Wireless transceivers for mobile terminals: architectures, analysis and signal processing

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Multicarrier OFDM and multi-antenna MIMO techniques have emerged as enabling technologies for 4G communication systems. They have also generated new challenges in terms of transmitter architectures with good efficiency and linearity, and in term of integration of transceiver and antennas in mobile user terminals. Smart everyday objects incorporating sensors, wireless communication and positioning devices, are supporting many new applications such as environment monitoring, machine-to-machine communications and body area networks. They require low cost, low power consumption smart transceivers. Our work focuses on wireless transceivers for multi-radio and future cognitive radio terminals, millimeter wave mobile communications with low power consumption and ultra-wide band transceivers (UWB). We address the problem with two complementary perspectives: RF technology and digital technology using signal processing. Association of digital technologies and signal processing is a very fruitful approach for baseband and RF parts of wireless transceivers in terms of integrability, reconfigurability, adaptativity and smart processing. Our main recent contributions are the following ones:

High efficiency signal generation architectures with good linearity and flexibility for multi-frequency, multi-standard mobile transmitters:
- Design of new architecture efficient and robust to power amplifier non-linearities based on a combination of EER (envelope elimination and restoration) and LINC (Linear amplification with non linear components). Theoretical analysis of components impairments of the performances of these architectures.
- Use of switched power amplifiers in RF transmitters: Analysis of the influence of envelope coding on the performance of a class E power amplifier. Design of multi-band class E power amplifier.
- Specifications of a polar sigma-delta architecture associated to a high efficiency switched mode power amplifier for multi-standard mobile transmitters including WiMax or LTE standards.
- Proposal of a cartesian transmitter architecture using baseband sigma-delta modulators and switched power amplifier. Analysis of the constraints and influence of sampling frequency.
- Analysis of front end filtering requirements on a mobile cognitive multi-radio transmitter

Frequency synthesis and PLL (Phase Locked loop) using digital signal processing for multistandard transmitters and future cognitive transmitters:
- Exact calculation of phase noise of RF Digitally Controlled Oscillator with frequency resolution improved by dithering.
- Study of frequency synthesis in a multistandard transmitter architecture:
  - Design of a PLL based frequency synthesizer using switched loop bandwidth for mobile transmitters: optimization of the trade-off between bandwidth and lock-up time for switching of the loop filter; phase noise analysis; dual Mode Hybrid PLL Based Frequency Synthesizer for Cognitive Multi-Radio Applications.

Towards cognitive radio networks:
- Spectrum utilization measurements and Analysis of spectrum utilization in some urban and suburban environments. Evaluation of potentials for cognitive radio.

Physical layer and transceiver architecture design for ultrawideband (UWB) communications
- Millimetre wave mobile transceivers: specification and performance analysis of a Multi band, on-off keying, Impulse radio UWB transceiver for low cost, low power consumption mobile millimetre wave transceivers.
- Design of a physical layer for UWB impulse radio body area network.


Other results: 3 Best paper awards, Chair of the EuWiT 2010 conference