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Report on Exploitation Y2

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Abstract

This deliverable has been created as part of the work in the project Work Package (WP) 6 "Promotion" and reports the activities performed for exploitation of project results toward vertical stakeholders. It presents the activities performed in terms of the planned organization of training workshops mainly targeting transport, public safety, and rural communities.

Keywords

Dissemination, exploitation, user groups, workshops, vertical markets

Acknowledgements

Executive Summary

This deliverable corresponds to the second of a total of three deliverables, concerning the exploitation activities of the 5G-ALLSTAR project within the scope of WP6 focusing on promotion. In this second document, we report activities that both each partner and the consortium performed during the second year, including those already reporting in terms of progress in D6.9.

More specifically, it details the exploitable knowledge developed by each partner involved in the task, and the individual exploitation actions.

The reports that will follow in Y3 (M36) will present the activities effectively performed in the relative period.

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List of Abbreviations

3GPP	3rd Generation Partnership Project		**MIST**	Korea's Ministry of Science and ICT
4G	4th Generation mobile network		**mmWave**	Millimeter wave
5G	5th Generation mobile network		**MN**	Moving Network
B2B	Business-to-Business transaction type		**MNO**	Mobile Network Operators
B2C	Business-to-Consumer transaction type		**PoC**	Proof of Concept
CAN	Controller Area Network		**R&D**	Research & Development
EPC	Evolved Packet Core		**RAN**	Radio Access Network
GEO	Geostationary Earth Orbit		**RAT**	Radio Access Technology
HAPS	High Altitude Platforms		**SA(n)**	3GPP's Service and System Aspect meeting
IP	Intellectual Property		**SME**	Small and Medium Enterprise
IPR	Intellectual Property (Rights)		**SNO**	Satellite Network Operators
KPI	Key Performance Indicator		**V2X**	Vehicle to Everything
LEO	Low Earth Orbit		**WAVE**	Wireless Access in Vehicular Environments
MEC	Multi-access Edge Computing		**WN**	Wireless Communication and Network

1 Introduction

The results already obtained within the context of 5G-ALLSTAR and the expected results of the project suggest a viable exploitation of them for commercial use.

In this document, we report project's results, based on the plan established in D6.9 for the exploitation toward vertical stakeholders in the transport, public safety markets, and rural communities.

Among these activities, we identified two main activities to foster project's innovations awareness, and future diffusion:

1.	The development of potential user and key stakeholder groups in the identified verticals;

2.	The organization of training workshops where the opportunity of satellite 5G and multiconnectivity are presented.

To assure a successful outcome, these activities are expected to be performed by project partners, both in Europe and Korea. In the following sections, we report them, their expected outcomes, the risks assessment and the mitigation plan.

## 1.1	Context of this document

This deliverable corresponds to the first report of a series of three documents planning and then reporting the activities for fostering project's results exploitation for vertical markets.

This document is a deliverable within WP6, Task 6.3 "Business models and focus exploitation for vertical markets". The objectives of Task 6.3 can be summarized as follows:

1.	Refine the business models/cases for the proposed 5G-ALLSTAR multiple access concept, initially developed within Task 2.4, and summarized in D2.4, along project's journey.

2.	Set-up user groups from the targeted verticals in the area of transport (e.g. Railway Transportation sector which is actually active in 3GPP), public safety and rural communities.

3.	Organize training workshops with representatives from the targeted verticals on the 5G-ALLSTAR defined solutions and developed technologies to collect feedback on the relevance of the business models and KPIs achieved.

The present deliverable document D6.10 reports the activities performed by project partners for the exploitation toward the targeted vertical markets.

2   Planned activities

In D6.9 of WP6, Task 6.3 "Business models and focus exploitation for vertical markets", we report the knowledge for each partner involved in the task, and the individual exploitation plan. In the document, some partners had already detailed the exploitable knowledge they developed within the project, and the anticipated opportunities for exploitation. With D6.10, we extend the previous report to account for the additional activities performed in the latest 6 months since the delivery of D6.9 the 31/12/2019.

2.1   Exploitable results

The following table reports the main exploitable 5G-ALLSTAR results along their descriptions and supposed mean of exploitation as previously identified.

Table 2 1: Exploitable Results

Exploitable Result	Means of exploitation
Identification of potential use cases and related requirements and design of system architecture with required functionalities.	By **telco operators** to setup a heterogeneous 5G network comprising satellite and terrestrial wireless networks. By **service providers**, which can be provided with a key reference capable of creating new business models and facilitating the development of new applications. By **standardization bodies** to update relevant standards.
Analysis, simulation results and interference mitigation algorithms regarding spectrum sharing between satellite and cellular systems	By **telco operators** to optimize cell plan to minimize the interference with satellite links By **SNOs** to minimize interference and improve service quality By **standardization bodies** to develop specification that can avoid interference between cellular and satellite systems By **regulatory bodies** to harmonize and optimize spectrum resources
Open source channel model (e.g., geometry-based channel model) allowing a common framework for cellular and satellite	By **telco and SNOs operators** to use for the optimization of cell planning for both cellular and satellite systems by predicting and avoiding possible coverage holes. By the **research community** to model and assess 5G systems including cellular and satellite systems.
PoC testbeds and trial platforms	By **standardization bodies** to validate the benefits of some concepts. By both **SNOs** and **MNOs** (Mobile Network Operators) to identify some viable interoperability scenarios.

The expected exploitable results cover a broad spectrum of possible applications and transversal addressable markets, namely telecommunication, satellite and mobile operators, and service providers. Beyond these economic actors, standardization and regulatory bodies, and the overall research community may benefit from project results.

At the same time, within 5G-ALLSTAR we directly address vertical markets to foster adoption and facilitate knowledge transfer, eventually resulting in a faster business exploitation of the

early results. Therefore, the partners of the project will coordinate their effort to address them directly and in accordance with their unique strategies.

2.2 Stakeholders Interests in the project

Table 2.1 below summarizes the objectives of exploitation of the partners in the consortium. Details are further presented in the Section 3.

Table 2 2: Identified objectives of exploitation

Partner (Role)	Exploitation interest	Exploitation Overview	Target Vertical Market
GEM (Business school)	Business models Business R&D	**Short term:** increasing the understanding of the reconfigurations of business models following the introduction of 5G networks and virtualized infrastructures. **Long term:** leverage the competences developed in the impacts of 5G on business models to study the condition that facilitates technology adoption and digital innovation diffusion	No single target market, but prioritizing the study of those identified within the project: transport, public safety markets, and rural communities
HHI (Research Institute)	Integrated terrestrial / satellite channel model based on Quadriga	Further increase the user base of Quadriga by adding features that allow the satellite communications community as well as the vertical industry to get an understanding of the physical characteristics of the terrestrial radio access network and especially the impact of an overlay satellite constellation on top of that.	No specific target vertical market.
CRAT (Research consortium)	Traffic Flow controllers for Multi-Connectivity; Quality of Experience management systems	**Short term:** increasing the expertise of the company and general awareness regarding 5G by teaching activities and workshops in the masters held at the Universities constituting CRAT; dissemination of the scientific results of the project; development of a prototype for the demonstration of the proposed solutions starting from the PoC of the project. **Long term:** Contacts with SMEs and general technology transfer activities for the development of a market-ready solution that derives from the results of the project; Involvement in new and more advanced research projects.	No single target market, but prioritizing the study of those identified within the project: transport, public safety markets, and rural communities
ETRI (Research Institute)	Product, Standard and R&D (mmWave-band vehicular communication systems)	**Short term:** dissemination of the scientific results of the project; development of a prototype system for the demonstration of the proposed solutions. **Long term:** continuous participation in relevant standardization activities to secure IPRs from research results; technology transfer to Korean SMEs through	No single target market, but prioritizing broadband Wi-Fi service on public transportations (e.g., trains,

		technology licensing, allowing them to reduce their R&D costs and strengthen their competitiveness; Involvement in new and more advanced research projects.	city/express busses) and other V2X applications
KT SAT (Service Operator)	Service	**Short term:** dissemination of the scientific results of the project; development of a prototype system for the demonstration of the proposed solution by aspect of satellite-based **Long term:** exploration how to this project outcome enable to develop global satellite business market and technologies to global customers	No single target market, but prioritizing the study of those identified within the project: transport, public safety markets, and rural communities
SKT (Service Operator)	Service	**Short term:** dissemination of the scientific results of the project; development of a prototype system for the demonstration of the proposed solution **Long term:** exploration how to this project outcome enable to develop next cellular network technologies	No single target market
KATECH (Research Institute)	Service R&D (mmWave band vehicular communication systems for connected and automated vehicle application)	**Short term:** dissemination of the scientific or technical results of the project **Long term:** following standardization activities in ITS standardization in terms of hybrid V2X service for connected automated driving system	No single target market, but prioritizing the study of those identified within the project: transport, public safety markets, and rural communities
SnetICT (Enterprise)	Service, R&D (mobile core network solution for automated vehicle application using multi-connectivity)	**Short term:** development of a prototype system for the demonstration of the proposed solutions. **Long term:** announcement and publication of research results; Discover business models and analyze technology economics related to market	No single target market, but prioritizing the study of those identified within the project: transport, public safety markets, and rural communities

3 Exploitable Knowledge and Individual plans

3.1 Grenoble Ecole de Management (GEM)

GEM is a leading European business school which mission is to accompany corporate performance by providing the knowledge, skills and talent to meet the economic challenges firms face today and prepare them for those that still lay in the future. As both a teaching and research institution, GEM's objective in the project concerns the development of expertise and the identification of the emerging business opportunities of 5G multi-connectivity.

3.1.1 Exploitable Knowledge

The following table identifies the exploitable knowledge developed by GEM in the context of the project.

Table 3 1: GEM's exploitable knowledge

ID	Exploitable Knowledge	Target Vertical Market	Timeframe	Possible IP protection or exploitation
1.GEM	Business models of satellite 5G	No single target market, but prioritizing the study of those identified within the project: transport, public safety markets, and rural communities	3 years	Know-how
2.GEM	Capabilities of multi-connectivity 5G	No single target market, but prioritizing the study of those identified within the project: transport, public safety markets, and rural communities	3 years	Know-how

3.1.2 Progress and outcomes

GEM activities focused on the accumulation of the knowledge necessary to frame the overall opportunity of multi-connectivity and 5G. Specifically, we focused on the analysis and understanding of the expected impacts and opportunities through the Delphi study and an analysis of the available documentation concerning current 5G based satellite businesses.

The COVID pandemic has largely affected GEM's operations putting on halt our research projects. We kept our ongoing gathering of the available documentation on 5G based satellite businesses. The activities are being resumed, and a set of new interviews with key informants is planned to enrich the analysis. However, participation in workshops and contacts targeting vertical stakeholders were postponed.

3.2 Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute (HHI)

The core competence of HHI is in the areas of mobile broadband systems, photonic networks, and electronic imaging technology for multimedia. The Wireless Communication and Networks (WN) department develops solutions within the broad area of wireless communication systems and networks ranging from information theory via channel measurement, algorithm and protocol design, system and network simulation right through to the implementation of algorithms in demonstrators and tests in the field.

Conducting workshops to introduce stakeholders to the software and demonstrating its applicability in the design process for new solutions in the field of mobile communications play an essential part of our exploitation strategy.

3.2.1 Progress and outcomes

The refinement of our Quadriga channel model software with respect to satellite scenarios is still ongoing. A publication is currently drafted to introduce the latest version to the research community.

3.3 Consortium for the Research in Automation and Telecommunication (CRAT)

CRAT expects to reinforce and develop its collaboration with the consortium's members, in particular with end users and other research centers. The collaboration with the end users will enable CRAT to acquire familiarity with realistic and high-end testbeds, allowing the development of new researches in the scope of 5G, compliant with the latest standards and state of the art demonstrators.

3.3.1 Exploitable Knowledge

The following table identifies the exploitable knowledge developed by CRAT in the context of the project.

Table 3 2: CRAT's exploitable knowledge

ID	Exploitable Knowledge	Target Vertical Market	Timeframe	Possible IP protection or exploitation
1.CRAT	Traffic Flow Control algorithms and solutions	Every utility network (power, gas, water, transport…) control system may benefit from some of the results developed in WP4, even if the main target market is, by design, Telco operators.	3 years	Know-how
2.CRAT	QoE-aware traffic steering	Quality of Experience-based control systems are an emerging solution for 5G service provision. No particular vertical has been identified among the ones identified by the project as the most impactful for 5G.	3 years	Know-how
3.CRAT	Adaptive video streaming tailored to satellite 5G	Entertainment and media delivery systems	3 years	Know-how

3.3.2 Progress and outcomes

CRAT completed the methodological development behind the multi-connectivity algorithms of WP4. The acquired know-how allowed the universities that constitute CRAT to update the material of their courses (in particular the graduate courses of Control of Communication and Energy Networks and Control of Multi-Agent Systems held at the university of Rome "La Sapienza") and to held several seminars for the general public and the engineering students.

The activities for the development of the PoC related to the activities of WP4 are being continued as planned in the GA and a preliminary ad-hoc demonstrator for the modules under CRAT's responsibility is being tested.

3.4 Electronics and Telecommunications Research Institute (ETRI)

As a government funded research institute and a key technology innovator in Korea, ETRI is carrying out numerous research projects on developing 5G and future mobile communication systems. As an extension of ETRI's previous and current research, 5G-ALLSTAR project provides a great opportunity to exploit our accumulated technical expertise and outcomes of previous research to facilitate technological evolutions of this project, primarily focusing on cellular and satellite multi-connectivity technology and its applicability to mmWave-band vehicular communication systems through a close collaboration between European and Korean partners.

3.4.1 Exploitable Knowledge

The following table identifies the exploitable knowledge developed by ETRI in the context of the project.

Table 3 3: ETRI's exploitable knowledge

ID	Exploitable Knowledge	Target Vertical Market	Timeframe	Possible IP protection or exploitation
1.ETRI	IPRs related to the specification design and the developed key enabling technologies for mmWave-band vehicular communication system	No single target market, but prioritizing broadband Wi-Fi service on public transportations (e.g., trains, city/express busses) and other V2X applications	3 years	Know-how
2.ETRI	Software/hardware design (e.g., source codes and associated technical documents) of mmWave-band vehicular communication system with beam switching and cellular-satellite multi-connectivity techniques	No single target market, but prioritizing broadband Wi-Fi service on public transportations (e.g., trains, city/express busses) and other V2X applications	3 years	Know-how

3.4.2 Progress and outcomes

During the first year of the project, ETRI implemented the first version of a trial platform for a mmWave-band vehicular communication system called Moving Network (MN) system. A preliminary test was conducted in the center of Daejeon city, which successfully validated that the MN system with the developed beam switching technique can achieve a peak physical layer data rate of up to 2.5 Gbps and a satisfactory performance was observed even when the vehicle changes lanes or overtakes.

During the second year, ETRI is mainly working on the enhancement of the trial platform developed in the first year, including the stabilization of each protocol layer (L1 and L2/L3) and the interworking testing between the different protocol layers. The functional test of L1 and L2/L3 modules was almost completed and an indoor demonstration with the developed L2/L3 modules has been conducted successfully, showing that the developed L2/L3 modules are capable of supporting 4K video streaming service on YouTube. In addition, by integrating the developed

L1 and L2/L3 modules, ETRI is implementing and testing key functionalities, HARQ and handover procedures, into the MN system, which will be being tested along with multi-connectivity functionality for cellular and satellite link integration during the third year of the project.

Several scientific publications including both journal and conference papers have already been produced by ETRI, and in 3GPP SA5 meeting, ETRI's proposal on defining use case for multi-RAT load balancing associated with a satellite RAN and a terrestrial RAN has been approved.

3.5 Korea Telecom Satellite (KT SAT)

As a wholly owned by KT Corps, the largest telecom/media service provider in Korea, KT SAT is the only one satellite service provider in Korea. As a part of customer service, KT Sat provides satellite-based mobile communication backhaul for LTE coverage over remote area using LTE Femtocell and satellite links.

3.5.1 Opportunities for Exploitation

Currently, global satellite industry including KT SAT, is under conduct researching with a lot of interest in interworking technologies between satellite and 5G, such as 5G-ALLSTAR project. KT SAT expects to be able to acquire technologies and expertise to provide multi-connectivity services to customer on moving vehicle (such as cars, vessels, etc.) by successfully executed 5G-ALLSTAR project.

3.5.2 Progress and outcomes

KT SAT will strive to develop this service continuity use-case on moving vehicle or applying other use-cases to provide service to our (potential) customer through 5GSAT multi-connectivity technique mainly in terms of service continuity, which will be based on the technique performed our jointly test.

In addition, KT SAT will promote our jointly test results to (potential) customers and will contribute to various space-scientific journals with related organization.

3.6 SK Telecom (SKT)

SK Telecom is the largest mobile operator in Korea with nearly 50 percent of the market share. The company successively commercialized 5G network on December 1st, 2018 and launched the world's first 5G B2B service for smart factory. Then the company commercialized the world's first 5G smartphone for 5G B2C service, Samsung Galaxy S10 5G, for purchase in Korea starting April 3, 2019.

3.6.1 Exploitable Knowledge

The following table identifies the exploitable knowledge developed by SKT in the context of the project.

Table 3 4: SKT's exploitable knowledge

ID	Exploitable Knowledge	Target Vertical Market	Timeframe	Possible IP protection or exploitation
1.SKT	Service feasibility for mmWave solutions, architecture design know-how for inter-operable systems between cellular and sate-lite systems	No single target market, but prioritizing mmWave service for 5G	3 years	Know-how

3.6.2 Progress and outcomes

SKT attended in 3GPP standardization activities relevant to mmWave systems and cellular and satellite multi-connectivity technologies. And the company exploited lessons learned of the research results of 5G-ALLSTAR project including IPRs (e.g., patents) and outcomes of software/hardware design (e.g., source codes and associated technical documents) to evolve SKT's 5G network. The company provided the outcomes of mmWave services with the partners of 5G-ALLSTAR project

3.7 SNET Information and Communication Technology (SnetICT)

The core capability of SnetICT is to develop core network solutions that provide 5G heterogeneous access through multi-connectivity research.

3.7.1 Progress and outcomes

SnetICT has implemented the first trial version of 5G core network system based 3GPP standard specifications for vehicular communication system called Moving Network (MN). Through the verification of MN service, we tested fundamental functions of control plane and data plane.

3.8 Korea Automotive Technology Institute (KATECH)

KATECH in Korea is the Korea's only R&D institute specializing in automotive parts providing comprehensive and systematic technical support and playing a leading role in technology development. KATECH has been established with government and private fund to support systematic R&D for auto part industry in Korea based on "Industrial Technology Innovation & Promotion Law". With rich experience and knowledge of automotive communication system such as CAN, WAVE, Wi-Fi, etc., KATECH will develop traffic aggregation technology among 5G network, satellite modem, and Wi-Fi network. KATECH will also provide urban type smart vehicle testbed supporting various communication system such as WAVE, Wi-Fi and 5G for 5G-ALLSTAR Korean trial.

3.8.1 Progress and outcomes

During the first year of the project, KATECH designed the data aggregation system supporting multi-connectivity, a so-called Traffic Controller (TC), for acquiring data from both a mmWave-band vehicular communication system and a satellite communication system.

During the second year, KATECH is mainly working on the developing data aggregation test platform to test and to evaluate the data aggregation algorithm for supporting multi-connectivity access between mmWave-band vehicular communication system and a satellite communication system. The basic functional test of the data aggregation system was almost completed.

4 Conclusions

This deliverable document D6.10 "Report on Exploitation Y2 defines the proposed activities for 5G-ALLSTAR project results exploitation.

In this document, we first summarize expected exploitable knowledge of the main stakeholder and their progress toward the identified verticals in the area of transport (e.g. public safety sector, Railway Transportation), public safety and rural communities, and toward different addressable markets depending on their individual strategies (e.g., SMEs, B2B, B2C). It describes the progress in the exploitation of the identified exploitable knowledge on a by-partner basis, and addresses the current progress and outcomes up to this stage of the 5G-ALLSTAR project.

Overall, the timeframe for 5G-ALLSTAR project results exploitation corresponds mainly to the mid-term, targeting +3 years. The COVID-19 pandemic affected our capacity to diffuse the developed knowledge and directly affect the vertical stakeholders. We hope that as the situation stabilizes, more contacts and activities will resume.