PoC #1 • On-chip frequency generation

Short description of PoC:
This PoC covers the full on-chip frequency generation system including transport of signals to receiving blocks. 5G frequency bands around 30 GHz as well as 60 GHz have been considered.

Benefits:
The main benefits are cost, size, and power reduction while using state of the art CMOS technology allowing for high-level system integration.
PoC #2 • Active SIW antennas with integrated power amplifiers for K/Ka frequency bands

Short description of PoC:
In this PoC an active SIW antenna with integrated power amplifier for operation in the 17-30 GHz frequency range is developed: the full-wave/circuit of the planar antenna and power amplifier are co-designed.

Benefits:
This active transmit antenna with integrated power amplifier for 5G RF frontends allows both cost reduction and performance improvement of the art CMOS technology allowing for high-level system integration.

Assembled prototypes of the integrated antenna and PA
PoC #3 • PAPR reduction and power amplifier pre-distortion

Short description of PoC:
This PoC focuses on developing a new Peak-to-Average Power Ratio (PAPR) reduction scheme named as Weighted Selective Mapping (WSLM) algorithm and implementing both the PAPR reduction technique and a Digital Pre-Distortion (DPD) technique to reduce the PAPR value.

Benefits:
Demonstration of the PAPR performance improvement using both WSLM and DPD techniques.
PoC #4 • Multi band transmitter

Short description of PoC:
Multiband transceiver solutions exploit broadband and multiband capabilities of components to realize transceiver chains, which support concurrent operation in multiple radio bands.

Benefits:
This transmit-chain allows reducing the hardware complexity by decreasing the number of implemented transceivers. This solution covers simultaneously different radio bands between 2.6 and 3.6 GHz for concurrent multiband operation.
PoC #5 • Full duplex transceiver

Short description of PoC:
This proof of concept demonstrates the practical feasibility of full duplex with a particular focus on 5G applications.

Benefits:
Even in a scenario where only the Access Point (AP) is able to transmit and receive at the same time and frequency, the overall performance of the system does improve significantly.
PoC #6 • High-speed low power LDPC decoder

Short description of PoC:
This PoC addresses the design of cost-effective Low Density Parity Check (LDPC) decoders, suitable for the new generation of communication systems, requiring increased data rates and reduced energy footprint.

Benefits:
The expected benefits are to meet 5G requirements in terms of end-user data rates, while reducing implementation cost at the terminal side.
PoC #7 • HW/SW function split for energy aware communications

Short description of PoC:
KPI-driven function split of the hardware-accelerated (HWA) and software (SW) communication stack functions for flexible 5G C-RAN (dynamic hotspots). On top of the function split, the following parameters are modifiable according to specific KPIs & 5G use cases: bandwidth, modulation an coding scheme (MCS), resource block groups (RBGs), RF transceiver output power.

Benefits:
Different HWA-SW function splits (denoted as network configurations (NETCFGs)) can be used to satisfy KPIs such as energy efficiency.
PoC #8 • Reconfigurable and programmable radio platform and SW programming performed and injected by the network

Short description of PoC:
The goal of this PoC is demonstrating the whole adaptation loop of 5G technologies, by reconfiguring the radio behavior according to advanced context estimates and different optimization criteria. This is possible exposing simple programming interfaces able to read the state of the resources and to enforce a desired configuration, according to decisions taken by a local SW agent interacting with a remote network controller.

Benefits:
This allows multi-cell dynamic resource allocations, the configuration of device medium access rules for operating in relay-mode or direct access and switching across technologies according to the link quality, as well as Multi-node dynamic HW/SW partitioning for both device and network element functions either inside or between network stack layers, according to monitored KPIs.
PoC #9 • Flexible, scalable and reconfigurable small cell platform

Short description of PoC:
This PoC builds a flexible, scalable small cell platform able to allow third parties to deploy SDR processing functions based on raw samples or higher-layer traffic (e.g., TCP/UDP). This is useful in situations where multiple independent tenants are running different processing functions on the same shared platform.

Benefits:
The realization of a multi-tenancy platform ensuring that 5G requirements are still met. This is used to enable the possibility of multiple operators (or MVNOs) sharing the same physical resource while still guaranteeing segregation.
**PoC #10 • Flexible resource allocation in CRAN/vRAN platform**

**Short description of PoC:**
The PoC is implementing/showing a small scale prototype of Virtual RAN, consisting a group of eNBs and multiple LTE commercial terminal. The purpose of this PoC is to analyze the effects of resource allocation algorithms for CRAN/vRAN networks, focusing in particular on advanced CoMP techniques, dynamic RRH activation/deactivation and BBU allocation and RRH association.

**Benefits:**
The PoC will be demonstrating benefits in terms of reducing inter-cell interference and increasing the user-throughput.

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*Implemented in WP5. Integration in WP6 within the PoC.*
PoC #11 • Multi-chain MIMO transmitter

**Short description of PoC:**
The multi-chain MIMO transmitter demonstrates a feasible all-digital transmitter approach at small scale with 8 transmit branches and to complete one chain with the required amplification stage. An all-digital massive MIMO transmitter architecture is evaluated inside this PoC.

**Benefits:**
The benefit of this approach is on the promotion of MIMO systems implementation due to multi-chain RF signal generation in a single component and the amplification suitable for antenna arrays.
- **Joint demo** with **Coherent** project: “FlexCRAN: Flexible Cloud-RAN Platform”

**Short description of PoC:**
This PoC is built based on OpenAirInterface and Mosaic-5G FlexRAN platforms. It demonstrates a flexible RRU/DU/CU architectural framework for C-RAN deployment in 5G.

**Benefits:**
Functional split and compression on the performance of the Fronthaul/midhaul networks as well as the feasibility of Ethernet-based fronthaul/midhaul. Programmability in RAN to enable RAN sharing use-case.
• Joint demo with 5G-Crosshaul project: “Network split with integrated fronthaul and backhaul”

Short description of PoC:
This PoC demonstrates an end-to-end transmission from the remote host to an UE based on Flex5Gware building blocks, such that the transport network is composed of the integrated fronthaul and backhaul developed in 5G-Crosshaul.

Benefits:
This PoC showcases the interoperability of different building blocks developed within two different 5G PPP Phase I projects: 5G-Crosshaul and Flex5Gware.
• **Joint demo** with FANTASTIC-5G project: “BF-OFDM MIMO transceiver based on software programmable hardware”

**Short description of PoC:**
The aim in Fantastic-5G is to demonstrate the Leti’s Block-Filtered OFDM (BF-OFDM) which is a quasi-orthogonal, multicarrier waveform for 5G multi-service transmission, that overcomes the shortcomings inherent in conventional LTE waveforms. Real-time implementation of a 2x2 BF-OFDM MIMO transceiver is done on a custom SDR prototyping board built around a high end FPGA (Zynq 7045), ARM processors and an agile RF front end (AD9361). This PoC is running on the same HW platform than demo.

**Benefits:**
Flexible and efficient use of all available non-contiguous spectrum through BF-OFDM waveform (well localized frequency response). Compatibility with classical LTE signaling and MIMO schemes. Ability to deal with multiservice applications: mobile broadband, mMTC and URLLC.
• **Joint demo** with SPEED-5G project: “Capacity distribution in random small-cell deployments and hierarchical machine learning-based management for RAT/ Spectrum/ Channel selection”

**Short description of PoC:**
Demonstrating enhancements in RRM and MAC by RAT, spectrum and channel selection based on hierarchical machine learning, with a proprietary 5G simulator. Showing impact of an algorithm for RAT, spectrum, and channel selection, which has been designed and developed in the context of SPEED-5G for radio resource management (RRM) for cells in order to serve UEs in (un-)licensed and lightly-licensed (3.5 GHz) bands. Also new DCS-MAC design features (dynamic channel switching in licensed or unlicensed bands and between the two) and FBMC-MAC design features are taken into account. Using theoretical results to predict maximum achievable performance gains from optimal resource usage in a dense unplanned multi-RAT small cell deployment.

**Benefits:**
The SPEED-5G concept provides a framework for heterogeneous spectrum aggregation and for inter-RAT load balancing, extended to unlicensed and lightly-licensed bands, in order to aggregate resources from different RATs and different licensing regimes to increase network capacity. Demos allow benchmarking actual performance gains of hardware PoCs against theoretically achievable levels.
• Joint demo with 5GEx project: “Cross-Domain Wireless Communication Service”

Short description of PoC:
This demo shows the interconnection of 2 different SDN/NFV domains containing a flexible vRAN implementation.

Benefits:
Enable business and technical cross-domain services by combining network, computing and storage resources.