Rethinking Collisions in Wireless Networks

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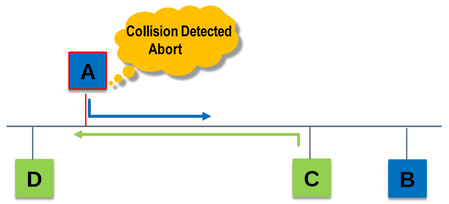
CSMA/CD

- Wired networks
  - Collision at transmitter implies collision at receiver
  - Transmitter aborts transmission upon collision detection
- CSMA/CD is beneficial
  - Avoids wasteful transmissions once collision is detected

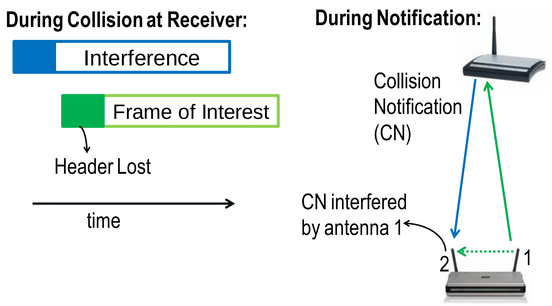


CSMA/CD in Wireless?

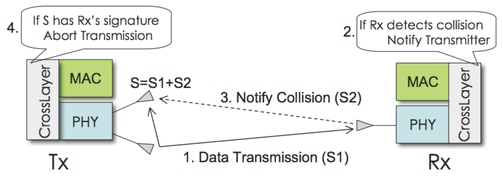
- CSMA/CD not easy in wireless
  - Collision at receiver cannot be reliably detected at transmitter
- Wireless networks use CSMA/CA
  - Carrier Sense
  - Backoff
- Packets still collide
  - Transmitter unaware of collision
  - Continues to transmit
- Recovery from collision
  - Through retransmissions

To Achieve CSMA/CD …

- Detect collision and notify before packet is fully transmitted
  - Packet header often corrupted
  - Receiver cannot identify packet destination
- Transmitter needs to listen on second antenna to detect collision notification
  - Difficult because of interference from self antenna



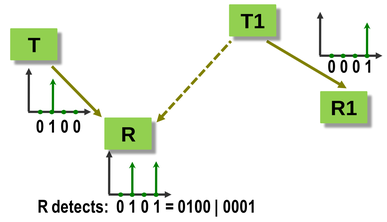
Collision Detection and Notification



- Cross-layer approach to detect and notify: ***CSMA/CN***
- Identifying src/dst in presence of interference
  - Use signatures
    1. OFDM subcarriers
    2. Bit -sequence Correlation

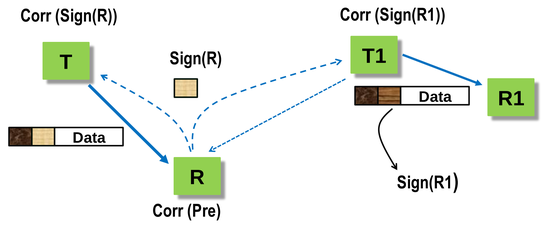
1. OFDM Subcarriers

- Small subset of subcarriers transmit a ***signature*** (on/off sequence)
- Per link sig. identifies active links
- Concurrent transmissions produce aggregate signature (bitmap)
  - A bitwise OR of all signatures
- Collision detected by observing sigs.



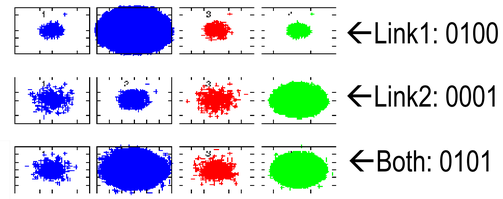
2. Bit Sequence Correlation

- Collision detection
  - SoftPHY
  - Preamble correlation
- Receiver sends notification
  - Bit sequence unique to link
- Transmitter correlates for sequence
  - Correlation spikes
  - Works under strong interference

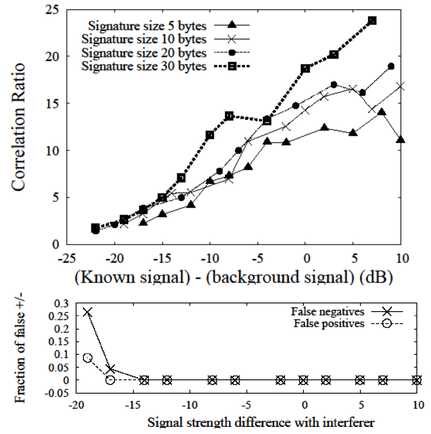


Preliminary Results

- GNU Radio/USRP platform
- OFDM subcarrier signatures
  - 4 subcarrier example



- Correlation
  - Correlation Ratio: Correlation observed with signature divided by the avg. correlation before its arrival



Ongoing Work

- Improving detection latency
- Efficacy with multiple interferers
- Accommodate many signatures
- Compare with CSMA/CA, PPR…