WiMAX OFDMA Scheduler
Simulation: Status and Issues

Ritun Patney, Raj Jain
Washington University in Saint Louis
Saint Louis, MO 63130
jain@cse.wustl.edu

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These slides are also available on-line at:
http://www.cse.wustl.edu/~jain/wimax/schd704.htm
Overview

- Limitations of Current WiMAX Forum NS2 Model
- Our Implementation
- Simulation Parameters
- Workload
- UL Throughput vs # of SSs for UGS
- Average Delay vs # of SSs
- UGS Throughput Computation
- UGS Delay Computation
Limitations of Current WiMAX Forum NS2 Model

- Fragmentation is not working properly
- ARQ allowed only without fragmentation
- All users are allocated every frame. If users do not generate traffic every frame, some frames may be empty.
- No facility to indicate QoS parameters, such as bits/sec, delay
- CBR traffic only
Our Implementation

- Data structures for two dimensional frame structure with uplink and downlink subframes
- Multiple parallel receptions at the base station for OFDMA (single carrier allows only SS transmission at a time)
- OFDMA PHY MIB (Subchannels, symbols)
- Tiles and slots
- Different modulation and coding
- Allocation of slots
- Mapping of slots to the frequency and time
- Null Phy ⇒ No interference, No contention slots
Simulation Parameters

- Frame Duration: 5ms
- Downlink:Uplink symbols = 26:21
- Modulation Scheme: QPSK ½
- Bandwidth: 10 MHz
- Number of DL Subchannels: 30
- Number of UL Subchannels: 35
- ARQ Enabled
- Single BS with multiple SSs
Workload

- UL; CBR Traffic over UDP
- 40 bytes MAC SDU per 50 ms per SS
  6 more bytes for MAC header.
- UGS Allocation
  = 46 bytes with an allocation counter of 1
  ⇒ Every user every frame
  ⇒ 9 of 10 frames have no UL traffic
  with this UGS workload
- Vary the number of SSs
- Performance Metrics: Throughput (kbps) and Delay (ms)
UL Throughput vs # of SSs for UGS

Observations:
- The throughput increases linearly
- Maximum 30 users
Observation:

- 4.86 ms average delay
UGS Throughput Computation

- 1 tile = 8 data carriers across time and frequency
- 8 data symbols/tile, QPSK ⇒ 2 bits/symbol
  QPSK \( \frac{1}{2} \) ⇒ \( 8 \times 2 \times \frac{1}{2} = 8 \) bits/tile
- 6 tiles/slot ⇒ Slot Capacity = 48 bits = 6 bytes
- Total Slots/UL subframe = \((21/3) \times 35\) subchannels = 245
- Workload of 46 bytes, requires 8 slots.
- Allocated connection IDs/UL subframe = 245/8 = 30
  ⇒ Max Number of SS = 30
UGS Delay Computation

CIR packets generated at the start of a new frame

- Scheduling algorithm: round robin.
- Always allocates the first n connections until frame is full.
- Connections beyond n are not serviced and hence the delay is constant even when throughput becomes constant.
- Delay for individual users can vary from 2.63 ms to 5 ms ⇒ Average of 4.8 ms
Summary and Plans

- OFDMA scheduler implementation started
- Preliminary UGS results using the “round-robin and greedy” scheduler
- Throughput and delay match computed values (preliminary verification)
- Significant implementation limitations
  ⇒ Need to transition to the new code
- Revisit the implementation issues and limitations after transition