# Chapter 7
Wireless and Mobile Networks

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Thanks and enjoy! JFK/KWR
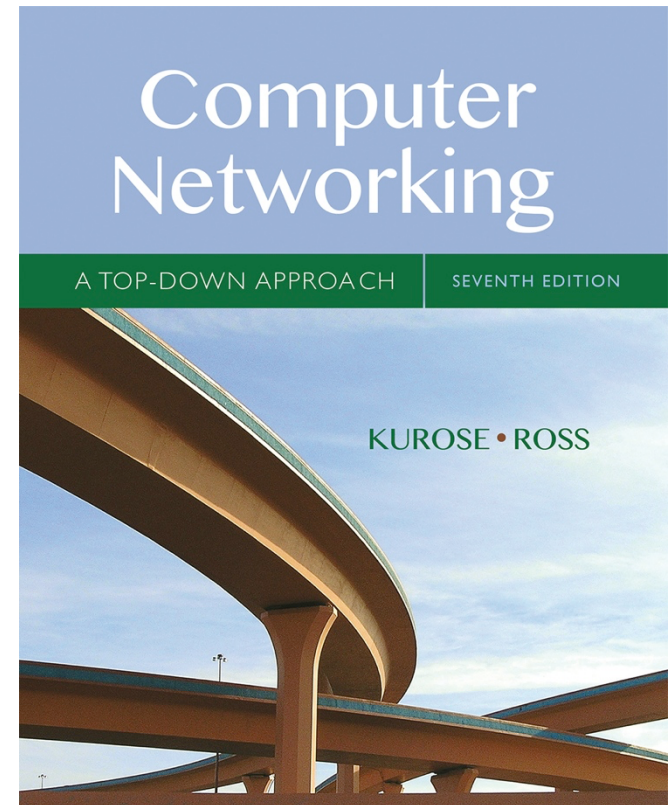
Computer Networking: A Top Down Approach

7th edition
Jim Kurose, Keith Ross
Pearson/Addison Wesley
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Minor modifications made to original slides by Nathan Bowman

Network Layer

IEEE 802.11: multiple access

- avoid collisions: 2$^+$ nodes transmitting at same time
- 802.11: CSMA - sense before transmitting
  - don't collide with ongoing transmission by other node
- 802.11: *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)

A's signal strength

C's signal strength
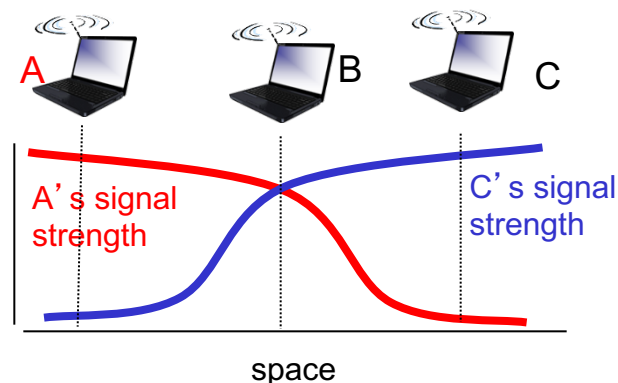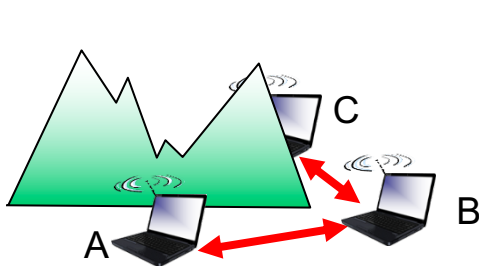
space

IEEE 802.11 MAC Protocol: CSMA/CA

802.11 sender

1 if sense channel idle for **DIFS** (DCF interframe space) then

   transmit entire frame (no CD)

2 if sense channel busy then

   start random backoff time

   timer counts down while channel idle

   transmit when timer expires

   if no ACK, increase random backoff interval, repeat 2

802.11 receiver

- if frame received OK

   return ACK after **SIFS** (short interframe space) (ACK needed due to hidden terminal problem)

sender   receiver

DIFS

data

SIFS

ACK
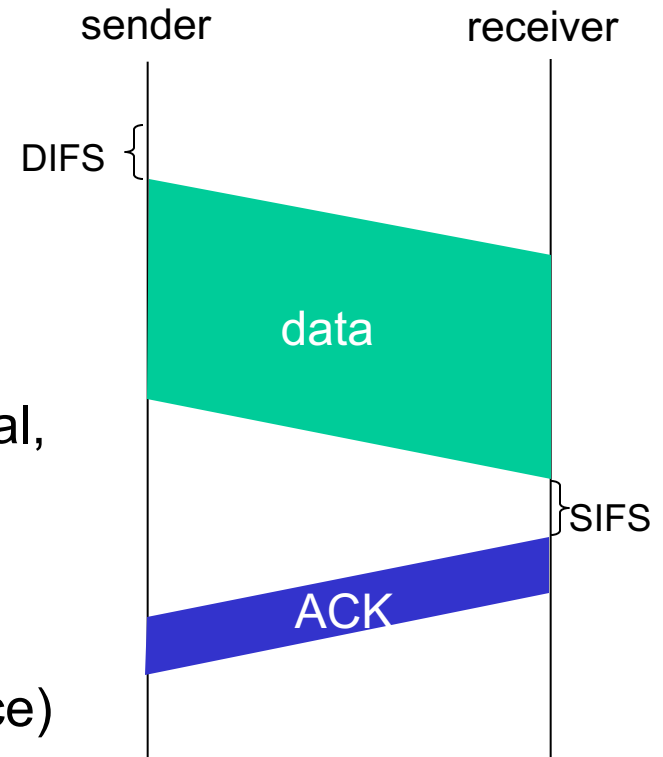
IEEE 802.11 MAC Protocol: CSMA/CA

Note some major differences from CSMA/CD

- Backoff time initiated when would-be sender senses channel is busy – not necessary to wait until actual collision
- Use of ACKs
- No collision detection possible

sender   receiver

DIFS

data

SIFS

ACK
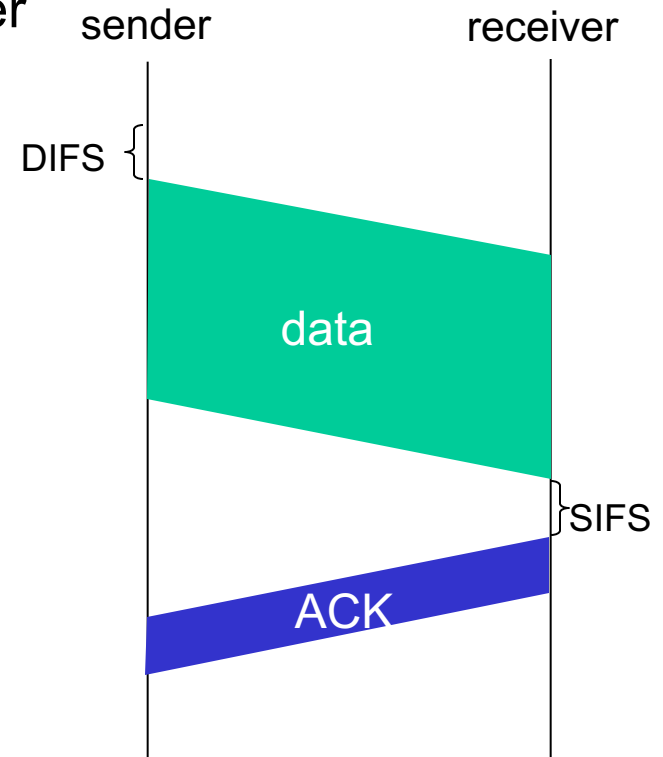
Avoiding collisions (more)

idea: allow sender to "reserve" channel rather than random access of data frames: avoid collisions of long data frames

- sender first transmits *small* request-to-send (RTS) packets to BS using CSMA
  - RTSs may still collide with each other (but they're short)
- BS broadcasts clear-to-send CTS in response to RTS
- CTS heard by all nodes
  - sender transmits data frame
  - other stations defer transmissions

avoid data frame collisions completely using small reservation packets!

Collision Avoidance: RTS-CTS exchange

A

AP

B

RTS(A)

RTS(B)

reservation collision

RTS(A)

CTS(A)   CTS(A)

DATA (A)

defer

time

ACK(A)   ACK(A)