E16 - Intermediate report on dissemination, exploitation and academic activities v4.0

31/12/2023

SP2
TSI-063000-2021-6
OPEN6G

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Editor Principal	Carmen Delgado Pinillos
Contribuyentes	Esteban Municio Hernández, Ginés García Avilés, Xavier Costa Pérez
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Nivel de diseminación	
PU	Publico
PP	Restringido a otros participantes del programa
RE	Restringido a un grupo especificado por el consorcio
CO	Confidencial solo para miembros del consorcio

Tipo	
PR	Prototipo
RE	Reporte
SP	Especificación
TO	Herramienta
OT	Otro

	Histórico de versiones del documento			
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Table of Contents

List of Tables

List of Figures

Acronym List

3D	3 Dimensional
5G	5th generation mobile network
5G-NR	5G-New Radio
6G	6th generation mobile network
ACK	Acknowledgements
AI	Artificial Intelligence
AI4CI	Artificial Intelligence for Connected Industries
B5G	Beyond 5G
BsC	Bachelor of Science
CCL	Compute Continuum Layer
DAEMON	Adaptive and Self-Learning Mobile Networks
EU	European Union
GNSS	Global Navigation Satellite System
IoT	Internet of Things
INSTINCT	Integrated Sensing and communications for Future Interactive, Immersive, and Intelligent Connectivity Beyond Communications
ISAC	Integrated Sensing and Communications
MsC	Master of Sciences
MWC	Mobile World Congress
NI	Network Intelligence
O-RAN	Open Radio Access Network
ORIGAMI	Optimized Resource Integration and Global Architecture for Mobile Infrastructure
PhD	Philosophy Doctor
PRTR	Plan de Recuperación, Transformación y Resiliencia
RAN	Radio Access Network
RIS	Reconfigurable Intelligent Surfaces
SCWE	Smart City Expo World Congress
UAV	Unmanned Aerial Vehicle
UNICO	Universalización de Infraestructuras Digitales para la Cohesión
UPC	Universitat Politècnica de Catalunya
UPF	Universitat Pompeu Fabra
ZTL	Zero-Trust Exposure Layer

1 Executive Summary

This document represents the deliverable E16 "Intermediate report on Dissemination, Exploitation and Academic Activities", envisaged in the framework of Open6G TSI-063000-2021-6's Work Package 6 (P6). It includes the updated list of activities of dissemination, exploitation and academic activities performed during the second part of the project. All these activities aim at promoting the Open6G TSI-063000-2021-6 project and its results beyond the project's own community.

The three main objectives of this deliverable are to update the dissemination activities carried out during the project's life, to update the exploitation plan and its achievements to date, and to elaborate on the academic activities performed during the duration of the life of the project. This deliverable includes detailed information about the type of impact of each activity performed within the second part of the project. The dissemination activities include those tasks boosting awareness of Open6G TSI-063000-2021-6 results in the scientific community, working on the same research field. In general, this has been carried out through publications in high-impact journals/magazines, presentations in high-quality conferences and forums, and participation in technical events. This also includes the dissemination of Open6G TSI-063000-2021-6 contributions in a way that is easily understood by a non-specialist audience, e.g., the media and the general public. The exploitation plan covers activities aiming at promoting the ideas and results in further research activities other than those covered by the project, such as developing, creating and marketing products or processes, as well as creating and providing a service not only as scientific publications but also as technology transfer. Finally, this deliverable also reports on the academic activities that seek to ensure the integration of the Open6G TSI-063000-2021-6 contributions into the academic community.
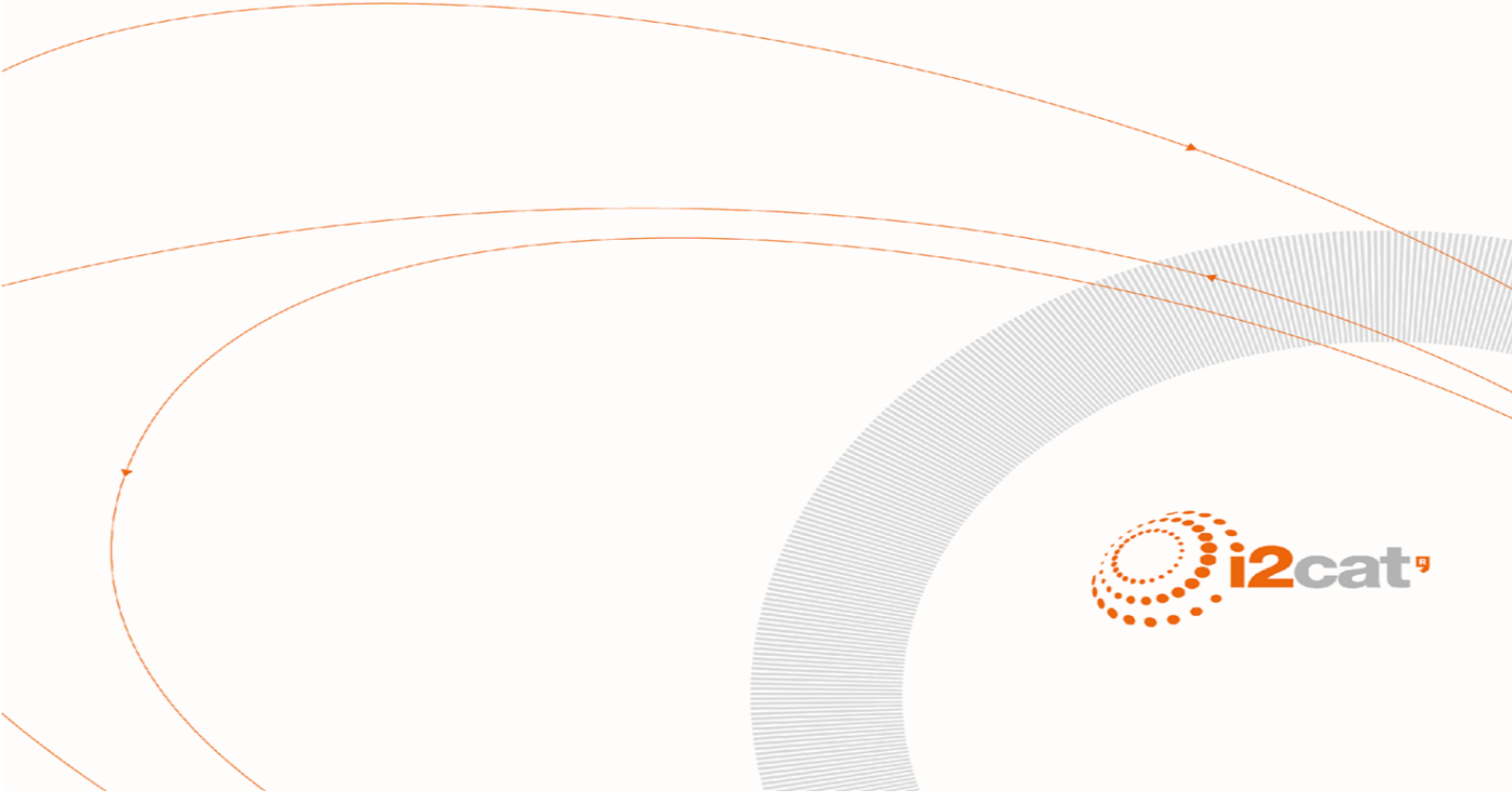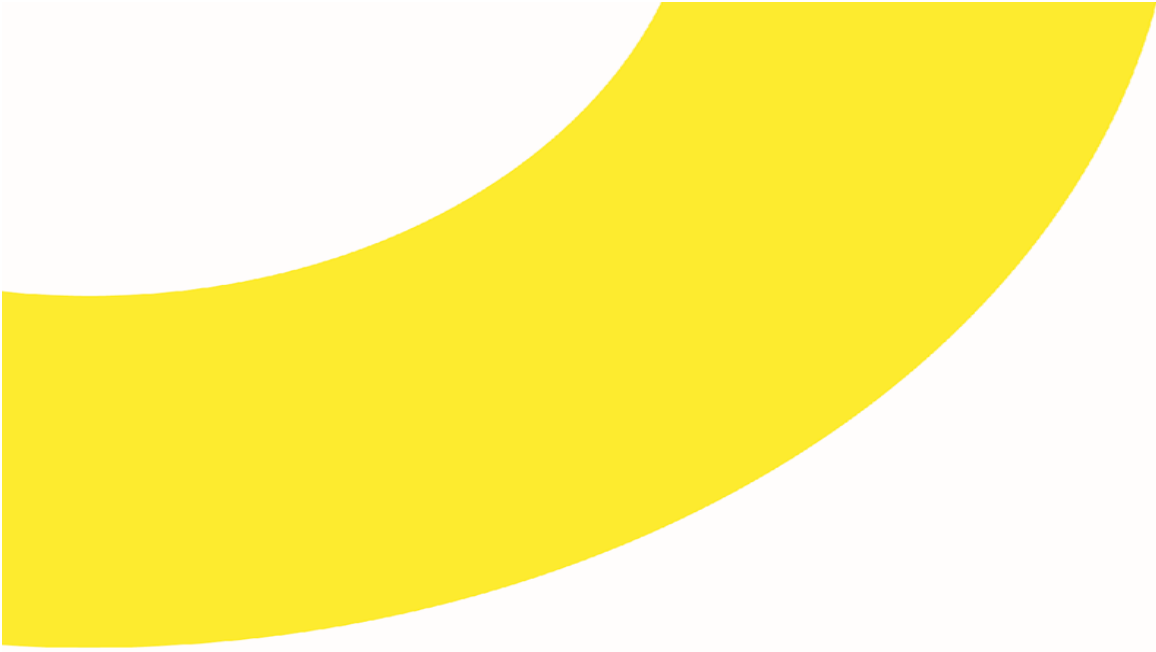
2 Introduction

2.1 Objectives of this deliverable

The Dissemination, Exploitation and Academic Activities deliverables of the Open6G project aim at describing the tools and strategies used for the creation of impact related to the results of the project, detailing the plan and the activities performed throughout its execution.

Open6G Dissemination, Exploitation and Academic Activities Work Package (P6) covers the following three types of activities:

- Dissemination activities: These activities have the goal of raising awareness of Open6G results in a technical community, i.e., working in the same field of research. These activities will usually be performed through peer-reviewed publications in scientific conferences and journals, and through participation and organization of technical events (e.g., workshops, tutorials, etc.). However, this will also include communication activities encompassing all actions concerning the promotion of the project and its results beyond the project's own community. In this way, the target will also include the general public, i.e., non-specialists, and the message shall be encoded in a way that is understood by this audience.
- Exploitation activities: These activities cover initiatives that foster further research activities, i.e., other than those covered by Open6G. These include (i) activities to develop, create and market products or processes, (ii) activities to create and provide a service, and (iii) standardization activities.
- Academic activities: There will be different academic activities carried out to strengthen the links between academia and research. Some of these activities will be the publication of results in some of the most prestigious international specialized magazines, participation in conferences of recognized prestige, dissemination of the obtained knowledge through its incorporation to Spanish Universities Philosophy Doctor (PhD) programs with a solid research focus in telecommunications, mathematics and computer science research. PhD Program on Network Engineering, degree and master thesis in the framework of the project and demonstrators as a proof of concept of the obtained results.

These core activities are key to maximizing the impact of the Open6G project results and ensuring a positive outreach of the project, ultimately facilitating the process of potential exploitation by different industry sectors and/or enhanced work by the academia. It is crucial to disseminate the findings of such innovative actions, in order to foster more innovation, feed positive synergies which may accelerate development and implementation and, for specific industry partners, market competitiveness. For this reason, in this deliverable, we will detail all the activities performed during the project life that aim at achieving these objectives.

2.2 Status of this deliverable

This is the second deliverable from Work Package 6 (P6) (Dissemination, Exploitation and Academic Activities): "Intermediate report on dissemination, exploitation and academic activities". During the first deliverable of this Work Package ("Initial report on dissemination, exploitation and academic activities"), we described the Open6G TSI-063000-2021-6 planned activities related to the promotion of the project.

Now, in this second deliverable, we report the updated list of dissemination, exploitation and academic activities with those performed during the second part of the project. Furthermore, at the end of the project we will update all the activities in the "Final report on Dissemination, Exploitation and Academic Activities".

In Table 1 we show the status of the Work Package 6 deliverables:

Table 1: OPEN6G SP2 P6 Status

P6: Dissemination, Exploitation and Academic Activities		
Deliverable	**Due Date**	**Status**
SP2 - E15 Initial report on dissemination, exploitation and academic activities	31/12/2022	Submitted
SP2 - E16 Intermediate report on dissemination, exploitation and academic activities	31/12/2023	This deliverable
SP2 - E17 Final report on dissemination, exploitation and academic activities	31/12/2024	Pending

2.3 Target Audience

This document is intended to be of interest to all audiences, so that the proposed dissemination, exploitation, and academic activities can be easily understood. Interested readers, as well as the entities involved in the project, can enrich the set of impact-creation activities with the aim of maximizing the visibility of the project.

2.4 Deliverable Structure

This deliverable is structured as follows:

Section 1 and Section 2 present the executive summary and the introduction of the document, which define the scope, objectives and current status of the deliverable, and provide insights about the target audience and the document's structural organization. Section 3 addresses the Communication Strategy. Section 4 focuses on the

Dissemination Strategy, including the scientific publications, dissemination events and collaboration with other projects. In Section 5 we present the Exploitation Strategy, updating the previous plans regarding the exploitation of the project. Section 6 explains the academic activities. Finally, the document concludes in Section 7, by briefly explaining the deliverable content.

3 Communication Strategy

3.1 Communication Plan

As detailed in the previous deliverable, the "Initial report on Dissemination, Exploitation, and Academic Activities", an adequate plan is needed to create a significant impact on the public or audience of interest. This section presents the updated strategy to be followed to achieve successful communication of the project results and how it has been implemented so far.

The results generated by the project will be made known to the general audience and/or to a specialized audience, presented with a clear project brand, embarked on the "Universalización de Infraestructuras Digitales para la Cohesión" UNICO I+D 6th generation mobile network (6G) program, a defined target audience, an activity identified to disseminate the results, and an appropriate work schedule.

The dissemination plan is a key part of the creation of impact in the Open6G project. This plan, as will be later detailed, comprises various ways of presenting, and discussing project solutions and approaches, including participation in fairs, summits, workshops, and conferences; production of magazine articles; also, organization of dedicated events through which to approach the large professional network and digital communities of stakeholders in the field of 5th generation mobile network (5G), Artificial Intelligence-driven Open Radio Access Network (O-RAN), Integrated Sensing and Communication (ISAC) systems and Reconfigurable Intelligent Surfaces (RIS).

3.2 Communication Tools

The UNICO I+D 6G Open6G website[1] will continue to have an important role in the dissemination and communication activities since it has been designed to operate as a "dissemination and promotion" center and give the public access to various materials, from technical specification and reports (i.e., project deliverables, white papers, etc.); extending to press releases, blogs, videos, news about events and activities taken at major conferences and exhibitions (e.g. demos, stands, presentations, etc.). Therefore the website will continue to be the main platform to disseminate and communicate the results of the Open6G project to a general audience. Figure 1 presents the front page of the UNICO I+D 6G program website.

The website has been created under the responsive design criteria in order to guarantee the best user experience whether viewed on a desktop or a smartphone. Also, the website has been designed to be compliant with the Visual Identity requirements established by Plan de Recuperacion, Transformacion y Resiliencia (PRTR) from the Spanish Government, see Section 7.3 (Visual Identity) at this link[2].

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[1] https://i2cat.net/unico/open6g/
[2] https://planderecuperacion.gob.es/identidad-visual.

Figure 1: UNICO I+D 6G program website

On this website, a dedicated subsite is integrated for the Open6G project. The subsite offers a general description of the project and its main objectives and a brief reference to the principal investigator. All the information about the project's activities (past, ongoing, upcoming), developments, and results will be accessible from the Open6G subsite. Figure 2 presents the front page of the Open6G I+D 6G program website.

Additionally, the Open6G subsite already includes pages where to disseminate the results achieved in the project. Specifically, the website incorporates a "News" section to communicate the different phases of the project as well as the achievements reached within it. The website also includes a "*Documents*" section which offers open access to all the scientific publications (e.g. journals, conferences, workshops, etc.) and links to the code repositories with the resulting software. The Open6G subsite will also include links to other relevant websites from the project's point of view, such as the code repository, or links to the project's publications.

The URL for Open6G subsite is the following: https://i2cat.net/unico/open6g/

In order to ensure the sustainability of the project results, the UNICO I+D 6G program website will be available for at least two years after the project's end.

Figure 2: Open6G program website

Open6G will be present in social networks as well. News, events and achievements from the project will also be disseminated through LinkedIn and X (formerly Twitter).

The i2CAT X[3] account will help when disseminating news, events, and achievements from the project. Open6G social presence will also extend to the i2CAT LinkedIn[4]. Figure 3 depict some examples of interactions/posts/updates made by i2CAT and the subcontractors through LinkedIn. And Figure 4 shows an example of update through the i2CAT's X account.

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[3] https://twitter.com/i2CAT
[4] https://www.linkedin.com/company/i2cat/

Figure 3: Example of posts through LinkedIn by i2CAT and subcontractors

Figure 4: Example of update through the i2CAT's X account

The i2CAT Communications department will closely work with the project's research team to keep track of the project and elaborate press releases when new achievements might be of interest to the media. i2CAT will also mention it in other external campaigns aimed at disseminating the i2CAT's 5G and 6G research strategy.

3.3 Visual identity of promotional materials and Templates

Additionally, in order to inform the public when organizing or participating in events, leaflets, brochures and posters are key elements to disseminate information about the project. Leaflets could be distributed on the events where the Open6G project will be present.

The project will respect the visual identity in such material according to the following rules:

1. In the publications, communication activities, and websites, it must be indicated the Ministerio de Asuntos Económicos y Transformación Digital and the European Union-NextGenerationEU as funding entities, in the "marco del Plan de Recuperación, Transformación y Resiliencia y el Mecanismo de Recuperación y Resiliencia", as indicated in the "artículo 34.2 del Reglamento (UE) 2021/241 del Parlamento Europeo y del Consejo, de 12 de febrero de 2021,

por el que se establece el Mecanismo de Recuperación y Resiliencia". In Section 4.1. Dissemination plan, procedure and Acknowledgements, it is detailed how scientific publications have to acknowledge the project in the corresponding way.

2. It must present in all the communication activities (posters, electronic publications, website, etc.), in a correct and relevant form, the UE banner with the statement of the funding that indicates «financiado por la Unión Europea-NextGenerationEU», with the logo of the PRTR (available in this link[5]) as can be seen in Figure 5.

Figure 5: Example of logos for communication activities

3. Communication activities will avoid any discrimination image against women, promoting the equality, and the role plurality. Additionally, it must avoid sexist language.
4. In order to have a more coherent view of the Open6G outcomes, a set of templates has been distributed among the members and subcontractors of the project to be used for presentations and deliverables.

In Figure 6, we show an example of the deliverable template that should be used for all the reported deliverables.

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[5] https://planderecuperacion.gob.es/identidad-visual.
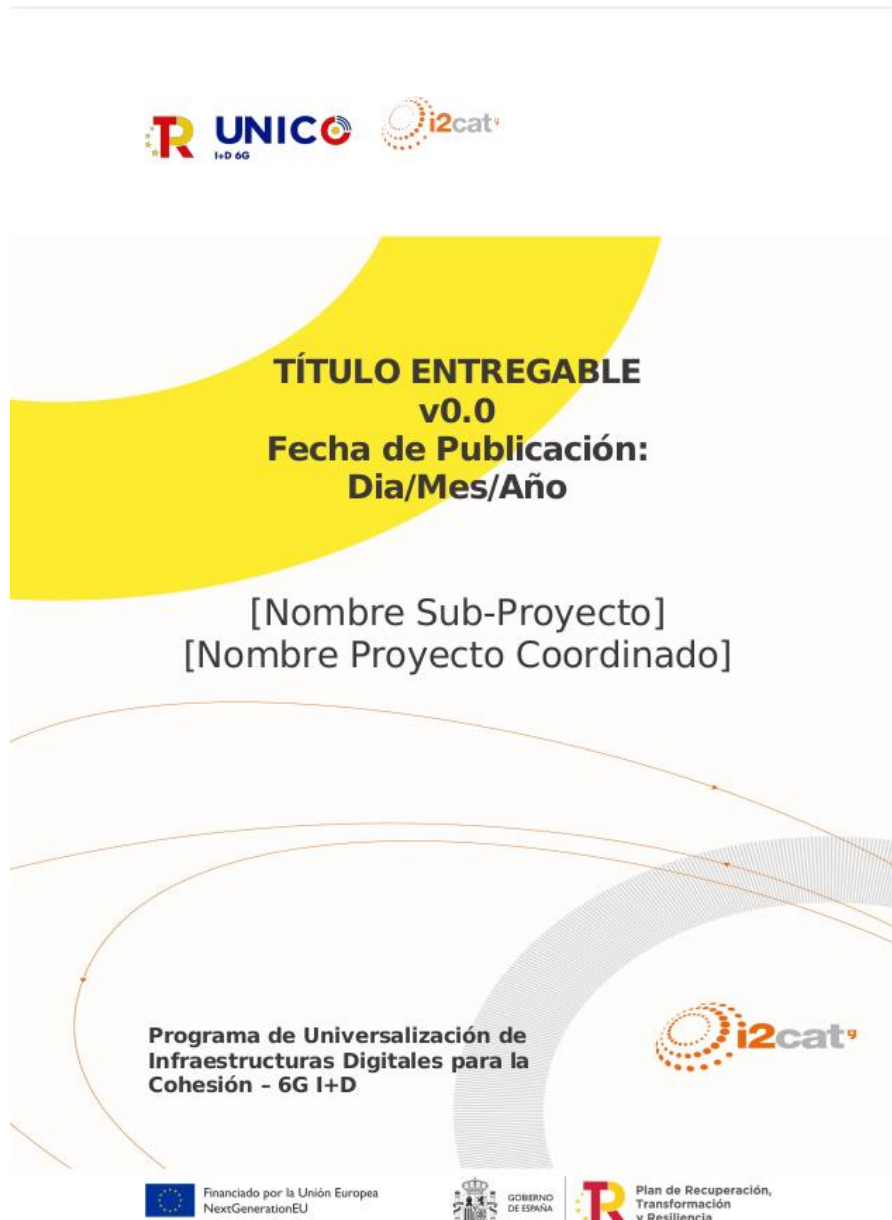
Figure 6: Deliverable document template

Finally, in Figure 7 we show an example of the PowerPoint template to be used in all the dissemination activities provided by i2CAT.

Figure 7: Dissemination powerpoint template

4 Dissemination Strategy

4.1 Dissemination plan, procedure and Acknowledgements

As previously detailed in the "Initial report on Dissemination, Exploitation and Academic Activities", among the actions targeting the dissemination of the scientific results of Open6G, the publication of scientific works will be one of the most relevant. These publications will expand the project's reach and will include top-tier peer-reviewed scientific journals (Q1) and international conference publications. These publications will target different audiences at different venues, such as the Industry Community, the Scientific Community or just the general public attending EU-organized Events. Additionally, the Open6G members will increase the impact of the project's results through the participation and organization of technical events (e.g., presentations, talks, demonstrations, panels, workshops, tutorials and other events) in such international conferences.

The types of documents in each of the segments are as follows:

- Industry related (Smart City Expo World Congress (SCWE), Mobile World Congress (MWC), etc.): Publications of White papers, magazines, technology roadmaps, and industry-led journals.
- Scientific community: Publication of scientific results in high-impact journals (e.g., IEEE TMC, ACM/IEEE TON, IEEE JSAC, IEEE TNSM, IEEE Communications Magazine, IEEE Network) and leading conferences (IEEE ICC, IEEE Globecom, IEEE NFV/SDN, such as ACM CoNEXT, NSDI, IEEE INFOCOM, ACM MobiCom, AAAI, ICML, IEEE SECON, IFIP/IEEE IM, IFIP Networking, IEEE/IFIP NOMS, IEEE CNMS, etc.).
- EU events (e.g., EuCNC, etc.): Presentation of Open6G results, research and innovation activities, booth exhibition and demo set ups.

Posters may be created during the project's lifetime. At the beginning posters will include key information related to the project. Later versions will be enhanced with research results and achievements of the project. The posters will be used in conferences, workshops and other events to increase awareness about the objectives and outcomes achieved by the project.

All scientific publications shall follow an internal procedure of i2CAT to ensure their quality. Specifically, 14 days prior to the submission of the document, the main author shall provide the resulting manuscript to the different authors to receive their feedback. When a publication gets reviewed and approved, it will be submitted to the corresponding publisher media, and follow the corresponding peer-reviewed process. If the manuscript is accepted for publication, it shall be uploaded to the project website.

In order to keep track of all the dissemination activities within the members of the Open6G project, i2CAT has made available a dissemination tracking tool where all the members are updating it with their corresponding works. This tool aims at reporting on the journal publications, conference proceedings, OpenSource Materials, Academic Activities, Standard contributions, Dissemination Events, Whitepaper contributions, to

name the most relevant ones. According to the necessities of the project members, this tool will be adapted by including new terms to report.

Additionally, all the publications, conference proceedings, presentations on workshops, seminars, press releases or public events must include the following text:

Spanish: *"Este trabajo ha recibido financiación del Ministerio de Asuntos Económicos y Transformación Digital y de la Unión Europea – NextGenerationEU, en el marco del Plan de Recuperación, Transformación y Resiliencia (PRTR) (convocatoria UNICO I+D 5G 2021, expediente TSI-063000-2021-X- Completar con el acrónimo del proyecto)."*

English: "*This work was supported by the Spanish Ministry of Economic Affairs and Digital Transformation and the European Union – NextGeneration EU, in the framework of the Recovery Plan, Transformation and Resilience (PRTR) (Call UNICO I+D 5G 2021, ref. number TSI-063000-2021-X-To complete with the project's Acronym)"*

The reference numbers for the 3 different Open6G subprojects are:

-   Open6G: Open6G: AI-driven Open 6G Automation
    Número de referencia: **TSI-063000-2021-3-Open6G**

-   Open6G: Joint Open 6G Communications and Sensing
    Número de referencia: **TSI-063000-2021-6-Open6G**

-   Open6G: Smart Surfaces for Joint Communications and Sensing Systems
    Número de referencia: **TSI-063000-2021-7-Open6G**

4.2 Scientific Publications

As a result of the dissemination and communication plans, the Open6G project has produced several scientific works. The scientific publications with Open6G TSI-063000-2021-6 acknowledgments (ACKs) during the life of the project in international conferences and workshops are listed below in Table 2:

Table 2: Publications in scientific conferences and workshops

#	Title	Conference	Authors
1	OROS: Orchestrating ROS-driven Collaborative Connected Robots in Mission-Critical Operations	IEEE 23rd International Symposium on a World of Wireless, Mobile and Multimedia Networks (WoWMoM 2022), Belfast, United Kingdom	Carmen Delgado, Lanfranco Zanzi, Xi Li, Xavier Costa-Pérez

| 2 | European 5G Security in the Wild: Reality versus Expectations | In Proceedings of the 16th ACM Conference on Security and Privacy in Wireless and Mobile Networks (WiSec 2023) Guildford, United Kingdom | Ó. Lasierra, G. Garcia-Aviles, E. Municio, A. Skarmeta, and X. Costa-Pérez |
| 3 | European 5G Security in the Wild: Reality versus Expectations (DEMO) | In Proceedings of the 16th ACM Conference on Security and Privacy in Wireless and Mobile Networks (WiSec 2023) Guildford, United Kingdom | Ó. Lasierra, G. Garcia-Aviles, E. Municio, A. Skarmeta, and X. Costa-Pérez |

Table 3 lists the scientific publications with Open6G TSI-063000-2021-6 ACKs which have been reported during the life of the project in scientific journals and magazines.

Table 3: Publications in scientific journals

#	Title	Journal	Authors
1	Sensing Integrated DFT-Spread OFDM Waveform and Deep Learning-powered Receiver Design for Terahertz Integrated Sensing and Communication Systems	IEEE Transactions on Communications 2022	Yongzhi Wu, Filip Lemic, Chong Han, Zhi Chen
2	Toward Full-immersive Multiuser Virtual Reality with Redirected Walking	IEEE Access, 2023	T. Van Onsem, J. Struye, X. Costa Pérez, J. Famaey, F. Lemic
3	OROS: Online Operation and Orchestration of Collaborative Robots using 5G	IEEE Transactions on Network and Service Management, 2023	A. Romero, C. Delgado, L. Zanzi, X. Li and X. Costa-Pérez
4	Predictive Context-Awareness for Full-Immersive Multiuser Virtual Reality with Redirected Walking	IEEE Communications Magazine, 2023	Lemic, F., Struye, J., Van Onsem, T., Famaey, J., Costa Pérez, X.

4.3 Dissemination Events

As discussed in the Dissemination Plan, in addition to the conference publications, which have already been described, the Open6G members have promoted the content and results of the project in several events aiming at reaching a wide audience. These are listed in the following Table 4:

Table 4: Dissemination Events

#	Title	Event, Place, Dates	Speaker
1	UNICO 5G/6G I+D at i2CAT: Projects, ecosystem and Preliminary results	Valencia 5G Days 2023, Valencia, 16/11/2023	Yuri Murillo (i2CAT)

2	National 6G research activities in Spain and i2CAT's impact	one6G Summit, Munich, 9/11/2023	Sergi Figuerola (i2CAT)
3	Graph Neural Networking workshop Chair	ACM CoNEXT, Paris, 8/12/2023	José Suárez-Varela (TID)
4	Forjando las redes del mañana: Aprovechamiento del aprendizaje profundo para la planificación y explotación de redes móviles	Invited talk at 42 Madrid, Fundación Telefónica, 16/11/2023	José Suárez-Varela (TID)
5	Athonet UPTIME	The Private 5G World Community Conference, Museum of Marconi, Bolonia, 8-9/06/2023	Matteo Grandi (Neutroon)
6	Online presentation of the R&D activities	MEO 5G-Challenge Empresas, Online, 19/09/2023	Matteo Grandi (Neutroon)
7	Presentation of R&D activities and innovation lines	Barcelona Tech Forum, Barcelona, 27-28/09/2023	Matteo Grandi (Neutroon)
8	Presentation of the R&D activities	Web Summit, Altice arena, Lisbon, 13-16/11/2023	Matteo Grandi (Neutroon)
9	Presentation of the R&D activities and innovation lines	Total Telecom Congress, Amsterdam, 20-23/11/2023	Matteo Grandi (Neutroon)

In Figure 8, we show two pictures of the first two mentioned events.

Figure 8: Photos from dissemination events

And in Figure 9 we show a X post on the one6G Summit:

Figure 9: X post on the one6G Summit

4.4 Collaboration with other Projects

In order to maximize the impact of the achieved results by the project, collaboration with other EU-funded projects will be established. This will improve the dissemination of the carried out work and boost its significance.

First, both i2CAT and several entities, are already working in two EU projects that are already running for at least one year, thus they are identified as possible candidates to collaborate with:

- **H2020 DAEMON** (i2CAT, NEC, TID) develops and implements innovative and pragmatic approaches to Network Intelligence (NI) design that enable high performance, sustainable and extremely reliable zerotouch network systems. aDAptive and sElf-Learning MObile Networks (DAEMON) designs an end-to-end NI-native architecture for Beyond 5G (B5G) that fully coordinates NI-assisted functionalities and beyond 5G and 6G smart connectivity considered in Open6G.
- **H2020 AI@EDGE** (i2CAT, UPC) will develop a connect-compute fabric – specifically leveraging the serverless paradigm – for creating and managing resilient, elastic, and secure end-to-end slices. Such slices will be capable of supporting a diverse range of AI-enabled applications. Privacy-preserving machine learning and trusted networking techniques will be used to ensure each stakeholder can use the platform without disclosing sensitive information.

- **HORIZON-JU-SNS BEGREEN** (i2CAT, NEC, TID) takes a holistic view to provide evolving radio networks that not only accommodate increasing traffic and service levels but also consider power consumption as a factor. Among its goals, the consideration of the cost of energy and the societal factors, together with the necessity of reducing global emissions, are significantly linked with Open6G goals.

Furthermore, there are some upcoming EU projects related to the Open6G topics that will be considered as possible candidates to collaborate with:

- **HORIZON EUROPE - INSTINCT** (i2CAT, NEC, TID**)** stands for Integrated Sensing and communications for Future Interactive, Immersive, and Intelligent Connectivity Beyond Communications. INSTINCT aims at enabling globally sustainable, interactive, immersive, and intelligent 'beyond communications' 6G connectivity by developing three complementary but critical breakthrough technology pillars: sensing-assisted communication technologies, intelligent surfaces, holographic radios, and cell-free systems and machine learning.
- **HORIZON EUROPE - ORIGAMI** (i2CAT, NEC, TID) stands for optimized resource integration and global architecture for mobile infrastructure for 6G. ORIGAMI aims at spearheading the next generation of mobile network architecture, overcoming eight factual barriers to ensure a successful 6G future. With three critical architectural innovations - Global Service-based Architecture (GSBA), Zero-Trust Exposure Layer (ZTL), and Compute Continuum Layer (CCL).

Furthermore, i2CAT and Universitat Politècnica de Catalunya (UPC) are now working on a European Project of the Advanced Digital Skills of the Digital Europe Programme, where the main purpose is to develop a Joint European Master degree titled "**Artificial Intelligence for Connected Industries (AI4CI)**". In this regard, the link in this project will also help to improve the dissemination of the Open6G project.

There are also several projects where several entities are working in the national framework, as can be seen in Table 5:

Table 5: National Projects

#	Type	Title	Participants
1	National. UNICO I+D 6G, convocatoria 2022. Ministerio de Economía y Competitividad, TSI-064100-2022-006.	Open Scientific Research Laboratory in 6G of the UPC (6G-OpenLab)	UPC
2	National. PID2019-108713RB-C51	Towards zero touch network and services for beyond 5G (TRUE5G-UPC).	UPC
3	National. PID2022-137329OB-C41	Enabling Native-AI Secure deterministic 6G networks for hyper-connected environmEnts (6G-INSPIRE)	UPC
4	National. UNICO 5G I+D call	AEON-ZERO (TSI-063000-2021-52)	TID

| 5 | National. UNICO 5G I+D call | AEON-CPS (TSI-063000-2021-38) | TID |

4.5 Open Source Repositories

Table 6 shows the open source repositories that the members of the Open6G project are currently using, and that will be updated:

Table 6: Open Source Repositories

#	Type	Title	Authors
1	Controlador inteligente de asignación de recursos en el MEC/RAN	Controlador inteligente https://github.com/alexllor1991/Intelligent-Controller	Alejandro Llorens Carrodeguas (UPC) September 2023
2	Algoritmo para la Ubicación óptima de recursos en 5G/6G MEC para rutas de vehículos autónomos conectados impulsadas por aprendizaje por refuerzo profundo	https://github.com/carlos-UPC-AI/zero-touch-FEC	Carlos A. Ruíz de Mendoza (UPC) October 2023

5 Exploitation Strategy

The exploitation strategy plan to be followed by the Open6G members has been initially defined, although in the final deliverable ("E17 Final report on dissemination, exploitation, and academic activities") will be revised in order to satisfy the members' necessities.

In this section, we first review the exploitation plans of each of the Open6G members, and later we describe the standardization activities performed by the members of the project.

5.1 i2CAT Exploitation Plan

First, i2CAT will benefit from Open6G use case definitions and architectural specifications, primarily along the lines of assessing the applicability of an in-house O-RAN-based 5G system prototype for ISAC-enabled network architectures and scenarios that we are actively developing. In addition, we will be able to assess the integration capabilities of our O-RAN-based 5G network prototype in some of the proof-of-principle integrated systems and demonstrators. The in-house prototype is a primer for sustainable research in the domain of 5G and beyond networks at AI-Driven Systems Lab at i2CAT. The integration capabilities of our O-RAN prototype will be enhanced with sensing functionality, eventually resulting in an ISAC-integrated O-RAN-based testbed for supporting our future research, innovation, and visibility needs.

At i2CAT, we will also actively pursue publication of scientific work in top-level venues. We will target heterogeneous audiences with different outcomes of the Open6G project. Specifically, the academic community is to be targeted through scientific results presented at conferences and journals, business and market-focused audience through experimental proof-of-concept systems and demonstrators, the general public with our research outputs through long-term exploitation, and new talents will be attracted thanks to the additional visibility gained through this project.

Moreover, the utilization of Open6G results will facilitate further research in our active research domains such as Virtual reality, but also allow us to kick-start new research lines. Through active scientific publications at top-notch venues, as well as through collaboration with the consortium partners, our exploitation will revolve around training our younger researchers and PhD students to become research and innovation leaders in future 6G technologies.

5.2 NEC Exploitation Plan

NEC is committed to leveraging the results of the Open6G research project to drive innovation in its future products. A careful evaluation of the discoveries and emerging technologies derived from Open6G will be carried out, with the aim of identifying strategic areas for integration into the products and solutions we will develop. This process will ensure that NEC is positioned at the forefront of technological evolution, offering our

customers advanced and effective solutions that reflect the significant advances achieved within the framework of the project.

Furthermore, the detailed description of the use cases derived from Open6G will not only be used for immediate implementation in products, but will also play a crucial role in the continuous improvement and refinement process. NEC will leverage the data and experiences gathered from these use cases to feed back into the development cycle, enabling fine-tuning and refinements to our existing products. This iterative approach will ensure the continued adaptability and efficiency of our products in response to changing market needs and customer demands. In addition, the detailed documentation of the use cases will provide a solid basis for future research, serving as a starting point for exploring new directions and opportunities in the field of 6G communications and related technologies. This proactive approach will drive not only the continuous improvement of our current products, but also the expansion of our horizons towards future innovations and discoveries in the field of next generation communications.

5.3 Neutroon Exploitation Plan

For Neutroon, projects such as Open6G play a vital role in driving the technology development process. The objectives of Open6G are aligned with the company's strategic objectives, and this convergence allows for an expanded portfolio of expertise and technology offerings.

Neutron envisages (but is not limited to) the following exploitation scenarios:

- Technology transfer. Both internally within the company and with external entities, the results obtained will be presented at events, panels, fairs, and forums where the topics covered in this project may be of interest.

- Knowledge transfer. Neutron organizes regular sessions in which the new product features are presented, and each work team presents the results obtained. Together with the product and business areas, these results are periodically analyzed to contribute to the creation of new knowledge, dissemination activities, and contributions to the product with market analysis. In addition, Neutroon is part of 6GIA, EUWENA, NetWorld Europe, 5G-OIL, and UKTIN, among other stakeholders that can add relevance to the publication and dissemination of results.

- Expansion of the product portfolio and functionalities. The perfect alignment between Open6G objectives and Neutroon's innovation roadmap will allow the expansion of the product portfolio. The integration of the project results into Neutroon's service offering is one of the key objectives within the exploitation plan.

5.4 TID Exploitation Plan

TID plans to submit a patent application on the AI-based anomaly detection solution for open 6G access network environments that they are currently developing. The registration of this patent will depend on obtaining internal approval as well as subsequent acceptance by the relevant patent office.

5.5 UPC Exploitation Plan

The results obtained by the UPC in the Open6G project focus on providing, developing and evaluating a set of federated ML algorithms that allow automating certain O-RAN functionalities in the 6G framework. The proposed algorithms are multi-agent deep learning based (MADL). These solutions will be validated in a proof of concept and on a field-controlled platform with an automotive vertical.

Based on these considerations, the UPC's exploitation plan aims to valorise the knowledge acquired in the project. The valorisation will be focused on two axes, technology transfer and knowledge transfer through academic activities. The latter will be described in the following section. Now, we focus on the Technology transfer:

- Research infrastructure. The knowledge acquired in Open6G will be implemented in the 6G-UPC-OpenLab[6] platform to offer a service to research groups, companies, the national and international scientific community, and the administration, suitable for experimental developments, and monitoring-validation of applications, services, infrastructure and new 6G devices.

  With the results obtained, we will develop on this platform a cloud continuum (Cloud-MEC) applying MADL algorithms that automate part of the RAN functionalities.

  6G-UPC-Openlab is an open 6G infrastructure project led by Cristina Cervelló, the main contact person for UPC in Open6G. The project, called **Laboratorio Abierto Científico-Tecnológico de Investigación en 6G de la UPC**, is defined as a "6G research infrastructure and equipment that develops an extensive network beyond 5G/6G with end-to-end multi-technology based on a radio and optical access network and a high-capacity core network, which will support a set of network services and intelligent and cognitive applications, in order to holistically design, monitor, validate and deploy new 6G devices, services, applications and verticals".

  The platform forms a multi-technology, intelligent and cognitive, multi-domain and extensive infrastructure that covers the two most important campuses in ICT technologies of the UPC: the Baix Llobregat Campus in Castelldefels, with its Mediterranean Technology Park (PMT), and the North Campus in Barcelona, interconnected by fiber optics and WDM technology. This platform is being built

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in the laboratories and in the exteriors (adjacent streets) of the buildings of both campuses. For example, the PMT in Castelldefels, with traffic-controlled streets, 336,000 m2 and 2.3 km perimeter, includes the laboratories of the research groups, the School of Telecommunications and Aerospace Engineering of Castelldefels (EETAC), the School of Agri-Food and Biosystems Engineering of Barcelona (EEABB), the Drone-Lab and the greenhouse managed by the EEABB. The Drone-Lab is a large research infrastructure made up of a 90 m x 45 m x 15 m protected structure for drone flight, open to industry and research centers.

The knowledge acquired will allow us to cooperate and integrate into major European research infrastructures, and to participate in national, European and international 6G R&D projects.

- Participation in research projects: Proposals will be prepared for participation in competitive national and European research projects in the framework of Horizon.
- Patents: With the results acquired, we will consider the presentation of a patent.

5.6 Standardization Activities

In this subsection we report on the standardization activities and achievements made by the Open6G members. In Table 7 these activities are listed.

Table 7: Standardization Activities

#	Organization	Working Group	Partners
1	O-RAN Alliance	Working Group 2	NEC
2	SNS	Open SNS	i2CAT, NEC
3	SNS	6G Architecture	i2CAT, NEC

6 Academic Activities

In the first deliverable of WP6 ("Initial report on dissemination, exploitation and academic activities") we described the academic activities plan. Now, based on that plan, in this deliverable ("Intermediate report on dissemination, exploitation and academic activities") we elaborate on the activities performed to date while also explaining the plans for the last period of the project.

During the life of the Open6G TSI-063000-2021-6 project, several Thesis and Internships on specific topics of the project have been developed (or are still ongoing). In the following Table 8, we list them.

Table 8: Academic Activities

#	Title	Type, University	Partners
1	Collaborative Connected Robots	MsC Thesis, UPC	i2CAT
2	Drone-based Mobile Localization Systems	Internship, UPC	i2CAT
3	Cellular-based search-and-rescue drone localization solutions	BsC Thesis, UPC	i2CAT
4	On the suboptimal energy-aware strategies for Collaborative Connected Robots	Internship, UPC	i2CAT
5	Energy aware multi-robot planning: Towards digitalized integration of IoT technologies in robotics	PhD, UPC	i2CAT
6	Fusion of 5G-NR and GNSS Positioning Systems for High Accuracy Localization	PhD, UPF	i2CAT

Even though these works have been developed within i2CAT, the students come from the Universitat Politècnica de Catalunya (UPC) and Universitat Pompeu Fabra (UPF). This shows the close relationship between the entities, which not only allows for more impact of the project, but also could potentially help to build future works together.

To get a closer overview of these works, this is a short summary of the presented works:

- **Collaborative Connected Robots** (MsC Thesis, Arnau Romero, 2022): In this work, a centralized coordination energy-aware approach is proposed for multi-robot exploration in unknown outdoor environments. Robot hardware usage, path planning and charging is determined through the use of an edge-computing orchestrator entity. Both sensing and communications are evaluated in the framework.

- **Drone-based Mobile Localization Systems** (Internship, Álmos Veres-Vitályos, ongoing): In this work, small UAVs are envisioned to operate in hard-to-reach areas for enabling applications such as structural monitoring. Towards

showcasing this vision, we demonstrate a small UAV-supported setup for real-time autonomous generation of 3-Dimensional (3D) representations of static objects. In the setup, a small UAV (i.e., CrazyFlie 2.1) is envisioned to visit a set of locations, acting as a carrier and power source of a camera sensor. At each location, the sensor is expected to take a picture of the object and report it to the station. The station implements a pipeline for 3D reconstruction of the object based on its pictures taken by the UAV.

- **Cellular-based search-and-rescue drone localization solutions** (BsC Thesis, Andra Blaga, 2022)**:** This work presents a localization solution for possible victims lost or trapped under the rubble due to natural disasters or areas in emergency situations using their mobile phones. The proposal is based on deploying a drone loaded with a base station to provide coverage of the disaster scene. The main idea is to estimate the channel between the mobile devices and the base station to extend the distance and direction data of the network users. Therefore, cellular signals are used for localization (sensing) purposes. Furthermore, to obtain more accurate results, artificial intelligence has been used.

- **On the suboptimal energy-aware strategies for Collaborative Connected Robots** (Internship, Pol Pifarré Cots, ongoing): In this work, a set of suboptimal strategies for collaborative connected robots are explored in order to provide energy-awareness to the set of robots. Both sensing and communications are taken into account for the evaluation of the scenarios.

- **Energy aware multi-robot planning: Towards digitalized integration of IoT technologies in robotics** (PhD, Arnau Romero, ongoing): In this work, a collaborative robotics framework for Search and Rescue use cases is proposed to optimize resources during mission execution. A digitalization of real robots is proposed to learn energy consumption behaviors and use its predictability for high-level decision making algorithms. Integrated Sensing and Communication strategies will be studied.

- **Fusion of 5G-NR and GNSS Positioning Systems for High Accuracy Localization** (PhD, Federico Campolo, ongoing): In this work, the fusion of 5G-NR and GNSS positioning systems is proposed to achieve high accuracy localization across different scenarios (Rural, Suburban, and Urban). A flexible framework is proposed that takes as input all the distance estimations available (from both 5G-NR and GNSS) and combines them in a weighted multilateration approach. Integrated Sensing and Communication strategies will be studied related to the distance estimation measurements provided by the 5G-NR system.

Although not yet public, as an exploitable result, some of the software developed during these works might be set public as open source, so the academic and research communities can build future projects based on these tools.

Last but not least, the knowledge generated in the Open6G project will be incorporated into UPC's academic activities. This way, students will benefit from the project's state-of-the-art results. In this line, the Open6G project will aim to add core skills for technology development within the project into academic curriculums. Lecture materials related to Open6G might be introduced in academic courses and considered for the undergraduate, master, and PhD syllabus. In this regard, a series of workshops and lectures are already planned for next year at the UPC. They will be open to all, so that

not only Bachelor of Science (BsC), Master of Sciences (MsC), and PhD students can attend, but also any interested university or company members. Some of the topics will cover ISAC and the O-RAN architecture.

7 Conclusions

This deliverable reports on the communication, dissemination, and academic activities that have been carried out during the life of the Open6G project. The aim of these activities is to maximize the project impact by targeting key communities for dissemination and communication, and also by interacting with the academia, where the Open6G contributions might be explored and promoted.

Furthermore, this deliverable also updates the exploitation plans after the tender process is finalized this current year, by including the Open6G entities exact plans. In the final deliverable (E17 "Final report on Dissemination, Exploitation and Academic Activities"), we will report on the exact communication and dissemination strategies and actions taken, while also providing the exact exploitation and academic activities that will continue after the end of the project. It is also important to note that as technical work progresses, the plans presented in this document might also evolve, whenever needed, to ensure an effective and coherent dissemination of results.