Week 1.1: WiFi discussion (Hotspot or Home)

- Q: Where is the bottleneck
  - E.g., AP, provider, Internet, Server
- Now, consider AP
  - AP association
  - Channel selection
  - Rate selection (e.g., to get sufficient BER)
- Now, assume same
  - Number of users
- Consider CSMA/CA
  - … sketch of analysis …

CSMA/CA (analysis sketch)

- Similar to "renewal period" example, but this time instead consider three types of slots
  - Backoff (b), collision (c) and successful transmission (s)
- S = E[throughput] = E[# bytes bits successfully transmitted in timeslot] / E[duration of timeslot] = $[P_t P_s L] / [(1-P_t)T_b + P_t(1-P_s)T_c + P_t P_s T_s]$
- Here,
  - P_t = P(at least one transmission)
  - P_s = P(a transmission is successful)
  - L = E[payload length in bits]
  - T_b, T_c, and T_s are the expected lost durations for the three types of slots … (e.g., can measure in system)

CSMA/CA (cnt. analysis sketch)

- Similar to for ALOHA
  - $P_t P_s = N\tau(1-\tau)^{N-1}$
  - τ = probability that each station is transmitting
- Also
  - $P_t = 1 - (1-\tau)^N$
- Consider the collision probability …
  - Assume independent of backoff stage
  - $c = 1 - (1-\tau)^{N-1}$
- Need another relationship between c and τ to solve for τ
  - After some assumptions and some math …

$\tau = \frac{1}{1+\frac{1-c}{1-c^{B+1}}\sum_{i=1}^{B} c^i T_i}$, where $T_i = 2^i W_{min}/2$, W_{min} is the initial backoff window, and B is the maximum number of backoff rounds