

WiMAX OFDMA Scheduler Simulation: Status and Issues

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

WiMAX Forum Application Architecture Task Group (AATG)
NS2 Simulation Call, April 13, 2007

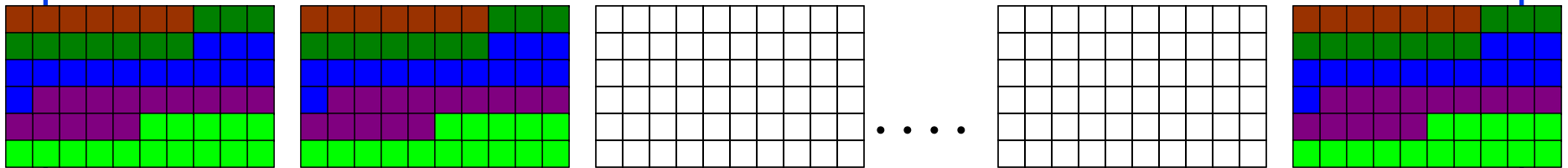
These slides are also available on-line at:
<http://www.cse.wustl.edu/~jain/wimax/schd704.htm>



- ❑ 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 \Rightarrow No interference, No contention slots

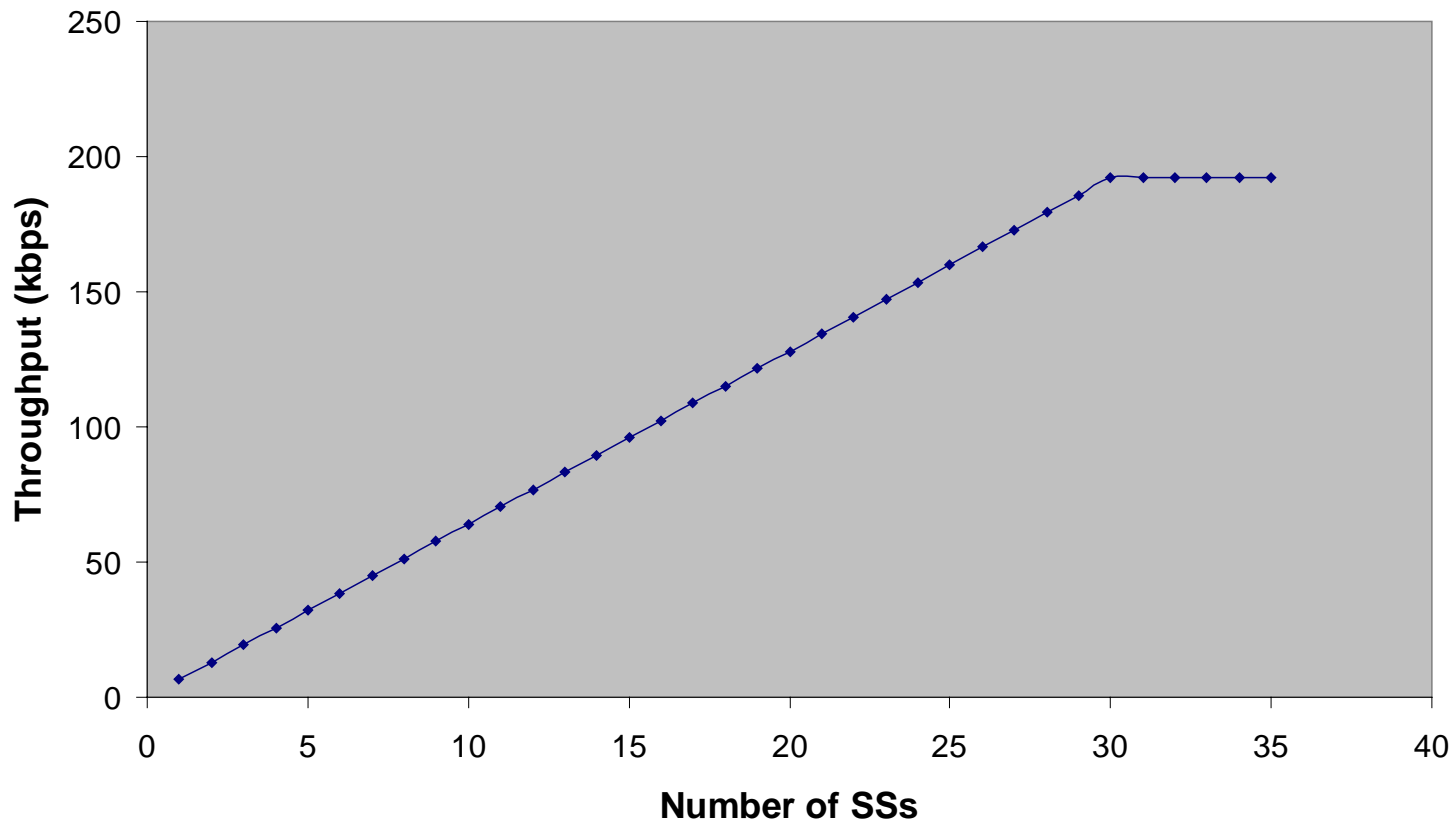
Simulation Parameters

- ❑ Frame Duration: 5ms
- ❑ Downlink:Uplink symbols = 26:21
- ❑ Modulation Scheme: QPSK $\frac{1}{2}$
- ❑ 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)

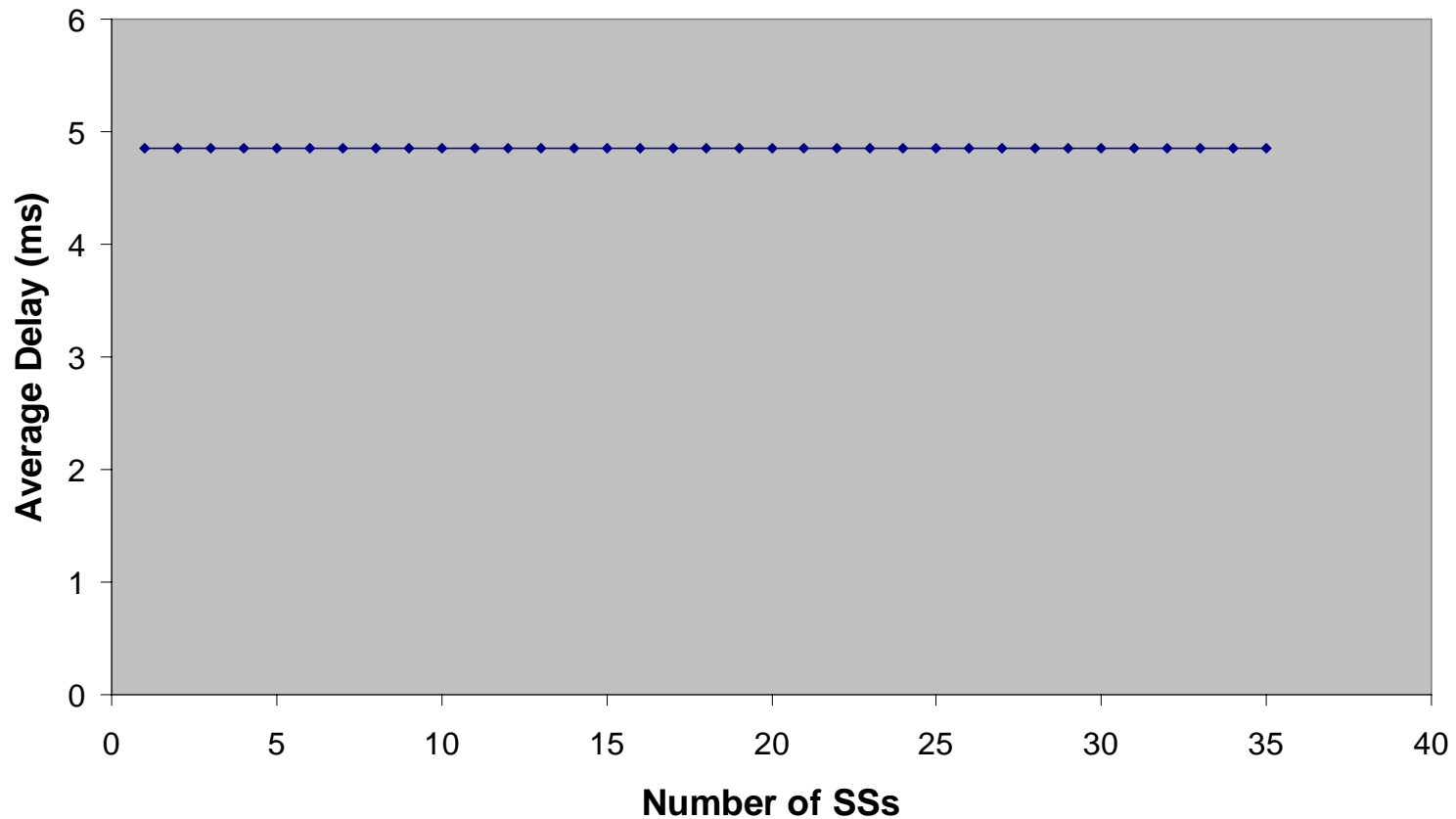
UL Throughput vs # of SSs for UGS



□ Observations:

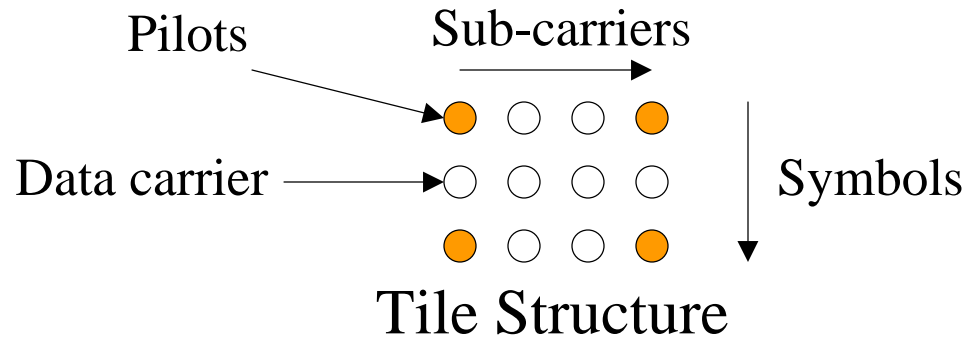
- The throughput increases linearly
- Maximum 30 users

Average Delay vs # of SSs



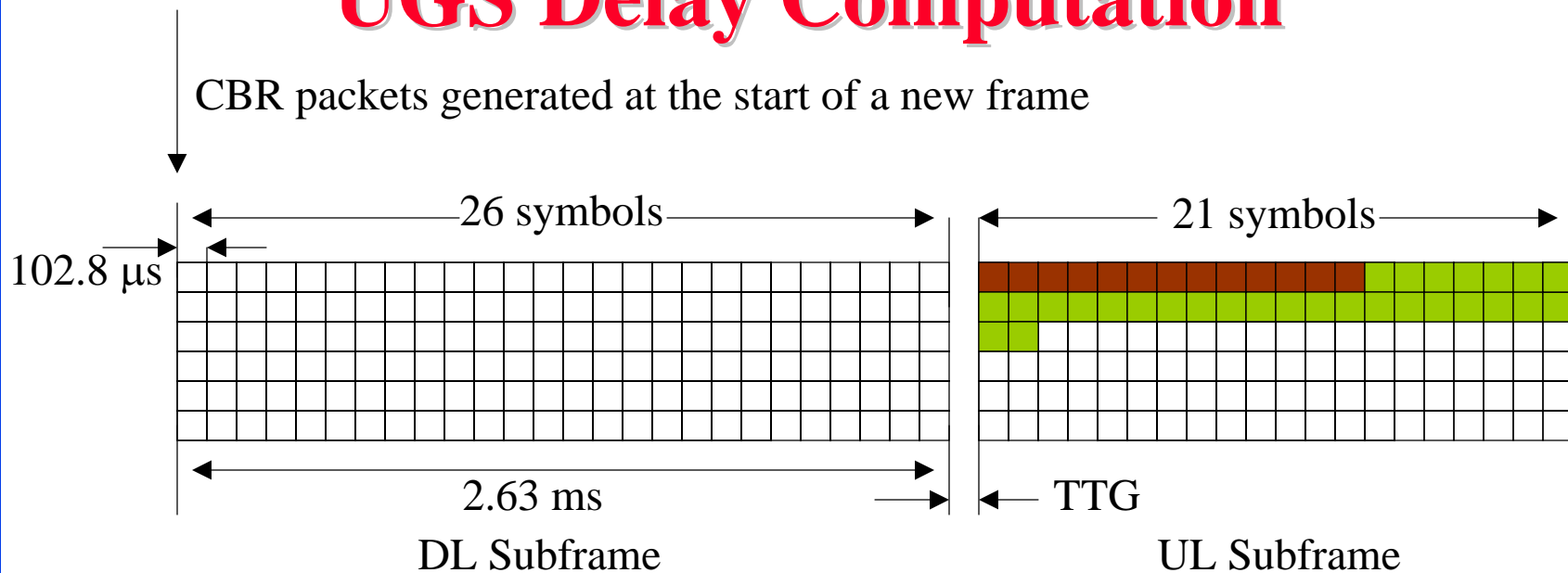
- Observation:
 - 4.86 ms average delay

UGS Throughput Computation



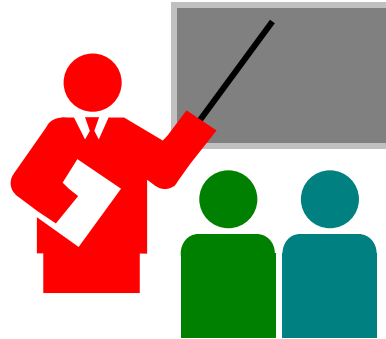
- ❑ 1 tile = 8 data carriers across time and frequency
8 data symbols/tile, QPSK \Rightarrow 2 bits/symbol
QPSK $\frac{1}{2} \Rightarrow 8 \times 2 \times \frac{1}{2} = 8$ bits/tile
- ❑ 6 tiles/slot \Rightarrow Slot Capacity = 48 bits = 6 bytes
- ❑ Total Slots/UL subframe = $(\frac{21}{3}) \times 35$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

UGS Delay Computation



- ❑ 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
 \Rightarrow 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