# CSE 461 - Module 7C: MAC Layer Part 3

802.11 (WiFi): Overview

- Radio transmission
    - Losses due to noise, multipath, shadowing, contention
    - Generally, signal strength diminishes with at least the square of the distance
        - (Much) higher attenuation occurs indoors
        - Physical layer provides choice of bit rates
            - 802.11b (1999): 1, 2, 5.5, 11 Mbps
            - 802.11g (2003): 6, 9, 12, 18, 24, 36, 48, 54 Mbps
            - 802.11n (2009): 7.2-72.2 Mbps (or twice that, with channel bonding)
            - 802.11ac (2013): up to 3.46 Gbps (but uses full spectrum)
    - Carrier sense is possible
    - Collision detection isn't possible
- Topology
    - (http://technet.microsoft.com/en-us/library/cc757419(v=ws.10).aspx)
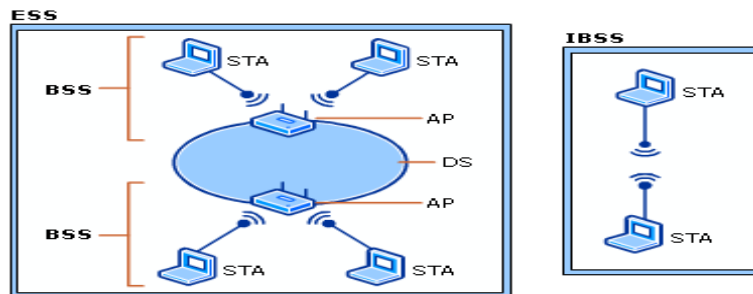
    - *Infrastructure* vs. *ad hoc* mode
    - "Station," "access point," "distribution system"
    - What is the shared medium?
        - Best to think of it as the receiver (e.g., AP)
        - But it's also the RF "channel"
    - Everyone can hear the AP, but not everyone can hear everyone else
        - **Hidden terminal** problem
        - **Exposed terminal** problem

802.11 MAC and Collision Resolution

- Many specialized frame formats (in an attempt to make frames short)

- This applies to data frames (and some control frames)

- 802.11 uses ARQ with positive acknowledgements

- The acknowledgement must immediately follow the transmissions

    ○ Time is reserved for it

- Scheme:

    ○ Sender computes a "duration" for the frame: time to transmit data frame plus short inter-frame (idle) time plus time for receiver to send ACK

    ○ Sender listens and defers if medium is busy

    ○ Sender sends:

        ▪ The frame header carries a duration field

        ▪ Any station hearing the frame should keep quiet for the time specified by the duration

        ▪ If receiver gets the frame, it must immediately ACK

    ○ If sender doesn't hear an ACK:

        ▪ Sender picks a random idle time in [0,W]

            • W is doubled on each failed transmission attempt (binary exponential backoff)

        ▪ Sender counts down idle time **only** while medium is sensed idle

            • Avoids synchronizing competing stations on the end of transmission of some other stations

Why?

- Why does 802.11 implement ARQ?

    ○ Why not leave reliability to some higher layer?