CS 655
Computer Networks

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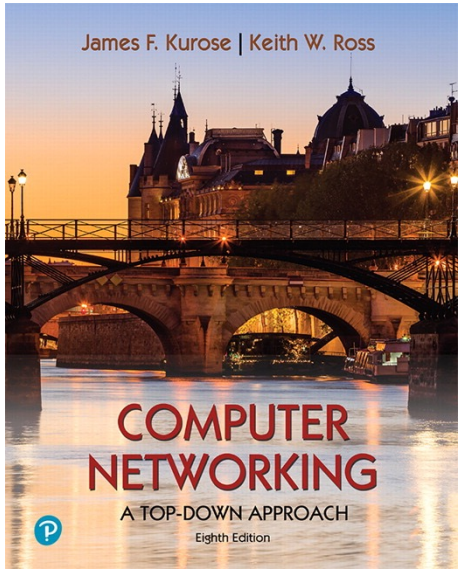
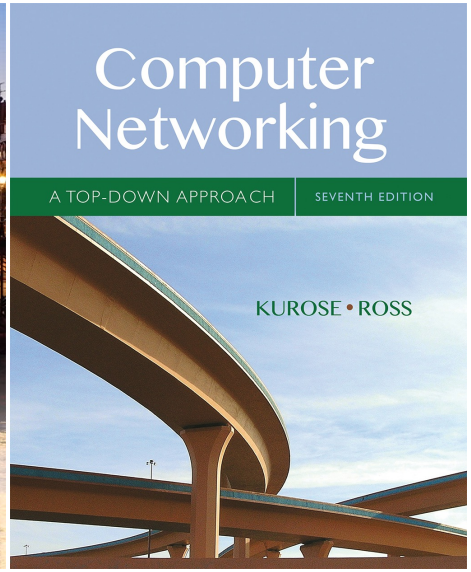
Chapter 7
Wireless and Mobile Networks



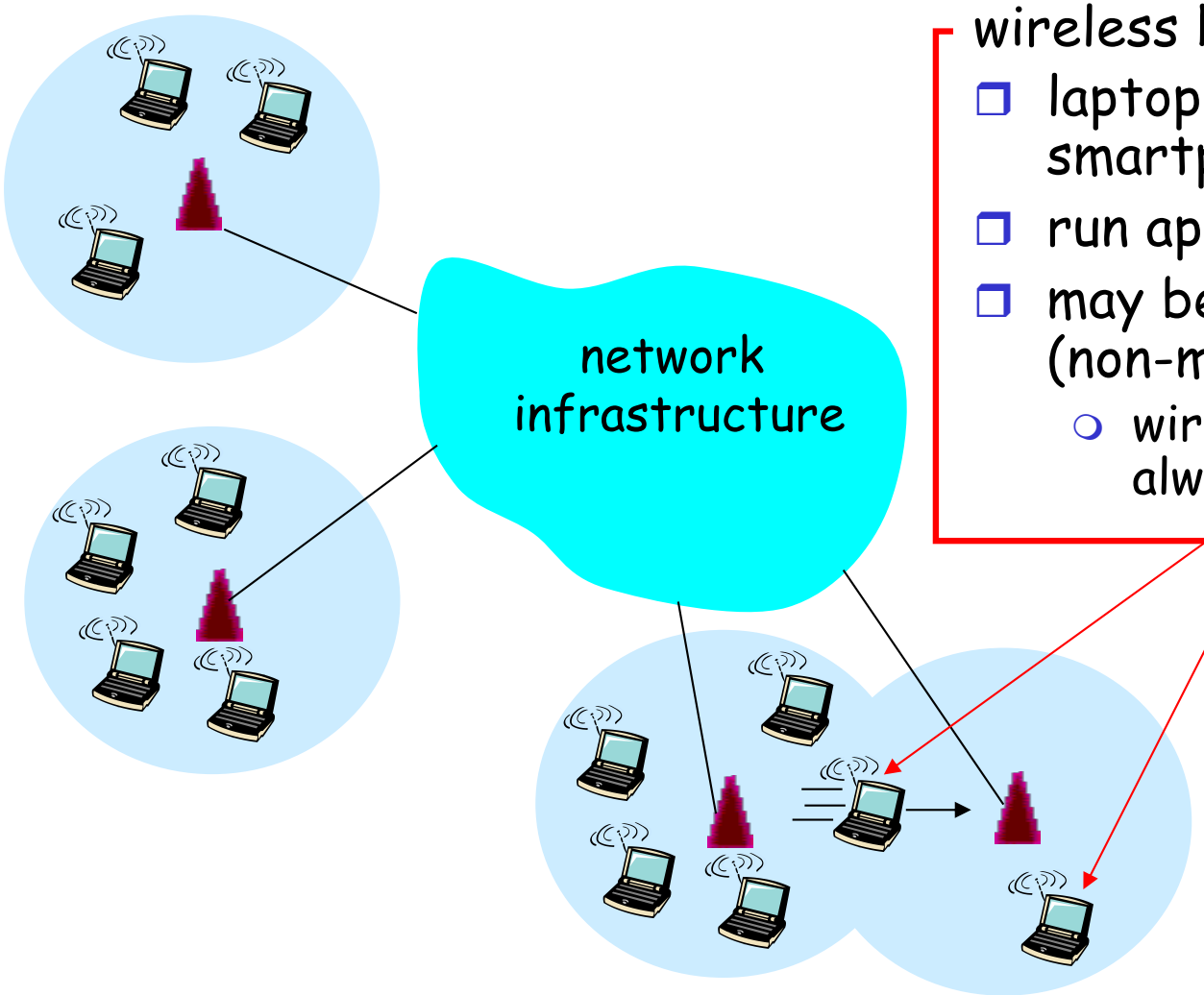


Computer Networking: A Top-Down Approach, 8th edition. Jim Kurose, Keith Ross. Pearson. 7th edition is OK too!

Challenges

- Higher BER (Bit Error Rate) over wireless link
  - more susceptible to attenuation, noise
  - usually link-level ARQ employed
- Wireless devices (laptops, tablets, smartphones) can be mobile
  - change point of attachment to network
  - how to keep communication going?

Elements of a wireless network

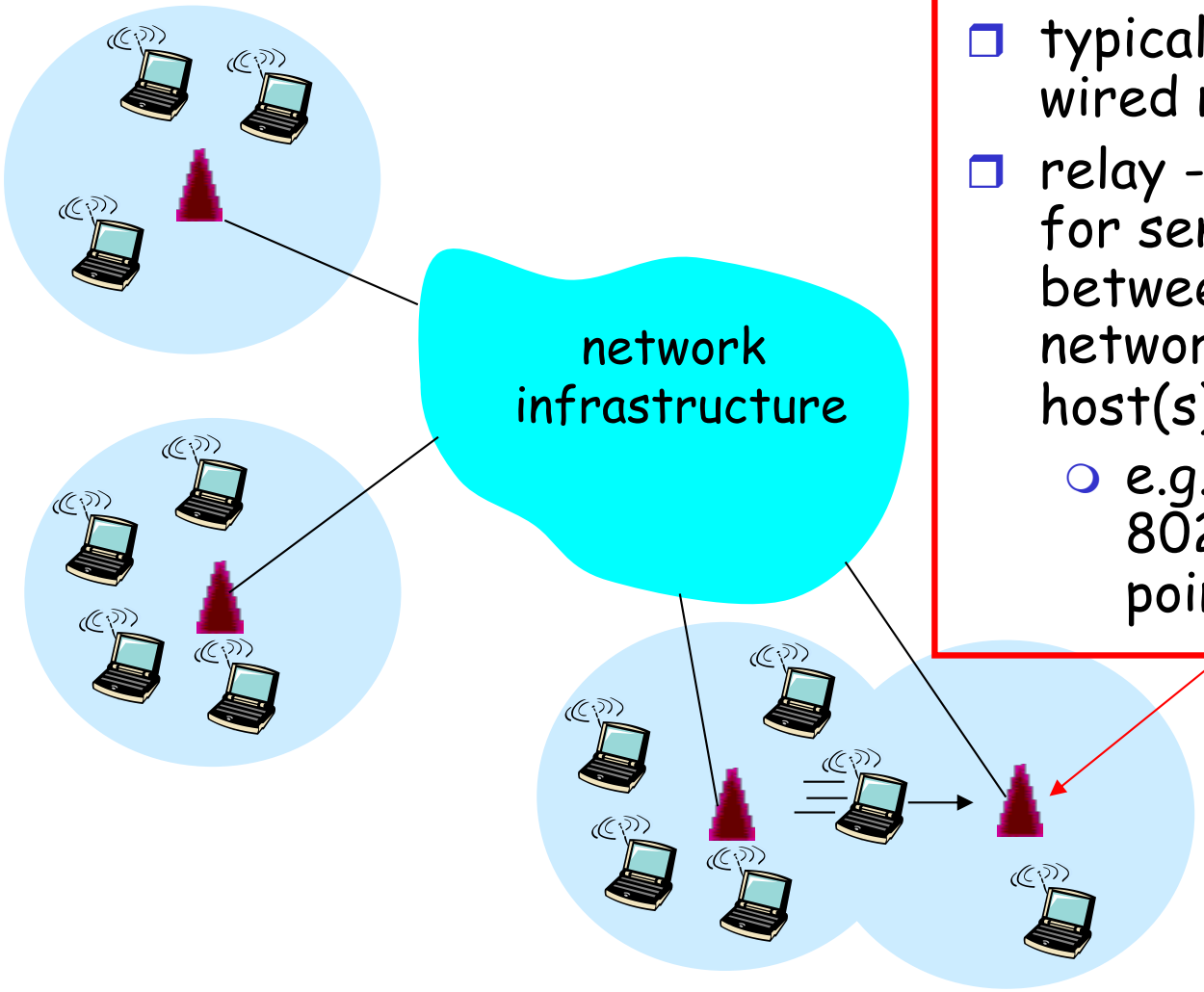


wireless hosts

- laptop, tablet, smartphone
- run applications
- may be stationary (non-mobile) or mobile
  - wireless does *not* always mean mobility

wireless ≠ mobility

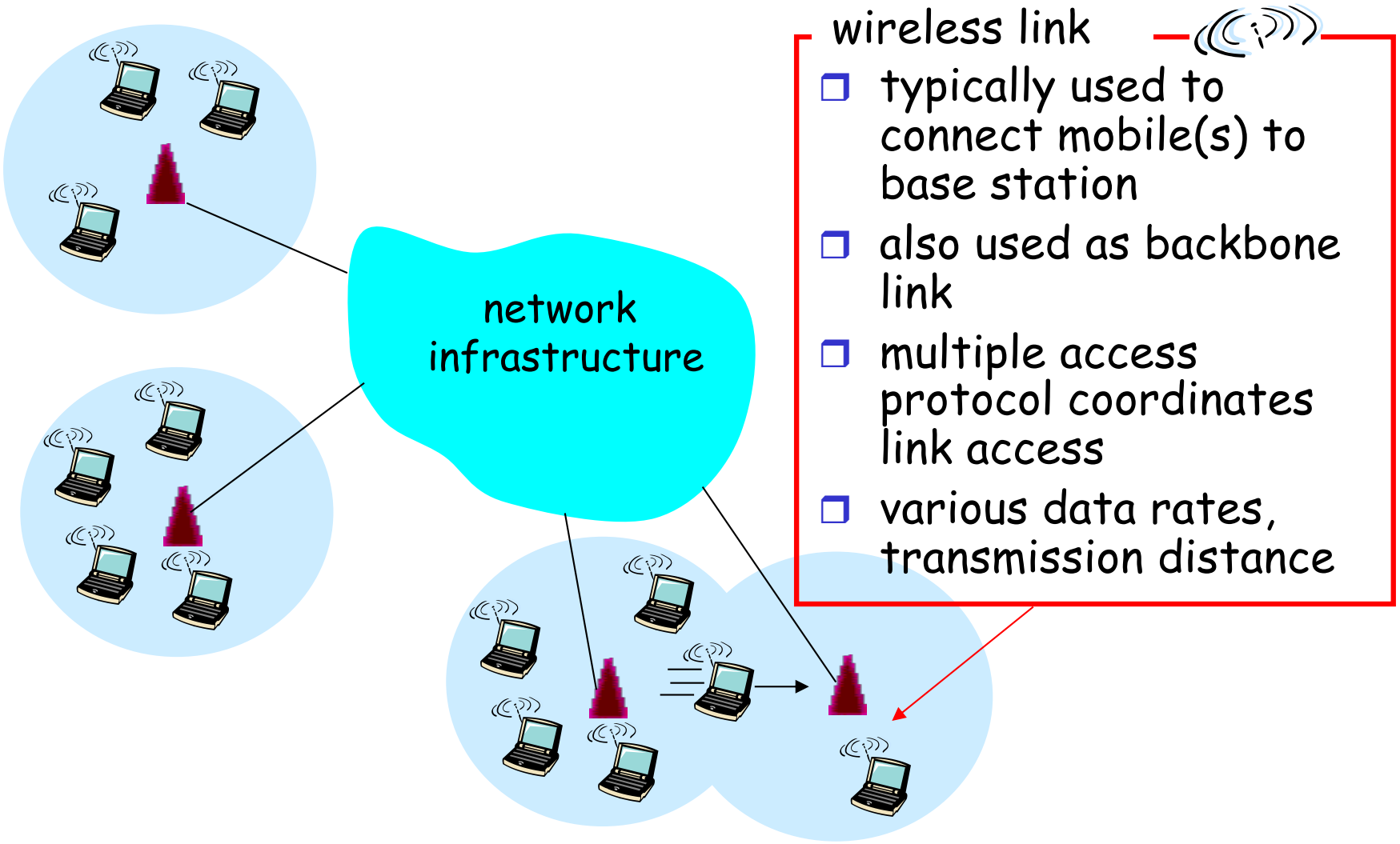
Elements of a wireless network



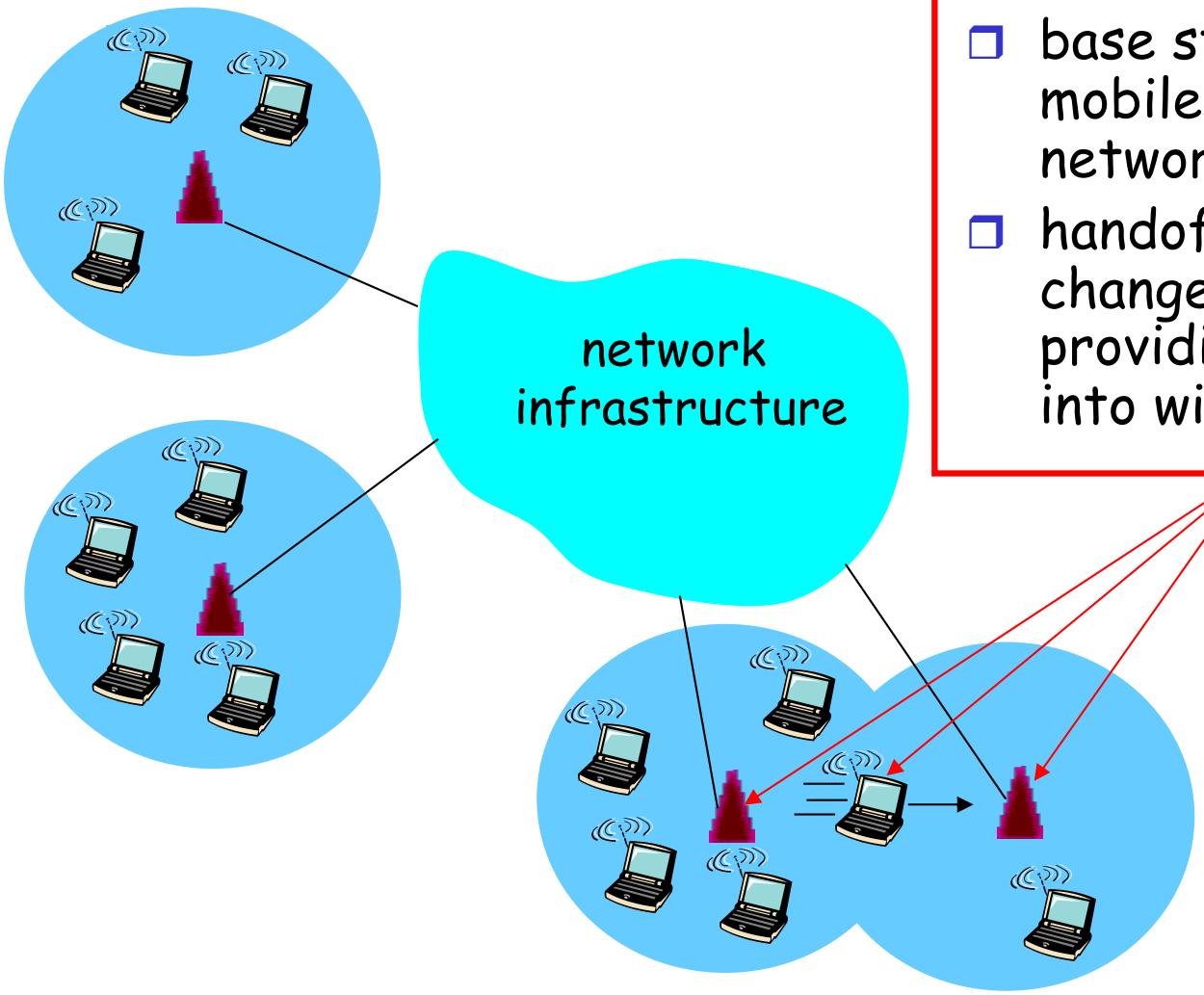
base station

- typically connected to wired network
- relay - responsible for sending packets between wired network and wireless host(s) in its "area"
  - e.g., cell towers, 802.11 access points

Elements of a wireless network



Elements of a wireless network

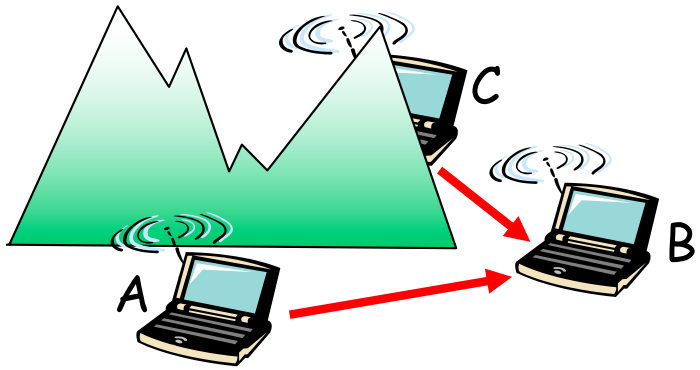


infrastructure mode

- base station connects mobiles into wired network
- handoff: mobile changes base station providing connection into wired network

Wireless network characteristics

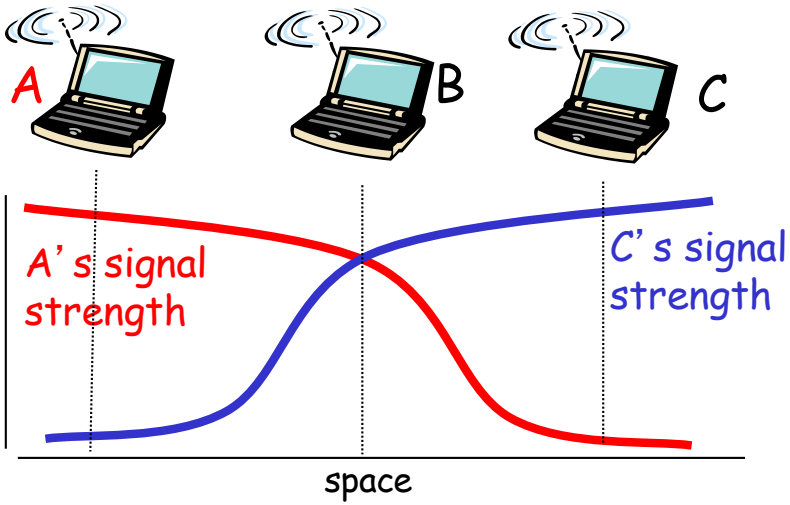
Multiple wireless senders and receivers create additional problems (beyond multiple access):



Hidden terminal problem

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

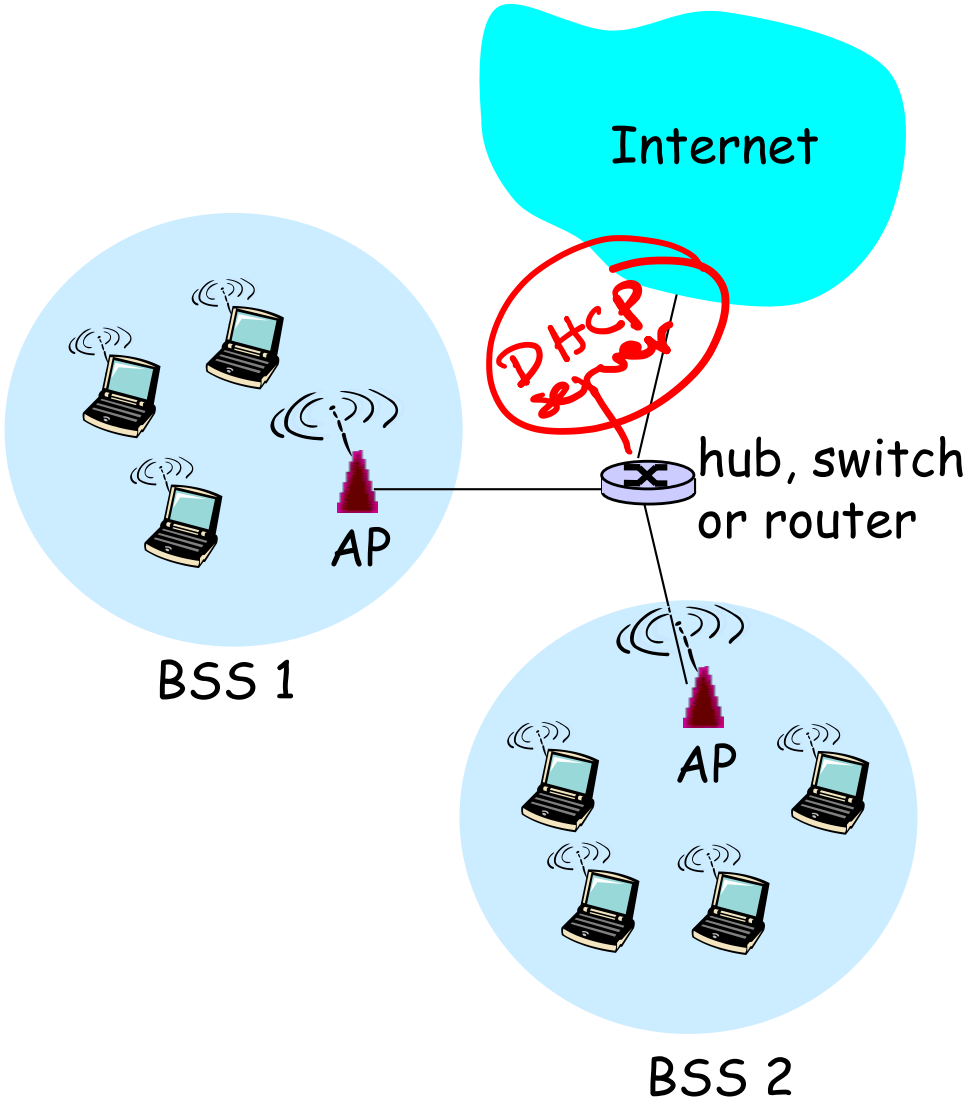
means **A, C unaware of their interference at B**



Signal fading:

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

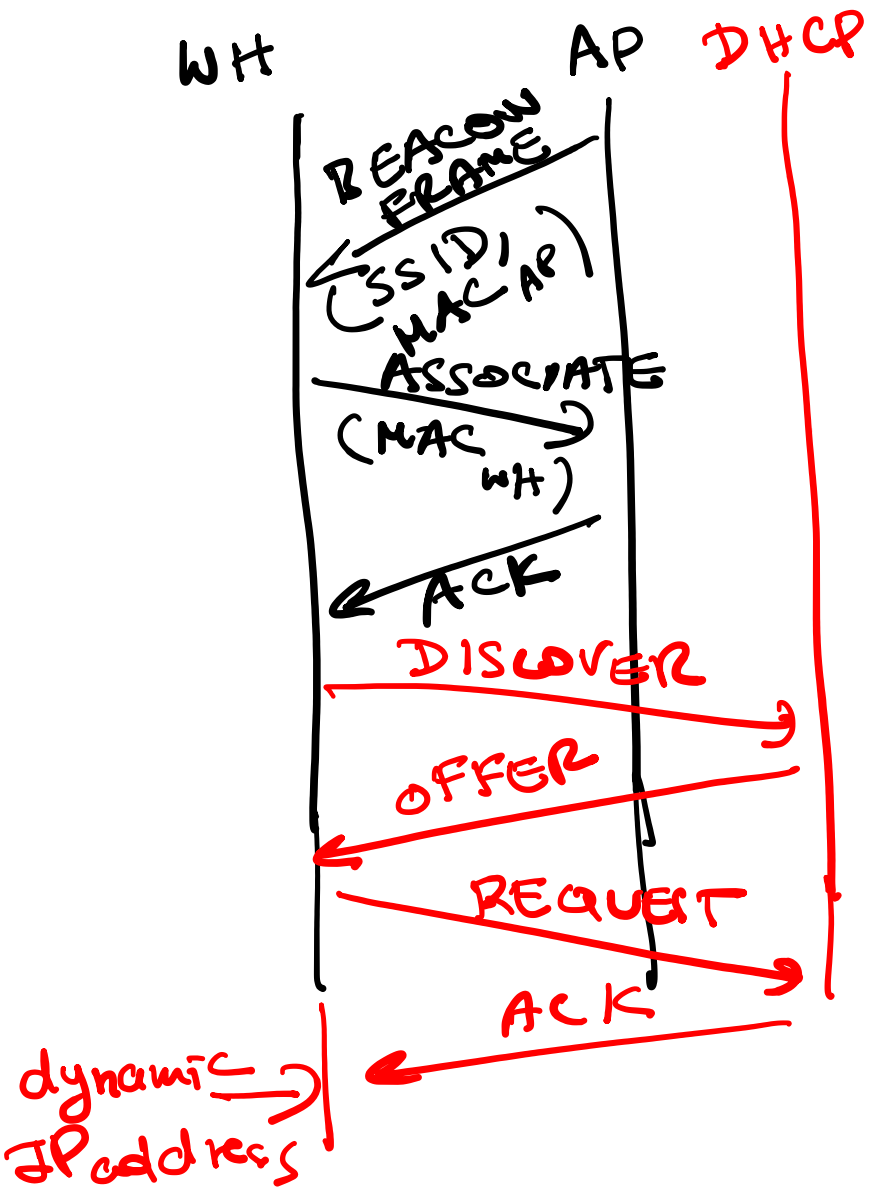
802.11 LAN (Wi-Fi) architecture



- wireless host communicates with base station
  - base station = access point (AP)
- Basic Service Set (BSS) (aka "cell") contains:
  - wireless hosts
  - access point (AP)

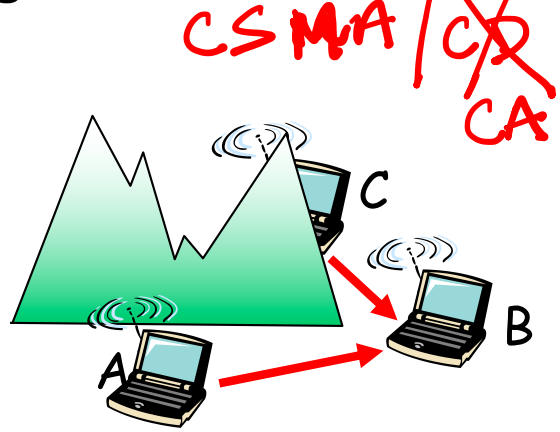
802.11 association

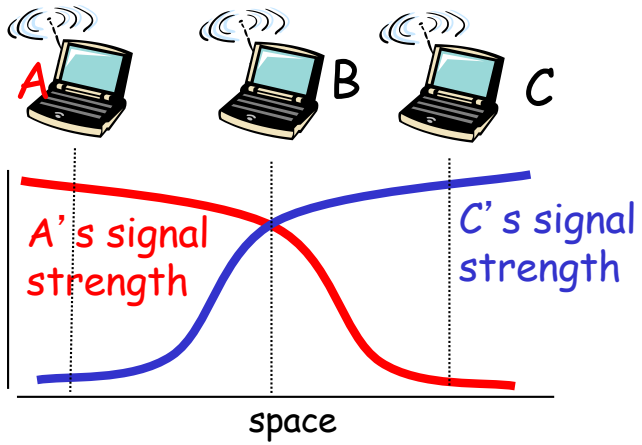
- host must *associate* with an AP
  - listens for *beacon frames* containing AP's name (SSID: Service Set ID) and MAC address
  - selects AP to associate with
  - will typically run DHCP to get IP address in AP's subnet



IEEE 802.11: multiple access

- avoid collisions: 2+ nodes transmitting at same time
- CSMA - sense before transmitting
  - don't collide with ongoing transmission by other node
- *no* collision detection!
  - difficult to receive (sense collisions) while 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)





IEEE 802.11 MAC Protocol: CSMA/CA

802.11 sender

1 if sense channel idle for **DIFS** then
    transmit entire frame (no CD)
2 if sense channel busy then
    2.1 start random backoff time
    timer counts down while channel idle
    transmit when timer expires
3 if no ACK, increase random backoff interval, repeat 2.1
4 if ACK and more to send, go to 2.1

802.11 receiver

- if frame received OK
  return ACK after **SIFS** (ACK needed due to hidden terminal problem)