

InterOP – ATCZ175

Interoperability of Heterogenous Radio Systems

IP 1b Förderung von Investitionen der Unternehmen in F&I
IP 1b Podpora podnikových investic do výzkumu a inovací

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Project overview

- Duration: Jan. 2018 – Dec. 2020
- Project partners: 3 universities (2 x AT, 1 x CZ)
- Strategic partners: 3 companies (2 x CZ, 1 x AT)
- Budget: 653 k EUR

Challenges in IoT

- 20 – 40 Billiards of mobile RF devices in 2020 expected
- High density of networked devices that communicate wirelessly
- Increasing demand of channel capacity for high data rates
- Challenges in unlicensed bands:
 - Frequencies are used in a uncoordinated way
 - Unknown number of users
 - Many different standardized as well as proprietary transmission protocols
 - Collisions and transmission errors reduce the transfer capacity and reliability.



Why is interoperability critical?

- **Interoperability** guarantees that products or system will work with other products or systems, present or future, without any restrictions.
- With the high number of RF devices is the system performance is negatively impacted by effects that had no or neglectable impact in present applications.
- Many battery-powered systems (sensors, home automation). Retransmissions cause reduced life-time of the devices.
- Key steps to bring interoperability under control:
 - Analyze the root-cause of possible interoperability issues.
 - Describe the systems using models.
 - Analyze the behavior and understand issues by doing simulations.
 - Take countermeasures and verify improvements by emulation in early-stage of the design.

Needs of the industry

- Shorter time-to-market and reduce re-designs
- Tools, Models and Methods for interoperability verification
- Complex know-how provided by local R&D partners
- Reliable way to predict the performance of their products
 - Startups and SMEs that cannot afford complex tools will benefit from the outcome of the project
- Evaluation of real-issues on strategic partners' use-cases

How InterOP solves these issues?

- Three universities with strong background in applied research offer their know-how and simulation tools.
- Collaboration with strategic partners drives the focus.
- Rich experience in different projects with industry in the regions will be shared to better understand technical relationships.
- Focus on
 - Developing models, simulation and emulation tools and measurements.
 - Analysis of linear and non-linear interference.
 - Develop real-time simulation/emulation tools
- Outcome of the proposed project will be publicly available
 - Data and statistics out of measurement campaigns
 - Models of interference scenarios
 - Modules and libraries for SDR and simulation platform
 - Contribution to standardization of RF communication protocols

SIX-BUT Introduction

- Sensor, Information and Communication Systems (SIX), Brno University
- The activities are split into the following groups:
 - Sensors
 - Signals
 - Radiofrequency systems
 - Mobile communication systems
 - Advanced cyber-security
 - Antennas and microwave circuits
- Direct R&D contracts with the industry
 - 2014 - 6,9M Kč (256k EUR)
 - 2015 - 8,5M Kč (315k EUR)
 - 2016 - 9,0M Kč (330k EUR)

Selected SIX'industrial partners



TUW/EMCE Introduction

- TU Wien,
Institute of Electrodynamics, Microwave and Circuit Engineering
Microwave Engineering Group
- The activities are split into the following groups:
 - Microwave engineering
 - (Integrated) circuit design
 - Biosensors
 - Electromagnetics (and simulation)
 - THz electronics
- Funding of the group >65% by research projects and industry
- State of the art microwave measurement equipment and antenna measurement systems

Selected partners of EMCE/Microwave Engineering Group



FHO RG Embedded Systems

- 12 researchers and professors at department HW/SW design
- NFC Research Lab (Langer)
 - Very High Bit Rates
 - Security & NFC
- Modelling and simulation of circuits and systems (Brachtendorf)
 - FWF: THz devices based on plasma oscillations
 - Fp7 nanoCOPS: CAD tools for nanoelectronic devices
 - Int. PhD programme with JKU: GPUs for numerical circuit and device simulation

Focus of strategic partners

- Sewio (Brno)
 - Real-time localization systems
- Honeywell (Brno)
 - Aerospace, Automation & Control Solutions, Transportation Systems
- KB Micro (Brno)
 - Design, development, simulation, prototyping, testing of electronic systems
- Intel (Linz): Ics for 3G, 4G, 5G mobile phones
- CDE (Hagenberg): security and wireless solutions for NFC and medical engineering
- ARCOSIC Research (Mödling): R&D in radio communication and engineering
- Frequentis (Wien)
 - Communication solutions for safety-critical applications, civil/military air traffic control
- Datamatix (Wien)
 - Wireless solutions, truck telemetry, direct radio links, satcom, UHF RFID
- Funktechnik Böck (Wien)
 - Radio equipment for private mobile radio, aircraft radio, maritime radio, spectral monitoring

Why cross-border cooperation?

- BUT brings in **measurement** and **verification** tools for an **evaluation** of emerging communication protocols and RF channels.
- FHO brings in a **simulation tool** for the simulation of RF circuits and systems
- TUW brings in **the required linear and non-linear measurement equipment and system expertise** for internal verification and test.
- The joint research project will result in a **unique simulation framework** for RF interoperability.

Initial steps

- Identify interference scenarios
- Develop X-parameters models to describe non-linearities of RF systems
- Provide state-of art SDR for real-time emulation of interferences
- Provide simulation algorithms using the unique fast Linz-frame circuit simulation engine

Expected impact on the program regions

- Improvement of the **competitiveness** of regions by providing **R&D** to innovative solutions in the RF microwave systems and IoT.
- **Pilot studies** with strategic partners.
- Availability of **tools, measurements and methodologies** to local industry to support design of their products.
- Support startups and SMEs that cannot afford complex tools to support their product design process.
- **Increase the level of education** in wireless communication and microwave engineering.