5Genesis

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

[H2020 - Grant Agreement No. 815178]

Deliverable D7.6

Standardization and Regulation Report (Release B)

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Version History

Rev. N	Description	Author	Date
1.0	Release of D7.6	David Artuñedo Guillén	29/06/2020

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 D7.6 is to update the analysis and the strategy at project level towards fulfilling needs and gaps found on standardization and regulatory bodies activities performed during the second year of the project.

In the second year, 5GENESIS partners have continued monitoring main standardization boides, as described in Section 2 of this document. Most relevant standardization tracking activities are related to the following Standards Developing Organizations (SDOs):

- 5GRAN: tracking of 3GPP RAN WG1 (RAN1) group
- mmWave Access for 5G: monitoring of IEEE 802.11az, 802.11ay and Wi-Fi sensing
- Tracking IoT Interoperability and protocols
- Multi-Access Edge Computing monitoring of ETSI activities in MEC
- SDN based transport monitoring of Open Networking Foundation activities in SEBA and CORD.
- Spectrum Management monitoring of groups in IEEE, ETSI and 3GPP
- Satellite Comminucations into 5G monitoring of satcom related work in 3GPP RAN (referred to as NTN) and in 3GPP SA
- Mission Critical Services in 5G monitoring ETSI MCPTT/MCX

During the second year of the project, 5GENESIS has evolved its Platforms from Release A to Release B, as described in Deliverables D4.2 (Athens Platform), D4.5 (Málaga Platform), D4.8 (Limasol Platform), D4.11 (Surrey Platform), D4.14 (Berlin Platform) and D4.17 (Portable Platform). As part of this evolution, several partners have identified concrete contributions to SDOs that are described in Section 3 of this document.

The Málaga Platform has contributed significantly to several SDOs, with big focus on **ETSI OSM** charter (https://www.etsi.org/committee/1407-osm), where several contributions are described. In the reporting period 5GENESIS has become a member of the Research and Contributors community in OSM. Additionally, contributions are described in **3GPP** like Mission Critical Services and **IETF** on 5G Transport.

The Athens Platform has contributed mainly in the Policy Management component of the 5GENESIS architecture .

The Surrey Platform main contributions are placed in the space of dynamic Spectrum allocation where IEEE, ETSI and 3GPP are potential contribution targets in year 3.

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

Finally, Section 4 summarize the meetings held during year 2 with Regulators and Operators regarding 5GENESIS innovations and Spectrum allocation during the project. Additionally, updates on Spectrum assigned to each Platform are provided in that section.

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1. INTRODUCTION

The scope of deliverable D7.6 is to report on the impact and on the performed analysis of technology gaps found on standardization, as well as update on the strategy at project level to interact with regulatory bodies for the second year of the project.

The document is kept short and comprehensive, and as such it is composed of the following three main sections:

- Standardization tracking and SDOs Liaison activities
- 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 5G PPP Pre-standardization WG and AIOTI. It includes a list of conducted activities separated per technology, architecture and Platform needs.

The *Contribution to Standards* section aims at pointing to standardization lacks identified by project partners developing solutions for 5GENESIS in related SDOs. The section comprises an updated list of gaps found during the second year of 5GENESIS, which will serve as a guidance for planning activities or the remaining part of the project.

The *Regulation bodies engagement and Spectrum Licensing* 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 UPDATE

During first year of 5GENSIS, the partners set up the needed infrastructure to be represented in strategic SDOs for each partner. As it was described in previous edition of this document (D7.5) the following clusters of SDOs where monitored by the mentioned partners:

SDO		Partner	Key Topics
Radio/Access	3GPP RAN WG1	RunEL, INT	5G RAN
	Small Cell Forum (SCF)	Eurecom	OpenAir Interface
	mmWave Access for 5G	IHP, FhG	IEEE 802.11ay (WiFi fronthaul for Small Cells)
	MultiFire Radio Access	Athonet	LTE on unlicensed spectrum
	ETSI SES SCN	AVA	Satellite communications
	AIOTI	UPV	IoT interoperability
	IETF Core WG	KAU	CoAP protocol
Core / Edge	5G Core	Athonet	5G Core Functions
	5G Positioning	IHP, FhG	IEEE 802.11az (Next Generation Positioning)
	IETF Transport Services	KAU	TAPS
	3GPP SA2 WG: Network Sharing	UMA	MOCN, GWCN
	ETSI ISG MEC	Athonet, INT, TID, NCSRD	Multi-access Edge Computing
	TIP	Athonet, TID	MEC, ORAN
	Open Networking Foundation (ONF)	TID	SDN
Management and Orchestration	ESTI NFV	Atos, TID, NCSRD	Open Source MANO (OSM)
	MEF	NCSRD	Real time deployment of MEF Services
	3GPP	NCSRD, Atos, INT	Slice Management
	3GPP, ETSI RRS, IEEE1932.1 WG	INT, IT	Dynamic Spectrum Management
	NFV ISG	Athonet, TID, Atos	NFV Plugfests

	3GPP, ITU-R and NGMN	TID, UMA, FOGUS	5G KPIs
Verticals	ETSI CTI and TC TCCE WG	Nemergent, Athonet	MCPTT/ MCS/ MCX
	3GPP MCS, 3GPP SA1	Airbus, INT	MCPTT, MCData and MCVideo
	3GPP TSG SA WG3	Airbus	Security
	IEEE 802.11 WG	FhG, IHP	Enhanced Broadcast Services

Table 1 : SDOs Tracking activities per Partner

5GENESIS 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, and exhaustive description of activities during first year of the project was included in **D7.5 "Standardization and Regulation Report (Release A)"**.

In the sections below, partners have continued monitoring and analysing the relevant SDOs, or sub-working-groups of them, especially those focusing on architectural and protocol issues, during the second year of the project.

2.1. SDOs tracking update

2.1.1. 5GRAN

During year 2 RunEL and INT participated in several 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 Uu radio Interface for UE, Evolved UTRAN, and beyond, covering both FDD and TDD modes, as well as the physical layer of the Un Interface for Relay Nodes. 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 definition of measurements and their provision by the physical layer to the upper layers

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

INT participated to all RAN1 meetings, whereas the meetings RunEL participated to were:

- RAN-1 Meeting at Gothenburg Sweden starting on August 20th, 2018 and
- RAN-1 Meeting at Chengdu China starting on October 8th, 2018

- RAN-1 meeting at Xian China from 8-12 April 2019.

The purpose of RunEL and INT participations is to gather information about the standardization process, Release-15, Release-16, and the start of Release-17, so to report to the other 5GENESIS partners on any major events that may influence 5GENESIS plans of action.

- Standardization plans regarding SDO WGs

RunEL and INT plan to continue monitoring the PHY layer Standards and Report to the 5GENESIS consortium about the impact on 5GENESIS plans of action.

- Standardization GAPs identified.

No Standardization GAPs have been identified so far.

- Standardization strategy to contribute to tracked SDOs.

No need for contribution has been identified so far, so RunEL and INT activities are mainly focusing on a close tracking of the RAN 1 standardization activities.

2.1.2. mmWave Access for 5G

IHP is monitoring the activities within 802.11 that are relevant to 5GENESIS. IHP is mainly focusing on the evolution of the following standards:

- 802.11az
- 802.11ay
- Wi-Fi sensing – new Topic Interest Group (TIG)

- Standardization plans regarding SDO WGs

IHP intends to keep a low profile in contribution and participation to standards until the end of the second year of the project (May 2020), while it awaits for the evolution and maturity of its millimetre wave technology and related algorithms being leveraged within the framework of the 5GENESIS project. Contributions will be prepared from Sep 2020 and will be proposed to the group. In terms of attendance, the goal is that one IHP representative participates in 4 out of 6 IEEE Meetings in the third year of the project.

- Standardization GAPs identified.

No Standardization GAPs have been identified so far.

- Standardization strategy to contribute to tracked SDOs.

An active monitoring of the work proposed in the SDOs and the one carried out by IHP will serve to identify possible ways of contribution to the standards, whether they are related to high-data rate communication systems at millimetre waves or they are related to the work on positioning and localization activities.

2.1.3. IoT Interoperability and protocols

UPV is in charge of monitoring the SDOs related with the IoT and its liaison with the 5G technology, applied in the 5GENESIS Platforms. Specifically, the bodies that have been tracking are: AIOTI (mainly in WG03 and WG04), ITU-T (SG20; SG11; SG12; SG13), W3C, and ETSI-IoT working groups. Additionally, related with IoT interoperability UPV participates in three EC initiatives: IoT-EPI, IoT-LSP and AIOTI.

- Standardization plans regarding SDO WGs

UPV will participate to the following events:

- IoT Week 2021: it is celebrated together with the AIOTI General Assembly and some ITU-T sessions.
- Collaboration with ETSI on semantic interoperability and ontologies, associated with AHA, paper to appear in third quarter 2020.
- ITU Smart Sustainable Cities.
- Collaboration with CSA OpenDEI in the framework of data standards for digital transformation.

Finally, our aim for the next period is also to track other more specific IoT/sensors networks SDOs as: LoRa Alliance, ZigBee Alliance or OSGi Alliance, that also provides Open source relevant for the IoT use cases.

- Standardization GAPs identified
  - Secure connections for IoT devices (and its data). There is no standard or a common solution to secure the communication of Non-3GPP LPWAN networks, nor to provide integrity for the user data plane. Since IoT devices connected to 5G networks increase their attack surfaces, there is the need of providing a lightweight mechanism to secure the connections of the great number of existing heterogeneous IoT devices and networks. We will assess the current academic research for addressing this gap, with the aim at contributing within the tracked SDOs.
  - Integration/Standardization of IoT technologies (Non-3GPP AN beyond Wi-Fi) within the 5G infrastructure. Although N3IWF is the function of the 5G Core network for connecting with Non-3GPP access networks, currently it is used only for Wi-Fi integration (although thought to be applicable to integrate WiMAX or CDMA networks as well). However, Non-3GPP LPWANs do not make use of this function, and therefore it should be evaluated whether this mechanisms is suitable for this kind of networks. Currently, LPWAN are integrated with 5G in other ways, such as (i) providing 3GPP connectivity in the LPWAN gateway, (ii) adding LPWAN packets to WiFi traffic and then making use of N3IWF, establishing an IPsec Security Association procedure, or (iii) integrating the LPWAN gateway with the gNB, where LPWAN packets are added to user's data, among other options. Still, these kinds of integrations do not exploit all the capabilities of 5G networks. For instance, Non-3GPP LPWAN networks do not achieve the same degree of mobility and roaming capabilities that cellular networks have (roaming of devices across different domains), and therefore there is room for standardizing these mechanisms. We will study the possibility of making direct use of

N3IWF function to integrate a Non-3GPP LPWAN network (LoRaWAN) as well as the applicability and suitability of this integration mechanism.

- Standardization strategy to contribute to tracked SDOs.

UPV will participate in the events organized by the aforementioned SDOs, presenting the novelties proposed by 5GENESIS, more specifically those worked on in the Limassol Platform (e.g. Lora-5G example of integration and testing, plus satellite connectivity for underserved areas, VNF oriented to IoT, etc.). UPV will also analyse the managing of sensor networks through a 5G connectivity, in order to identify more gaps and present related paper/presentations/demos in the events organized by the SDOs in order to influence their work. Although several events have been cancelled due to COVID-19, virtual online alternatives are available, e.g., the role of standards in accelerating innovation – The case of IoT/IIoT, organised by EC.

Moreover, if SDOs provide some open source software of reference, it could be interesting the collaboration with this open source community by means of software collaboration (pull request, code issues, etc.).

Not related with IoT: thanks to the collaboration with the 5G PPP Software network WG, UPV is monitoring the standards of ETSI NFV, which we managed to influence thanks to our contributions to the white paper produced by this WG, and CNCF expecting to collaborate in the future standards related with *softwarization* and virtualization of the network.

2.1.4. Multi-Access Edge Computing (MEC)

INT has been attending ETSI MEC activities and Athonet has been attending and contributing to:

- ETSI MEC
- CBRS Alliance

Solutions for IoT API and private networks were proposed.

Additionally, in the second year of the project, Athonet participated to ETSI plugtests, to the following events:

- 4th ETSI NFV plugtest, Sophia Antipolis France, June 2019
- 4th MCX plugtests, Kuopio, Finland, September 2019

Athonet is also monitoring the activity in the MulteFire alliance and Telecom Infra Project.

- Standardization plans regarding SDO WGs

Athonet and INT plan to keep on participating and actively contributing to ETSI MEC, especially Athonet as rapporteur of the MEC IoT API specifications, as well as to the CBRS alliance in the context of roaming support for IMS services in CBRS Networks. ETSI MEC organizes typically 4-6 face to face meetings a year (of which Athonet plans to attend half) and weekly calls (regular participation). CBRSA organizes typically 3 meetings a year, all attended to by Athonet, and weekly calls (regular participation).

Athonet plans to participate to the 2020 edition of both the NFV and MCX plugtests organized by ETSI. Currently, the 5th MCX POlugfest is panned for Sep 21st to Cot 1st as published in ETSI website[5]

- Standardization GAPs identified.

In none of the followed SDOs so far concrete opportunities to impact the ongoing work have been identified. We will go on monitoring and, in case of fit, we will provide contributions related to the work plan of 5GENESIS.

- Standardization strategy to contribute to tracked SDOs.

The plan is to notify the consortium whenever relevant topics for 5GENESIS arise in the tracked SDOs, in order to identify potential collaborations and synergies.

2.1.5. SDN-Based transport control network

Telefónica is a Member at Open Networking Foundation (ONF)[1], and participates regularly in ONF activities. During year 2 of the project, Telefonica continues to participate actively in ONF activities, increasing our involvement in some areas:

- Telefónica has a representative in CORD Technical Steering Team [2]
- Telefónica participates regularly at VOLTHA project to develop the Optical access solution, that is deployed as part of MEC node in Malaga Platform. [3]
- Telefónica attended in September ONF Connect 2019 event co-presenting the Plenary session: "Who dares wins! How access transformation can fast-track evolution of operator production Platforms" [4]

- Standardization plans regarding SDO WGs

Telefónica continues during 2020 the collaboration with ONF as Member, as described at the Open Networking Foundation website)[1].

- Standardization GAPs identified.

No Standardization gaps have been identified so far.

- Standardization strategy to contribute to tracked SDOs.

The plan is to notify the consortium whenever relevant topics for 5GENESIS arise in the tracked SDOs, in order to identify potential collaborations and synergies.

2.1.6. Spectrum management

INT and IT have been constantly monitoring the activities relevant to the spectrum management aspects in focus in 5GENESIS in the following standardization groups:

- 3GPP RAN, SA and CT
- ETSI RRS
- IEEE SA-P1932.1 (Standard for Licensed / Unlicensed Spectrum Interoperability in Wireless Mobile Networks)

- Standardization plans regarding SDO WGs

  INT and IT plan of activities for the forthcoming quarters focuses on going on monitoring and contributing, when possible, to ETSI RRS WG1.

  Unfortunately, all activities in 3GPP groups have been heavily affected by COVID-19 and only essential features for fixing 5G phase 2 features and some key enhancements for Release-17 manage to be discussed in the virtual meetings held since the Q1 2020. As recently announced, all 3GPP meeting will continue virtually till the end of 2020, and that will minder the possibility for 5GENESIS to propose novel topics, aside the main activities of the agenda of the 3GPP WGs. Indeed, that is an issue for research projects like 5GENESIS, which targets research topics, well advanced compared to the currently ongoing main activities of SDOs.

  Regarding IEEE SA-P1932.1, INT and IT have asked for a slot to present a 5GENESIS based contribution to the next meeting of the standard body, which has been shifted since a couple of months, due to the impact of COVID-19. A current date is not yet available, but INT and IT are in contact with the IEEE SA-P1932.1 chairman and have been allocated a contribution to the next meeting, when it will take place.

  INT will go on attending all planned ETSI RRS and 3GPP virtual meetings and make its best to find a suitable slot to impact the ongoing work with topics related to 5GENESIS activities.

- Standardization GAPs identified.

  None of the standardization groups in focus of INT and IT are discussing (or have plans to discuss) the proposed research topic of advanced dynamic spectrum management.

- Standardization strategy to contribute to tracked SDOs.

  The plan is to work together with other partners in 5GENESIS to deliver the results obtained from the work done on the topic advanced dynamic spectrum management.

2.1.7. Satellite Communication integration into 5G

Avanti has been monitoring the satcom related work in 3GPP RAN (referred to as NTN) and in 3GPP SA through its work on SaT5G and liaison with the 5GENESIS team. In addition, Avanti attends ETSI SES SCN meetings where some 5G related work takes place. Avanti is an active member in a couple of satcom related coordination groups that seek to align the standardisation efforts of the satcom sector:

  - ESOA (EMEA Satellite Operators Association) standards working group, they are also the MSRP to 3GPP and are engaged with NGMN on satcom related matters;
  - ESA (European Space Agency) has a 5G standards coordination project called SSIG (Standards Special Interest Group).

- Standardization plans regarding SDO WGs

Avanti plans to continue to support coordinated inputs to SA (FS_5GSAT_ARCH) and RAN (Rel 17 NTN WI) along with some inputs to ETSI SES SCN as and when appropriate building on its SaT5G work as extended to 5GENESIS.

- **Standardization GAPs identified.**

No gaps identified so far.

- **Standardization strategy to contribute to tracked SDOs.**

Avanti will continue attending the coordination meetings within the satcom sector lead by ESOA and ESA.

2.1.8. Mission Critical Services in 5G

Nemergent is responsible for monitoring the MCPTT status in ETSI. The role in the SDO is regular attendant to the ETSI MCPTT/MCX Plugtests and offline monitoring of documents inherited from 3GPP standardization. Both actions are performed so that the MCS solutions fully follows the standard and the solution is interoperable. For 5GENESIS this is a key feature due to the fact that Airbus and Nemergent expect to run communications with involved components from both companies. So, instead of applying an ad-hoc solution that could not be reusable in other context, by monitoring and following the standard the interoperability is in principle granted. Plugtest events are used to create a consensus on some controversial points between different vendors, as each one of them potentially has a different understanding of how the standard is to be implemented.

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

4th MCX Plugtest event in Kuopio, Finland, 23rd-27th September 2019.

- **Standardization plans regarding SDO WGs**

Regarding 5GENESIS, 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 MCS/MCX services with 5G architecture and other standardized solutions.

In 2020 Nemergent is planning to attend the 5th MCX Plugtests (still discussing venues and dates with potential hosts) and following ones as well.

Airbus DS has contributed as planned to the 3GPP MCS standard definition, composed of MCPTT (Mission Critical Push To Talk), MCData (Mission Critical Data) and MCVideo (Mission Critical Video).

Airbus DS role in the SDO was, as a regular contributor, the active attendance and contribution to the MCS in Working Groups SA1 (services requirements), SA6 (System Architecture for Mission Critical Services), SA3 (Security) and CT1 (protocols) at 3GPP.

Airbus will attend all the upcoming 3GPP meetings for the working Groups SA1 (services requirements), SA6 (System Architecture for Mission Critical Services), SA3 (Security) and CT1 (protocols).

- **Standardization GAPs identified.**

No standardization GAPs have been identified so far.

- **Standardization strategy to contribute to tracked SDOs.**

Even though there are no clear GAPs in the SDOs, 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 Nemergent as part 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 (MCS) will be deployed in the 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 MCS (scale-up, scale-down, precise mission critical slices, load balancing, …). Nemergent and Airbus will progress in the direction of clarifying the existing aforementioned so as to achieve an agile, flexible and responsive MCS over 5G.

The monitoring of 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 to the coming 3GPP CT and SA meetings.

3. 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 this section 5GENESIS reports its findings on the activities that have led to contributions to standards. Contributions are gouped around Platforms, where main contributions have been originated. This does not mean that this contribution is coming exclusively from a specific Platform, as Platforms share a common architecture and many componets.

Those results were obtained fulfilling some of the gaps detected in existing standards, in order to fully accomplish the vision of the 5GENESIS project, and around the Open Source communities, supporting these standards delivering reference implementations of them, where 5GENESIS has produce significant contributions

Additionally, we include additional activities related to standards impact carried out in collaboration 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.

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

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

3.2. Málaga Platform originated contributions

3.2.1. ETSI OSM

ETSI Open Source MANO has been the main contributed OSS community from the 5GENESIS MANO perspective. The technical development has been produced in the framework of WP3 in Task 3.1 “Management and Orchestration”, more detailed information about the implementation of the features will be properly documented in the report D3.2, that will be produce as the result of the task activity outcome.

In this deliverable we provide an overview of the contributions provided, the specific meetings that have been attended, and the 5GENESIS components involved.

Event	Date	Location/ Link	Activity
7th OSM Hackfest	9-13 September 2019	Patras (Greece)	Testing and Interoperability

8th OSM Hackfest	9-13 March 2020	Madrid (virtual)	Mid-release 8
9th OSM Hackfest	7-11 September 2020 (Rescheduled)	Remote	Testing and Interoperability. Has been shifted to work remotely due to COVID-19.

Table 2 : ETSI OSM event participation

Moreover, 5GENESIS is part of the research and contributors' projects that closely collaborate with the OSM community and provide feedback from the experiments and results executed in the 5GENESIS platofrms. 5GENESIS has been recently included in the ETSI OSM website[1] as part of the research activities that are using or contributing to OSM. The following picture shows the 5GENESIS description and the five Platforms involved in the 5GENESIS facility.

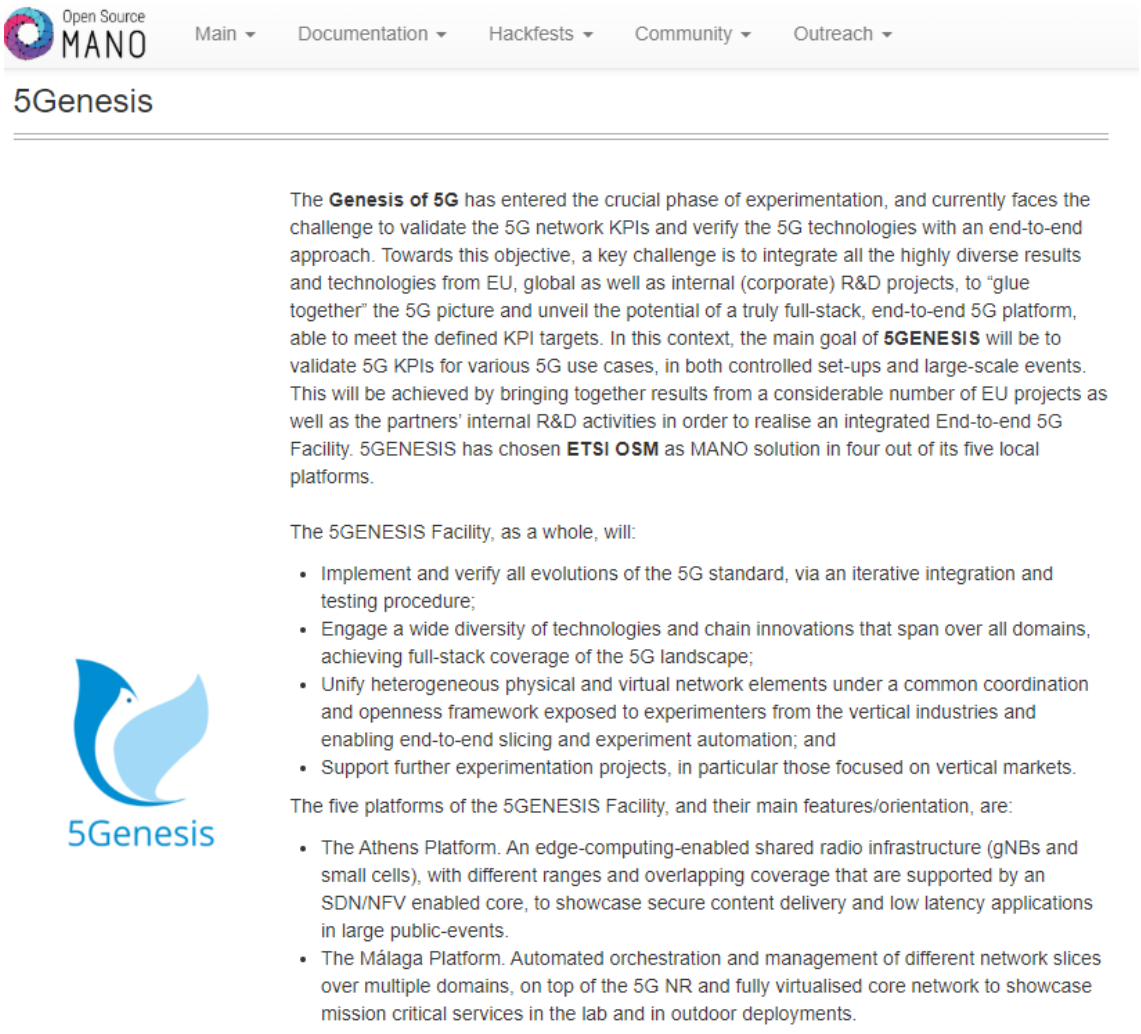

Figure 1. 5Genesis reference in OSM Website

The technical committee and the community of OSM is already working in mid-release of the Release EIGTH of OSM framework with all the new functionalities. The final release was planned to be launch at the end of June 2020, though it has been delayed, to be tested over cloud-

[1] https://osm.etsi.org/wikipub/index.php/Research#5Genesis

native applications for NFV environments. It foresees to bring major enhancements, designed to deploy container Network Function workloads on Kubernetes.

In this new release two main improvements were developed to address 5GENESIS challenges, while project's contributions have been added to the latest release of the OSM community. The main modules focused on the management and operation of the Network Services located in the Coordinator layer of the 5GENESIS architecture. The features goal develops an NS external repository to improve the VNF loading and onboarding to the ecosystem; and plugging involved in the validation process while onboarding the NS in the repository catalogue.

In the first contribution, Atos developed a module that validates the syntax of the descriptors uploaded in the MANO wrapper. The package defines the creation and validation of the NS onboarded in the system. It evaluates the mandatory fields needed to execute the functions and the different parameters and required format of the files. The validation tool implements a plugin for Python library "pyang" JSON schema output, defined in the RFC7951. The tool result generates the output validation of the file, taking into account the schema and file provided.

The scope of this contribution has been also extended to the validation of the Experiment Descriptor (ED). The experimenter filled with the required parameters to the ED template; once it is instantiated in the coordinator layer for the execution of the experiment, it is validated to assure the details information for the experiment accomplishment. This functionality will be enhanced with the recommendations and outputs results of the Platform trials.

In the second contribution, Atos defined a standardized model format to implement a consumption mechanism for a remote VNF repository, that could be queried and managed by OSM abstracting from the actual storage mechanism; the interface will be exposed by HTTP requests. Authentication and authorization mechanism will be required to access the external repository in order to onboard the VNF stored in the catalogue. The repository follows the same index reference model based on the VNF repo specification, the interaction of OSM and storage services synchronize the full repository folder, where developers and service providers can onboard and test with several VNFs. This feature has been extended in 5GENESIS to cover the full NS with VNFs and NSDs, and all the metadata required to manage the artefacts.

As final contribution, TID has added functionality to OSM's OpenNebula connector at the Resource Orchestrator component. This functionality is related to the support for multi vdu over virtual network function instantiation, support for multi-vnf over network service instantiation, fix of several bugs to deploy several virtual infrastructure manager with OpenNebula flavor, and improvement over code, that is basically the use of Pyone library and refactor as it simplify the concrete integration. These changes are reflected as specific commits to the OSM repository:

- https://osm.etsi.org/gerrit/#/c/osm/RO/+/7662/
- https://osm.etsi.org/gerrit/#/c/osm/RO/+/7762/

These contributions are useful for the correct behavior and deployment of virtual functions at release 7 and future releases for infrastructure controlled by the OpenNebula virtual infrastructure manager as the Malaga Platform Edge in 5GENESIS.

3.2.2. Experimenter Lifecycle Manager

The Experiment Lifecycle Manager (ELCM), which is the main orchestration component of the coordination layer of the 5GENESIS architecture, has been released as Open Source under the Apache 2.0 license model as stated in the following document: https://github.com/5genesis/ELCM/blob/release_A/LICENSE

ELCM software is available as Open Source in the following repository:

- https://github.com/5genesis/ELCM

In addition, other developments of UMA, such as the 5GENESIS Portal and several probes and helpers are available in the following repositories:

- https://github.com/5genesis/Portal
- https://github.com/5genesis/TAP-plugins
- https://gitlab.com/OpenTAP/Plugins/university-of-malaga/uma-android
- https://gitlab.com/OpenTAP/Plugins/university-of-malaga/uma-adb-agents
- https://github.com/5genesis/Remote_Ping_Agent
- https://github.com/5genesis/Remote_iPerf_agent

3.2.3. VIM abstraction

5GENESIS supports internally different types of VIMs, but this information is not revealed to the experimenter user, as that information should be irrelevant to him. In order for that to happen, a logical VIM abstraction layer is introduced: ATOS has developed an OpenNebula connector which allows the Slice Manager to interact with the VIM in a transparent way, regardless the underlying technology, supporting the basic operations necessary to prepare and deploy a slice, like creating users, projects, groups, networks, etc. ATOS has also implemented a new feature that is not available in the original framework API, which is for uploading images. This feature is required as part of the Open APIs, so an external user can upload an image belonging to a certain VNF to the right VIM without having the knowledge of the infrastructure below.

This connector is available in the public repository of the project [https://github.com/5genesis] to allow external users to contribute to the OpenNebula community [https://forum.opennebula.io].

3.2.4. Mission Critical Communications Standardization Impact

Nemergent and Airbus are joining forces in order to impact standardization bodies from their collaborative work in 5GENESIS in the framework of mission critical communications and services. Two are the main envisioned paths:

1.- The task force driven by GCF-TCCA to try to push mission critical certification as defined by 3GPP in RAN5 [2]. At the moment the task force is in the process of precisely defining the detailed scope, timeline and future steps where both Airbus and Nemergent participate to reach a

[2] https://www.rcrwireless.com/20200120/test-and-measurement/gcf-tcca-to-tackle-mission-critical-certification

general consensus. The (temporary) GCF-TCCA Joint Task Force will be closed in June 2020. Its activities will be continued by the permanent GCF Mission Critical Agreement Group (MCAG) to encourage an active dialog between manufacturers, authorities, etc.(creation of the group pending GCF approval). For now, the joint task force has: 1) identied testing dependencies of both LTE and MCPTT/MCS/MCX depending on the selected releases (e.g. number of APNs) so that the full testing chain is equally compliant; 2) surveyed the most important and appealing testcases for the stakeholders; and 3) discussed on the preferable MCX release based on the work already specified RAN5/TS 36.579-2 and TTCN work in progress to define tests according to this specification (based of Release-13 and Release-14) and the interest of MCX related 3GPP RAN5 conformance test specifications 3GPP TS 36.579-x with Release-15. Both Nemergent and Airbus contribute to the active specification in RAN5/TS 36.579-2 and once the final GCF-TCCA release roadmap decision is taken, both will try to align their joint interoperability effort in 5GENESIS to the definition of testcases and/or fine-grained detail protocol specification.

https://www.rcrwireless.com/20200120/test-and-measurement/gcf-tcca-to-tackle-mission-critical-certification

2.- Besides, in the framework of the Airbus and Nemergent interoperability work in 5GENESIS, both companies could drive 5G mission critical proposals to 3GPP or possible CRs out of the Plugtest work. This is, both Nemergent and Airbus have already carried out a first stage interoperability involving common procedures such as register, affilitation, call establishment and floor control among other features where none of the companies have detected a different understanding from the standard or a controversial field. However, both will continue working in the interaction with 5G procedures (e.g. QoS management in 5G) and interoperability of other type of calls, emergency upgrade/downgrades, MCData and so forth, and will push standard mofifications if needed.

3.2.5. IETF Impact on 5G Transport Network Bencmarking

Telefónica representatives in 5GENESIS (David Artuñedo Guillén and Alberto Flórez Pages), have collaborated with 5GEve Telefónica representative (Luis Miguel Contreras), in the **IETF Internet Draft 5G transport network benchmarking**: https://tools.ietf.org/html/draft-contreras-bmwg-5g-01 .

The purpose of this document is to overview the implications of 5G services in transport networks and to provide guidance on benchmarking of the infrastructures supporting those services. For this purpose, previous work from 5GENESIS in 5G PPP TMV, collected in the whitepaper "Validating 5G Technology Performance", 5G PPP TMV WG , June 2019, has been used as a reference model for 5G KPI definitions.

3.3. Athens Platform originated contributions

3.3.1. Policy Management in ONAP

APEX is a policy engine initially developed by LMI, which later became part of ONAP. In 5GENESIS, we plan to integrate APEX with the Slice Manager, in order to facilitate slice optimisations.

LMI has kept in contact with ONAP representatives for updates on current use cases that involve APEX and the ONAP Policy Framework which is built around APEX. We analysed the work done in new use cases such as BBS (mostly involving fixed networking), performed in the Dublin release of ONAP, and PMSH (counter collection coordination and configuration) done in the Frankfurt release of ONAP.

ONAP plans for the next release (Guilin) of ONAP include 5G network slicing and possibly using APEX for network slicing. This is aligned with our plans in 5GENESIS, where we plan to use APEX for triggering optimisations for the network slices.

As such, our work on APEX for slice optimisations can provide valuable and timely input to ONAP, including the policies we develop and also experiences with validation and testing of APEX in a real 5G testbed. This is planned for Year 3 of 5GENESIS, once out APEX integration into Slice Manager and testing around it are finalised.

3.3.2. Testing Automation in OpenTAP

OpenTAP is an opensource automation tool, which is use as one of the components of ELCM, towards automating the experimentation process on top of 5GENESIS facility. Since 5GENESIS consortium has released OPEN 5GENESIS Suite, the evolution and further developments in OpenTAP are continues, and therefore 5GENESIS consortium actively participates and contributes in this open-source project.

5GENESIS Athens campus took the initiative to officially include 5GENESIS in the supporting and contributing organization of OpenTAP, which realised by adding 5GENESIS project logo at the OpenTAP site.

3.4. Surrey Platform originated contributions

3.4.1. Advanced Dynamic Spectrum Allocation

INT and IT are still working on finalizing the technical content on advanced spectrum management mechanisms that can then be pushed into standards. That activity was slowed down due to COVID-19 impact.

Also due to COVID-19, all SDOs are currently running meetings only in a virtual manner, and that is having an important impact on the progress of the SDOs work, i.e. slowing it down. As a consequence, all work items or topics that are not considered *essential* by the group chairmen are postponed to future releases of the standards (which for 3GPP that means out of Rel-17 activities) and meetings. In fact, 3GPP decided to run meetings in a virtual manner at least till the end of 2020. The work of 5GENESIS on advanced spectrum management is part of such more advanced topics that cannot be currently covered by the ongoing work of SDOs.

That information was also shared at 5G PPP level, where during the latest 5G-IA Steering Board meeting it was clarified that there is a big impact on research projects regarding the capability to push their results into standards due to COVID-19.

Therefore, the focus of 5GENESIS is on impact IEEE SA-P1932.1, to the earliest possible moment, which currently is by the end of June 2020, and ETSI RRS groups.

3.5. Standardization opportunities through 5GPPP activities

5GENESIS project joined the 5G PPP Pre-standardization WG in 2019. 5GENESIS representatives in the WG continue to be:

- David Artuñedo Guillén (Telefónica I+D) as Standardization Manager in 5GENESIS and Task 7.4 Leader,
- Arthur Lallet (Airbus) as TASK 7.3 Leader.

The WG has specific goals that can be summarized as:

- Collect and monitor inputs from the family of 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 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 organized the "3rd 5G Vertical User Workshop" on the 5th May 2020 that was organized online, and 5GENESIS attended 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.

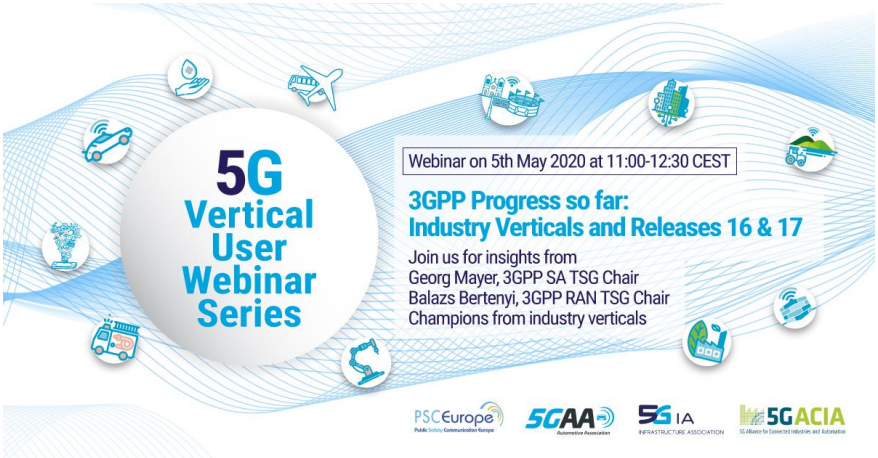

Figure 2. 3rd 5G Vertical User Webinar announcement

The WG has organized as well a Webinar on "**5G Spectrum for Industry Verticals**" on June 18th 2020, and 5GENESIS has attended it and shared with the ecosystem the outcomes of the workshop.

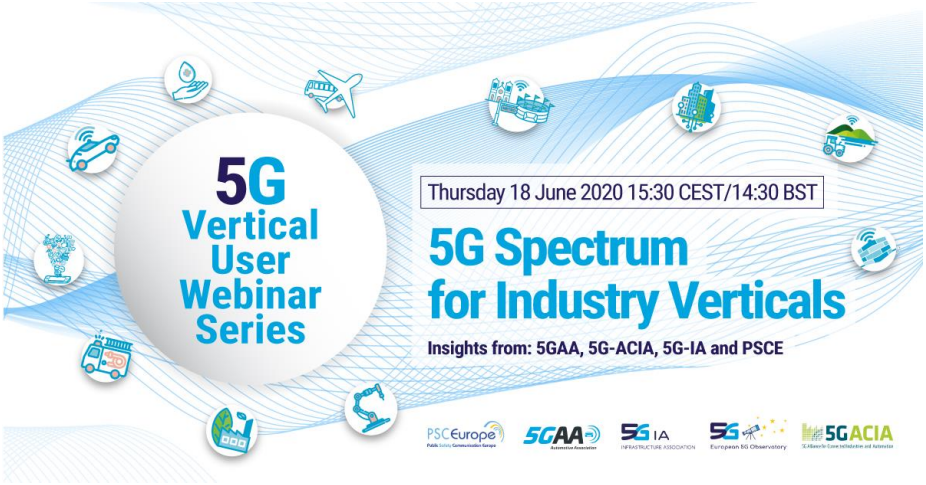

Figure 3. 5G Spectrum for Industry Verticals Webinar

Finally, the 5GENESIS Standardization Manager has submitted to the Pre-Standardization WG the information requested by Riccardo Trivisonno, working group manager, for tracking SDOs impact for 5GPPP projects to be integrated in the Standards tracking tools that the workgroup is promoting. This information will be pusblhised in the coming weeks in the 5G PPP website.

4. REGULATION BODIES ENGAGEMENT AND SPECTRUM LICENSING STATUS UPDATE

4.1. Introduction

Following the first report on meeting Regulatory bodies and Spectrum allocation per Platform, we now describe the further meetings being held with Regulatory bodies during the second year of the project, and we update the status of Spectrum allocation per Platform.

4.2. Meetings with Regulation bodies during Year 2

4.2.1. Telefónica de España (ES)

Meeting: November 20th 2019. Place: Ada Byron building

Review meeting of Contract 28/2019 to define installation of 4 RRH Nokia AHHA AirScale micro 4T4R B7 20W and 4 RRHs 5G Nokia AWHQF AirScale Micro 4T4R n78 B43 40W and Airscale BBU Nokia.

Meeting: December 2nd 2019. Place: Comisaría Plaza de la Merced

Review meeting of Contract 78/2019 to define installation of 5 RRH Nokia AHHA AirScale micro 4T4R B7 20W and 6 RRHs 5G Nokia AWHQF AirScale Micro 4T4R n78 B43 40W.

4.2.2. RGDP new group on spectrum sharing

UMA had virtual meetings and email communication with the with the Spanish representative in the new spectrum sharing group of Radio Spectrum Policy Group of the European Commission. Pedro Merino (TM) explained the usual requirement to access spectrum by the ICT-17 projects and detailed how Málaga Platform is addressing this issue with the MOCN solution explained in Deliverable 4.4 (sent to the representative in RDGP)[3].

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

The Limassol Platform had a high number of email correspondance in Year 2 with the OCECPR in Cyprus through Primetel's R&D department and also through face to face contact through its Chief Technology Officer. OCECPR is aware that the 5G Experimental Licence has not been renewed for the year 2020 due to commercial planning by DEC (details of which are reported in 2.3.2.), fact which limits to certain extend what could be demonstrated in 2020 utilising the 5G spectrum. The Officer of Technical Affairs is aware of this limiting situation but has expressed however high interest of the progress of 5GENESIS Limassol Platform and looks

[3] RSPG20-004final-implications_RSPG_subgroups.pdf, , https://rspg-spectrum.eu/

forward for an invite for a demonstration in the next phase of testing and demonstration in Cyprus.

4.3. Spectrum Licensing status per Platform

Building on top of the previous report (D7.5), we now provide an update to the status of Spectrum allocation per Platform.

This section outlines the current 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 release, as the status of some Platform will continue evolving along the project duration, though little changes are expected.

4.3.1. Málaga Platform

Málaga Platform Spectrum agreements are summarized in the following table:

Platform	Spectrum	Legal Agreement	Timeline	Geography/Area
Málaga	40 MHz in B43 (3.6-3.8 Mhz) B7 (2.6 Mhz)	Public contract SU. 28/2019 PA signed on 07/11/2019 between UMA and Telefonica de España.	3 years	UMA Campus (500m)
		Public contract 78/2019 signed on 7/2/2020 between Ayuntamiento de Málaga and Telefonica de España.	3 years	City Center

4.3.2. Limassol Platform

As mentioned in D7.5 Primetel PLC (The ISP of the Limassol Platform) was the first ISP in Cyprus to apply and obtain a 5G Spectrum Licence from the Department of Electronic Communication (DEC), of the Ministry of Transport, Communications and Works. The application which was sent in 2018 was a success and Primetel PLC was granted access for 5G experimentation in band 3600MHz [3400-3800MHz] (TDD), 100MHz channel bandwidth, in the 3400-3500 until 30 November 2019. Closer to this deadline Primetel PLC made several efforts for renewal of the licence by at least a year however DEC was only in position to extend it to end of 2019. During early 2020 DEC announced a number of draft plans for the year which included:

- The intention of the DEC to hold a tender, in March 2020, and to award the spectrum available on the 700 MHz and 3.6 GHz bandwidths.
- With the 700MHz bandwidth to be given to the highest bidder by 30 June 2020 the 3.6GHz bandwidth until 31 December 2020.

Most likely this plans will be postponed. At the time of this Deliverable no further updates have been announced. Primetel R&D is currently discussing the situation with the legal department with internal plans for requesting from DEC a renewal of the Licence at least in a localized

fashion to allow for testing of new and prototype mobile technologies, especially if commercial license opportunities are postponed even further. In terms of planning, the 5G Limassol Platform has a number of associates milestones in the Autumn of 2020 and early 2021, plans which have dependencies on the aforementioned access to spectrum. Consequently the Limassol Platform is closely following the progress and will consider providing contingency plans if and where necessary for any associated milestones.

4.3.3. Surrey Platform

Surrey Platform Spectrum agreements are summarized in the following table:

Platform	Spectrum	Legal Agreement	Timeline	Geography/Area
Surrey	100 MHz in 700 MHz band	Agreement between UNIS and Ofcom	08/08/2021 (yearly renewal)	UNIS campus (4km^2)
	30 MHz in 2.3 GHz band		11/05/2021 (yearly renewal)	
	70 MHz in 2.6 GHz band		29/02/2021 (yearly renewal)	
	10 MHz in 800 MHz band		29/02/2020 (yearly renewal)	
	80 MHz in 3.5 GHz band		12/06/2021 (yearly renewal)	

4.3.4. Berlin Platform

No changes has been reported for year 2 in Spectrum allocation.

4.3.5. Athens Platform

Athens Platform Spectrum agreements are summarized in the following table:

Platform	Spectrum	Legal Agreement	Timeline	Geography/Area
Athens	100MHz in band 3500MHz	Ref. No 140/2020-178 extension approval, received by NCSRD on 30/01/2020	Valid until 31/12/2020	Athens

NCSR Demokritos submitted an official request to the Ministry of Digital Governance for extending the spectrum license issued in 2019 for experimental purposes. The request was approved, so NCSRD received a renewed license of 100MHz in Band 3.5GHz until 31/12/2020 for conducting trials at areas of the 5GENESIS Platform. The Hellenic Telecommunications and Post Commission was also notified of the decision, in order to update the National Registry of Radio Frequencies. This temporary license is issued by the Greek Authorities to support the research and experimentation activities in the context of H2020 5GENESIS Project.

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