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The GTEC 5G Link-Level Simulator

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Introduction

- The GTEC 5G Simulator is a versatile and flexible link layer simulator developed at the GTEC group of the University of A Coruña
- Developed using the MATLAB language
- Motivation: evaluation of the current 4G communication techniques, as well as the new 5G proposals
  - Orthogonal Frequency-Division Multiplexing (OFDM)
  - Filter Bank Multicarrier (FBMC)
- Modular implementation
  - New functionalities can be added easily by changing or implementing new modules
- fully integrated with the GTEC testbed
- publicly available under the GPLv3 license at https://bitbucket.org/tomas_bolano/gtec_testbed_public.git

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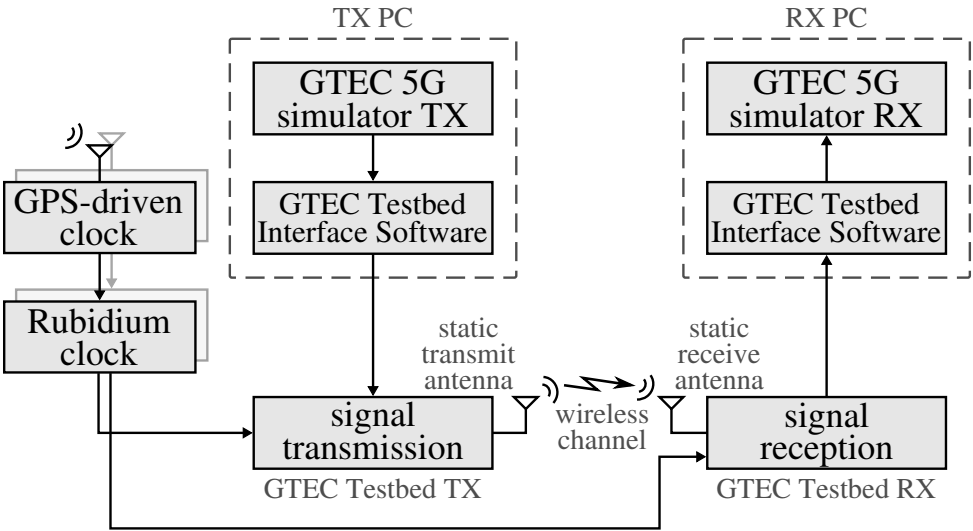
The GTEC Testbed

- Testbed developed at the GTEC group, which was extensively used in the past for experimental evaluations of WiMAX and LTE in different environments (subways, railways and high speed environments)
- The GTEC 5G simulator is fully integrated with the GTEC testbed enabling us not only to perform simulation-based evaluations, but also by means of over-the-air measurements in different environments.
- The GTEC testbed and the GTEC 5G simulator have been used for experimental evaluations of OFDM an FBMC waveforms

GTEC Testbed structure

- Consists of several nodes
- Hardware for each node:
  - Universal Software Radio Peripheral (USRP) B210 board built from the AD9361 chip by Analog Devices
  - Laptop equipped with two solid-state drives conected to the USRP
- Software for each node (running in the Laptop)
  - GTEC Testbed Interface Software
    - Communicates directly with the USRP
    - Used to set up or change the configuration, read the signals to be transmitted from disk and store the acquired samples.
    - Developed in C++ with MATLAB wrappers.
  - GTEC 5G Simulator
    - Generate and process the signals

GTEC Testbed structure



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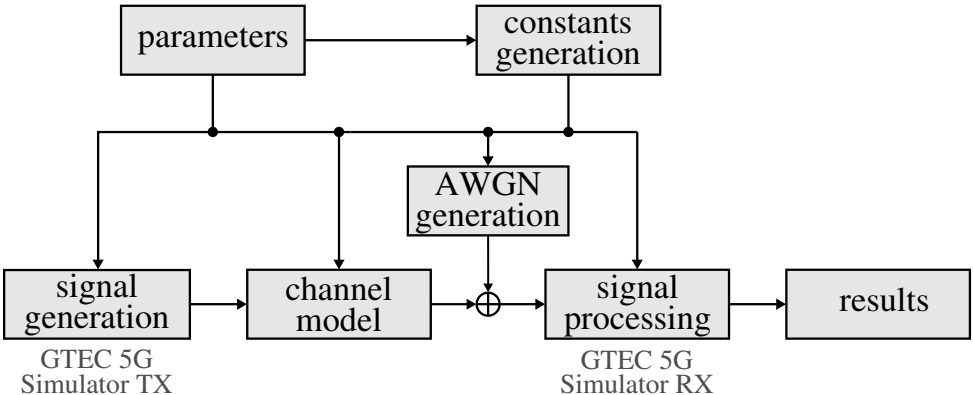
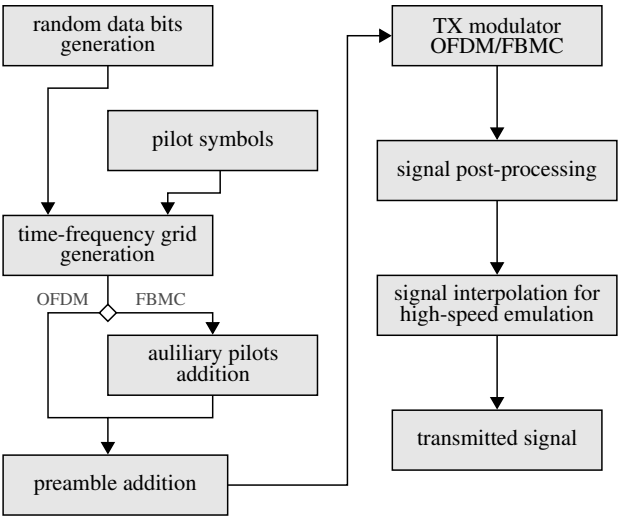
Overall Description of the Simulator

- Link level simulation of both OFDM and FBMC
- Two different prototype filters implemented for FBMC
  - PHYDYAS
  - Hermite
- Basic algorithms implemented at the receiver
  - channel estimation
  - channel equalization: based on a Zero-Forcing (ZF) strategy
  - time and frequency synchronization
  - FBMC interference cancellation methods: auxiliary pilots
- Configured via an standarized parameters file
- Several channel models for simulations
  - AWGN
  - Flat Rayleigh fading
  - Standardized channel models using the MATLAB `stdchan` function

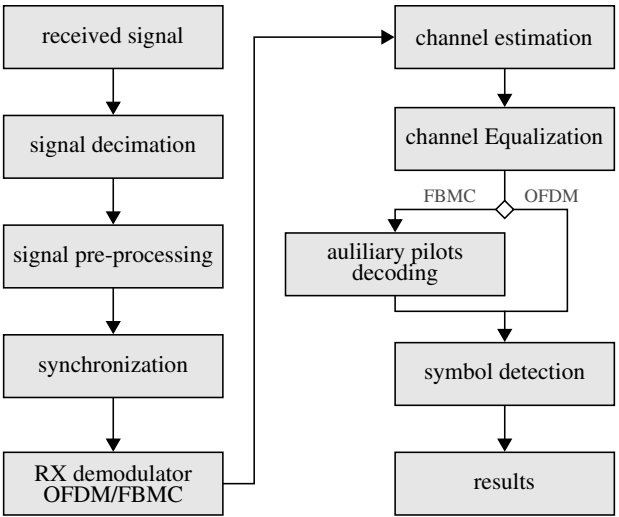
Structure of the Simulator



Structure of the Transmitter Block



Structure of the Receiver Block



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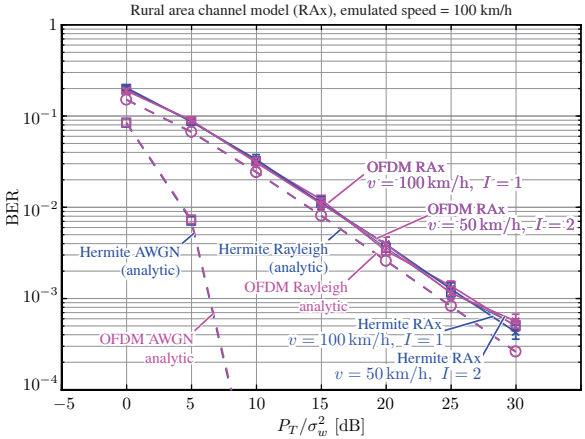
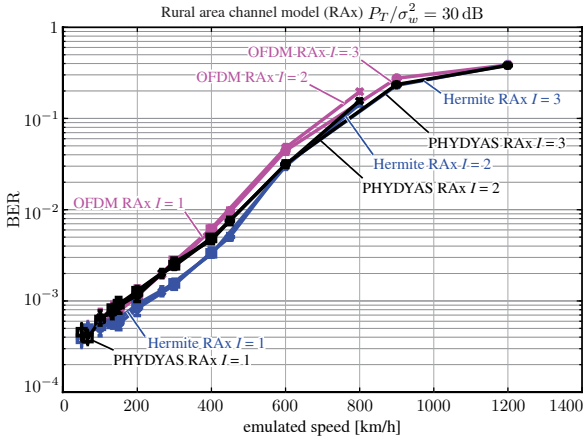
Simulations iterating by noise



Sample results of BER versus emulated speed for OFDM and FBMC with the PHYDYAS and Hermite prototype filters. Rural Area channel model (RAx) channel model and $P_T/\sigma_w^2 = 30$ dB.

Simulations iterating by speed



Sample results of BER versus emulated speed for OFDM and FBMC with the PHYDYAS and Hermite prototype filters. RAx channel model and $P_T/\sigma_w^2 = 30$ dB.

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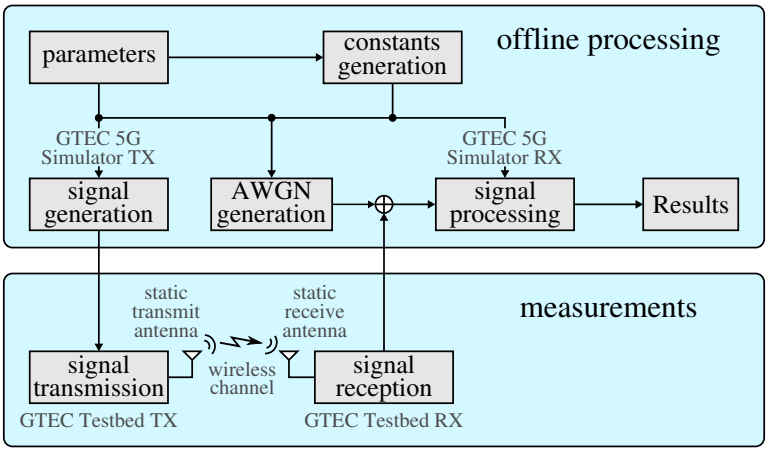
Measurements methodology



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Conclusions

- We presented the overall structure of the GTEC 5G link-level simulator as well as the details of its main blocks
- We showed how the simulator is integrated with the GTEC testbed, enabling us to perform evaluations both by simulations and by over-the-air measurements.
- We explained how simulations are performed and showed some exemplary results.
- We described the typical workflow followed during a measurement campaign.

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