

CS640: Introduction to Computer Networks

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Lecture 22 -
Wireless Networking

Wireless Challenges

- Force us to rethink many assumptions
- Need to share airwaves rather than wire
- Mobility
- Other characteristics of wireless
 - Noisy → lots of losses
 - Slow
 - Interaction of multiple transmitters at receiver
 - Collisions, capture, interference
 - Multipath interference

2

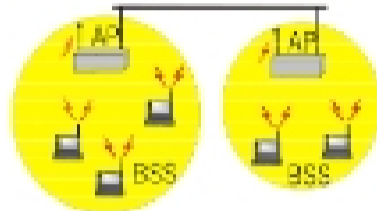
IEEE 802.11 Wireless LAN

- **802.11b**
 - 2.4-2.5 GHz unlicensed radio spectrum
 - up to 11 Mbps
 - direct sequence spread spectrum (DSSS) in physical layer
 - all hosts use same chipping code
 - widely deployed, using base stations
- **802.11a**
 - 5-6 GHz range
 - up to 54 Mbps
- **802.11g**
 - 2.4-2.5 GHz range
 - up to 54 Mbps
- All use CSMA/CA for multiple access
- All have base-station and ad-hoc network versions

2

IEEE 802.11 Wireless LAN

- Wireless host communicates with a base station
 - Base station = access point (AP)
- Basic Service Set (BSS) (a.k.a. "cell") contains:
 - Wireless hosts
 - Access point (AP): base station
- BSS's combined to form distribution system

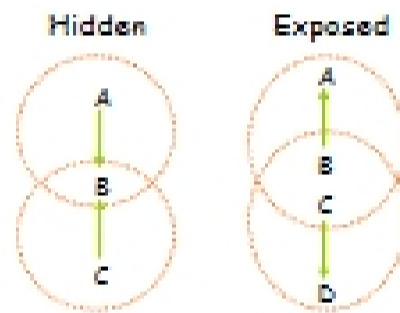


4

CSMA/CD Does Not Work

• Collision detection problems

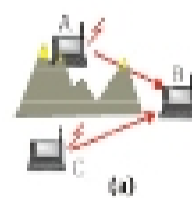
- Relevant contention at the **receiver**, not sender
 - Hidden terminal
 - Exposed terminal
- Hard to build a radio that can transmit and receive at same time



5

Hidden Terminal Effect

- **Hidden terminals:** A, C cannot hear each other
 - Obstacles, signal attenuation
 - Collisions at B
 - Collision if 2 or more nodes transmit at same time
- CSMA makes sense:
 - Get all the bandwidth if you're the only one transmitting
 - Shouldn't cause a collision if you sense another transmission
- Collision detection doesn't work
- CSMA/CA: CSMA with Collision Avoidance

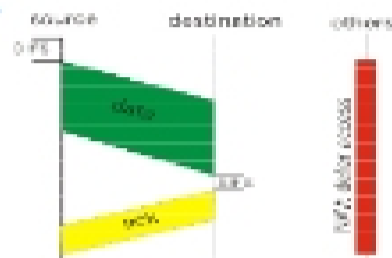


6

IEEE 802.11 MAC Protocol: CSMA/CA

802.11 CSMA: sender

- If sense channel idle for DIFS (Distributed Inter Frame Space) then transmit entire frame (no collision detection)
- If sense channel busy then binary backoff



802.11 CSMA: receiver

- If received OK return ACK after SIFS -- Short IFS (ACK is needed due to hidden terminal problem)

7

Collision Avoidance Mechanisms

• Problem:

- Two nodes, hidden from each other, transmit complete frames to base station
- Wasted bandwidth for long duration!

• Solution:

- Small reservation packets: RTS+CTS
- Nodes track reservation interval with internal "network allocation vector" (NAV)

8

Collision Avoidance: RTS-CTS Exchange

- Explicit channel reservation

- Sender: send short RTS: request to send
- Receiver: reply with short CTS: clear to send
- CTS reserves channel for sender, notifying (possibly hidden) stations

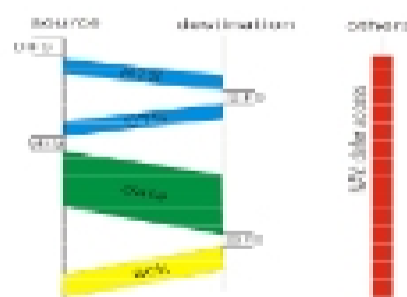
- RTS and CTS short:

- collisions less likely, of shorter duration
- and result similar to collision detection

- Avoid hidden station collisions

- Not widely used/implemented

- Consider typical traffic patterns



9
