WiMAX System-Level Evaluation Methodology Update

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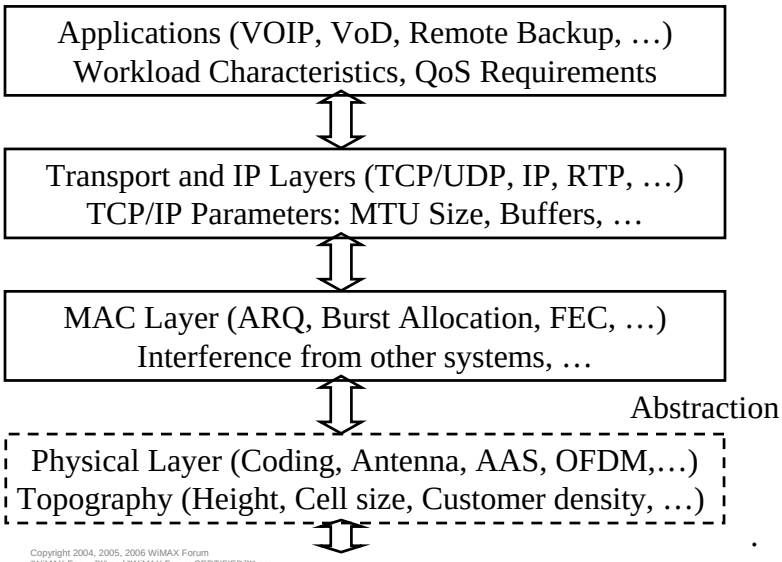
Overview

- 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

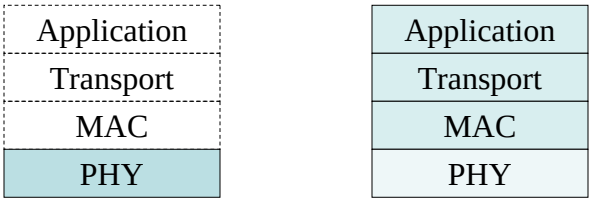
WiMAX Model Components



Link-Level vs System-Level Models

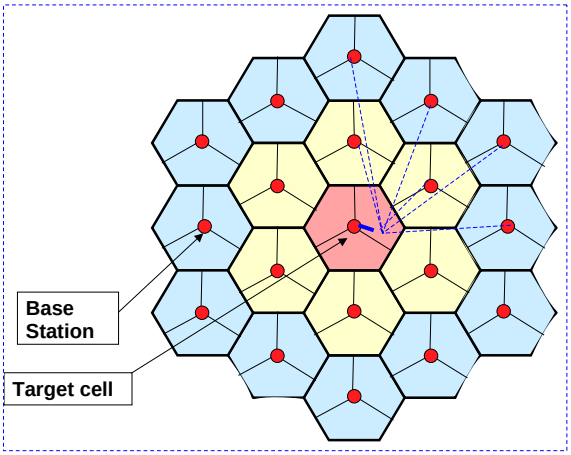
Link-Level:
- Goal: Study different signal transmission and reception schemes
- Single Link
- Single Cell
- Single Base Station
- Emphasis on PHY
- Some MAC

System-Level:
- Goals: Application Level Performance
- Multiple users
- Multi-Cells
- Multiple Base Stations
- Large # of subscribers
- Emphasis on All Layers
- => PHY abstraction



[AT&T]

System Simulation Approach



[3GPP]

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

Recent Reviewers and Contributors

- Bong Ho/ POSDATA
- Raj Iyengar/RPI
- Nat Natarajan/Motorola
- Jiu Hui/Intel
- Xiangying Yang/Intel
- Jungnam Yun/POSDATA
- Yaron Alpert/Alvarion
- Arvind Raghavan/Arraycom
- Honghai Zhang/Lucent
- John Kim/Sprint
- Rok Preseren/Telsima
- 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

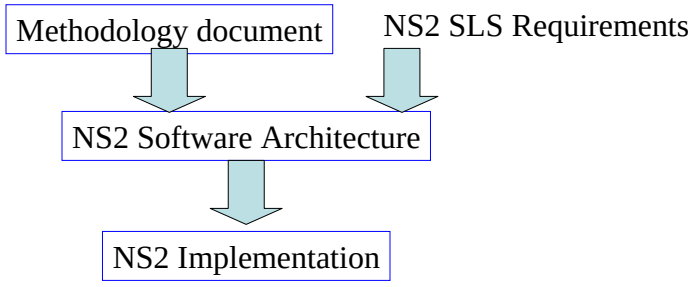
- 19 Cell Methodology
- Added traffic models
- Protocol Layer Modules
- NS2 program Modules
- Open Issues:
  - Write up user drop processing
  - Finalize user loading in neighbor cells
  - Settle on system simulation parameters

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
- 5.4.1Frequency Re-use
- 5.4.2Inter-cell Interference
- 5.5 MODELLING ADVANCED PHY FEATURES
- 5.6 CHANNEL MODELS AND INTERFERENCE FOR SYSTEM SIMULATION
- ERCEG MODEL
- References
- 5.6.1Channel 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.3.1Effective 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 (ß) 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 ? VALUES FOR THE OFDM EESM APPROACH IN SYSTEM-LEVEL SIMULATIONS
- E.2.1 Reference ß 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 FRAMWORK COMMON MODULES
- ANNEX H: SYSTEM SIMULATION RESULTS

Review