Int5Gent

5G PPP
The 5G Infrastructure Public Private Partnership

Project Title

Integrating 5G enabling technologies in a holistic service to physical layer 5G system platform

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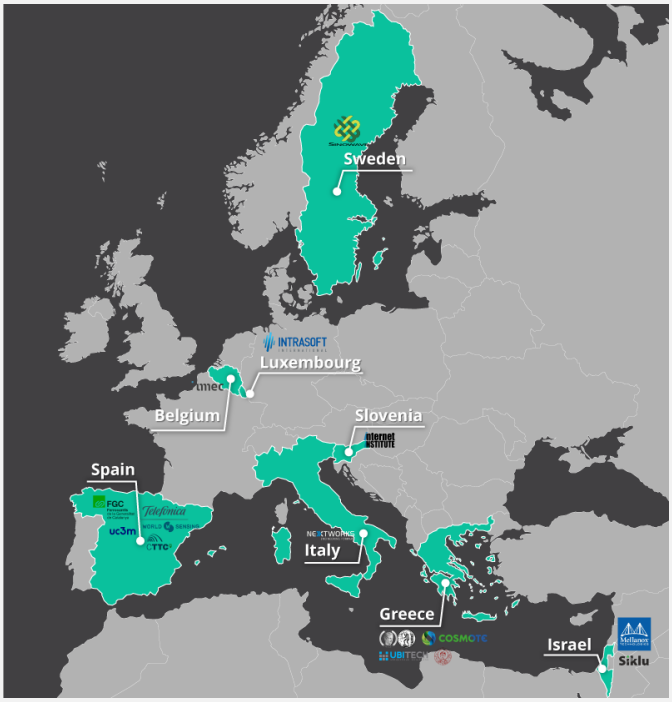

The Challenge

The necessity of an enabling 5G infrastructure, from the data plane technology blocks to the control plane and application deployment layer, is of paramount importance for maintain the market penetration momentum of 5G, generating in turn the functional requirements for meeting the expected 5G key performance indicators and therefore supporting the creation and growth of truly innovative vertical markets. From the networking point of view, the increasing interest in new use cases with strict latency requirements, fast service deployment times, dynamicity and trustworthiness generates a clear trend towards distributed network models implemented through the edge computing concept. According to this concept, the execution resources (compute and storage) are positioned at proximity to the end users and data generation sources. This denotes the deployment of an advanced infrastructure at the access and metro segments able to provide sufficient data transport connectivity and management of physical and virtualized network functions for a large number of distributed nodes. Essentially, the introduction of edge computing model in 5G alters the typical and simple-structured cloud-based connectivity model (access-core-cloud) to a mesh type model in which some functions must be executed at the edge part of the network and provide feedback to the attached end user devices, while portions of data can also be passed to the cloud. The complexity increases further by considering different types of edge nodes that may span from simple gateway servers to mini-data centers (DCs), thus having different connectivity requirements.

From the data plane point of view, the new technology building blocks should enable the 5G network infrastructure to provide the flexible high capacity and expandable connectivity between 5G terminals and edge computing nodes as well as among mobile edge, computing and content delivery nodes, and the core infrastructure also supporting the legacy cloud computing level. For this purpose, the move towards higher operating bands (V, W and even D-band) and the deployment of photonic interconnection solutions are necessary and require efficient elements for data distribution and demanding RF electronic system designs. In addition, the service level requirement for low latency in combination with new intelligent processing algorithms at the edge node denotes the deployment of edge processing units able to handle such services in real time and flexibly in terms of resource usage. Recently, the GPU assisted edge processing has gained interest for its usage in various applications requiring extensive parallelism as for example in AI-based applications and related video processing and data analytics services.

The Vision

Within this highly demanding environment, Int5Gent aims to deploy a holistic 5G system platform that combines new technological blocks for the data plane infrastructure orchestrated by flexible PNF-VNF instances over a generalized NFV Infrastructure (NFVI) that is extended to edge computational, storage and networking resources. An overlay application orchestrator for the vertical services allow a pragmatic approach for the services' deployment, the extraction of analytics and the inclusion of policy criteria. The overall goal is to integrate innovative solutions at different development layer of the 5G stack and combine

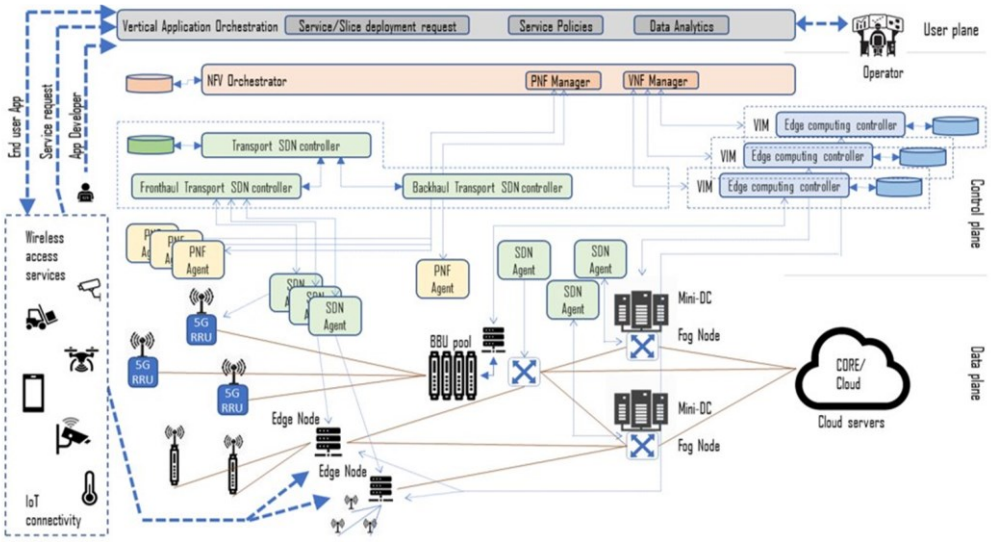

Fig. 1: *Int5Gent architecture*

them optimally in the quest to promote true 5G enabling solutions for new technology and service provisioning vertical markets.

Project Objectives

Empowered by its ambitious vision, Int5Gent aims to seamlessly interconnect access nodes supporting any type of IoT device and related services over a bandwidth flexible and adaptive fronthaul/backhaul infrastructure and control and manage the network and computational resources, as well as orchestrate the lifecycle of the deployed service functions. More specifically, Int5Gent will:

- Develop a mmWave point-to-multipoint (PtMP) mesh node to enhance the connectivity of IoT devices in support of low-latency computing at the edge
- Develop D-band 5G Terminal Nodes supporting flexible co-packaged electro-optics interfaces for practically unlimited fronthaul/backhaul transport capacities
- Develop a multi-stream bit-interleaved sigma-delta modulated interface for bandwidth-efficient, low-power interconnection between edge box and frequency agnostic 5G RRH nodes
- Edge-Box deployment based on advanced baseband processor platforms for MEC-oriented use cases
- Architect a truly flexible 5G C-RAN with reconfigurable optical fronthaul interfaces and “on-demand” optical bandwidth-capacity steering functionalities
- Dynamic application driven orchestration of network slices in distributed 5G infrastructures with edge-fog computing capabilities
- Develop an end-to-end 5G network slicing management and orchestration framework to dynamically reconfigure a multi-technology network at service runtime.
- Validate 5G technological blocks in a series of scalable lab- and field-trial demonstrators targeting service-oriented use cases.
- Deliver a holistic roadmap for transforming Int5Gent innovations into business opportunities with strong 5G market potential

Technology Exploitation

Int5Gent targets the integration of innovative data plane technology building blocks under a flexible 5G network resource, slice and application orchestration framework, providing a complete 5G system platform for the validation of advance 5G services and IoT solutions.

The project builds upon a suite of innovative 5G technological solutions spanning hardware, software, and networking systems that have been conceptualized and developed under the latest 5GPPP initiative projects and are now taken to TRL-7 and above. It also combines novel and state-of-the-art solutions able to further upgrade the capabilities and maturity level of cutting-edge 5G core technologies enabling the creation of an innovative 5G ecosystem. A sample of the developed and offered technologies include flexible multi-RAT baseband signal processing, beam steering, mmWave technology solutions at 60GHz and 150GHz bands, hardware-based edge processor with TSN, GPU processing capabilities, innovative 5G terminals and elastic SDN-based photonic data transport. The integration of the technology blocks is performed as part of an overall 5G architecture that promotes edge processing and is orchestrated by an NFVO compatible framework with edge node extensions at the network layer and an overlay vertical services application orchestrator at the user plane layer.

The overall platform is implemented in two extended testbeds which include actual field deployed segments and managed by the network operators of the consortium. The validation and showcasing testbeds host 3 use case scenarios covering the deployment of services related to multiple vertical sectors as well as innovative applications for smart IoT networked devices. The use cases are designed in order to highlight the benefits of the adopted technologies in terms of increased bandwidth, low latency and high reliability and create new markets opportunities especially for the participating SMEs through pilot validation of their offered solution.