Cognitive Radios Adaptable Wireless Transceivers

Sdr has already started its way to conquer traditional radio configurations, by moving base band (de)modulators completely to the digital world, implementing them in software or re-configurable hardware. This project aimed to study some of the current sdr physical layer limitations, starting from agile rf front ends and considering fpga based implementations with improved flexibility, efficiency and dynamic range figures of merit.

GENERAL MOTIVATION AND OBJECTIVE OF THE PROJECT

Nowadays, new telecommunications standards or new releases of existing ones (e.g., Worldwide interoperability for microwave access (wimax), 3gpp long term evolution (lte), universal mobile telecommunications system (umts), high speed downlink packet access (hspa+), etc.) are constantly appearing. In this scenario, interoperability across existing standards is a crucial requirement to achieve a high quality of service (qos). Software defined radio (sdr) technology holds the best promise of meeting the requirement whilst efficiently tackling the ever-increasing complexity of radio systems.

One of the most interesting potential applications of sdr is to increase the spectrum occupancy by designing opportunistic radio systems. It systems capable of dynamically allocating regions of the spectrum that happen to be free at a given moment, which implies the ability to ‘see’ or ‘be aware’ of the entire spectrum and its usage at a precise time. This has motivated the scientific community to study different radio architectures with the ability of detecting signals over a broad frequency band with a high dynamic range. This requirement poses problems due not only to bandwith restrictions but also to high peak-to-average power ratio (papr) demands or rf interference from one or more sources.

CHALLENGE

Building flexible multi-mode/multi-standard sdr and cognitive radios (cr) requires digital processing of high-frequency and wide-band signals, which is challenging in terms of sampling rate, operating speed, dynamic range and power consumption.

In that respect several objectives were proposed:
1. Study and evaluate the signal statistics and signal behaviour of the expected waveforms to be used in cr approaches
2. Improved algorithm for signal quality evaluation, and also signal processing approaches for reducing peak to average power ratios and maximize the dynamic range of the hardware components was achieved
3. Proposal of new and improved behavioural models for hard ware components
4. Proposal of very wide bandwidth receivers for spectral sensing
5. Very high dynamic range receivers were proposed
6. New algorithms able to reconfigure fpga’s on the fly based on the decisions gathered and proposed by the dsp algorithms, the fpga approach should adapt in an almost real time solution
7. All digital transmitters based on fpga design was achieved, in - cluding the first multi-band all digital transmitter
8. With the knowledge gathered with the previous work, a new and agile radio front end will be built

TECHNICAL ACHIEVEMENT OF THE IT TEAM

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5. Proposal of new algorithms and receivers for spectral sensing
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