Supélec (France)

Interests for 5G-PPP

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P1: 5G Wireless System Design

Objective
- Design the 5G wireless system that
efficiently meets the large variety of use cases and application requirements beyond 2020
- **builds upon a smooth migration from current technology**
- also considers satellite and broadcast potential

Scope
- Identify and evolve key 5G scenarios and consolidate the requirements for 5G within the 5G-PPP and with external stakeholders
- **Design a Multi-RAT system that efficiently integrates legacy and 5G air interfaces**
- Integration of **new radio access concepts** especially from other 5G PPP project, and exploiting radio access capabilities to address the service requirements
- **Interference, mobility and spectrum management**
- Control- and user-plane design for novel 5G components
- Moderation of service requirements versus radio access capabilities
- **Integration of innovative spectrum usage concepts** (e.g. sharing, pooling...)
- Define an architecture that supports the 5G system concept whilst also making it as RAT agnostic as possible to anticipate future RATs integration
- Ensure overall KPI evaluation by providing an evaluation framework and performing an overall assessment in **close collaboration with other 5G-PPP projects**
- Tight cooperation with most related/relevant 5G-PPP projects

Expected Impact
- A 5G wireless system that meets the requirements for integrated wireless communications well beyond 2020
- Industrial and global alignments: Preparation of WRC 18 and contribution to the ITU-R 5D evaluation work, preparation of a European head start in standardization of 5G in e.g. 3GPP
- Demonstrate the key 5G system components
P2: Air Interface and Multi-Antenna, Multi-Service Air Interface below xx GHz

Objective
• To design a highly flexible and adaptable air interface being able to support efficiently
  • the multitude of service classes (from continuous high rate to sporadic low rate and with an
    option for very low latency)
  • and device types (from high-end tablet to low-end device)
  • and MIMO capabilities (in both UE and eNB)
  • in various areal settings (from heterogeneous ultra dense urban setting with cooperation to
    macro cell dominated rural areas) with flexible spectrum usage

Scope
• Scalability, adaptability, flexibility - to meet temporal and areal fluctuations of active service
  and device class mixes and to support massive simultaneous network access
• Energy efficiency - both for the radio access network and devices
• Uniform coverage, high capacity – interference-robustness, adaptability to a wide range of
  spectrum allocations, high spectral efficiency at minimal control overhead
• Unified multi-antenna support - support localized, distributed and co-ordinated multi-antenna
  systems as an embedded feature in a natural way
• Robustness – to support very high velocity (high-speed trains, access and backhaul) and relaxed
  synchronisation (low-end devices)

Expected Impact
• Enable 5G to support both broadband and machine type transmissions within the same band with
  high efficiency and at similar costs (devices and energy) compared to dedicated solutions.
• Expand the business model and broaden the market of providing wireless services
• Easy implementation under various settings (deployment, carrier frequency …)
• Increased and uniform quality of experience
- Advanced MC waveforms with low PAPR for efficient power amplification
- Sparse signal Processing for front ends consumption mitigation
- Dynamic Partial reconfiguration for FPGA consumption mitigation
Spectral efficiency

• Learning for opportunistic spectrum access
  – no a priori knowledge of frequency channels occupation by primary users (PUs)
  – secondary users (SUs) run reinforcement learning algorithms (MAB) in order to fast reconstruct knowledge of the other users (PUs and SUs) channels occupation from partial sensing (only one channel at a time)
  – no need to extend SU bandwidth more than one transmission channel to enable CR

→ Decision making for flexible spectrum

• Demonstrators on real radio signals

MAB

SU #1

PU #1

PU #3

SU #2

PU #4

PU #2

SU #3

PU #4

Frequency spectrum

K Machines
Flexible RAT for HetNet

- Multi-mode RAT implementation/ scalable communications.
- Enhancing the out-of-band interference.

- Techniques for coexistence /Adapted Power control
- Achieve better spectral coexistence in HetNet context.
- Duplexing aspects / in-band FDD mode
- Interference control and management using cognitive approaches

Massive MIMO Technologies

- Design of Massive MIMO/small cells deployment using mathematical tools such as random matrix theory and stochastic geometry
- Self-organized dense networks based on game theoretic tools

How to densify: "More antennas or more BSs?"
Thank you for your attention
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