5Genesis

5TH GENERATION END-TO-END NETWORK, EXPERIMENTATION, SYSTEM INTEGRATION, AND SHOWCASING

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Editors David Artuñedo (TID), Daniel García Sánchez (TID)

Contributors Valerio Frascolla (INT), Arthur Lallet (ADS), Eneko Atxutegi (NEM), Jara Suarez (UPV), Pedro Merino (UMA), Iván González (UMA) Fabio Giust (ATH), Daniele Munaretto (ATH), Andreas Perentos (AVA), Marc Emmelmann (FhG), Jesús Gutierrez Terán (IHP), Eckhard Grass (IHP),Antonio J. Morgado (IT), Anna Brunström (KAU), Anne Marie Cristina Bosneag (LMI), George Xilouris (NCSRD), Harilaos Koumaras (NCSRD), Israel Koffman (REL), Alberto Florez Pagés (TID), Seiamak Vahid (UNIS), Nikos Passas (FOGUS), Michael Georgiades (PLC), Panagiotis Matzakos (ECM), Sonia Castro, Javier Melian (ATOS).

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List of Authors

TID	Telefonica I+D
David Artuñedo Guillén, Daniel García Sánchez, Alberto Florez Pagés	
INT	Intel
Valerio Frascolla,	
ADS	Airbus
Arthur Lallet	
NEM	Nemergent
Eneko Atxutegi	
UPV	Universidad Politécnica de Valencia
Jara Suárez Puga	
UMA	Universidad de Málaga
Pedro Merino, Iván González	
ATH	Athonet
Fabio Giust	
AVA	Avanti
Andreas Perentos	
FhG	Fraunhofer FOKUS
Marc Emmelmann	
FOGUS	Fogus Innovations & Services
Nikos Passas, Dimitris Tsolkas	
IHP	
Jesús Gutiérrez, Eckhard Grass	
IT	Instituto de Telecomunicacoes
Antonio J. Morgado, Shahid Mumtaz, Jonathan Rodriguez	
KAU	Karlstads Universitet
Anna Brunström	
LMI	Ericsson
Anne Marie Cristina Bosneag	
NCSRD	National Center for Scientific Research "DEMOKRITOS"
George Xilouris, Harilaos Koumaras	
REL	RunEL
Israel Koffman	

UNIS	**University of Surrey**
Seiamak Vahid	
PLC	**PrimeTel PLC**
Michael Georgiades	
ECM	**Eurecom**
Panagiotis Matzakos	
ATOS	ATOS SPAIN
Sonia Castro, Javier Melian, Elisa Jimeno	

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LIST OF ACRONYMS

Acronym	Meaning
AIOTI	The Alliance for Internet of Things Innovation
CA	Consortium Agreement
eBCS	Enhanced Broadcast Services
EPC	Evolved Packet Core
FDD	Frequency Division Duplexing
GA	Grant Agreement
KPI	Key Performance Indicator
LSA	Licensed Shared Access
MANO	Management and Orchestration
MCS	Mission Critical Services
MCPTT	Mission Critical Push To Talk
MEC	Multi-access Edge Computing
NFV	Network Function Virtualisation
NR	New Radio
NSA	Non-Standalone
OAI	OpenAirInterface
ONF	Open Networking Foundation
OSS	Operations Support Systems
OSM	Open Source MANO
RAN	Radio Access Network
SA	Standalone
SCF	Small Cell Forum
SDN	Software Defined Networks
SDO	Standards Developing Organization
TDD	Time Division Duplexing
UE	User Equipment
UTRAN	UMTS Terrestrial Radio Access Network
WG	Working Group

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Executive Summary

The scope of deliverable D7.5 is to analyse and provide a strategy in project level towards fulfilling needs and gaps found on standardization and regulatory bodies. This document is also dedicated to capture how the consortium plan to contribute to these groups spanning the whole duration of the project.

The information regarding engagement and activities with Standards Developing Organizations (SDO) and other organizations related to SDOs, such as 5GPPP Pre-standardization working group (WG) or AIOTI (The Alliance for Internet of Things Innovation), has been grouped following the key layers of the 5GENESIS architecture, presented in the following picture.

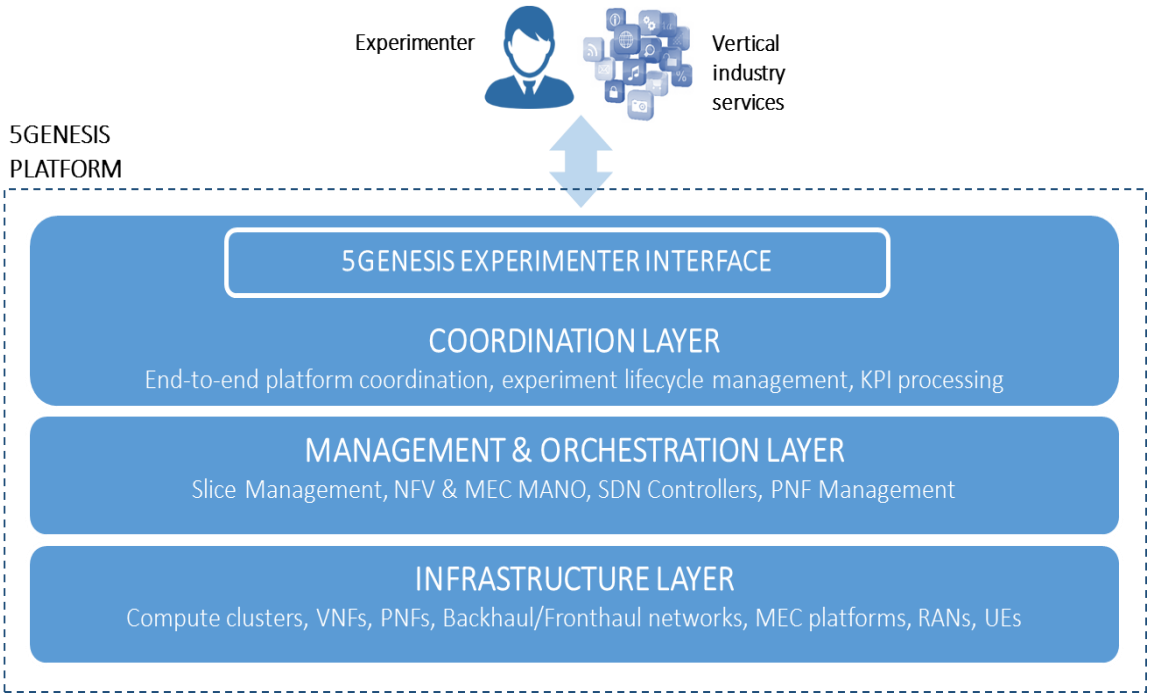

Figure 1: 5GENESIS Platform architecture

The *Infrastructure Layer* is the component that has registered most of the efforts, as partners providing technology components are actively involved in Standardization activities as part of their technology development. There are activities reported in several radio access technologies like **5GRAN** (RUNEL, UMA), **mmWave access for 5G** (IPH), **MulteFire Radio Access** (Athonet), **Satellite backhaul** (Avanti), **IoT** (KAU, UPV). Additionally, technology topics like **5G Positioning** (IHP, FhG), **IETF Transport Services** (KAU), **Network Sharing** (UMA), **Multi-Access Edge Computing** (ATH, TID, IT), **SDN based Transport control** (TID) and **5GCore functions** (ATH) are included as part of fundamental building blocks of the 5GENESIS infrastructure.

The *Management and Orchestration Layer* covers technology building blocks such as **MANO** (ATOS, TID) where Open Source MANO (OSM) plays a dominant role in 5GENESIS platforms. NCSR Demokritos (NCSRD) has conducted a proof of concept on **MEF Services** orchestrated on 5G Network, showed at MEF2018 event. LMI is exploring the integration of **APEX, the Policy and Charging Control function** in ONAP (Open Network Automation Platform). ATH is participating in activities related to **NFV Testing and Validation** by being involved in NFV Plugtest program of

ETSI. In addition, UMA is working on **Slice Management,** while INTEL and IT are working on **Dynamic Spectrum Management.**

The *Coordination Layer* has two areas where partners are mostly involved. The first one is a key activity of the project and is the **5G KPIs**, where UMA and TID are actively involved, having already organized a 5G PPP Test, measurement and validation WG meeting in Málaga on April 9th-10th. The second topic has just started and is focused on **OPEN APIs,** where the TM Forum and the Ecosystem API Portal are taken as the reference for further development, and REST as the API Framework for development.

Finally, as for the *Vertical Industry Services*, both NEM and ADS, with other partners like ATH, bring their expertise in **Mission Critical Services (MCS)** where they are contributing significantly to Standards evolution. On Media, FhG is working on **Enhanced Broadcast Services (eBCS)** to bring broadcast enhancements on 802.11 based networks.

Partners have reported **over 30 specific actions** (see Table 2)Table 2 List of Meetings attended by 5GENESIS Partners including meeting participation, collaboration in Whitepapers, participation in Plugfest events, etc. As a result of the participation in Standardization forums and events, 5GENESIS Partners have identified concrete areas where standards still need to evolve to match 5GENESIS requirements based in the evolution that 5GENESIS Platforms will bring in years 2 and 3. In year 1, clearly, the 5GENESIS participation in the 5G PPP Pre-Standardization WG has been a reference point for the 5GENESIS facility development.

Regarding Regulation Bodies and Spectrum Licensing Status, several meetings with National Regulatory entities and Operators are enumerated with the topics discussed, actions agreed, and plans for the future.

Finally, each Platform includes the status of the **Spectrum Licensing usage agreements** they have reached in terms of Spectrum Bands that will be used by 5GENESIS, capacity available to run the experiments, and time duration of these agreements. If required, renewal information of those agreements will be reported in future editions of this document.

5GENESIS Partners will continue monitoring and engaging standardization activities, linked to the three layers of the 5GENESIS facility, and they are committed to explore potential contributions to Standards as the 5GENESIS facility development progresses in years 2 and 3 of the project.

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1. INTRODUCTION

The scope of deliverable D7.5 is to analyse and provide a strategy in project level towards fulfilling needs and gaps found on standardization and regulatory bodies. This document is also dedicated to capture how the consortium plan to contribute to these groups spanning the whole duration of the project. The document is kept short and comprehensive, and as such it is composed of three main sections clustered as follows:

- Standardization tracking and SDOs Liaison activities,
- Potential Contribution to Standards,
- Regulatory bodies and Spectrum Licensing.

The Standardization tracking and SDOs Liaison activities section comprises all tracking activities and actions led by 5GENESIS project partners monitoring and attending selected SDOs and additional organizations related to SDOs and standardization activities, such as 5GPPP Pre-standardization WG and AIOTI. It includes a list of conducted activities separated per technology, architecture and platform needs.

The Potential Contribution to Standards section aims at pointing to standardization lacks identified by partners developing solutions for 5GENESIS in related SDOs. The section comprises a list of gaps found during the first year of 5GENESIS, which will serve as a guidance for the second and third year of the project.

The Regulation bodies engagement and Spectrum Licensing Status section provides information about the meetings held with Regulatory entities and Operators regarding the use of Spectrum needed by 5GENESIS platforms for the duration of the project.

2. STANDARDIZATION TRACKING ACTIVITIES

The 5GENESIS project has been committed to survey and monitor the standardization landscape. A first plan of related actions was provided in **D7.1 "Dissemination, Standards and regulatory bodies plan"**, submitted in Month three (M3) of the project.

In the sections below, partners have monitored and analysed the interested SDOs, or sub-working-groups of them, especially those relevant to architectural and protocol issues.

The activities are grouped according to 5GENESIS architecture. All 5GENESIS platforms have the same architecture, though there are differences in some of the components used for implementing and integrating them.

The general 5GENESIS Platform architecture diagram has been defined in several deliverables of the project (see Figure 1) and it is used here as a guide for the rest of this section.

2.1. SDOs tracking driven by 5GENESIS reference architecture

2.1.1. Infrastructure Layer

2.1.1.1. 5G RAN

(a) 3GPP RAN WG1

Since the project started, 5GENESIS partner RunEL has participated in three **3GPP RAN WG1** (RAN1) meetings. Within the scope of TSG-RAN, RAN WG1 is responsible for the development of specifications dealing with Evolved UTRA, and beyond. RAN WG1 is responsible for specification of the physical layer of the radio Interface for connecting the UE with the RAN, covering both FDD and TDD modes. The work in RAN WG1 includes especially:

- Specification of physical channel structures,
- Specification of the mapping of the transport channels onto physical channels,
- Specification of the physical layer multiplexing, and channel coding and error detection,
- Specification of the spreading and modulation,
- Specification of the physical layer procedures,
- Specification of the definition of measurements and their provision by the physical layer to the upper layers.

RAN WG1 also carries out work related to handling the physical layer related UE capabilities and to physical layer related parameters used in UE tests developed in TSG RAN.

The meetings 5GENESIS participated in were:

- Meeting at Gothenburg Sweden starting on August 20th, 2018,
- Meeting at Chengdu China starting on October 8th, 2018,
- Meeting at Xian (China) starting on April 8th, 2019.

The purpose of 5GENESIS participation is to gather information about the standardization process, the content of the different 3GPP Releases (e.g., currently Release-15 and Release-16) and report to the 5GENESIS consortium on any major events that may influence 5GENESIS plans.

(b) Small Cell Forum

5GENESIS, by means of the partner Eurecom, follows the activities of the Small Cell Forum (SCF) [1] for the specification of FAPI/NFAPI (i.e., (network) functional application platform interface) for 5G-NR. FAPI provides an API for MAC-PHY interfaces and functional split, which can be used as a common basis for hardware/software suppliers. It was first introduced from SCF for the LTE RAN stack [2] for which there is an open source implementation from Cisco (pen-NFAPI) which was integrated in OpenAirInterface (OAI) 4G. For the implementation of 5G-NR, OAI updated FAPI for use in both gNB and UE. Currently, SCF is about to release the 5G-NR FAPI specification and OAI has been closely following and participating in this work. Additionally, OAI has committed to adapt its current 5G-NR FAPI implementation according to the new specification from SCF.

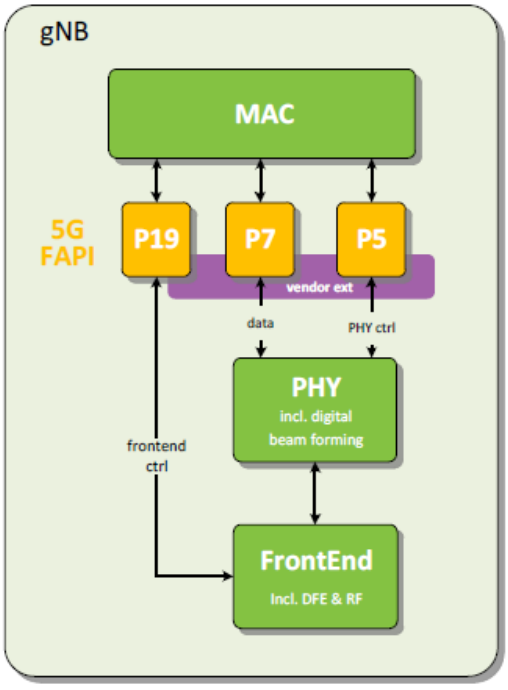

Figure 2 5G FAPI interfaces [3]

(c) O-RAN

5GENESIS also follows the activities of O-RAN alliance. O-RAN organization was created from operators worldwide, aiming to provide a common ground for building virtualized RANs controlled from a RAN Intelligent Controller (RIC) based on a reference architecture and standardized open interfaces [4].

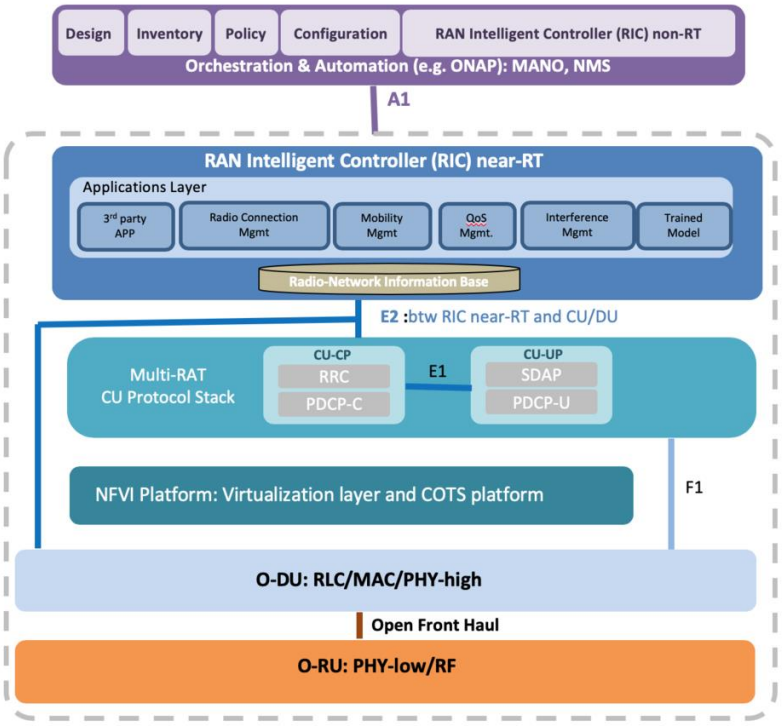

Figure 3 O-RAN reference architecture [4]

In the context of OAI extensions for 5G-NR, 5GENESIS closely follows the activities of "The Near-real-time RIC and E2 Interface Workgroup" focusing on architecture aspects and the specification of the E2 interface between RIC and the CU/DU RAN stack.

(d) mmWave Access for 5G

The IEEE 802.11ay standards extends the IEEE 802.11 Wi-Fi standard with communication capabilities in the 60 GHz band, in particular it goes even beyond the previous 802.11ad amendment. In fact, the maximum data rate of 802.11ad is about 7 Gbit/s, whereas 802.11ay promises much higher data rates, up to 38 Gbit/s per spatial stream. Such data rate is achieved by supporting channel bonding of up to 4 channels of 2.16 GHz bandwidth each. Furthermore, MIMO communication with up to 4 spatial streams is supported. Thanks to the above-mentioned new features, one of the potential applications of IEEE 802.11ay is for fronthaul/backhaul links in the context of 5G small cells.

5GENESIS partner IHP monitors the progress and the technical specification of the **IEEE 802.11ay** standard by studying the available documents from the IEEE document server. Furthermore, colleagues from IHP have attended several standardization meetings to get directly in touch with the standardization group. In 2018, the meeting in May taking place in Warsaw was attended. Attendance of the Meeting in July 2019, taking place in Vienna is planned.

Since the definition of the 802.11ay amendment is in its final stage within 802.11, technical contributions are right now not useful. The main activity of the group is the comment resolution within 802.11 before going into another review-at-large, i.e. the SA Ballot Process. During the

latter process, the entire 802.11ay amendment is open again for technical comments and corresponding technical submissions related to those comments. As such, the SA Ballot Process allows to propose some adaptations to accommodate the 5GENESIS use cases. As such, engaging in the SA Ballot pool is planned. The final approval of the standard is planned for March 2020.

From the perspective of transport network connectivity, the newly defined amendment IEEE802.11be may be a suitable platform. Even though this amendment is currently defined for carrier frequencies below 7.25 GHz, the planned data rate of 30 Gbit/s is interesting for transport network applications. Therefore, we do plan in the future to monitor the development of this standard and possibly contribute some 5GENESIS requirements and results. Innovations which could be contributed to this standard are in the area of Line-of-sight MIMO communications or hybrid beamforming.

Jointly with IHP, FhG will act as co-authors to enable a submission in the procedural working process.

(e) MulteFire Radio Access

MulteFire 1.0 is a novel technology designed to create new wireless networks by operating LTE technology on unlicensed or shared spectrum. The latest update MulteFire 1.1 [5] evolves the technology aiming at further improving its performance, and enhancing its potential, while maintaining backwards compatibility with MulteFire 1.0. Athonet has been a full member of MulteFire since its public launch at MWC 2016.

Athonet has taken part at a 5-partners demo exhibited at MWC 2019, where Athonet provided the 4G core network functionalities [6].

Furthermore, Athonet was one of the key partners with live end-to-end demo product at MulteFire commercial launch open day in Tokyo Feb 2019 [7].

Athonet attends all the quarterly technical standards WG sessions, and, as a member of the Multefire marketing WG, is a regular attendee of the bi-weekly calls, contributing to the definition of use cases and deployment models.

2.1.1.2. Satellite Access Integration

Avanti is an active contributor in 3GPP in RAN and SA non-terrestrial work items and contributes to 5G activities in ETSI SES. Besides, it is a member of Networld 2020 Satcom WG, ESA 5G Satellite task force and 5G PPP trials, vision & technical WGs.

In the scope of 5G and Satellite integration, Avanti will contribute to the standardization activities related to satellite communications, by preparing a report on the results of the Limassol testbed for dissemination to relevant work items in ETSI SES and 3GPPP on non-terrestrial 5G communications.

SDOs need to be provided with a technical report on the results of a high throughput (Ka-band) satellite communication enabled 5G testbed in order to be able to take the right decisions on which standards to adopt with regard to satellite communications.

At this stage of the work in 5GENESIS, Avanti's standardization activities have largely been constrained to following a variety of activities as follows:

- Coordination of standardization direction through the ESA Alix project "Standardization special interest group";
  - Alix is a project within ESA's "Satellite for 5G initiative" [8][8],
  - Alix project's [9] stated objective is "*supporting active participation* [by the satellite industry] *in the 3GPP standardization process to define the 5G satellite component and its interfaces with other networks as well as the creation of a critical mass to influence this standardization process*" and includes twenty-eight (28) 3GPP members,
  - The project is jointly led by ESA and Thales Alenia Space (France) and holds regular calls to align the participants standardization views;

- Dialogue with other satellite operators and vendors through the ESOA (EMEA Satellite Operators Association) standardization WG with a view to finding common ground on requirements;
  - They hold fortnightly calls to align their varying and diverse standardization views,
  - 5G is an area of special attention for ESOA [10], of particular note is "*ESOA and the Next Generation Mobile Networks (NGMN) Alliance have joined forces to strengthen their relationship and to foster a closer co-operation in the area of integration of satellite solutions in the 5G ecosystem*" [11];

- Liaison with the EC H2020 SaT5G project team;
  - SaT5G is an EC project [12] that "*bring*[s] *satcom into 5G by defining optimal satellite-based backhaul and traffic offloading solutions*", and "*The project aims to be a primary vector for defining the integration of satellite solutions for 5G in 3GPP*",
  - Avanti is the project coordinator supported by 15 other organisations [13] across the satellite and terrestrial arenas,
  - The SaT5G project has *"received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 761413*".

As the 5GENESIS project progresses and the satellite communication links are deployed, it is anticipated that this will provide useful data that have the potential to impact the work of different standards bodies, more specifically:

- ETSI SES SCN - the WG on Satellite Communications and Navigation (SCN) is part of the Technical Committee (TC) on Satellite Earth Stations and Systems (SES);
  - Activities in this area will focus on what satellite communications need to do to inter-operate in 5G networks;
- 3GPP WGs;
  - SA2 Architecture, in case of relevant architectural outputs from 5GENESIS,
  - SA3 Security, in case of relevant security related outputs from 5GENESIS,

  - SA5 Telecoms management, in case of relevant MANO related outputs from 5GENESIS,
  - RAN groups, in case of any RAN outputs, such as protocols, from 5GENESIS,
  - CT (Core Network and Terminals), in case of any relevant outputs from 5GENESIS;
- Others, if and as identified later in the project such as ITU or similar.

2.1.1.3. IoT Interoperability and protocols

(a) AIOTI – Alliance for Internet of Things Innovation

AIOTI – Alliance for Internet of Things Innovation Error! Reference source not found., aims at d efining dialogue and interaction among IoT players in Europe, and to contribute to the creation of a dynamic European IoT ecosystem. Members of the Alliance include key IoT industrial players – large companies, successful SMEs and dynamic start-ups – in addition to well-known European research centres, universities, associations and public bodies. 5GENESIS UPV partner is part of this alliance. AIOTI is structured in different WG (currently 13). WG1-WG4 are related with horizontal aspects of IoT; and WG05-WG13 are related to different verticals. There has been some evolution, but the current distribution is rather stable.

The most remarkable WGs for 5GENESIS are:

- WG03 related with IoT Standardization, with the goal of identifying and, where appropriate, making recommendations to address existing IoT standards, analysing gaps in standardization, and developing strategies and use cases aiming for (i) consolidation of architectural frameworks, reference architectures, and architectural styles in the IoT space, (ii) (semantic) interoperability and (iii) personal data & personal data protection to the various categories of stakeholders in the IoT space,
- WG04 related with IoT Policy, with the main goal of identifying, and, where appropriate, making recommendations to address existing and potential barriers that prevent or hamper the take-up of IoT in the context of the Digital Single Market.

AIOTI has signed MoU with different associations, one of them with the 5G PPP. In February 2019 a report highlighted several collected IoT vertical domain use cases and determined the specific requirements they impose on the underlying network infrastructure. These use cases and requirements can be used by SDOs such as 3GPP, ITU-T and IEEE as requirements for automation in vertical domains focusing on critical communications.

Additionally, AIOTI has provided an agreement with the 5G Infrastructure Association (5GIA) in order to provide a vision on Future Networks, Services and Applications. 5GIA and AIOTI can uniquely establish such a multi-actor collaboration platform that may involve several application domains platforms, and attract the non-technical stakeholders that often are lacking in EU innovation programs today. Increasingly, those stakeholders will provide critical input for the success of digitizing Europe and will also need to play an ambassador role in innovation and deployment.

Finally, from the point of view of 5GENESIS, a key requirement for the IoT Interoperability component architecture is the alignment with the reference models of other IoT projects, especially with the AIOTI.

The AIOTI High Level Architecture (HLA) model [15] is suitable for guiding the development of the IoT Interoperability component architecture (Concretely Section 7.2 Cloud and Edge computing considerations and 7.5 Virtualization aspects). The use of the AIOTI vision of the Internet Architecture of Things will be useful to use its results and other projects to avoid reinventing a new architectural model from scratch and align and be compatible with those projects. Thus, serving as a blueprint for the design of the components provided to achieve IoT interoperability in the Use Cases defined by the 5GENESIS platform.

(b) IETF CORE WG

In relation to the IoT use case targeted by the Surrey Platform, the work of the CORE WG within IETF is important. The WG has defined the Constrained Application Protocol (CoAP), which will be used as one of the IoT protocols in the Surrey Platform. Due to the importance of CORE to 5GENESIS, KAU has been monitoring the work of the CORE WG. The CORE WG has met all the IETF meetings held since the start of 5GENESIS: IETF 102 in Montreal in July 2018, IETF 103 in Bangkok in November 2018 and IETF 104 in Prague in March 2019. Similarly, KAU is also monitoring the Light-Weight Implementation Guidance (LWIG) IETF WG. The LWIG WG collects experiences from implementors of IP stacks in constrained devices. Such experiences are an important input for the work on energy efficiency in Surrey.

KAU will continue to monitor the CORE and LWIG WGs as part of its participation in upcoming IETF meetings. Relevant results and knowledge will be used in setting up the experiments related to energy efficiency within the Surrey Platform. A goal with the planned experiments is to explore the interaction between IoT protocols and the underlying network protocols in order to optimize energy efficiency, applying cross-layer optimizations when appropriate. Depending on the outcome of the experiments, relevant findings may be reported back to the WGs.

Any potential contributions to the above mentioned IETF WGs will depend on the outcome of the upcoming experimentation with IoT energy efficiency in the Surrey Platform. No contributions are planned at the time of writing.

2.1.1.4. 5G Core functions

5GENESIS partner Athonet, brings the 4G enhancements and 5G core network evolution in Multefire and CBRS Alliance, aiming at enabling smart traffic routing and VoLTE for vertical-specific and enterprise use cases. In CBRSA, Athonet is leading the Local Breakout work item within the technical WG. Starting already in 4G technology along with the Non-Standalone (NSA) architecture and then in 5G technology when the SA will come, the separation of the user and control planes to ease flexible and agile deployments as required by specific 5G use cases (e.g., URLLC). Furthermore, virtualisation and distribution to the edge of core network functionalities, such as the user plane functions, will allow running applications as close as possible to the users, improving service delivery and quality of experience.

As depicted in 3GPP TS 23.501, control plane and user planes are architecturally separated from the (R)AN between the interfaces N2 towards the Access and Mobility Management Function (AMF) and N3 towards the User Plane Function (UPF). This will ease the deployment of the 5G network starting from the edge. In addition, the already rich set of APIs exposed by the Athonet Mobile Core will be enhanced and harmonized in order to reflect Common API Framework (CAPIF) envisioned by Rel 16 of the 5G specifications.

2.1.1.5. 5G positioning techniques and results

IEEE 802.11az, also called Next Generation Positioning (NGP), represents a task group that was formed in January 2015 to address the needs of a "*Station to identify its absolute and relative position to another station or stations it's either associated or unassociated with*." The objectives of the group are to define modifications to the MAC and PHY layers that enable "*determination of absolute and relative position with better accuracy with respect to the Fine Timing Measurement (FTM) protocol executing on the same PHY-type, while reducing existing wireless medium use and power consumption, and is scalable to dense deployments.*"

IHP has contributed to this study group in the past. Contributions on efficient positioning methods for multiuser scenarios have been presented. A representative from IHP took part in the meeting held in Warsaw in May 2018.

The definition of the 802.11az standard is under revision and technical contributions can no longer be provided, only amendments to the text. The current estimate on approval of this standard is March 2021 (see Figure 4).

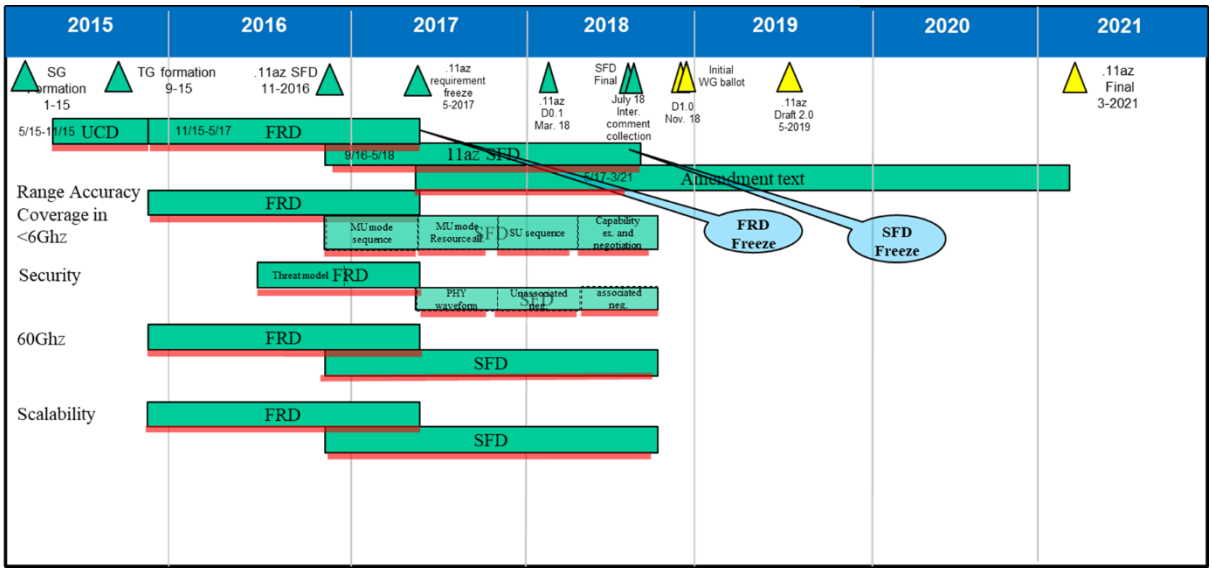

Figure 4: 802.11az current approved timelines (source: IEEE).

FhG will also act as co-authors to enable a submission in the 802.11az procedural working process. From a procedural and political perspective, the next efficient chance to contribute is within the sponsor ballot which will occur later in time. FhG will become members of the sponsor ballot pool to comment on and provide potential adjustments to 802.11az based on future work and measurements in 5GENESIS.

2.1.1.6. IETF Transport Services

The goal of the Transport Services (TAPS) architecture, currently under standardization within the TAPS WG of the IETF, is to provide a common, flexible, and reusable interface for transport protocols. As applications adopt this interface, they will benefit from a wide set of transport features that can evolve over time and ensure that the system providing the interface can optimize its behaviour based on the application requirements, current network conditions and system policy without requiring changes to the applications. This flexibility enables faster deployment of new features and protocols, and can support applications with racing and fallback mechanisms which otherwise need to be implemented in each application separately. It further allows transport behaviour to be dynamically tuned and governed by system policy.

In the context of 5GENESIS, use of a TAPS compliant transport system on the UE side offers the possibility for policy-based configuration of higher layer protocols and interfaces as part of slice management, enabling end-to-end service optimization. This will be researched within the context of the Surrey Platform and its focus on multi-RAT environments. The work of the TAPS WG is thus highly important for 5GENESIS and the progress of the group is closely monitored. Experiences from 5GENESIS will, when available, also be brought to the TAPS WG.

Since the start of 5GENESIS, the TAPS WG has met physically on three occasions: at IETF 102 in Montreal in July 2018, at IETF 103 in Bangkok in November 2018 and at IETF 104 in Prague in March 2019. It has further held two on-line interims on September 12, 2018, and January 15, 2019. While several informational RFCs have already been published, providing the foundation for the work, three core WG documents are currently under active development:

- An architecture for transport services (proposed standard),
- An abstract application layer Interface to Transport Services (proposed standard),
- Implementing Interfaces to transport services (informational).

5GENESIS partner KAU, through Anna Brunstrom, is actively involved in the TAPS work, being an author and editor for the architecture and implementation drafts, respectively.

The use of multiple paths and interface selection is also closely related to work in the Multipath TCP WG and in the Path Aware Networking research group within the IRTF. KAU is also contributing to and following these groups closely.

2.1.1.7. Network sharing architecture

UMA is following several 3GPP technical specifications related to network sharing, an aspect that will be applied in the Málaga field deployments. In particular, the TS 23.251, “Network Sharing; Architecture and functional description”, depicts Multi Operator Core Network (MOCN) and Gateway Core Network (GWCN), functionalities which provide RAN sharing between different operators.

The TS 23.401 “GPRS enhancements for E-UTRAN access” and the TS 36.413 “S1 Application Protocol” describe the Dedicated Core Network (DECOR) and eDECOR functionality, which allows UEs to be served by dedicated core networks according to its specific needs (i.e. IoT or V2X dedicated core networks).

Based on the analysis of the Spanish situation, the design of the outdoor deployments at Málaga city centre and UMA campus is planned with MOCN functionality. So, the 3GPP SA2 WG (SA2 - Architecture) is the most relevant one to be followed in the next months.

2.1.1.8. Multi-Access Edge Computing (MEC)

(a) ETSI ISG MEC

ETSI ISG MEC is regarded as the key standardization body for edge computing, as it is the industry's first attempt to produce standard specifications for an interoperable and multi-vendor environment for third parties' edge computing applications. ETSI MEC has already released a number of specifications and white papers that are regarded in 5GENESIS as key elements to build the edge computing use cases. IT-Portugal and Intel are monitoring the standards being published by **ETSI ISG MEC**, in order to align, whenever possible, the development of software components for the edge network with the ETSI MEC standard (e.g. by using the standardized interfaces and APIs).

To this end, **Athonet** is a regular attendant and active contributor to ETSI ISG MEC, having participated in the latest white papers issued by the ISG, "MEC in an Enterprise Setting: A Solution Outline", ETSI white paper #30, and "Developing Software for Multi-Access Edge Computing", ETSI white paper #20, published respectively in November 2018 and February 2019. Athonet has submitted contributions to different ETSI MEC documents and is involved in the creation of a document devoted to an API for IoT deployments.

Athonet is also following the ongoing discussions in ETSI MEC about the interworking between the ETSI MEC system and the 5G one, e.g., with regards to traffic steering influenced by the behaviour of end applications.

NCSRD is member of **ETSI NFV** and **ETSI MEC** and is following the discussions on the MEC APIs and interfaces as well as the reuse of NFV components for the implementation of the MEC environment. It is elaborating on the produced and in progress drafts and recommendations and monitors any chances for 5GENESIS contributions. NCSRD is targeting in participating in 2020 NFV Plugtests and MEC PoCs. 5GENESIS infrastructure will host several edge locations that will support edge computing/MEC infrastructure.

(b) Telecom Infra Project (TIP)

The **Telecom Infra Project (TIP)** is an engineering-focused initiative which aims at creating simple, efficient and flexible technologies to build and deploy telecom network infrastructure. The mission is enabling global access for all, aiming to solve engineering problems associated with rolling out large-scale networks for 4G and future 5G technologies.

Athonet participates in TIP since its launch at MWC 2017. Athonet is also a member of the TIP Ecosystem Acceleration Centre (TEAC) program. TEACs are global technology innovation centres that work as start-up incubators to connect them to venture capitalists.

Athonet participates in the Edge computing project, and Athonet solutions are used at the TIP home lab at Facebook and at the BT TIP Lab in UK, which prototypes were exhibited at the TIP

congress in London in October 2018. Athonet has been a featured technology demo partner at TIP in MWC 2018 and 2019.

2.1.1.9. SDN-based transport control network

The **Open Networking Foundation (ONF)** is a non-profit operator led consortium driving transformation of network infrastructure and carrier business models. It is an open, collaborative, community of communities. The ONF serves as the umbrella for a number of projects building solutions by leveraging network disaggregation, white box economics, open source software and software defined standards to revolutionize the carrier industry.

Telefónica I+D (TID) is a "Collaborating Innovator" [16] at the ONF and has been at the ONF Board during 2018 represented by Patrick López, Director of Networks Innovation. Full member list of participants in ONF can be checked in [17].

ONF promotes several Open Source projects, some of them categorized as Exemplar Platforms. One of the most innovative solutions is CORD (Central Office Re-architected as Datacentre), that Telefónica I+D is tracking actively and contributing to the Code repositories in the last years. Key contributions from TID to CORD project are the VOLTHA Adaptors for Celestica GPON vOLT and Movistar Base Router (both for Mitrastar and Askey vendors).

Telefónica I+D has deployed CORD in some Central Offices in Telefónica de España, and has a running Datacentre at the Peñuelas Central Office in Madrid.

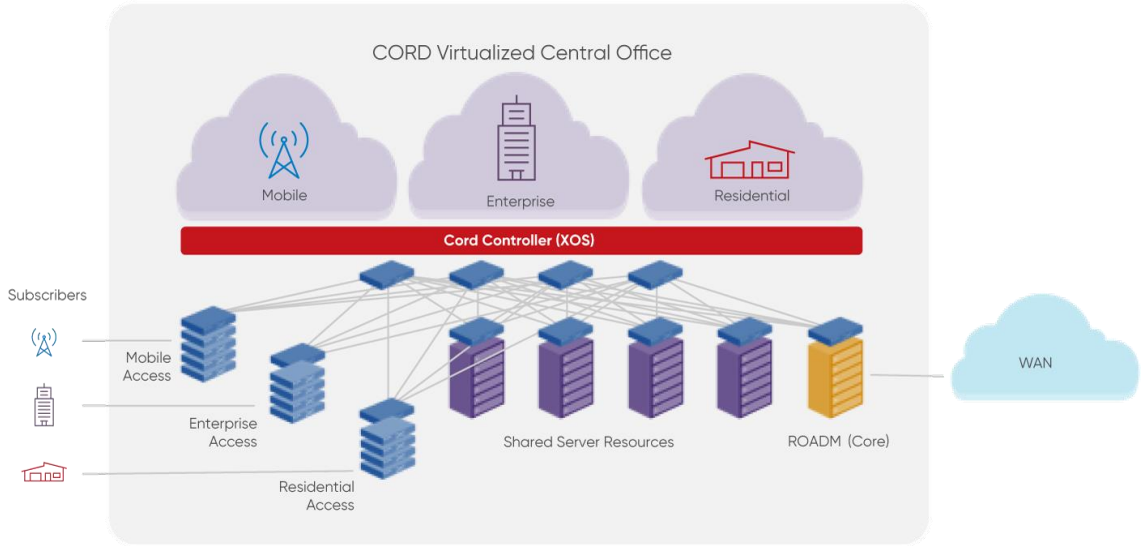

Figure 5. CORD architecture for MOBILE and Fixed Access Network

CORD defines a Datacentre architecture for the Central Office, consisting on shared compute resources and a CLOS Fabric build on Whitebox switches using OpenFlow.

This compute & switching infrastructure support Network functions and Cloud Native Applications running at the edge of the Network.

Telefónica is providing this architecture to Málaga Platform in the form of an Edge Computing Infrastructure that includes not only the Hardware, but the Software stack to make the Infrastructure part of the Málaga Platform. This infrastructure is described in **Deliverable D4.4.**

As part of the activities during cycles 2 and 3 of the 5GENESIS project, a number of Virtual Network Functions (VNFs) will be deployed on this infrastructure using OSM to orchestrate the deployment.

Telefónica I+D plans to contribute the know-how and integration recipes so that ONF community can benefit from the experience acquired integrating them into CORD as part of 5GENESIS use cases implementation. These use cases will be used in dissemination conferences that ONF organizes, like ONF Connect where **Telefónica I+D already presented 5GENESIS as an European use case for CORD in last ONF connect conference** [18].

As part of the tracking activities, Telefónica I+D has attended ONF Connect 2018 taking place in Santa Clara on December 4-6th 2018 [19].

2.1.2. Management and Orchestration Layer

2.1.2.1. Management and Orchestration

NFV and SDN are universally recognized as necessary technologies for future 5G networks and, consequently, network operators are progressively embracing the shift towards the virtualization of their networks.

In particular, NFV technology has revolutionized the way networks are built, deployed and managed by introducing a virtualization layer, decoupling software from hardware. ETSI highlighted these key differences between current and future NFV-enabled networks [20]:

- Decoupling software from hardware,
- Flexible network function deployment,
- Dynamic operation.

However, this transition is complex and not only technical but also organizational barriers have to be faced. A key element of any NFV architecture is a MANO solution, required to tackle the new challenges introduced by NFV.

NFV standardization has been driven mostly by ETSI NFV ISG, SDN by ITU-T, while IETF/IRTF community is active in both areas. However, these standardization bodies are not the only organisations working on the development of open standards for NFV and SDN. On the contrary, there is a large number of other SDOs and open source initiatives involved in developing standards and creating guidelines for SDN and NFV. Open Platform for NFV (OPNFV) led by the Linux Foundation, OSM hosted by ETSI, Open Network Automation Platform (ONAP) under the Linux Foundation, Open Baton or SONATA funded under European Union R&D programs are just a few examples of it.

(a) OSM

Through its work in 5GENESIS, **Atos** has integrated OSM release #FIVE as MANO solution into the Málaga Platform. **OSM [21]** is delivering an open source MANO stack aligned with ETSI NFV Information Models. As an operator-led community, OSM is offering a production-quality open source MANO stack that meets the requirements of commercial NFV networks.

Atos is a member of the OSM community since 2017. The organisation has been monitoring the delivery of the OSM different software releases, from release #ZERO in May 2016 to the latest release #FIVE late in 2018, but also participating in several of their release technical meetings and Hackfests. Atos has even contributed some code to OSM, as it is the case of the key 5G network slicing functionality included in release #FIVE, jointly developed between ATOS and the Centre Tecnològic Telecomunicacions Catalunya in the context of the EU funded 5GTANGO project [22].

Both Partners, Atos and Telefónica I+D, attended the 5th OSM Hackfest held in Barcelona from 4-8th February 2019 [23].

Atos´ intention is to keep closely monitoring this open source community to update this component as new software releases are delivered in order to increase its functionality. Items of common interest between 5GENESIS and OSM as well as potential points of collaboration will be also explored.

NCSRD has joined the OSM community and plan to follow and contribute to the Slicing mechanism that are being currently elaborated by the community. The current implementation of *netslices* (i.e. OSM component) is an internal component of the OSM architecture. In 5GENESIS the slice manager is a higher layer component (most probably part of the OSS) that communicates with OSM in order to orchestrate the end-to-end slicing over multi-technology, multi-domain environment. NCSRD is exploring the requirements and the possible ways of reusing and extending the OSM available mechanisms in 5GENESIS deployments. NCSRD joins the discussions via mailing list and phone conferences. As the implementation of Slice Manager is more matured, it plans to attend the meetings and identify concrete work items for contributions.

(b) MEF

NCSRD conducted a Proof of Concept (DEMO) for the deployment of MEF services over orchestrated 5G Network. A preliminary version of the PoC was demoed at MEF2018 event and members meeting in Los Angeles. The demo was deployed over the Athens 5GENESIS platform infrastructure hosted in NCSR Demokritos campus featuring 4G evolution and 5G features. The scenario involved the real-time deployment of a MEF Service (i.e. EVC) for first responders over a 5G ready infrastructure.

In relation to MEF, NCSRD will continue tracking with respect to the PoCs that may be proposed or be part of those that are already running. In order to do so, NCSRD expects to fulfil the first integration and testing cycle of 5GENESIS.

2.1.2.2. Slice Management

Network slicing feature entails the handling of several physical and virtual network resources to meet specific requirements of services and users. The efficient management and

orchestration of those resources is the cornerstone of network slicing, thus, it has been a matter of intense discussion amongst the research community and the industry.

5GENESIS is actively monitoring 3GPP standardization network slicing work. 3GPP groups have composed several specific network slicing technical specification documents (TS) and also have addressed this issue as part of other TSs with a more general vision. In the following are listed the more relevant TSs for 5GENESIS regarding network slicing which are available so far:

- TS 23.501: System Architecture for the 5G System; Stage 2,
- TS 23.502: Procedures for the 5G System; Stage 2,
- TS 28.530: Management and orchestration. Concepts, use cases and requirements,
- TS 28.531: Provisioning of network slicing for 5G networks and services,
- TS 28.532: Management and orchestration. Generic management services,
- TS 28.533: Management and orchestration. Architecture framework.

The start point of these TSs is 3GPP Release 15 (5G standardization phase 1). They are being updated with new material as the 3GPP milestones are completed. A close tracking of their evolution is highly recommended.

2.1.2.3. Spectrum management

(a) 3GPP

The technical activities performed by IT and INTEL in 5GENESIS are mainly focused on the development and integration of advanced spectrum management functions in the 5GENESIS platforms. These would allow the coexistence, from the radio perspective, of multiple network slices with very different requirements. In this sense, IT and INTEL are constantly monitoring 3GPP study and work items dealing with:

Release 15 topics:

- RF parameters, e.g. frequency range, system bandwidth (RAN 4),
- Frame structure and duplex mode (RAN 1),
- Carrier aggregation, and dual connectivity (RAN1, RAN 2),
- Splitting of the RAN architecture into a “central unit” and a “distributed unit” and their impact on RAN management. (RAN 2, RAN 3, SA5),
- Basic structure of RAN network functions (RAN 3),
- Different ways of implementing network slicing (RAN 2, RAN 3),
- Channel modelling for 5G in frequencies up to 100GHz (RAN1).

Release 16 topics:

- Utilization of unlicensed bands (RAN 1, RAN 2, RAN 4);
  - Interworking with non-3GPP systems, e.g. Wi-Fi,
  - Licensed Assisted Access,
  - Standalone (SA) 5G operation in unlicensed bands;
- Utilization of non-orthogonal multiple access schemes (RAN 1),
- Use of 5G radio technology to support non-traditional usage scenarios (e.g. V2X, Broadcast, Industrial IoT…) and associated radio KPIs (SA, RAN, CT).

After the implementation of spectrum management functions in 5GENESIS, IT and INTEL will be available to participate in a contribution to 3GPP on spectrum management functions, if the 5GENESIS consortium decides a submission of such contribution is relevant. The contribution that might be made is related to the description of use cases related to spectrum management.

(b) ETSI RRS

Another standardization body dealing with spectrum management is **ETSI RRS.** This Technical Committee (TC) is responsible for the standardization of Reconfigurable Radio Systems (RRS), including reconfigurable equipment architecture and Cognitive Radio, as enabling technologies for the sharing of under-used spectrum bands.

During its activity, this TC produced four standards regarding the reconfiguration of mobile terminal equipment – radio reconfiguration requirements, architecture, information models, security framework - and two spectrum sharing standards - the European TV white spaces (TVWS) standard and the Licensed Shared Access (LSA) standard, both of which rely on the use of geolocation databases.

In a few words, we may say that TVWS makes possible that unlicensed devices use the part of the TV band (470-694 MHz) that is not used in a given geography, as long as they consult a database before transmitting to know which frequencies are available at their location. However, the standard does not include any measure to avoid that multiple unlicensed devices start using the same 'unused' frequency, nor to protect them from interference from the TV broadcasting networks in the adjacent channels. This makes TVWS suitable for short-range devices applications and private local area networks, but not for wide-area mobile broadband networks.

Regarding LSA, the basic idea is to define a contractual agreement between the incumbent(s) of a specific band and a limited number of new licensed user(s) of the band. Thus, LSA allows a faster entrance of new licensed users in a band without requiring it to be reframed [24]. Before using the bands, the new licensed users (LSA licensees) must consult a database (LSA Repository) to know which frequency they may use in a given location. Then, they may start using that frequency under the conditions defined in the contractual agreement with the incumbent. The LSA licenses are protected from interference because the LSA Repository is updated to reflect the fact that those frequencies became occupied by LSA licensees. It is the protection against interference that makes LSA a viable solution for mobile broadband wide-area-networks. Currently, the bands where LSA is regulated are the band 2300-2400MHz and 3600-3800MHz. ETSI RRS first standard on LSA [25][26][27] was focused in the sharing of IMT bands between incumbents and LSA licensees with national coverage according to fixed long-term sharing agreements. With the introduction of 5G and the foreseen willingness of verticals to deploy custom applications, ETSI RRS considered the development of the evolved LSA (eLSA) standard focusing in high-quality wireless networks with local coverage areas and limited timeframes. This standard includes [28], which identified three feasible spectrum sharing schemes to deploy vertical applications using spectrum previously licensed to mobile operators; [29] that lists the requirements that guides eLSA development, and [30] that will propose the eLSA network architecture.

As most contributions of **IT-Portugal** to 5GENESIS are related with spectrum management, this partner is monitoring the activities of ETSI TC RRS regarding spectrum sharing, and intends to

contribute with a proposal of a dynamic spectrum sharing algorithm for 5G networks in the band 3600-3800MHz. Since IT-Portugal is not a member of ETSI, the submission of such contribution has to be previously agreed with the 5GENESIS partner that is an ETSI member and is available to submit it.

It is worth stressing that 5GENESIS, through its consortium member Intel, in November 2018 contributed to the ongoing work of the standardization body RRS1, during the ETSI TC RRS#44 meeting held in Rome with the following two contributions:

- RRSWG1(18)044009, "Adding dynamicity to spectrum management", Intel Corporation (UK) Ltd [31],
- RRSWG1(18)044010, "EU-funded project 5GENESIS high-level description", Intel Corporation (UK) Ltd [32].

In fact, INTEL presented the discussion paper RRSWG1(18)044009 [31], to check the interest of the WG to support the vision of the 5GENESIS project. In addition, also a general presentation of the 5GENESIS project (RRSWG1(18)044010) [32] was presented at the same meeting.

Overall the discussion was interesting and the feedback received was a positive one. It was discussed to come with more contributions and clarify more what the intention of the project is. Further contributions on this topic are planned to take place before the end of 2019.

(c) IEEE 1932.1 WG

Besides 3GPP and ETSI, 5GENESIS is also interacting with IEEE, more specifically with IEEE 1932.1 WG, on spectrum management issues. IEEE1932.1 WG aims to deliver a Standard for Licensed/Unlicensed Spectrum Interoperability in Wireless Mobile Networks. The officers of this WG are:

- Chair: Anwer Al-Dulaimi, EXFO Inc., Toronto. Canada,
- Vice-Chair: Shahid Mumtaz, Institute of Telecommunication (IT), Aveiro, Portugal (member of 5GENESIS),
- Secretary: Qiang Ni, Lancaster University, Lancaster, UK.

The WG meets at least on a monthly basis to review technical contributions and discuss the current proposals. The meetings have a good attendance from current members. The WG members have full access to all documents and on-time notifications using iMeetCentral. Besides the members already enrolled, there are new requests from some industrial collaborators to join the WG.

In the technical side, the WG has been able to make good progress on defining the new standard considering two aspects:

- Virtual controller that provides the time alignment between licensed and unlicensed RATs. However, the WG is still discussing how to make this controller comply with 5G networks and whether this controller should be attached to physical or logical networks or maybe both using user customized online transmission profile,
- Unified RAT that integrates all licensed and unlicensed RATs into one shared platform. There has been a lot of work done in this task and the WG has good material. The main concept here is to attach this platform with the above controller for efficient access of all spectrum opportunities.

In 2019, the WG has a series of meetings to merge all documents and contributions for a draft. The current plan is to produce the standard draft before September 2019. To achieve this goal, the WG plans to continue with online meetings and the possibility to have a face-to-face meeting is under discussion.

2.1.2.4. System-level tests and verification

In the scope of NFV testing validation, along with the **NFV ISG**, **ETSI** coordinates the NFV Plugtests Programme, aiming at accelerating NFV adoption and interoperability.

NFV Plugtests provide a continuous and ubiquitous environment for collaborative testing and validation activities among different organizations and consists of a series of remote activities complemented by periodic face to face events, allowing the Programme community to meet and run intensive testing sessions.

Athonet is a regular attendant to the Plugtests bi-weekly online calls, and after taking part to the 3rd Plugtest F2F event in Sophia Antipolis in June 2018, is planning to attend the 4th event too, in the same location in June 2019. The program for 2019 includes testing the solutions against the latest specifications, and for the first time, will include the support to MEC environment as well.

2.1.3. Coordination Layer

2.1.3.1. 5G KPIs

UMA, **TID,** and **FOGUS** are actively participating in the **5G PPP test, measurement and validation pre-standardization WG**. An experiment descriptor will be provided from 5GENESIS work. It will include the definition of the test case, the scenario, and the network slice configuration that needs to be specified to perform the experiments and to validate the KPIs defined.

5GENESIS hosted a meeting in Málaga of this WG on April 9th-10th, where all the ICT-17 phase 3 projects were attending. 5GENESIS representatives presented the test cases formalization, and this specification was taken as a first input for the reference framework. In the same context, **FOGUS** has provided inputs to the first White paper of the WG, released in June 2019 during EuCNC 2019.

The main objective is all ICT-17 phase 3 projects follow the same approach. In order to achieve this, 5GENESIS will also contribute to the definition of the KPIs based on monitorization of 3GPP, ITU-R and NGMN work on defining the 5G KPIs. Activities done by the 5G PPP technology board, which is based on phase 2 projects, are also being monitored.

It is essential to follow the same approach and be aligned with the work conducted by other projects. Indeed, all the phase 3 projects will be aligned and will not necessarily develop artifacts that have already been made. Therefore, the attendance to the biweekly WG and 5G PPP technology board meetings and workshops are being followed by 5GENESIS.

The aim is the work done within 5GENESIS consortium can be reused in the future.

5G PPP is planning a meeting on the 9th of July 2019 in Rome called "5G Vertical Users Workshop". This event is an initiative of a subset of European 3GPP Market Representation Partners (MRPs) designed to help vertical industries become part of the standardization process, create new synergies and obtain guidance from 3GPP by exchanging on future needs and upcoming standards developments.

A key outcome of the workshop will be boosting contributions to 5G standardization across verticals and 5G projects, with the current focus in 3GPP on Release 17. The agenda for this 5G Vertical Users Workshop, therefore, focuses on: 5G vertical requirements, technical priorities, and common interests. The workshop as a result, aims to produce a report ("Input Document") shared directly with the 3GPP Project Coordination Group (PCG) detailing concrete action points around greater involvement of the 5G Vertical Users in the 3GPP process. TID is attending the workshop as a representative of the 5GENESIS facility to show public safety MSC and edge use cases.

In addition to this, in the context of the KPIs and testing methodologies, UMA is tracking NGMN activities, specifically, the document titled "Definition of the Testing Framework for the NGMN 5G Pre-Commercial Network Trials, NGMN, Version 1" has been reviewed in D2.3. In the same context, 3GPP TS 28.554 and 3GPP TR 37.902 specifications have been also analysed in D2.3.

2.1.3.2. Open API, Service-level functions and interfaces for verticals

Although the initial version of the 5GENESIS Open API has been defined based on the requirements identified in deliverable D2.2, the consortium has been monitoring some standards organisations that are anyhow tackling the Open APIs topic. A clear example of it is TM forum with its Ecosystem API Portal [33]. One of the most important parts of the TM Forum API program is a set of standard REST based APIs which make it easier to create, build and operate complex, innovative services.

2.1.4. Vertical Industries Layer

2.1.4.1. Mission Critical Services in 5G

One of the main goals of 5GENESIS is to validate 5G PPP KPIs for 3GPP Mission Critical Services (MCS) combining various technologies such as LTE, 5G NR and MEC. For that purpose, several SDOs' WGs have been tracked in the scope of MCS.

(a) ETSI MCPTT/MCS/MCX

Nemergent and Athonet are responsible for monitoring the MCPTT/MCS/MCX status in ETSI. To this end, both CTI and TC TCCE WG are followed. It is important to keep the standardization status tracked in order to apply the gathered information into an enhanced use-case or better integration of MCPTT/MCS/MCX services with 5G architecture.

Nemergent and Athonet have followed and will continue following the status of the standardization (functionalities, interfaces or protocol specifications) through the output documents of ETSI that are usually inherited from the 3GPP standardization. Even though the

name is MCPTT (Mission Critical Push To Talk), it is gradually changing into MCX in order to refer to the whole family MCPTT, MCData (Mission Critical Data), MCVideo (Mission Critical Video) and so on. Another important task is the assistance to the Plugtest events and report of the status once the official numbers and details are publicly released.

In this regard, from 3rd December 2018 to 31st January 2019 the first remote MCX Plugtest [34] took place after the increasing success of the first two face-to-face Plugtest events. Quoting ETSI [35] [36], "During these 2 months sessions, 1 000 test cases were run between 26 Vendors with a 92% success rate. More than 150 test sessions were executed between different vendors.". The long list of participating vendors includes Nemergent Solutions and Athonet.

The next Plugtest, the 4th, is scheduled to happen in September 2019. The Plugtest will include remote and face-to-face phases, hosting the face-to-face event in Kuopio, Finland.

Summing up, the participated Plugtest events during 5GENESIS were/are:

- 2nd MCPTT Plugtest event at College Sattion, USA, 25th-29th June 2018,
- 3rd MCX remote Plugtest event from December 3rd 2018 to 31st of January 2019,
- Forthcoming 4th MCX Plugtest event in Kuopio, Finland, 23rd-27th September 2019.

(b) 3GPP Mission Critical Services (MCS)

As planned Airbus DS has contributed to the 3GPP MCS standard definition, composed of MCPTT, MCData and MCVideo.

Airbus is participating in the 3GPP SA1 standardization which defines the service and feature requirements applicable to mobile and fixed communications technology, including 5G.

Airbus actively contributed to the 3GPP SA1 #85 meeting in Tallinn in February 2019. For this meeting, Airbus contributed to two change requests (S1-190435 and S1-190243) regarding the requirements for discreet listening in voice and video communications. Many topics were presented and discussed during the meeting, including:

- Study on Asset Tracking Use Cases (FS_5G_ATRAC),
- Smart Infrastructure over 5G Systems (5GSI),
- LAN support in 5G (5GLAN).

Airbus participated in the 3GPP SA6#26 meeting (Vilnius, Lithuania, October 15-19, 2018). During this meeting Airbus actively participated in the discussions for the following release 16 features: Enhancements to Functional architecture and information flows for Mission Critical Data, Enhanced mission critical system migration and interconnection, Enhanced Mission Critical Communication Interworking with Land Mobile Radio Systems, MBMS APIs for Mission Critical Services (TS 23.479), Study on Mission Critical Services support over 5G System, and several other work items.

Airbus participated in the 3GPP SA6#27 meeting (West Palm Beach, FL, USA, November 26-30, 2018) and continued to contribute to the same work items as for the SA6#26 meeting. Airbus also submitted some change requests for corrections and clarifications: S6-181856 (pre-arranged vs chat group calls), S6-181873 (late entry for chat group call), and S6-181743 (pre-established session).

At the 3GPP SA6#28 meeting (Kochi, India, January 21-25, 2019) Airbus proposed a correction for the MCVideo Group join information flows and procedure (S6-190241). For the Enhanced Mission Critical Push-to-talk architecture phase 2, Airbus contributed to the procedure for MCPTT user leaving a group call and to some corrections to the chat group late entry.

Mr. Jukka Vialen from Airbus was elected as new SA WG6 Vice Chairman during the 3GPP SA6#29.

During the 3GPP SA6#30 meeting from the 8th to the 12th of April 2019 in Newport Beach California, Mr. Jukka Vialen from Airbus, as a SA6 Vice Chairman, chaired the mission critical specific breakout sessions for MONASTERY (Mobile Communication System for Railways) and two study items MCSAA (Study on MC services access aspects) and enhMCLoc (Study on location enhancements for mission critical services).

Airbus continued as vice chair of the 3GPP SA6#31 meeting from 20th to the 24th of May 2019 in Bruges. During this meeting, among many critical services topics, it was agreed that the study on Mission Critical over 5GS was postponed by one year (from 9/29019 to 9/2020) in order to enable inclusion of two ongoing Release 17 SA2 features (Proximity based Services and multicast-broadcast services) into this study. This also means that the normative work will be moved to release 18.

Airbus participated in the 3GPP CT1 meeting in November 2018 and contributed with a total of 15 contributions to 3GPP 24.883 (Mission Critical Systems Connection to LMR) and 3GPP 24.379 (Mission Critical Push To Talk call control; Protocol specification).

Airbus took part in the 3GPP CT1 meeting from January 21st to 25th in Bratislava. The CT1 main stream was focusing on 5G, essentially on Release 15 fixes, while Release 16 work items were waiting to be completed at stage 2 level. Work related to Mission Critical is handled in breakout sessions. Airbus made 18 contribution documents for this meeting on SIP (re)-INVITE for a chat group.

Airbus took part in the 3GPP CT1 meeting in China from the 8th to the 12th of April 2019. Because of the absence of US delegates at that particular meeting, there had been a gentlemen agreement not to conduct any contentious work during this meeting.

The following 3GPP CT1 meeting was held mid-May 2019 in Reno USA. Due to the situation of the previous meeting there were many contributions (44) to the Mission Critical Communications Interworking Stage 3.

(c) 3GPP TSG SA WG3 (Security)

The 3GPP TSG SA WG3 (Security) meeting was held between the 12th and 16th of November in Spokane USA. Airbus made a change request contribution, which was noted, on the topic of the addition of symmetric key distribution mechanisms to TS 33.180 (Technical Specification Group Services and System Aspects; Security of the mission critical service; Release 14).

Airbus also took part in the 3GPP TSG SA WG3 (Security) meeting between the 6th and 10th of May in Reno USA. During this meeting many topics were discussed among which the “Security aspects of the 5G service-based architecture”, “Security aspects of single radio voice continuity from 5G to UTRAN”, “Security for 5GS enhanced support of vertical and LAN services” and “Authentication enhancements in 5GS”. Airbus contributed to three change requests about the

compliance of Mission Critical (MCPTT, MCSec, eMCSec, MONASTERY_SEC) with the IETF RFC3711. The three change requests were agreed.

The monitoring and contribution to this standardization work ensures that the 5GENESIS architecture and capabilities continue to be adapted to the MCS standard evolutions. Airbus will continue to take part and contribute to the coming 3GPP CT and SA meetings as already planned.

2.1.4.2. Enhanced Broadcast Services

The eBCS is a new initiative within the IEEE 802.11 WG that will consider broadcast service enhancements within an 802.11-based network. The initiative started as a Technical Interest Group (TIG) in the March 2018 meeting and was afterwards transformed into a Study Group (SG) chartered to create a PAR and CSD document in order to start a new amendment project to the IEEE 802.11 standard. The IEEE Standards Board approved the project in December 2018; as a result, a new task group (TGbc) was created within IEEE 802.11. The goal of the Enhanced Broadcast Services Task Group (IEEE 802.11 TGbc) is to draft a new amendment to the IEEE 802.11 standard. The amendment specifies modifications to the IEEE 802.11 medium access control (MAC) specifications that enable enhanced transmission and reception of broadcast data both in an infrastructure BSS where there is an association between the transmitter and the receiver(s) and in cases where there is no association between transmitter(s) and receiver(s).

The amendment introduces origin authenticity protection for broadcast data frames. In addition to enhancing traditional broadcasting services directed from an access point (AP) towards several non-AP stations (STA), the BCS TIG/SG discussed use cases in which non-AP STAs employs broadcasting to disseminate information, e.g. in an IoT environment, to other STAs so that any of the receiving STAs may act as an access to the Internet.

The focus of 802.11bc on broadcast services overlaps with the application use case considered for the Berlin trials and allow to steer insights from 5GENESIS on the performance of a 5G Core network to which both, 5G NR and non-3GPP access technologies are attached, into the standardization body.

In this context, FhG plans to submit a presentation on the Dense User Use Case / Festival of Lights once 5GENESIS Berlin Platform has the first initial results from the use case in November 2019. FhG anticipates the insights from using 802.11 as a non-3GPP access technology within the 5GENESIS use case will yield relevant results to be submitted. Depending on the results, technical enhancements to 802.11bc will be drafted.

IHP has long experience in IEEE 802.11 standardization. Together with FhG-FOKUS, IHP will monitor the developments in 802.11bc. Based on the results of the Berlin testbed, IHP will jointly generate technical contributions. During the technical sessions at the standardization meetings, IHP will support the proposals and presentations originating from 5GENESIS.

2.2. Establishing Liaisons with the SDOs and participation at SDOs meetings during Y1

Many 5GENESIS partners are participating and engaging relevant SDOs on a regular basis, attending meetings, participating in whitepapers and providing inputs to SDOs as those partners are involved in standardization activities through representatives and delegates.

As described in the 5GENESIS proposal, the Partners with presence in relevant SDOs is summarized in the following table:

Related 5GENESIS activity	Target SDO	Presenting Partner
NFV MANO adaptations for end-to-end	ETSI NFV ISG, Open-source MANO	TID
SDN-based transport network control	Open Networking Foundation	TID
5G network element designs	Telecom Infra Project (TIP)	TID
Use cases and scenarios, architecture and KPI related work	3GPP SA1, SA2, RAN1, RAN2, CT1	INT
Spectrum management	ETSI RRS	INT, UNIS
5GENESIS high level architecture	3GPP TSG SA, 5G PPP Architecture WG	NCSRD, UMA, INT
Reconfigurable radio solutions	ETSI TC RRS	IT, INT
Mobile edge computing innovations	ETSI ISG MEC	IT, ATH, INT
Mission-critical service integration in 5G	ETSI MCPTT	NEM
5G positioning techniques and results	IEEE 802.11az	IHP
mmWave innovations	IEEE 802.11ay	IHP
Enhanced Broadcasting Services	IEEE 802.11bc	FOKUS
Joint NFV/MEC orchestration	5G PPP Software Networks WG	NCSRD, UMA
End-to-end slicing techniques and protocols	IETF Network Slicing WG, IETF Transport Services WG	NCSRD, KAU
Network automation and coordination	ONAP	LMI
Mission Critical Services in 5G	3GPP MCS	ADS
5G/satellite integration	ETSI SES	AVA
5G NR advances	3GPP TSG RAN	REL, INT
IoT interoperability and protocols	IoT-EPI, IoT-LSP, AIOTI, IETF	UPV, KAU

Table 1 List of SDOs monitored and Partners involved

Specifically, 5GENESIS partners have been involved directly in the following meetings and activities in SDOs:

5GENESIS Layer	Partner	Activities
Infrastructure Layer	RUNEL	RAN WG1 Meeting at Gothenburg Sweden starting on August 20th, 2018. RAN WG1 Meeting at Chengdu China starting on October 8th, 2018. RAN WG1 Meeting at Xian (China) starting on April 8th, 2019
	ATHONET	Athonet attends all the quarterly technical standards WG sessions, and, as members of the Multefire marketing WG, Athonet are regular attendees to the bi-weekly calls, contributing to the definition of use cases and deployment models.
	AVANTI	Liaison with other participants in the ESA Alix project "Standardization special interest group" and its regular calls to ensure the work in 5GENESIS is represented; Dialogue with other satellite operators and vendors through the ESOA (EMEA Satellite Operators Association) standardization WG with a view to finding common ground on requirements during the fortnightly calls; Ongoing liaison with the EC H2020 SaT5G project team to build on the standards work within that project; Please see section 2.1.1.2. for more information on Alix, ESOA and SaT5G.
	KAU	KAU will continue to monitor the TAPS, CORE and LWIG WGs as part of its participation in upcoming IETF meetings. During the first year of 5GENESIS, the TAPS WG has met physically on three occasions: · IETF 102 in Montreal in July 2018 · IETF 103 in Bangkok in November 2018 · IETF 104 in Prague in March 2019. It has further held two on-line interims on September 12, 2018, and January 15, 2019.
	ATHONET	Athonet has contributed to two WTSI Whitepapers on ETSI MEC ISG: ETSI white paper #30: "MEC in an Enterprise Setting: A Solution Outline" published in November 2018. ETSI white paper #20: "Developing Software for Multi-Access Edge Computing" published in February 2019.

	TID	Telefónica I+D has attended ONF Connect 2018 taking place in Santa Clara on December 4-6th 2018.
	IHP FhG	In 2018, IHP attended the meeting in May taking place in Warsaw, in preparation for 5GENESIS. Fokus attended almost all 802.11 meetings to monitor the activities of IEEE 802.11bc. [1]
	UPV	IoT-EPI and IoT-LSP meetings in IoT Week the 4th-6th of June 2018 in Bilbao. IoT-LSP meeting in Brussels, EC meeting on 17th – 18th of October 2018. IoT-LSP meeting in Brussels, EC meeting on 3th of May 2019. IoT-LSP meeting in IoT Week the 18th-20th of June 2019 in Aarhus.
Management & Orchestration Layer	ATOS	ATOS attended the 5th OSM Hackfest held in Barcelona from 4-8th February 2019.
	TID	TID attended the 5th OSM Hackfest held in Barcelona from 4-8th February 2019.
	ATHONET	Athonet has attended NFV Plugfest events: 3rd NFV Plugtest event in Sophia Antipolis in June 2018. 4th NFV Plugtest event in Sophia Antipolis in June 2019.
Coordination Layer	TID	TID attended 5G PPP event held the 9th of July 2019 in Rome called “5G Vertical Users Workshop”.
Vertical Industries Layer	ATHONET	2nd MCPTT Plugtest event at College Sattion, USA, 25th-29th June 2018. 3rd MCX remote Plugtest event from December 3rd, 2018 to 31st of January 2019. Forthcoming 4th MCX Plugtest event in Kuopio, Finland, 23rd-27th September 2019.
	NEMERGENT	2nd MCPTT Plugtest event at College Sattion, USA, 25th-29th June 2018. 3rd MCX remote Plugtest event from December 3rd, 2018 to 31st of January 2019. Forthcoming 4th MCX Plugtest event in Kuopio, Finland, 23rd-27th September 2019.

[1] Neither IHP nor FOKUS charged person months nor travel cost to 5Genesis for attending the corresponding meeting.

	AIRBUS	3GPP SA6#26 meeting in Vilnius, Lithuania, October 15-19, 2018 3GPP TSG SA WG3 (Security) meeting was held between the 12th and 16th of November in Spokane USA 3GPP SA6#27 meeting in West Palm Beach, FL, USA, November 26-30, 2018 3GPP SA6#28 meeting in Kochi, India, January 21-25, 2019 3GPP CT1 meeting from January 21st to 25th in Bratislava 3GPP SA1 #85 meeting in Tallinn in February 2019 3GPP SA6#30 meeting from the 8th to the 12th of April 2019 in Newport Beach California 3GPP CT1 meeting in China from the 8th to the 12th of April 2019 3GPP TSG SA WG3 (Security) meeting between the 6th and 10th of May in Reno USA 3GPP SA6#31 meeting from 20th to the 24th of May 2019 in Bruges

Table 2 List of Meetings attended by 5GENESIS Partners

3. POTENTIAL CONTRIBUTION TO STANDARDS

3.1. Introduction

In the previous section, a description of standardization efforts in various SDOs is included, summarising information on stable and developing standards which need to be monitored and identifying areas where 5GENESIS partners are already active in monitoring/contributing.

In the following sections the 5GENESIS project reports its findings on what are the potential activities that can lead to contributions to standards. Those results are obtained comparing the functionalities currently available in existing standards versus the functionalities that would be needed in order to fully accomplish the vision of the 5GENESIS project. We call this delta as 'gap analysis' and provide a summarising table at the end of this section. Such gap analysis is completed also taking into consideration the inputs coming out of the 5G PPP Pre standardization WG, thanks to the strong involvement of project partners in the WG activities since the beginning of the project.

In the following quarters, the work carried out by the project partners will also determine to what extend the project will be able to impact the ongoing work of the different standards bodies and related associations that deal with topics close to the project focus.

This section will be constantly kept updated in the future version of this Deliverable, i.e., D7.6 and D7.7, due by the end of year two and year three of the project, respectively. The updates will consist of the outcome of the work planned for the cycle 2 and cycle 3 of the 5GENESIS workflow.

3.2. Málaga Platform originated contributions

To the best of our knowledge, current 3GPP specifications lack a comprehensive description of a seamless interworking between 5G NR and other radio technologies in unlicensed spectrum, for instance the existing 3GPP Release 13 features LTE WLAN integration with IPSec tunnel (LWIP) or LTE WiFi aggregation (LWA) address only partially the topic. UMA will follow the evolution of the LWIP standards work and the potential development and definition of new similar features.

MEC is recognized as a technology that would benefit from a tighter integration on the one hand with the mobile network core, and on the other with the NFV environment. This would improve the programmability and automation characteristics of the 5G network that are sought in 5GENESIS. Although some initial work is already taking place in 3GPP SA6, ETSI NFV and ETSI MEC, still there are many aspects to be considered. In particular, specifications are not yet available on how to harmonize MEC APIs with the Common API Framework for northbound APIs, defined for 5G by 3GPP SA6. Similarly, ETSI MEC and ETSI NFV have already identified an integrated architecture that enables the deployment of MEC in NFV, but have not produced normative material to close protocol gaps with respect to the joint orchestration of applications and network elements.

As part of the monitoring activities actively performed by Atos regarding MANO solutions and specifically OSM, that is the one used in the Málaga platform, two main gaps have been identified:

- **Slicing feature:** As stated previously in this document, the Málaga Platform won´t use the slicing functionality currently provided by OSM. The main reason is that, in 5GENESIS architecture, the slice manager is a higher layer component that communicates with OSM in order to orchestrate the end-to-end slicing over multi-technology, multi-domain environment,
- **WIM feature:** The Málaga platform will not use the OSM WIM functionality either, but a new feature will be implemented instead as part of 5GENESIS work. This will facilitate having more control of the different deployments and the corresponding interconnection network, as OSM doesn´t support the connection of heterogeneous VIMs.

These two items may be considered as potential contribution opportunities for 5GENESIS consortium to OSM.

Under the umbrella of 3GPP standardizations, ETSI runs MCPTT/MCX Plugtest events to check interoperability between vendors. It is common to find standardized procedures that are unclear, misleading or have been understood in a different way by different parties. Under these circumstances, it is common to gather all the suggested modifications and clarifications to 3GPP through change request documents. The idea of 5GENESIS is to get involved in the possible future documents through one of the attending partners in the consortium or through third party entities.

Besides, from the SDOs perspective it is still unclear how the mission critical services will be deployed in 5G infrastructure in order to ensure all the capabilities available in the already existing standard under 4G, plus the potential additional benefits of the 5G infrastructure and procedures to deploy mission critical services (scale-up, scale-down, precise mission critical slices, load balancing, …). 5GENESIS will progress in the direction of clarifying the existing aforementioned so as to achieve an agile, flexible and responsive mission critical services over 5G.

3.3. Athens Platform originated contributions

NCSRD has identified the following standardization gap regarding network slicing management:

- 5G slice management and its implementation as part of the NFV MANO or as an external component at the OSS level.

NCSRD will focus on the exploitation of the evolution of 5GENESIS Slice Manager functionalities and more specifically, in the 3GPP 5G system framework. The focus will be in the identification of work items that align with NCSRD 5GENESIS work and to propose PoC that will provide lessons learnt and demonstrators.

3.4. Surrey Platform originated contributions

Partners involved in the Surrey Platform testbed, and by means of the SDO monitoring activities which have actively performed, have identified the following gaps which they consider potential contribution opportunities for 5GENESIS consortium based on the work and testing conducted in the project.

- In the scope of the radio spectrum management, UNIS has detected a gap regarding QoS. Namely, none of the current ETSI WIs, nor existing standards nor technical reports, address the predictable level of QoS with a more dynamic (beyond weekly/daily/hourly) approach to spectrum sharing.

- Regarding 5G policy and charging control, and as a result of ONAP development publications monitoring, three main areas for further development have been recognised, to which LMI work in 5GENESIS will contribute. These activities are:

    - Advancing the deployment of the ONAP Policy Framework,
    - Finalization /validation of the ONAP Policy Framework,
    - Discussions around the Authoring/Tooling for policies.

  Integrating ONAP Policy Framework in 5GENESIS will enable LMI to contribute to the advancement of the deployment of the ONAP Policy Framework through documenting these experiences with using it in a real 5G testbed.

  LMI will be contributing to the validation of the Policy Framework in a real scenario. This will also be enhanced by providing policies for the real-world use case defined in 5GENESIS, as well as accompanying documentation to explain LMI insights gained from applying these policies, as deliverables towards ONAP.

  The next need that LMI has identified regarding ONAP will focus on is the initiation of a discussion around the Authoring/Tooling. While LMI will not be directly involved in the development of this area, it can discuss working with the tools (e.g., GUI editor, CLI editor) in the 5G testbed and provide insights LMI have gained from its experience in 5GENESIS.

  Through implementing this strategy, LMI hopes to advance the ONAP Policy Framework work and bring it closer to real-world deployments.

- In relation to the use of transport services to dynamically adapt higher layer configurations and protocol selection there is a lack of knowledge on how to design the policy component within the architecture and the integration within 5G systems have so far not been considered. KAU will bring research and measurements on these aspects from the Surrey Platform into the ongoing standardization of transport services at the IETF.

3.5. Berlin Platform originated contributions

The monitoring activities performed by IHP and FhG have revealed gaps in different areas. These standardization gaps, which are considered potential contribution opportunities for the 5GENESIS consortium, are the following:

- Regarding **mmWave access for 5G**, **IHP** has identified an opportunity for contribution in relation to the 802.11 IEEE standard. Specifically, 802.11ay amendment will receive technical comments and proposals to fit the 5GENESIS use cases, while 802.11be amendment will be provided with requirements and results from 5GENESIS, along with innovations in the area of Line-of-sight MIMO or hybrid beamforming,

- Another topic that currently present a standardization gap is **5G Positioning**. IEEE 802.11az (Next Generation Positioning) document is still a work in progress, and IHP already presented contributions on positioning for multiuser scenarios. Additionally, **FhG** will act as co-authors and will provide comments and improvements supported by 5GENESIS measurements and results,

- Lastly, IEEE 802.11bc amendment on **eBCS** is also a work in progress which presents an opportunity for contributions. Berlin Platform's Dense User Use Case (Festival of Lights due November 2019) matches perfectly with the topic of 802.11bc, so FhG plans to contribute with important results gathered from using 802.11 as a non-3GPP access technology for the mentioned use case. IHP, given its experience in IEEE 802.11 standardization, will join FhG and provide technical contributions based on the results of the Berlin testbed.

3.6. Limassol Platform originated contributions

Limassol Platform partners, in particular **Avanti**, have identified a standardization gap in regard with **satellite backhaul** for 5G.

This results in several potential contribution opportunities to different standards bodies such as ETSI SES SCN and some 3GPP WGs. Limassol will focus its work on reporting useful data from their satellite communication links when they are deployed, which will contribute to already open issues as inter-operability among satellite communications and 5G networks, as well as provide any relevant 5GENESIS output regarding architecture, RAN, core network, security or MANO.

3.7. Standardization opportunities through 5GPPP activities

5GENESIS project has joined the 5G PPP Pre-standardization WG in 2019. 5GENESIS representatives in the WG are:

- David Artuñedo Guillén (Telefónica I+D) as Standardization Manager in 5GENESIS,

- Arthur Lallet (Airbus) as WP/TASK Leader.

The WG has specific goals that can be summarized as:

- Collect and monitor inputs from 5G PPP projects across the three funding phases to relevant standards bodies, e.g. 3GPP, ETSI, IETF, ITU, IEEE, and several industry associations,
- Influencing pre-standardization on 5G and related R&D: Potentially propose where topics should be standardized; Influence timing on R&D work programs (e.g. EC WPs). Foster the development of globally harmonised standards,
- Tracking progress towards EU priority topics as defined by the EC (Unit E1),
- Identify gaps to be targeted in future funding programmes,
- Develop a roadmap of relevant standards. Inputs from projects are tracked in a regularly updated file,
- Collaborate with other WGs and Task Forces (TF) as required, e.g. forthcoming white paper of the 5G PPP Architecture WG on relevant standards, as well as the Verticals TF and a recently formed TF with selected market representation partners attending 3GPP WGs.

The WG has identified potential gaps in the standards, and these gaps are being taken as inputs in 5GENESIS platforms to analyse the potential opportunities for each platform as described in the above information per platform.

The list of identified gaps in the WG so far includes:

Potential gap	Relevant for 5GENESIS Platform
Adding new features incrementally with New Radio (NR) covering all relevant use cases that are commercially viable, e.g. drones and public safety.	• Málaga Platform • Athens Platform
Enhanced NR unlicensed: essential features, with integrated access and backhauling.	• Málaga Platform • Surrey Platform • Berlin Platform • Limassol Platform
Massive Multiple Input Multiple output (MIMO): increase efficiency in real operations.	• All platforms
Industrial Internet of Things (IIoT) and URLLC: build on Releases 15 and 16, with IEEE integration and adding missing features (e.g. massive machine type communications, mMTC for terminal energy efficiency).	• Athens Platform • Surrey Platform • Limassol Platform
NB-IoT and LTE-M: sensor networks and public safety (sidelink, broadcasting, drones, mobile IAB nodes.	• Málaga Platform • Surrey Platform
Achieving very low latency and QoS for industrial applications, such as audio-visual media (there are 2 types of broadcast considered; one for	• Málaga Platform

media content and one for public safety), critical medical applications.	
Sidelink: network-controlled devices, gaming, media, logistics.	• Málaga Platform • Limassol Platform • Portable Demonstrator
Current Study Item on relays: indoors, important for blindspots; higher bit rates, lower latency, factories and interconnected devices.	*Not relevant for 5GENESIS*
Continued advancement of non-terrestrial networks, with many 3GPP inputs coming from 5G PPP phase 2 project, SAT5G.	• Limassol Platform

The WG is constantly following standardization activities, and keeps updated a document that tracks the status of this activity, document that was made available to all 5GENESIS consortium members in a shared folder within the project website.

This WG will be participating in the "2nd 5G Vertical User Workshop" on the 9th-10th of July at Rome, and 5GENESIS will be attending the workshop. This 5G Vertical Users Workshop, as an initiative of a subset of European 3GPP Market Representation Partners (MRPs), is designed to help vertical industries become part of the standardization process, create new synergies and obtain guidance from 3GPP by exchanging on future needs and upcoming standards developments.

Figure 6. 2nd 5G Vertical Workshop announcement

Relevant verticals for 5GENESIS discussed in the workshop are Public Safety (Málaga Platform) and Media Broadcasting (Berlin Platform).

4. Regulation bodies engagement and Spectrum Licensing Status

4.1. Introduction

In the first months of the 5GENESIS project lifetime activities aimed at impacting the regulatory bodies already started. In the following, more details are shared w.r.t. the meetings held in UK, Spain and Greece with the respective national regulatory bodies, and the first engagement in Cyprus w.r.t. the Limassol Platform.

For the other Platforms, engagements are ongoing and are planned to take place in the second half of 2019.

4.2. Meetings with Regulation bodies

4.2.1. Ofcom (UK)

The 5GENESIS consortium contacted Ofcom personnel in Q4 2018 to ask for a meeting at their premises. The rationale for the meeting was to present the 5GENESIS project, its uses cases and objectives, its Testbeds and the planned Facility, and finally to elaborate on how the project intends to impact the wireless ecosystem, especially w.r.t. 5G spectrum usage in the mmWave bands.

It was agreed that a meeting at Ofcom premises in London would take place before the 5GENESIS Consortium meeting planned in Guildford (13-15.12.2018), i.e. on Monday morning the 12th of December 2018. The plan was that at the meeting two people from the 5GENESIS team, i.e. Prof. Klaus Moessner and Dr. Valerio Frascolla, would meet a delegation of Ofcom personnel.

First try

Prof. Klaus Moessner and Dr. Valerio Frascolla met as planned at Ofcom premises in the late morning of the 12th. After some waiting time at the Ofcom entrance, it was finally possible to reach the Ofcom contact in the early afternoon. The 5GENESIS team understood that, due to a trivial misunderstanding on the day chosen for the meeting, it would have not been possible anymore to meet – as planned - the Ofcom delegation on that day. Notwithstanding the unplanned issue, the Ofcom contact person was so kind to offer to run by himself the meeting, but the 5GENESIS team preferred to postpone to the next day the meeting, so to have the whole delegation of Ofcom attending the 5GENESIS presentation, and not a single attendee.

That unfortunate change of plan, which caused a substantial delay in the schedule of the planned 5GNESIS activities of the day, made it impossible to run the innovation workshop at Surrey University premises, which was planned in the afternoon of Monday the 12th.

Second successful try

On Tuesday morning the 13th of December, Dr. Valerio Frascolla travelled to London from Guilford to represent the 5GENESIS consortium in front of the Ofcom delegation, composed of 4 people. Prof. Moessner couldn't join on the 13th as he was the host of the consortium meeting that started at 09:00 the 13th at the University of Surrey premises.

The meeting with Ofcom on the 13th was very successful. Dr. Valerio Frascolla discussed a presentation composed of 35 slides,focusing on explaining what the scope of the 5GENESIS project is, what are the main use cases, shortly describing the 5 Testbeds and the forthcoming planned project Facility. Also, the main research topics regarding spectrum management were briefly discussed. An open conversation followed the presentation and several questions were posed by the Ofcom personnel, mainly targeting at understanding in what the project could help in having better spectrum management capabilities, especially for spectrum above the 6GHz bands (lower mmWave domain).

The slides were shared with the Ofcom personnel and in case of questions Ofcom will come back to the 5GENESIS consortium for further clarifications.

As unfortunately the Surrey Platform owner, Prof. Moessner couldn't attend the meeting, some specific questions on the detailed planned set of actions related to the Surrey Platform enhancements and refurbishing for the 5G deployment at Guildford couldn't be answered. Due to that, Ofcom personnel was invited to Guildford to meet the people actually working on the Surrey Platform, so to have a live demo of the existing capabilities and to be educated on what are the next steps for enhancing the Testbed with the novel proposals coming out of the 5GENESIS proposal. Such meeting is planned to take place in the second half of 2019.

Finally, the Ofcom personnel expressed its interest to have updates, mainly from the Surrey Platform work, in the forthcoming quarters of the project duration.

4.2.2. Ofcom (CH)

In the context of the ETSI RRS meeting number RRS1#45, held in February 2019 in Biel and hosted by the Swiss regulatory body called The Swiss Federal Office of Communications (Ofcom), Intel presented the 5GENESIS project verbally to the attendees, among which also personnel from Ofcom Switzerland. The audience was rather interested and posed a few general questions.

4.2.3. Ministry of Digital Governance (GR)

NCSR Demokritos, as owner of the 5GENESIS Athens Platform, has got in touch with the representatives of the Ministry of Digital Governance, where a physical meeting took place in January 2019. The representatives of the ministry were informed of the activities and plans of the 5GENESIS tests in Athens and the discussion focused on the provision of band 42 (3.4-3.6GHz) with 100MHz bandwidth for the needs of the project.

Upon this meeting further communication has been followed and an official process has been initiated in order the clarify and agree upon the specific frequencies to be provided in the selected areas and for the period that the project foresees. More information is provided in Section 4.3, where the spectrum license process is described, as well as in Annex 2.

4.2.4. Dirección General de Telecomunicaciones in Madrid (ES)

Pedro Merino, as TM and leader of Málaga Platform, had several physical meetings with the staff of the Spanish regulator in Madrid (Dirección General de Telecomunicaciones y Sociedad de la Información, Secretaría de Estado para el Avance Digital). In the meeting held on November 21st, 2018, the TM presented 5GENESIS objectives and approach and started discussions towards having more information on the 5G plans in Spain, and in particular the process access to licensed spectrum to run 5GENESIS in Málaga Platform. Additional communications by email and other meetings followed the ones in Madrid. For example, during the 5GForum in Málaga, Pedro Merino presented the project to a large audience of operators, vendors and verticals, and Mr. Antonio Fernández-Paniagua, Deputy Director of the regulator agency, was one of the attendees.

The contacts with the Spanish regulator have produced several outputs:

- Visibility of the project to the Spanish regulator, who is interested in following the results,
- Early access to details of the Spanish 5G Plan, officially published at the government website [37],
- The creation of a communication channel with the regulator in order to get a specific experimental license in 28GHz to deploy mmWave gNBs in Málaga to be used (not exclusively) to support 5GENESIS Málaga Platform.

The contacts are still active and additional meetings are expected in the context of MWC2020 (Barcelona), 5GForum 2020 (Málaga) and the regulator office in Madrid.

4.2.5. Office of the Commissioner of Electronic Communications & Postal Regulations (CY)

The Limassol partners have been in close correspondence with the Officer of Technical Affairs, of the Office of the Commissioner of Electronic Communications and Postal Regulation (OCECPR, Cyprus, [38]). The officer has expressed interest on the latest Limassol Platform activities of 5Genesis and is regularly being updated by Primetel on this. There are plans to do a short demonstration when the 5G Spectrum provided to Primetel PLC through a 5G Experimental License from the Department of Electronic Communications is utilized (see Section 4.3.2 for more details).

4.2.6. Plan for further actions

4.2.6.1. BundesNetzAgentur (DE)

In Germany, the 5G spectrum auction took much longer than originally planned (it was the longest auction so far for the cellular frequency bands). The auction was completed in mid of June 2019, after almost 500 rounds.

5GENESIS plan was to wait for the auction to be finalized and then contact the German regulatory body, the BundesNetzAgentur, asking for a meeting at their premises to present the project vision and main results.

4.2.6.2. Further regulatory bodies

The French authority ANFR and Ofcom (CH) will be both addressed in 2019 to ask for their willingness to have a call or a meeting at their premises to discuss the 5GENESIS project, similarly to what has already been done with the other regulatory bodies in UK, Spain and Greece.

4.3. Spectrum Licensing status per Platform

This section outlines the status of the Spectrum usage agreed per platform with National Regulatory entities and/or Operators collaborating in 5GENESIS project. This section will be updated in next releases as the status of some platform will evolve along the project.

4.3.1. Málaga Platform

Málaga Platform has completed the plans to use 5G frequencies in three different areas.

- Inside UMA lab at Ada Byron building: most of the test will be done with RF cables to avoid over the air emissions. This is the approach followed in TRIANGLE project with the LTE emulators, which are now part of 5GENESIS, and is also the method used to connect the RunEL and Eurecom solutions. On top of the cable solution, small cells and SDR equipment will transmit over the air with minimum power and using ad-hoc attenuation boxes like the one in the picture. With these approaches we don't need a specific license to use frequencies 2600 MHz FDD and 3500 MHz TDD in the context of 5GENESIS,

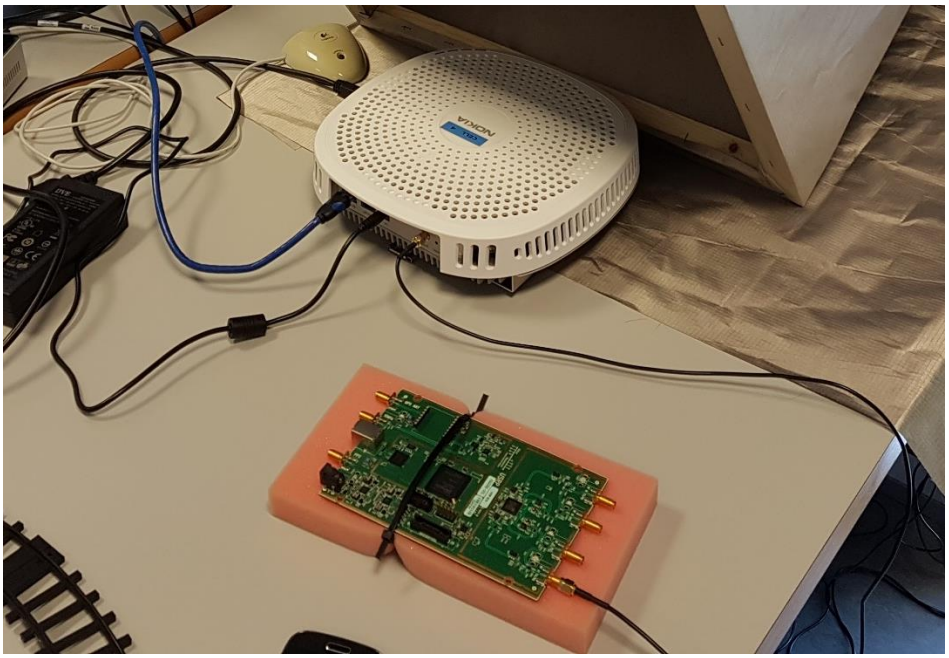

Figure 7. Nokia 5G base station used at Málaga Platform.

- Outdoor UMA deployment: UMA has published a call for tenders in order to deploy 4 LTE RRHs and 4 5GNR RHHS on the roof of Ada Byron building working in 2600 MHz FDD and 3500 MHz TDD, respectively. Initially, the whole set will work in NSA mode. The call for offers includes a clause for provision spectrum from a national operator to support the operation of the cells in the next 3 years, with possible extensions. In addition, as described above, there are contacts with the Spanish regulator in order to get a specific experimental license in 28GHz to deploy mmWave gNBs in University of Málaga to be used (not exclusively) to support 5GENESIS Málaga Platform,

- Outdoor deployment at Málaga city: The Municipality of Málaga has prepared a call for tenders with the same specifications that proposed by University of Málaga. The applicants should commit to provide 6 units of 5G NR RRH plus 5 units of LTE RRHS supporting NSA, along with spectrum from a national operator in the bands 2600 MHz and 3500 MHz, respectively.

4.3.2. Limassol Platform

At the end of 2018, PrimeTel PLC applied for a 5G experimental spectrum license at the Department of Electronic Communications of the Ministry of Transport, Communications and Works [39]. The application was successful and PrimeTel PLC was granted access for 5G experimentation in band 3600MHz [3400-3800MHz] (TDD), 100MHz channel bandwidth, in the 3400-3500MHz frequency range. The license is valid until 30 November 2019.

Furthermore, the Ministry of Transport, Communications and Works gave a press conference on 5G developments in Cyprus in April 2019 in which PrimeTel were asked to provide updates

on both 5GENESIS and commercial activities. There are plans for a face to face meeting at the next achievable technical milestone.

4.3.3. Surrey Platform

The Surrey Platform coverage is based on two deployments:

- Outdoor deployment: Surrey has currently deployed (commercial) 70 LTE RRHs and 9 5GNR RHHs on the university campus working in 2600 MHz and 3500 MHz TDD, respectively. Initially, the 5GNR deployment will work in NSA mode. The experimental/test licenses obtained from OFCOM are valid for a year, with continues extensions. In addition, Surrey has specific experimental license in 28GHz to deploy mmWave gNBs to be used (not exclusively) to support 5GENESIS Surrey Platform,
- Indoor deployment: within the 5GIC building there are currently 6 LTE commercial RRHs supporting NSA, operating on 2600 MHz.

The current licensing status in surrey is as follows:

- 2.6 GHz - BW = 20 MHz, 4G,
- 2.3 GHz - BW = 20 MHz, 4G,
- 3.5 GHz - BW = 100 MHz, 5G,
- 700 MHz - BW = 20 MHz, 5G.

4.3.4. Berlin Platform

Since the 5G auction in Berlin took longer than expected, the Berlin Platform approached the Bundesnetzagentur (BNetzA) as well as operators to obtain permissions to use for experiments spectrum, which was previously auctioned to operators, or which will be assigned to operators or local deployments as part of the 5G auctions.

As such, Berlin currently holds experimental spectrum licences for the following bands:

- 700 MHz Band 28 (Deutsche Telekom); 20 MHz bandwidth (4G),
- 700 MHz Band 28 (Vodafone); 20 MHz bandwidth (4G),
- 2500 MHz (Vodafone); 20 MHz, 4G,
- 3700 – 3800 MHz; 100 MHz bandwidth (open for 4G and 5G usage).

Following the 5G auction in Germany, both IHP and FOKUS will apply for a permanent license for the 3700 MHz band as part of the German plan to assign such frequency for local deployments.

4.3.5. Athens Platform

NCSR Demokritos has received the spectrum license by the Greek Authorities for 5G Trials at the areas of 5GENESIS platform in Athens at 3.4-3.6 GHz and bandwidth 100MHz, clarifying that this is made for the experimental purposes of H2020 5GENESIS research activities.

As such, Athens currently holds experimental spectrum licences for the following bands:

- 3400 – 3600 MHz; 100 MHz bandwidth

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[10] https://www.esoa.net/5g/
[11] https://www.esoa.net/press-room/ngmn-alliance-and-esoa-sign-co-operation-agreement
[12] https://www.sat5g-project.eu/
[13] https://www.sat5g-project.eu/partners/
[14] https://aioti.eu/
[15] https://aioti.eu/wp-content/uploads/2018/06/AIOTI-HLA-R4.0.7.1-Final.pdf
[16] Collaborating Innovators contribute both financially and with time & skills (with a minimum of one dedicated FTE). Collaborating Innovators influence the direction of the ONF through active involvement and with the opportunity to run for an at-large ONF board seat. They also benefit from access to additional support and co-marketing opportunities.
[17] https://www.opennetworking.org/member-listing/
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[26] ETSI TS 103 235 (V1.1.1): "Reconfigurable Radio Systems (RRS); System architecture and high level procedures for operation of Licensed Shared Access (LSA) in the 2 300 MHz - 2 400 MHz band".
[27] ETSI TS 103 379 (V1.1.1): "Reconfigurable Radio Systems (RRS); Information elements and protocols for the interface between LSA Controller (LC) and LSA Repository (LR) for operation of Licensed Shared Access (LSA) in the 2 300 MHz - 2 400 MHz band".

[28] ETSI TR 103 588 (V1.1.1): “Reconfigurable Radio Systems (RRS); Feasibility study on temporary spectrum access for local high-quality wireless networks”.
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[30] ETSI TS 103 655-2 V1.1.1: “Reconfigurable Radio Systems (RRS); evolved Licensed Shared Access (eLSA); Part 2: System architecture and high-level procedures - eLSA architecture”.
[31] Valerio Frascolla, “Doc. RRSWG1(18)044009 - Adding dynamicity to spectrum management”, ETSI TC RRS#44 Meeting, Rome, November 2018.
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[33] https://projects.tmforum.org/wiki/display/API/TM+Forum+Ecosystem+API+Portalhttps://projects.tmforum.org/wiki/display/API/TM+Forum+Ecosystem+API+Portal
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ANNEX 1: PARTNERS STANDARDIZATION PLANS

Detailed standardization plans per partner are:

TID is representing Telefónica at the ETSI NFV ISG. Besides being part of the core team that produced the initial whitepaper and contributing to the work of the ISG, TID has chaired the MANO WG and the Performance Expert Group. Currently TID chairs the ISG, actively contributing to all WGs. TID is active in other ETSI related initiatives, such as the MEC ISG and TC CYBER. Moreover, TID represents Telefónica in the Open Networking Foundation, currently being member of the Board. Additionally, TID contributes in different working activities, including Transport API functional requirements, SDN managed microwave link implementation and trials, ONOS and CORD (Central Office Central Office Re-architected as a Datacentre). Finally, Telefónica also has an ONF Ambassador. Also, TID actively contributes to IETF activities (SFC, PCE, I2NSF, I2RS, ANIMA), and currently chairs the Network Function Virtualization Research Group, within IRTF and contributes to NMRG and DINRG. Other standardization activities: TID participates in 3GPPP activities, the BBF, and the TMForum, as well as Open Source MANO65, where TID leads this open source community, which provides a practical implementation of the reference architecture for NFV Management & Orchestration. TID is a member of the Board of directors of TIP, representing Telefónica. Moreover, TID co-chairs two WGs within TIP: Edge Computing and Artificial Intelligence and Applied Machine Learning, while actively working in other groups. TID also contributes to OpenStack, OpenNebula, OPNFV and OpenDayLight.

INT is playing an active key role in several standards bodies and will provide support and work together with other consortium partners to push into relevant standard bodies the main outcomes of the project. The target groups include but are not limited to: 3GPP SA1, SA2, RAN1, RAN2, CT1 for the use cases and scenarios, architecture and KPI related work. ETSI (INT serves as ETSI RRS chairman and as ETSI board member) RRS 01, RRS 02, RRS 03 as well as IEEE SA-P1932.1 for spectrum related work. Specifically, following the outcome of a discussion driven by INT (V. Frascolla) during a RRS01 meeting in Mainz in November 2017, INT will start a new WI in ETSI RRS 01 on a more dynamic management of spectrum bands, which will contain the outcome of the research work done together with IT and UNIS. ETIS ISG MEC (INT serves as group secretary) for the MEC- related work. INT is also active in other fora like ITU and CEPT bodies, and will engage with them for the adoption of the main project outcomes. Finally, INT will leverage its active role in GSA, 5G-IA, NGMN, and other industry- driven associations to push for the adoption of the project results.

IT (Dr. Shahid Mumtaz) is leading the standard in IEEE SA-P1932.1 on Licensed/Unlicensed Spectrum Interoperability in Wireless Mobile Networks, which helps 5GENESIS to standardize the project results. Regarding 5G standardization, we are available to participate in a joint 5GENESIS contribution to:

- 3GPP TSG SA about 5GENESIS use cases and high-level architecture.
- ETSI TC RRS on reconfigurable radio solutions adopted in the mobile network.
- ETSI ISG MEC on the adoption of the mobile edge computing framework in 5GENESIS which may be presented as a proof of concept (PoC) within this industrial standardization group.

ATH is actively involved in the ETSI MEC ISG body and other 3GPP/ETSI activities and initiatives (e.g. SCF plugtests). Athonet is also member of the MulteFire Alliance and of the Telecom Infra Project (TIP).

NEM actively follows the 3GPP standardization process related to both MC services and 5G networks. The main target is that the implemented solutions in 5GENESIS are in accordance to the latest specifications. NEM has actively participated in the 1st ETSI MCPTT Plugtest in June 2017, and is committed to keep on the participation in future interoperability events. Although this is not a direct contribution to SDOs, the outcomes of the interoperability tests are reported by ETSI to the 3GPP in order to identify potential interpretation issues that need to be solved. NEM estimates that the 3rd and 4th editions (2019 and 2020) will allow testing the new service deployment interfaces for 5G networks.

IHP plans to actively contribute with technical comments and proposals to address technical issues to 802.11ay and 802.11az. On the latter, Together with FhG-FOKUS, we will monitor the developments in 802.11bc. Based on the results of the Berlin testbed, we will jointly generate technical contributions. During the technical sessions at the standardization meetings, IHP will support the proposals and presentations originating from 5GENESIS.

FOKUS plans to actively attend the IEEE Standards Association, IEEE 802.11 to monitor and contribute to ongoing standards allowing for seamless integration of non-3GPPP access technologies into the Open5GCore. Having more than a decade experience in contributing to IEEE 802.11 and holding active leadership positions in 802.11, FOKUS will support and guide IHP on feeding 5GENESIS research results in applicable standards activities.

UNIS, through the 5GIC member organisations has links into all the major SDOs and regulatory bodies – 3GPP, IEEE, IETF, ETSI, DVB, ITU, ICANN, W3C, BSI. This will enable UNIS to bring forward the knowledge gained from 5GENESIS on the suitability of individual standards for use in multi-RAT, multi-network, spectrum sharing scenarios, so that they can be evolved for the 5G Era. It must be noted that a dedicated group for discussing and planning standards activities between the 5GIC and its member organisations is already active. 5GIC is also able to mobilise its member organisations towards setting up new standardization activities. Indicative examples are the ETSI Industry Specification Groups (ISGs) on Next Generation Protocols (NGP) and Mobile & Broadcast Convergence (MBC). Therefore, if it is appropriate for there to be a new 5GENESIS related standardization activity to consider the over the top multi-network and/or spectrum sharing issues, the relevant and proven experience will allow for its realisation and pursuit.

UPV research team is an active member of IoT related standardization efforts. Mainly in the area of interoperability: W3C, ETSI, ITU-T, IETF and OGC. Related with IoT interoperability UPV participates in three EC initiatives: IoT-EPI, IoT-LSP and AIOTI, contributing with architecture components associated with the networking building block. Additionally, UPV is an active member of 5G PPP, BDvA and EFFRA in order to include the use of 5G networking technologies in different application domains; from Industry 4.0 to transportation and logistics.

NCSRD is a member of ETSI Network Function Virtualisation Industry Specification Group (ETSI NFV ISG) and closely following the activities of the Internet Engineering Task Force (IETF). Additionally, NCSRD is participating in the 5G PPP WGs and through the participation in several EU-funded projects has made valuable contributions to the 5G PPP Software Networks, Security and Architecture WGs. NCSRD will seek opportunities for promoting the results of the project

to those groups by participating in group-level paper releases and delivering 5GENESIS presentations at 5G PPP events.

LMI will internally recommend results coming from 5GENESIS to our standardization-responsible staff. In addition, we will explore working with open source communities as a form of informal standardization path but which has potential to be of high impact in terms of wide adaptation within the communities. More specifically, we will continue to actively contribute to Linux Foundation ONAP.

ATOS will promote 5GENESIS project contributing to open sources initiatives with the results achieve during the project execution, positioning and contributing to maximise the project impact. Atos is an active member of some 5G PPP WGs, where project results will be exposed and pushed towards the overall 5G PPP program goals.

ADS is a key contributor to the 3GPP Mission Critical Services (MCS) standard definition, composed of MCPTT (Mission Critical Push To Talk), MCData (Mission Critical Data) and MCVideo (Mission Critical Video) which will enable to provide broadband mission critical services on top of LTE and later on 5G to Public Safety users. Airbus DS SLC actively contributes to SA2, SA3, SA6, CT1and RAN groups and will therefore contribute to make sure that MCS evolutions and more generally multimedia critical communications take advantage of 5G evolution.

AVA is an active contributor in 3GPP in RAN and SA non-terrestrial items; contributes to 5G activities in ETSI SES; a member of Networld 2020 Satcom WG & ESA 5G Satellite task force; and member of the 5G PPP trials, vision & technical WGs. Avanti will contribute to the standardization activities related to satcom, by preparing a report on the results of the Limassol testbed for dissemination to relevant work items in ETSI SES and 3GPPP on non-terrestrial 5G communications.

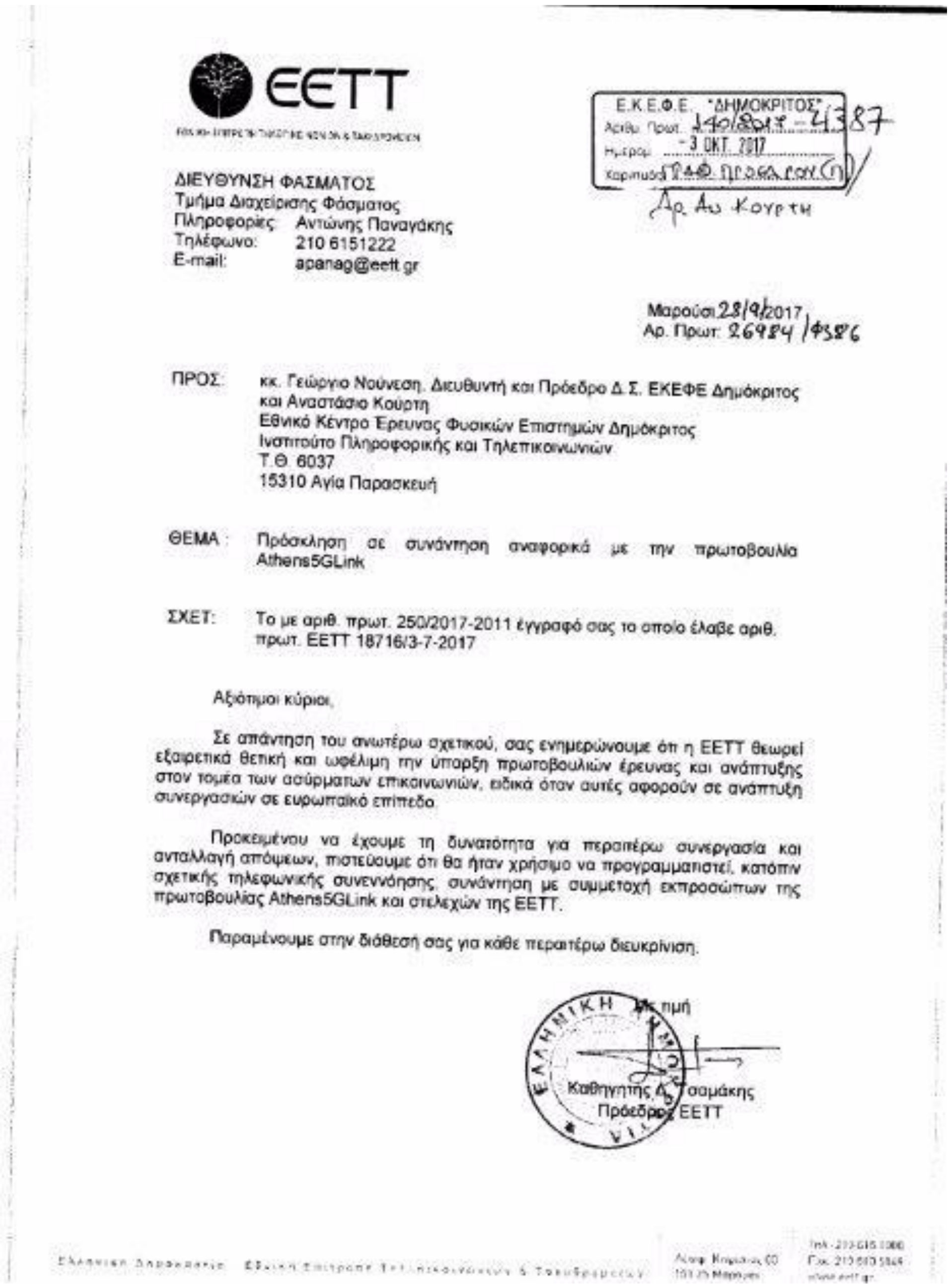
REL is participating in the 3GPP meetings related to the 5G RAN. RunEL is an active party in HERON, an Israeli 5G technologies R&D consortium. RunEL will push and recommend using 5GENESIS outcomes in these societies.

UMA as part of 5G IA, UMA will contribute to the 5G PPP WGs with the aim to promote results from 5GNESIS to be part of standards.

KAU is actively engaged in standardization within the IETF and currently chairs the RTP Media Congestion Avoidance Techniques (rmcat) WG. In line with this engagement, KAU plan to bring relevant 5GENESIS results to IETF for possible standardization (for example possible improvements to IoT protocols such as CoAP to the core WG or results related to multi-connectivity to WGs such as dmm and mptcp.).

ANNEX 2: ATHENS PLATFORM DOCUMENTS FOR SPECTRUM LICENSE

NCSRD has initiated the process of issuing a 5G spectrum license for experimenting and testing purpose from the proposal phase of the 5GENESIS project. The next letter (in Greek) provides a positive feedback from the Hellenic Telecommunications and Post Commission regarding spectrum use licensing for 5G trials, where we were invited to a f2f meeting.



EETT

ΔΙΕΥΘΥΝΣΗ ΦΑΣΜΑΤΟΣ
Τμήμα Διαχείρισης Φάσματος
Πληροφορίες: Αντώνης Παναγάκης
Τηλέφωνο: 210 6151222
E-mail: apanag@eett.gr

Ε.Κ.Ε.Φ.Ε. "ΔΗΜΟΚΡΙΤΟΣ"
Αριθμ. Πρωτ. 140/2017 - 4387
Ημερομ. - 3 ΟΚΤ. 2017

Μαρούσι 28/9/2017
Αρ. Πρωτ. 26984/4586

ΠΡΟΣ: κκ. Γεώργιο Νούνεση, Διευθυντή και Πρόεδρο Δ.Σ. ΕΚΕΦΕ Δημόκριτος και Αναστάσιο Κούρτη
Εθνικό Κέντρο Έρευνας Φυσικών Επιστημών Δημόκριτος
Ινστιτούτο Πληροφορικής και Τηλεπικοινωνιών
Τ.Θ. 6037
15310 Αγία Παρασκευή

ΘΕΜΑ: Πρόσκληση σε συνάντηση αναφορικά με την πρωτοβουλία Athens5GLink

ΣΧΕΤ: Το με αριθ. πρωτ. 250/2017-2011 έγγραφό σας το οποίο έλαβε αριθ. πρωτ. ΕΕΤΤ 18716/3-7-2017

Αξιότιμοι κύριοι,

Σε απάντηση του ανωτέρω σχετικού, σας ενημερώνουμε ότι η ΕΕΤΤ θεωρεί εξαιρετικά θετική και ωφέλιμη την ύπαρξη πρωτοβουλιών έρευνας και ανάπτυξης στον τομέα των ασύρματων επικοινωνιών, ειδικά όταν αυτές αφορούν σε ανάπτυξη συνεργασιών σε ευρωπαϊκό επίπεδο.

Προκειμένου να έχουμε τη δυνατότητα για περαιτέρω συνεργασία και ανταλλαγή απόψεων, πιστεύουμε ότι θα ήταν χρήσιμο να προγραμματιστεί, κατόπιν σχετικής τηλεφωνικής συνεννόησης, συνάντηση με συμμετοχή εκπροσώπων της πρωτοβουλίας Athens5GLink και στελεχών της ΕΕΤΤ.

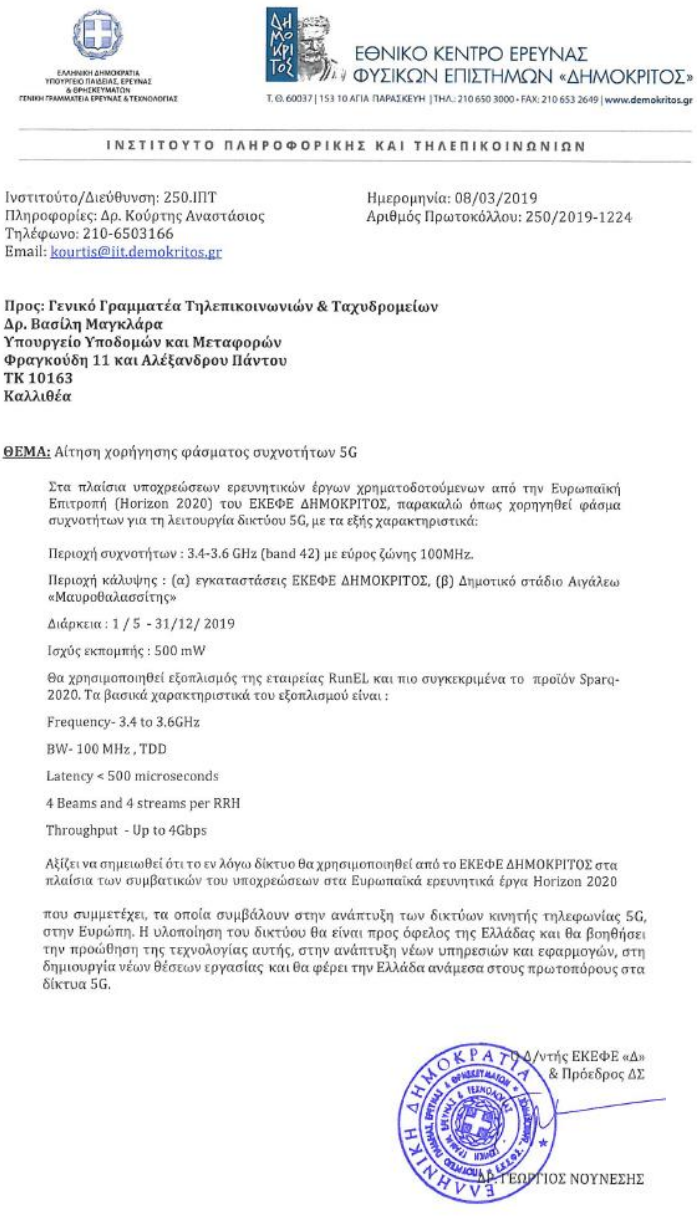
Παραμένουμε στην διάθεσή σας για κάθε περαιτέρω διευκρίνιση.

Με τιμή

Καθηγητής Δ. Τσαμάκης
Πρόεδρος ΕΕΤΤ

Figure 8. Hellenic Telecommunications and Post Commission regarding spectrum use licensing for 5G trials.

Upon the feedback that we received from the meeting and following other meetings with the Greek authorities and regulatory bodies, NCSR Demokritos as platform leader of the Athens 5GENESIS platform was guided to submit a detailed technical request for a spectrum license for testing purposes in the areas of the Athens platform at the Ministry of Transports and Infrastructures. For this reason an official request made by the president of the NCSR Demokritos, Dr. Nounesis to the responsible public regulatory body, applying for a 5G spectrum license at 3.4-3.6 GHz and bandwidth 100MHz, describing also all the relevant technical details as we advised from HTPC. In Figure 9, we provide the official request that was made by the president of NCSR Demokritos towards the Greek state, clarifying that this is made for the needs of H2020 research activities.



ΕΘΝΙΚΟ ΚΕΝΤΡΟ ΕΡΕΥΝΑΣ ΦΥΣΙΚΩΝ ΕΠΙΣΤΗΜΩΝ «ΔΗΜΟΚΡΙΤΟΣ»

Τ. Θ. 60037 | 153 10 ΑΓΙΑ ΠΑΡΑΣΚΕΥΗ | ΤΗΛ.: 210 650 3000 - FAX: 210 653 2649 | www.demokritos.gr

ΙΝΣΤΙΤΟΥΤΟ ΠΛΗΡΟΦΟΡΙΚΗΣ ΚΑΙ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ

Ινστιτούτο/Διεύθυνση: 250.ΙΠΤ
Πληροφορίες: Δρ. Κούρτης Αναστάσιος
Τηλέφωνο: 210-6503166
Email: kourtis@iit.demokritos.gr

Ημερομηνία: 08/03/2019
Αριθμός Πρωτοκόλλου: 250/2019-1224

Προς: Γενικό Γραμματέα Τηλεπικοινωνιών & Ταχυδρομείων
Δρ. Βασίλη Μαγκλάρα
Υπουργείο Υποδομών και Μεταφορών
Φραγκούδη 11 και Αλέξανδρου Πάντου
ΤΚ 10163
Καλλιθέα

ΘΕΜΑ: Αίτηση χορήγησης φάσματος συχνοτήτων 5G

Στα πλαίσια υποχρεώσεων ερευνητικών έργων χρηματοδοτούμενων από την Ευρωπαϊκή Επιτροπή (Horizon 2020) του ΕΚΕΦΕ ΔΗΜΟΚΡΙΤΟΣ, παρακαλώ όπως χορηγηθεί φάσμα συχνοτήτων για τη λειτουργία δικτύου 5G, με τα εξής χαρακτηριστικά:

Περιοχή συχνοτήτων : 3.4-3.6 GHz (band 42) με εύρος ζώνης 100MHz.

Περιοχή κάλυψης : (α) εγκαταστάσεις ΕΚΕΦΕ ΔΗΜΟΚΡΙΤΟΣ, (β) Δημοτικό στάδιο Αιγάλεω «Μαυροθαλασσίτης»

Διάρκεια : 1 / 5 - 31/12/ 2019

Ισχύς εκπομπής : 500 mW

Θα χρησιμοποιηθεί εξοπλισμός της εταιρείας RunEL και πιο συγκεκριμένα το προϊόν Sparq-2020. Τα βασικά χαρακτηριστικά του εξοπλισμού είναι :

Frequency- 3.4 to 3.6GHz

BW- 100 MHz , TDD

Latency < 500 microseconds

4 Beams and 4 streams per RRH

Throughput - Up to 4Gbps

Αξίζει να σημειωθεί ότι το εν λόγω δίκτυο θα χρησιμοποιηθεί από το ΕΚΕΦΕ ΔΗΜΟΚΡΙΤΟΣ στα πλαίσια των συμβατικών του υποχρεώσεων στα Ευρωπαϊκά ερευνητικά έργα Horizon 2020

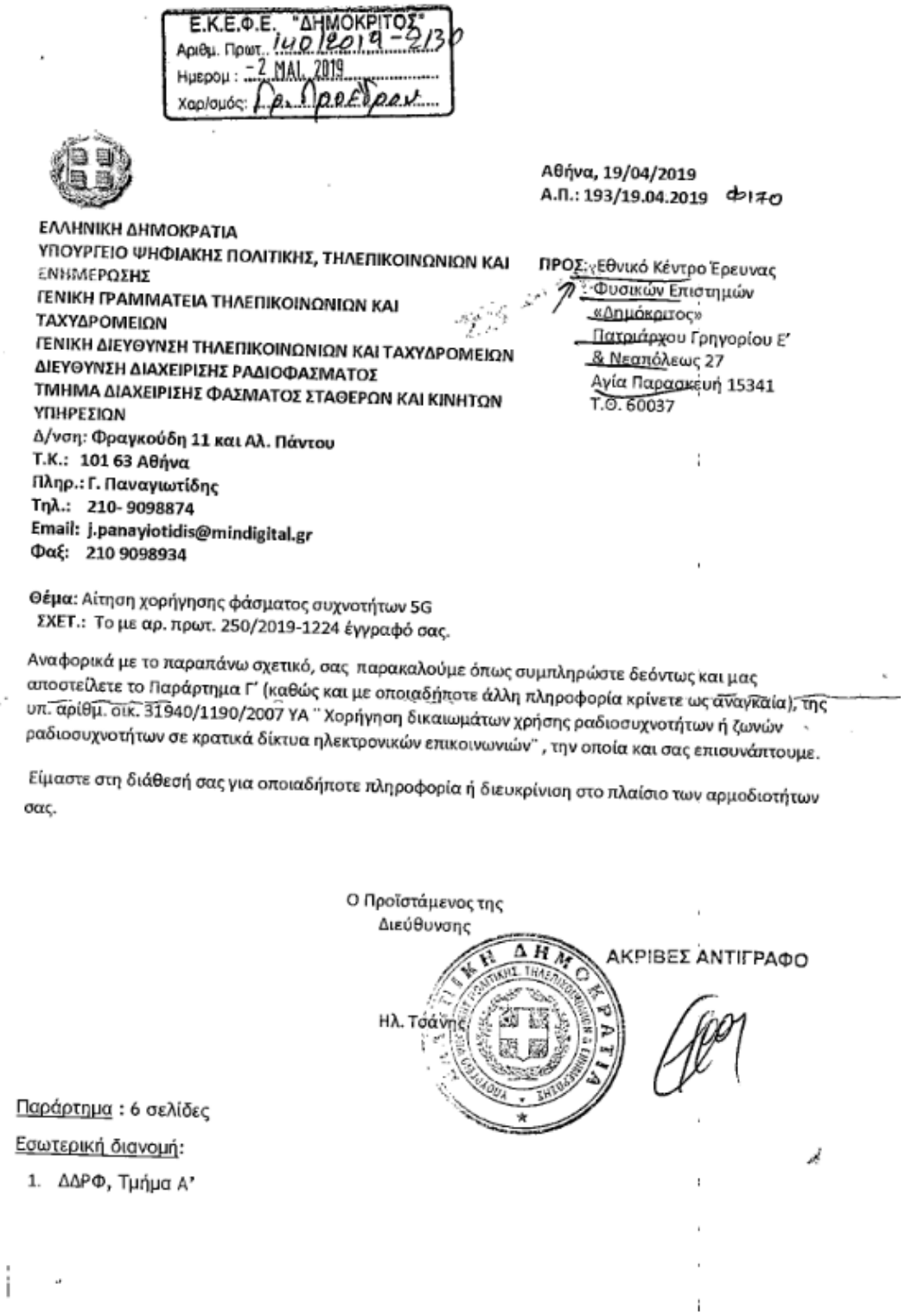
που συμμετέχει, τα οποία συμβάλουν στην ανάπτυξη των δικτύων κινητής τηλεφωνίας 5G, στην Ευρώπη. Η υλοποίηση του δικτύου θα είναι προς όφελος της Ελλάδας και θα βοηθήσει την προώθηση της τεχνολογίας αυτής, στην ανάπτυξη νέων υπηρεσιών και εφαρμογών, στη δημιουργία νέων θέσεων εργασίας και θα φέρει την Ελλάδα ανάμεσα στους πρωτοπόρους στα δίκτυα 5G.

Δ/ντής ΕΚΕΦΕ «Δ»
& Πρόεδρος ΔΣ

ΔΡ. ΓΕΩΡΓΙΟΣ ΝΟΥΝΕΣΗΣ

Figure 9. The official application by the president of NCSRD to the Greek Regulatory Body for issuing a 5G license for trials at 3.4-3.6GHz

In reply to this request, the ministry as the responsible regulatory body replied positively, requesting further details on the location and the technical specifications of the 5G equipment that will be deployed.



Ε.Κ.Ε.Φ.Ε. "ΔΗΜΟΚΡΙΤΟΣ"
Αριθμ. Πρωτ. 140/2019-2130
Ημερομ : - 2 ΜΑΙ. 2019
Χαρ/σμός: Γρ. Προέδρου

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΨΗΦΙΑΚΗΣ ΠΟΛΙΤΙΚΗΣ, ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ ΚΑΙ ΕΝΗΜΕΡΩΣΗΣ
ΓΕΝΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ ΚΑΙ ΤΑΧΥΔΡΟΜΕΙΩΝ
ΓΕΝΙΚΗ ΔΙΕΥΘΥΝΣΗ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ ΚΑΙ ΤΑΧΥΔΡΟΜΕΙΩΝ
ΔΙΕΥΘΥΝΣΗ ΔΙΑΧΕΙΡΙΣΗΣ ΡΑΔΙΟΦΑΣΜΑΤΟΣ
ΤΜΗΜΑ ΔΙΑΧΕΙΡΙΣΗΣ ΦΑΣΜΑΤΟΣ ΣΤΑΘΕΡΩΝ ΚΑΙ ΚΙΝΗΤΩΝ ΥΠΗΡΕΣΙΩΝ
Δ/νση: Φραγκούδη 11 και Αλ. Πάντου
Τ.Κ.: 101 63 Αθήνα
Πληρ.: Γ. Παναγιωτίδης
Τηλ.: 210- 9098874
Email: j.panayiotidis@mindigital.gr
Φαξ: 210 9098934

Αθήνα, 19/04/2019
Α.Π.: 193/19.04.2019 Φ170

ΠΡΟΣ: Εθνικό Κέντρο Έρευνας Φυσικών Επιστημών «Δημόκριτος»
Πατριάρχου Γρηγορίου Ε' & Νεαπόλεως 27
Αγία Παρασκευή 15341
Τ.Θ. 60037

Θέμα: Αίτηση χορήγησης φάσματος συχνοτήτων 5G
ΣΧΕΤ.: Το με αρ. πρωτ. 250/2019-1224 έγγραφό σας.

Αναφορικά με το παραπάνω σχετικό, σας παρακαλούμε όπως συμπληρώστε δεόντως και μας αποστείλετε το Παράρτημα Γ' (καθώς και με οποιαδήποτε άλλη πληροφορία κρίνετε ως αναγκαία), της υπ. αρίθμ. οικ. 31940/1190/2007 ΥΑ " Χορήγηση δικαιωμάτων χρήσης ραδιοσυχνοτήτων ή ζωνών ραδιοσυχνοτήτων σε κρατικά δίκτυα ηλεκτρονικών επικοινωνιών" , την οποία και σας επισυνάπτουμε.

Είμαστε στη διάθεσή σας για οποιαδήποτε πληροφορία ή διευκρίνιση στο πλαίσιο των αρμοδιοτήτων σας.

Ο Προϊστάμενος της Διεύθυνσης

ΑΚΡΙΒΕΣ ΑΝΤΙΓΡΑΦΟ

Ηλ. Τσάνης

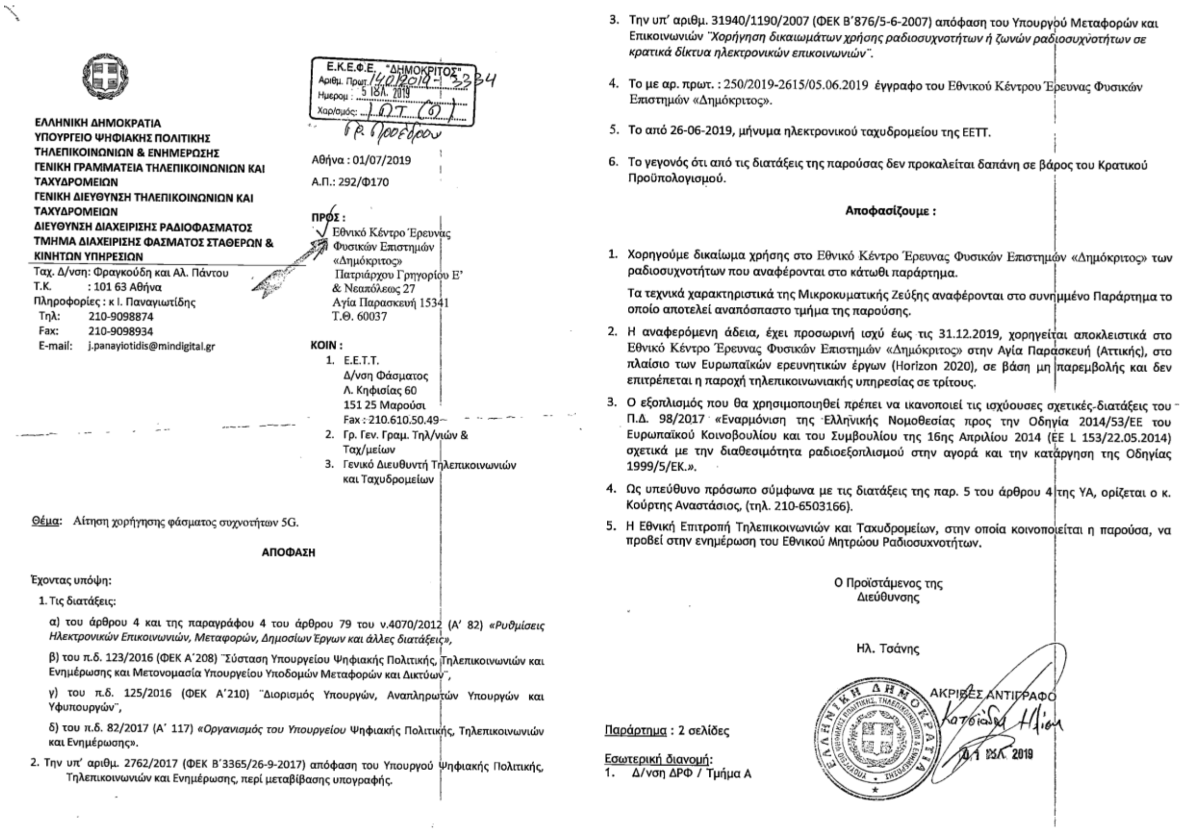
Παράρτημα : 6 σελίδες

Εσωτερική διανομή:

1. ΔΔΡΦ, Τμήμα Α'

Figure 10. The official reply by the Greek Regulatory Body for issuing a 5G license for trials at 3.4-3.6GHz for NCSRD use as a public body

Following all this communication and based on conference calls that took place with the authorities, NCSRD received the spectrum license for trials at the areas of 5GENESIS platform in Athens, as Figure 11.



Ε.Κ.Ε.Φ.Ε. "ΔΗΜΟΚΡΙΤΟΣ"
Αριθμ. Πρωτ. 1401/2019-3334
Ημερομ.: 5 ΙΟΥΛ. 2019
Χαρ/σμός: ΙΩΤ (Ω)
Γρ. Προέδρου

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΨΗΦΙΑΚΗΣ ΠΟΛΙΤΙΚΗΣ
ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ & ΕΝΗΜΕΡΩΣΗΣ
ΓΕΝΙΚΗ ΓΡΑΜΜΑΤΕΙΑ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ ΚΑΙ ΤΑΧΥΔΡΟΜΕΙΩΝ
ΓΕΝΙΚΗ ΔΙΕΥΘΥΝΣΗ ΤΗΛΕΠΙΚΟΙΝΩΝΙΩΝ ΚΑΙ ΤΑΧΥΔΡΟΜΕΙΩΝ
ΔΙΕΥΘΥΝΣΗ ΔΙΑΧΕΙΡΙΣΗΣ ΡΑΔΙΟΦΑΣΜΑΤΟΣ
ΤΜΗΜΑ ΔΙΑΧΕΙΡΙΣΗΣ ΦΑΣΜΑΤΟΣ ΣΤΑΘΕΡΩΝ & ΚΙΝΗΤΩΝ ΥΠΗΡΕΣΙΩΝ

Ταχ. Δ/νση: Φραγκούδη και Αλ. Πάντου
Τ.Κ. : 101 63 Αθήνα
Πληροφορίες : κ Ι. Παναγιωτίδης
Τηλ: 210-9098874
Fax: 210-9098934
E-mail: j.panayiotidis@mindigital.gr

Αθήνα : 01/07/2019
Α.Π.: 292/Φ170

ΠΡΟΣ :
Εθνικό Κέντρο Έρευνας Φυσικών Επιστημών «Δημόκριτος»
Πατριάρχου Γρηγορίου Ε' & Νεαπόλεως 27
Αγία Παρασκευή 15341
Τ.Θ. 60037

ΚΟΙΝ :
1. Ε.Ε.Τ.Τ.
Δ/νση Φάσματος
Λ. Κηφισίας 60
151 25 Μαρούσι
Fax : 210.610.50.49
2. Γρ. Γεν. Γραμ. Τηλ/νιών & Ταχ/μείων
3. Γενικό Διευθυντή Τηλεπικοινωνιών και Ταχυδρομείων

Θέμα: Αίτηση χορήγησης φάσματος συχνοτήτων 5G.

ΑΠΟΦΑΣΗ

Έχοντας υπόψη:

1. Τις διατάξεις:

α) του άρθρου 4 και της παραγράφου 4 του άρθρου 79 του ν.4070/2012 (Α' 82) *«Ρυθμίσεις Ηλεκτρονικών Επικοινωνιών, Μεταφορών, Δημοσίων Έργων και άλλες διατάξεις»*,

β) του π.δ. 123/2016 (ΦΕΚ Α΄208) "Σύσταση Υπουργείου Ψηφιακής Πολιτικής, Τηλεπικοινωνιών και Ενημέρωσης και Μετονομασία Υπουργείου Υποδομών Μεταφορών και Δικτύων",

γ) του π.δ. 125/2016 (ΦΕΚ Α΄210) "Διορισμός Υπουργών, Αναπληρωτών Υπουργών και Υφυπουργών",

δ) του π.δ. 82/2017 (Α΄ 117) *«Οργανισμός του Υπουργείου* Ψηφιακής Πολιτικής, Τηλεπικοινωνιών και Ενημέρωσης».

2. Την υπ' αριθμ. 2762/2017 (ΦΕΚ Β΄3365/26-9-2017) απόφαση του Υπουργού Ψηφιακής Πολιτικής, Τηλεπικοινωνιών και Ενημέρωσης, περί μεταβίβασης υπογραφής.

3. Την υπ' αριθμ. 31940/1190/2007 (ΦΕΚ Β΄876/5-6-2007) απόφαση του Υπουργού Μεταφορών και Επικοινωνιών *"Χορήγηση δικαιωμάτων χρήσης ραδιοσυχνοτήτων ή ζωνών ραδιοσυχνοτήτων σε κρατικά δίκτυα ηλεκτρονικών επικοινωνιών"*.

4. Το με αρ. πρωτ. : 250/2019-2615/05.06.2019 έγγραφο του Εθνικού Κέντρου Έρευνας Φυσικών Επιστημών «Δημόκριτος».

5. Το από 26-06-2019, μήνυμα ηλεκτρονικού ταχυδρομείου της ΕΕΤΤ.

6. Το γεγονός ότι από τις διατάξεις της παρούσας δεν προκαλείται δαπάνη σε βάρος του Κρατικού Προϋπολογισμού.

Αποφασίζουμε :

1. Χορηγούμε δικαίωμα χρήσης στο Εθνικό Κέντρο Έρευνας Φυσικών Επιστημών «Δημόκριτος» των ραδιοσυχνοτήτων που αναφέρονται στο κάτωθι παράρτημα.

   Τα τεχνικά χαρακτηριστικά της Μικροκυματικής Ζεύξης αναφέρονται στο συνημμένο Παράρτημα το οποίο αποτελεί αναπόσπαστο τμήμα της παρούσης.

2. Η αναφερόμενη άδεια, έχει προσωρινή ισχύ έως τις 31.12.2019, χορηγείται αποκλειστικά στο Εθνικό Κέντρο Έρευνας Φυσικών Επιστημών «Δημόκριτος» στην Αγία Παρασκευή (Αττικής), στο πλαίσιο των Ευρωπαϊκών ερευνητικών έργων (Horizon 2020), σε βάση μη παρεμβολής και δεν επιτρέπεται η παροχή τηλεπικοινωνιακής υπηρεσίας σε τρίτους.

3. Ο εξοπλισμός που θα χρησιμοποιηθεί πρέπει να ικανοποιεί τις ισχύουσες σχετικές-διατάξεις του Π.Δ. 98/2017 «Εναρμόνιση της Ελληνικής Νομοθεσίας προς την Οδηγία 2014/53/ΕΕ του Ευρωπαϊκού Κοινοβουλίου και του Συμβουλίου της 16ης Απριλίου 2014 (ΕΕ L 153/22.05.2014) σχετικά με την διαθεσιμότητα ραδιοεξοπλισμού στην αγορά και την κατάργηση της Οδηγίας 1999/5/ΕΚ.».

4. Ως υπεύθυνο πρόσωπο σύμφωνα με τις διατάξεις της παρ. 5 του άρθρου 4 της ΥΑ, ορίζεται ο κ. Κούρτης Αναστάσιος, (τηλ. 210-6503166).

5. Η Εθνική Επιτροπή Τηλεπικοινωνιών και Ταχυδρομείων, στην οποία κοινοποιείται η παρούσα, να προβεί στην ενημέρωση του Εθνικού Μητρώου Ραδιοσυχνοτήτων.

Ο Προϊστάμενος της Διεύθυνσης

Ηλ. Τσάνης

ΑΚΡΙΒΕΣ ΑΝΤΙΓΡΑΦΟ
01 ΙΟΥΛ. 2019

Παράρτημα : 2 σελίδες

Εσωτερική διανομή:
1. Δ/νση ΔΡΦ / Τμήμα Α

Figure 11. The 5G license for trials at 3.4-3.6GHz for NCSRD use as a public body