

CSc 450/550
Computer Networks
Wireless LAN

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Review

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

Today's topics

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

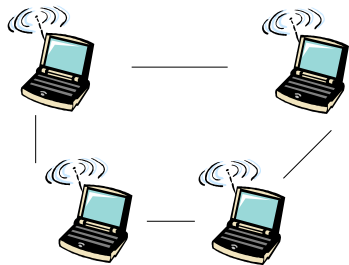
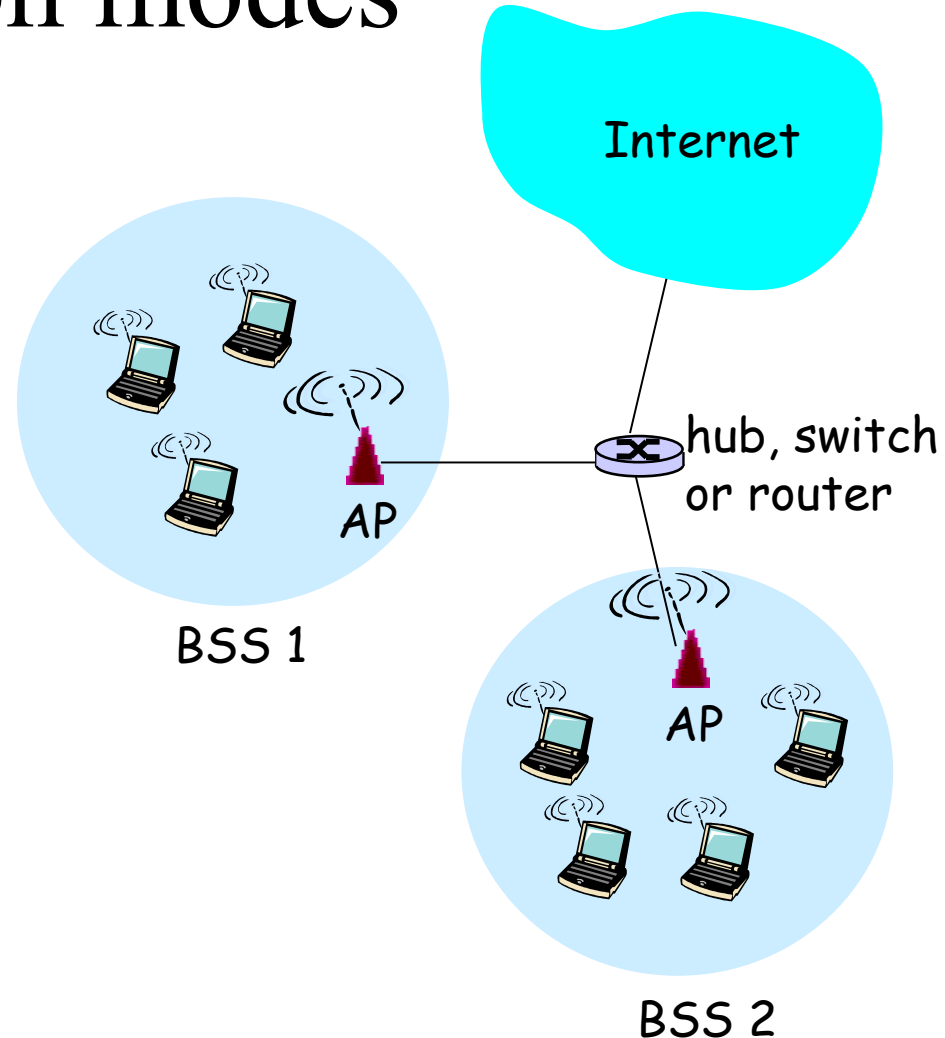
Wireless LAN

- 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



Operation modes

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



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

Media access control

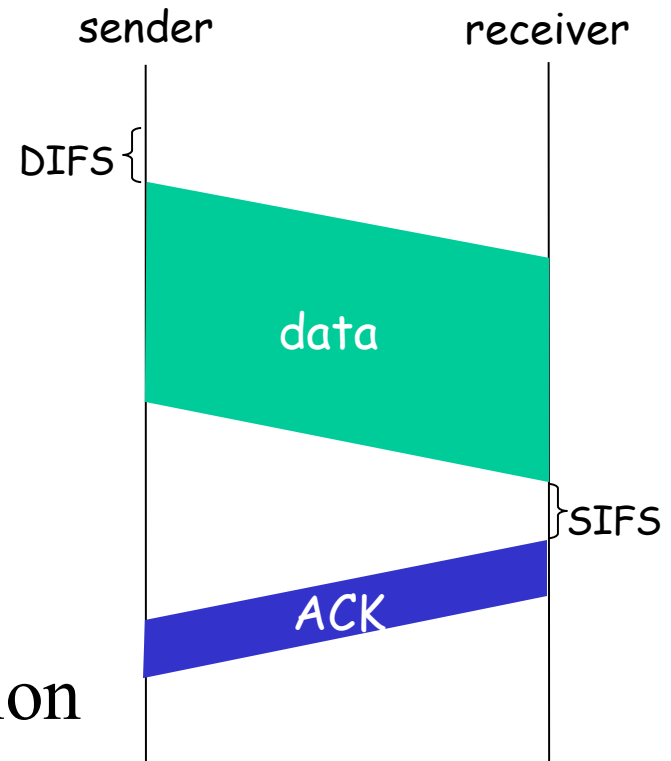
- Contention-free
 - PCF: point coordination function
 - e.g., AP
 - optional (not widely implemented)
- Contention-based
 - DCF: distributed coordination function
 - widely implemented
 - CSMA/CA

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)

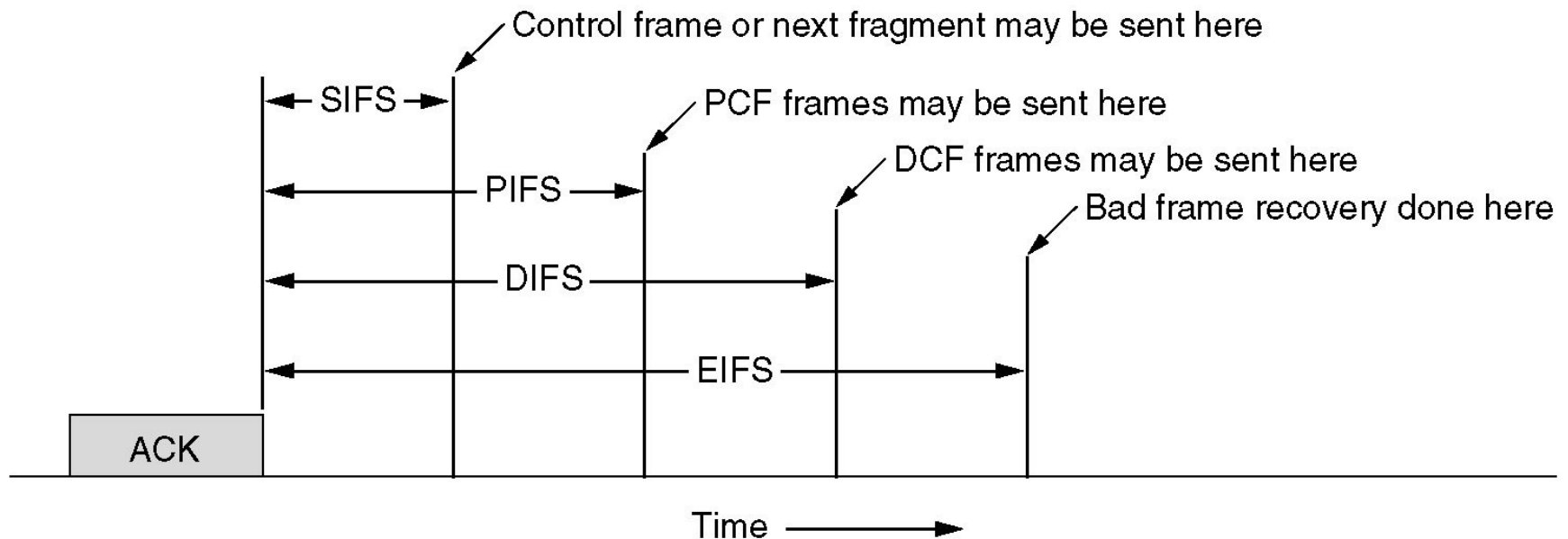
CSMA/CA

- 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

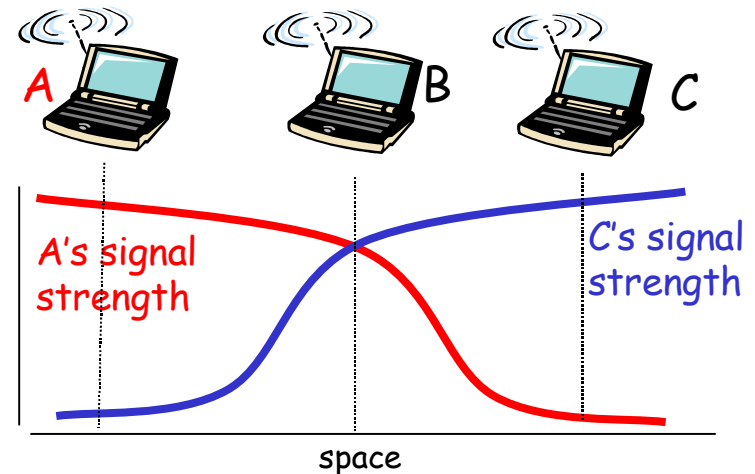
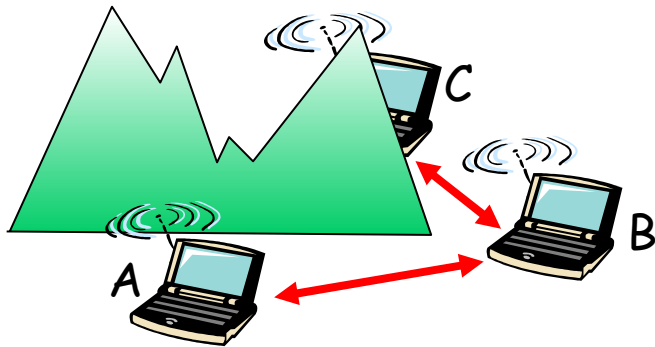


Inter-frame spacing

- 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

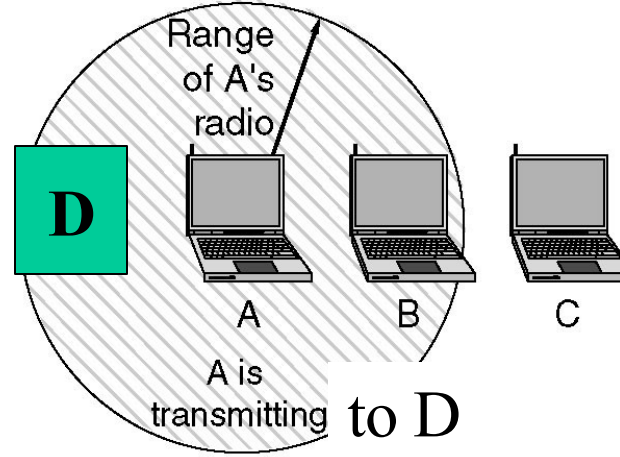
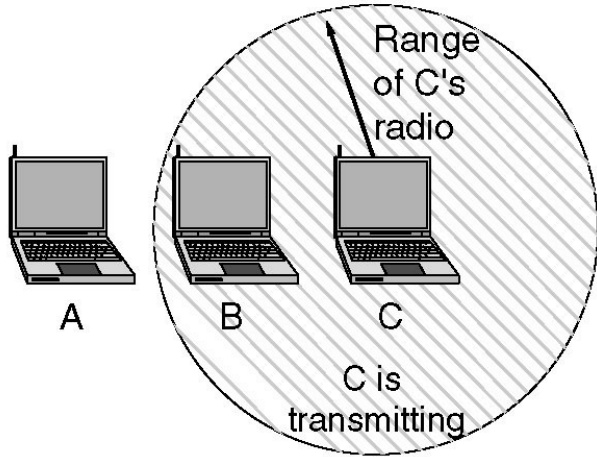
Signal fading:

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

A wants to send to B
but cannot hear that
B is busy

B wants to send to C
but mistakenly thinks
the transmission will fail

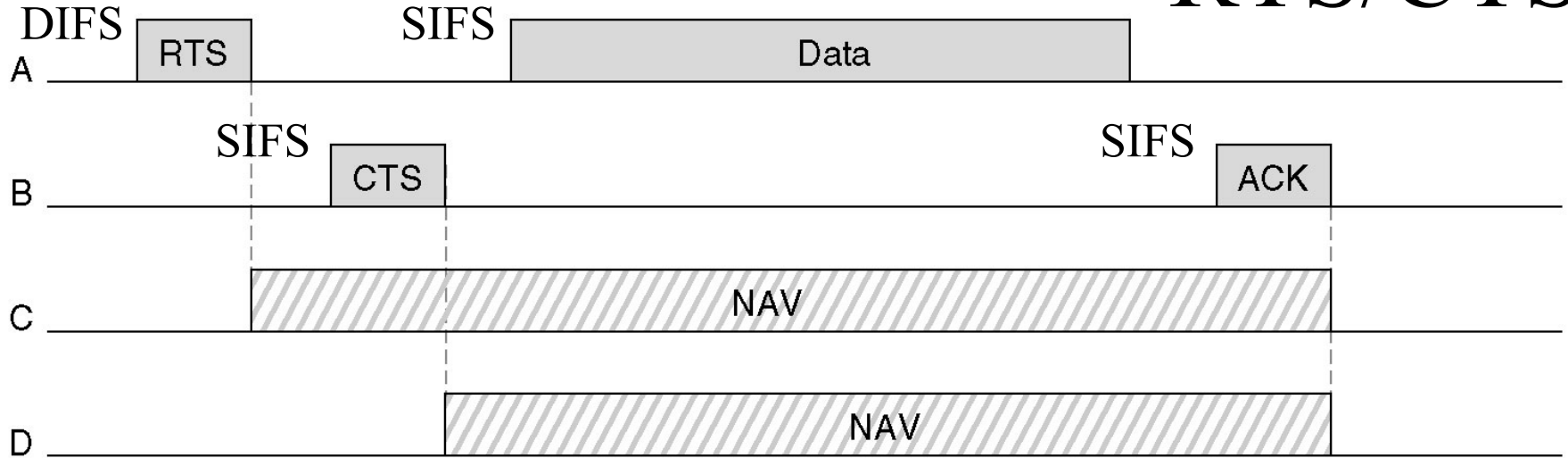
Hidden vs
exposed
terminal



(a)

(b)

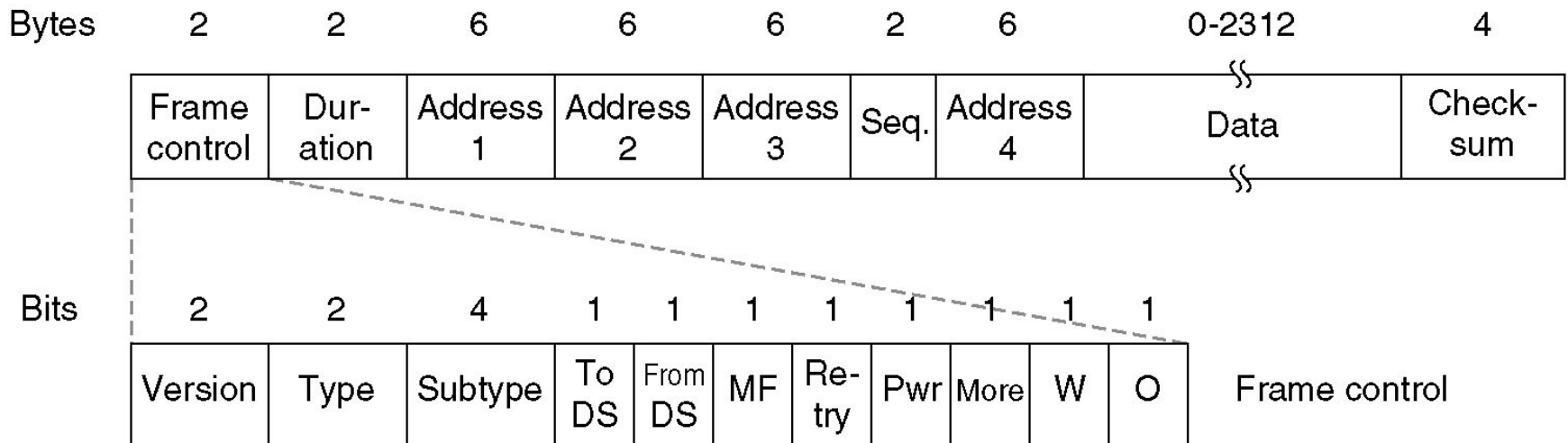
RTS/CTS



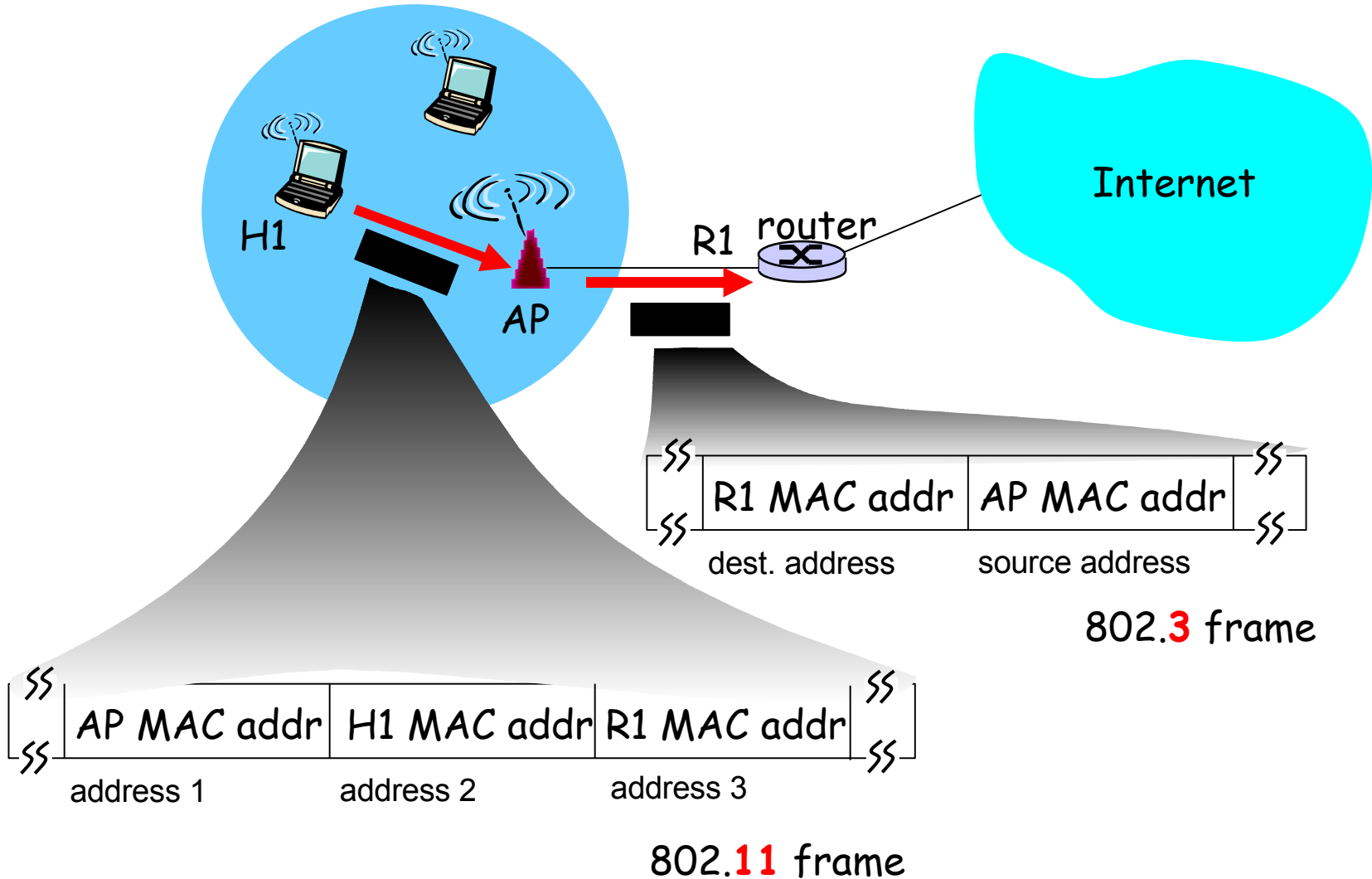
Time →

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
- Explore further
 - *new!* CSC463: Wireless and Mobile Networks

Next lecture

- July 30: Interworking
- August 2: 3rd in-class midterm exam
 - extra before-exam office hours: August 1
 - regular office hours: MR 10:30-11:30am
- Course evaluation: now!