Listen Before You Talk, But on the Frequency Domain

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802.11 Channel Access Today

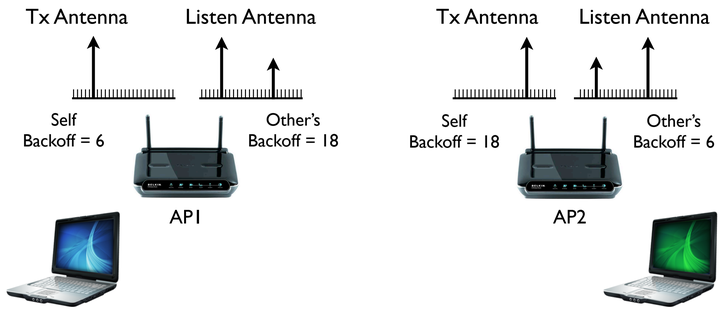
- Backoff arbitrates channel contention
  - AP waits for a random backoff before transmission
  - Low utilization because channel must remain idle
  - Collisions due to same backoff also reduce utilization

Redesigning 802.11 Channel Contention

- Backoff is fundamentally not a time domain operation
- Can we implement backoff in frequency domain?
  - Opportunity: 48 OFDM subcarriers can be used for choosing random backoff

T2F: Time-to-Frequency

- Replace temporal backoff with subcarrier transmission
- During contention:
  - AP chooses a random subcarrier to transmit
  - Concurrently listens to find other active subcarriers
- Active subcarriers imply contending APs' backoff

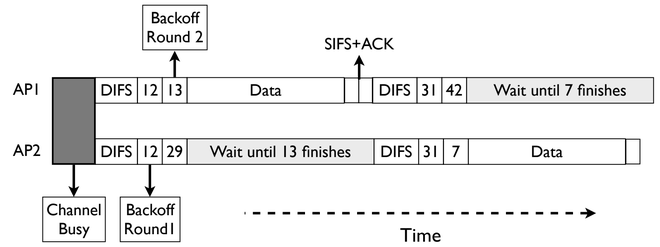


- Both APs learn that AP1 is winner
  - T2F takes 8us Vs 802.11 160us

Frequency Domain Backoff has lower overhead than Time Domain Backoff

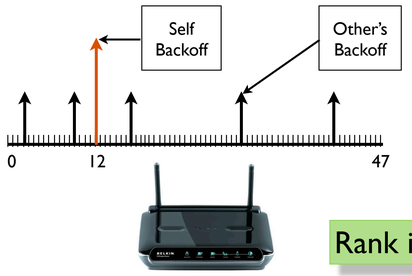
Reducing Collisions using Second Round

- In dense networks, multiple winners of T2F backoff
- Winners of the first round repeat T2F backoff
- Few APs in the second round means fewer collisions



Scheduled Transmission

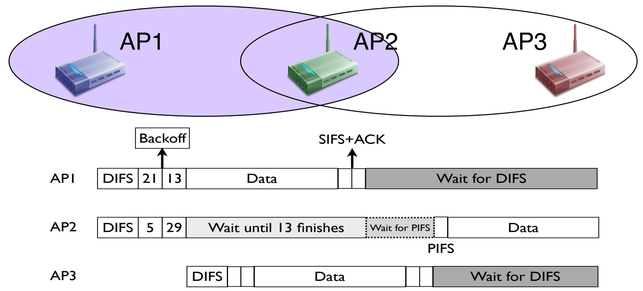
- Active subcarriers imply backoff chosen by other APs
  - Each AP knows its rank in the sequence
  - Enables back to back TDMA like transmission



Rank in TDMA: 3

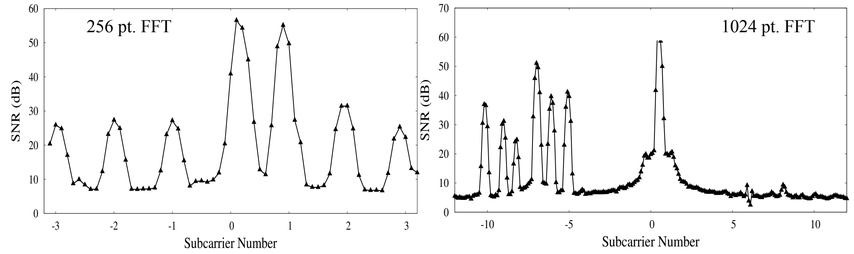
Multiple Collision Domain Coexistance

- Insert PIFS delay between sequential transmissions



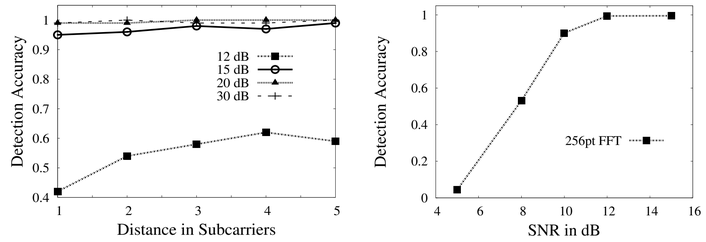
Practical Constraint: High Self Signal

- Use higher FFT sizes at the listening antenna

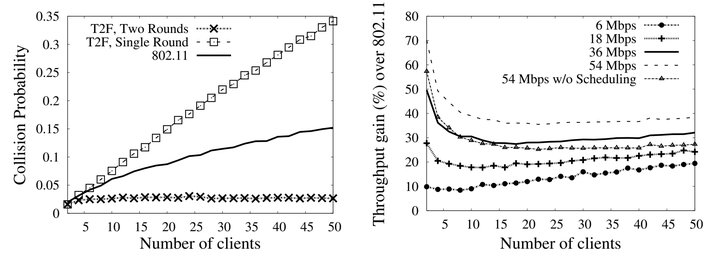


Testbed Implementation and Evaluation

- 8 node USRP/GNURadio testbed
- Subcarrier detection accuracy of ~95%



- Low collision probability with two rounds
- Upto 70% throughput gain over 802.11
  - Due to reduced overhead and fewer collisions



Ongoing Work

- Improve subcarrier detection accuracy
- Experiment with multiple collision domains
- Online implementation in progress