CONVERGE - Telecommunications and Computer Vision Convergence Tools for Research Infrastructures

D4.2: Report on dissemination, standardisation and exploitation activity (initial)

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D	29/01/2024	Ari Pouttu	UOULU	Added section on Engagement with other RIs
E	30/01/2024	Filipe B. Teixeira	INESC TEC	Added section on Dissemination
F	31/01/2024	Filipe B. Teixeira	INESC TEC	Added Executive Summary, Introduction and Conclusion sections
G	31/01/2024	Paulo Marques, Maria Garcia-Fernandez, and Guillermo Alvarez Narciandi	ABS, QUB	Internal review
H	31/01/2023	Filipe B. Teixeira and Luís M. Pessoa	INESC TEC	Final review

EXECUTIVE SUMMARY

The document outlines the progress and achievements of the CONVERGE project during its initial 12-month period. The project has been actively engaged in dissemination, communication, standardization, training, and collaboration with other research infrastructures.

Key highlights include:

- Dissemination and Communication: The project has effectively disseminated its work through the publication of two journal papers, a conference contribution, and the organization of an industry panel at GLOBECOM. Participation in multiple public events, with over 2000 attendees, has further enhanced project visibility. A robust communication strategy, including a website, social media channels, and newsletters, has been established to ensure effective dissemination
- Standardization Efforts: CONVERGE has actively monitored and reported on standardization activities within 3GPP and ETSI, focusing on sensing applications and RIS channel modelling. The project has contributed to the public Group Report GR001, published in January 2024, demonstrating its commitment to standardization initiatives.
- Training and Exploitation Activities: While training and exploitation activities are slated for the project's later stages, an upcoming training session will cover essential topics such as data management principles, interoperability issues, and reproducible research methodologies.
- Engagement with Research Infrastructures: CONVERGE has established strong connections with various research infrastructures, both nationally and pan-European. These collaborations pave the way for meaningful exchanges and shared objectives in the field.

Looking ahead, the CONVERGE consortium remains committed to advancing its objectives in the second year of the project. Several publications are already accepted for international conferences, and workshops, such as SUPER-CLAM at IEEE ICASSP 2024, are scheduled to further disseminate project outputs and results and commit to the dissemination and communication KPIs. Additionally, submissions to PIMRC 2024 and EuCNC 2024 are in progress, highlighting the project's ongoing commitment to knowledge sharing and collaboration.

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ABBREVIATIONS

3GPP	3rd Generation Partnership Project
5G	Fifth Generation mobile system standard
5GTN	5G Test Network
6G	Sixth Generation mobile system standard
6G SANDBOX	Supporting Architectural and technological Network evolutions through an intelligent, secureD and twinning enaBled Open eXperimentation facility
6G-XR	6G eXperimental Research infrastructure to enable next-generation XR services.
ESFRI	European Strategy Forum on Research Infrastructures
ETSI	European Telecommunications Standards Institute
HE	Horizon Europe
ICASSP	IEEE International Conference on Acoustics, Speech, and Signal Processing
IEEE	Institute of Electrical and Electronics Engineering
ISAC	Integrated Sensing and Communication
ISAG	Industry Specification Approving Group
ISG	Industry Specification Group
KPI	Key Performance Indicators
LIS	Large Intelligent Surface
OAI	OpenAirInterface
O-RAN	Open Radio Access Network
PIMRC	IEEE International Symposium on Personal, Indoor and Mobile Radio Communications
RAN	Radio Access Network
RI	Research Infrastructure
RIS	Reconfigurable Intelligent Surface
SDO	Standards Development Organisation
SLICES-RI	Scientific Large-scale Infrastructure for Computing/Communication Experimental Studies – Research Infrastructure
SUPER-CLAM	Super-resolution integrated communications, localization, vision and radio mapping

1 INTRODUCTION

The primary aim of the CONVERGE project is to create an innovative set of tools that integrate radio and vision-based communication and sensing technologies. This toolset will facilitate research in a new field centred around the concept of "view-to-communicate and communicate-to-view." By integrating these technologies, the project aims to enhance a group of Research Infrastructures (RIs) to align closely with the ESFRI SLICES-RI (Scientific Large-scale Infrastructure for Computing/Communication Experimental Studies – Research Infrastructure).

This new research area moves away from traditional isolated studies in wireless communications, computer vision, sensing, and machine learning, focusing instead on generating new knowledge at their intersection. The envisioned toolset will be implemented across 7 RIs involved in the project, aligned with ESFRI SLICES-RI access modes and policies. The objective is to enhance the competitiveness of these RIs. Researchers and industry stakeholders will utilize this toolset and associated RIs to explore various scenarios across different verticals such as telecommunications, automotive, health, manufacturing, and media. Detailed descriptions of these scenarios can be found in CONVERGE Deliverable 1.1 - Requirements and use cases.

Due to the CONVERGE focus on infrastructure development, engaging in outreach activities holds significant importance. These activities aim to connect with specific audiences, including researchers and companies who may utilize the CONVERGE RI in the future. Additionally, outreach efforts target other key stakeholders alongside the broader public to ensure widespread awareness and involvement.

D4.1 presented the CONVERGE plan for dissemination, communication, exploitation, and training, including plans for achieving impact on standardisation bodies and plans for engagement with other research infrastructures and initiatives, starting by SLICES-RI, but extending to other projects and initiatives worldwide. In this document, we present an initial report on CONVERGE activities of the WP4 over the first year of the project (M1-M12) and an assessment of the impact achieved with respect to the defined KPIs at the beginning of the project. The document includes the following sub-sections:

- Dissemination activities: scientific publications in conferences, workshops and journals, and organisation of events such as conferences, workshops, special sessions, tutorials, exhibition booths, and public demos, among others.
- Communication activities: media kit, presentation slides template, deliverables template, website, social media, newsletters, posters, and press-releases.
- Standardisation: recent activities for achieving an impact on standardization (such as in 3GPP, IEEE, and ETSI), resulting from the participants' activity in various standards groups, and simultaneously monitor ongoing standardisation activities for keeping the project aligned with the relevant developments in standards.
- Engagement with other RIs: recent and ongoing engagement with other research infrastructures and initiatives, starting by SLICES-RI, but extending to other projects and initiatives worldwide.

The CONVERGE consortium will continue pursuing the objectives of the Work Package 4 during the second year of the project. A report for the second year of the project will be produced in D4.3.

2 DISSEMINATION ACTIVITIES

In this section we provide an overview of the CONVERGE dissemination activities from M1-M12. We first highlight the scientific publications (journal and conference publications), followed by the presence in public events, where posters or talks were given. We then provide an overview on the organisation of workshops and special/convened sessions, and discussion panels. Finally, we evaluate the dissemination KPIs.

2.1 Journal publications

Two journal papers have been published in the first year of the project:

- Romero A, Carvalho P, Côrte-Real L, Pereira A. Synthesizing Human Activity for Data Generation. *Journal of Imaging*. 2023; 9(10):204. https://doi.org/10.3390/jimaging9100204
- Pereira, P. Carvalho, N. Pereira, P. Viana and L. Côrte-Real, "From a Visual Scene to a Virtual Representation: A Cross-Domain Review," in *IEEE Access*, vol. 11, pp. 57916-57933, 2023. https://doi.org/10.1109/ACCESS.2023.3283495

2.2 Conference publications

One international conference publication was published in the first year of the project:

- Almeida, E.N., Fontes, H., Campos, R., Ricardo, M. Position-Based Machine Learning Propagation Loss Model Enabling Fast Digital Twins of Wireless Networks in ns-3. In *Proceedings of the 2023 Workshop on ns-3 (WNS3 '23)*. Association for Computing Machinery (ACM), New York, NY, USA, 69–77. https://doi.org/10.1145/3592149.3592150

  This paper received the “Best Paper Award” by the TPC Chairs of the WNS3 ’23 Conference.

Four publications on international conferences are accepted and will be presented during the second year of the project. Another publication is under review.

2.3 Presence in Events

The participation on public events is an important way to disseminate the CONVERGE project and its results. The combined number of attendees on these events (mainly in person) exceeds 2000. Some examples of the participation of the CONVERGE consortium on these events are summarized in the next subsections.

2.3.1 Symat COST Action Meeting

The Symat COST Action CA18223 - SYMAT[1] - Future Communications with higher symmetric engineered artificial materials meeting happened in Lisbon, Portugal from 4-5 May 2023. An overview of INESC TEC research activities including a summary of CONVERGE Project was presented to an audience of approximately 40 participants, as seen in Figure 1.

[1] Symat COST Action Meeting - https://symat-cost.eu/

Figure 1 - Symat COST Action Meeting.

2.3.2 EuCNC & 6G Summit 2023

The 2023 edition of the European Conference on Networks and Communications & 6G Summit (EuCNC)[2] was celebrated in Gothenburg, Sweden, from 6-9 June 2023. A CONVERGE poster was presented at ALLBESMART booth, as depicted in Figure 2. The booth had approximately 100 attendees.

Figure 2 - CONVERGE poster presentation at EuCNC 2023.

[2] EuCNC & 6G Summit 2023 - https://www.eucnc.eu/2023/www.eucnc.eu/

2.3.3 IEEE/MTT-S IMS 2023

The 2023 IEEE/MTT-S International Microwave Symposium[3] took place from 11-16 June 2023 at San Diego, United States of America. A OAI gNB dashboard demonstrator for 5G/6G research was presented as seen in Figure 3.

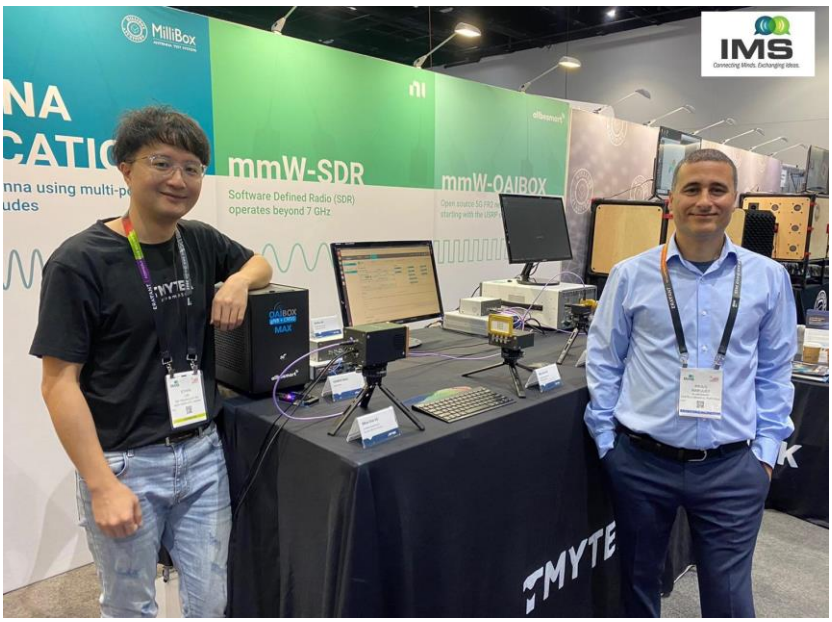

Figure 3 - Demo at IEEE/MTT-S IMS 2023.

2.3.4 WNS3 2023

The Workshop on ns-3 (WNS3)[4] took place in Washington, D.C., United States of America, from 28-29 June 2023. An invited talk was given, presenting CONVERGE and how to leverage ns-3 as a Digital Twin for such Next-generation Networks (Figure 4). The workshop had approximately 70 attendees.

Figure 4 - Paper presentation and invited talk on Workshop of ns-3 2023.

[3] IEEE/MTT-S IMS 2023 - https://ims-ieee.org/

[4] WNS3 2023 - https://www.nsnam.org/research/wns3/wns3-2023/program/

2.3.5 Spanish URSI Symposium 2023

The URSI 2023[5] - XXXVIII Simposio Nacional de la Unión Científica Internacional de Radio conference took place in Cáceres, Spain, from 13-15 September, 2023. A presentation entitled "RIS for communications and sensing" was presented, as seen in Figure 5, where the CONVERGE project was highlighted to an audience of approximately 20 persons.

Figure 5 - Spanish URSI Symposium 2023.

2.3.6 Joint OSC/OSFG-OAI Workshop

The Joint OSC/OSFG-OAI Workshop[6]: End-to-End Reference Designs for O-RAN was held in partnership with the Institute for the Wireless Internet of Things and the Open6G Center, in Boston, United States of America, from 14-15 November 2023. The OpenAirInterface Software Alliance organizes regular workshops, currently twice a year. The purpose of these events is to report recent developments in the OAI, publicize the newest projects and collaborations, teach OAI to new members, and give existing members and the broader community an opportunity to meet, discuss and show their recent work.

The O-RAN Software Community (OSC) and the OpenAirInterface Software Alliance (OSA) are now collaborating, backed by the O-RAN Open Source Focus Group (OSFG), to showcase the O-RAN architecture using open-source components they've developed. The workshop showcased their progress and emphasized the need to enhance collaboration, streamline code sharing, and establish a method for maintaining integrated O-RAN reference designs."

CONVERGE research infrastructure adopts an Open RAN architecture based on the open-source OpenAirInteface (OAI) code base. In this workshop there were three presentations from Eurecom as founder member of the OAI Software Alliance, and one Open RAN demonstrator from Allbesmart with early results from CONVERGE gNB to an audience of approximately 50 persons.

[5] URSI 2023 - https://www.ursicaceres2023.com

[6] Joint OSC/OSFG-OAI Workshop - https://openairinterface.org/joint-osc-oai-workshop-end-to-end-open-source-reference-designs-for-o-ran/

2.3.7 4th Vision of Future Communications Summit

The 4th Vision of Future Communications Summit[7] was held in Lisbon, Portugal, from 7-8 November 2023. A presentation on Synergy of Integrated Sensing and Communications (ISAC) with Network Digital Twins for Beyond-6G Research was given to approximately 60 participants.

2.3.8 ANACOM URSI Congress

The 17th Congress of the Portuguese Committee of URSI[8] "Smart materials for radioscience" took place in Lisbon, Portugal, on 24 November 2023. A presentation entitled: "6G – The path towards a new paradigm of Communications and Sensing empowered by Reconfigurable Intelligent Surfaces"; CONVERGE was presented to approximately 40 persons (Figure 6).

Figure 6 - ANACOM URSI Congress.

2.3.9 IEEE GLOBECOM 2023

The IEEE Global Communications Conference 2023 IEEE Global Communications Conference[9] was celebrated in Kuala Lumpur, Malasya, from 4-8 December 2023. A demonstration of OAI gNB dashboard for 5G/6G research was performed to about 100 participants. Figure 7 also shows the CONVERGE poster featured at the ALLBESMART booth.

[7] 2.3.6 4th Vision of Future Communications Summit - https://futurecomresearch.eu/

[8] ANACOM URSI Congress - https://anacom.pt/render.jsp?contentId=1758414

[9] IEEE GLOBECOM 2023 - https://globecom2023.ieee-globecom.org/

Figure 7 – IEEE GLOBECOM 2023.

2.3.10 INESC Brussels HUB Winter Meeting

The INESC Brussels HUB Winter Meeting[10] took place in Porto, Portugal, on 25 January 2023. A Poster presentation of the CONVERGE project (shown in Figure 8) was shown to an audience of about 200 participants.

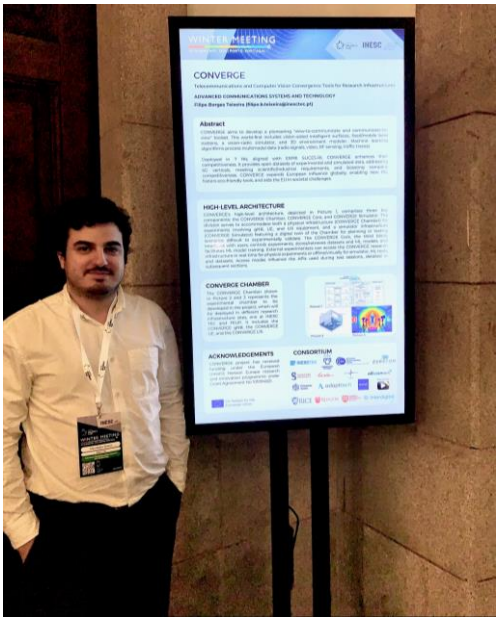

Figure 8 - Poster presentation at INESC Brussels Hub Winter Meeting.

[10] INESC Brussels Hub Winter Meeting - https://www.inesc-id.pt/events/inesc-brussels-hub-winter-meeting-jan-25-26-2024-in-porto/

2.4 Organisation of Workshops and Special/convened sessions

Workshops and special/convened sessions offer targeted forums for in-depth exploration of CONVERGE main research topics. They promote interactive learning, skill development, and community building among stakeholders.

During the first year of the project, the "Super-resolution integrated communications, localization, vision and radio mapping (SUPER-CLAM)[11]" workshop is being organized for the International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2023), that will take place in April 2024, in Korea.

The workshop solicits high quality papers in different topics related to integrated communications, localization, vision and radio mapping, including, but not limited to:

- Vision-aided wireless communications
- Vision-aided localisation and sensing
- Computer vision empowered by RF sensing/imaging
- ISAC at Millimeter-wave and sub-THz
- Radio and vision data fusion
- Machine learning for ISAC
- RIS-aided localisation and sensing
- RIS-aided device-free environment mapping
- RIS-aided super-resolution ISAC, waveform design and channel estimation
- ISAC with automated ground/aerial vehicles

The workshop organizing committee include Dirk Slock (EURECOM), Luís Pessoa (INESC TEC / FEUP), George C. Alexandropoulos (National and Kapodistrian University of Athens) and Filipe B. Teixeira (INESC TEC / FEUP).

2.5 Organisation of discussion panels

Organizing discussion panels fosters collaboration, knowledge exchange, and diverse perspectives. Panels facilitate interdisciplinary dialogue, critical analysis of project outcomes, and policy implications. Two discussion panels were organized during the first year of the project.

2.5.1 Industry Panel at IEEE 2023 GLOBECOM

CONVERGE organised an industry panel at IEEE 2023 Global Communications Conference (GLOBECOM), that took place in Kuala Lumpur, Malaysia, from 4th to 8th December 2023. The panel entitled "Convergence of wireless communications and computer vision: a new paradigm created by the CONVERGE project"[12] (Figure 9) had the goal of discussing new potential opportunities and challenges that can be anticipated by the usage of tools combining radio with computer vision, including potential contributions to science, standards, and industry verticals.

[11] SUPER-CLAM Workshop at ICASSP 2023 – https://super-clam.inesctec.pt

[12] Industry Panel at IEEE 2023 GLOBECOM - https://globecom2023.ieee-globecom.org/program/industry-panels#IPA2

The panel highlighted the transformative power of vision and multimodal data in shaping the future of wireless communications:

- Empowering 6G wireless communications with vision and multimodal sensing: Vision and multimodal data together with AI as a catalyst for device-free user tracking, beam management, and intelligent control of reconfigurable intelligent surfaces (RIS).
- Paving the way for ISAC architectures: Emphasised the pivotal role of vision data in multi-modal Sensing and Integrated Sensing and Communications (ISAC) 6G architectures, enabling new applications such as semantic communications, holographic/haptic communications and digital twins.

The panel specifically addressed the following questions:

- Why is it important to create scientific/instrumentation tools for the vision-communications convergence field and what should be their main characteristics?
- What are the main research questions that these tools will help scientific community to answer?
- What new applications can be enabled by this vision-communications convergence field and what will be their impact in vertical markets?
- How to open the tools and produced datasets, including video, to the community and how to deal with ethics and GDPR?
- Which standardisation impacts are expected?

The panel was moderated by Manuel Ricardo (INESC TEC), and counted with the following panellists: Youssef Nasser (Greenerwave), Ivan Seskar (Rutgers University), Hamed Rezazadegan Tavakoli (Nokia) and Luis Pessoa (INESC TEC).

IEEE GLOBECOM is one of the IEEE Communications Society flagship conferences. It counted with over 2000 attendees from 70 countries. The program consisted of 1,262 symposium papers, 361 workshop papers, 20 Tutorials, 25 Industry Sessions, 7 Keynotes, and 2 Executive Forums.

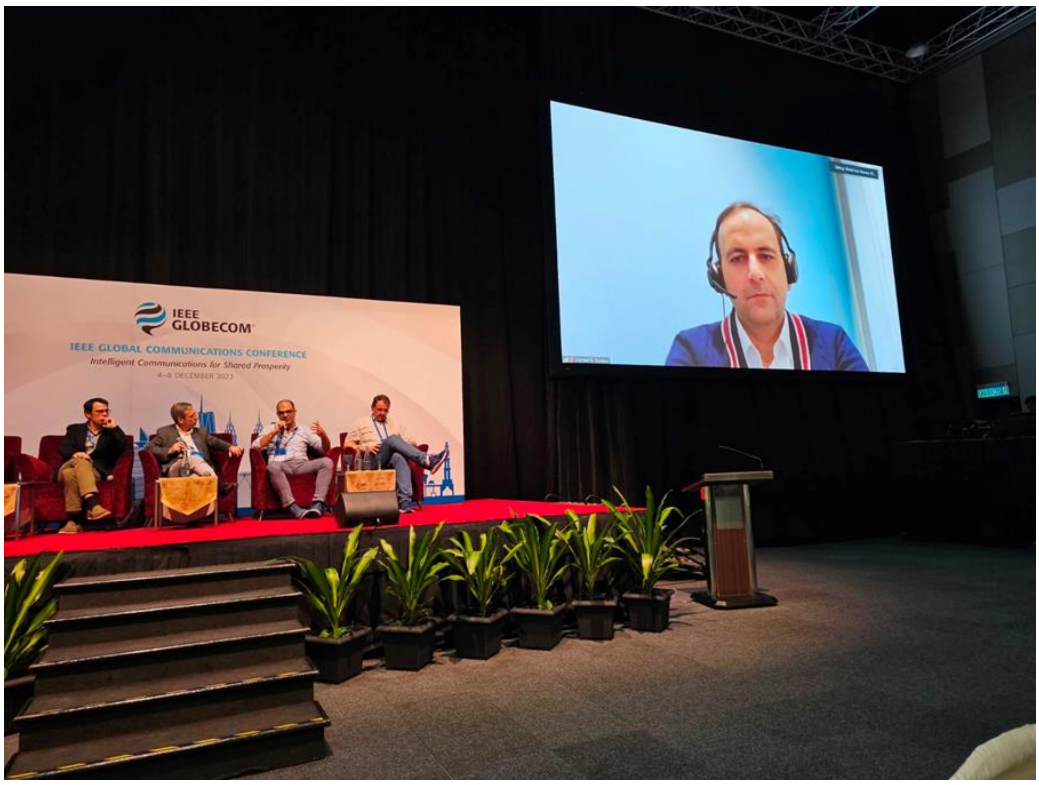

Figure 9 - Industry Panel at IEEE 2023 GLOBECOM.

2.5.2 Duscussion Panel at CTM OpenDay 2023

A discussion panel was organized under the CTM Open Day 2023[13], which took place on May 10, 2023 at the Faculty of Engineering of the University of Porto (Figure 10). Under the motto "Communications and Machine Perception - Convergence and Societal Challenges", the 2023 edition of the event explored the relationship between telecommunications, sensing based on radio and computer vision techniques, and artificial intelligence. This initiative addressed the technological challenges associated with the implementation of these solutions, and the impact of said technologies on society and environmental sustainability.

The discussion panel was moderated by Arlindo Oliveira (INESC & IST-UL) and included the panellists Ivan Seskar (WINLAB, Rutgers & COSMOS), Luís Pessoa (INESC TEC & FEUP), Paula Viana (INESC TEC & ISEP) and Aníbal Matos (INESC TEC & FEUP).

The CTM Open Day is an annual initiative of the Centre for Telecommunications and Multimedia of INESC TEC. This 11th edition had an audience of approximately 100 attendees.

Figure 10 - Discussion Panel at CTM OpenDay 2023.

[13] Discussion Panel at CTM OpenDay 2023 – https://opendayctm.inesctec.pt

2.6 Delivery of tutorials and webinars

A tutorial was given at 2023 IEEE 97th Vehicular Technology Conference: VTC2023-Spring[14], held on Florence, Italy on 20 June 2023. The tutorial was on "Multi-Antenna and In-Band Full Duplex Radio Techniques for Spectrum Sharing Vehicle-to-Everything (V2X) Communications (Figure 11).

Figure 11 - VTC2023-Sring tutorial.

2.7 Dissemination KPIs evaluation

The continuous monitoring of CONVERGE dissemination activities allow us to periodically evaluate the progress towards the achievement of the established Key Performance Indicators (KPIs). These KPIs are presented in Table 1, where we can see that most KPIs are increasing towards the expected numbers. A strong increase is expected during the second and third years of the project.

[14] VTC2023-Spring tutorial - https://events.vtsociety.org/vtc2023-spring/tutorials-available/t1-multi-antenna-and-in-band-full-duplex-radio-techniques-for-spectrum-sharing-vehicle-to-everything-v2x-communications/

Table 1 - Dissemination KPIs for M1-M12

Dissemination action	Expected KPI at the end of the project	KPI at the end of the first year (M12)
Publications in target conferences and workshops	20	1 (5%)
Publications in target journals and magazines	6	2 (33%)
Organisation of Workshops and Special/convened sessions	6	1 (17%)
Delivery of tutorials and webinars	3	1 (33%)
Organisation of discussion panels	3	2 (66%)
Contributions to industry and research associations	6	1 (17%)
Organisation of Scientific Challenge	1	0 (0%)

3 COMMUNICATION ACTIVITIES

In this section, we provide an overview of the CONVERGE website, a user-friendly and eye-catching way of providing news and useful information about the project. Furthermore, we present the LinkedIn and Twitter/X social networks of CONVERGE and two example of posters that were presented in events during the first year of the project. Finally, we show the result of the press-releases produced on news appearances and the contents of the first newsletter. It is important to mention that the media kit, presentation slides template and deliverables template were already presented on the D4.1, but were produced during this report period.

3.1 Website

The CONVERGE project website plays a vital role in the communication strategy by offering complete and updated information to relevant stakeholders and the general public. It was designed to be a user-friendly interface that mirrors the project's branding and visual identity, guaranteeing a smooth and intuitive experience for users, and boosting news, scientific publications, public deliverables, and relevant project media presence.

The website structure is organized into different sections:

- Home
- About
- News
- Output and Results
    - Scientific Publications
    - Public Deliverables
    - Events and Media
    - Newsletter
- Consortium
- Contact

The website is based on the open-source WordPress platform and is hosted at INESC TEC premises. It has received more than 1000 pageviews, and over 400 unique visitors. You can find the website homepage in Figure 12.

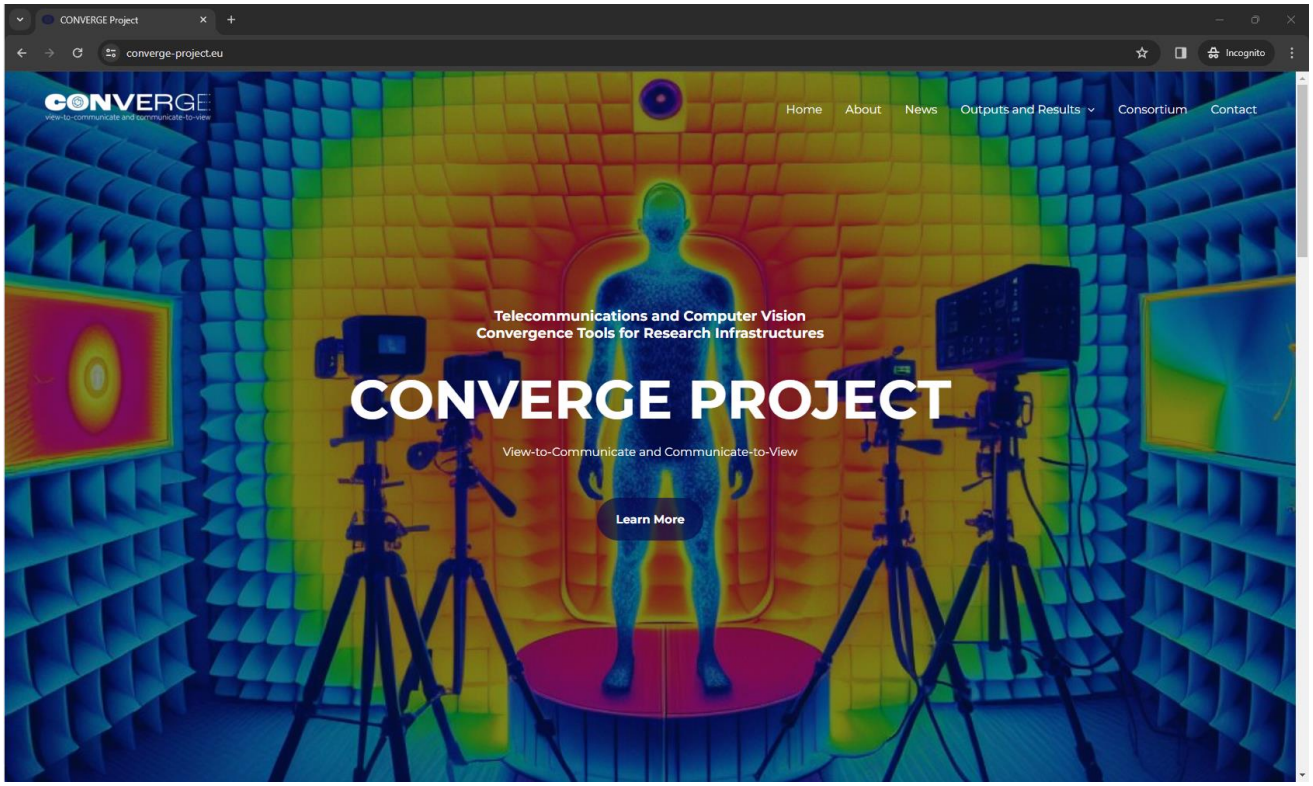

Figure 12 - CONVERGE website homepage.

3.2 Social Networks

Social networks are integral to European projects, facilitating seamless communication, collaboration, and dissemination of project outcomes. They enhance visibility, engagement with stakeholders, and foster meaningful dialogue. Through targeted messaging and interactive content, social networks amplify impact and sustainability, driving effective communication and broader community involvement. In CONVERGE we have considered the use of LinkedIn and Twitter/X social networks.

3.2.1 LinkedIn

The LinkedIn account has been established (Figure 13). It is available at https://www.linkedin.com/company/converge-project/

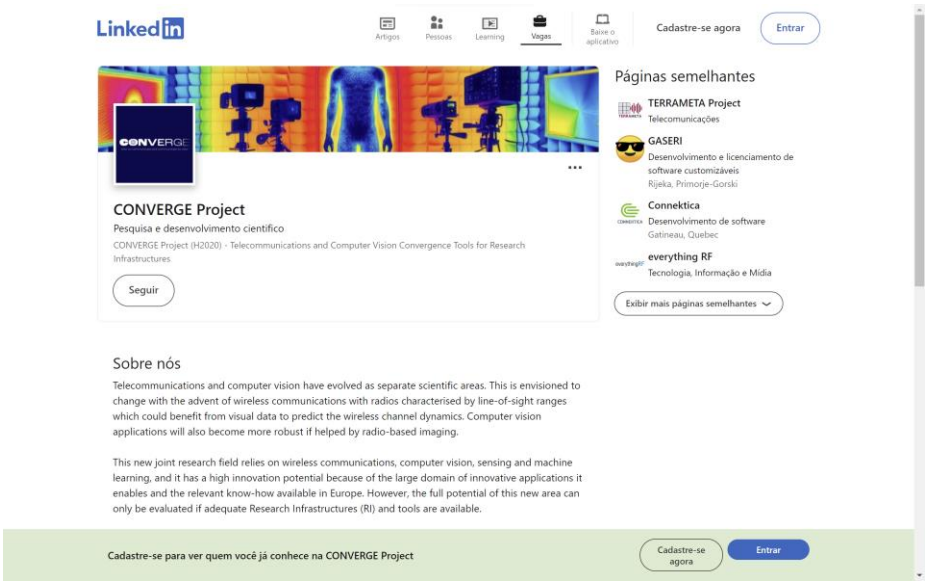

Figure 13 - CONVERGE LinkedIn page.

3.2.2 X/Twitter

The X page (formerly Twitter) has been created (Figure 14) and is available at https://twitter.com/converge_eu.

Figure 14 - CONVERGE X/Twitter.

3.3 Posters

Posters serve as a powerful visual communication tool, succinctly conveying the project objectives, milestones, and outcomes to diverse audiences. They enhance project visibility at conferences, workshops, and exhibitions, engaging stakeholders and fostering dialogue, hence complementing other communication channels.

Three examples of posters are presented in Figure 15, Figure 16, and Figure 17.

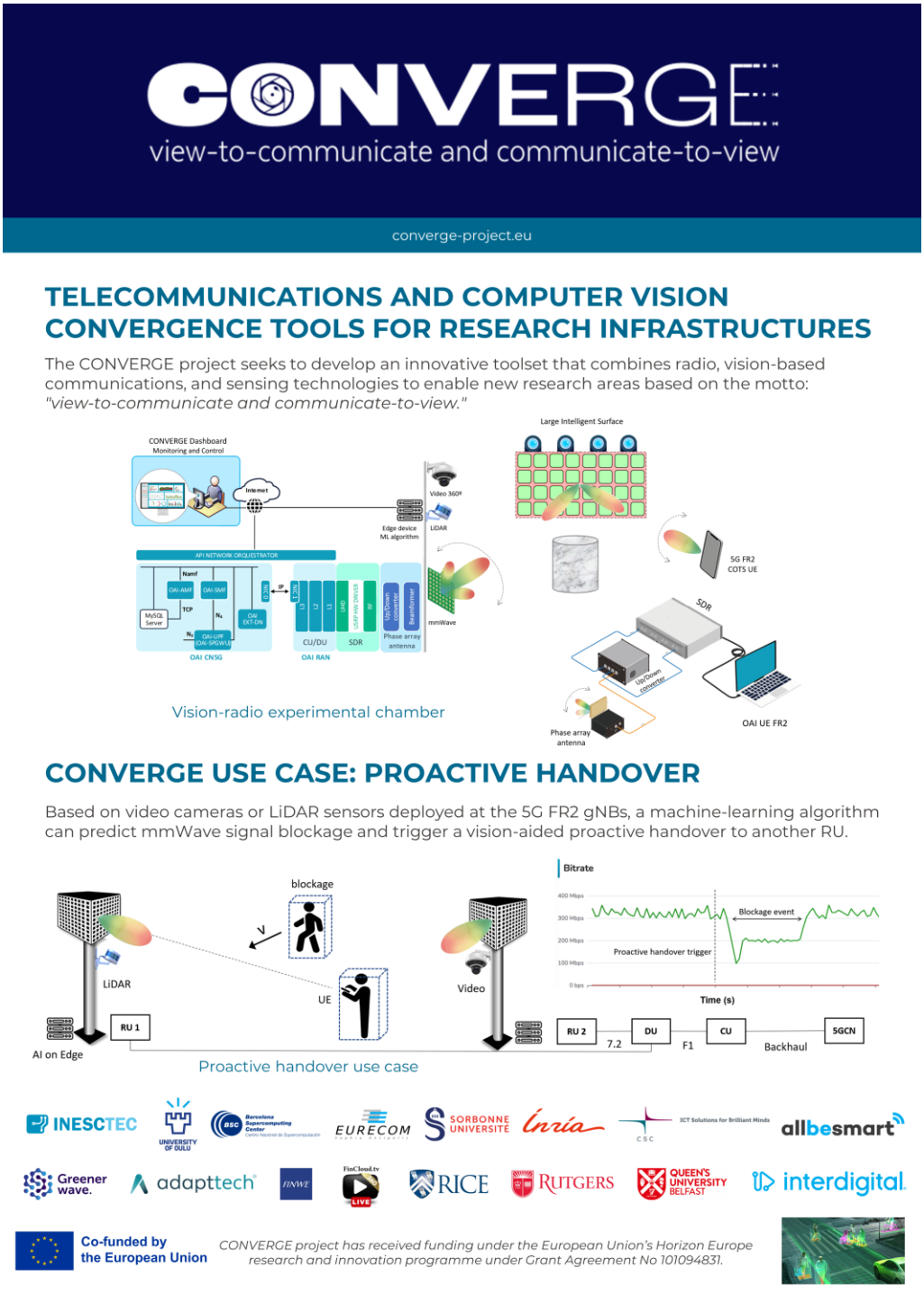

Figure 15 - CONVERGE Poster at EuCNC 2023.

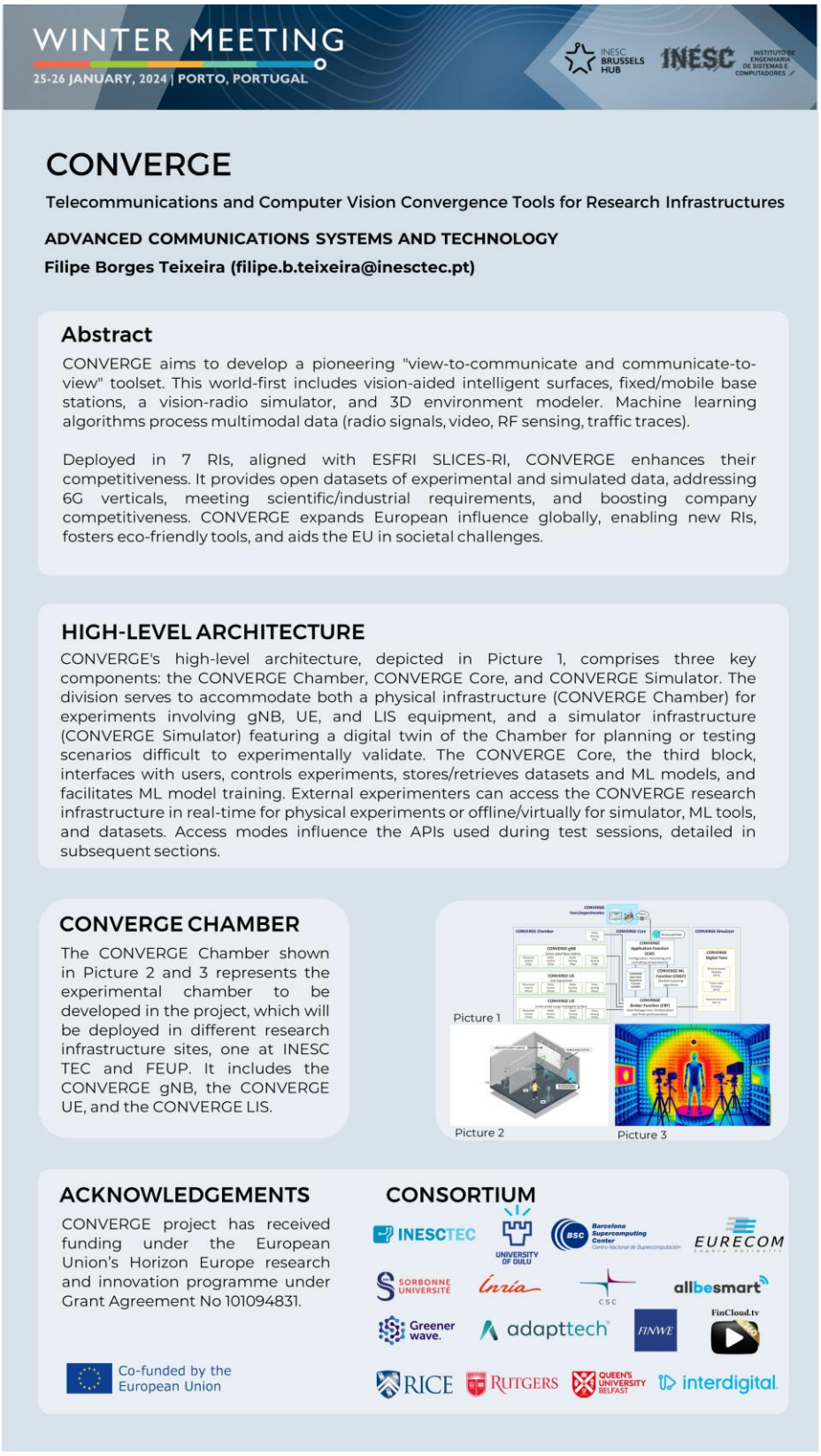

Figure 16 - CONVERGE poster at INESC Brussels Hub Winter Meeting.

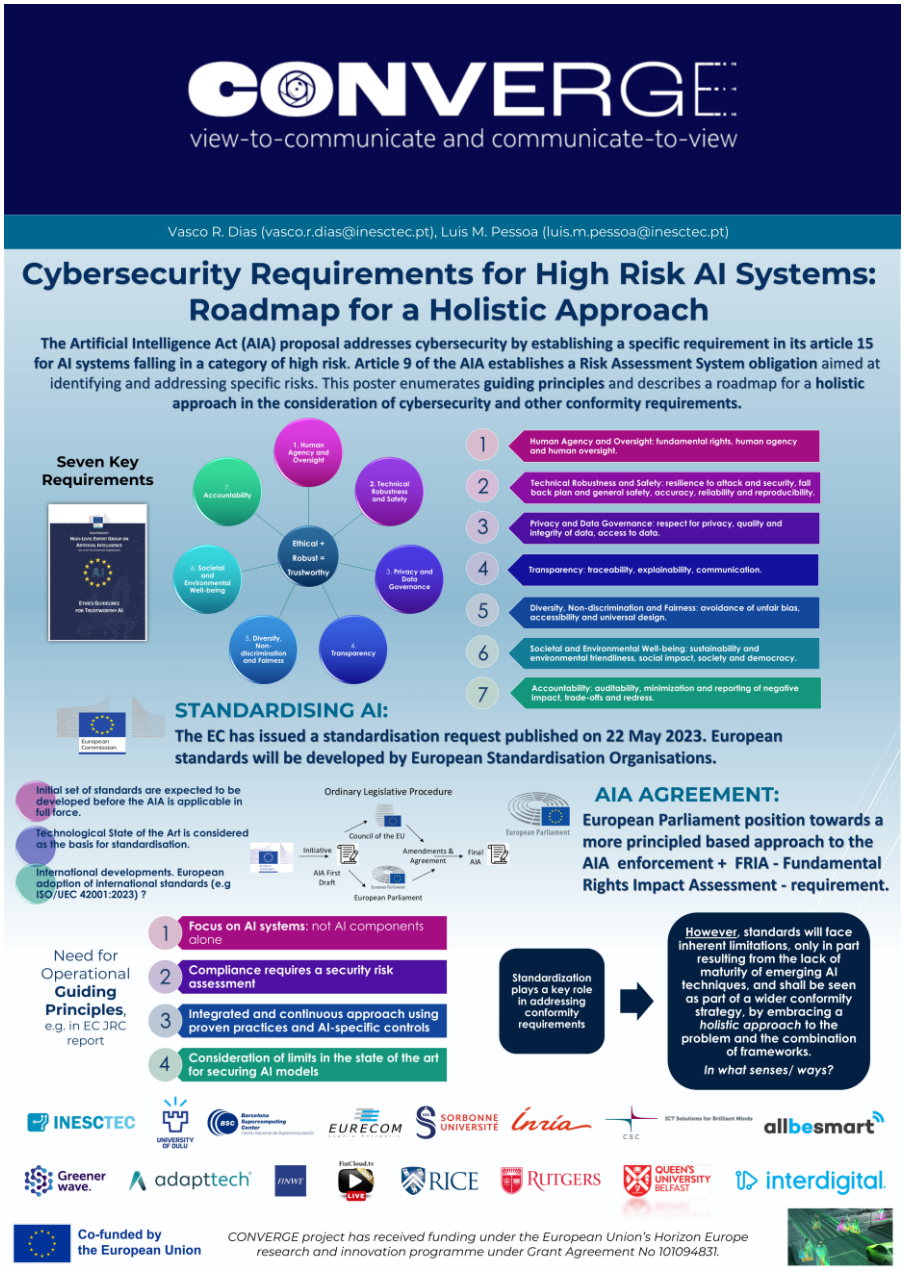

Figure 17 - CONVERGE poster at ETSI AI conference.

3.4 Press-releases and news appearances

The purpose of crafting compelling Press Releases is to actively engage with media outlets and industry authorities, amplifying CONVERGE's visibility and influence. These releases will be carefully crafted and disseminated to announce noteworthy project achievements, events, and outcomes, targeting both national and international media platforms. Press Releases, news and interviews can result in a wide coverage across various media channels including press, blogs, newspapers, scientific journals, podcasts, videocasts, panels, TV, and radio broadcasts.

Some examples of news appearances from the CONVERGE kick-off meeting press-release are presented in Figure 18 - Figure 22.

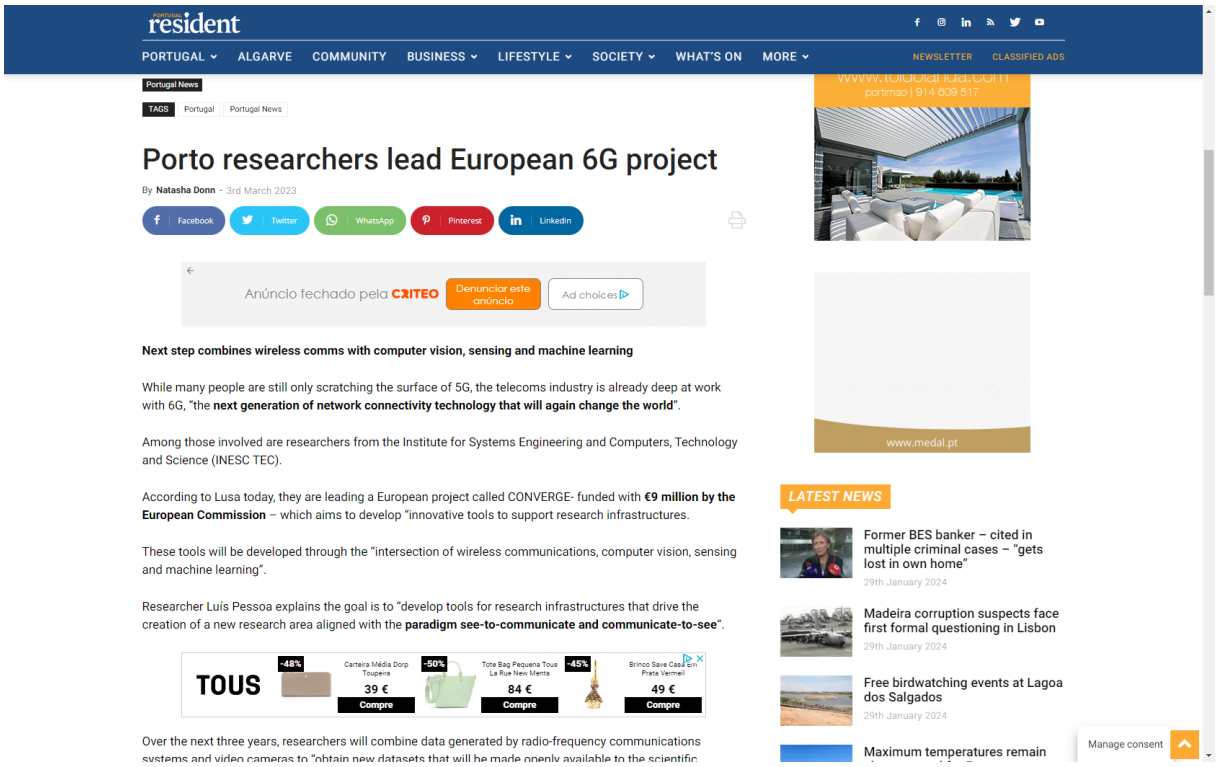

Figure 18 - Porto researchers lead European 6G Project – Portugal Resident.

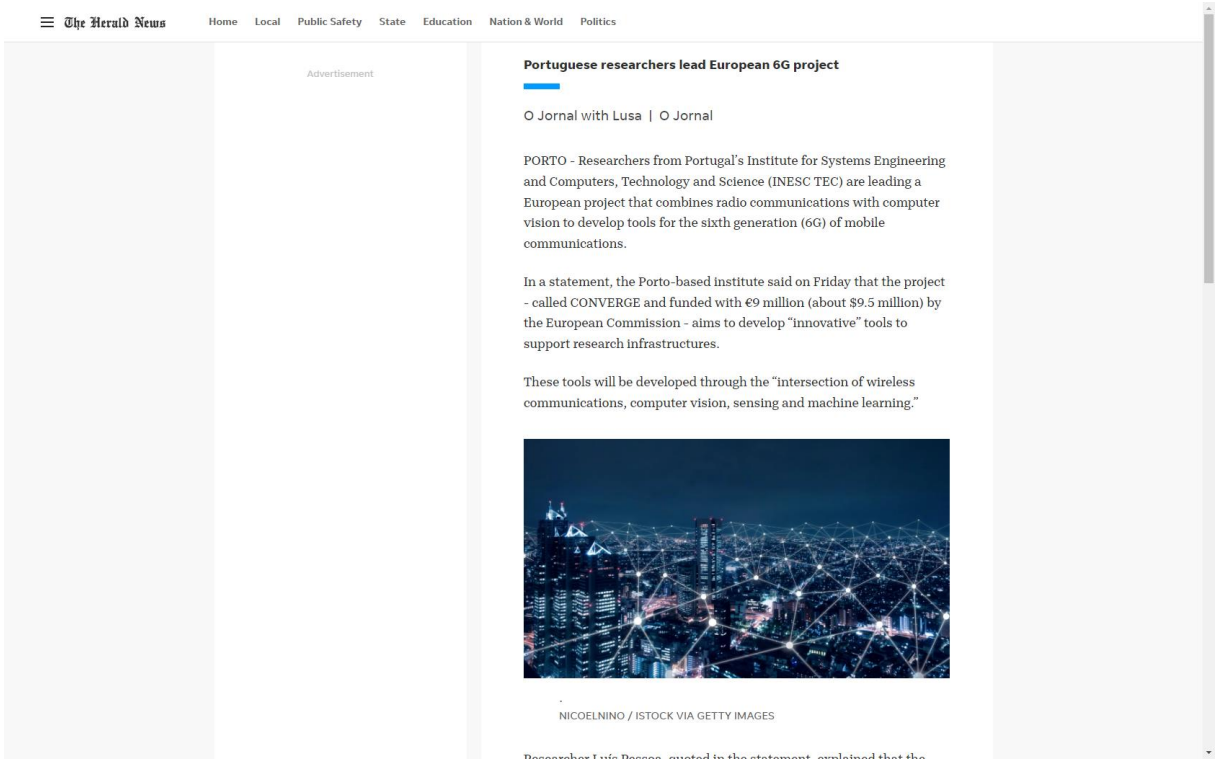

Figure 19 - Portuguese researchers lead European 6G project – The Herald News.

Figure 20 - INESC TEC leads European project that combines radio communications with computer vision towards 6G – BIP INESC TEC.

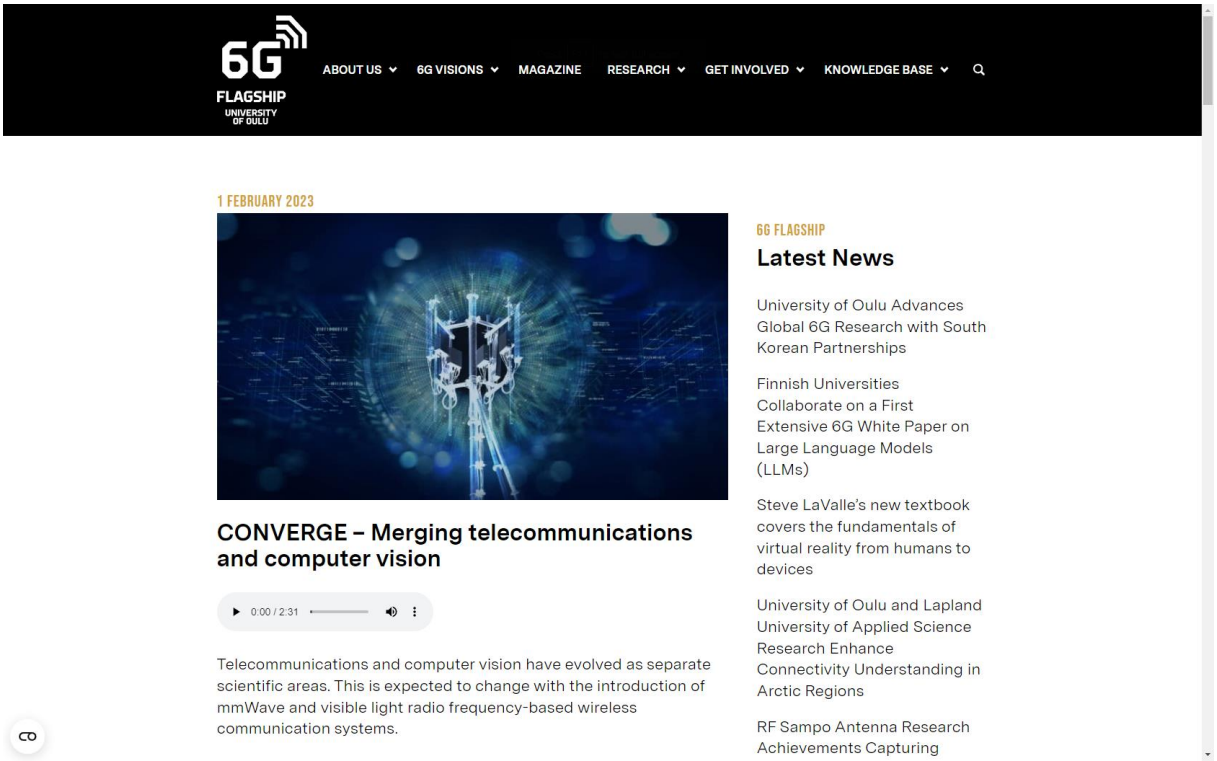

Figure 21 - CONVERGE - Merging telecommunications and computer vision – 6G Flagship.

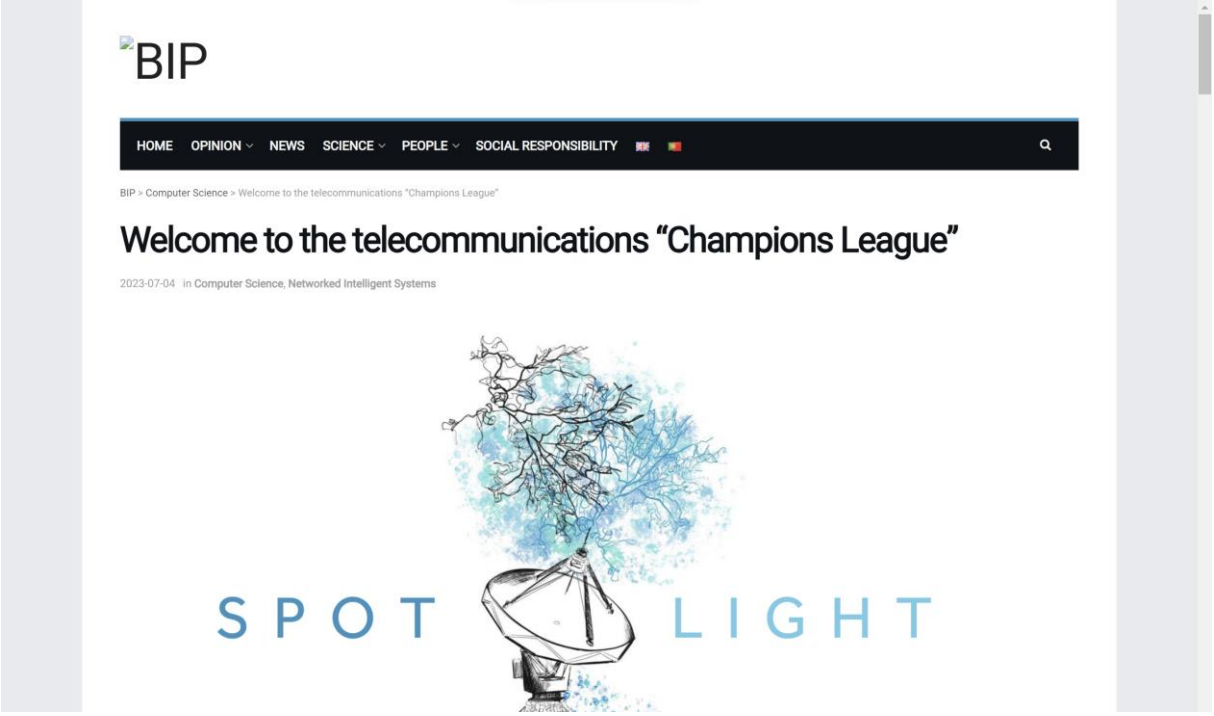

Figure 22 - Welcome to the telecommunications "Champions League" - BIP INESC TEC.

3.5 Newsletter

Newsletters are essential for effective communication, stakeholder engagement, and visibility, serving as centralized platforms for sharing project updates, achievements, and crucial information with diverse stakeholders across different countries. Newsletters foster engagement, ensuring sustained interest and commitment to project goals while enhancing visibility among policymakers, industry professionals, researchers, and the general public.

The first edition of the CONVEGE newsletter has been produced (Figure 23) and will be available on the project website. It will be disseminated on multiple channels and features an overview of the project, the milestones achieved since the kick-off, future and past events, and the progress on the project activities.

The topics addressed in the first newsletter are:

- Editorial note from the Project Coordinator;
- Kick-off meeting in Porto, Portugal;
- Second Face-to-Face meeting in Sophia Antipolis, France;
- Use cases and high-level architecture specification;
- Innovations in Vision-radio Simulation and 3D Modelling;
- Industry panel at IEEE GLOBECOM 2023;
- Super-CLAM Workshop at IEEE ICASSP 2024.

To extend the impact of the newsletter, there is now the option on the CONVERGE website to subscribe to it.

Figure 23 - First CONVERGE Newsletter.

3.6 Communication KPIs evaluation

The periodic monitoring of CONVERGE communication actions allow us to evaluate if communication objectives are being achieved. To assess the impact, we define a set of KPIs that are presented on Table 2. We can see that we are progressing in most communication channels, but the communication tends to increase as the project outcomes become more frequent during the next years of the project.

Table 2 - Communication KPIs for M1-M12

Communication channel	Responsible partner(s)	Activity Timing	Expected KPI at the end of the project	KPI at the end of the first year (M12)
Website	INESC TEC (management) All partners (content contribution)	M3 to M36	~2000 unique visitors	1000 (50%)
Promotional video clips (YouTube)	All partners	M6 to M36	~200 views	0 (0%)
Communication materials (brochures, flyers, posters)	INESC TEC and Allbesmart	M6 to M36	~1000 brochures/flyers 6 posters	0 (0%) 3 (50%)
Social Media channels	INESC TEC (management) All partners (content contribution)	M6 to M36	~200 unique followers ~3000 reach	15 (8%) n/d
Newsletters	EURECOM	M6 to M36	Every 6 months ~200 subscribers	n/d
Press-Releases	All partners	Continuously	5 press-releases	1 (20%)
News appearances	All partners	Continuously	50 news, opinion articles or interviews	5 (10%)

4 STANDARDISATION ACTIVITIES

The primary objective of the CONVERGE project is the development of innovative toolsets that combine radio and vision-based communications as well as sensing technologies. This is developed to enable an emerging area of research aligned with the motto "view-to-communicate and communicate-to-view". This section outlines the updated plan for standardization and open-source activities along with their initial accomplishments. It is organized based on the phases of the roadmap and the relevant SDOs. The plan revolves around making significant contributions to major global Standards SDOs such as 3GPP, IEEE, and ETSI, with the aim of shaping and influencing their processes.

In the context of standardization activities, a number of partners are monitoring different work groups in different SDO and reporting these activities into relevant WPs in the project. The results reported in different WPs (e.g. WP1, WP2 and WP3) are being identified for potential dissemination in different SDOs.

4.1 Standardisation Roadmap

In this sub-section, the updated standardization roadmap is presented:

- **Technical requirements**: The technical requirements of CONVERGE were defined in D1.1 and then updated in D2.1. The update in D2.1 captures the CONVERGE service-oriented architecture that aligns with the 5G network architecture, as suggested by D4.1.
- **Identification of missing requirements for CONVERGE**: Identify the missing requirements for CONVERGE in any SDO. These requirements could be identified based on the activities in WP2 and WP3 throughout the project.
- **Anticipated contributions**: Based on the missing requirements, partners are analysing and anticipate potential contributions. The anticipated requirements could be based on the innovations in WP2 and WP3.
- **Active contributions**: After anticipating a potential contribution to a specific SDO, a contribution can be prepared by relevant partners. In this context, a contribution was submitted to ETSI ISG THz as reported later in this section.

4.2 Standardisation Activities

This section presents updates to the SDOs corresponding to working groups and activities that are relevant to CONVERGE project scope.

4.2.1 3GPP

3GPP covers a wide range of telecommunications technologies, which include RAN, service capabilities and core networks (CN). 3GPP specifications and technical studies are based on contributions by member companies and organizations that are actively participating into working groups. In 3GPP, there are three main technical specification groups (TSGs), which include RAN, services and systems aspects (SA) and core network and terminals (CT). This SDO is one of the primary targets of CONVERGE.

CONVERGE partners are monitoring standardization activities in 3GPP and report to the consortium. Potential opportunities in 3GPP are RAN1 and RAN4. For instance, there has been a great interest in sensing related application in 3GPP, e.g. ISAC, which aligns well with the CONVERGE project.

On the other hand, Reconfigurable Intelligent Surfaces (RIS) have been down-prioritized in 3GPP. In TSG Rel-19 workshop, there were a number of contributions on RIS, which were mainly on channel modelling for RIS. Hence, RIS would be captured in pre-standardization bodies (e.g. ETSI ISG RIS).

4.2.2 ETSI

In CONVERGE, there are opportunities to engage and disseminate the project results into three ISGs, namely ISG RIS, ISG THz, as well as the newly established ISG ISAC:

- **ISG RIS**: ISG RIS has kicked-off its second release and will be running for two years. The first release covered multiple RIS technology components, such as use cases, architecture, channel modelling, etc. However, the second release will focus on implementation between interplay RIS and MIMO (Multiple Input Multiple Output). Interdigital is the chair of ETSI ISG RIS.
    - CONVERGE can be proactive in contributing to ISG RIS by disseminating the results from WP1, WP2 and WP3 into relevant work items. This can be specifically relevant to the second release, which focuses on the implementation aspect of RIS.
- **ISG THz**: the THz ISG focuses on streamlining pre-standards efforts on Tera Hertz (THz) communications (0.1 – 10 THz), and Interdigital is the Secretary of ETSI ISG THz. This ISG completed drafts for DGR/THz-001 (GR) on identification of use cases for THz communication systems, and DGR/THz-002 (GR) on identification of frequency bands of interest for THz communication systems.
    - CONVERGE is monitoring different work items in ISG THz and a contribution was submitted.
    - **A contribution was submitted to ETSI ISG THz** DGR/THz-001, document number THz(23)000169, titled "Use case on Simultaneous Imaging, Mapping, and Localization". This contribution concluded that the computational complexity involved in the high-resolution imaging and localization algorithms can be alleviated by resorting to a multi-modal sensing approach, combining RF sensing with computer vision. This is relevant to the work in CONVERGE, especially on the combined radio sensing and vision sensing components defined in D1.2. This contribution was subsequently included in the public Group Report from ETSI, "TeraHertz technology (THz); Identification of use cases for THz communication systems," ETSI GR THz 001, ETSI ISG THz, 2024.
- **ISG ISAC**: a newly ETSI ISG on ISAC has been established (with the approval of 4 work items covering use cases and evaluation methodologies, channel model and measurement, system architecture, and security, privacy, and sustainability considerations). Interdigital is the chair of ETSI ISG RIS.
    - CONVERGE can be proactive in engaging and contributing to ISG ISAC by disseminating the results from WP2 and WP3 into relevant work items.

4.2.3 6G-IA/6G-SNS Working Groups

CONVERGE is present through its partner INESC TEC in the 6G-IA Pre-standardisation Working Group (since M1), led by Huawei, which gathers 6G-IA members and representatives of ongoing 5G-PPP/SNS-JU Projects. This Working Group aims to develop and propose own roadmaps for 5G/6G, influencing pre-standardization on 5G/6G and related research, propose/identify SDOs where topics should be standardized, and influence timing on R&D work programs. By participating in this forum, CONVERGE is permanently getting timely updates on SDO trends and upcoming activities, leveraging synergies with other projects sharing coherent goals and maximizing the transfer of research results to standards.

CONVERGE is also participating in the 6G-SNS Test, Measurement and Validation (TMV) Working Group, led by Keysight and WINGS, through its partner INESC TEC. This WG has had its kick-off meeting in January 2024. One of the topics that TMV will address is data reusability in the scope of the

6G-SNS, aiming to create a standard for experimental data storage/meta data labelling for EU projects to ensure data reuse as well as to create a standard for experiment, methodology, data, and result description. This topic is extremely relevant for CONVERGE, in particular for the extension and enhancement of its Data Management Plan, and therefore it is expected that the participation in this WG will be highly beneficial for the project.

5 ENGAGEMENT WITH OTHER RESEARCH INFRASTRUCTURES

The CONVERGE consortium aims to engage with other research infrastructures and stakeholders, fostering continuous interaction to align user needs, promote collaboration, technology transfer, and innovation. This engagement is crucial for assessing RI impact and facilitate broader thematic clustering and networking activities. CONVERGE project targets global engagement, especially with vertical markets like telecommunications, automotive, health, manufacturing, and media sectors. In this section we report the connectivity and collaboration in Finland, Portugal and at pan European level.

5.1 Connectivity and collaborations within Finland

The CONVERGE developments have been discussed in some activities in Finland, including 5GTN and 6G Flagship.

5.1.1 5GTN

An overview of the Finnish national main sites and locations are presented in Figure 24. The architecture is based on the 5G test network (5GTN) project[15]. The UOULU 5GTN is connected to other sites in Finland including VTT Oulu, VTT Espoo, Aalto University, Centria applied University of Science, Tampere University, Oulu University hospital (OYS) Nokia Espoo and Nokia Tampere. The main part of the network is based on Nokia products, but also includes an open-source network based on open-air interface (OAI) protocols, mainly by Allbesmart. The network has, furthermore, been connected, for instance, to South Korea's ETRI's network already in 2018 for Winter Olympics demo and later in 2022 for 5G-URLLC tests in industrial control applications. The research infrastructures have been extensively used in national research projects in Finland and CONVERGE will add a significant contribution to the RI's service catalogue.

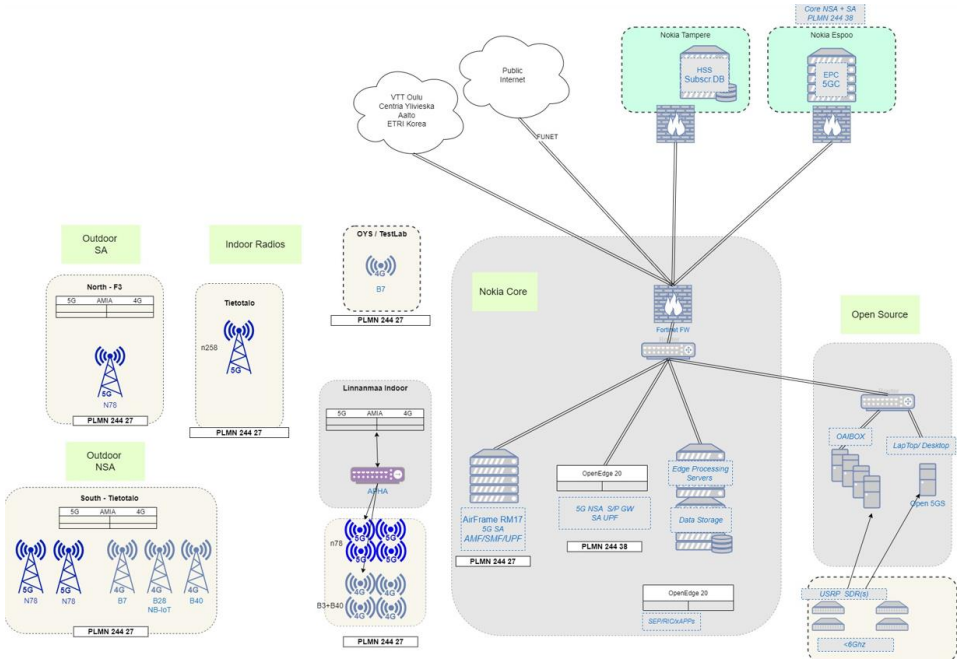

Figure 24 - 5GTN system level architecture and national connections[15].

[15] 5GTN – 5G Test Network - https://5gtn.fi/

5.1.2 6G Flagship

6G Flagship[16] is the world's first 6G research programme, leader in 5G adoption, and a research partner in 6G development globally. 6G Flagship delivers high-quality 6G research to create future know-how and sustainable solutions for society's needs in the 2030s. 6G Flagship operates under the University of Oulu, which also provides funds together with the Research Council of Finland. The nexus of 6G Flagship programme is the rapidly evolving, open 5G Test Network (5GTN). University of Oulu is developing the test network further towards more 6G flavoured capabilities. The 6G Test Network (6GTN) will become the main co-creation and research environment for 6G with new features to facilitate product-testing capabilities for 5G and beyond markets. For this purpose, the 6G Flagship program is creating the necessary tools and equipment to empower the 6GTN as the world's first end-to-end 6G-trial platform to be integrated in the future 6G Radio Park. The CONVERGE project can leverage the 6G Flagship ecosystem with more than 500 academic partners (71 countries) and more than 400 industrial partners (31 countries) globally.

5.1.3 6G Bridge

Business Finland, an agency funding technological innovations R&D has launched a 130 M€ 6G programme entitled 6G Bridge. Within this programme several activities, inspired by the Horizon Europe projects including CONVERGE (described later in this chapter) and partially linked to the activities in RIs, have been funded. These include projects such as:

- **EMETA**, enabling Metaverse to improve understanding about the practical Metaverse ICT requirements, develop 5G Evolution/Advanced based communication and computing, real-time multi-user 3D Digital Twin, AR/VR/XR and blockchain technologies and solutions for Metaverse key features. The project will also implement test environments and proof-of-concepts which demonstrate the control and utilization of smart building resources and facilities;
- **Local6G**: Studying hyperlocal 6G network solutions operating under the private network paradigm;
- **6GTNF**, 6G test network Finland: Upgrading RI's to Rel. 16 and Rel. 17 devices, looking at Rel. 18 and Rel. 19 solutions.

5.2 Connectivity and collaborations within Portugal

The CONVERGE project has some connectivity and collaboration with other activities in Portugal, namely NEXUS, PRODUTECH R3 and Test Bed 5G and Digital Transformation.

5.2.1 NEXUS

The NEXUS Agenda[17] consortium is headed by the Port of Sines and comprises 35 partners sharing the ambition to develop innovative solutions aiming at achieving both a Green and Digital Transition Agenda. Representative of the whole value chain, the consortium gathers port authorities, maritime, terminal and railway operators, carriers, dry ports, logistics operators, technology suppliers, importers,

[16] 6G Flagship - https://6gflagship.com/

[17] NEXUS - https://nexuslab.pt/

and exporters, being supported by universities and research institutes, whose skills and expertise will play an important role on the fulfilment of this pioneering Agenda. Figure 25 summarizes the Core Product of the NEXUS Agenda.

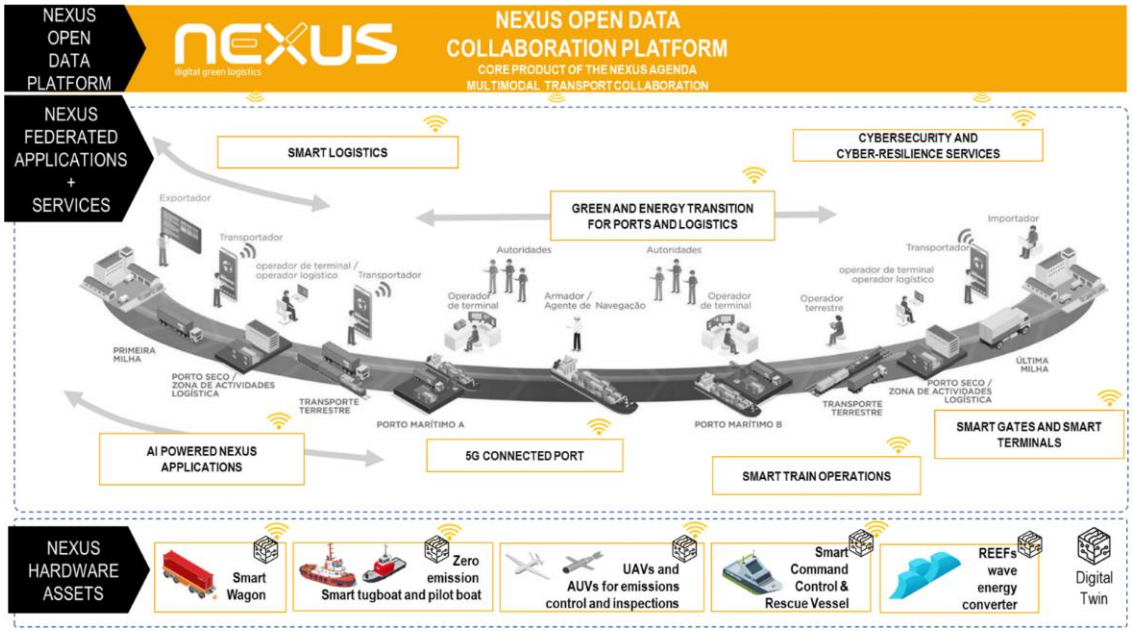

Figure 25 - Core Product of the NEXUS Agenda, including the 5G Connected Port[17].

In the context of the 5G Connected Port (Work Package 6), the NEXUS agenda is specifying and deploying a 5G network to support the port operations, considering the requirements of its heterogeneous tenants and respective applications that should be supported. INESC TEC is collaborating in this Work Package, in close collaboration with Altice Labs, by implementing an innovative mobile 5G base station that is able to complement the existing 5G network coverage, by reinforcing network coverage in areas that do not justify the investment of installing a permanent and fixed 5G infrastructure. CONVERGE benefits from the NEXUS Agenda since its tools, such as the Mobile Base Station, are being inspired by the needs of innovative and demanding real use cases. The close collaboration established with Altice mobile operator also gives important insight regarding the design and implementation of such innovative solutions, including their integration in real operational environments. NEXUS Agenda will also benefit from CONVERGE since the experimentation tools being develop in CONVERGE will allow for a first evaluation and validation of the NEXUS innovative solutions in a controlled experimental setting before being deployed in the real environment of Port of Sines.

5.2.2 PRODUTECH R3

The PRODUTECH R3[18] project aims to induce a structural change in the Production Technologies Sector (PTS), enabling it to explore the significant investments that the industry will make with the green and digital transition, reducing external technological dependence, increasing the added value generated in the country and contributing to a change in the specialization of the Portuguese economy.

[18] PRODUTECH R3 - https://r3.produtech.org/

Based on a partnership that brings together 108 companies and other entities, from PTS, the main sectors of industry and the scientific and technological system, the project envisages the collaborative development of 85 new innovative products and services and their demonstration in more than 52 pilots in companies of user sectors and the development of complementary actions in the areas of education and training, internationalization, dissemination and training of PTS, inducing a structural change and the creation of a true innovation ecosystem in the area of production technologies, dynamic and sustainable.

In the context of this project, INESC TEC is collaborating with the NOS Portuguese mobile operator to deploy 5G communications infrastructure to support innovative applications in industrial scenarios, such as the support for the operation of Autonomous Mobile Robots supported by edge computing, and the Digital Twinning of multiple industrial processes. CONVERGE is benefiting from the interaction with PRODUTECH R3 by collecting realistic requirements based on the real industrial use cases being addressed by PRODUTECH R3. PRODUTECH R3 will also benefit from CONVERGE tools, once they become available, to test innovative solutions in a controlled and reproducible setting before deploying the new solutions in a production environment.

5.2.3 Test Bed 5G and Digital Transformation

The Test Bed 5G and Digital Transformation[19] project fits into the National Test Beds Network. The consortium is led by NOS, with co-promotion from Sonae MC and Wells, and has INESC TEC, CEiiA and Ericsson as core partners. It aims to boost innovation and leadership in experimentation based on 5G, as a central and unavoidable piece in the digital transformation of various sectors, accelerating its adoption in Portugal and contributing to convergence at European level. The consortium plans to support the development of up to 165 5G pilots, i.e. innovative products or services that use new connectivity generation in structuring areas in the Portuguese economy and society: Industry, Retail, Health, and Smart Cities and Sustainability. For this purpose, the co-promoters will invest approximately eight million euros.

INESC TEC is leading the support for the pilots that are addressing the Industry-related use cases, by leveraging its iiLab[20] (Industry and Innovation Lab) facilities and the 5G network connectivity provided by NOS Portuguese mobile operator. The functionality implemented in this laboratory closely represents a range of advanced industrial processes that could benefit from the improved connectivity provided by 5G. Hence, a close collaboration between both projects is inspiring the definition of the Industrial Use cases considered in the CONVERGE project, and influencing the CONVERGE tools requirements, design and subsequent implementation. In the end, the CONVERGE tools will allow to run experiments addressing industrial use cases, and the performance results could be compared against the ones obtained in iiLab.

5.3 Connectivity and collaborations on pan European level

The partners of CONVERGE projects are beneficiaries in many European projects. The CONVERGE consortium has sought and will seek collaborative actions and synergies between the different projects and their partners in engagement with different stakeholders.

[19] Testbed 5G - https://www.nos.pt/content/dam/nos/institucional/media/comunicados/5g/files/13_07_2023_PR_NOS_ANIVERSARIO_HUB_5G.pdf

[20] Digital Transformation - https://www.inesctec.pt/en/laboratories/iilab-industry-and-innovation-lab#mission-and-objectives

5.3.1 SLICES-RI

Within the CONVERGE partners, University of Oulu, Sorbonne University, Eurecom, and Inria are also partners in the Pan-European SLICES-RI[21] initiative that has been accepted to the roadmap of European Strategy Forum for Research Infrastructures (ESFRI). SLICES is an initiative designed to support large-scale, experimental research focused on networking protocols, radio technologies, services, data collection, parallel and distributed computing and in particular cloud and edge-based computing architectures and services and which are federated. SLICES consortium gathers partners from 15 European countries, all of them having committed to contribute resources and has received the endorsement of key stakeholders and the political support of 11 European Governments. The SLICES ecosystem is depicted in Figure 26. Several of the current partners are operating facilities that are already on their national and regional RI roadmaps. SLICES will encourage and foster all the initiatives at different levels (European, national, and regional) for the inclusion of SLICES in their respective roadmaps. Discussions and negotiations have already started in several countries involved in SLICES with their respective ministries in order to broaden the SLICES consortium.

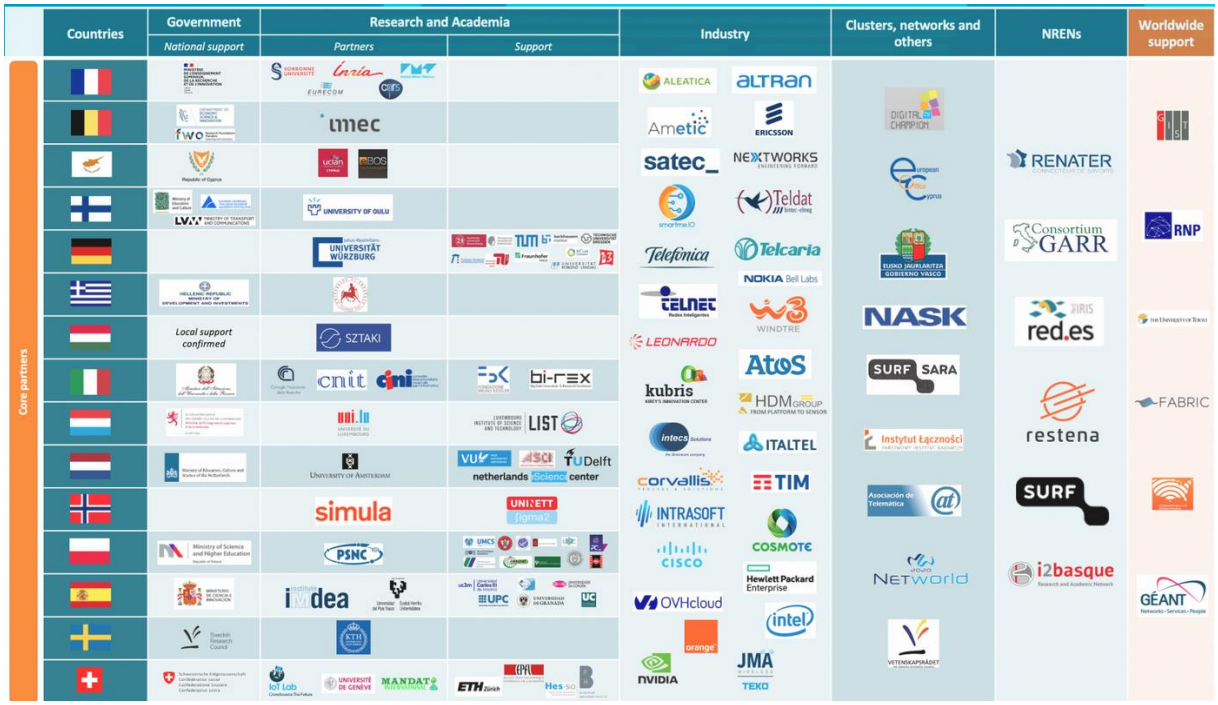

Figure 26 - SLICES-RI ecosystem[21].

5.3.2 HE SUNRISE-6G

Within the consortium members of CONVERGE, UOULU, Sorbonne University, Eurecom, and Greenerwave are partners in the Sustainable Federation of Research Infrastructures for Scaling-up

[21] SLICES-RI – https://slices-ri-eu

Experimentation in 6G (SUNRISE-6G) project[22]. This project was selected under the Smart Networks and Services Joint Undertaking (SNS JU) second call for proposals and is stream C project. SUNRISE-6G aspires to federate 6G test infrastructures in a pan-European facility supporting converged Testing as a Service (TaaS) workflows and tools, along with a unified catalogue of 6G enablers publicly accessible by experimenters and cross-domain vertical application onboarding. This offering is facilitated via a Tenant Web Portal that acts as a single-entry point to the facility, serving various stakeholders like experimenters, vertical developers, infrastructure owners, and 6G component manufacturers. The project is centred around establishing and expanding a Pan-EU experimental infrastructure for 6G, validating end-to-end 6G architectures. The project started on January 2024 and has 29 partners and is federating almost 10 research infrastructures. The collaboration of CONVERGE with SUNRISE-6G will be pursued continuously, for example including the joint organisation of events, sharing of experimental results/datasets and lessons learnt, and promotion of the CONVERGE toolset in 7 additional research infrastructures that are not part of CONVERGE consortium.

5.3.3 HE 6G-XR

6G eXperimental Research's[23] ambition is to strengthen European leadership in 6G technologies by enabling next-generation XR services and infrastructures that will provide beyond-state-of-the-art capabilities towards the 6G era. 6G-XR is a SNS JU phase 1 stream C project. Within the CONVERGE partners, University of Oulu, is a partner in 6G-XR. The project will develop an experimental multisite Research Infrastructure (RI) to provide a validation platform for various 6G use cases by developing enablers for networking and computing, radio access technologies beyond 5G, enablers for XR services with in-build federation, trial management, abstraction tools as well as energy measurement frameworks. The RIs to be connected within 6G-XR are UOULU 5GTN, VTT 5GTN, and in Spain 5GTonic in i2cat Barcelona and in Madrid run by Ericsson, Telefonica and CapGemini. The project also offers to third parties (with value of 1,8 M€ including experimenters from open calls) automated experimentation capabilities. Specifically, three open call projects can be mentioned that support also CONVERGE:

- Subject: Automated IP network measurement system - Awarded proposal: Bringing Automated Network QoS Monitoring Capabilities for Re-search Infrastructures (BANQ);
- Subject: Fab Lab digital twin environment - Awarded proposal: FAb LAb DIgital TwiN (FALADIN);
- Subject: End-to-end slicing with RAN resource sharing - Awarded proposal: Enabling end-to-end O-RAN slicing in 6G-XR (6G-SLICE).

5.3.4 HE 6G-SANDBOX

6G-SANDBOX[24] is a HE SNS JU phase 1 funded stream C research project. The 6G-SANDBOX project brings a complete and modular facility for the European experimentation ecosystem (in line and under the directions set by SNS JU), which is expected to support for the next decade technology and research validation processes needed in the pathway towards 6G. Within the CONVERGE consortium, University of Oulu and The Queen's University of Belfast are participating organisations of 6G-SANDBOX. The target is at technologies and research advances, that span over the entire service

[22] HE SUNRISE-6G - https://sunriseproject.org/

[23] HE 6G-XR – https://6g-xr.eu

[24] HE 6G-SANDBOX – https://6g-sandbox.eu

provisioning chain, and refer to user/data, control and management planes. In this direction, 6G-SANDBOX introduces the concept of Trial Networks, which refers to fully configurable, manageable, and controlled end-to-end networks, composed of both digital and physical nodes. The 6G-SANDBOX Trial Networks incorporate infrastructures distributed in EU (namely in Malaga, Athens, Berlin and Oulu) and offer to third parties (including experimenters from open calls) automated experimentation capabilities through a rich and extensible toolbox. Through cooperation initiatives with the SANDBOX project, CONVERGE aims to promote the adoption of its toolset in the 3 SANDBOX research infrastructures that are not part of CONVERGE consortium.

5.3.5 Other activities

Besides national and pan-European project collaborations, the CONVERGE project will engage with stakeholders through attending expos and demo events (e.g. EUCNC and 6G Summit, MWC) and organizing special sessions, and workshops (at relevant conferences and events, such as ICC, GLOBECOM, PIMRC, EUCNC and 6G Summit), and performing dedicated marketing efforts.

6 CONCLUSIONS

This deliverable has presented the activities on the dissemination, communication, standardisation, training, and engagement with other research infrastructures over the first 12 months of the CONVERGE project.

During the first year of the project, the CONVERGE work culminated in the publication of two journal papers, one contribution to a conference, and the organization of an industry panel at GLOBECOM. The dissemination of the project was also complemented by the participation on multiple public events, with a combined number of attendees exceeding 2000. Different communication channels were setup, including an eye-catching and easy to navigate website as well as social networks. Together with the newsletter, they contribute to an effective project dissemination.

The standardisation efforts during this period include the monitoring and internal reporting of standardization activities in 3GPP, namely in sensing related applications and RIS channel modelling. Regarding ETSI, the ISG RIS, ISG THz and the ISG ISAG are the three Industry Specification Groups where CONVERGE has opportunities to engage and disseminate the project results. A concrete contribution was submitted and included in the public Group Report GR001 published in January 2024.

Training and exploitation activities are more focused on the second and third year of the project and will be reported on the D4.3 and D4.4. A training activity is already being organized in articulation with SLICES, to be held in M13, aiming to introduce to all CONVERGE partners the general principles of data management including FAIR (Findable, Accessible, Interoperable, Re-usable) principles, interoperability issues with EOSC (European Open Science Commons) and Research Infrastructures, and Replicable and reproducible research, including challenges with experimental data and what infrastructure services are needed.

Strong engagement with other research infrastructures is being developed, with national and pan-European connectivity and collaborations, including 5GTN, 6G Flagship, 6G Bridge, NEXUS; PRODUTECH R3, Test Bed 5G & Digital Transformation, SLICES-RI, HE SUNRISE-6G, HE 6G-XR, HE 6G-BRICKS, HE 6G SANDBOX.

The CONVERGE consortium will continue pursuing the objectives of the Work Package 4 during the second year of the project), increasing the dissemination and communication KPIs defined at the beginning of the project. Several publications are already accepted for publication and submitted to international conferences. Also, the SUPER-CLAM workshop, part of the IEEE ICASSP 2024 conference, will take place in April 2024, in Korea. A workshop submission to PIMRC 2024 and EuCNC 2024 is also underway.