



WiMAX System-Level Evaluation Methodology Update

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- Goal
- Link-Level vs System-Level Models
- Accomplishments and Open Issues:
 - PHY Models
 - MAC
 - Overall System Simulation Approach
- Cross-Team Relationship
- This is only an incremental update since San Diego Plenary. See AATG website for a detailed presentation on methodology (July 2006), http://www.wimaxforum.org/apps/org/workgroup/aatg/download.php/8087/wimax_sim.ppt

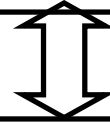


Goal

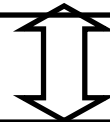
- Standardized methodology for system level simulation of WiMAX systems
- Can be used by any modeling system: NS2, Opnet
- Can be used by Equipment vendors/service providers to model their system
- This methodology will be used for AATG NS2 simulation
- Similar documents exist for 3GPP/3GPP2

WiMAX Model Components

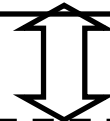
Applications (VOIP, VoD, Remote Backup, ...)
Workload Characteristics, QoS Requirements



Transport and IP Layers (TCP/UDP, IP, RTP, ...)
TCP/IP Parameters: MTU Size, Buffers, ...



MAC Layer (ARQ, Burst Allocation, FEC, ...)
Interference from other systems, ...



Physical Layer (Coding, Antenna, AAS, OFDM,...)
Topography (Height, Cell size, Customer density, ...)

Abstraction



Link-Level vs System-Level Models

Link-Level:

Goal: Study different signal transmission and reception schemes

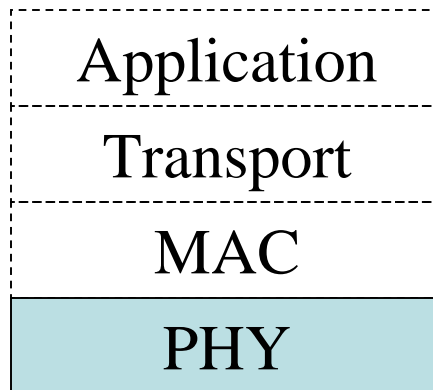
Single Link

Single Cell

Single Base Station

Emphasis on PHY

Some MAC



System-Level:

Goals: Application Level Performance

Multiple users

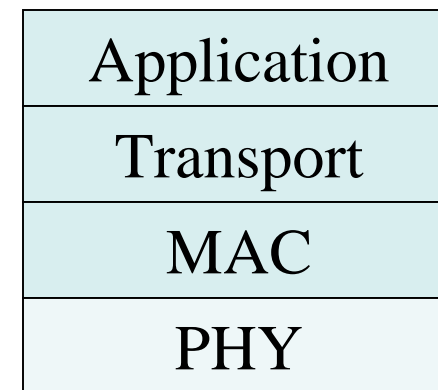
Multi-Cells

Multiple Base Stations

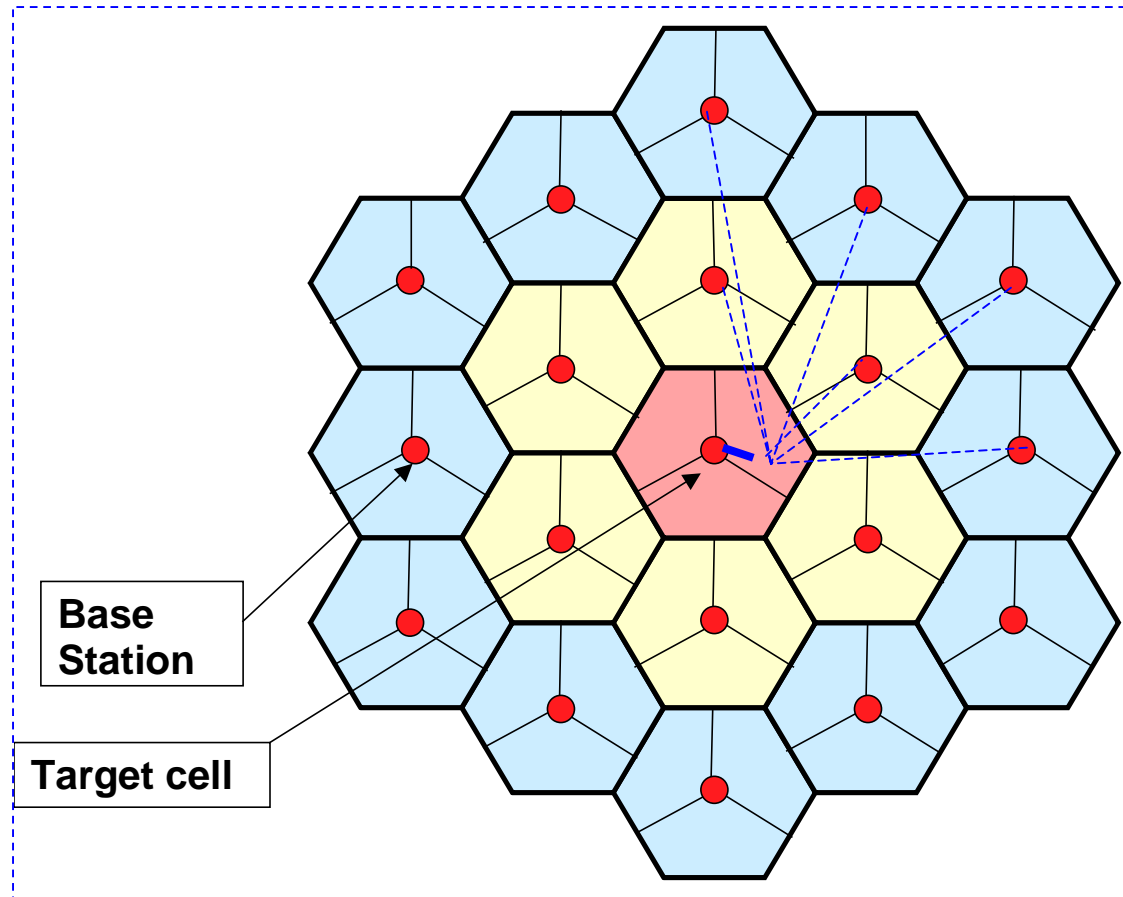
Large # of subscribers

Emphasis on All Layers

=> PHY abstraction



System Simulation Approach



System Simulation Approach

- Simulate multiple WiMAX cells
- Model different applications with different levels of penetration
- Simulate application traffic streams; use realistic traffic models
- Distribute user session randomly among the cells
- Utilize neighboring cell traffic to create interference in the center cell
- Abstract PHY to a table/graph mapping physical condition to Block Error Rate (BLER)
- Apply generic MAC scheduler and MAC layer interfacing with PHY abstraction
- No link level simulation



Acknowledgement

Contributions from the following companies have been used:

- Alvarion
- Arraycom
- AT&T
- Intel
- Lucent
- Motorola
- Postdata
- Siemens
- Sprint
- Telsima
- Venturi Wireless

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Recent Reviewers and Contributors

- Bong Ho/ POSDATA
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- Jiu Hui/Intel
- Xiangying Yang/Intel
- Jungnam Yun/POSDATA
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- John Kim/Sprint
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- Shyam Parekh/Lucent
- Tech Hu/Siemens
- Vafa Ghazi/Coware
- Arun Ghosh/AT&T

PHY Models

- Started with 3GPP and 3GPP2 concepts
- Changes to accommodate:
 - Broadband
 - SOFDMA
- Path Loss
- Established basic path loss formulas
 - Verify choice with MTG
- Resolved Error Probability Model
 - EESM/MIC/MIM
 - Established granularity: FEC block
- Open Issue:
 - Simplification of interference
 - Reconcile MWG system evaluation table parameters with our contribution



3 APPLICATION TRAFFIC MODELS

- 3.1 Internet Game
- 3.2 VOIP
- 3.2 Video Conference
- 3.3 PTT
- 3.4 Music/Speech
- 3.5 Video Clip
- 3.6 Movie Streaming
- 3.7 MPEG-4 Streams
- 3.8 Instant Messaging
- 3.9 Web Browsing (HTTP)
- 3.10 EMail
- 3.11 Telemetry
- 3.12 FTP
- 3.13 P2P
- 3.14 VPN Service
- 3.15 HTTP [3GPP]
- 3.16 FTP [3GPP]
- 3.17 NRTV (Near Real Time Video) [3GPP]



MAC

- MAC Modeling Section –Jie Hui, Editor
 - Good momentum on channel coding, scheduler
 - Discuss overhead numbers (N1 to N9)
 - Need to write up the enhanced proportional fair scheduler
- Packet processing flows clarified – See next slide
- Open Issues:
 - Need contributions on MAC features



4. MAC LAYER MODELLING

4.1 Convergence Sublayer

4.2 MAC PDU Formats

4.3 ARQ Mechanisms

4.4 MAC Support of PHY Layer

4.5 Dynamic Service Flow Operation

4.6 MAC Scheduler

4.7 UL/DL Maps

4.8 HARQ

4.9 Mobility Management (Wave-2)

4.10 Power Management (Sleep-Idle Mode)

4.11 Security (Wave-2)

4.12 Multicast and Broadcast Services (Wave-2)

4.13 Buffer Management



Overall System Simulation Approach

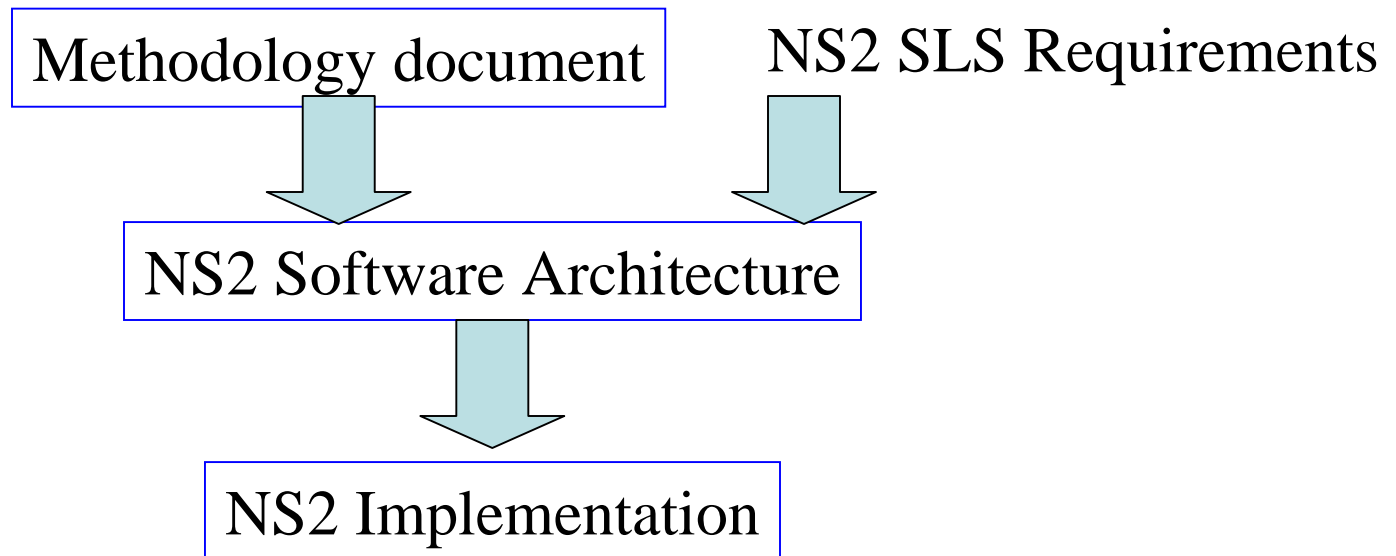
- 19 Cell Methodology
- Added traffic models
- Protocol Layer Modules
- NS2 program Modules
- Open Issues:
 - Write up user drop processing
 - Finalize user loading in neighbor cells
 - Settle on system simulation parameters



System Level Simulation

1. INTRODUCTION
 2. SYSTEM SIMULATION MODELLING
 3. APPLICATION TRAFFIC MODELS
 4. MAC LAYER MODELLING
 5. PHY LAYER MODELLING
- ANNEX A: CHANNEL MODELS FOR SLS
- ANNEX B: EESM PHY ABSTRACTION
- ANNEX C: MIC PHY ABSTRACTION
- ANNEX D: MIM PHY ABSTRACTION
- ANNEX E: EESM GRAPHS
- ANNEX F: MODELING PUSC IN SLS
- ANNEX G: NS2 PROTOCOL LAYER MODULES

Cross-Team Relationship





1. INTRODUCTION

- 1.1 OFDMA BASICS
- 1.2 SCALABLE OFDMA
- 1.3 OFDMA SUB-CARRIERS AND SUB-CHANNELS
- 1.4 WIMAX FORUM PROFILE

2. SYSTEM SIMULATION MODELLING

- 2.1 SYSTEM LEVEL SIMULATION FLOW
- 2.2 PARAMETERS AND ASSUMPTIONS
 - 2.2.1 Antenna Pattern
 - 2.2.2 ANTENNA ORIENTATION
- 2.3 COMMON SYSTEM LEVEL SIMULATION ASSUMPTIONS
- 2.4 PERFORMANCE METRICS
 - 2.4.1 Output Metrics for Data Services

4. MAC LAYER MODELLING

- 4.1 CONVERGENCE SUBLAYER
- 4.2 MAC PDU FORMATS
- 4.3 ARQ MECHANISMS
- 4.4 MAC SUPPORT OF PHY LAYER
- 4.5 DYNAMIC SERVICE FLOW OPERATION
- 4.6 MAC SCHEDULER
- 4.7 UL/DL MAPS
- 4.8 HARQ
- 4.9 MOBILITY MANAGEMENT (LATER RELEASE)
- 4.10 POWER MANAGEMENT (SLEEP-IDLE MODE)
- 4.11 SECURITY (LATER RELEASE)
- 4.12 MBS (LATER RELEASE)
- 4.13 BUFFER MANAGEMENT

5. PHY LAYER MODELLING

- 5.1 PHY MODEM ABSTRACTION FOR SYSTEM SIMULATION
- 5.2 LINK BUDGETS FOR WIMAX SYSTEM
- 5.3 REFERENCE OFDMA CONFIGURATION FOR THE EVALUATION
- 5.4 FREQUENCY RE-USE AND INTER-CELL INTERFERENCE
 - 5.4.1 Frequency Re-use
 - 5.4.2 Inter-cell Interference
- 5.5 MODELLING ADVANCED PHY FEATURES
- 5.6 CHANNEL MODELS AND INTERFERENCE FOR SYSTEM SIMULATION
 - ERCEG MODEL
 - References
 - 5.6.1 Channel Models

ANNEX A: CHANNEL MODELS

- A.1 ITU MODELS
- A.2 IMPACT OF DOPPLER ON SYSTEM SIMULATION CHANNEL MODEL
- A.3 EFFECTIVE SIR MAPPING FUNCTIONS
 - A.3.1 Effective SIR Mapping Functions for OFDM
- A.4 SYSTEM-LEVEL HARQ MODELLING
 - A.4.1 Chase-Combining HARQ Modeling for OFDM



ANNEX B: EESM

- Objective
- Definition of PHY Abstraction
- Implementation of EESM (verify the steps)
- Beta (β) Training
- References



ANNEX C: MIC

- Objective
- Definition of PHY Abstraction
- Implementation of PHY Abstraction
- Implementation of MIC
- Implementation of ESM
- References



ANNEX D: MIM

- Objective
- Comparison for various methods
- Summary
- References

ANNEX E: EESM GRAPHS

- E.1: REFERENCE AWGN BLER CURVES FOR SYSTEM-LEVEL SIMULATIONS
- E.2 REFERENCE β VALUES FOR THE OFDM EESM APPROACH IN SYSTEM-LEVEL SIMULATIONS
 - E.2.1 Reference β Values Using a Random OFDM Subcarrier Interleaver

ANNEX F: MODELING PUSC

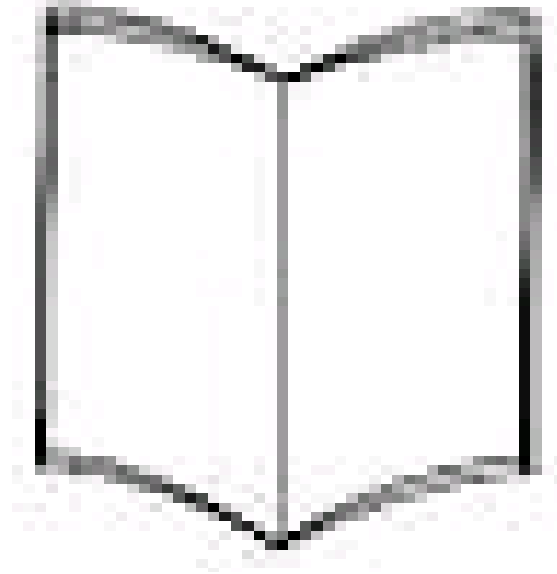
- 1. Introduction of PUSC
- 2. Implementation of PUSC
 - 2.1 Implementation of Standard DL PUSC [1,2]
 - 2.2 Implementation of PUSC approximation: pseudorandom permutation
- References

ANNEX G: NS2 MODULES

- G.1 NS-2 QUICK OVERVIEW
- G.2 PROTOCOL STACK MODULES AVAILABLE IN NS-2
- G.3 APPLICATION LAYER:
- G.4 TRANSPORT LAYER
- G.5 NETWORK LAYER
- G.6 MAC LAYER
- G.7 PHY LAYER
- G.8 NS2 FRAMEWORK COMMON MODULES
- ANNEX H: SYSTEM SIMULATION RESULTS



Review



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