



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

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Deliverable D7.10

Innovation and exploitation activities report (Release C)

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LIST OF ACRONYMS

Acronym	Meaning
4G	The 4 th Generation
5G	The 5 th Generation
5GIC	5G Innovation Center
5GQI	5G QoS Identifier
6G	The 6 th Generation
AF	Application Function
AI	Artificial Intelligence
API	Application Programming Interface
AR	Augmented Reality
BEREC	Body of European Regulators for Electronic Communications
BKM	Best-Known Methods
CA	Consortium Agreement
CCW	Critical Communication World
CNCF	Cloud Native Computing Foundation
CNF	Cloud-Native Network Function
COTS	Commercial Off-The-Shelf
CRUD	Create, Read, Update and Delete
DEC	Department of Electronic Communications
GA	Grant Agreement
E2E	End-to-End
ELCM	Experiment Life Cycle Manager
EO	Exploitable Outcome
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
ETP	European Technology Platform
FP	Framework Programme
GST	Generic network Slice Template
ICT	Information and Communication Technologies
IFRS	International Financial Reporting Standards
IMT	International Mobile Telecommunication
IoT	Internet of things
ISG	Industry Specification Group
ITU	International Telecommunication Union
JU	Joint Undertaking
KNF	Kubernetes-based Network Function
KPI	Key Performance Indicator
M&A	Monitoring and Analytics
MANO	Management and Orchestration
MCPTT	Mission Critical Push-To-Talk
MCS/MCX	Mission Critical Services / Mission Critical X
MEC	Multi-Access Edge Computing
ML	Machine Learning
MWC	Mobile World Congress

NFV	Network Function Virtualization
NFVO	Network Function Virtualization Orchestrator
NSI	Network Slice Instance
NST	Network Slice Template
OAI	Open Air Interface
ORAN	Open RAN
OSM	Open-Source MANO
PCF	Policy Control Function
PMR	Professional Mobile Radio
PoC	Proof of Concept
PPDR	Public Protection and Disaster Relief
QoE	Quality of Experience
QoS	Quality of Service
RAN	Radio Access Network
RR	Radio Regulation
RSRP	Reference Signal Received Power
SAB	Strategy Advisory Board
SBA	Service-Based Architecture
SDN	Software Defined Networking
SLICES	Scientific LargeScale Infrastructure for Computing/Communication Experimental Studies
SME	Small and Medium Enterprise
SNR	Signal- to-Noise Ratio
SNS	Smart Network and Services
SRIA	Strategic Research and Innovation Agenda
SRIDA	Strategic Research, Innovation and Development Agenda
SSG	Standards Sub Group
SVR	Support Vector Regression
TAP	Test Automation Platform
TETRA	Terrestrial Trunked Radio
TRL	Technology Readiness Level
UAV	Unmanned Aerial Vehicles
UE	User Equipment
VN	Virtual Node
VNF	Virtual Network Function
VR	Virtual Reality
WG	Work Group
WRC	World Radiocommunication Conference

Executive Summary

This deliverable, D7.10 “Innovation and exploitation activities (Release C)”, reports the activities of the 5GENESIS consortium on the Innovation management program and on exploitation activities performed by the project partners from the month eighteen till the project end.

The 5GENESIS Platforms specific exploitation plans as well as partner specific exploitation plans are also reported.

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1. INTRODUCTION

This deliverable reports the activities, finalized during the months between eighteen and the end of the 5GENESIS project, focusing on two important project-wide topics, i.e., the consortium-wide innovation management program, and the exploitation activities, both from the single consortium member point of view, and from each one of the five 5GENESIS Platforms.

Regarding the consortium-wide innovation management program, activities have focused on providing 5GENESIS Platforms with the right tools and business methodologies to assess their impact in the ecosystem, and in identifying, focusing on two main categories of exploitation, as detailed in Section 2, what are the main exploitation actions that would allow most of the benefits not only for the 5GENESIS project partners, but also for the overall ecosystem, including final users and the broader society. All of the above is elaborated and described in Section 2.

Regarding the exploitation plans of the project outcomes, it was decided to split the report of the executed and planned activities in two main areas: first partner-specific exploitation subsections, and then 5GENESIS Platforms-specific exploitation subsections. All of the above is elaborated and described in detail in Section 3.

Finally, in Section 4 the conclusion and main takeaway from the 5GENESIS project on Innovation and exploitation matters are provided.

2. INNOVATION MANAGEMENT PROGRAM

The innovation management program had to be re-focused following the impact of the COVID-19 pandemic and the impossibility to have face-to-face meetings, already starting with Q1 2020.

The original plan was to hold a set of workshops both at Platform-level and at partner-specific level, and to also involve entities external to 5GENESIS. e.g., the local ecosystems and partners of 5GENESIS consortium members, as described in the previous Deliverable D7.9 [1]. Compared to that plan and considering that the planned activities entailed the need for interaction and face-to-face meetings, partner-related specific activities were reduced, and more effort was spent on Platform specific activities. That decision was taken also in line with similar issues recorded in industry-driven internal similar activities.

For instance, to make some concrete examples focusing on Intel internal status (but similar considerations and actions do apply and can be reported also for the other consortium partners), the Innovation Manager of 5GENESIS, Dr. Valerio Frascolla, used to run Innovation workshops internally for the benefit of several teams spread along different Intel business units; he is a trained trainer and is both a mentor and a coach for internal activities (e.g., helping recently hired people to fast ramp-up into the company culture, or providing guidance on career and strategic development of colleagues), and for external activities (e.g. the recently started Intel ignite program, providing support to Start-up on business related matters – program that had to start in 2021, instead of the planned early 2020 due to the COVID pandemic). All of the just mentioned activities, including internal courses, have been put on hold as the interaction scheme, e.g., what-if scenarios and games to stress some best-known methods (BKM) or business-related learnings, cannot be adapted - as is - to virtual meetings, where interactions are sub-optimal to say the least; as a matter of fact, all games need to be totally re-defined.

As a second example of the impact of COVID-19 on Intel internal similar activities, most internal courses for the whole duration of 2020 and H1 2021 were put on hold, the usual 2-3 days training held in a remote location to concentrate and avoid the daily-mails were cancelled. Trainers and course-designing-persons have been therefore working together, so to re-define the structure and the content of most courses, and the first new versions have been deployed as trials starting with 2021. For instance, Dr. Frascolla managed to start again giving the Intel internal course ‘Connect and Learn, Presentation skills’ starting with Q4 2021, after two years of hold-status. Also the course ‘New Employee Orientation (NEO)’, for which Dr. Frascolla is a trained trainer, had to be totally re-designed, all the interactions were cut out and as a counter measure, time had to be dedicated to 1:1 virtual sessions, in case the new hired had some questions to pose.

All of the above is meant to provide concrete examples of the need for the shift of focus from partner-specific workshops, to Platform-specific ones, as the latter have more impact from the business and exploitation point of view. Of course, also Platform-specific workshops suffered the same issues, and more time than planned had been spent on running them, but thanks to the

good will of all consortium partners, good and useful results could be obtained, as detailed in the following sections.

The Platform-related activities are split in two main domains, one more focusing on academia-oriented Platforms (Surrey and Berlin), and the other one on more industry-focused Platforms (Limassol, Athens, and Malaga). The following two sections reflect these different focuses and report on the main outcomes of the Innovation and business program run in two exemplary Platforms, Surrey for the academic-flavour, and Malaga for the industrial flavour. The method, exercises and approach can be easily expanded to the other Platforms, but due to the very time-consuming activities of such virtual workshops (compared to what would have taken running virtual meetings), the consortium decided to focus on Malaga and Surrey.

2.1. Industrial oriented Platform

Here below it is reported in a concise way the outcome of 8 Workshops held virtually – unfortunately - along the second half of 2020 and 2021, with participation of all active members of the Malaga Platform.

The methodology adopted for the Malaga Platform workshops was described in detail in D7.8 [2] and D7.9 [1], to which deliverables an interested reader is kindly asked to refer, especially for the definition of Exploitable Outcomes, the Value Proposition Canvas, and finally the Lean Canvas models.

It is worth noting that most of the time spent on the run workshops was dedicated on building up business acumen and in practicing with the proposed methodology. All partners attending the workshops agreed that the time was well spent, and that helped them all a lot in understanding better the market potential of an idea that can become an innovation, and that can have a market potential.

2.1.1. Definition of the Malaga Platform Exploitable Outcomes

A set of so-called Exploitable Outcomes (EO) have been defined for the Malaga Platform, which can be summarized in what follows.

Outcome	Project/Platform Result Category	Exploitable Type	End Customer
Platform as a private network operator service	Pre-product	Business Development	Vertical Industry
Testing and validation as a service	Pre-product	Business Development	Vertical Industry
OPEN 5GENESIS Suite	Pre-product	Business Development	Vertical Industry
Interoperability testing for 3GPP MCX services	Pre-product	Business Development	Technology Vendor
Consultancy services for 5GB testing	Other	Business Development	Software Developer

Table 1 – Exploitable Outcomes for an Industry-oriented Platform

EO#1 – Platform as a private network operator

The OE#1 was defined to be making use of the Platform as a private network operator. It is therefore assumed that the Platform can deliver services related to a private network operator, making use of the SW and HW part of the Platform and the developed by 5GENESIS interfaces and APIs.

The ‘Result category’ is mainly focusing on delivering pre-product help to companies and SMEs in need of pre-product launch information, KPIs and learnings coming out of the Platform.

The ‘End Customer’ is identified in general terms as being mainly a vertical industry, more specifically in the Malaga Platform set-up that correspond to the municipality of Malaga through its Police Department, which is able to use a production-like network for its own purposes. The spectrum of services delivered to the end user can be considered more a production rather than a prototype kind of service, thanks to the collaboration of SMEs and Industrial partners in making the Malaga Platform as close to a product as possible.

EO#2 - Testing and validation as a service

The second defined EO is making use of the Platform a service that focuses on delivering testing and validations insights. That kind of knowledge is very much looked forward from SMEs and Industrial partners that want to have tested their innovation in a pre-competitive but close to product level environment. The idea is that a vertical might want to test a new service, and at the same time also move into the validation phase, which is allowed by the advanced features provided by the Malaga Platform.

All of the above is mainly meant to provide such services to a vertical that wants to expand the validation of some of its products that are targeting new market segments, so to have a competitive advantage (less expenses than testing and validating in a real business-grade deployment, faster testing and validation cycle thanks to the support of the experts running the Malaga Platform).

The ‘Results Category’ and the ‘End Customer’ fields have the same values as the previous EO.

EO#3 - OPEN 5GENESIS Suite

The third identified EO is the OPEN 5GENESIS Suite, which has been defined in several Deliverables of 5GENESIS. The main idea is that an entity (a vertical, a university, an SME) is interested to build a replica of the Malaga Platform, but with different set-ups and slightly modified features, to accommodate its own specific needs of the implementation in focus.

Of course, plug-ins and configurations might be different, as well as some pieces of HW could be enhanced or removed, depending on the set of supported features in focus for that specific business need.

The ‘Results Category’ and the ‘End Customer’ fields have the same values as the previous EO.

EO#4 - Interoperability testing for 3GPP MCX services

The fourth EO focuses on the offering to run interoperability tests in different conditions, conditions that can be adapted by the Malaga Platform depending on the specific need of the customer. The capability to run interoperability tests before launching a product or a new feature is a solid need especially for SMEs, that have limited capabilities to make use of commercial networks to check for any interoperability issues their new product or feature might incur into.

A provided setup might be as follows: the Malaga Platform can run a set of Mission Critical Services (MCS) solutions as ‘standard’, an interested customer can bring its own solution and check it that can interoperate with the existing one already running the Malaga Platform. There’s also the option of asking to deploy additional solutions and check the interoperability of the extended set of options within the same Platform.

The ‘Results Category’ and the ‘End Customer’ fields have the same values as the previous EO.

EO#5 - Consultancy services for 5GB testing

The last identified EO is tuned towards offering consultancy services on how to test 5G and 5G advanced features in a 5G environment. The idea is to make use of the acquired expertise of the Malaga Platform personnel and share that with interested customers that for lack of resources or skills do not have that skill-set among their personnel.

This EO has a different ‘Result Category’, we used ‘Other’ to follow the given rules of the methodology, as such activities cannot really be covered under the Pre-Product domain, and actually follow in a sort of teaching-service kind of category.

Also the ‘End Customer’ is a different one compared to the other Eos; for this EO we envision that the main beneficiary could be a software developer or a SW house that wants to ramp-up in a fast way and not spending too much effort expertise in 5G and 5G and beyond system KPIs and insights in real-life deployments.

Among the 5 defined EOs, after a couple of rounds of discussion, the 5GENESIS team decided that the most promising from a business point of view are the one in the order listed from EO#1 to EO#5 (so the most appealing is the EO#1, the least appealing is EO#5).

In what follows, for the EO#1 'Platform as a private network operator service', the most promising from the business point of view, three Value Proposition Canvas are proposed, each one focusing on a different potential Customer, interested to the EO#1 value proposition.

2.1.2. The Value Proposition Canvas

Value Proposition canvas for the Exploitable Outcome #1 - Customer Vertical service developer

In what follows we decided to call the Customer 'vertical Service Developer'.

The following Figure reports the outcome of a series of workshops run to define and fill up the Product, and the Customer areas, to derive the Pain and Gain, and to brainstorm on the needed product features to accommodate the customer needs.

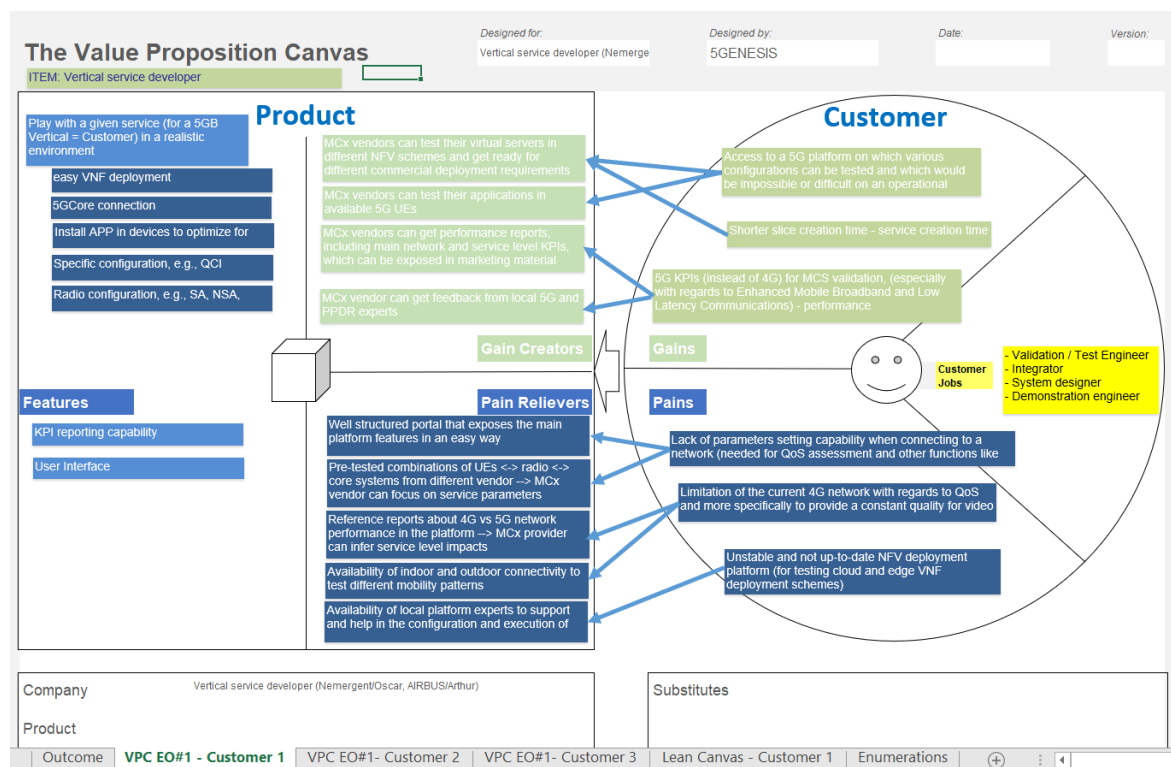


Figure 1: VPC for EO#1 and Customer#1: Vertical service Developer

In this exercise, one of the project partner Nemergent, could be easily spotted as being the sought-for customer. In fact, the Pains and Gains, as reported in the Figure above, are the ones that such an SME would look for and suffer, respectively, if it wanted to make use of the Malaga Platform.

It's interesting to note that the team managed to identify more than one *Pain reliever* and more than one *Gain creator* per identified *Pain* and *Gain*, respectively. That, according to the guidelines of the methodology, is a good sign that the Workshops provided meaningful results, that can add value to the Customer in focus and can motive with concrete examples what would be the added value for a customer to make use of the Malaga Platform.

Value Proposition canvas for the Exploitable Outcome #1- Customer Research Project

In the second VPC, we identified a potential customer in a (funded or not) research project, that is looking for capability to test its results. The list of Pains and Gains is pretty much different from the previous VPC, and the set of Features has been increased, so to offer a catalog of testing capabilities to the interested customer in focus.

Of course, other kinds of customers, more oriented to business services, like for instance a software house, could also be taken as Customer, the exercise could be run several times with different Customers and check the derived differences in *Pains* and *Gains*. However, that would have taken much more time and we mention this option just to clarify that the methodology offers a set of tools that can really span different set-ups and different customers. The lack of time allowed us to concentrate on only one customer per EO, also to streamline the resources and to reflect in the project schedule and planned activities the time dedicated to the business activities of the project, which need to be balanced against the time dedicated to the research and the technology development, which of course took most of the agenda of the project, being this a collaborative research project and not a sheer business activity per se.

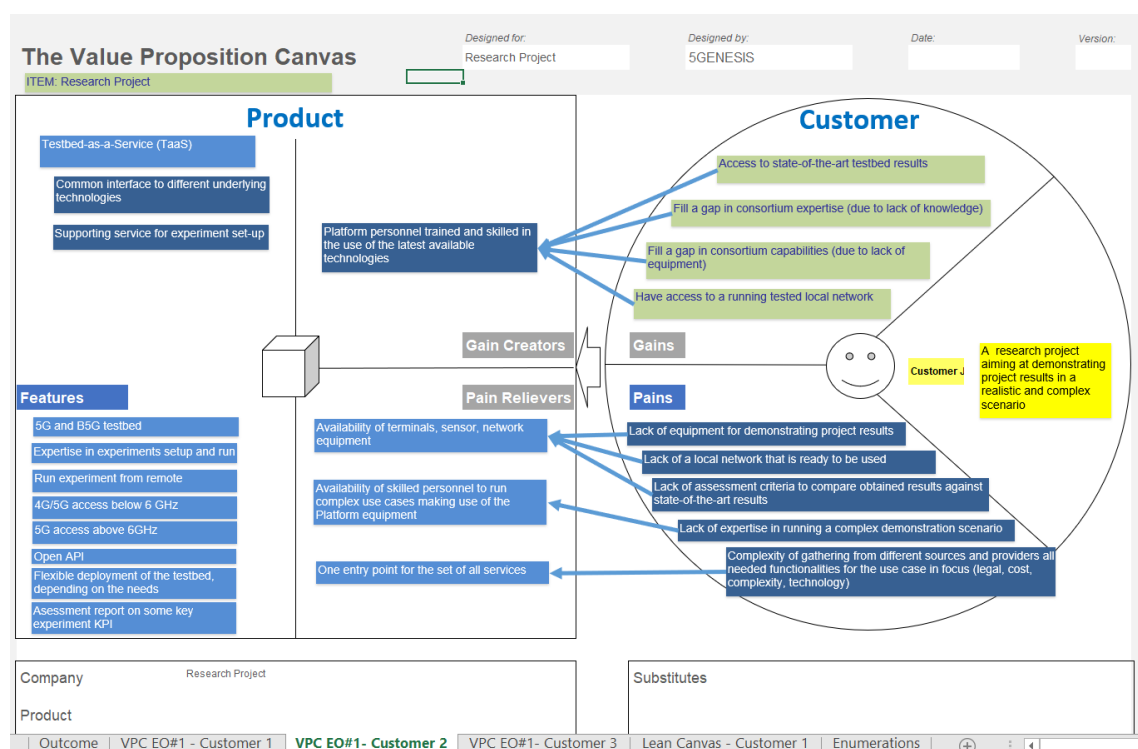


Figure 2: VPC for EO#1 and Customer#2: Research Project

Value Proposition canvas for the Exploitable Outcome #1 - Customer Service Operator / Evaluator

This VPC concentrates on a Customer called Service Operator or Service Evaluator; such a Customer can be mapped to the Police Department of Malaga for instance, just to mention also a partner of the 5GENESIS project. More in general, all entities interested to evaluate or to operate a service in a smart city could be targeted by this EO.

As shown in the following figure, the Police department might be interested to evaluate different competitive Public Protection and Disaster Relief (PPDR) technologies and pick the one(s) that best satisfy its specific needs. Of course that assessment can change in time and depends on the focus put from the Customer, which could be activities to counter-act terrorism, or activities meant at providing a more secure service in the Malaga steers or areas that might be more problematic, for instance for personal security of people moving around.

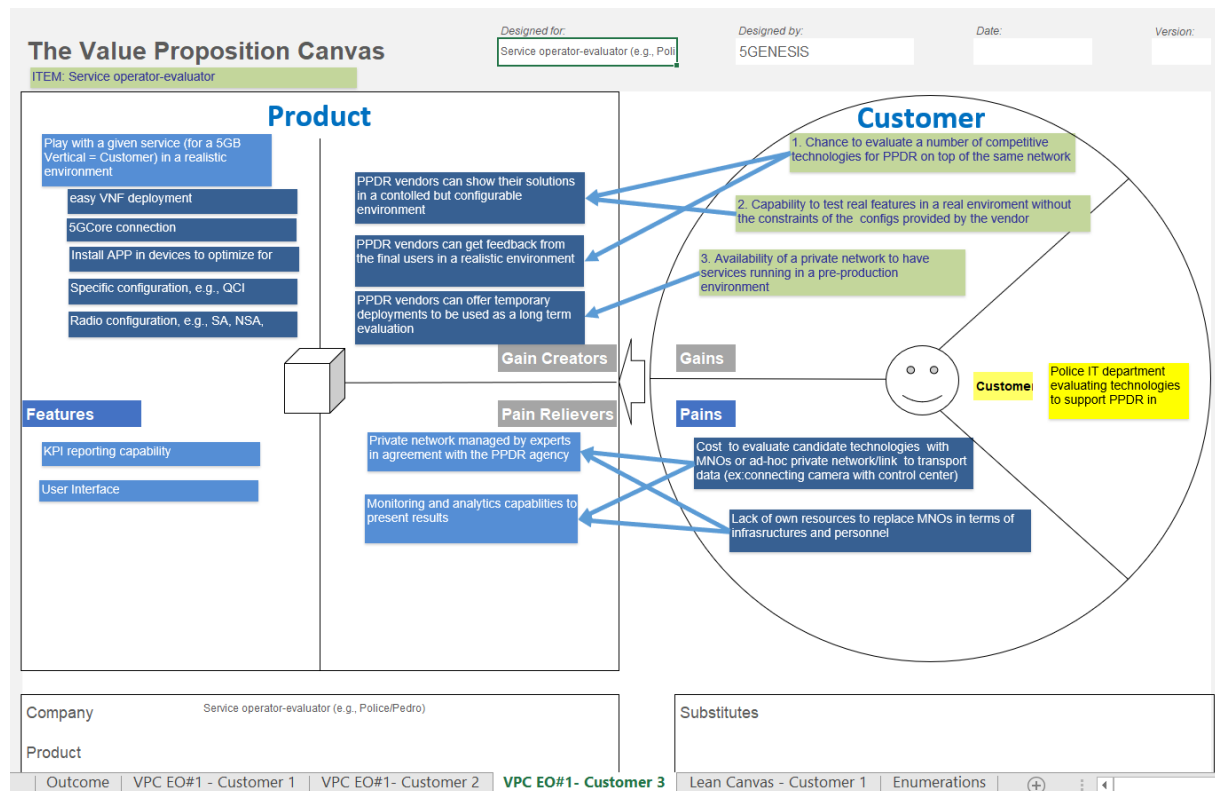


Figure 3: VPC for EO#1 and Customer#3: Service Operator / Evaluator

Following another couple of round of analysis, the team decided that the most promising mapping EO – Customer is the first one, so the analysis of the business aspects moved to consider the couple EO#1 and Customer #1, i.e. *Platform as a private network operator service*, deployed for the benefit of a *Vertical service provide as a Customer*.

The following section details the outcome of the workshop focused on EO#1 and Customer#1.

2.1.3. Lean Canvas

Out of the three VPCs discussed above, the most promising one is in what follows taken to derive a more refined business analysis.

As the text in each one of the block is too small to be read in the following figure, we report next the text of each block and finally analyze briefly the derived outcome, providing also some revenue streams.

	A	B	C	D	E	F
1	PROBLEM	SOLUTION	UNIQUE VALUE PROPOSITION	UNFAIR ADVANTAGE	CUSTOMER SEGMENTS	
2	Lack of access to experimental platforms: 1. Lack of parameters setting capability when connecting to a network 2. Network limitations w.r.t. guaranteed QoS 3. Unstable and not updated NFV deployment platform	Private testing network plus technical support (human resources / technical staff and SW tools) for executing and evaluating. Circumvent the operator limitations to open their network: exposing the network capabilities to the service providers. As the Platform is run by a university team, the personnel cost is very low/ competitive, and that helps with the limited budget of public administrations.	1. Early validation of 5G services. 2. Fully customizable Platform (e.g. adding or testing new algorithms or functions). 3. Expert advice from skilled personnel (e.g., to define KPIs, parameters, what are vendors' offering that can be implemented).	1. Product is offered on low cost due to the fact that the platform is operated by a public university and revenues are not the main driver of the proposal of the Platform. 2. The operator and the municipality are part of the team, therefore the Platform can offer more than is offered from a "normal" commercial service.	1. Vertical Service Developer. 2. Research projects and individual research institutions. 3. Start-ups ecosystem. 4. SME looking for specific expertise and testbeds.	
3	EXISTING ALTERNATIVES	KEY METRICS		CHANNELS		
4						
5						
6						
7	1. Emulators, do not really fit the requirements: too many limitations (e.g., #terminals, # features, speed of execution, costs) 2. Other open Platforms, e.g., the one in Sofia Antipolis (FR) (which failed due to not working business model, i.e., lack of customers) or other sibling projects like 5G-Eve and 5GVINNI. Also outside of the 5G-PPP programme there are platform available, e.g., in Finland.	1. Number of features that can be tested. 2. Number of failures in services under test detected and related improvements acquired thanks to the testing. 3. Number of observers / potential customers you can get because the service is made public and in principle can attract additional customers (e.g., the fire department), thanks to the visibility of the testing campaign. 4. Number of funded projects making use of the Platform, that shows that the Platform brings added value as it is used and kept updated by several projects.		1. Take part to and organize public events (e.g., conferences, 5G World) where the Platform is presented and showcased. 2. Web-based advertising like social networks. 3. Dedicated promotion plan driven by Malaga university.	PPDR vendors, which are the companies that are actually asking to use the platform. In particular CBS (Cellular Broadcast Sector), that develop services to their customers (police or municipality), that will then offer the service to final users through operators.	
8	COST STRUCTURE		REVENUE STREAMS			
9	A) running the Platform as is X (basic cost to run the Platform) B) Customize the Platform to the user's needs					

Figure 4: Lean Canvas for EO#1 and Customer#3: Service Operator / Evaluator

Problem

Lack of access to experimental platforms:

1. Lack of parameters setting capability when connecting to a network
2. Network limitations w.r.t. guaranteed QoS
3. Unstable and not updated NFV deployment platform

Existing Alternative

1. Emulators do not really fit the requirements, too many limitations (e.g., #terminals, # features, speed of execution, costs)
2. Other open Platforms, e.g., the one in Sofia Antipolis (FR) (which failed due to not working business model, i.e., lack of customers) or other sibling projects like 5G-Eve and 5GVINNI. Also outside of the 5G-PPP programme there are platforms available, e.g., in Finland.

Solution

Private testing network plus technical support (human resources / technical staff and SW tools) for executing and evaluating.

Circumvent the operator limitations to open their network: exposing the network capabilities to the service providers.

As the Platform is run by a university team, the personnel cost is very low/ competitive, and that helps with the limited budget of public administrations.

Key Metrics

1. Number of features that can be tested.
2. Number of failures in services under test detected and related improvements acquired thanks to the testing.
3. Number of observers / potential customers you can get because the service is made public and in principle can attract additional customers (e.g., the fire department), thanks to the visibility of the testing campaign.

4. Number of funded projects making use of the Platform, that shows that the Platform brings added value as it is used and kept updated by several projects.

Unique Value Proposition

1. Early validation of 5G services.
2. Fully customizable Platform (e.g., adding or testing new algorithms or functions).
3. Expert advice from skilled personnel (e.g., to define KPIs, parameters, what are vendors' offering that can be implemented).

Referring to the reason why other Platform failed in the past (see Existing Alternative point above), and deem the Malaga Platform is different, it worth mentioning that the Malaga Platform faces a different situation that those other platforms, as the 5G environment of mature enough, there are many more players, especially SMEs are appearing in the market, and many more verticals are now willing to take part to the 5G narrative and related business opportunities. That was not the case when those 'too early' other platform popped up in the market.

Unfair Advantage

1. Product is offered on low cost due to the fact that the Platform is operated by a public university and revenues are not the main driver of the proposal of the Platform.
2. The operator and the municipality are part of the team, therefore the Platform can offer more than is offered from a 'normal' commercial service.

Channels

1. Take part to and organize public events (e.g., conferences, 5G World Congress) where the Platform is presented and showcased.
2. Web-based advertising like social networks.
3. Dedicated promotion plan driven by Malaga university.

Customer Segments

1. Vertical Service Developer.
2. Research projects and individual research institutions.
3. Start-ups ecosystem.
4. SME looking for specific expertise and testbeds.

Early Adopters

PPDR vendors, which are the companies that are actually asking to use the platform. In particular, CBS (Cellular Broadcast Sector), that develop services to their customers (police or municipality), that will then offer the service to final users through operators.

The **Cost Structure** and the **Revenue Stream** fields are treated together in the following text, which hints at providing a skeleton business plan for the continuation of the Malaga Platform.

Cost per year (based on the last 5 years)

1 technical staff full time	44.800€
update HW	15.000€
SW licenses	15.000€

Summing up to **74.800€/year**, excluding main investment in creating the infrastructure, in case that is needed.

Revenue per year

A typical experiment can last 1 month

Basic availability and access to network and support	3.000€
Bug of 30 hours for specialized support	1.800€
Additional benefit to cover incentives 10%	480€
Indirect cost by the university 15%	792€
Summing up to	6.072€ / month

Total revenue per year, assuming the capability of running 11 Experiments, each one lasting 1 month: **66.792€ / year**. We took the realistic assumption that at least 1 month is taken by holidays, and the conservative assumption that not more than one Experiment is run per month (it could be of course more than one, depending on the effort required per experiment, and the level of SW and HW requested per experiment).

In summary, **66.792€ - 74.800€ = - 8.008€ / year**, which is money that the main responsible partner of the Malaga Platform (UMA) has to allocate. That is a very reasonable business model, considering that the Platform is also used for internal research and that UMA is a university and making money is not among its main priorities.

We have shown that running the Malaga Platform, or any other industry-oriented Platform of the 5GENESIS project, can make sense, taking all the mentioned constraints and assumptions into consideration (and please note that we used a conservative approach, not the best-possible scenario), and stressing the fact that UME does not necessarily need to make money out of its activities, as it focuses on spreading knowledge and enabling the ecosystem to move to the next steps in their market domain (especially SMEs).

2.2. Academia oriented Platform

As an example of another way a 5GENESIS Platform can add value to the ecosystem, we worked on the Surrey Platform with most of the partners involved, in order to derive a similar, but simplified, exercise as we did with the Malaga Platform, as detailed in the previous Section.

Due to the different focus of an academia-oriented Platform, the Exploitable Outcomes we defined in a set of Workshops for the Surrey Platform are as follows:

	A	B	C	D	E
1	#	Outcome	Project/Platform Result Category	Exploitable Type	End Customer
2		Foster knowledge in Surrey academic ecosystem	Publications	Research Achievements	Academia
3		Support for start-ups from around the UK	Prototype	Product Development	Technology Vendor
4					

Table 2 – Exploitable Outcomes for an Academia-oriented Platform

EO#1: Foster knowledge in surrey academic ecosystem

The first identified EO focuses on the specific role that a university plays in its surrounding and overall in the society: spread knowledge and teach students in order to give them the needed professional skills that will help them find a suitable job in the market.

In fact, the ‘Result Category’ is all on publications, and the end Customer’ is the academic world itself.

EO#2: Support the start-up ecosystem form around the UK

The second EO focuses on fostering and nurturing the start-u ecosystem, that usually flourish around an important academic institution. The main driver here is to allow start-ups to access advanced and product-like set-ups and deployment, so to better assess their innovation and novel technologies before going into the market.

The ‘Result Category’ is mapped to Prototype, as that is what a star-up is desperately looking for, in order to show its added value to the surrounding ecosystem. The End customer is mapped to Technology vendor’, which is the category that each start-up aims to achieve. For the first EO, in what follows we performed a VPC exercise, which has a lot of similarities with previous ones, as one can see from the *Pain* and *Gain* entries.

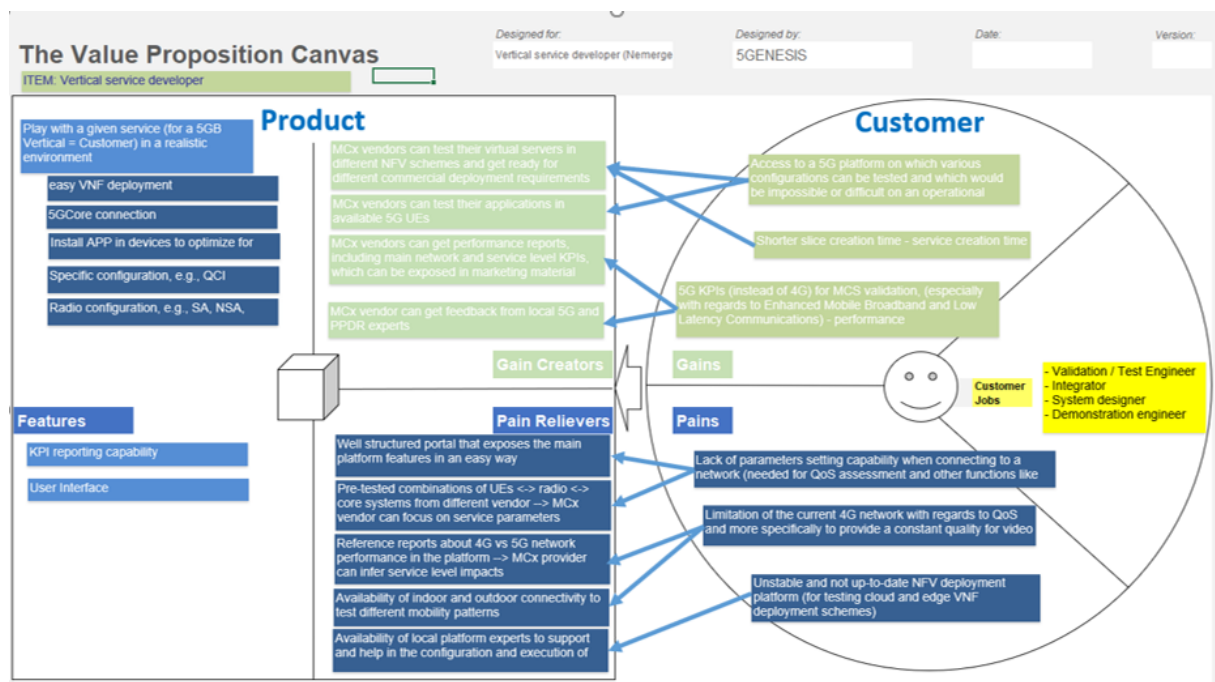


Figure 5: VPC for EO#1 and Customer#1: Students and researchers of the Surrey ecosystem

It is worth mentioning that the Platform in an academic context is devoted to increase the knowledge of the students and all people who can make use of it, ideally also start-up that spun out of a university department.

The related business model is therefore not comparable to an industry-oriented platform, as the main reason to sustain and expand such Platforms is not making money but adding value to the research and education ecosystem.

For those reasons, all costs of future enhancements and maintenance of such Platforms are completely up to the university in charge of them.

3. EXPLOITATION ACTIVITIES

This chapter elaborates on the exploitation plans of 5GENESIS from two perspectives: first project partners-specific exploitation plans are reported, and then project Platform-specific exploitation plans are elaborated.

3.1. Partner-specific exploitation plans

3.1.1. Airbus

Airbus DS SLC is a global supplier of advanced communication and collaboration solutions based on TETRA, TETRAPOL and 4G / 5G technologies. Our solutions focus on large-scale mission or business critical networks and enhance multimedia communication for public safety users during crisis and mission management. The Professional Mobile Radio (PMR) communication technologies will be part of the digital transformation enabled by 5G and in such context we intend to demonstrate that the 5G technologies developed in the project will further enable Mission Critical and Business Critical organizations and end users with rich and reliable capabilities, services and applications.

We expect to address the future market of Mission Critical with products and solutions which bring the best technology to the PPDR users and fully compliant with their expectation and needs. Thanks to the project, we have been able to experiment with 5G and confirm that our technologies can operate and take full advantage of this technology. We have also deployed our solution on the OpenStack private cloud Platform and it is now used in some of our customer deployments. We have also been able to study the deployment of our mission critical services system with the 5G network slicing feature which in the future will ensure that, over a given period, the network and application resources are made available to a set of users.

As a conclusion, these project outputs will nurture Airbus DS SLC products and solutions roadmap to build a competitive portfolio and to maintain its leadership in the PMR industry.

3.1.2. Athonet

Athonet, as a well-established solution provider for 4G / 5G private core networks, expects to benefit from 5GENESIS to promote top-level 5G products mainly in the mobile private network domain, to accelerate the corresponding market growth and, to a broader extent, to increase the awareness and business opportunities of private cellular networks for different vertical segments involving industrial and academic partners.

For what concerns future collaborative research, the participation in the 5GENESIS project has facilitated the communication, interaction and discussions among different academic and industry partners eventually members also of other European funded projects and initiatives. Our plan is to continue communicating and disseminating results for larger outreach, to

industrial, business and scientific public, as well using 5GENESIS results as basis for building next European research projects.

We plan to continue the exploitation of the project results in top world fairs (e.g., Mobile World Congress (MWC), SDN/NFV world congress, Edge Computing Congress, AWS Reinvent, Critical Communication world (CCW)), events for the general public and university career/open days.

3.1.3. ATOS

Atos is a global leader in digital transformation with 110,000 employees and annual revenue of € 12 billion. European number one in cybersecurity, cloud and high-performance computing, the group provides tailored end-to-end solutions for all industries in 73 countries.

The purpose of Atos is to help design the future of the information space. Its expertise and services support the development of knowledge, education and research in a multicultural approach and contribute to the development of scientific and technological excellence. Across the world, the group enables its customers and employees, and members of societies at large to live, work and develop sustainably, in a safe and secure information space.

The general organization of the company comprises 6 different Industries and a customer centric operating model pivoting around Industry Operations. Within Operations, the Competence Centers lead R&D, testing and design of cutting-edge offerings supported by internal investment, while Atos Research & Innovation department (ARI) is the R&D pillar of emerging technologies and source of innovative ideas coming from EU and national funded projects. The results from the R&D EU projects in which ARI is involved play a vital role to booster the innovation process within the organisation and enhance the portfolio of products and technologies offered to its customers

Replicating the global organisation of the company and with the goal of facilitating the integration of research and innovation activities, ARI is divided into 6 industries, being the Telecommunications Media and Technology (TMT) one of them. It is this group, in concrete the Smart Networks and Services (SN&S) team, which participate in the 5GENESIS project.

In 5GENESIS, the SN&S team has developed the dispatcher component as well as designed the service experimentation open APIs. Below, we describe the exploitation scenarios foreseen for Atos developments as part of the project:

1) Enhancement of the TMT portfolio:

The dispatcher includes a VNF repositories functionality which allows access and privacy management and validation among VNF vendors for NFV Orchestrator (NFVO) onboarding in a common repository. This functionality, 100% developed by Atos with TRL 5 under Apache 2.0 license, is fully aligned with Atos TMT portfolio and, in concrete, with the Next Generation Telecom Networks offering.

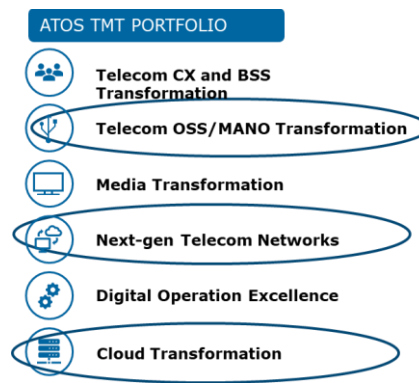


Figure 6: ATOS TMT Portfolio

This asset has been already presented to the TMT industry, which is supporting creation of a technical roadmap to evolve it, which may facilitate its future integration in the TMT portfolio.

2) Integration in other existing / future research projects

The integration and (re)use of the results derived from the research projects is of key importance for Atos. In this sense, it is relevant to highlight that the aforementioned asset is already being used and evolved as part of the 5GROUTES project ([Home - 5g routes project \(5g-routes.eu\)](http://5g-routes.eu)). This asset, which offers an artefacts repository to both validate the correctness of ETSI-compliant network functions descriptors and to onboard them to the NFVO and VIM of a 5G infrastructure, is being improved in 5GROUTES to be used for CAM services. In concrete, it is being aligned with the latest release of ETSI OSM, as well as with the project's specific 5G Orchestrator; it will also introduce a novel way to provision multi-domain scenarios.

3) Integration in OSM

Atos has been member of OSM for several years now, being part of the OSM Technical Steering Committee for Releases SEVEN and EIGHT Cycles. Atos active participation in the community has resulted even in concrete code contributions to different OSM releases through the work developed in projects like SONATA (phase 1 project), 5GTANGO (phase 2 project) and, as could not be otherwise, 5GENESIS (phase 3 project).

During its lifetime, Atos provided 5GENESIS project with the knowledge and experience acquired as a result of its active participation in OSM, as well as visibility of the project in this open-source community, encouraging collaboration. The result of such collaboration materialised with two concrete contributions to OSM release EIGHT, which clearly widened the impact of the 5GENESIS results. These contributions were produced in the framework of WP3 in Task 3.1 “Management and Orchestration”. Detailed information about the implementation of the features was properly documented in the report D3.2.

On the other hand, 5GENESIS was an opportunity for Atos to keep its collaboration with OSM, which gives the organisation a lot of visibility in the open-source community in general and is a key advantage when communicating with Atos Business Units and customers; it also positions the company in a privileged place to extend its business opportunities around open source solutions.

3.1.4. Avanti

Avanti's exploitation will build on the satellite backhauled 5G-SA architecture achieved in the framework of the Limassol Platform, being the first of its kind. This work, coupled with our design approach in supporting 5G satellite network slicing using conventional satellite class of service and VLAN separation, will be exploited through further development and automation in the course of ESA ARTES project INSTANT5G.

This project, commencing Dec 2021, aims to implement an end-to-end “zero-touch service management” of satellite 5G connectivity service tailored for multiple horizontals including MNOs & Tower Companies in Africa, Europe and the Middle-East along with private 5G networks for government and civilian applications. This will allow many different vertical industries to benefit from 5G where they might otherwise be unable.

Trials with these organizations are planned for 2023 with full commercial service following on.

3.1.5. Ayuntamiento de Malaga (Municipality of Malaga – MoM)

MoM has participated in 5GENESIS as a final user, so the exploitation of the results will go in a different direction than the technical partners.

The main outcome of the project for MoM is the part of the 5G infrastructure hosted in the city and the lessons learned from the trials with the service providers related to MCS and mobile video.

The first result, the infrastructure has a clear value to support further trials in a urban environment, so it will be promoted for other use cases by the government of the city as well as for further collaborations with national and international partners in new projects.

The experience and lessons learnt with technology providers like Nemergent and Airbus will also offer the Police the chance to expand this activities with other companies willing to test their products in the city.

3.1.6. COSMOTE

Aligned with the initial individual exploitation analysis presented in D7.8, COSMOTE, as the leading mobile operator in Greece, has identified the high potentials of the 5GENESIS Athens testbed and the overall open5GENESIS framework towards bringing a significant competitive advantage in offering to its customers enriched services and high quality of experience (QoE). The participation of COSMOTE in 5GENESIS had already been considered a unique opportunity to:

- Delve into the market/business challenges and opportunities from the Telecom Operator's perspective, and contribute to the identification of novel business models,

- Be at the forefront of the 5G trials in Greece and experiment with pragmatic implementations of vertical application use cases in an end-to-end manner,
- Evaluate potential technical challenges and new network risks at quite an early stage. Work done and expertise gained will become a reference towards 5G network preparations and timely uptake of corrective actions,
- Acquire early results on the performed 5G KPIs validations to shape commercial services and safeguard realistic service level agreements,
- Investigate the requirements and conditions for the introduction of the project solutions into COSMOTE network beyond the project's end.

In this front, COSMOTE has already exploited the 5GENESIS Athens infrastructure and partnership with NCSRDI in other research actions and projects within 5GPP and towards 6G, such as the:

- 5G-DRONES¹ project, where extensive UAV trials have already taken place at the OTE Academy²,
- EVOLVED-5G³ project, built on top of the 5GENESIS Athens testbed to allow SMEs to experiment with Industry 4.0 Non Public Network 5G deployments.

It is by now clear that the monetization of 5G is expected through partnerships with the vertical industries, that seek to exploit the premium EMBB, URRLC and MMTC services that the 5G technology can offer. In the Greek market, the interest of our enterprise customers to run proof of concepts and experiment with 5G for their business digitalization is raising. COSMOTE has already offered 5G testbeds for pilots to strategic collaborates, and indicatively the following can be mentioned:

- CALPAC 5G pilot, to demonstrate and evaluate the 5G private/campus network in the production line of solar water heating equipment manufacturing⁴ at the premises of CALPAC⁵ factory, a 4000 square meter plant that was established in 1976 by BP (British Petroleum),
- Athens International Airport 5G pilot⁶, exhibiting the value 5G for incident management and physical security at the airports,
- National and Kapodistrian University of Athens (NKUA) 5G pilot to present to the medical academic community the benefits of remote patient examination via COSMOTE 5G during transportation by the National Emergency Assistance Centre (EKAB)⁷.

Moreover, COSMOTE is committed to further raise the awareness of the 5G benefits in the industrial community and as the interest for 5G is densified and extends beyond the big industrial players to medium-scale companies and SMEs, the operation of the local OTE-Academy 5GENESIS testbed, as a ready-made playground for enterprises to plug and test their

¹ <https://5gdrones.eu/>

² <https://www.youtube.com/watch?v=7Dj3ehOxQog>, <https://www.youtube.com/watch?v=FiwrNOyLmjw>

³ <https://evolved-5g.eu/>

⁴ https://www.cosmote.gr/cs/otegroup/en/smart_manufacturing.html

⁵ <https://calpak.gr/about-us/our-company/>

⁶ https://www.cosmote.gr/cs/otegroup/en/5g_campus_network.html

⁷ https://www.cosmote.gr/cs/otegroup/en/5g_asthenoforo.html

applications becomes very appealing. It is expected, that even beyond the 5GENESIS project end the OTE Academy 5GENESIS testbed will continue to operate and be modernized with new network capabilities from various vendors and be available to on-board applications of interested SMEs and start-ups.

On a different perspective, the open5GENESIS framework, as a set of system and software components that once installed can be used to formalize and systematically support the experimentation with 5G with the appropriate capabilities (such as slice provisioning, monitoring and KPIs reporting), is evaluated for its suitability for adoption beyond the research activities for building the commercial 5G pilots. The idea is that the open5GENESIS, once installed on top of a small-scale 5G infrastructure, can automate and speed up the setup and execution of the industrial pilots for which the interest is raising.

As a final remark, COSMOTE through the dissemination of the project results within the Deutsche Telecom (DT) Group, is paving the way for the exploitation and reuse of the identified gains by the other telecommunication operators of the DT Group. Last but not least, COSMOTE seeks to educate and drive the industrial ecosystem to experiment with the 5G for verticals offerings and to this end, special reference to the 5GENESIS testbed and its transformative impact has been presented in a wide enterprise audience during the Innovation Forum⁸ of the Greek-German Chamber of Commerce and Industry.

3.1.7. Ericsson LMI

Ericsson is a world leader in developing a distributed network management solution for 5G networks. In Ericsson Ireland, we are actively involved in research around 5G, orchestration, data analysis and automation. The results and knowledge gained through our participation in 5GENESIS have been and will continue to be exploited to:

- (1) enhance internal know-how in the areas of automatic optimisations, data analytics, orchestration
- (2) have a continuous role in collaborative European research projects,
- (3) assess impact & improvements that we could bring towards our products.

We have, throughout the duration of the project, disseminated our work and results in 5GENESIS internally throughout our organization. This has been done through one-to-one discussions, department-level presentations, as well as major events such as OSS Tech Day, where participants from the various sites involved in OSS development in Ericsson are invited, together with our customers. Experiences from these communications have been considered in our new SMO Framework, Ericsson Intelligent Automation Platform. Additionally, we have organized special training events, in which we taught our engineers the process of developing data analytics services, based on our experience with developing the 5GENESIS Analytics framework. This was an in-depth training, where we went through the process of developing the framework, as well as details in terms of implementation and lessons learnt.

Additionally, internal dissemination included also other initiatives in which we were involved as part of 5GENESIS, such as 5G-PPP white papers, in particular the ones on 5G Architecture

⁸ <https://griechenland.ahk.de/2-innovationsforum-2021/parallele-workshops>

and ML/AI in 5G. This ensures wider dissemination of the 5G-PPP and EU Research Programmes inside the company.

Our participation in the collaborative work done in 5GENESIS enhanced our network of contacts and intensified discussions on new EU collaborative research initiatives that would benefit us. Also, the knowhow we gained helped us progress faster in our other H2020 projects, where we bring in our knowledge regarding ML/AI in 5G and use of Adaptive Policies through APEX. Our experience of integrating the APEX policy engine (which is part of ONAP) into the 5GENESIS slice manager has increased our competence in an important area of future network management. The experiences of APEX working with Slice Managers has decreased the learning curve associated with working with this technology and has enabled more complex Use Cases through having a greater understanding of the network components involved. All these experiences have been disseminated internally, as well as externally towards ONAP.

Another direction of internal exploitation was to recommend the 5GENESIS work towards our internal teams, where different groups have assessed the work in the 5GENESIS open repository. This includes our internal groups interested in orchestration solutions, policy-based automations and ML groups.

3.1.8. Ekinops

The market for roll-out services will continue to be driven by growth. The provided bandwidth continues to increase, in mean while operators are seeking to reduce the Average Per-Bit Delivery Cost as the revenue-per-bit is falling below its cost-per-bit. Although broadband penetration is rising, the digital divide is still high. The network operators will continuously expand their network capacity and coverage to support exponential traffic growth, while on the other side users will consume larger data volumes from different devices and locations. This will impact the network edge, backhaul links and the core network, which needs upgrade and modernize of the operators' legacy networks at access, backhaul, core and transport networks.

Today, operators are embracing the Multi-Access Edge Computing (MEC) as the solution to achieve better performance, scalability and ensuring a seamless and predictable user experience. The SDN and NFV technologies complement the MEC to deliver higher levels of network automation, fast and agile service deployment driving new revenue streams and bringing efficiencies in terms of management, operations and cost. In addition, the key features of satellite communications such as wide-scale coverage, broadcast/multicast support and high availability, together with significant amounts of new satellite capacity coming online, anticipate new opportunities for roll-out satellite communications services as an integral part within upcoming 5G systems. The combination of satellite and terrestrial components to form a hybrid network will constitute, more than ever, a promising approach to significantly improve the delivery of communication services.

As an exploitation plan, the technology developed in the 5GENESIS project that concerns the Limassol Platform will facilitate the adoption of enabling technologies in satellite segment and hybrid terrestrial satellite network. This allows new operators to enter the satellite market space easily. Traditionally, deploying new satellite services can be a daunting affair as a satellite system can be seen as closed world, expensive, hard to manage and hard to operate.

The baseline of this advance relies in network infrastructure sharing using SDN and NFV by multiple tenants and offered based on pay-per-use models instead of traditional model of procuring infrastructure to use it. In this way, service delivery with satellite networks is envisioned to be shifted from a network for connectivity model to a network for service model with a high degree of service customization and adaptability, including satellite bandwidth on-demand and support for cross-domain integration with terrestrial networks. Multi-tenancy in infrastructure sharing model and network slicing will enable multiple tenants to cohabitate while being assured they can manage their own segment in an isolated, flexible and secure fashion.

The work performed during the 5Genesis project enhances significantly the Ekinops' multi-link technology which is ambitioned to be a strong feature of the company's SD-WAN solution. This integration will open more market segments to the company where resilience, smart link management and Quality of Experience are paramount.

#	Exploitable Knowledge & Products	Sector(s) of Application	Timeframe	Patents or Other IPR Protection
1	SD-WAN	EuCNC and 5GIC demonstration Service Providers Enterprises	2019 2020	patent no 1454645
2	3GPP AT3S	5G networks	2020	
3	QUIC protocol	Heterogeneous networks	2020	
4	Multi-link	5GENESIS project Limassol testbed	2020	

Table 3: Ekinops exploitation outcomes

The technology is a critical part of the EGINOPS SD-WAN solution which is under industrialization and will be integrated as physical and virtual components into a mainstream commercial solution for the Service Provider and System Integrator market.

3.1.9. EURECOM

EURECOM is one of the leading French engineering schools with excellent teaching and research activities on Communications Systems, Digital Security and Data Science. EURECOM is the founding member of OpenAirInterface, an open-source software/hardware ecosystem for the 4G/5G core and radio access components of 3GPP cellular networks, running on top of commercial off-the-shelf (COTS) hardware. EURECOM's contributions for 5GENESIS project will have a significant impact on research facilities, as open interfaces and

interoperable hardware for end-to-end 5G systems will enable further research. Research facilities will increase their knowledge base in the area of Open RAN and core as well as 5G architecture, private networks, integration and operator models. The developed software solutions can be reused in future projects or licensed to third parties.

In this context, EURECOM is part of the SLICES Platform consortium [1] which focuses among others on large scale experimental research on networking protocols, radio technologies, cloud and edge-based computing architectures and services. SLICES has been admitted as a new project in the ESFRI 2021 roadmap update [4]. It is envisioned that the results from 5GENESIS, especially with respect to the support of 5G Non-standalone and Standalone developments in OpenAirInterface, as well as the deployed 5G infrastructure at EURECOM will be exploited in these large-scale experimentation and research efforts.

Last but not least, the availability of 5G end-to-end setups based on OpenAirInterface gives the opportunity to integrate hands-on 5G experimentation activities in technical courses of the Communication Systems department at EURECOM.

3.1.10. FOGUS

Fogus Innovations & Services is a Greek, innovative SME, aiming at integrating state-of-the-art technological advancements and cutting-edge research achievements towards an immersive communication and computing experience. Founded by a group of experienced industrial and academic experts covering a wide range of disciplines in the area of Information and Communication Technologies (ICT), Fogus exhibits strong research record and vast experience in managing and implementing ICT Research & Innovation actions.

In the context of 5GENESIS, Fogus testbeds and simulation infrastructure has been enriched and extended, towards three main directions: i) the establishment of an experimentation Platform on top of a 4G/5G connectivity infrastructure, ii) the development of vertical applications for on demand video consumption, and iii) the implementation of an end-to-end IoT testbed with outdoor and indoor infrastructure. Those tangible additions for the company, have definitely strengthen the position of the company against the competition in the fields of experimentation and benchmarking. As a consequence, the company grows constantly and have managed to reuse the 5GENESIS developments in order to join new consortia.

Also, since Fogus invests on training and consulting services, the know-how acquired by the 5GENESIS project is currently being exploited by the training and consulting sector in Fogus to devise new courses and training material.

In addition, i) the overall technical know-how that the company gained as well as ii) the participation in 5G fora (e.g., the 5GPPP activities), defined a positive long-term impact for the company that is currently materialised by a new strategic plan for the company towards 5G and beyond R&D activities (including actions such as the membership in 5G-IA).

3.1.11. FON

5Genesis project has been a key strategic project in the future of Fon Technology. The participation on the project has provided the possibility to make first level relationships with 5G actors in Europe. This has opened new research projects opportunities, new business partners and new internal product development.

WiFi 5G convergence has not been deeply studied in the current 5G developments and not many research projects have been involved so far in a core 5G 3GPP Release 16. The development done in 5Genesis and the successful outcome obtained has attracted research centres and companies interested to collaborate with Fon and continue the research of technology

It is expected that once 3GPP Release 17 for 5G become available more research projects will appear, and new consortiums will be generated.

In the following table there is the detailed number of companies interested to collaborate and the projects at national and European level interested in new developments.

Companies interested to collaborate	5
Research center	3
Projects on going at national level	3
European projects on going	2

Table 4: FON summary of engagements with externals

5G Deployments are more available now and new deployments are coming in next years, as public or private networks. The need to create 5G-Wi-Fi convergence will be more demanding, especially for the companies that want to reuse their old Wi-Fi devices under the core 5G, or they want to enlarge the coverage of the 5G network with the use of Wi-Fi6 access points, that it is cheaper option.

In Spain there are 5 projects demonstrators where the country wants to share the benefits of 5G technology. Now that 5Genesis is finishing we have the focus to productize the technology developed on it, and use 3 of these demonstrators in Basque country (<https://5g-euskadi.com/>), Catalunya (<https://www.pilot5gcat.com/>) and Andalucía (<https://www.piloto5gandalucia.es/>) as flagship to show the benefits of the convergence Wi-Fi-5G.

The exploitation roadmap assures to protect the technology developed by Fon technology in the project, with one of the protection instruments prepared for this, as patent or trade secret. The goal is to exploit as technology that we can provide to our customers and sell licenses per use and per year. The license will be charge by core 5G.

Typical customers will be core 5G manufacturers, installation operators, telecommunication companies that provide 5G services, and all the companies that could provide 5G services.

The main exploitation plan will happen in Europe where are the main customers of the company. Even though we don't hesitate to go abroad if there is a market opportunity.

The strategy of the commercialization will be based in AIDA model. AIDA concept is attributed to St. Elmo Lewis, an American advertising and sales pioneer, who introduced it in 1898 (<http://en.wikipedia.org/wiki/AIDA-marketing>). He created the AIDA marketing funnel model explaining personal selling business. Based on his research of successful salespeople, Lewis proposed the application of the following hierarchical process. The process is based on the four cognitive phases that buyers follow when accepting a new idea or purchasing a new product and it is the one Fon Technology will follow:

- Stage 1 Awareness, to consider how to attract the attention of consumers. (That is the reason that 3 Proof of Concepts are planned to develop in Spain in 2022),
- Stage 2 Interest, Once the consumer is aware that the product or service exists, the business must work on increasing the potential customer's interest level (for this we will create another proof-of-concept focus in Public Wi-Fi with proof of concept easy to understand for many customers),
- Stage 3 Desire, After the consumer is interested in the product or service, then the goal is to make consumers desire it, moving their mindset from "I like it" to "I want it",
- Stage 4 Action, the goal is to drive the receiver of the marketing campaign to initiate action and purchase the product or service.

3.1.12. Fraunhofer FOKUS

Fraunhofer FOKUS will exploit the results from 5GENESIS mainly in four directions:

- Continuation of the operation of the FOKUS part of the Berlin Platform to use the testbed in various research and development projects,
- Replication of Platform components to establish 5G testbeds at other academic and industrial institutions (derivation of 5G Testbed Blueprints),
- Usage of the Platform for further developments of the Fraunhofer Open5GCore,
- Exploitation of the Platform to PhD and Master students for future research.

The 5GENESIS project provided for Fokus the framework to significantly enhance the previously existing 5G playground towards an advanced 5G experimental Platforms incorporating – at a small scale – operator graded network and RAN infrastructure. This outcome of 5GENESIS was a key enabler for FOKUS to be considered a preferred partner in new research and development projects funded by the EU, German government, and industry. Those projects will evaluate upcoming technologies, such as 5G ORAN based networks, or fully decentralized new network architectures envisioned for future 6G networks. As part of those confirmed, funded projects, FOKUS will exploit the Berlin site to various players from industry and academia. The following figure provides an overview of confirmed, funded projects (total project volume of approx. €160 M) that in part will be based on or make use of the Berlin side of the 5GENESIS.

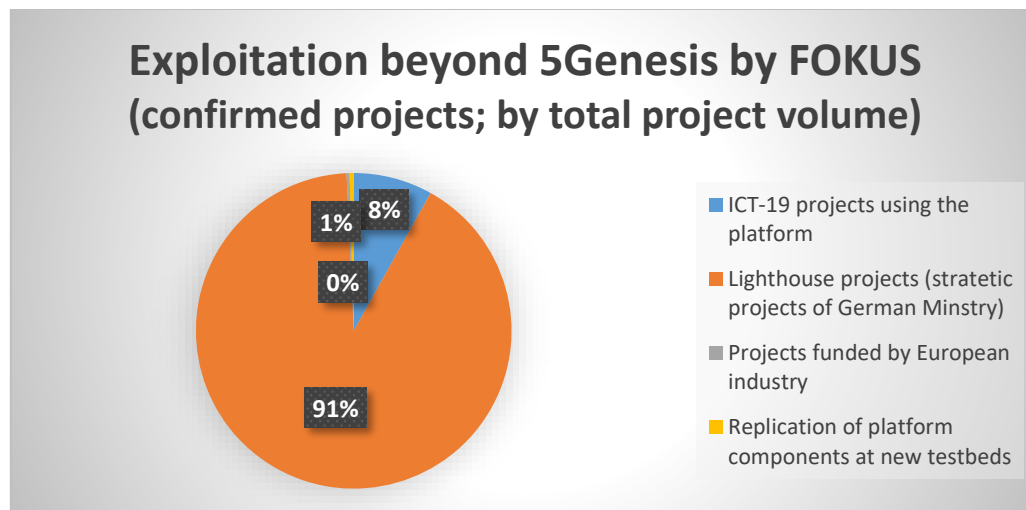


Figure 7: FOKUS exploitation beyond 5GENESIS

To underline the commitment of FOKUS to continue the Berlin site operation and the importance of the Platform itself for the exploitation activities of FOKUS, the following figure shows the additional internal funding (in addition to the one received from 5GENESIS), which FOKUS has already invested in the Berlin testbed, thereby nearly pairing the funding received from 5GENESIS by FOKUS internal investments.

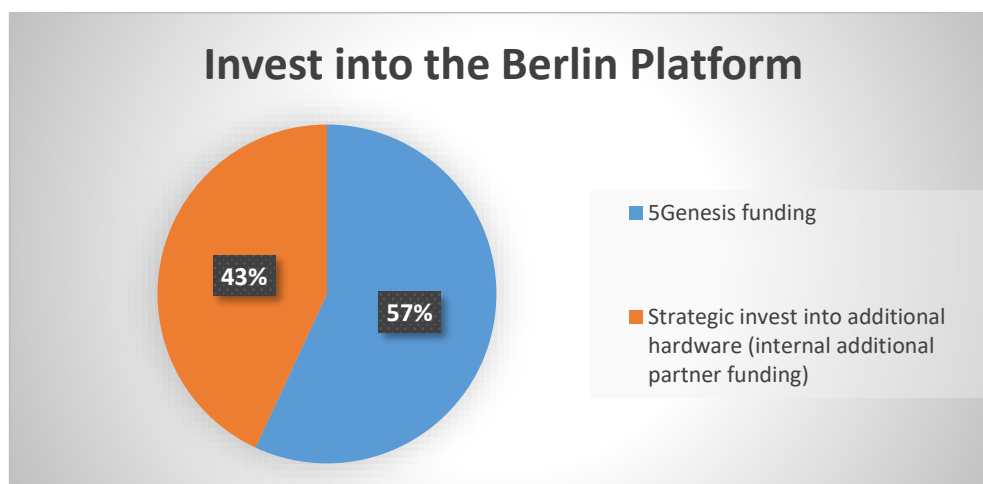


Figure 8: Split of the sources of investment in the Berlin Platform

Besides, the architecture of the Berlin Platform as developed in 5GENESIS has brought significant insights on how 5G-based testbeds can in general easily replicated. FOKUS will exploit such a testbed blueprint towards industry partners, which aim at installing their own 5G testbed, mainly based on the Open5GCore developed by FOKUS.

As such, FOKUS will continue exploiting its Open5GCore via licensing towards academia and industry. The Berlin facility of 5GENESIS is therein an important cornerstone as the Platform allows to test and improve the performance of the 5G core for future releases.

Finally, the close cooperation with Technical University Berlin allows to use the Berlin facility to conduct future research of PhD students and the execution of master thesis thus exploiting

the outcomes of 5GENESIS towards future graduates who will bring their knowledge into industry upon graduation.

In addition, Fraunhofer FOKUS has started negotiations with the 5G-ACIA industry alliance in order to convert parts of the Berlin Platform into a 5G-ACIA approved testbed.

3.1.13. IHP

IHP being a R&D Institute with the main focus of technology development has gained knowledge in 5GENESIS related to the 5G architecture design, testbedding and 5G systems deployment in general. The latter is being currently strengthened thanks to an internal strategic invest that has been an important part of the final Berlin Platform field trial. The 5G system deployed at IHP will serve for assessing different 5G deployments that could perfectly accommodate the latest technological IHP developments related to THz systems, joint communication and sensing, advanced MIMO systems, etc.

The work in 5GENESIS has also made possible the tight collaboration with the Berlin Platform core partner Fraunhofer FOKUS, with whom IHP is leading the Berlin Facility deployment in the ICT-19 project 5G-VICTORI, with the demonstration of several Rail/Media/Future Mobility use cases taking place in an operational environment such as Berlin Central Station in Berlin, Germany.

All in all, IHP will make the know-how and outcomes from 5GENESIS exploitable in three directions:

- Continuation of the operation of the IHP site of the Berlin Platform for its use scientifically, and as a research and experimentation testbed in various research and development projects.
- Usage of the Platform for further evaluation of 5G/beyond 5G/6G technologies developed internally for the migration to 6G networks with IHP novel mmWave/THz/photonic developments.
- Exploitation of the Platform to PhD and Master students for future research in collaboration with IHP's joint labs: Humboldt University, University of Cottbus, Technical University of Berlin, etc.

3.1.14. INFOLYSIS

INFOLYSiS. is an innovative SME company, established in Athens, Greece, specialising on the design and development of chatbots, either as custom-made standalone applications or as subscribed-based services (Chatbot as a Service) via the privately owned chatbot Platform, operating in also 5G and IoT enabled environments. Chatbots are applications that simulate human conversation, based primarily on conversational flows and occasionally enriched with DL/NLP technologies for more sophisticated automation of use-cases.

INFOLYSiS, in parallel to its commercial activities, is committed to driving research results forward by experimenting with novel technologies and infrastructures, such as 5G, SDN/NFV at the network edge and container-based virtualization in IoT areas (mainly of IoT interoperability) in order to advance the chatbot capabilities and expand its applicability in novel ICT use-cases such as 5G and IoT enabled environments, smart home solutions and smart cities. An indicative example includes the INFOLYSiS IoT Virtual GW, which offers the provision of agile interoperability over heterogeneous IoT domains which was further developed and elaborated for 5G environments through the lifetime of 5GENESIS and successfully applied and supported 5GENESIS Surrey 5G Platform use cases and trials.

INFOLYSiS will further exploit 5GENESIS results by increasing INFOLYSiS's presence and penetration in the respective areas of IoT and 5G research and will facilitate the processes to make the project achieve maximum visibility and to maximise its impact within the business and scientific communities, as well as within the chatbot apps commercial market, so as to guarantee a fast adoption of the project outputs and easier commercialization of its chatbot based services. INFOLYSiS participation to the 5GENESIS project, in particular through the INFOLYSiS provision of IoT Virtual GW and IoT protocols mapping VNFs to 5GENESIS Surrey 5G Platform use cases and trials, and in conjunction with the participation and outcomes of relevant ongoing 5G related projects (5G!Drones and EVOLVED-5G) will further:

- Enrich the know-how and the research expertise of the company in 5G technologies under IoT enabled environments,
- Further evolve and enrich INFOLYSiS IoT Virtual GW with additional operations and functionalities (e.g., supporting more IoT protocols, using dpi features etc.),
- Foster INFOLYSiS IoT and 5G R&D activities coupled with chatbot technologies,
- Encourage the development of chatbot based applications using the 5G network capabilities for IoT enabled interoperable environments,
- Create new chatbot based products and services targeting new markets and sectors,
- Exploit 5GENESIS results within related scientific and industry communities as well as in the evolving chatbot apps markets,
- Use expertise gained in the research activities of ongoing 5G related projects in which INFOLYSiS participates.

3.1.15. Instituto de Telecomunicações

The results achieved within 5GENESIS, namely the ones in which IT were directly involved as well as the general ones, have become part of IT's knowledge base, enriching and further extending its expertise in several fields, such as dynamic spectrum management, network virtualization, 5G field trial, machine learning, network slicing, etc. This acquired knowledge will eventually be used to enhance specific high degree technical courses in Portuguese universities (e.g., University of Aveiro), but will also represent an important background for further involvement in future related research and R&D projects, as IT is currently involved in national project proposals that focus on radio resource management for beyond 5G and 6G networks.

IT's exploitation of 5GENESIS results can be summarised as follows.

Internal discussions at the consortium level created synergies and cooperation through the exchange of know-how with other partners (including INT) establishing a partnership for long-term collaboration.

The integration of 5GENESIS solutions, as well as the consideration of its use cases in educational programs and in their planning, will contribute to the impact of the project, at the institutional level, including after its conclusion.

IT disseminated the achieved results in peer-reviewed conferences, journals, magazines, and editorial books as part of their mission (which is to create and disseminate knowledge in the field of telecommunication). IT also contributed to IEEE 1932.1 standard to create further impact.

3.1.16. Intel

Intel has based its exploitation activities till the conclusion of the project lifetime taking as guidance the original exploitation plan sketched in the previous deliverable D7.8 [2]. As a matter of fact, all planned activities have been performed, as detailed in what follows.

First, it is worth mentioning that in November 2019 Intel decided to carve out most of the R&D working on the cellular modem to Apple. That decision created a set of Intel internal re-organizations, impacting all the team working at that time on 5GENESIS. Notwithstanding the changed situation, compared to the project start, a clear decision was taken so not to disrupt Intel commitment and tasks in 5GENESIS and to guarantee a successful continuation of the project scope and actions.

Till the end of 5GENESIS, Intel personnel involved in the project have constantly kept informed Intel internal R&D teams about the latest development and obtained results of the 5GENESIS project; that happened not only within the division spending efforts to the project, i.e., Intel Labs, the central division working on research topics, but also to all other personnel belonging to other divisions, specifically those involving business R&D related to 5G products pre-development activities. Such internal dissemination and exploitation activities happened during quarterly come-together meetings of cross-functional R&D teams that first the wireless division and then Intel Labs (the two divisions that have been involved in 5GENESIS) organized: produced project deliverables and 5G implementation experience – coming out of the 5 5GENESIS Platforms on the 5G Key Performance Indicators (KPIs) (regarding the feature set of 3GPP Release 15 and successor releases) - have been instrumental in deriving lesson learnt, useful for future product definitions, especially in the Edge domain.

Thanks to 5GENESIS involvement, Intel personnel has had access to a huge set of activities at Work Group (WG) level of several European (**5G-IA**, **AIOTI**, **BDVA**, **Digital Europe**) and national (**Bitkom**) associations, and European Technology Platforms (ETP) (**Networld 2020 and afterwards NetworldEurope**). Representing 5GENESIS most of the time, Intel personnel has proactively provided - and learnt a lot in doing so – several inputs to **Strategic Research and Innovation Agendas (SRIA)**, for instance:

- Strategic Research and Innovation Agenda (SRIA) 2021-27, edited by Networld2020 ETP, 2020.09,

- Strategic Research, Innovation and Deployment Agenda (SRIDA) ‘AI, Data and Robotics Partnership’, edited by the BDVA Association, 2020.09,
- AIOTI SRIA 2022-2025, To be published in Q1 2022,

to **White Papers**, for instance:

- 5G-IA
 - o Edge computing for 5G networks, 02.2021 (reviewer),
 - o European Vision for the 6G Network Ecosystem, 06 2021 (co-editor),
 - o 5G Ecosystem, 09.2021 (reviewer),
 - o 5G PPP – View on 5G Architecture, 11.2021 (reviewer and contributor),
- Network2020
 - o Enabling technology for future vertical ecosystem transformation,
- BDVA
 - o Towards a European-governed Data Sharing Space, 12.2020 (reviewer),
 - o AI and Big Data for the Financial Sector – still to be published (reviewer),

to **associations’ WGs’ activities**, for instance:

- 5G-IA/Architecture,
- 5G-IA/Communications,
- 5G-IA/Task Force on 5G Verticals,
- 5G-IA/Trials,
- 5G-IA/Pre-standardization,
- 5G-IA/Vision – several sub-WG (Business, Pre-structuring model, Strategy),
- BDVA/Security,
- TCI/Use cases,
- AIOTI/Research & Partnerships,
- Network2020/ Enabling Technologies for Future Vertical Ecosystem Transformation,

and facilitated to acquire responsibilities and **driving roles at WG level** of the mentioned associations’ activities, for instance:

- Board of Director member of the BDVA Association,
- Extended Steering Board member of the 5G-IA association,
- Steering Board member of the AIOTI association,
- Chairman of the “Trials/5G and towards 6G Vertical” workgroup in the 5G-IA association,
- Co-chairman of the “Research & Partnerships” Workgroup of the AIOTI association,
- Vice-chairman of the Enabling Technologies for Future Vertical Ecosystem Transformation WG Network2020 association,
- Core Team member of the Trans-Continuum Initiative (TCI),

and finally, **Advisory Board member** of the collaborative research projects:

- ULTRAWAVE,
- Interconnect,
- LIPS (German),

- FORTE (English),
- 6G HUB Open6GHub (German),
- 6G HUB 6GEM (German).

All of the above allowed Intel to be recognized as a key contributor to the European research ecosystem and Intel personnel to be involved in several new project proposal submissions, especially within the latest Horizon Europe calls.

Finally, it is worth mentioning that all the above listed ecosystem-related activities helped Intel in better understanding the European landscape and get involved with key industrial players; indeed, all of that facilitated the announced plan of collaboration of Intel with the European Union on building a cutting-edge chip factory in the EU, which is expected to see Intel investment of around €80 B from 2022 till 2030 and hire in the same period around 10.000 people in EU countries. That indeed is a big impact on EU and a proof that being involved in successful funded projects like 5GENESIS has made a difference for Intel and for the EU.

3.1.17. KaU

As an academic partner, the exploitation of 5GENESIS project outcomes is governed through research, education, dissemination and communication activities. The 5GENESIS activities and results have significantly strengthened the KaU knowledgebase in particular areas such as performance monitoring, analysis and experimentation in 5G; slice management; and protocol and application tuning and optimizations as well as in 5G systems in general.

Such strengthened knowledgebase increased scientific impact and enhanced European networks within the 5G area will be exploited for future collaborative research projects. In particular, KaU is currently working on a project proposal for a large collaborative project targeting one of the Swedish national funders. The proposed research agenda builds directly on 5GENESIS results. KaU is further discussing with a consortium of European partners (some from 5GENESIS) about a project proposal for an upcoming call in the Smart Network and Services (SNS) Institutional partnership.

The knowledge gained within 5GENESIS will also be integrated within the undergraduate and graduate curriculum at KaU. In particular, KaU is currently developing a new Master's program in Networked Systems and Cybersecurity, including a new advanced level course on 5G systems. KaU also just installed a 5G innovation network on campus in collaboration with one of the Swedish operators. Results from 5GENESIS around performance monitoring and experimentation as well as around 360° video will be integrated in the testbed and used both in courses and for various student projects. The testbed will also be used for demonstrations and collaborations with local industry.

3.1.18. MARAN

Maran Gas Maritime Inc. (“MGM”) is the Gas Shipping unit of Angelicoussis Shipping Group (“ASGL”). MGM was set up in July 2003 to manage the LNG and LPG carriers of ASGL. ASGL has a well-established track record in shipping dating back to 1947. ASGL’s fleet now comprises bulk carriers, tankers, LNG vessels and LPG vessels. Today it employs a staff of approximately 300 shoreside professionals as well as over 3,700 officers and crew.

MGM besides the capability of transferring cargo around the globe is committed in continuous pursuit of technical innovations such as:

- Cooperation with educational and industry bodies and Charterer Forums – delivering presentations, lectures, issuing technical papers, etc.,
- Cooperation with engine manufacturers, oil suppliers, performing studies and tests towards improvement and optimisation,
- Participation in R&D Programs in co-operation with universities with the aim to developing solutions/proposals for safer and more environmentally friendly shipping,
- Installation of innovative systems promoting better performance and energy efficiency,
- Participation in technical committees of major classification societies (ABS, DNV, LRS, SIGTTO), proposing several rule changes and amendments,
- Cooperation and active participation in national and international technical societies promoting knowledge (SNAME, CIMAC, MARTECMA).

As a result, MGM supported 5GENESIS project by participating in Limassol 5G Platform as a demonstrator with a successful trial of real-time rust detection using AI and augmented reality application using 5G connection onboard vessel MARAN GAS KALYMNOS.

Maran Gas plans to seize the opportunity through participation in 5GENESIS by:

- Enhancing the use of real time application for rust detection with large datasets for better results,
- Cooperate with partners to create additional features within the app for:
 - Water leakage,
 - Pipe cracks,
 - Rope age,
- Enhance the use of 5G hotspot in hot works within the vessel through smart watch to measure real-time physical activity and fitness,
- Enhance the use of 5G hotspot in healthcare and telemedicine field measuring physical conditions and report to the Captain,
- Explore smart vessel and smart port connectivity using vessel as hub.

3.1.19. Municipality of Egaleo (MoE)

MoE through the participation of 5GENESIS will have the opportunity to offer to Egaleo citizens the 5G experience. The advances that took place at Egaleo stadium will be further exploited for the development of novel services for the citizens. As regards to the technological

opportunities that the project will present, the City of Egaleo will specifically invest in discovering its exploitation as regards to the following fields of interest:

Infrastructure

The establishment of the 5G facility will make ways to revamp and upgrade its public infrastructures, through the establishment of a Smart Grid that will connect all infrastructure needs via Internet of Things (IoT). This will result in the adequate management of services like public street lighting, controlling the congestion of traffic through offering alternative routes in the phones of citizens, monitoring the quality of air in municipal buildings and moderate noise levels, more efficient energy consumption, waste and water management. These services will interact with the smartphones of citizens that will register in Egaleo's application and make them able to interact and communicate directly with the relevant Departments of the administration to resolve relevant issues.

Economy

The communication and connection opportunities offered by 5G networks will reinforce the local economy by offering pivotal growth opportunities for local businesses. Citizens and companies will have faster online access to all services offered by the Municipality by automating procedures, enabling them to focus on the other aspects offered by 5G networks. Businesses can enjoy holistic waste and energy management of their facilities, along with unique opportunities that the network will bring for local interaction, as for example sharing offers and opportunities with citizens directly through their Municipal app. Another important aspect that will enhance local economy is the usage of 5G networks for local tourism, as it will enable larger data processing while also giving opportunities for citizens to find information about local historical infrastructure with more ease, while also embarking on digital tours in the city. There is also the possibility of developing digital tools to analyze profile and visitor behavior, so that the local market can adapt to their preferences and demands.

Civic Life

Apart from the practical issues that the 5G will resolve regarding the infrastructure and economy, it will also result to the vast improvement of the way of living for the citizens of Egaleo. The citizen's app that will have interconnectivity with the aforementioned services will also enable citizens to leave their feedback for them, so that the municipality can constantly upgrade its provision services. The app will also give them access to all sports and cultural happenings in the municipality, as they will have the option to re-watch football games or theater performances occurring in the Municipal infrastructures, recording them with a 360° camera that will offer top image quality. Citizens will have more impact on the city's governance through their enhanced online communication with the relevant services of Egaleo.

3.1.20. Nemergent Solutions

Nemergent Solution as technology provider is fully focused on the development and provisioning of 3GPP-compliant standardized mission critical services over mobile broadband networks. In new releases (Release 16+), it is being defined how these services should be deployed over 5G networks. NEM, as a pioneer in MCPTT/MCS pilots has always wanted to

lead the experimentation and integration of MC services in 5G networks, being able to provide the required MC basic functionalities as a VNF that might be flexibly deployed in any required location. This effort has been possible thanks to the collaboration in 5GENESIS and has opened the opportunity to offer services in similar infrastructures with OpenStack or OpenNebula to customers.

During 5GENESIS Nemergent has been able to integrate the service in the 5G end-to-end chain involving procedures like seamless service deployment and delivery together with the definition of 5G needs for the mission critical communications that at the end resemble in the final definition of utilized 5G slice. These features have provided Nemergent with the required understanding of cross-dependencies to be able to tackle different client and adjust to each customer needs. Besides, Nemergent has driven a first study of the management of QoS in 5G using the SBA concept of the 5G Core and directly requesting the linked bearers to the PCF. Even though that due to the non-presence of mature PCF and 5QI in the full chain, the implementation was halted, the study resulted in the definition of the minimum set of functionalities that are needed for the 5G QoS management to work from the AF perspective and will be of critical importance for further future steps. Additionally, the integration of the service as VNF as brought Nemergent with the understanding of the system modules like the orchestrator and the underlying descriptors that are crucial for a future evolution to evolve it to allowing service as CNF or KNFs.

The market need is increasing and in parallel more and more public tenders will include the necessity to provide the services in a similar fashion as in 5GENESIS, giving the chance for Nemergent to have a strong position. Additionally, once the public events are back again, Nemergent will continue disseminating product lines as outcome of 5GENESIS to future customers in fairs like MWC, CCW, EENA and so forth or more dedicated US fairs like PSCR stakeholder meeting.

3.1.21. NCSR Demokritos (NCSR D)

5G Ventures signs partnership agreement with NCSR “Demokritos”



5G Ventures signed a memorandum of partnership with the National Centre of Scientific Research “Demokritos”. The agreement is part of the strategy for the development of an ecosystem that will support the development of new generation

digital services in Greece.

According to the agreement, companies hosted at the “Lefkippos” Technology Park and spinoffs of “Demokritos” could be examined by 5G Ventures for a potential investment through Phaistos Investment Fund.

NCSR “Demokritos” will contribute, as part of incubation and acceleration programmes, in supporting businesses where Phaistos has invested, offering on a case-by-case basis:

- Access to the pilot 5G Standalone and Non-Standalone networks (5GENESIS and EVOLVED-5G) developed by NCSR “Demokritos”,
- Development, in cooperation with 5G Ventures, of testbeds for testing applications, services and technologies developed by Phaistos’ investees,
- Access to libraries, electronic knowledge bases, and excellence & innovation centres such as the Digital Innovation Hub and the Technology Parks of NCSR “Demokritos”.

5G Ventures and NCSR “Demokritos” will exchange information about technology & science, best practices on innovation -emphasizing on open innovation models-, issues connected with the development of ecosystems, and promoting entrepreneurship.

The agreement also includes:

- Provision of guidance and mentoring to enterprises,
- Organizing seminars and workshops by 5G Ventures staff or Phaistos’ investees, for the staff of the NCSR “Demokritos”,
- Organizing lectures by the scientific personnel of the NCSR “Demokritos” in seminar and workshops organized by 5G Ventures, where undergraduate and postgraduate students can attend. The lectures will focus on subjects such as entrepreneurship, investments, technology utilization, product and service development, marketing, and sales,
- Promotion partnerships with enterprises, the NCSR “Demokritos”, and the industry,
- Networking companies where Phaistos has invested in, with scientific partners of the NCSR “Demokritos” and developing and supporting Research & Development centres of the particular enterprises,
- Networking with venture capital funds and private investors.

Demokritos and Vodafone Greece join forces to create the Giga Campus



The National Centre for Scientific Research “Demokritos” and Vodafone Greece announce that they are entering into a strategic partnership, through the creation of the Giga Campus, a hub of innovation, which aims to support the acceleration of Greece’s digital

transformation through the Internet of Things (IoT) and 5G, in a Gigabit society, thus contributing to the strengthening of the country's businesses and to a more sustainable, digital tomorrow. A representative list is:

- Vodafone Smart Parking,
- Accessible Parking Monitoring,
- Smart Water Metering,
- Smart Bins Management,
- IoT Fleet Control,
- Business Temperature Tag,
- Temperature Control Advanced,
- Remote Healthcare,
- Sensing as a Service,
- Mobile Asset Tracking,

- Occupancy Control.

More info on this joint exploitation direction is available at the following video: <https://www.youtube.com/watch?v=OsCuwYC3zTU>.

More information is available at the following URL (Youtube video): <https://www.youtube.com/watch?v=OsCuwYC3zTU>

The aim of this effort is to create a model hub of innovation, the Giga Campus by Vodafone & Demokritos that will operate on the premises of Demokritos, as a living laboratory of exponential technologies that utilises the most innovative applications of the 4th industrial revolution and Vodafone's 5G network.



Figure 9: Dr Harilaos Koumaras, 5GENESIS coordinator with Dr. G. Nounesis, President of NCSR Demokritos and Mr. Kyriakos Pierrakakis, Minister of State and Digital Governance

The partnership focuses on the pilot implementation and evolution of modern IoT services - and not just them - with the aim of subsequently disseminating them in the Greek market by the Demokritos' ecosystem. Moreover, in the framework of the partnership, the start-ups that are hosted in the "Lefkippos" Technology Park of Demokritos shall be supported through Vodafone Business modern technological services.

The meeting of the two organisations, in view of the partnership launch, which took place at NCSR Demokritos in Ayia Paraskevi was attended by the Minister of State and Digital Governance, Mr. Kyriakos Pierrakakis.

Dr. Georgios Nounesis, Director and Chairman of the Board of NCSR "Demokritos" stated: "Our agreement with Vodafone Greece is a fundamental milestone for our development strategy. At Giga Campus, Greek businesses will have a unique opportunity to access IoT and 5G infrastructure, as well as create synergies with leading research teams of Demokritos. A dynamic digital innovation ecosystem is being created in Attica that will support Greek businesses on the road to their digital transformation. We are proud of our partnership with Vodafone Greece and we will work hard and systematically to achieve brilliant technological

goals, to highlight and utilize young scientists' talent and, certainly, to generate added value that will help underpin the recovery of the Greek Economy".

Harry Broumidis, Chairman and CEO of Vodafone Greece, said: "In Democritus we see a reliable partner that works with passion, so that Greece may take advantage of all the 4th industrial revolution's benefits. Vodafone consistently innovates in Greece, strategically investing in the development of cutting-edge technologies. By utilizing the power of Vodafone Giga Network 5G and the high specialization of Vodafone's global IoT research and development center in Greece, our partnership with Demokritos will accelerate our goal of ushering in the digital future, by creating a hub of innovation that will contribute to Greece's effort to make its digital leap".

The collaboration was also announced in the news <https://www.youtube.com/watch?v=szAkF0O2iIg>

Ahedd Digital Innovation Hub



NCSRD established Ahedd, a digital innovation hub, which fosters the development of an ecosystem matching the business needs of SMEs and organisations to commercial-ready solutions. Ahedd is registered in the European Commission DIH catalogue and is also a BDVA/DAIRO gold-

labelled i-space.

Ahedd Digital Innovation Hub is an ecosystem of research & corporate entities that have exceptional know-how in offering digital transformation & innovation solutions using Artificial Intelligence, 5G, Big Data and Internet of Things technologies as horizontal enablers.

Ahedd acts as a one-stop-shop for enterprises looking to enrich their competitive advantage portfolio and for public entities that need to improve their processes and services, offering business support through experimentation facilities, like 5GENESIS Athens Platform, for testing new technologies before investing, as well as through training, networking and acceleration services.

3.1.22. Primetel PLC

Primetel PLC has already gained a lot from the 5GENESIS projects in the last 42 months of its duration. Primarily 5Genesis acted as an initial trigger for Primetel to be the first in Cyprus to apply for a 5G experimental license and spectrum from the National Department of Electronic Communications (DEC) to be in position to do initial 5G pilot testing in Limassol, Cyprus. Related discussions with DEC and the National Regulator (OCECPR) especially on the frequency band and channel bandwidth gave the opportunity also to the Mobile Services Department of the company (not only R&D) to prepare 5G compatible equipment orders with existing vendors. Since 2020 has bid and obtained a 5G Commercial License (please see D7.6 for more details regarding the License).

R&D wise Primetel PLC has gained the confidence and know-how to collaborate in such integrated solutions in a safe and secure manner, acting also as a host and an integrator besides offering mobile and terrestrial communication. Leveraging on the current 5Genesis Limassol

Platform, Primetel could consider involvement in new proposals in the areas of Advanced 5G, 5G Long Term Evolution and even 6G.

Commercially and as mentioned in D7.8 [2] Primetel is also interested in expanding its portfolio of services in the IoT domain a business direction which could be highly stimulated and supported by 5GENESIS novel systems targeting new customers and/or new services provisioning for existing customers. Deploying 5G multi-access solutions through 5G/x heterogeneous network architectures in the IoT domain will offer competitive advantage for example in urban and maritime scenarios.

3.1.23. RunEL NGMT Ltd

RunEL is an Israeli SME developing technologies, products, and solutions for 5G infrastructure, more specifically RunEL developed Hardware Accelerators (defined as Sparq-2025 System on Chip) for two essential components of the 5G Base Station (gNodeB) the O-RU and O-DU (referred as RRH and DRAN in the 5GENESIS project) that are specifically designed to comply with the 3GPP URLLC requirements

The above products have been tested in the UMA test bed Platform to achieve an exceptional and record-breaking round trip latency of 1.3 milliseconds.

Based on the above results RunEL developed the Sparq-2025-P Private 5G Network Platform for vertical markets that need the specific features of URLLC as described in the figure below

The solution is a complete 5G network that include only two type of modules, The NIB (network in a BOX) and the O-RU (Radio) connected with an ethernet ring based on the ORAN PHY split interface (Split 7.2)

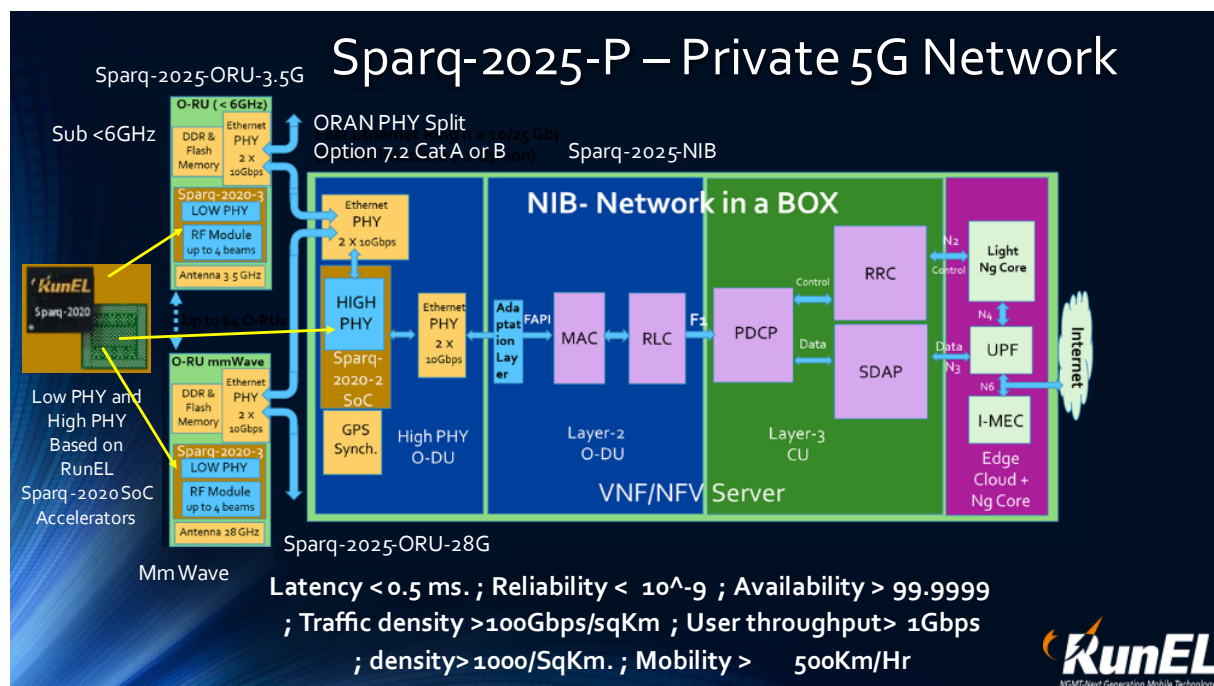


Figure 10: Sparq-2025 Private Network general architecture

The Sparq-2025-P exploitation plan is focused on the new greenfield market of Private 5G Networks described in the following Figure

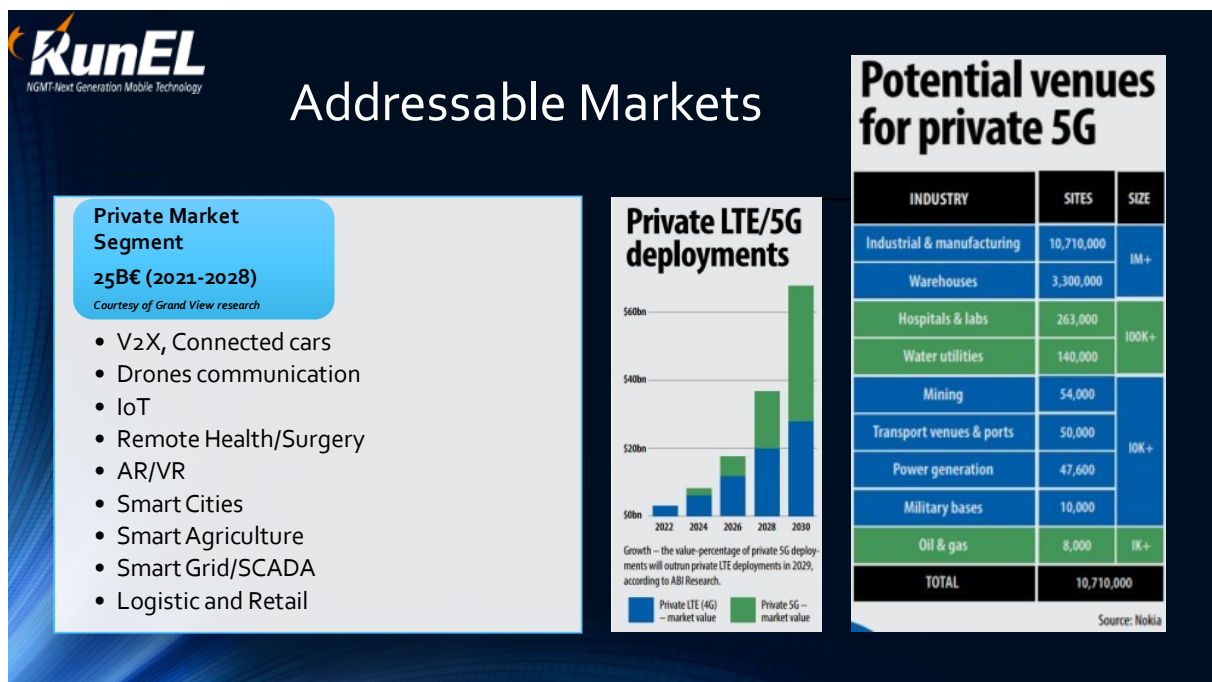


Figure 11: RunEL addressable market

In order to penetrate, exploit and be substantial player in this market, RunEL prepared a detailed marketing and sales plan based on the main assumptions and facts described in the following figure

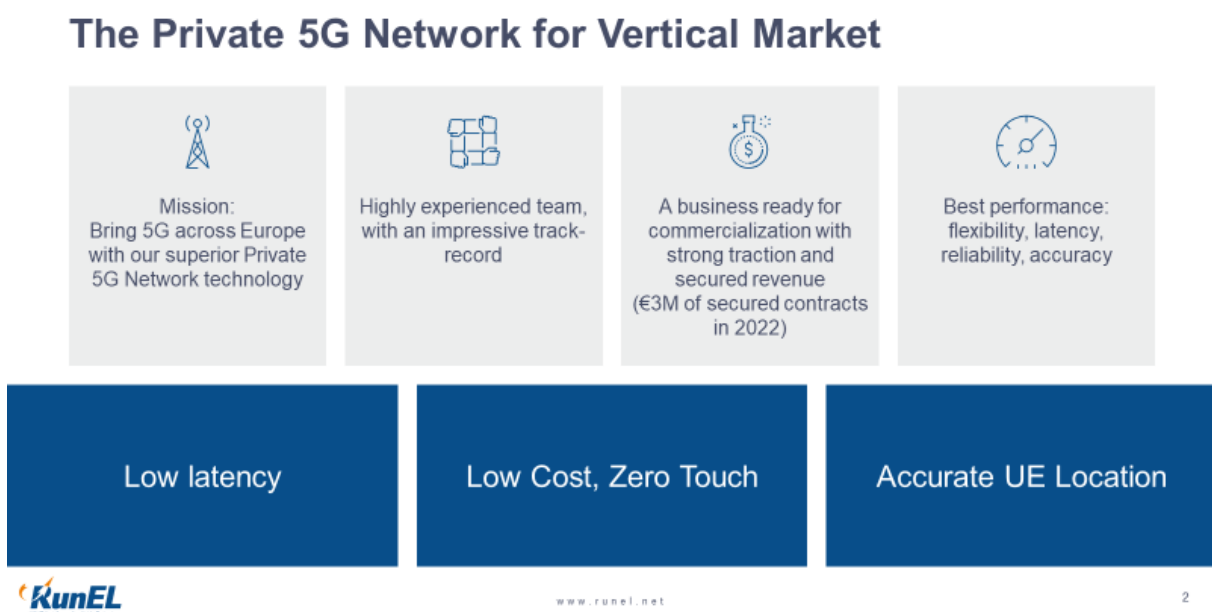


Figure 12: private Networks for Vertical markets

3.1.24. SIMULA Research Laboratory

During the 5Genesis project, SRL have gained extensive knowledge in 5G systems, especially in terms of Monitoring and Analytics of 5G systems. Being an academic partner, SRL will use this knowledge in two ways:

- (i) to train graduate students with advances in 5G ecosystem in courses and seminars in communication networks and systems,
- (ii) to conduct and publish high quality research in order to enhance SRL's impact portfolio and develop their reputation and academic profile.

In terms of training graduate students, in collaboration with University of Oslo, Simula is contributing a new course on Mobile Systems with a focus on 5G and beyond networks. This course will be a hands-on course where SRL will use both the open-source software (e.g. the open 5genesis suite) as well as open data provided by 5Genesis in the course mandatory project assignments. Furthermore, currently 2 master students are continuing their master theses on the outcome of the data produced by 5Genesis project.

In terms of publications, we have produced significant number of high-quality publications during the project lifetime which has already helped enhancing SRL's academic profile. These publications have been in collaboration with different partners. Such close collaboration has extended our networks of European research partners and has already increased our involvement in future research projects. So far, with some of the 5Genesis partners, we have submitted an H2020 project proposal and we are also working towards the upcoming Horizon EU as well as SNS calls in the Spring 2022.

3.1.25. Space Hellas (Cyprus) Ltd.

Space Hellas is one of the leading ICT systems integrators in SE Europe. SHC acknowledges the business potential of 5G infrastructure and applications and, as leader of the Limassol Platform integration and experimentation, under 5GENESIS, has implemented a portable full-stack 5G testbed (5G hotspot) which implements most features of the 5GENESIS architecture and can be used for experimentation. This has been the main tangible exploitable result of the project. In addition, SHC has acquired a very good 5G project reference and significant know-how in: 5G radio and core technologies, core and edge service virtualization and management and test automation.

Currently, SHC is exploiting 5GENESIS assets and expertise in three different dimensions:

- **Satcom-5G integration:** Space Hellas is leading the ESA DEGREES project (contract under preparation) on cybersecurity for converged satcom – 5G networks and is currently the leading technical partner in Greece and Cyprus with expertise on this convergence,
- **5G for defense applications:** Space Hellas, as a registered defense manufacturer in Greece and Cyprus, is working with another major Greek Defense industry towards prototyping a 5G testbed for tactical applications (so-called “5G tactical bubble”),

- Providing infrastructure and expertise for 5G application developers: SHC is in interaction with the “Phaistos” fund, under the auspices of the Ministry of Digital Governance, which funds startups for developing 5G applications. Space Hellas is also a founding member of “ π -NET”, the first 5G innovation hub in Greece.

3.1.26. TELEFONICA

Telefónica I+D, as the innovation legal entity within Telefónica group, will continue exploiting 5GENESIS results in several directions.

On the research side, Telefónica I+D participates in multiple H2020 projects and knowledge acquired in 5GENESIS will be a strategic asset to participate in future research programs like Joint Undertaking (JU) SNS.

On the infrastructure dimension, 5GENESIS provides a perfect Innovation Sandbox that combines the flexibility to introduce changes and new technologies in the network with the commercial use and support of the infrastructure. 5GENESIS is a giant Lab deployed in Málaga city center and UMA campus with real customers where Telefónica can innovate, tests with real customers and get feedback on these new technologies and changes in the network with controlled risk and costs.

An example of the use of this Innovation Sandbox is the national funded project “Pilotos 5G Andalucía”, where Telefónica is piloting more than 20 use cases with 5 different companies and administrations during 2021 and 2022.

3.1.27. University of Malaga

UMA will continue exploiting 5GENESIS results in the internal research and education programs related to 5G and B5G. In particular the infrastructure 5GENESIS Malaga has become a strategic asset in the research Institute for Software Technologies and Software Engineering (ITIS-UMA, www.itis.uma.es). This research infrastructure is supporting internal work in areas like Quality of Experience, end to end protocols, time sensitive networking, zero touch configuration and management, and will support new activities in digital twins, massive data analytics and cybersecurity. In parallel, the support to research expands to master and PhD students, so ITIS-UMA can offer a unique environment for attracting talent.

The availability of 4G/5G equipment as well as consultancy capacity in UMA made possible the support more than 30 SMEs and research organizations in the context of open calls in FP7/H2020 projects Fed4FIRE, TRIANGLE and Fed4FIRE+. One example is the hosting of the 6th MCS ETSI plugtest in UMA in November 2021 (<https://www.etsi.org/events/1940-6th-mcx-plugtests>). The visibility and capabilities offered now by 5GENESIS Malaga is attracting more SMEs to test their products, so ITIS-UMA will define a regular service to support such requests, potentially following the business model defined in the previous section and, when appropriate, in cooperation with other key partners like Telefonica and Malaga Police.

The development of 5GENESIS suite, where UMA has provided key components like the Experiment Life Cycle Manager, has open new opportunities in 5G PPP with the projects 5GEPICENTRE, EVOLVED5G and AFFORDABLE5G. In these projects, UMA components are used as integration tools or as validation tools, and UMA expects to continue expanding such contributions in new Horizon Europe projects, mainly within the JU SNS. In the same direction, the results coming from 5G PPP have allowed ITIS institute to apply for a €4 M set of 5 coordinated projects to create an ecosystem for research in advanced 5G and 6G in Malaga. Such coordinated project is already approved and will be managed by ITIS-UMA researchers coming from 5GENESIS with the commitment to apply to JU SNS projects.

3.1.28. Universitat Politecnica de Valencia (UPV)

UPV is a non-profit academic and research-oriented institution, with strong expertise in IoT-related technologies. The participation in the project has increased the presence of the university in the 5G research field and improved scientific indicators, and has opened additional research opportunities. The outcomes and knowledge gained in the project will be exploited for further collaborative research, education and technology transfer activities.

Regarding education, research results from the action will flow into the academic and formative curricula. Specifically,

- (i) the Open 5GENESIS suite developed within the project will be deployed and configured on internal premises, with open source 5G Radio Access Network (RAN) and Core Network (CN) technologies, conforming a small testbed for training students and researchers in the management and experimentation with 5G networks,
- (ii) UPV's software gateway, which has been used for interoperate IoT protocols and access networks (e.g., LoRaWAN) with cellular networks, has been extended and will keep on being part of UPV's portfolio to inspire students towards the design of interoperable IoT systems.

With respect of further collaborative research, participating in 5GENESIS has facilitated being member of other 5G European projects and initiatives, and the plan is to continue communicating and disseminating results for larger outreach, to both general and scientific public. Besides, as a group focused on IoT, UPV aims at bringing concepts and approaches of the 5G world to the next generation of IoT, where 5G is a key enabler. In particular, UPV plans to explore the usage of NFV-related solutions for orchestrating vertical applications in constrained, decentralised environments, typical in the IoT field.

Finally, UPV aims at promoting technology transfer by engaging industry through PoC deployments and technical fairs, leveraging 5GENESIS results and knowledge for attracting industry consulting contracts. UPV already had knowledge and custom tools (i.e., software gateway) for managing several kinds of IoT protocols and access networks, and the participation in the project has helped to increase it, with cellular-related technologies.

3.1.29. University of Surrey (UNIS)

As a higher-education as well as a research-oriented institution, the University of Surrey will exploit the outcomes and results achieved in 5GENESIS in several ways. This includes the targeted inclusion of graduate researchers in high-quality technical work to ensure the education of future research leaders in 5G technologies. The technology knowledge gained and the advances to the state of the art achieved by 5GENESIS will be used to enrich the material of relevant courses, including industrial short courses.

The outcomes of 5GENESIS are highly relevant to the Mobile Communications track of the relevant MSc courses taught at UNIS. The main aim is to educate the next generation of engineers and scientists with the latest information and research outcomes. The University will use the industrial partnership around Surrey's 5G & 6G Innovation Centres as vehicle for the exploitation of the 5GENESIS outcomes.

The facility is open to all members and partners from anywhere in the world, and a low-cost means is being introduced for SMEs and start-ups to test their innovations for 5G compatibility and showcase their products. UNIS will use the testbed as part of their involvement in 5GENESIS and intends, via the 5GIC & 6GIC, to inform some 25 of the leading telecommunication providers about the project findings and trial outcomes, thus facilitating a strong exploitation path.

3.2. Platform-specific exploitation plans

3.2.1. Intro

As a matter of fact, in a project as big as 5GENESIS, consisting of around thirty partners, it is impossible that all partners will go on collaborating on the same set of activities. That is due to the different kinds of partners (academia, industry, research centers, SME, public sector) each one with its own specific needs and strategy to be successful in its own domain. That is even more true considering the high dynamicity of the 5G markets and the related need to adapt to changes, mainly driven by external requirements, which make necessary continuous adaptation of strategic and exploitation plans from all the consortium partners.

Nevertheless, several partners managed to commit to join forces also after project end, in order to continue to provide support to the ecosystem thanks to the different focus areas and technologies developed in the five 5GENESIS Platforms.

In what follows each one of the five 5GENESIS Platform provides a plan of actions for the activities that are planned in the quarters and years after project end.

3.2.2. Athens

The Athens Platform exploitation plan is analyzed in four directions, namely:

- i) Operation as experimentation Platform for National Initiatives,
- ii) Openness of the Platform to SMEs and startups for experimentation and consultation,
- iii) Support of other research initiatives and 5G-PPP projects.

More specifically, towards these directions, the following activities have been performed:

5GENESIS Athens Platforms evolution continues by providing further support in research actions and projects towards 6G. For example, 5GENESIS Athens Platform participates in 5G-PPP EVOLVED-5G project, through which it is further upgraded with open core networks, such Open5GS, in order to support network programmability through standardized exposed APIs, such as NEF and CAPIF. These additional activities will further evolve the currently available Open5GENESIS experimentation framework in order to provide to the aforementioned activities enhance and more advanced experimentation capabilities. Similarly, 5GENESIS Athens platform supports the activities of the 5G-PPP ICT-19 5G!Drones project, extending the applicability of the Open5GENESIS suite to the drones vertical industry as well.

Towards this exploitation direction, the 5GENESIS Athens platform partners (i.e. NCSRD, COS and MoE) have closely collaborated in order to support different 5G configurations of the platform exploiting the interconnection of the three sites that compose the platform, as well as the different 5G equipment that is available at each site. For example, multi-cell setups can be provided or 5G LBO support can be delivered with distant 5G core deployment. 5GENESIS assisted the close collaboration of the Athens 5GENESIS platform partners in order to tightly combine the three sites of the platform, to evolve further the capabilities of the platform and finally provide a mature multi-domain experimentation facility.

In this framework, 5GENESIS Athens platform signed a collaboration agreement with 5G Ventures S.A. 5G Ventures Société Anonyme (“5G Ventures SA”) that has been established pursuant to Article 93 of Law n. 4727/2020 (Government Gazette A’ 184) and is a direct subsidiary of the Hellenic Corporation of Assets and Participations (HCAP SA). The purpose of the 5G Ventures SA is the establishment and management of Phaistos Investment Fund, based on the provisions of Article 7 of Law n. 2992/2002 (Government Gazette A’ 54), according to prevailing market conditions, with guarantees for full transparency and accountability and complying with International Financial Reporting Standards (IFRS). The objective of the Phaistos Investment Fund is the public investment in businesses that are actively involved in 5G-related research and/or development of products and/or services in Greece, in sectors such as transport and logistics, manufacturing, public goods and utilities, health, tourism, information and media. As a result, 5GENESIS Athens Platform through this collaboration will be able to support the development of services and products for the 5G ecosystem.

Finally, the 5GENESIS Athens Platform has joined as infrastructure the Ahedd Digital Innovation Hub of NCSR Demokritos (<https://ahedd.demokritos.gr/>), which is open to the SME and startup community for testing, validating and experimenting with novel services and applications. Therefore, the experimentation Platform of 5GENESIS in Athens reassures its sustainability by opening its access to external parties that are interested to experiment and test the capabilities of the 5G network.

3.2.3. Berlin

The Berlin Platform consists of two sites: the Berlin side at Fraunhofer FOKUS and the Frankfurt Oder side at IHP. Both partners have agreed to continue the operation of the joint, integrated testbed. Both partners will bring in the integrated Berlin-Frankfurt-Oder testbed into two Lighthouse projects of the German Ministry for Research.

Thus, the Berlin Platform will be exploited jointly towards various project partners from academia and industry. To emphasize the importance of the Berlin Platform for both partners and to underline the commitment to continue the operation, both partners have up to now -- in addition to funding received from 5GENESIS -- invested significant internal strategic funding to further enhance the Platform.

The following figure provides an overview from the Berlin Platform perspective towards funds received from 5GENESIS to build the testbed vs. additional investments of the partners towards the testbed.

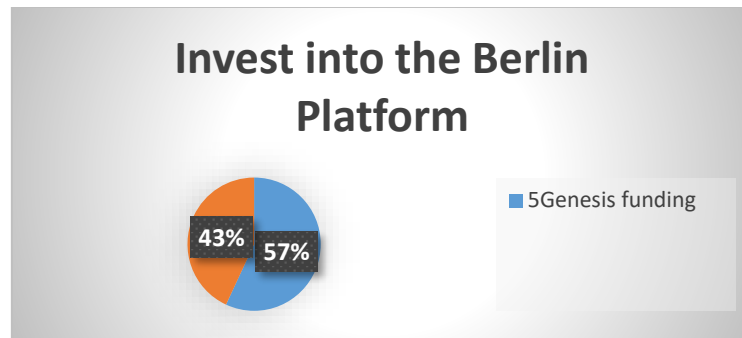


Figure 13: Split of the investments in the Berlin Platform

This additional investment into the Berlin Platform may be seen as a proof that both partners have strategic interest in maintaining the Berlin Platform operational. As such, the long-term exploitation plans for the Berlin Platform are closely linked towards the confirmed strategic cooperation between FOKUS and IHP and should be read in addition to the individual exploitation plans of FOKUS and IHP as given above.

Confirmed funding for upcoming R&D activities guarantees that the Platform will be kept operational for at least three years.

3.2.4. Limassol

The 5GENESIS Limassol Platform acted as an initial trigger for the Cyprus partners to push and obtain a 5G Experimental License from OCECPR and the National Department of Electronic Communications. Both OCECPR and the National Department of Electronic Communications have both expressed interest on current and future experimentation using the Platform.

On the partner level, the integrated Mobile/Satellite nature of the Platform allowed the involved partners to test and gain new insights, know-how and experience on the provisioning of multi-access solutions and novel services in such environments, that could be further exploited by any of the involved partners on its own end. The successful joint integration and performance testing of the Limassol Platform has also provided a high confidence level for such activities and future joint activities to all involved partners. This means similar integrated technologies and associated validation testing could be considered in future scenarios e.g., 6G/Satellite integration with much more confidence especially since the Platforms' communication part will remain intact including a "testing-only" R&D rack at the associated Data Center, as well as routers, switches, cabling and high-end servers used for the Limassol Platform, at least for the next few years to come.

The Limassol Platform and its components will be exploited in the short term:

- by fostering further research and standardisation especially in the area of 5G slicing over satellite,
- by developing credible proof-of-concept scenarios (PoCs) for 5G applicability in the maritime domain. In addition to MARAN, who has been a project partner, two more shipping companies have recently expressed their interest in 5GENESIS results and discussions are ongoing,

- by supporting (with a fee) startups and SMEs developing 5G applications, also in the frame of “ π -NET”, the first 5G innovation hub in Greece, which was launched December 2021.
- by leasing the portable 5G hotspot for on-site trials, along with technical support. There is already one such contract under preparation with a major industry,
- by pursuing further co-funded research and R&D opportunities in the frame of national or EU calls.

3.2.5. Malaga

The Malaga Platform will be mainly exploited by UMA, Telefonica and Malaga Police due to reasons like ownership of the hardware, agreements to use the spectrum and geographical situation. However, for specific cases, more 5GENESIS partners could be involved. Specific exploitation by UMA, Telefónica I+D and Malaga Police has been already discussed above. Joint exploitation will follow several directions.

The first way to exploit the Malaga Platform is according to the business model described in section 2. When the resources and expertise involved in the experiments would require more than one partner, a joint exploitation agreement will be put in place.

The second way is the identification of joint opportunities coming from competitive calls. To provide some examples, this Platform is supporting the 5G-PPP project EVOVLED5G (Telefonica and UMA), one of the consortiums in the open calls of the H2020 project Broadway (Telefonica, UMA, Nemergent and Malaga Police) and one national 5G pilot to develop private networks in Andalucía (Telefonica, UMA, Malaga Police, Intel). It is expected that same partners will join forces in the JU SNS calls.

Finally, long term collaborations around 5GENESIS results will be started in the Malaga area. Telefonica and UMA have created a chair devoted to 5G networks and services. Telefonica has one representative in the advisory board of IT IS-UMA. In addition, Telefonica and UMA are going to create a Joint Research Unit.

3.2.6. Surrey

Being led by a higher education and research-oriented institution, the main exploitation path of the 5GENESIS Surrey Platform considers further developing the gained knowledge from 5GENESIS in the Surrey academic ecosystem, as well as supporting of start-up enterprises from across the United Kingdom.

Students of all levels as well as researchers currently experience a lack of in-depth knowledge of testing complex 5G use cases, or are taught undergraduate and/or postgraduate courses that do not include complex setups that could allow them to familiarise and practice the concepts they are taught in an actual networking environment. The 5GENESIS Surrey Platform will provide them with access to a real 5G Platform for experimentation and development of cutting-edge algorithms and solutions. Students and researchers will have the opportunity to evaluate

their applications using available commercial 5G equipment at the network edge, as well as to test their VNFs for performance in a commercial grade 5G establishment. This will facilitate and improve their system knowledge and will allow them to familiarise with the latest 5G features in both the core and radio sides. Taking advantage of the availability of local Platform experts to support and help in the configuration and execution of tests and the access to the Surrey Platform indoor and outdoor testbed facilities, students and researchers will have the opportunity to incorporate the 5GENESIS testing methodologies, solutions and technologies to evaluate main network and service level KPIs, which can then be further disseminated using different avenues (e.g., dissertations, publications, etc.)

Start-up enterprises are facing the problem of non-satisfactory support by available 5G testbeds for verticals. Moreover, they need to develop in-depth system-level knowledge of 5G features and technologies, as well as 5G testing techniques. The 5GENESIS Surrey Platform, offering rich and detailed documentation on its methodologies for use case development and testing, as well as its reference reports on performance comparison between 4G and 5G networks, provides verticals with the opportunity to infer the service level impacts of their solutions. The well-structured 5GENESIS portal, which exposes the main Platform features in an easy way, as well as the cutting-edge indoor and outdoor facilities of the Platform, provide start-up companies across the United Kingdom with the opportunity to evaluate their applications as well as VNF solutions in a commercial grade setup, enjoying the support from Platform experts who will bridge the gap between complex 5G testing environments and vendor-specific solutions.

4. CONCLUSION

The activities of the 5GENESIS consortium partners on innovation management and exploitation of project results have been reported in this deliverable.

Lots of efforts have been spent on sharing best-known-Methods regarding innovation management, and the latest approaches to increase business acumen and derive potential market impact have been shared and implemented along the project lifetime.

Exemplary analysis of the two main flavours of project Platforms, i.e., the more academic-oriented and the more industry-oriented ones, have been analyzed thanks to a series of workshops held unfortunately in a virtual manner due to the COVID-19 outbreak.

Interesting results have come out, and those are reported in this deliverable touching on the most important aspects of such workshops.

Exploitation plans, both at partner-level and at Platform-level have been provided, giving a glance on what is the close future of the activities that will still cluster project partners, after 5GENESIS end.

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