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Future Connectivity Systems

A unified network, computational and storage resource management framework targeting end-to-end performance optimization for secure 5G multi-technology and multi-tenancy environments

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Abstract: The deliverable contains the factsheet and brief presentation of the project.

Keywords: factsheet, project description

Table of Contents

List of Abbreviations

AI	Artificial Intelligence
BBU	Base Band Unit
CAPEX	Capital Expenditures
CO	Central Office
CPRI	Common Public Radio Interface
C-RAN	RAN centralization
D-RAN	Distributed Radio Access Network
DSP	Digital Signal Processing
EC	European Commission
EU	European Union
FiWi	Fiber-Wireless
MEC	Multi-Access Edge Computing
ML	Machine Learning
MNOs	Mobile Network Operators
NR	New Radio
OPEX	Operational Expenditures
OTT	over-the-top
PC	Project Coordinator
PO	Project Officer
QA	Quality Assurance
QKD	Quantum Key Distribution
RIA	Research and Innovation Action
RRH	Remote Radio Head
SDN	Software Defined Networking
WP	Work Package

1. Executive Summary

This document contains the factsheet of the 5G-Complete project alongside a brief description of the project's goals.

2. Introduction

2.1. Purpose of this document

This document contains the factsheet of the 5G-Complete project alongside a brief description of the project's goals.

2.2. Document Structure

The present deliverable contains the following chapter:

- Factsheet

2.3. Audience

The document is public.

3. Factsheet

The 5G-Complete factsheet-presentation is presented in the following pages.

Project Title

A unified network, **C**omputational and st**O**rage resource **M**anagement framework targeting end-to-end **P**erformance optimization for secure 5G mu**L**ti-t**E**chnology and multi-**T**enancy **E**nvironments

Contract No	871900
Programme	Horizon 2020 - Work Programme 2018-2020 - Information and Communication Technologies
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The Challenge

The global demand for mobile bandwidth capacity is growing at an exponential rate, due to the increasing popularity of over-the-top (OTT) media streaming services. With industry analysts predicting a 45% mobile traffic growth through 2021 and data networks continuously expanding to cover larger areas, this forecast presents real challenges for today's mobile network operators (MNOs). However, the current Distributed Radio Access Network (D-RAN) paradigm cannot pace with the economics of Access Point (AP) densification envisioned in 5G networks, which amongst other reasons, is imposed by the adoption of higher radio frequencies in the 5G New Radio (NR) standard.

The highest acclaimed solution for impairing the densification costs is the so-called RAN centralization (C-RAN) that separates the Base Band Unit (BBU) from the Remote Radio Head (RRH), leaving the now low-cost RRH at the access site and joining it through the fronthaul network to the BBU that is placed at the Central Office (CO) of the MNO. The centralized nature of C-RAN offers a plethora of advantages, like reduced power consumption, virtual resource pooling, coordinated multipoint communications facilitation, adaptability to non-uniform traffic and future-proof upgrading, while expediting deployment and scaling, resulting in a faster time to market and considerable savings in both Capital and Operational Expenditures (CAPEX and OPEX).

However, several emerging types of applications, can impose cumbersome traffic on the fronthaul, whereas mission critical applications, which require low latency and high reliability, are facing difficulties in being satisfied through C-RAN implementations. Multi-Access Edge Computing (MEC) was proposed, as an alternative extention for processing and storage capabilities to the edge. Nevertheless, merging MEC functionalities into next generation's 5G NR RAN solutions carries major research challenges. Firstly, optical and wireless technologies should be integrated in a flexible framework able to be adjusted to the data rate and satisfy latency requirements of 5G services. Secondly, a synergy of novel interfaces is imperative to drive this multi-technology environment and to solve the joint RAN/Cloud/MEC optimization problem. Thirdly, in order to increase network flexibility, both centralized and flexible, self-organized mesh networks need to be incorporated, and concurrently operated by a centralized SDN-enabled management and operation framework. Finally, security becomes a key challenge since application execution traverses the RAN and is exposed to intruders.

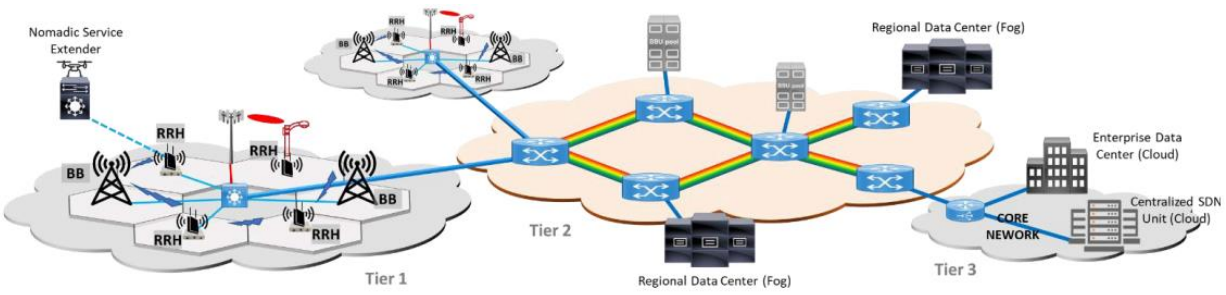

Fig. 1: *5G-COMPLETE architecture*

The Vision

Within this highly demanding environment, 5G-COMPLETE aims to revolutionize the 5G C-RAN architecture, by combining Cloud and Edge computing functionality while placing them on top of a unified ultra-high capacity converged digital/analog Fiber-Wireless RAN.

5G-COMPLETE's architecture combines a series of key technologies under a unique architectural proposition that brings together:

i) the high capacity of digital/analog opticsand high-frequency radio
ii) the audacity of converged FiWi fronthauling,
iii) the spectral efficiency of analog modulation and coding schemes
iv) flexibility of mesh self-organized networks
v) efficiency of high-speed and time-sensitive packet-switched transport,
vi) the rapid and cost-efficient service deployment through unikernel technology
vii) an enhanced security framework based on post-Quantum cryptosystems and QKD.

Project Objectives

Empowered by its ambitious vision (Fig. 1), 5G- Complete aims to merge the Mobile Edge Computing (MEC) and Cloud complementary forces under a common flexible, profitable and energy-efficient RAN infrastructure, being able of synergistically exploiting Computing, Access and Storage services in order to effectively respond to the emerging mobile data deluge. More specifically, 5G-COMPLETE will:

- Develop a mmWave point-to-multipoint (PtMP) mesh node and an integrated THz transceiver to enhance functionality and capacity at the network's edge.>
- Develop a delay time-sensitive and elastic optical bandwidth framework for converged network/computational/storage architectures
- Develop an advanced DSP platform to increase the bandwidth efficiency of edge optical transport layer and to support the needs of baseband processing in a multi-technology radio environment operating from sub-6 GHz to D-band nodes
- Develop and demonstrate a toolbox of hardware and software solutions to support trusted deployment of critical workloads across the host systems.
- Develop joint network, computational and storage resource allocation optimization algorithms leveraging AI/ML techniques for efficient end-to-end network performance and self-configuration in a multi-technology and multi-tenancy environment.
- Deploy serverless computing paradigms at the edge for low latency services.
- Develop an end-to-end 5G network slicing management and orchestration framework to dynamically reconfigure a multi-technology network at service runtime.
- Architect a low-latency, high energy efficiency, high-capacity and flexible 5G network.
- Validate its 5G network technologies in a series of scalable lab-scale and field-trial demonstrators.
- Deliver a holistic roadmap and business plan analysis for the cost-efficient and smooth

Technology Exploitation

5G-COMPLETE includes a coordinated set of actions towards the development of a flexible end-to-end 5G plug-and-play energy and resource efficient edge cloud network segment. It is a breakthrough concept that relies on the evolution of individual, well-established technologies and broadly accepted trends, thus offering the optimum balance of innovation and risk/maturity/time-to-market. 5G-COMPLETE's industry-driven consortium expands along the entire value chain and aims to foster the project's carefully selected set of innovations into tangible market outcomes. Driven by user needs, the project aims to combine Cloud and Edge computing functionality and place them on top of a unified ultra-high capacity converged digital/analog Fiber-Wireless RAN. 5G-COMPLETE's objectives address a vigorous multi-billion Euro market and the industrial partners of the consortium hold considerable market shares across the value chain. To this end, 5G-COMPLETE aims to industrialize the foreground knowledge that will be generated within the project and establish viable exploitation paths in order to reinforce the European industrial competitiveness.

The envisioned industrialization lines are associated with:

- Time Sensitive Networking platform
- Network Slice Manager
- mmWave and THz radio nodes
- Disaggregated and virtualized 5G RAN
- MEC platform
- FaaS framework for Edge devices
- Optical edge node technologies
- DSP engine supporting large bandwidth baseband signals suited for sub-6 GHz/mmWaves/THz frequency bands.
- Post-Quantum and QKD-enabled security framework
- DSP engines supporting broad 5G-compatible radio suited for mmWaves/THz frequency band.