WiMAX System Level Analysis Methodology Framework V0.2

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

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These slides are available on-line at:

http://www.cse.wustl.edu/~jain/wimax/sim604b.htm

Overview

- Modules of the System Level Model
- WiMAX Model Components
- Key Specs of Each Module
- PHY Layer Module
- MAC Module
- Transport Layer Module
- Application Layer Module

Goal

- Quantitative proof of WiMAX Superiority
- Marketing vs engineering: Qualitative vs Quantitative
- Carriers Need:
  - Capacity Planning
  - Performance Optimization
  - Operational Guidelines
- Users Need:
  - Operational Guidelines
- Vendors need:
  - Performance impact of various features

Goals (Cont)

- WiMAX Real-world Traffic Benchmark
  - Workload should exercise bottleneck
- Contents Distribution over WiMAX/Metro-WiFi
  - Particularly sensitive to QoS
  - Issues not clearly understood
- Need to unite individual models coming from different sources solving different parts of the problem
- Competition with 3GPP – Very thorough analysis available

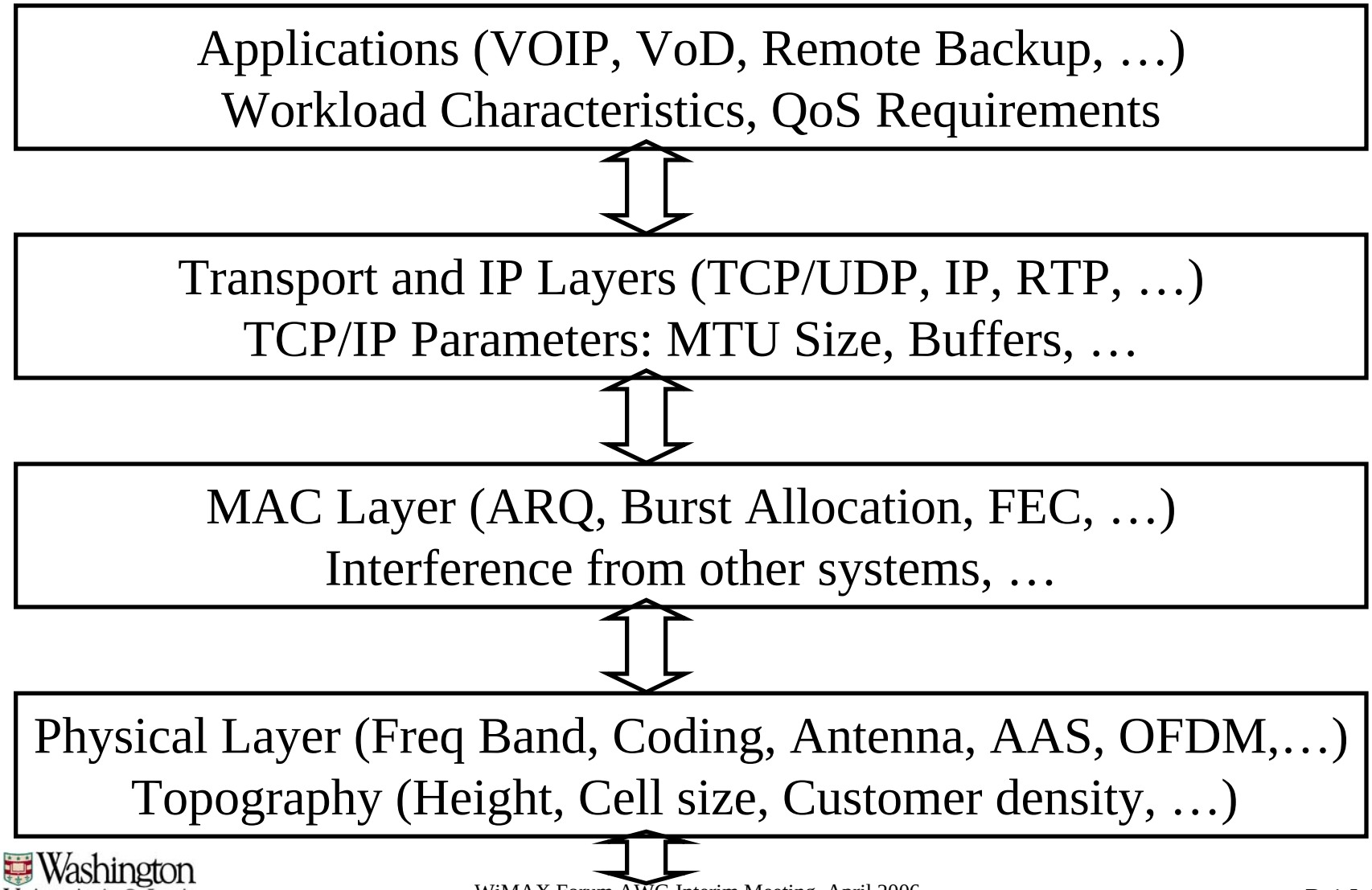
Modules of the System Level Model

- The system level model will modular with pre-defined interfaces so that users can easily interchange modules
- The overall model will consist of 4 different modules:
  1. PHY Module
  2. MAC Module
  3. Transport Module
  4. Application Module
- Each module itself will consist of pre-defined sub modules
- The parameters, workload, configurations, key sub modules for each of these modules are defined further in this document

Modeling Platform

- Preferred Platforms: NS2 and Opnet
- Modules in other platforms (e.g., Matlab) can be used using external calls or by table driven input/output interfaces
- Need to collect known known simple analytical models also in this document
- Analysis: Analytical + Simulation + Measured data

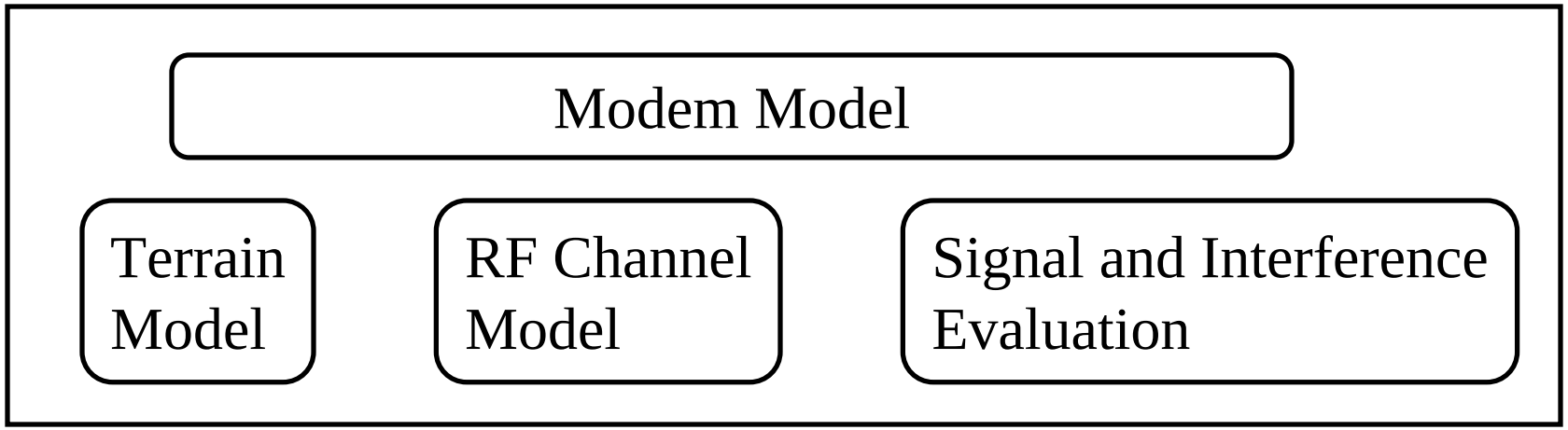
WiMAX Model Components



Key Specs of Each Module

- This document defines the following for each module:
  - Workload: Input characteristics
  - Configuration:
    - User controlled Configuration Parameters
    - Service Provider Controlled Configuration parameters
    - Manufacturer Controlled Configuration Parameters
  - Features/Algorithms to be studied/compared
  - Metrics: Throughput, Delay, Jitter, Availability, …
  - Assumptions

PHY Layer Module

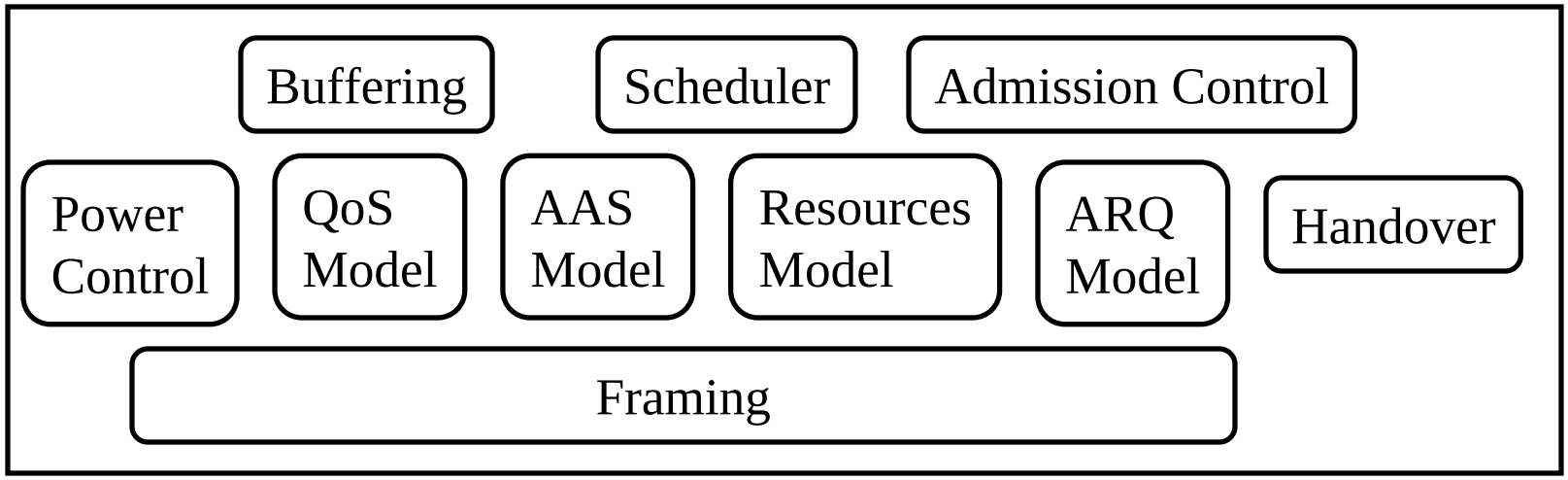


- Goal: To understand the effect of
  - Framing: TDD, OFDMA
  - Ranging
  - Power Management

PHY Layer Module

- Workload:
- Configuration Parameters:
  - User:
  - Service Provider: Antenna Height, Cell Size, Customer Density, UL/DL frame times, Sectors, Bandwidth per sector, channel size,
  - Manufacturer: Freq Band, Coding, Antenna, AAS, OFDMA, Number of subcarriers
- Metrics: Bit error rates,
- Features: Terrain Model, RF Channel Model,…
- Assumptions:
- Issues: Tight PHY-to-MAC coupling. Need a separate PHY focus group.

MAC Module

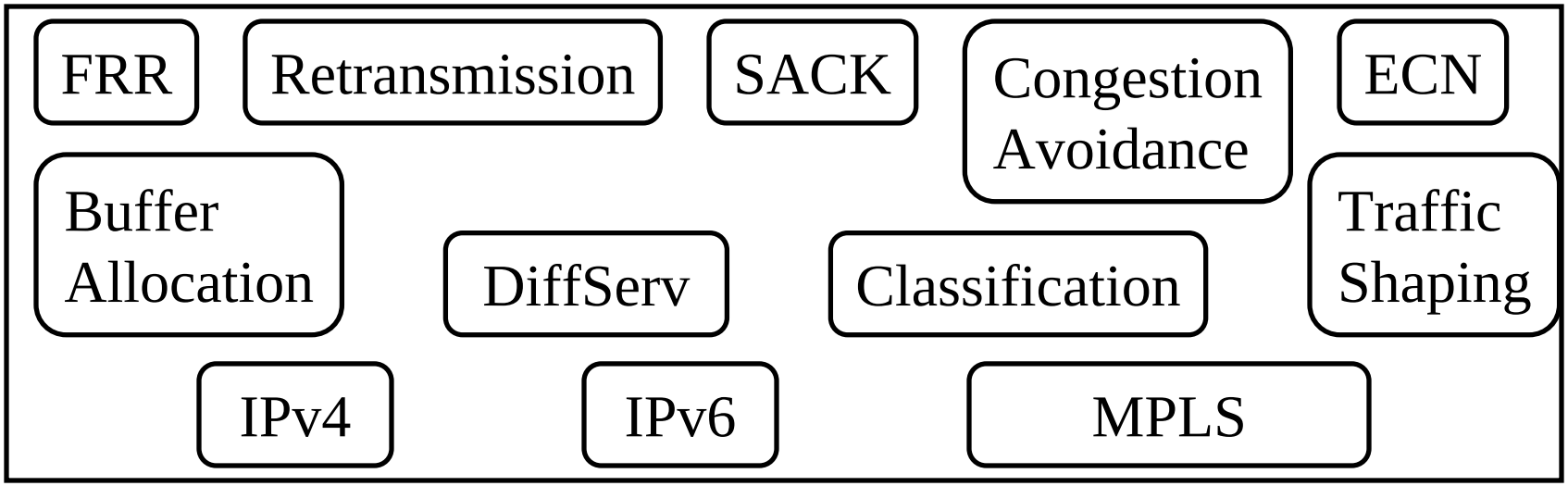


- Goal: Guidelines for
  - Base Station Scheduler Algorithms
  - Subscriber Station scheduler algorithms
  - H-ARQ
  - Admission Control

MAC Module

- Workload: Packet Burst Arrival Statistics, QoS service classes, connection setup rate,
- Configuration Parameters:
  - User: Subscribed data rate
  - Service Provider: Buffering,
  - Manufacturer:
- Metric: Throughput in bps, Residual loss rate, Packet error rate, bit error rate, Average delay, delay variation
- Features to be simulated: Power management, Ranging, Connection setup and release, UL/DL

Transport Layer Module

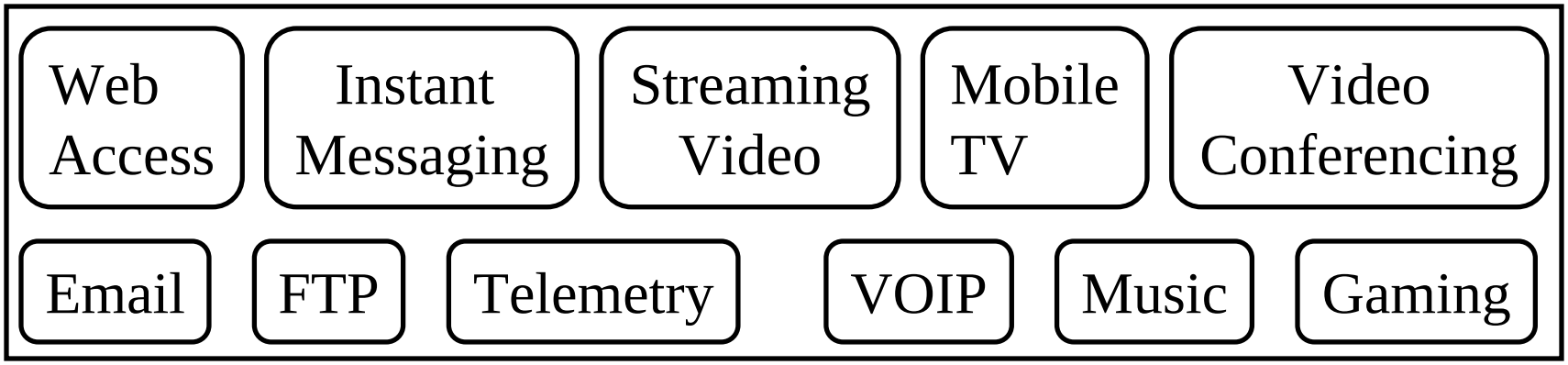


- Goal: To understand the effect of
  - WiMAX specific TCP Optimizations
  - Traffic Shaping, prioritization, buffer allocation,…
  - Guidelines for use of TCP options/algorithms

Transport Layer Module (Cont)

- Workload: Burst arrival pattern
- Configuration Parameters:
  - User: TCP/UDP/IP implementations
  - Service Provider: Prioritization
  - Manufacturer: Set of scheduling, shaping algorithms, level of drop preferences,
- Metrics: Goodput, Delay, Jitter, Loss rate
- Features:
  - DiffServ, Traffic shaping, …

Application Layer Module

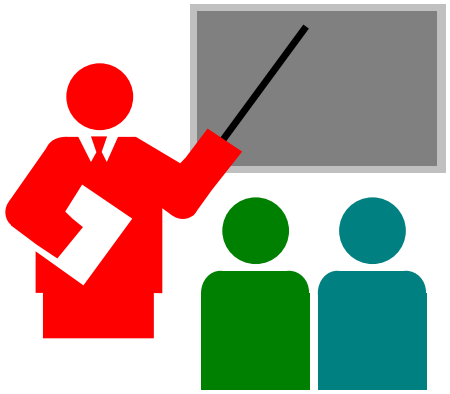


- Goal: To understand the effect of application specific options:
  - VOIP: Codec, customer usage, connection duration
  - Gaming: Types of games, user interactivity
  - Video: Frequency and lengths of video
- Workload: Number of users, Application Mix, Usage Pattern

Application Layer Module

- Configuration Parameters:
  - User: Type of usage, Usage frequency
  - Service Provider: Number of servers, Charging policies, services
  - Manufacturer: Capacity of servers
- Metrics: Number of customers supported
- Traffic Pattern – Burst interval statistics, Burst size statistics, Maximum burst size,
- Features:
  - Required delay tolerances, bit rates required for each application

Summary



1. The system level model will consist of 4 modules
2. Each module has several well identified components
3. Input workload, output metrics, will be agreed upon
4. User, Service provider and Manufacturer controlled parameters will be identified
5. Key features and assumptions will be identified

References

- Application Optimization Scope of Work White paper
- WiMAX Application Usage Profile
- 3GPP, "Feasibility Study for OFDM for UTRAN enhancement," TR25.892 V2.0.0