Prototyping the 5G Air Interface in SDR: A Filter Bank Multicarrier Primer
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TIGR Framework

- Rapid prototyping framework for performance validation and proof-of-concept of the novel communication techniques
- Offered by SDR technology based on general purpose hardware
- Transmitter and receiver node are composed of a host commodity computer and Universal Software Radio Peripheral (USRP)

Figure: The framework overview

- A modular, GNU Radio based reconfigurable SDR framework extends PHY layer functionalities of current wireless standards

Table: The set of reconfigurable system parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth (static)</td>
<td>Variable, up to 8 MHz</td>
</tr>
<tr>
<td>FFT length (static)</td>
<td>64 – 1024</td>
</tr>
<tr>
<td>Frame length (static)</td>
<td>Variable</td>
</tr>
<tr>
<td>Carrier frequency (dynamic)</td>
<td>2.400 – 2.483 MHz</td>
</tr>
<tr>
<td>Modulations (dynamic)</td>
<td>BPSK, QPSK, 8-PSK, 16-QAM, 32-QAM, 64-QAM, 128-QAM, 256-QAM</td>
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<tr>
<td>Power (dynamic)</td>
<td>Up to 20 mW</td>
</tr>
</tbody>
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Control and Feedback

- The control and feedback mechanisms allow for estimation of link quality and optimal assignment of predefined transmission parameters
- Low latency backbone implemented by ZeroMQ

Figure: ZeroMQ communication model within TIGR.

Graphical User Interface (GUI)

- The transmitter’s GUI
  - Static transmission parameters
  - Current rate and power allocation over subchannels
- The receiver’s GUI
  - Estimated signal parameters (SNR, CSI, BER, CFO)
  - Interactive interface for on-the-fly configuration

Figure: The transmitter’s and receiver’s GUls with interactive control interface

Filter Bank Multicarrier (FBMC)

- FBMC is an alternative multicarrier technique that offers superior adjacent channel leakage ratio (ACLR) properties and increased spectral efficiency compared to OFDM
- A possible PHY-layer candidate for the fifth generation of mobile telecommunications technology (5G) standards
- Prior to transmission, the symbols are overlapped in time domain
- Near perfect reconstruction at the receiver

Figure: FBMC transceiver.

TIGR Implementation

- GNU Radio Companion (GRC) model of the FBMC transceiver
- Interactive reconfiguration of system parameters

Figure: FBMC transmitter and receiver.

Preliminary Experimental Results

- Over-the-air validation of spectral properties
- Experimentation in different RF scenarios

Figure: BER vs. transmit amplitude in the presence of OFDM and FBMC interferers.