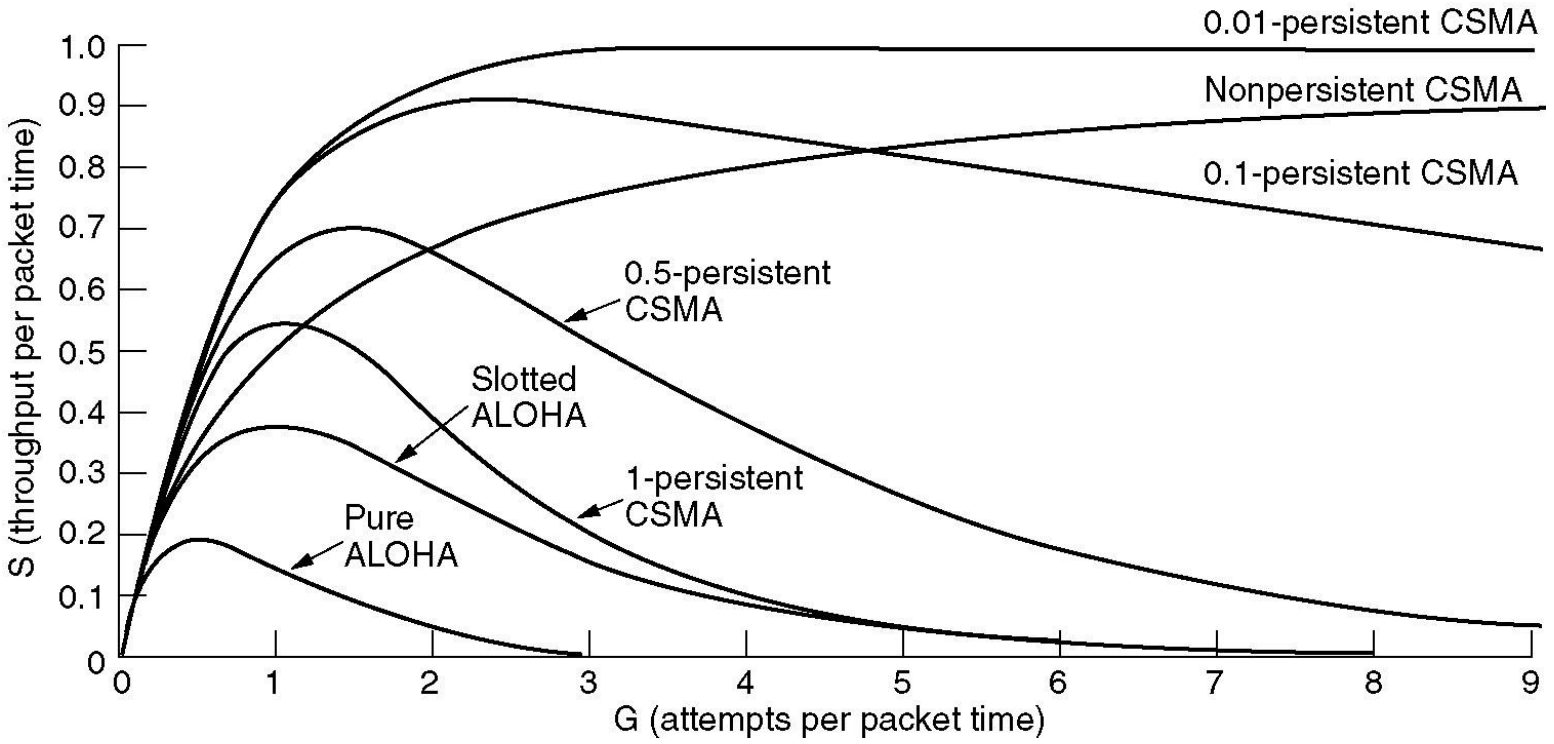
- Slotted time
- Synchronized nodes
- Transmission only at the beginning of a slot
  - if collision, retransmit in next slot with prob. *p*



Carrier sense multiple access

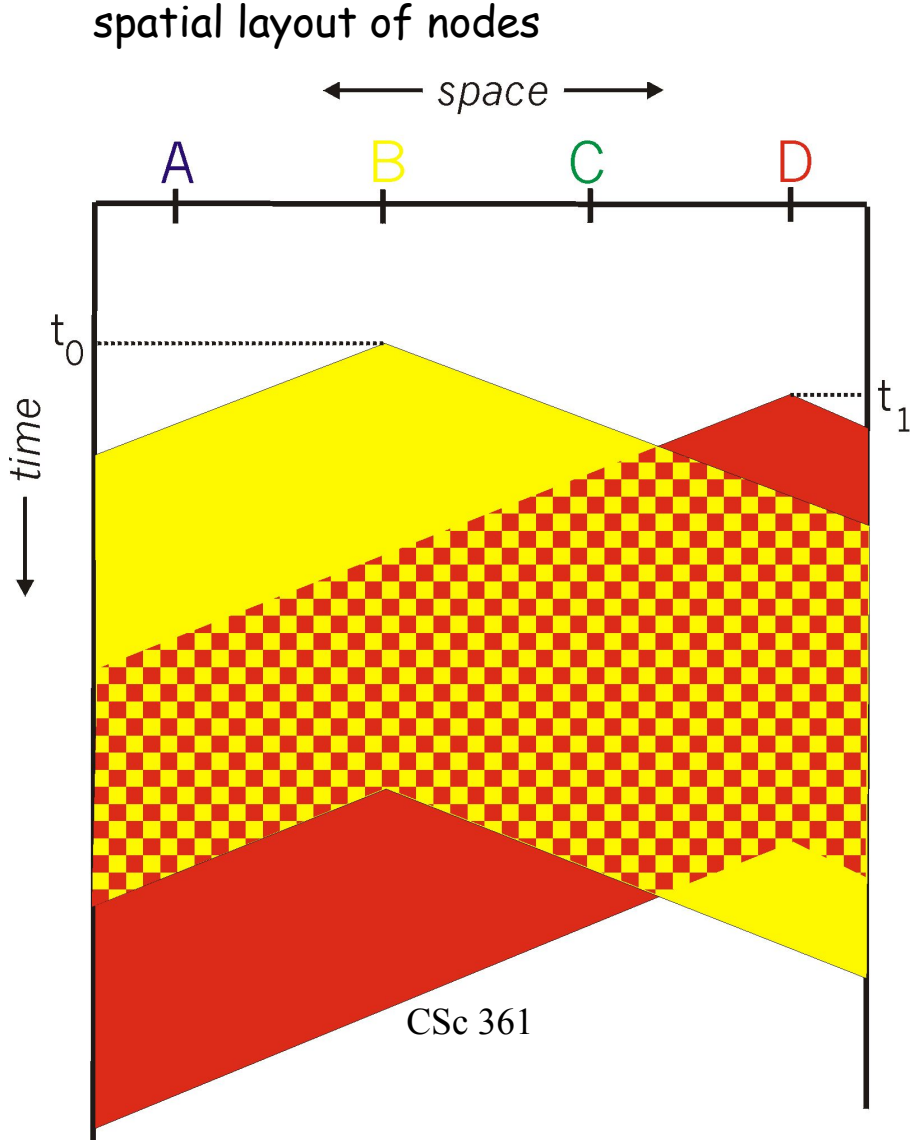
- 1-persistent CSMA
  - if channel is busy, wait
  - if channel is idle, transmit immediately
    - if collision, random back-off
- *p*-persistent CSMA
  - if busy, wait
  - if idle, transmit with probability *p*
- Non-persistent CSMA
  - if busy, back-off

Performance comparison



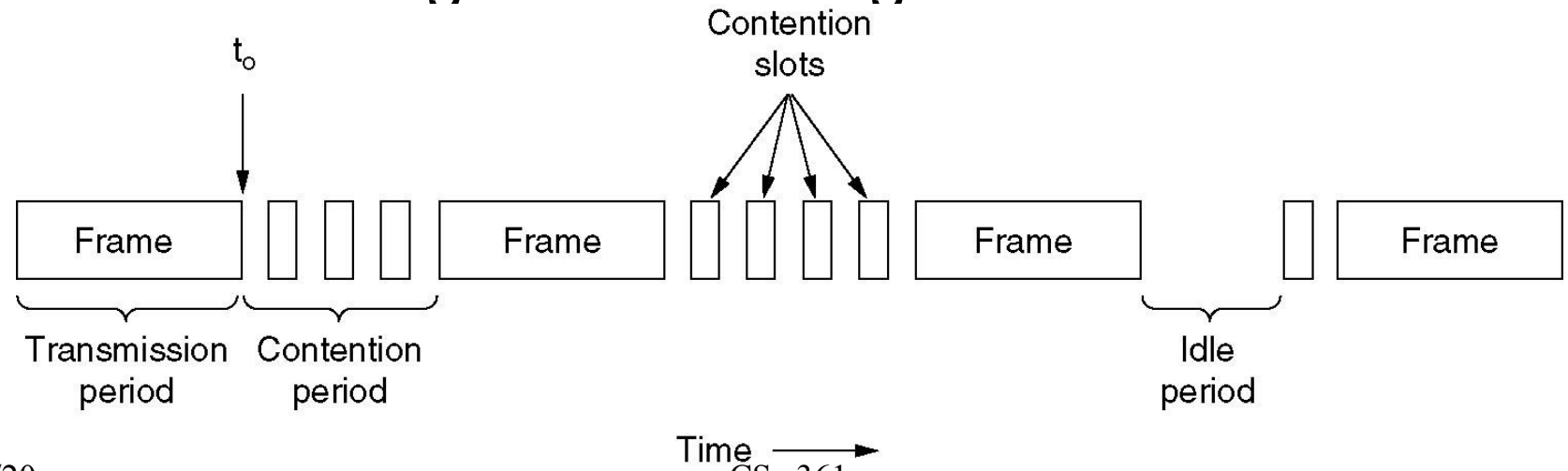
* ref: advanced networks courses

CSMA: collision "area"

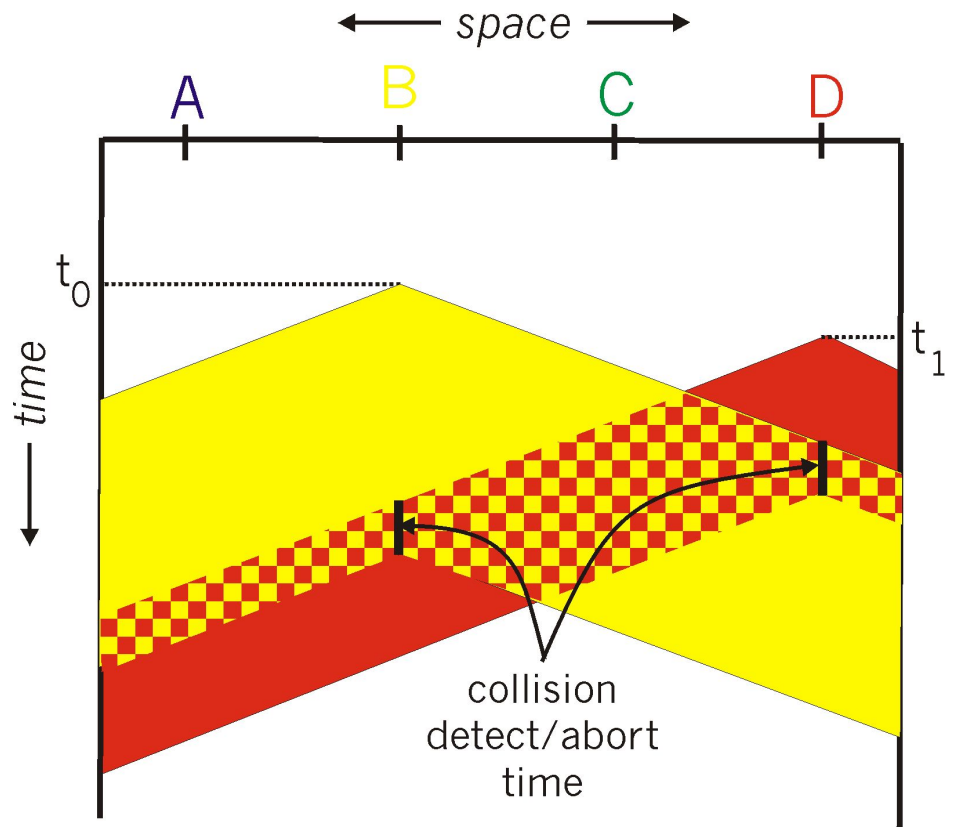


CSMA/collision detection

- CSMA
- CD
  - if collision, *abort* and back-off
  - receiving while sending



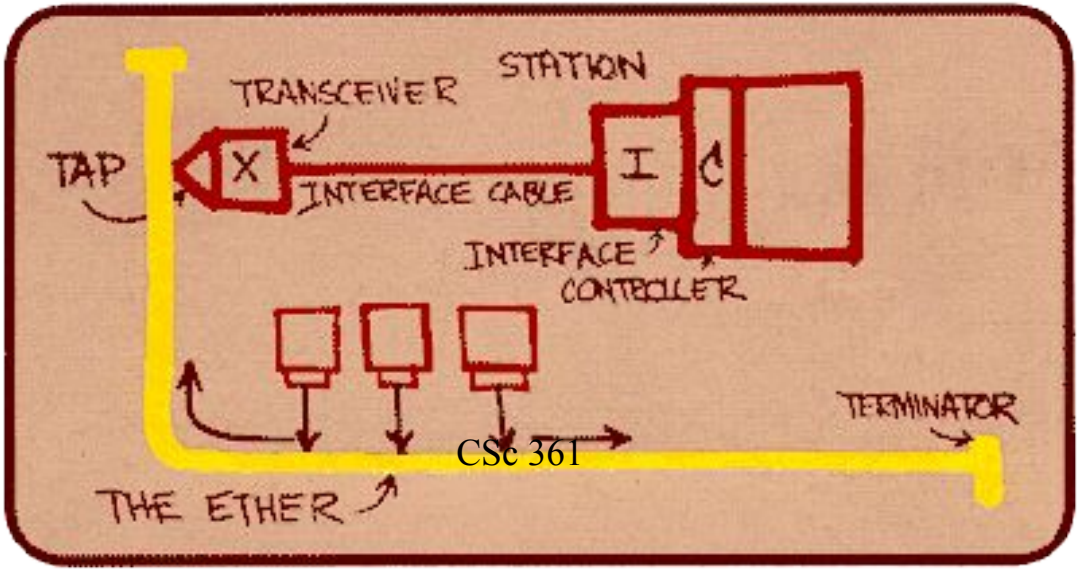
CSMA/CD: collision "area"



* minimal vs maximal frame size?

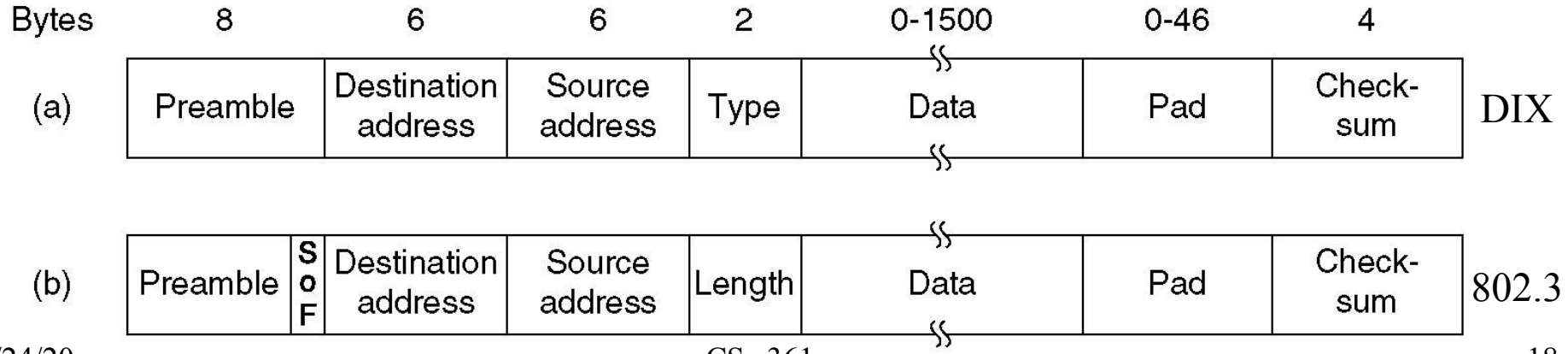
Ethernet

- Pervasive!
  - speed:10->100Mbps, 1->10->40->100Gbps
  - medium: coaxial, twist-pair, fiber
  - topology: bus, tree, star; range: LAN, MAN



Ethernet frames

- DIX format
  - type
- IEEE 802.3 format
  - length



* why pad? how to distinguish type vs length?

This lecture

- MAC
  - Aloha
  - slotted Aloha
  - CSMA
  - CSMA/CD
  - Ethernet
  - IEEE 802.3

Next lecture

- Wireless Ethernet
  - CSMA/CA
  - RTS/CTS
  - IEEE 802.11