

Vienna 5G System Level Simulator v1.2 - List of Features

General Functionality

The Vienna 5G System Level Simulator evaluates the average performance of large scale networks by means of Monte Carlo simulations.

- Multiple base station and user types in one simulation
- Flexible implementation using OOP in MATLAB
- Several performance metrics are evaluated (SINR, average user throughput etc.)
- Environment dependent choice of propagation models
- Downlink transmission

Network Elements

Base station, user and blockage types can be defined freely (number of antennas, transmit power, position) and used simultaneously in one simulation

- Macro, pico, femto cells
- Vehicular, pedestrian, indoor users with movement
- Buildings/blockages (Manhattan, predefined, [OpenStreetMaps](#))

Propagation Models

Several models for propagation effects are combined to large scale and instantaneous SINR

Incorporated propagation effects:

- Large scale path loss
- Shadow fading
- Antenna pattern
- Small scale fading
- Influence of blockage objects

Performance Evaluation

Simulation results:

- SINR/SNR
- user throughput
- transmission latency
- BLER
- link properties: LOS/NLOS, path loss, scheduling, cell association ...
- *lite* SINR/SNR

Transmission parameters

- Zero Forcing Equalizer
- NOMA transmission

Flexible parameterization of transmission frame structure:

- Symbol intervals
- Mixed subcarrier spacings with inter numerology interference

Traffic Models

- Full buffer
- Constant rate

Scheduler

Scheduler decision done per base station.

Supported schedulers are:

- Round Robin
- Best CQI

Path Loss Models

Path loss model is chosen dependent on the link state, i.e., LOS/NLOS, user height, indoor/outdoor.

Supported large scale path loss models are:

- | | |
|--------------|---------|
| • Fixed | • UMa |
| • Free Space | • UMa3D |
| • Indoor | • UMi |
| • Rural | • UMi3D |
| • Suburban | • Urban |
| • Macro | • RMa |

Base Station Placement

Placement of network elements is 3D in general.

- | | |
|------------------|---------------|
| • Hexagonal grid | • Predefined |
| • Hexagonal ring | • Uniform PPP |
| • Manhattan | |

Border Effect Mitigation

Add interference for border region users through:

- wraparound
- interference region

Channel Models

Supported channel models are:

- AWGN
- Rayleigh
- QuaDRiGa (interface, additional license required)

Supported PDP channel models (channel traces are pregenerated before the main simulation):

- | | |
|-----------------|-----------------|
| • Hilly Terrain | • Typical Urban |
| • PedA | • VehA |
| • PedB | • VehB |
| • Rural Area | • extended PedB |

Feedback

Quantized feedback for CQI according to the LTE-A standard with perfect CSI, including MIMO PMI and RI according to LTE release 8 for up to 4 user streams.

Quantized and perfect feedback supported:

- Rate adaptation feedback (CQI)
- MIMO feedback (RI/PMI)

User Placement

- Uniform Poisson point process
- Poisson on streets
- Clustered
- Predefined

Movement:

- | | |
|--------------------|--------------|
| • Random walk | • Constant |
| • Random direction | • Predefined |