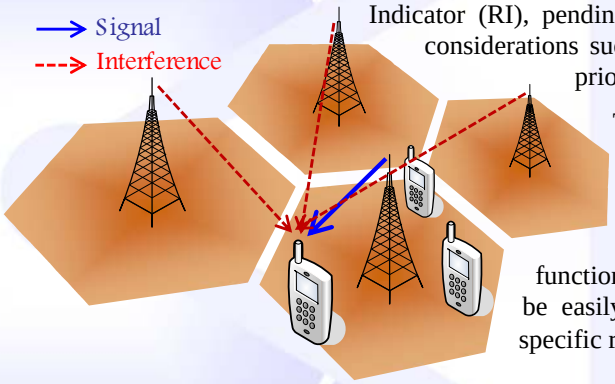
WM-SIM Datasheet (LTE Advanced)

About WM-SIM

WM-SIM is a standard compliant link-level simulation environment for the 3GPP Long Term Evolution Advanced (LTE-A) technology. The simulator has been developed by the Communications Engineering Research Group at the University of Malaga (Spain).

The physical layer implementation for both downlink and uplink is compliant with the 3GPP-LTE Release 10 specifications. Thus, WM-SIM provides support for Orthogonal Frequency Division Multiple Access (OFDMA) and Single Carrier Frequency Division Multiple Access (SC-FDMA) schemes as well as for Multiple Inputs Multiple Outputs (MIMO) transmission up to 4x4 antenna configuration. Adaptive Modulation and Coding (AMC) can be used to keep instantaneous BLock Error Rate (BLER) below a given target value. An Outer Loop Link Adaptation (OLLA) scheme is also implemented. Hybrid Automatic Repeat reQuest (HARQ) is used as high-rate forward error-correcting coding and ARQ error-control. Variable coding rate is achieved by applying different puncturing patterns depending on the current H-ARQ incremental redundancy (IR) version. The turbo decoder uses a MAP algorithm and a maximum of 8 decoding iterations.

At the MAC layer, several cross-layer scheduling algorithms are available to allocate time-frequency resources to the different users. The scheduler decisions are based on the per-user reported PHY measurements as Channel Quality Indicator (CQI), Rank Indicator (RI), pending HARQ retransmissions, and Precoding Matrix Indicator (PMI). Other considerations such as the terminal speed or Quality of Service (QoS) requirements (e.g., priority handling) can be also taken into account in the scheduling process.

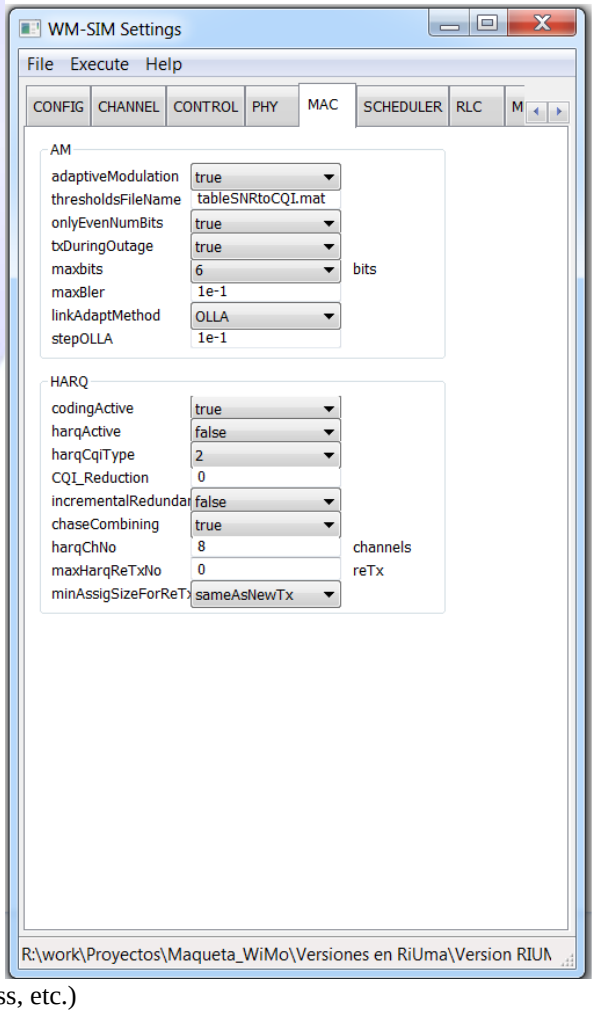


The simulator also includes a module responsible for collecting Quality of Service (QoS) statistics. WM-SIM results can be saved into files that are fully compatible with Matlab format (MAT files) making it possible to take advantage of its potential for off-line post-processing. Results available by default are closely related to Quality of Service (QoS) functionality (e.g., BER, BLER, delay, throughout,…). However, the simulator can be easily tailored to include new results data on demand and, therefore, more specific requirement can be met.

Features

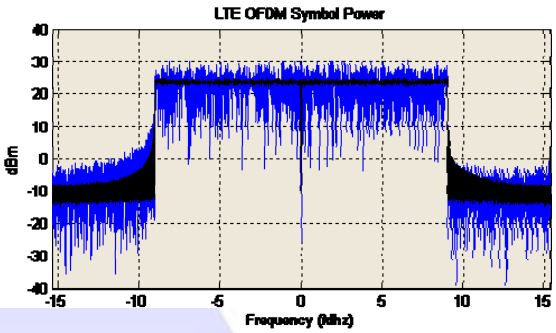
The main features of WM-SIM are listed below:

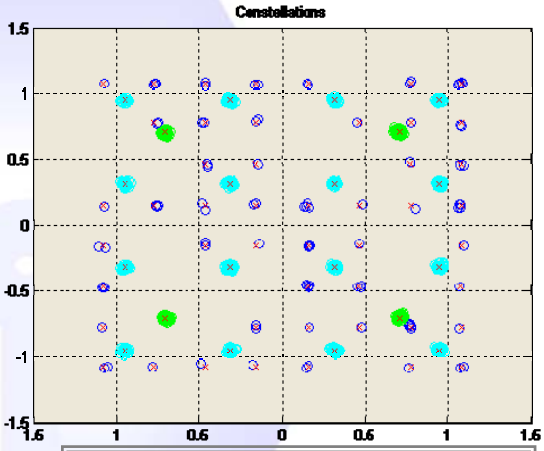
- System level configuration:
  - Different system bandwidth: 1.4, 3, 5, 10, 15, 20 MHz
  - Heterogeneous networks composed of Macro cell Base Stations (MBSs) and Small cell BS (SBSs)
  - Multi-cell configuration with regular and irregular deployments for MBSs and SBSs
  - Biased association criteria for the Downlink (DL); coupled and decoupled association criteria for the Uplink (UL)
  - DL power setting and UL fractional power control
  - Interference mitigation through Fractional Frequency Reuse (FFR)
- Source traffic (user specific) from a predefined set of models (Full buffer, Streaming) or possibility to import traffic traces from a data file (Gaming, Camera)
- Link level configuration:
  - QPSK, 16QAM or 64QAM modulations (fixed/adaptive)
  - Outer Loop Link Adaptation (OLLA)
  - HARQ with Incremental Redundancy (IR) and Chase Combining (CC)
  - DL / UL configuration (SISO or MIMO)
  - MIMO Transmission techniques: Beamforming, Multiplexing (SU and MU-MIMO), Space Frequency Block Coding (SFBC), Rank Adaptation (up to 4 layers)
  - Codebook based precoding
  - Configurable antenna correlation
  - Reception techniques: ZF, ZF-QR, ZF-SQR, MMSE, MMSE-QR, MMSE-SQR, MRC
  - Channel estimation: based on reference symbols (Zhao, Loss-pass, etc.)



- Scheduling algorithms: Round Robin (RR), Proportional Fair (PF), Opportunistic Hard Priority (OHP), Channel Dependent Earliest Deadline Due (CD-EDD), CD-EDD with postponed EDD term, semi-persistent scheduling, etc.

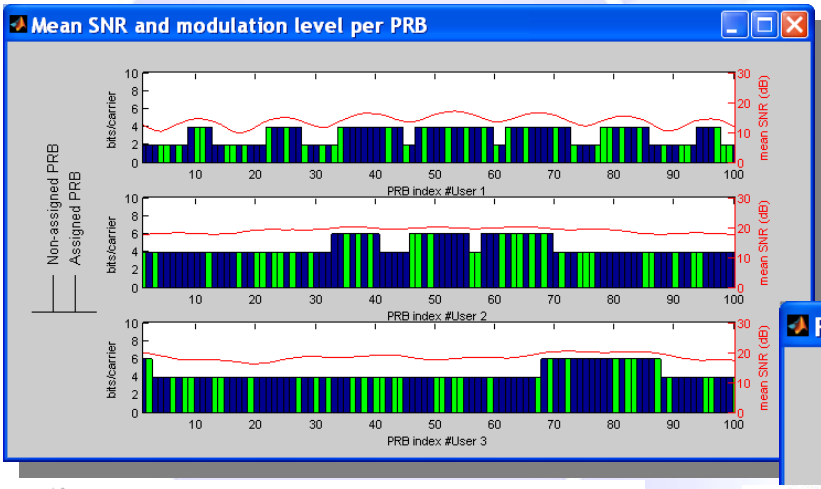
- Mobile channel model
  - AWGN and frequency selective fading (Rayleigh and Rice) channel model in time or frequency domains
  - Two types of multipath channel model are available:
    - Filtered Gaussian noise channel model
    - Jakes' sum of sinusoids (SOS)
  - Fully configurable channel delay profile
  - Different Doppler spread for each UE





Use Cases

- Generate suitable look-up tables to interface with a system level simulator (for different AMC formats and MIMO configurations)
- Develop and test new PHY/MAC algorithms (scheduling, reception techniques, etc.)
- Determine optimum configuration parameters' value for different scenarios (e.g. base station transmission power, maximum number or HARQ retransmissions, etc.)
- Evaluate the fairness between users with QoS constraints



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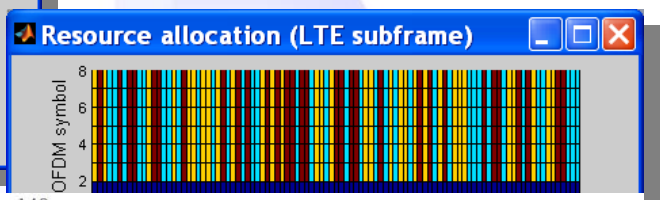

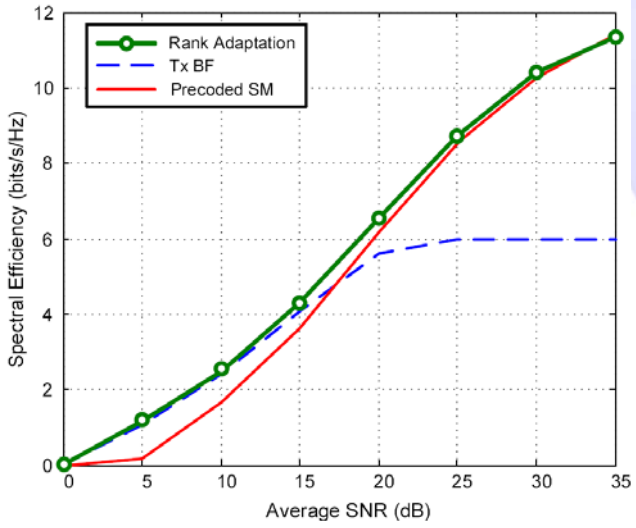

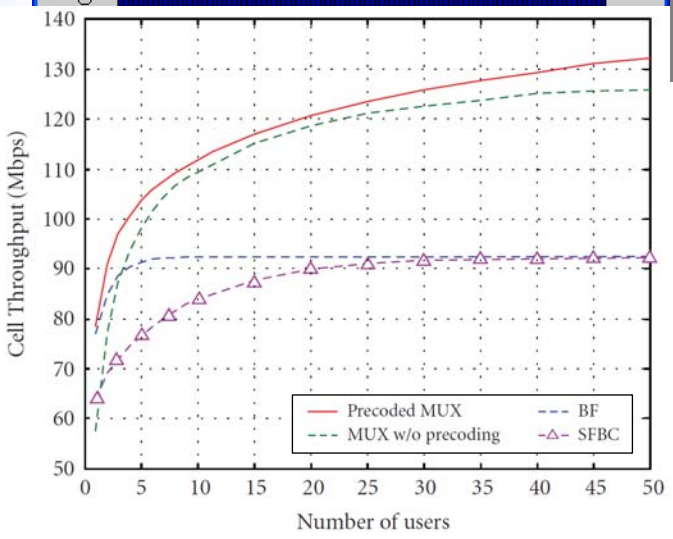

References

[1] Gerardo Gómez, David Morales-Jiménez, Juan J. Sánchez-Sánchez, J. Tomás Entrambasaguas, "A Next Generation Wireless Simulator Based on MIMO-OFDM: LTE Case Study", EURASIP Journal on Wireless Communications and Networking, 2010

[2] Juan J. Sánchez Sánchez, David Morales-Jiménez, Gerardo Gómez, Unai Fernández Plazaola, Eduardo Martos-Naya, J. Tomás Entrambasaguas: "WM-SIM: A Platform for Design and Simulation of Wireless Mobile Systems", Proceedings of the Second ACM Workshop on Performance Monitoring and Measurement of Heterogeneous Wireless and Wired Networks, Chania, Crete Island, Greece, October 2007

[3] Juan J. Sánchez Sánchez, Gerardo Gómez, David Morales-Jiménez, J. Tomás Entrambasaguas: "Performance Evaluation of OFDMA Wireless Systems using WM-SIM Platform", The 4-th ACM International Workshop on Mobility Management and Wireless Access (MobiWac), Torremolinos, Málaga, October 2006