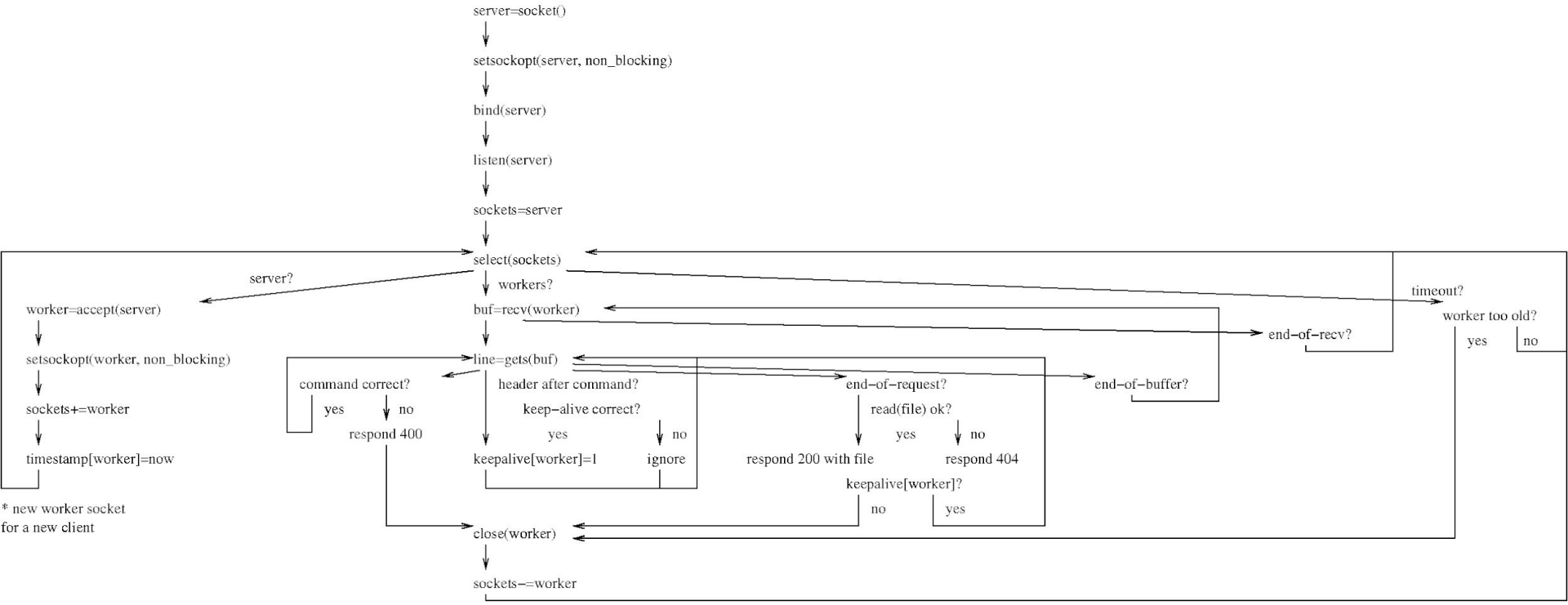
Our course reps

- 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

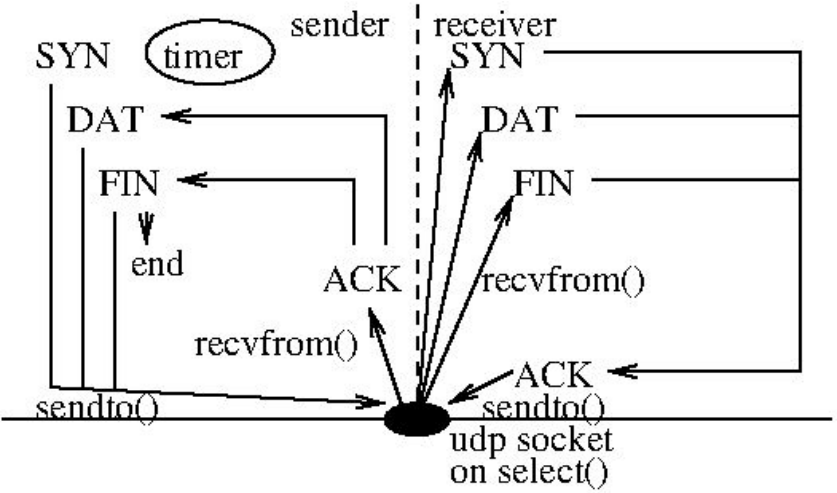
*** P3 has been extended to Monday, Nov 30, 5pm through connex. This week's "lab" hours are dedicated to P3 too**

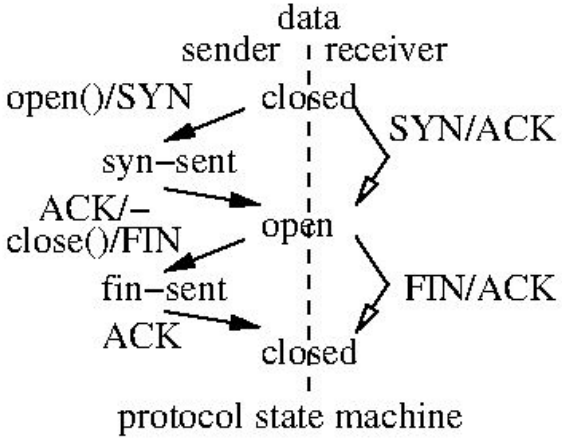
One *possible* P1 flow chart

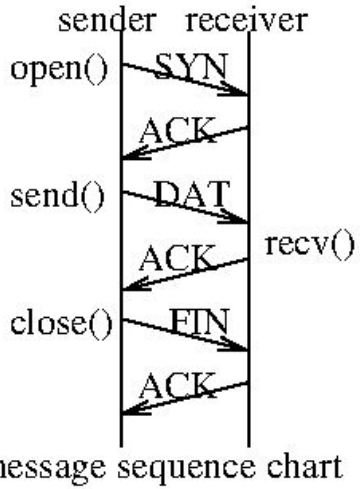


* python socket() with select() https://pymotw.com/2/select/ * python readline() or readlines() * split()

One *possible* P2 flow chart







sender pseudo code in open state

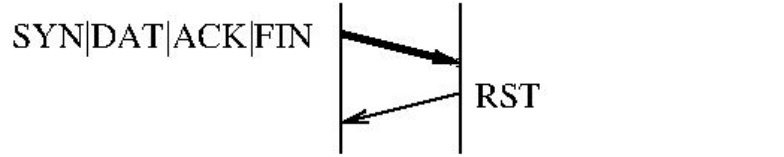
```
forever{
   on application write:
      packetize into packets
      send per receiver's window
      setup timer if not running
      update send_next

   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
}
```

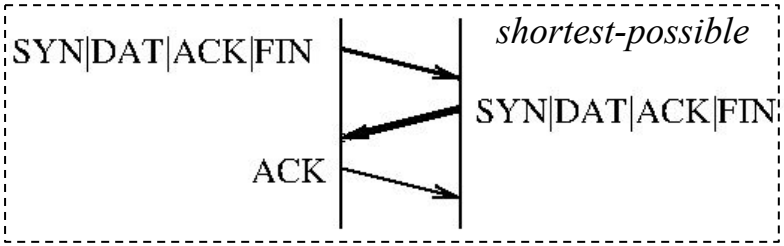
receiver pseudo code in open state

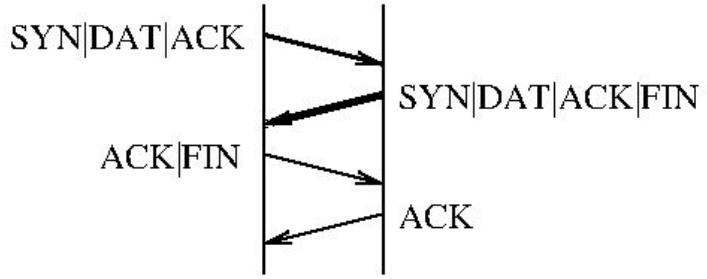
```
forever{
   on receiving DAT:
      below acked?
         drop
      beyond acked+window?
         send RST; exit
      out of order?
         buffer or drop
      in order?
         buffer and update ackno
      enough in−order data?
         write to file
      update window size
      send ACK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

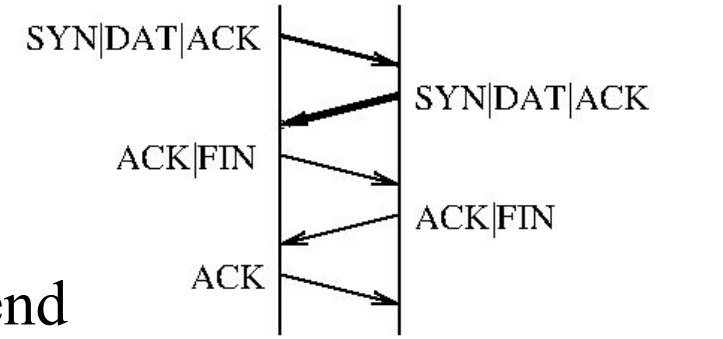
Possible P3 interactions

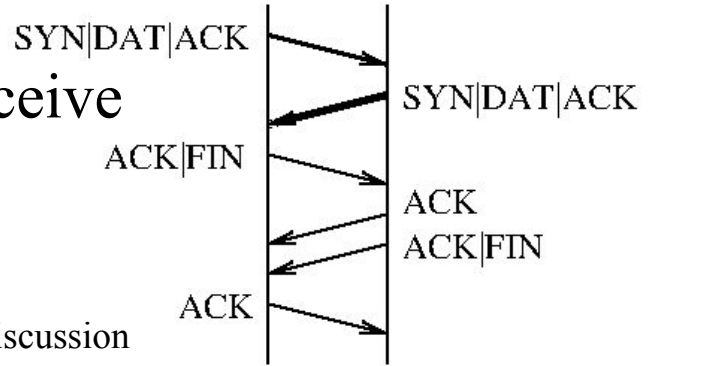
- non-exhaustive
  - nor complete
- so you need a
  - **protocol state machine**
- Be considerate
  - on what you send
- Be accommodative
  - on what you receive

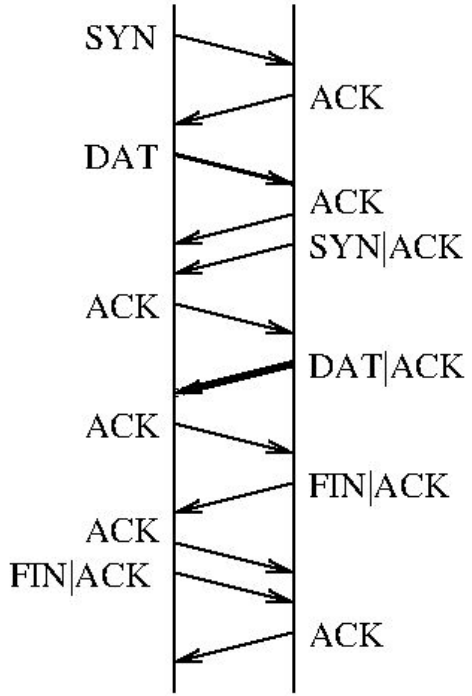


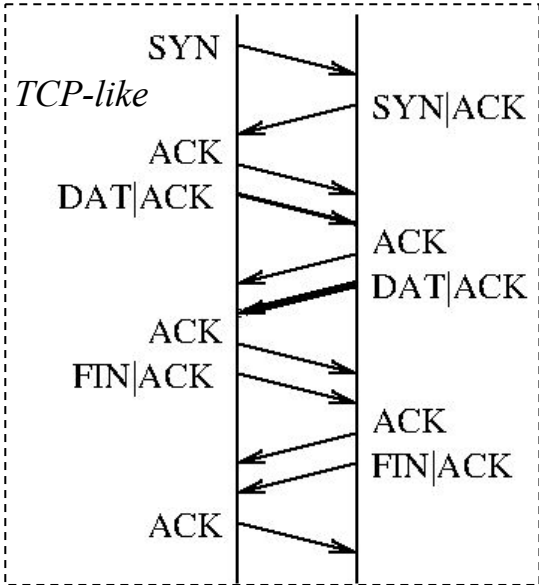












* see connex->forums->p3 for more discussion

Computer Networks

Wireless LAN

Jianping Pan
Fall 2020

Review

- Media access control
  - Aloha
  - Slotted Aloha
  - CSMA
    - 1-persistent, p-persistent, non-persistent
  - CSMA/CD
  - IEEE 802.3 Ethernet
    - frame control, error detection

Q: idle, busy, collision?

Today's topics

- WiFi: wireless fidelity
  - CSMA/CA
  - RTS/CTS
  - IEEE 802.11 family
    - frame control, error detection

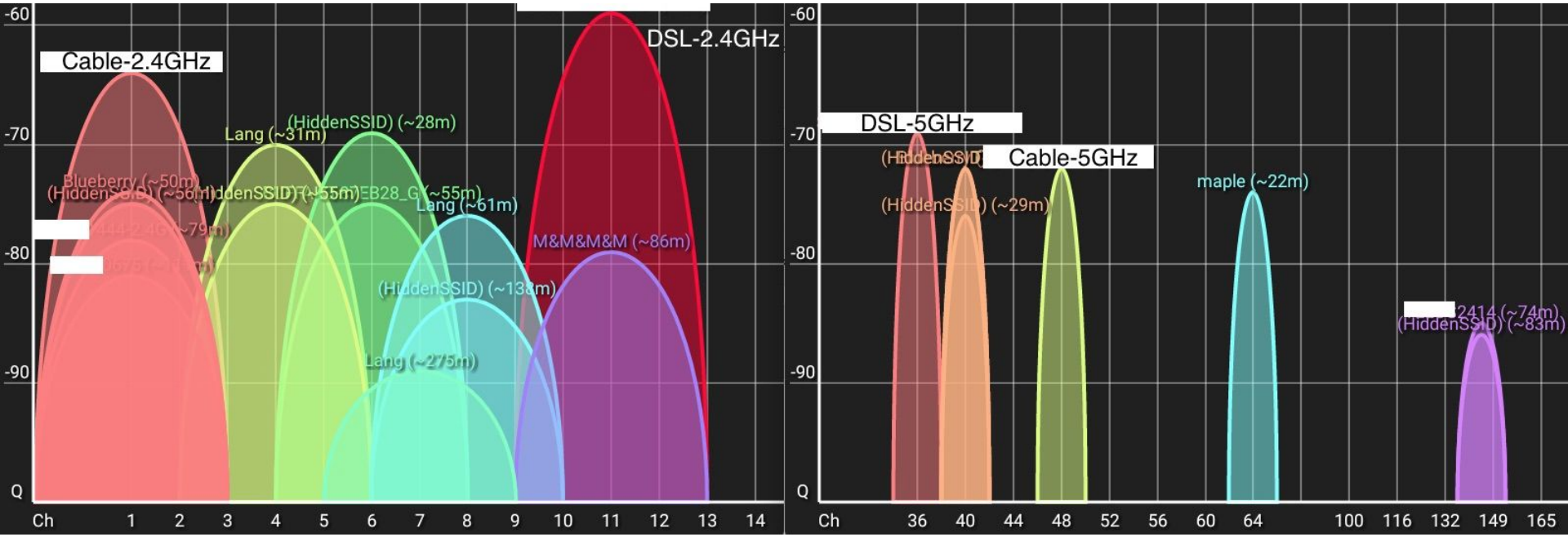
Wireless LAN

- IEEE 802.11 family
  - 802.11: 2.4GHz, 2Mbps
  - 802.11a: 5GHz, 54Mbps, 30ft
  - 802.11b: 2.4GHz, 11Mbps, 100ft
    - 11 channels in North America
    - 3 non-overlapping channels: 1, 6, 11
  - 802.11g: 2.4GHz, 54Mbps, 100ft
    - OFDM: frequency division
  - 802.11n: new radio, 2.4GHz, 540Mbps

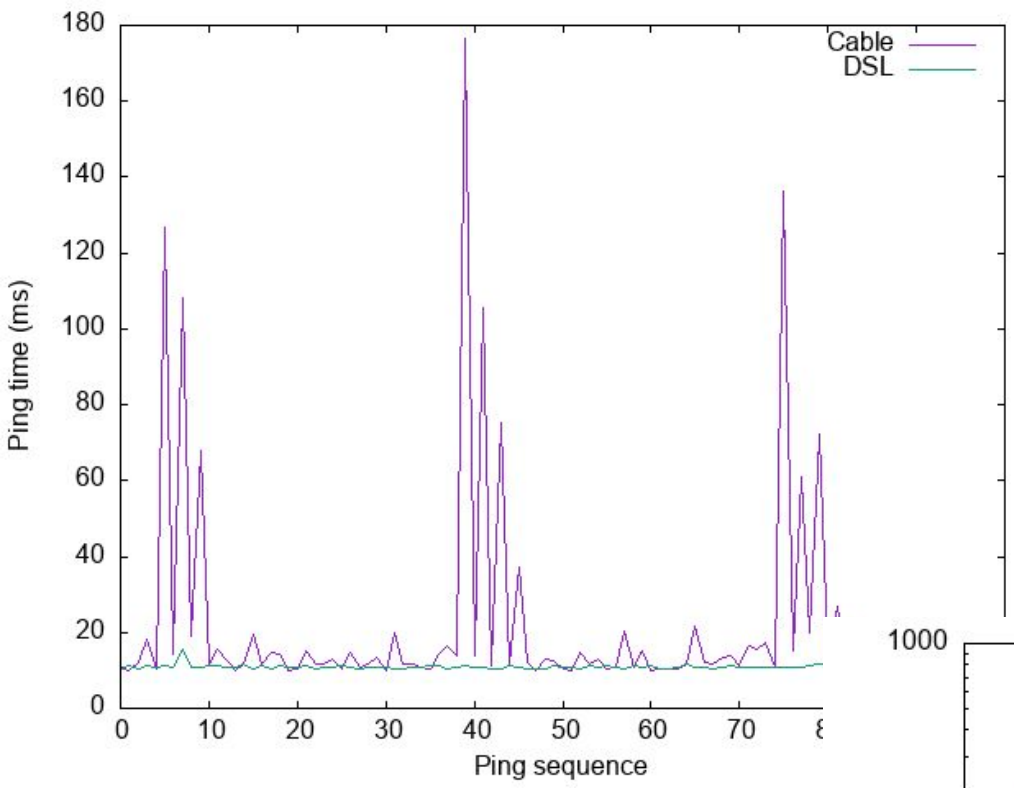
802.11ac: gigabit WiFi? * 802.11ax (WiFi 6) * 2.4GHz or 5GHz?

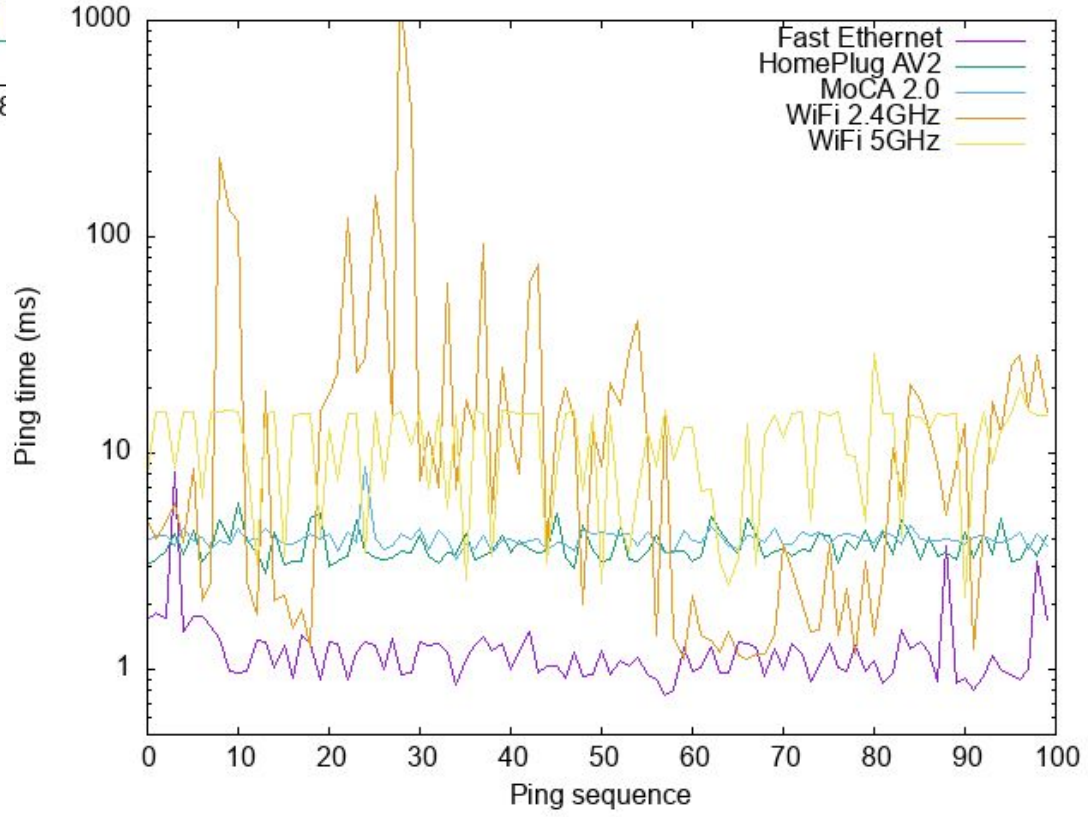
A neighborhood scan

- 2.4GHz vs 5GHz



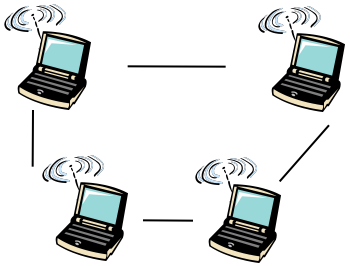
Internet access from home

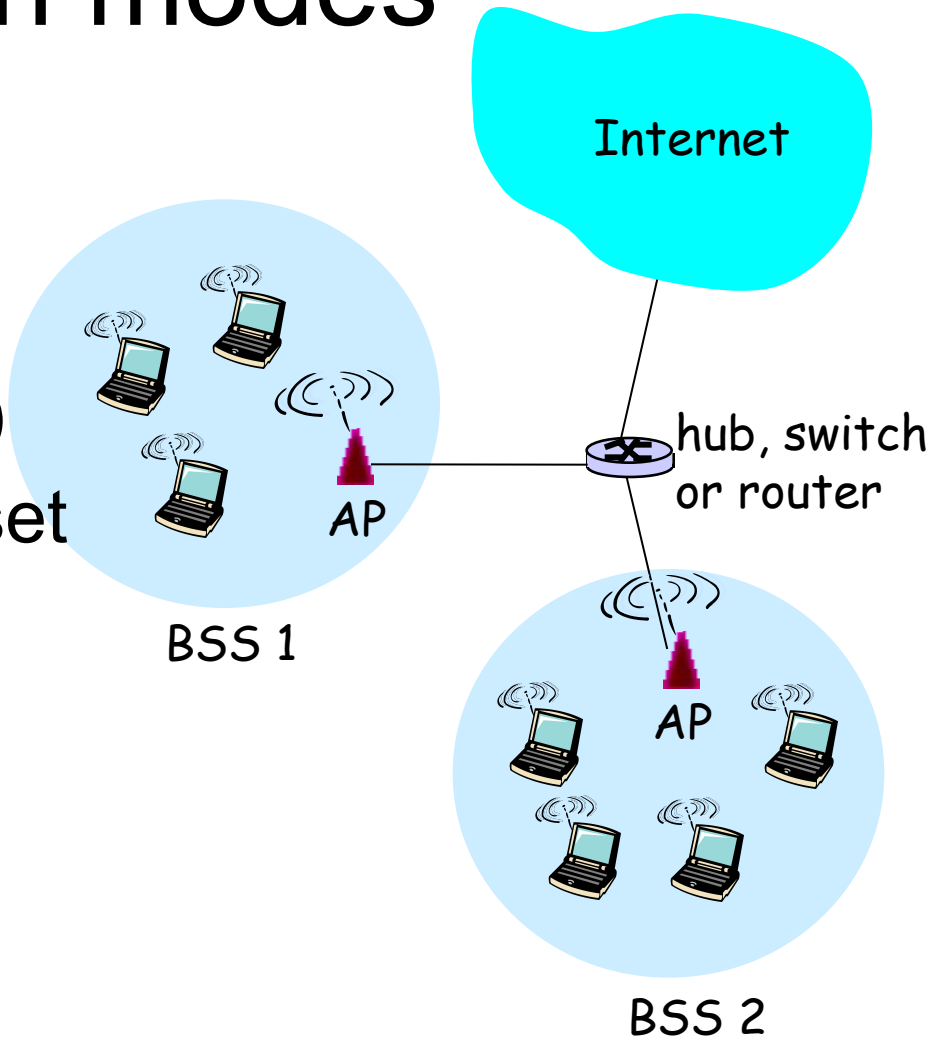




Operation modes

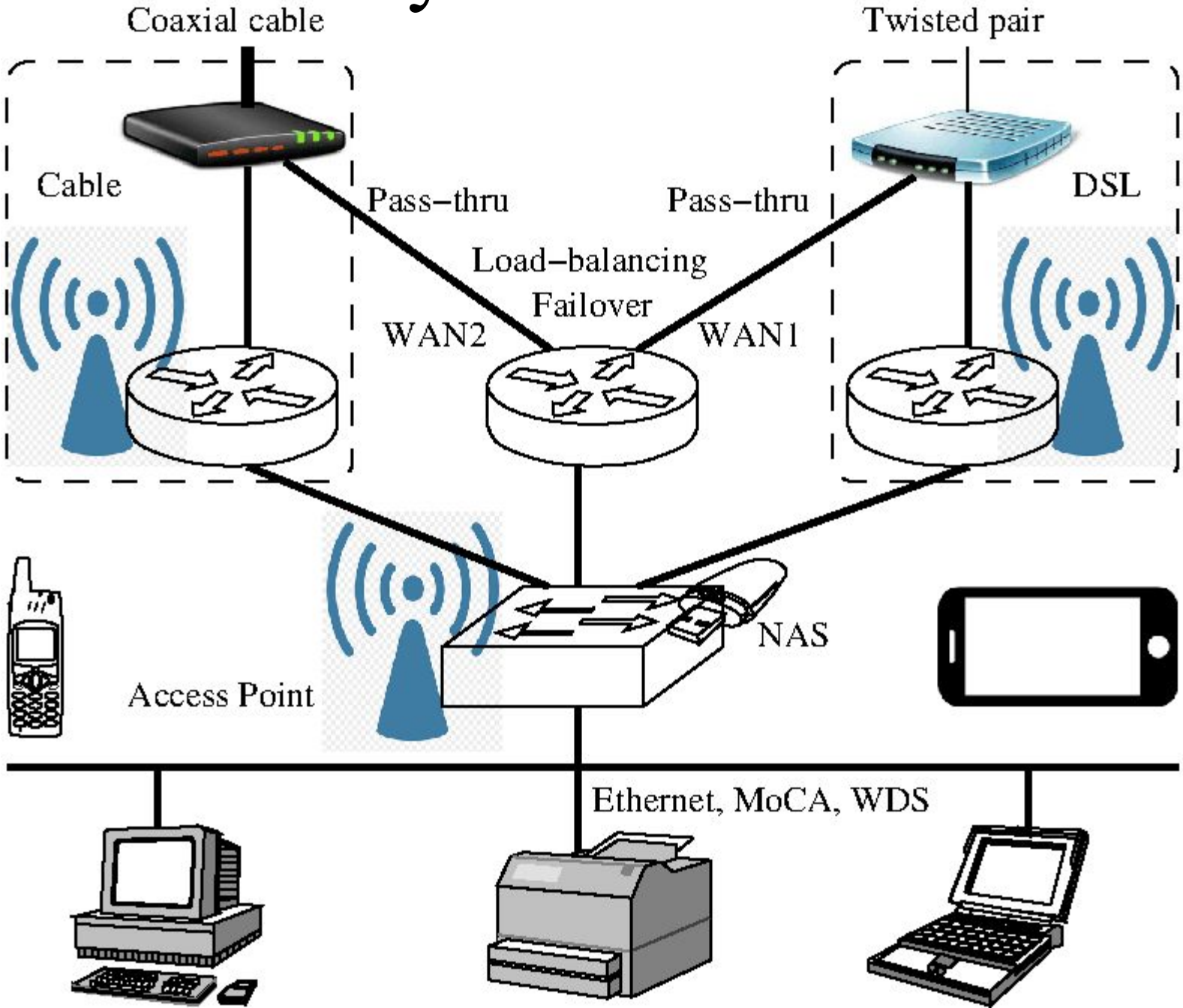
- Infrastructure mode
  - AP: access point
  - wireless station (sta)
  - BSS: basic service set
- Ad-hoc mode
  - no AP





* roaming on campus vs at home? http://tinyurl.com/tfhnsp

A hybrid network



Operation procedures

- Association
  - channel scanning
  - beacon frame from AP
  - list and select AP to associate
- Authentication
  - network/user authentication
  - and possibly encryption
- Configuration
  - e.g., DHCP to configure network parameters

Q: WEP (in)security

Media access control

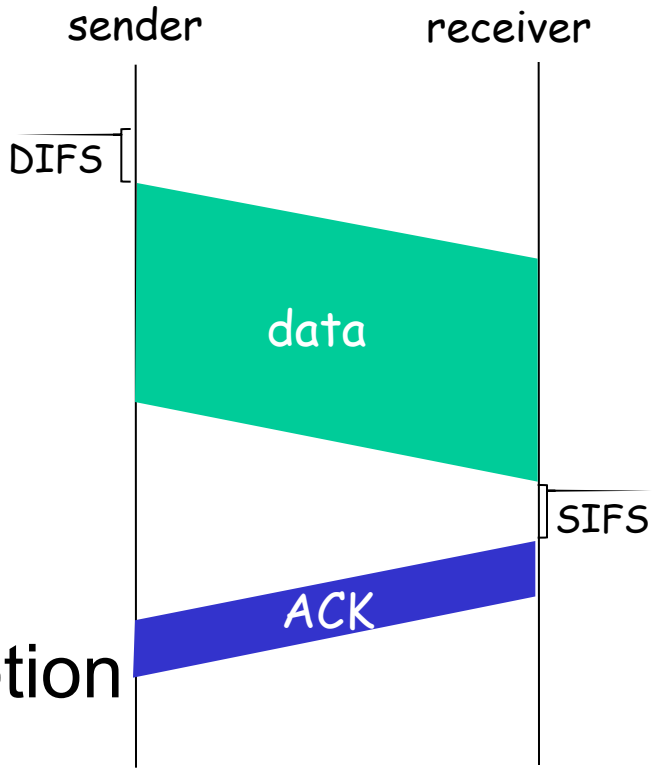
- Contention-free
  - PCF: point coordination function
    - e.g., AP
  - optional (not widely implemented)
- Contention-based
  - DCF: distributed coordination function
  - widely implemented
  - CSMA/CA

DCF

- Like Ethernet, uses CSMA:
  - random access
  - carrier sense: don't collide with ongoing transmission
- Unlike Ethernet:
  - no collision detection – transmit all frames to completion
  - acknowledgment – because without collision detection, you don't know if your transmission collided or not
- Why no collision detection?
  - difficult to receive (sense collisions) when transmitting due to weak received signals (fading)
  - can't sense all collisions in any case: hidden terminal, fading
- Goal: *avoid collisions:* CSMA/C(ollision)A(voidance)

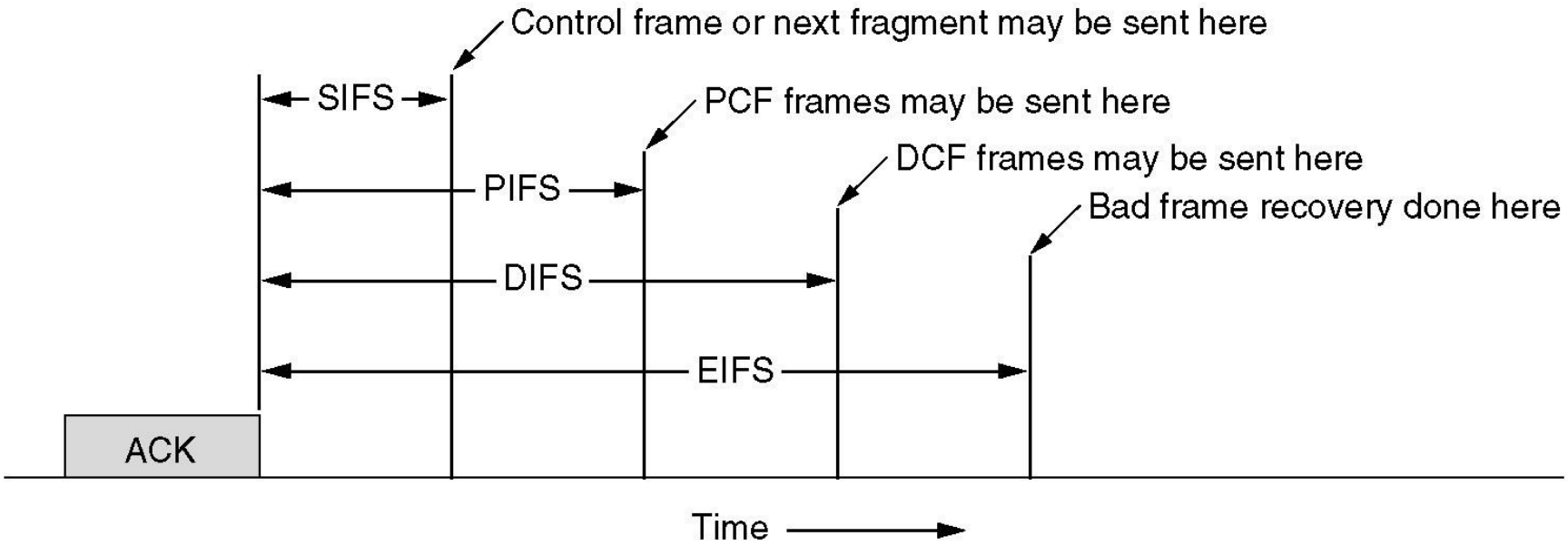
CSMA/CA

- CSMA
- CA: collision avoidance
  - if idle for DIFS, transmit
  - if busy, random back-off
    - count down when idle
    - transmit when count to 0
  - if no ack, collision or corruption
    - exponential backoff
    - CW: contention window

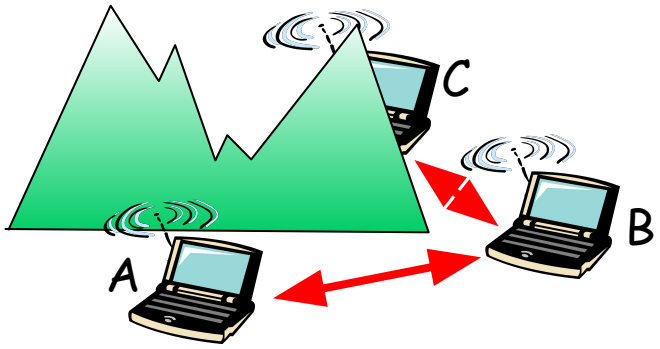


Inter-frame spacing

- SIFS: control frames or fragments
- DIFS: DCF frames



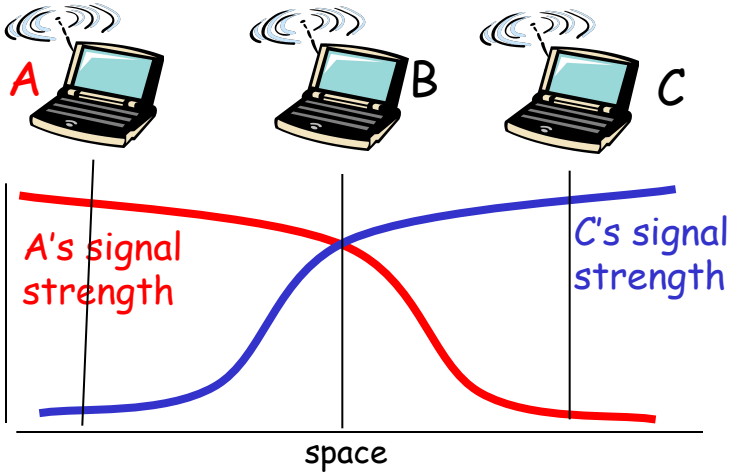
Hidden terminal problems



Hidden terminal problem

- B, A hear each other
- B, C hear each other
- A, C can not hear each other

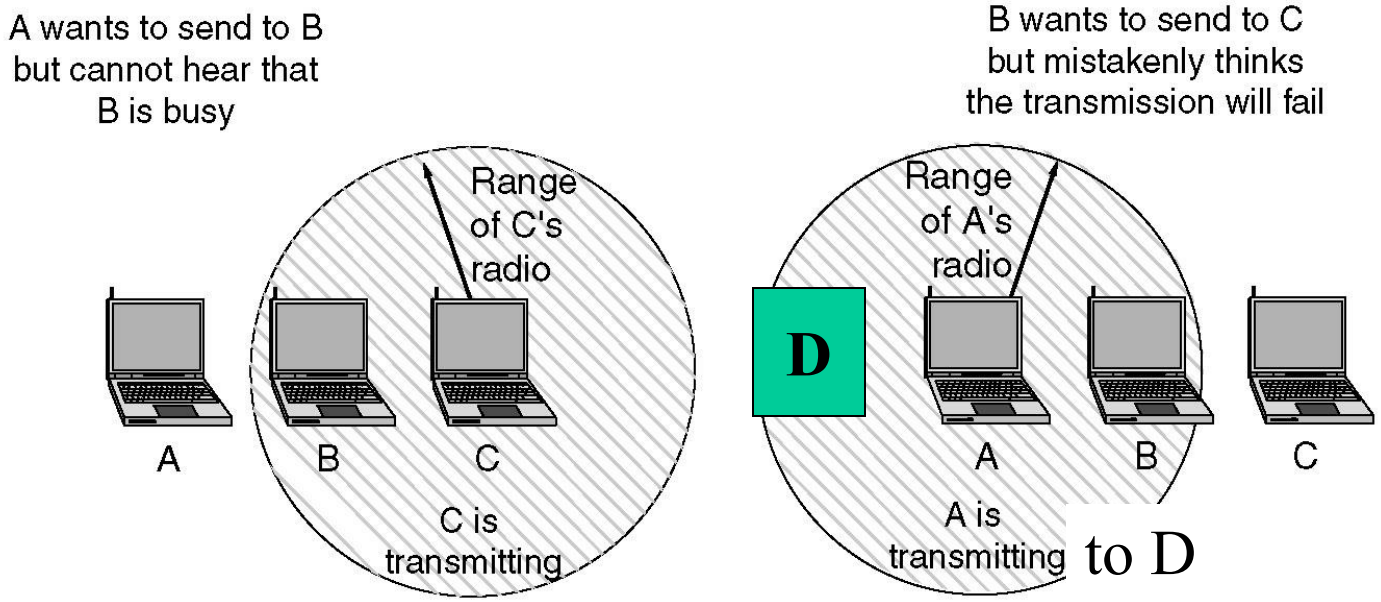
means A, C unaware of their interference at B



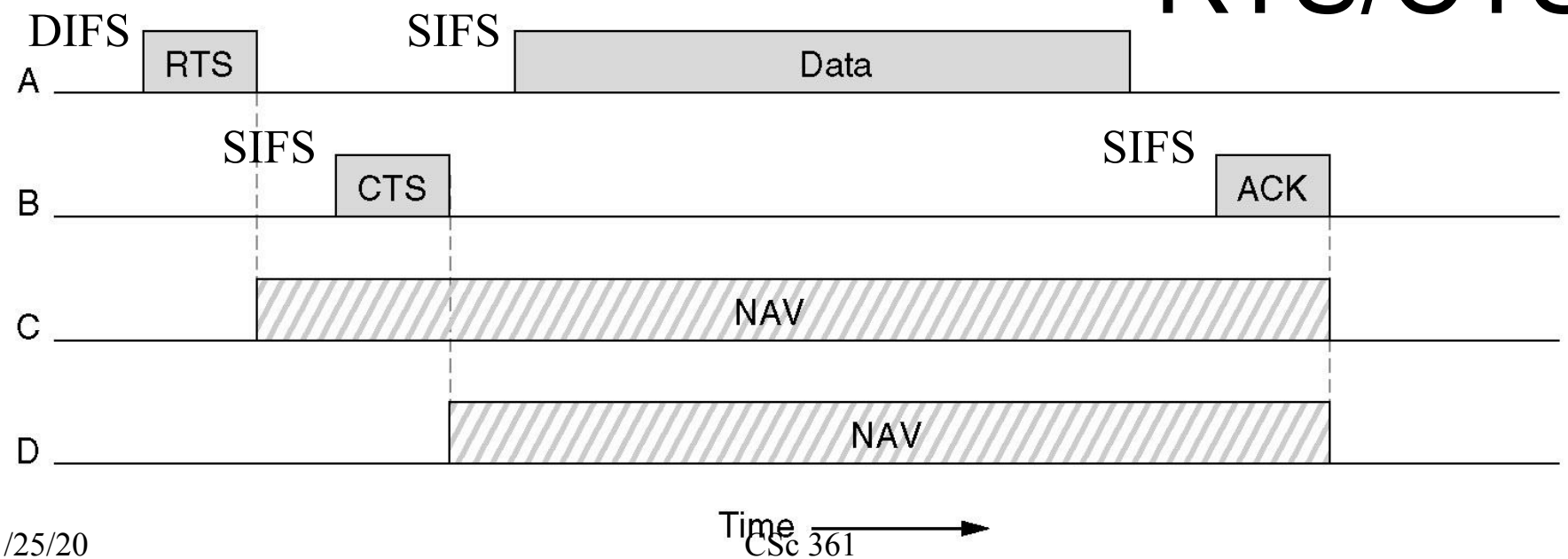
Signal fading:

- B, A hear each other
- B, C hear each other
- A, C can not hear each other interfering at B

Hidden vs exposed terminal



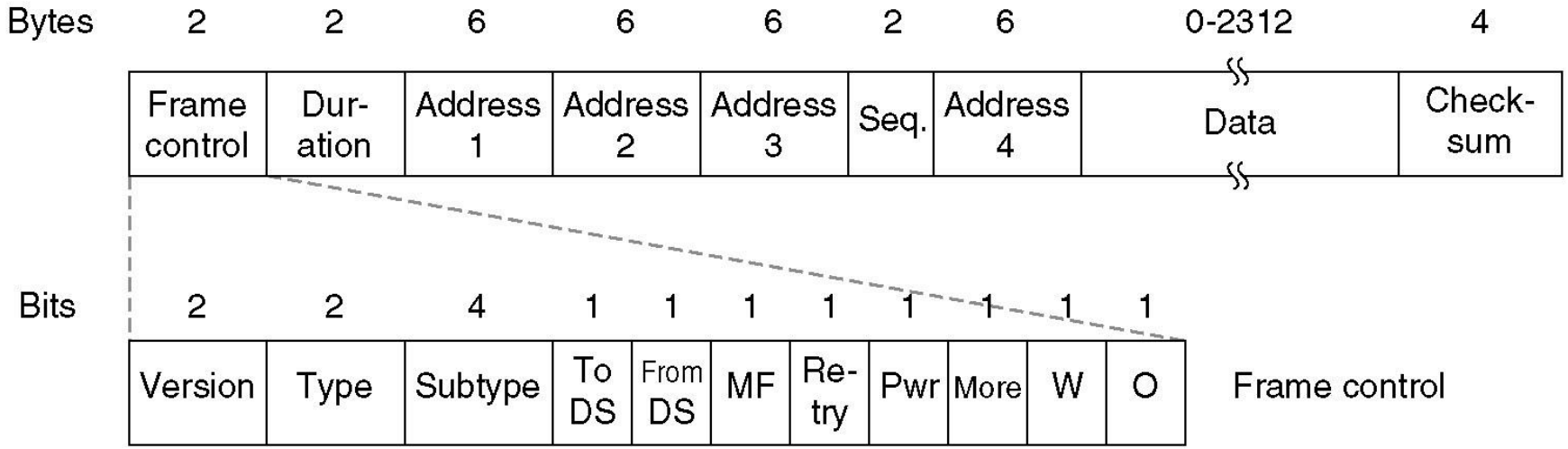
RTS/CTS



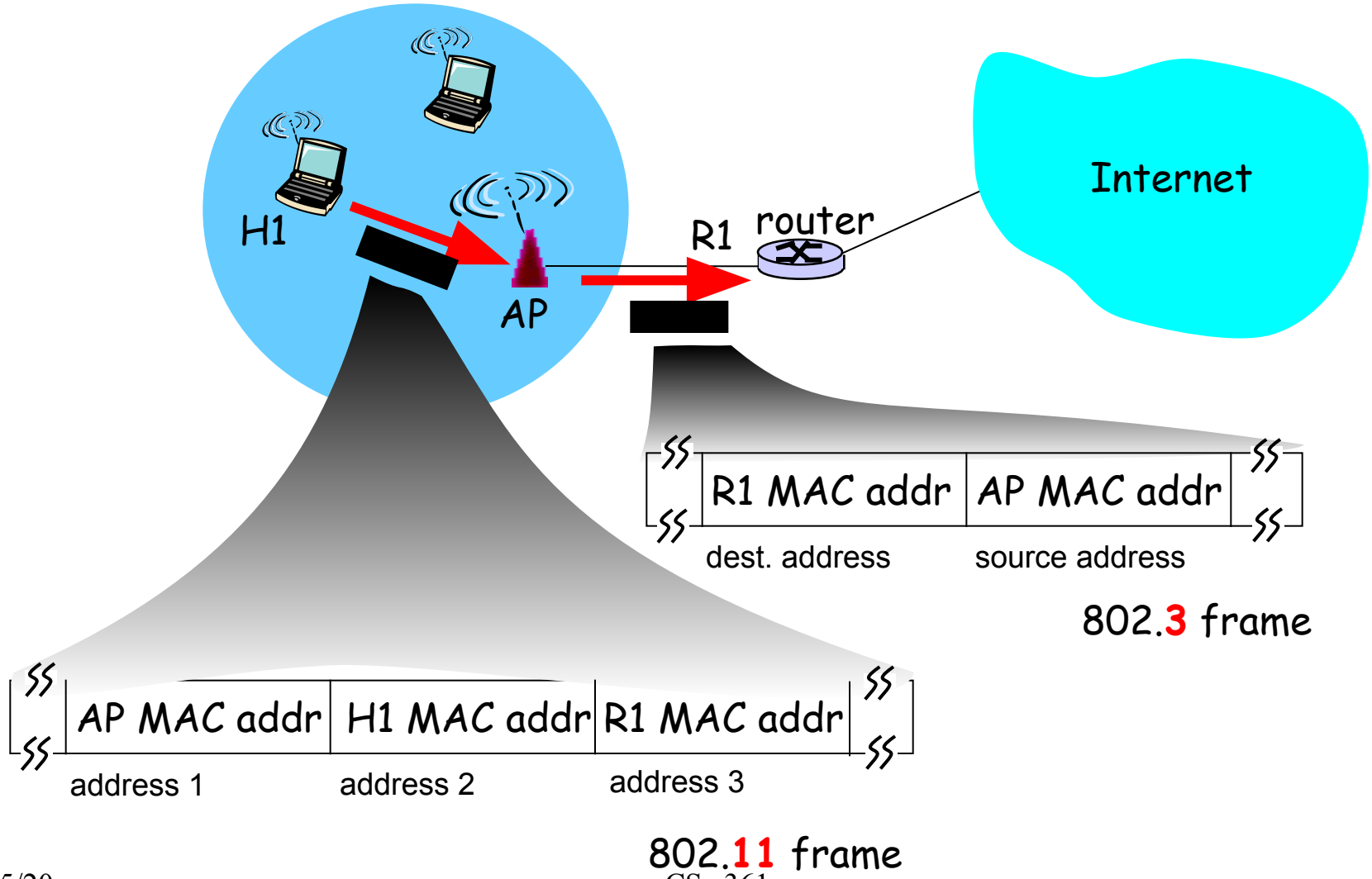
* check whether RTS/CTS can improve your WiFi performance at home

802.11 frame

- Frame control
- Duration: NAV (network allocation vector)
- Addresses: dst, src, receiving, transmitting



802.11 frame: addressing



This lecture

- Wireless LAN
  - CSMA/CA
    - why not CSMA/CD
  - RTS/CTS
    - hidden vs exposed terminal
  - IEEE 802.11 family
    - 802.11a/b/g/n/ac/ax
- Explore further
  - CSC463: Wireless and Mobile Networks

Next few lectures

- This Friday (Nov 27)
  - M3 preparation
  - Guest lecture: UVicNet in Days of CoViD-19
    - by Ron Kozsan, UVic Director of Infrastructures
- Next Tuesday (Dec 1): Interworking
  - Put all things together
  - DNS (name -> IP), ARP (IP -> Ethernet), etc
- Next Wednesday (Dec 2): Term Review
- Next Friday (Dec 4): M3

Teaching from Home: Network Support Perspectives

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* teach4theheart.com


* weareteachers.com

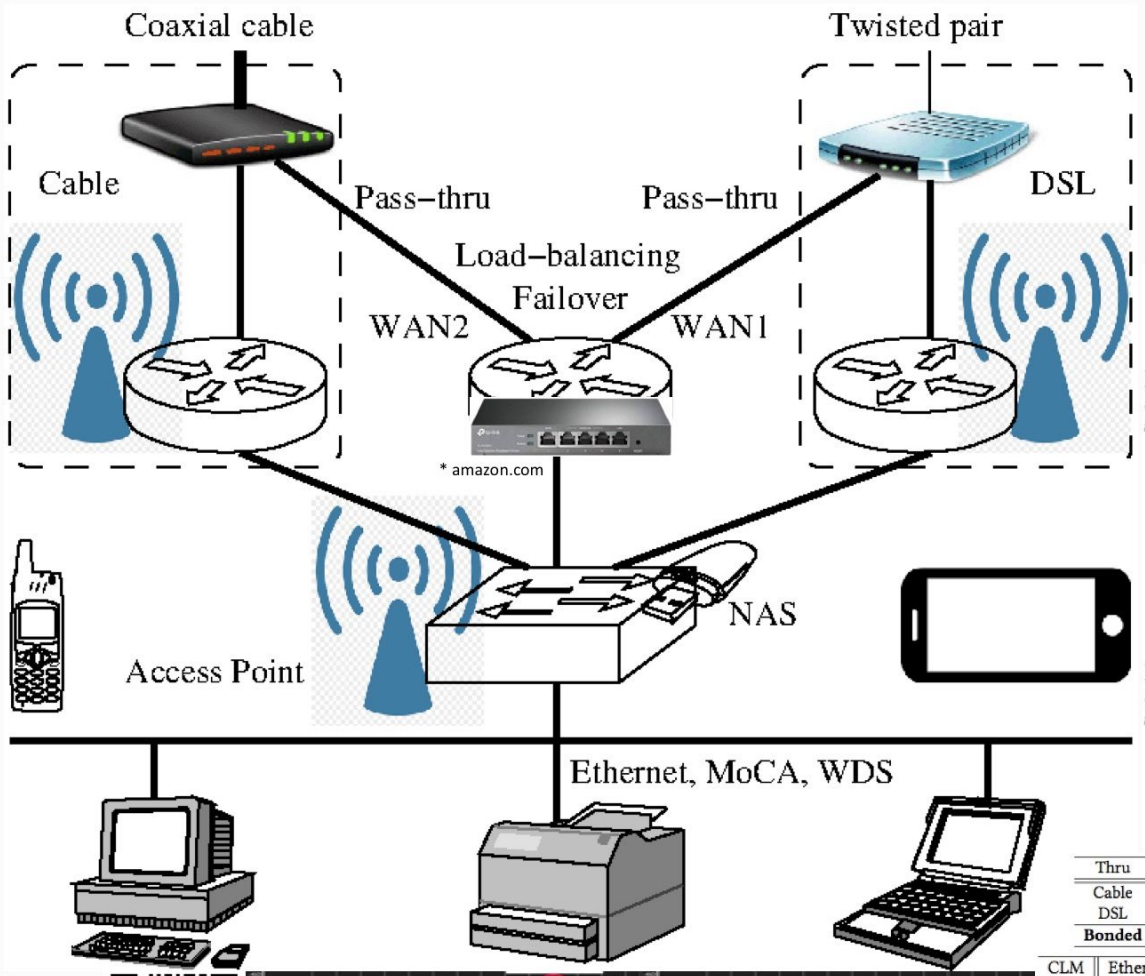
1. Pedagogical challenges
2. Technical challenges

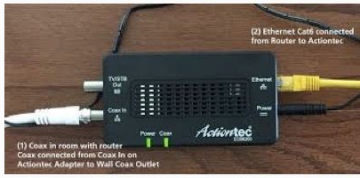
How?

* worldsofeducation.org

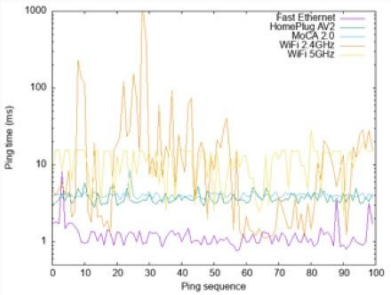

* pressandguide.com

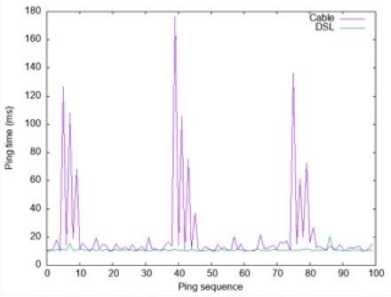

• jordanlewis.org





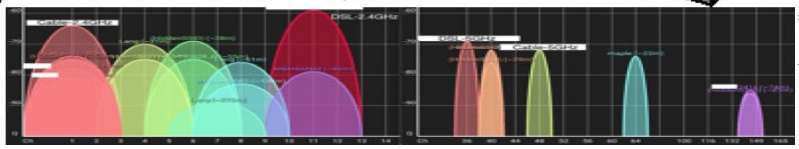
* forums.att.com





Thru	To Cable hosted server	DSL (ping, down/upload)
Cable	13 ms, 59.18/5.28 Mbps	13 ms, 57.43/5.32 Mbps
DSL	11 ms, 24.55/2.84 Mbps	10 ms, 24.25/2.81 Mbps
Bonded	11 ms, 80.99/8.15 Mbps	10 ms, 83.03/8.14 Mbps

CLM	Ethernet	WiFi	Cable (t: timer)	DSL (down/up)
App	0/0 sec	1/0 sec	t/0 sec	t/t sec
Web	40/0 sec	40/0 sec	3t/0 sec	2t/3t sec



http://tinyurl.com/tfhnsp

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