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SNS OPS – Supporting the SNS JU Operations

D4.2: Stakeholder Involvement and Interaction: Interim Report

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Abstract

The interim report on SNS OPS stakeholder involvement outlines strategic updates and key achievements covering the transition from Year 1 to 2 of the SNS OPS project. It maps the SNS stakeholder ecosystem, detailing engagement strategies for various sectors and outlines pre-standardization activities, SME engagement, and Working Group support. Activities span from mapping the SNS stakeholder ecosystem, analysing pre-standardisation trends, creating the Standards Tracker, boosting SME engagement through the NetworldEurope SME WG, and describing coordination between different SNS, 6G IA, and NetworldEurope Working Groups in 2023. Finally, future actions for the project's final year are outlined to enhance collaboration and innovation within the SNS ecosystem.

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Executive Summary

This document presents the SNS OPS interim stakeholder involvement and interaction interim report. It contains updates on the adopted strategic approach, key accomplishments, and work plan variations between M5 and M15 (March-April 2023 - March 2024). SNS OPS has taken several strategic and practical steps to enhance stakeholder involvement and cooperation and refine the stakeholder engagement methodology.

A first accomplishment is the comprehensive update and expansion of the SNS stakeholder ecosystem map, which now provides a clearer illustration of the complex interplay among various actors within the provisioning, user, and enablers/facilitators ecosystems. This refined map helps better identify and engage with the relevant stakeholders, ensuring that their roles, needs, and contributions are accurately represented and addressed, facilitating more effective collaboration across the SNS community.

Four Impact Assessment and Facilitation Actions (IAFAs) were successfully implemented in different areas between October 2023 and March 2024. These targeted the exploitation of synergies and establishment of cooperation roadmaps between the SNS JU with the Digital Innovation Hubs, particularly the Smart Connectivity Digital Innovation Hub Network (SCoDIHNet); the Chips JU and the EU microelectronics stakeholders and, the European Cybersecurity Organisation (ECSO) and the cyber community overall. Furthermore, the IAFA#4 consists of a three-event series focused on standardisation.

In this respect, the Standards Tracker has become a central tool for streamlining European involvement in the global standardisation landscape. This platform facilitates the synchronisation of SNS JU R&I projects with the broader standardisation roadmap, enhancing collaboration with key entities such as the European Telecommunications Standards Institute (ETSI) and the European Commission (EC). This strategic alignment underscores the European Union's commitment to maintaining a leading role in the development and standardisation of next-generation telecommunications technologies.

The involvement of small and medium-sized enterprises (SMEs) in the SNS ecosystem is another focal area. Analysis of SME participation in SNS JU calls has indicated a notable increase in engagement, highlighting the effectiveness of targeted support measures and the active role of the SME Working Group (WG). The WG has been instrumental in addressing specific challenges faced by SMEs and promoting their involvement and visibility within the SNS community. The launch and dissemination of the upcoming 2024 SME brochure are expected to further spotlight SME contributions and accomplishments, supporting a more diverse and inclusive SNS ecosystem.

Finally, support for the creation, progress monitoring, and resilience of each SNS WG is the fourth and last pillar of the SNS OPS stakeholder engagement strategy, which ensures the successful implementation of the multifaceted SNS JU programme.

Looking ahead, the strategy envisages the organisation of several IAFAs, the updating of the Standards Tracker with the input received by SNS R&I projects, the launch of a new SNS questionnaire that will gather feedback on the market outlook as well as the technical and vision aspects, and the further refinement of the stakeholder ecosystem map. These efforts aim to deepen stakeholder engagement, adapt strategies to evolving market and technological trends, and ensure comprehensive stakeholder representation and involvement. Additionally, fostering collaboration through new Working Groups and supporting key events like EuCNC remains crucial for maintaining Europe's competitive edge in telecommunications. Overall, the interim strategy reflects a strong commitment to advancing the SNS ecosystem, highlighting the need for continuous innovation, inclusion, and collaborative efforts.

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Abbreviations

3GPP	Third Generation Partnership Project
5G	5th Generation Wireless Systems
5G PPP	5G Public Private Partnership
5GAA	5G Automotive Association
5G-ACIA	5G Alliance for Connected Industries and Automation
5G IA	5G Infrastructure Association
6G	6th Generation Wireless Systems
6G IA	6G Smart Networks and Services Industry Association
AI	Artificial Intelligence
AIOTI	Alliance for the Internet of Things
AR	Augmented Reality
AWS	Amazon Web Services
B5G	Beyond 5G
BDVA/DAIRO	Big Data Value Association/Data, AI and Robotics
BSCW	Basic Support for Cooperative Work
BVME SG	Business Validation, Models, and Ecosystem Sub-Group
CAM	Connected and Automated Mobility
CAMARA	Common API Registry for #APIs and #Repo for API implementations
CCAMP	Common Control and Measurement Plane
CEF	Connecting Europe Facility
CEPT	European Conference of Postal and Telecommunications Administrations
CORD	Central Office Re-architected as a Datacentre
CSA	Coordination and Support Action
DEP	Digital Europe Programme
DetNet	Deterministic Networking
DIHs	Digital Innovation Hubs
DMM	Distributed Mobility Management
DMIMO	Distributed Multiple Input Multiple Output
EAG	Expert Advisory Group (of NetworldEurope)
EBU	European Broadcasting Union
EC	European Commission
ECSO	European Cybersecurity Organisation
EEN	Enterprise Europe Network
EE TC	Energy Efficiency Technical Committee
EIM	European Rail Infrastructure Managers

EMEA	Europe, the Middle East and Africa
EMF	ElectroMagnetic Field
ENI	Experiential Networked Intelligence
ENISA	European Union Agency for Cybersecurity
ERTICO	European Road Transport Telematics Implementation Coordination
ESA	European Space Agency
ESNA	European Startup Nation Alliance
ESOA	EMEA Satellite Operator's Association
ETSI	European Telecommunication Standards Institute
ETSI SES	Satellite Earth Station and Systems
ETP	European Technology Platform
EU	European Union
EuCNC	European Conference on Networks and Communications
FSG	Fifth Generation Fixed Network
G5GE	Global 5G Event
GB	Governing Board
GDPR	General Data Protection Regulation
H2020	Horizon 2020
IAFA	Impact Assessment and Facilitation Action
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
IEEE WCNC	IEEE Wireless Communications and Networking Conference
ISG	Industry Specification Groups
ISG THz	Industry Specification Group Terahertz
INT	Integration
ISAC	Integrated Sensing and Communication
ITS	Intelligent Transportation Systems
ITU	International Telecommunication Union
ITU-R	International Telecommunications Union Radiocommunication Sector
IWD	International Women’s Day
KER	Key Exploitable Result
KPI	Key Performance Indicator
KVI	Key Value Indicator
LoIs	Letters of Intent
LTE	Long Term Evolution
MANO	Management and Network Orchestration
MCData	Mission Critical Data

MCPTT	Mission Critical Push To Talk
MEC	Multi-access Edge Computing
MCS	Mission Critical Services
MCVideo	Mission Critical Video
MCX	Mission Critical Services over LTE
ML	Machine Learning
mmWave	millimetre Wave
MNO	Mobile Network Operator
MoU	Memorandum of Understanding
MR	Mixed Reality
MSI SG	Member State Initiatives in 5G/6G sub-group
MWC	Mobile World Congress
NEM	New European Media
NESSI	Networked European Software and Services Initiative
NFV	Network Function Virtualisation
NFV ISG	Network Functions Virtualisation Industry Specification Group
NFV SEC	Network Function Virtualisation Security
NGA	Next Generation Alliance
NGMN	Next Generation Mobile Networks
NMRG	Network Management Research Group
NI	Network Intelligence
NTN	Non-Terrestrial Networks
ODL	Operational Data Layer
ODTN	Open Disaggregated Transport Network
ONA	Open Network Architecture
ONAP	Open Networking Automation Platform
ONF	Open Networking Foundation
ONOS	Open Network Operating System
OOPT	Open Optical & Packet Transport
ORAN	Open Radio Access Network
OSA	OpenAirInterface Software Alliance
OSM	Open Source MANO
PCG	3GPP Project Coordination Group
PHY/MAC	Physical/Medium Access Control
PPDR	Public Protection and Disaster Relief
PPP	Public Private Partnership
PS&A SG	Portfolio Structuring and Analysis Sub-group

PSCE	Public Safety Communication Europe
PSM	Pre-Structuring Model
QCI	QoS Class Identifier
QoS	Quality of Service
R&D	Research & Development
R&I	Research & Innovation
RAN	Radio Access Network
RATS	Remote AttesTation procedureS
RAW	Reliable and Available Wireless
RIS	Reconfigurable Intelligent Surface
RoI	Return of Investments
SAI	Securing Artificial Intelligence
SatCom WG	Satellite Communication Working Group
SB	Steering Board
SCoDIHNet	Smart Connectivity Digital Innovation Hub Network
SDA	Strategic Deployment Agenda
SDN	Software Defined Networks
SDO	Standards Development Organisation
SEO	Search Engine Optimisation
SG	Sub Group
SME	Small and Medium Sized Enterprise
SNS JU	Smart Networks and Services Joint Undertaking
SNSV SG	Smart Networks and Services Vision Sub-Group
SNVC SG	Societal Needs and Value Creation Sub-Group
SON	Self-Organising Networks
SRIA	Strategic Research and Innovation Agenda
T&M	Test and Measurement
T&M	Test and Monitoring
TB	Technology Board
TC SES ETSI	Technical Committee Satellite Earth Stations and Systems ETSI
T&P	Trials and Pilots
TEAS	Traffic Engineering Architecture and Signalling
TEEP	Trusted Execution Environment Platforms
TF	Task Force
TFS	Teraflow SDN
THz	Terahertz
TIP	Telecom Infra Project

TMV WG	Test Measurement and KPIs Validation Working Group
ToR	Terms of Reference
TRL	Technology Readiness Level
TSDSI	Telecommunications Standards Development Society, India
TTC	Trade and Technology Council
UI	User Interface
UIC	Union Internationale des Chemins de fer
UX	User Experience
VSC WG	Vision and Societal Challenges Working Group
WCNC	Wireless Communications and Networking Conference
WG	Working Group
WiTaR WG	Women in Telecommunications and Research Working Group
WP	Work Package
WRC	World Radiocommunication Conference
WWRF	Wireless World Research Forum
XML	Extensible Markup Language
XR	Extended Reality
ZSM	Zero-touch network & Service Management

1 Introduction

1.1 Main objectives and activities

This document contains the latest Smart Networks and Services (SNS) Stakeholder Engagement Strategy and Action Plan updates, focusing on the transition between Years 1 and 2 of the SNS OPS project. Specifically, it thoroughly maps the SNS stakeholder engagement ecosystem, specific strategies and plans for the verticals and complementary domains, pre-standardisation activities, SME engagement and entrepreneurship promotion and support, and Working Group Support. Moreover, the document outlines the main actions carried out during the first project year to ensure a seamless transition between the final stage of 6GStart, complementing the project's stakeholder engagement activities finalised in December 2023.

The document is structured as follows:

- Section 2 describes the main activities and accomplishments in the SNS OPS stakeholder engagement strategy between M5 and M15. Besides mapping relevant SNS stakeholders and detailing engagement strategies and approaches, it provides the first stepping stone to the SNS market forecast. Finally, the first four Impact Assessment and Facilitation Action (IAFA) events are briefly described.
- Section 3 details the first years of activity resulting from verticals and complementary domain engagement. In particular, it details the steps that led to developing a shared database with ETSI to map and monitor the standardisation objectives of SNS JU R&I projects and outline a joint roadmap. Secondly, it discusses the steps leading to the construction of the SNS OPS Standards Tracker in terms of concept and technical implementation.
- Section 4 details the different actions implemented in the NetworldEurope SME WG to boost engagement, support, and enhance the SMEs' visibility and positioning within the SNS JU. Some relevant activities include SME identification and engagement, consolidation of the SME WG, active steps to promote entrepreneurship in the SNS ecosystem and engagement with relevant SME initiatives such as SCoDIHNet.
- Section 5 discusses SNS OPS's actions to coordinate different SNS, 6G IA and NetworldEurope WGs in 2023, supporting the transitioning phase between 5G PPP and SNS OPS.
- Section 6 outlines the next steps to undertake during the last project year to fulfil the main actions that will be taken from March 2024 to the project's finalisation in April 2025.

1.2 Handover from 6GStart

As defined in D4.1, "Stakeholder Involvement and Interaction Strategy and Plan", over the last year, SNS OPS has worked in synergy with 6GStart CSA to ensure alignment on activities, avoid overlaps and ensure a smooth transition between 5G PPP and the SNS JU programme.[1]

The overlap between SNS OPS (and SNS ICE) and 6GStart started in January 2023 and will continue until June 2024. Therefore, it was necessary to devise a set of measures to help minimise the potential conflicts arising from the simultaneous operation of the projects. The presence of some partners and stakeholders in both projects also facilitated efficient management, streamlining processes and ensuring an effective knowledge transfer from 6GStart to SNS OPS.

The transition from 6GStart to SNS OPS has been instrumental in laying the groundwork for continuing the programme's stakeholder engagement strategy, reinforcing the existing ties with key stakeholder groups and establishing new ones as the SNS ecosystem expands to collaboratively build on the successes and learnings from the 5G PPP. Further actions in this direction include assimilating new projects and participants into the SNS JU framework, with 38 Phase 1 projects already engaged throughout 2023 and 27 Phase 2 projects that kickstarted activities in January 2024.

The ultimate goal is to ensure a seamless operational flow and effective integration of new stakeholders and projects, thereby contributing to a robust and coherent SNS JU initiative and maintaining continuity and momentum in Europe's telecommunication advancements.

1.2.1 Target handover activities

Key handover activities between 6GStart and SNS OPS include:

- **SNS Stakeholder engagement strategy**: SNS OPS follows the Agile Stakeholder Management Framework, which was used during the previous programmes, including 5G PPP (6GStart and previous projects), with positive results. The main novelty in the Strategy are the IAFAs, research-based activities targeting relevant Partnerships, Initiatives and Associations, with a twofold objective: to evaluate the impact of the different activities carried out in the scope of the SNS JU and to ensure their relevance for the SNS community and beyond.
- **Vertical domain engagement and pre-standardisation activities**: SNS OPS has continued the vertical engagement activities initiated with 6GStart, with a focus on pre-standardisation road mapping. In this respect, a trend analysis has been carried out, a new Standards Tracker tool will be launched in the spring of 2024, and a dedicated event series has been organised between March and May 2024. Conversely, vertical engagement activities involving key international associations, mapping SNS JU projects' use cases and organising international events have been continued by SNS ICE.
- **SME engagement**: the involvement of SMEs has remained a priority in SNS OPS. The activities continue to be centred and channelled around the NetworldEurope SME WG. The results of the questionnaire implemented in 6GStart among the WG members are driving several actions that address the main challenges identified, including the centralisation of information, especially about available opportunities, the liaison with other WGs, and networking.
- **Working Groups:** throughout 2023, the Working Groups created under the 5G PPP and 5G IA have been shifted to SNS JU and re-branded under 6G IA, respectively. These continue the activities from previous WGs, addressing target topics and issues and publishing and disseminating visions and analyses from the SNS Community. The list includes 1) SNS Industry Working Groups (6G IA WGs) established by 6G IA and open to all members; 2) SNS JU Project Working Groups (SNS JU WGs) established by the inter-project Steering Board (SB); and 3) SNS Strategic Working Groups (SNS GB WGs) established by the SNS JU Governing Board (GB).

2 SNS Stakeholder engagement strategy

The SNS Stakeholder Engagement Strategy follows the Agile Stakeholder Management Framework. This chapter provides a detailed overview of the status of the main objectives and tasks of the Strategy, as well as the planned activities in Year 2.

2.1 Main objectives and status

The SNS Stakeholder Engagement Strategy's primary goal is to identify the SNS ecosystem's main players to understand their roles, needs and contributions. This information serves as a basis to facilitate the design and implementation of tailored engagement approaches for each actor and group, enabling the conditions for close cooperation.

The specific objectives and their current status are described below:

- **Update the SNS stakeholder identification performed in 6GStart.**

  Building on the 5G PPP stakeholder pictures, a mapping exercise was carried out to identify all the relevant players in the SNS ecosystem. A second update will take place in Year 2, as the SNS community continue to grow, to ensure the final SNS stakeholder map is as comprehensive as possible.

- **Better identify and engage the newly formed and evolving SNS ecosystem** and make sure that coordination among all relevant initiatives is as effective as possible.

  In addition to the SNS stakeholder map, which identifies all the stakeholders in the SNS ecosystem and, to a certain extent, their interactions, SNS OPS has implemented the first IAFAs. These are strengthening the existing cooperation with the SNS community whilst fostering the liaison with and integration of many initiatives, programmes, projects and organisations working in the SNS domain.

- **Demonstrate that the 5G/6G SNS capabilities will pre-empt great market changes and growth** as the new capabilities are exploited.

  To maximise the efficiency of the actions planned in SNS OPS, this activity was mainly carried out in the context of WP1. To understand the market changes triggered by 5G/6G SNS capabilities, the SNS questionnaire distributed among phase 1 projects (2022 call) had a section dedicated to gathering information about the market outlook.

  The results of the market questionnaire are reported in D1.2, “First Period Assessment and Planning Report”.

Overall, there has been important progress in the last 15 months towards the objectives. In particular, the elaboration of the SNS stakeholder ecosystem, which has been expanded and reconfigured, has prioritised the different actors' involvement.

2.2 Main activities M5-M15

This section provides a detailed description of the main activities encompassed in the SNS Stakeholder Engagement Strategy during the last ten months, which correspond to the objectives mentioned above.

2.2.1 Identification of stakeholders in the SNS ecosystem

Building on the pictures of the 5G PPP ecosystem, this activity focused on the identification of the SNS stakeholders to create a comprehensive SNS ecosystem map that includes all relevant players and captures the existing interplays amongst them.

Due to the higher complexity of the SNS ecosystem and its continuous evolution, it was decided that two consultation processes would take place to guarantee that all relevant inputs are collected and all

prominent actors identified. Therefore, the first formal consultation process, mixing a bottom-up and top-down approach, was launched in September 2023 (M09) and lasted until January 2024 (M13).

The bottom-up approach targeted the SNS projects. Contributions were requested via the SNS Steering Board and the SNS Technology Board. The projects were also reminded about this activity via the SNS Comms Taskforce. The updated version of the map was then shared with 6G IA for a preliminary check.

The top-down approach was divided into two stages. The first stage targeted the 6G IA full member associations (i.e. AIOTI, ERTICO, NESSI, etc.), the NetworldEurope Steering Board, and the SNS JU national contact points. The second stage was dedicated to finalising the map. SNS OPS partners revised the latest SNS map version to address specific additions, potential contradictions, the relevance of the categories, etc.

As a result of these processes, a map was elaborated consisting of three ecosystems according to the specific roles of the stakeholders:

Provisioning ecosystem: It includes stakeholders involved in the development, deployment, and maintenance of 5G/6G infrastructure, technology, and services, such as network operators, equipment vendors, and system integrators, as well as policymakers or standardisation bodies. These stakeholders play a crucial role in the implementation of 5G/6G technology by developing and delivering the necessary hardware, software, and network infrastructure to support the deployment of these advanced networks and enabled services. They work together to develop industry standards, policies, and regulations that enable interoperability and promote the widespread adoption of 5G/6G technology across different regions and markets.

Figure 1. SNS provisioning ecosystem

User ecosystem: it includes stakeholders who benefit from the deployment of 5G/6G technology, including those who use 5G/6G networks and services to deliver specific applications and services, such as healthcare providers, transportation companies, and smart city developers.

Figure 2: SNS user ecosystem

Enablers/Facilitators Ecosystem: it includes stakeholders who provide a variety of support services that enable and facilitate the provisioning and use-case ecosystems to operate effectively.

Figure 3: SNS enablers and facilitators ecosystem

It is important to note that many of the stakeholders are present in more than one ecosystem. For example, a stakeholder can be in the provisioning ecosystem while also being a user. In order to preserve the clarity of the SNS map, these overlaps were minimised, placing the stakeholders in the ecosystem where their role was most prominent when possible.

Once the map was completed, AUSTRALO\s graphic design team created the visuals to illustrate the SNS stakeholder ecosystem more attractively and appealingly. This design was also purposefully thought to be displayed in different media for dissemination.

Promoting the SNS Stakeholder Ecosystem Map entails a strategic approach to ensure visibility and accessibility to the target audience. The Map will be uploaded to the NetworldEurope website and, if relevant, the SNS JU website. An announcement will be made via different mailing lists, including the SNS SB and TB, 6G IA, and NetworldEurope. Moreover, social media platforms such as LinkedIn and X will be utilised for further promotion. Engaging with relevant communities, groups, and thought leaders in the smart networks and services will help amplify the reach of the announcement. This will facilitate collaboration and knowledge exchange, ultimately contributing to smart network and service innovation.

The second consultation will take place between October 2024 (M22) and January 2025 (M25). It will follow the same process as the one implemented during the first consultation.

2.2.2 Engagement of stakeholders in the SNS ecosystem

The SNS stakeholder ecosystem map served as a basis for building a tailored plan for actively involving each category of stakeholder in the SNS community. The engagement strategy seeks to integrate newcomers into the ecosystem whilst consolidating the existing community, continuing to foster a dynamic of cooperation between the different actors across the value chain that keeps them committed.

2.2.2.1 Impact Assessment and Facilitation Actions

The Impact Assessment and Facilitation Actions (IAFAs), one of the novel elements of the Strategy, have been central to establishing a cooperation framework with different partnerships, initiatives, verticals, programmes and organisations of relevance for the SNS community.

In addition to raising awareness about the SNS JU work and facilitating interaction with different stakeholders, the IAFAs intend to collect information to assess the impact of the different activities carried out in the scope of the SNS JU within the SNS community and beyond. IAFAs are key to better understanding whether SNS JU contributions fulfil the expectations of the ecosystem, ultimately helping to guarantee the relevance of its work within the wider European context.

IAFA #1 –Digital Innovation Hubs (DIH) to strengthen knowledge exchange with the SNS community and collaboration.

The first IAFA event occurred on the 5th of October 2023 and addressed **Digital Innovation Hubs (DIH) to strengthen knowledge exchange with the SNS community and collaboration.**

Figure 4: IAFA #1 infographic

This session aimed to facilitate cooperation between the Smart Connectivity Digital Innovation Hub Network (SCoDIHNet) members, linked to the Digital Innovation Hubs (DIHs), and the technology providers who contributed and are contributing to the SNS JU projects.

The objective of the DIHs is to digitalise the European industry, for which they are analysing the end user needs and try to find the most appropriate solution to make it happen. They are looking after innovations that could be used and the results of European projects is a huge source of solutions.

To this end, a catalogue mapping the technology providers and the DIHs at the regional level is being developed to help DIHs work closely with organisations at the local level. This tool, titled Replicability Catalogue, is intended to accelerate the digitalisation of the European industry, putting in place local consortiums with all the relevant expertise.

Some 35 SNS projects are already working on Beyond 5G and 6G technologies. They will deliver several innovations and use cases that will be developed and experimented. A number of these use cases and solutions could likely be replicated and feed the Replicability Catalogue. As mentioned before, the Catalogue allows DIHs to identify use cases and solutions fitting end-user needs. The Replicability Process is shown in Figure 5.

This event was a success, with more than 100 participants registered, including some coming from the DIHs and others from the technology providers' side. Both communities had the opportunity to better understand their role and potential area of cooperation.

- DIHs have the knowledge of the end user requirements;
- Technology providers have expertise in a number of key technologies and are developing solutions and
- Integrators and verticals are helping to use the technologies to develop use cases.

Scalability and interoperability are essential to fulfil the EU's strategy to create more connected and efficient innovation ecosystems to support the scaling of companies, encourage innovation and stimulate cooperation among national, regional and local authorities.

SCoDIHNet has the objective to facilitate the connection between technology providers contributing to the SNS JU projects and the DIHs, which are looking after solutions to digitalise the European Industry.

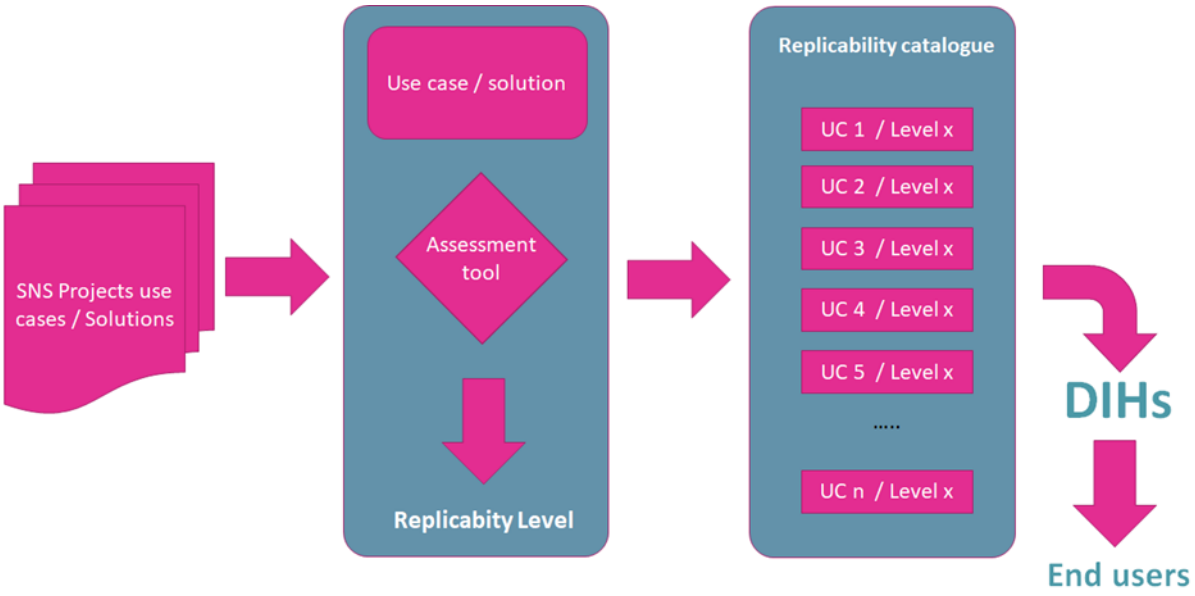

Figure 5: Replicability process

With the upcoming developments of the first SNS JU call projects, DIHs will be able to connect with the technology providers and check the relevance of the use case/solutions developed with regard to their customers. This is also a channel to collect end-user needs that could feed the SNS JU Strategic

Research and Innovation Agenda (SRIA) in order to ensure that the next 6G networks will support these needs and requirements.

Information about the event, including its context, agenda, objectives and speakers, as well as the recording of the event, are available on the SNS JU website.[2]

IAFA #2 - Connectivity and micro-electronics

A dedicated workshop on **"Microelectronics for 6G",** with experts from the Chips JU and the SNS JU, took place on the 16 of October 2023 in Brussels (Belgium). Due to the sensitivity of the subject, participants were directly invited by the team. A total of 26 people, including researchers, industry representatives and policymakers, attended.

During the workshop, 24 topics were identified as promising in the area of microelectronics for 6G, and next steps for each of them are currently being discussed with all involved stakeholders. A cumulative report will be produced to be used as a common reference for joint activities between the SNS JU and Chips JU, with the objective of stimulating strategic cooperation in the development of core 6G enabling technologies. This will be later reflected in the respective Work Programmes (WPs), with WP 2025 being currently the target.

Two main domains of activities for future cooperation have been identified:

i. Front End Modules (FEM) with challenging R&I issues such as integration of heterogeneous technologies, design, packaging, and multi-band operations with potential to be applied both on the infrastructure side and on the device side;
ii. computing technologies, with a first set of activities focusing on advanced accelerators for virtualised platforms.

These topics will be further processed, and endorsement will be sought in 2024. Based on the knowledge exchange and interaction of experts during the workshop, the 6G IA produced a critical white paper on the "Research Priorities on Microelectronics for 6G Networks", Figure 7.[3]

[2] More information can be found here: https://smart-networks.europa.eu/digital-innovation-hubs-dih-to-strengthen-knowledge-exchange-with-the-sns-community-and-collaboration-event/.
[3] 6G-IA (2024) "Research Priorities on Microelectronics for 6G Networks", available at: https://6g-ia.eu/wp-content/uploads/2024/02/6g-ia-position-paper_microelectronics-final.pdf?x21650

Figure 6: 6G IA Position paper as a result of IAFA#2

This white paper will act as the basis for further collaboration among 6G IA, the SNS community, and other EU-based Microelectronics stakeholders.

IAFA #3 – 6Gsec Common Path and Cardinal Points "6Gsec CP2"

The "6Gsec Common Path and Cardinal Points (CP²)" event took place on the 23 of January 2024 in the Cyber Campus in Paris, France.[4] Hosted by PTCC (*Programme de Transfert au Campus Cyber*[5]) and organised by SNS OPS, NetworldEurope, the European Cyber Security Organisation (ECSO) and the National Institute for Research in Digital Science and Technology (INRIA), the event brought together the cyber and 6G communities (Figure 7).

[4] For more information see https://smart-networks.europa.eu/event/6gsec-common-path-and-cardinal-points-6gsec-cp%C2%B2-save-the-date/.
[5] https://ptcc.fr/

Figure 7: IAFA #3 "6Gsec CP2" banner

Some 150 researchers, practitioners, industry members and policymakers from the cyber and 6G communities came together to discuss the security of 6G networks and services (Figure 8). The presentations on the current policy landscape and the existing and foreseen threats and challenges laid the ground to explore a research roadmap convergence, with the update of the cyber and 6G Strategic Research and Innovation Agendas (SRIA) in 2024, as well as the potential collaboration perspectives to forge a robust and resilient digital future.

European policies such as the Cyber Resilience Act, the Artificial Intelligence Act, and the NIS2 Directive emerge as critical cornerstones in the architectural design of 6G networks. These policies are instrumental in ensuring that 6G infrastructure is advanced in its capabilities and anchored in a framework that prioritises security, reliability, and ethical considerations.

Delving deeper in the policy landscape, there are several pressing challenges related to the proliferation of IoT devices, the security of supply chains, the confidentiality of exponentially high volumes of data, and the vulnerabilities of shared physical infrastructures.

Some of the debated trends and challenges that will define the SRIAs include technological integration, which is shifting the paradigm of how network services are conceptualised, designed, and delivered; extended lifecycle management, which demands flexible and resilient systems; and the digitalisation of the economy and society, which will demand solutions that not only ensure data protection and prevention of cyberattacks, but guarantee the stability and integrity of the digital infrastructure that increasingly underpins social interactions, economic transactions, and governmental functions.

Figure 8: Various moments of the "6Gsec CP2"

Various topics were further discussed from a technical standpoint, namely: the requirements of the security architecture enhancing trust and functionality; the progressive introduction of AI, which poses a risk but also offers unparallel capabilities to secure networks, and the use of crypto-based technologies; and, the importance of security knowledge sharing and deployment, involving comprehensive threat analysis and risk assessment and mitigation strategies, and the upcoming role of zero-trust architectures.

The event concluded with a firm commitment from the cyber and 6G communities to cooperate in developing and deploying 6G. Cybersecurity must be woven into the fabric of all technological implementations within the 6G ecosystem to ensure robust, secure, and privacy-compliant 6G networks that align with the EU's digital strategy and broader societal goals and preserve EU technological sovereignty.

IAFA #4 First Steps: 6G Research & Vision

The fourth IAFA event consisted of a mini-workshop series focusing on research-to-market and pre-standardisation road mapping in the context of 5G/6G technologies. This mini-workshop series stemmed from the need to provide SNS projects with a roadmap to tackle the significant challenges of addressing the unique needs of different industry sectors in the transition between 5G and 6G. There is a critical need for a detailed standardisation process that ensures these technologies meet the specific requirements of various applications. This underscores the necessity for collaboration between industry experts and standardisation groups to create universally accepted standards that ensure compatibility and unlock the full capabilities of 5G and 6G technologies.

The move to 5G Advanced and towards 6G, driven by SNS JU, showcases the pivotal contribution of European efforts to the international standardisation landscape, which is crucial for maintaining a competitive edge in telecommunication systems and services. The progression to 6G is expected to profoundly impact industries and societal functions, highlighting the importance of engagement from various stakeholders.

Given the need to involve standardisation experts directly in major Standards Development Organisations (SDOs), the online workshop series was organised in collaboration with ETSI and HSbooster.eu. The event featured the participation of experts sponsored through HSbooster.eu premium service programme and tackled topics such as SDOs' future 6G Agendas, SDOs 6G Work Items, verticals and standardisation, including the advancements and support of services enabled by 5G and 6G.

Figure 9: Banner for IAFA event # 4(1)

In this context, the first workshop, *First Steps: 6G Standardisation Requirements*, took place on the 12th of March 2024 (Figure 9). It focused on the initial phase of 6G technology, highlighting the latest research and the future goals for 6G while considering lessons learned from 5G deployments and service evolution. As such, it addressed the challenges and opportunities in the early stages of 6G development, discussing the potential applications and innovative aspects that 6G could bring to various industry sectors. Experts shared insights into how 6G could transform communication systems and services and the importance of aligning this new technology with the specific needs of different industries.

Recurring experts participating in the event were David Boswarthick (Director of New Technologies at ETSI), Muslim Elkotob (Principal Solutions Architect at Vodafone) and Tasos Dagiuklas (Head of Cognitive Systems Research Centre at London South Bank University).

Two other events will further develop the mini workshop series on pre-standardisation:

- **Event #4-2**: *Interim Steps: 6G Standardisation Requirements* (9 April 11 am 2024 CEST)
- **Event #4-3**: *Next Steps: 6G Trials & Testing* (13 May 2024 11 am CET).

This work is directly related to the activities and objectives of T4.2, "Verticals and complementary domains engagement" (see Section 3).

2.2.2.2 Additional activities

The SNS OPS partners have a long-standing collaboration with the principal SNS stakeholders. Some are also a fundamental part of the SNS ecosystem, with the influence to agglutinate other players around them. They are actively involved in flagship projects such as Hexa-X-II and the various WGs and Task Forces. All these connections are systematically leveraged to establish discussion pipes supporting the SNS JU's objectives.

2.2.3 Impact of SNS technologies in Europe: a business case

One of the key objectives of WP4, Task 4.1, Global stakeholder involvement and interaction, is to "*Demonstrate that the 5G/6G SNS capabilities will pre-empt great market changes and growth as the new capabilities are exploited".* Since elaborating a complete business case for 6G is beyond the scope of SNS OPS, the approach adopted by the WP4 team was to examine how the SNS stakeholders in the projects could collectively establish a shared and informed belief in future market opportunities to motivate investments and allocation of resources.

This approach would still require the mobilisation of numerous stakeholders, the collection and sharing of data, key success factors, and market insights across SNS projects and WGs, and,

eventually, the communication of the results via appropriate channels and thought leaders. Yet, the work was highly synergistic with that being carried out in WP1 in relation to the gathering of insights on the technical and vision aspects of the SNS JU. Thus, it was decided that aligning both activities would be more effective in terms of SNS OPS resources and prevent the fatigue associated with large data collection exercises. Consequently, the work was performed in collaboration with WP1.

The SNS OPS survey conducted in WP1 included a market section encompassing eight questions. These were responded to by the 33 SNS 2022 projects, resulting in a significant amount of information. The data was processed and analysed, and the results were reported in D1.2, "First Period Assessment and Planning Report," and presented in the SNS Webinar.

In this section, to avoid duplication, only a summary of the market outlook will be provided hereafter, highlighting the key findings.

Two important trends, perhaps contradictory, refer to the evolution of the market in the next few years: market fragmentation versus the rise of a few dominant industrial players. The market fragmentation would be mainly due to the modular architecture that would foster the emergence of new players covering the value chain. Contrariwise, the rise of a few globally dominant enterprises emerging from incumbents could be linked to the predominance of use cases requiring establishing private networks in most vertical sectors, generating new business opportunities for MNOs.

In terms of technologies, AI-based solutions are predicted to be a game changer for delivering high-level and more efficient services. Energy efficiency solutions and dynamic/zero-touch network management solutions are among the most anticipated innovations in the coming years.

Concerning verticals, Industry 4.0/Manufacturing and Media/xR are expected to be the v most impacted by the advent of 6G. According to the SNS projects surveyed, the ultra-low latency and increased bandwidth in 6G networks, which enables high-speed data processing coupled with wireless and mobile robotics, are deemed critical for industrial applications.

In relation to potential bottlenecks, deployment costs are seen as the main obstacle to the development of 6G networks. In particular, some projects indicate a lack of transparency regarding the Return of Investments (RoI). The lack of demand for unique 6G services and the lack of willingness to allow interoperability are also seen as notable challenges.

The number of Key Exploitable Results (KER) expected to be delivered was widely different among projects. Moreover, each identified very specific results. KERs were thus clustered into three main groups: integration/network technologies, management and security and privacy. Most projects will target medium Technology Readiness Levels (TLRs), i.e., between 4 and 5.

In terms of how the project owners validate their business opportunities in vertical sectors, most projects reported carrying out the validation by working with *use-case owners*. The *development of hypotheses about the potential technology needs of vertical sectors* is rather common. Inversely, the *hypotheses about potential business models for the technology being developed* by the project nor the *application of the methods suggested by 6G IA* are not widespread.

Please see Chapter 6 in "D1.2, First Period Assessment and Planning Report" for the full analysis.[2]

2.3 Work plan M15 – M27

In the period from M15-M27, SNS OPS will continue to foster dynamic cooperation among the stakeholders, both newcomers and established ones, across the SNS value chain and those in related domains. It will also focus on empowering the different stakeholders' participation in the several SNS actions.

The SNS stakeholder ecosystem map will be refined in the last quarter of Year 2. Between October 2024 and January 2025, a consultation among different stakeholders will be implemented, following the approach used in Year 1 (see section 2.2.2.1). The main benefit will be the larger critical mass of projects that will be able to partake in this upcoming consultation. As a result, a final SNS Stakeholder Ecosystem Map will be elaborated and published.

Several IAFAs will be organised and implemented from M15 to M27. At the moment, there are two upcoming IAFAs in the series related to standardisation. The 6G IA has already planned several additional IAFAs in the form of dedicated face-to-face (F2F) workshops to come into contact with additional experts of varied backgrounds, in a similar fashion as the Microelectronics WS (IAFA#2). More specifically, the following workshops have already been planned, and the experts invited:

- Photonics Workshop - Brussels, Belgium (10/04/2024)
- NTN workshop - Brussels, Belgium (11/04/2024)
- Security Workshop - Brussels, Belgium (12/04/2024)
- Wireless Tech workshop - Brussels, Belgium (15/04/2024)
- Service/Cloud workshop - Brussels, Belgium (10/04/2024)

Moreover, discussions are being held regarding the organisation of an IAFA on Industry 4.0/5.0 with 5G-ACIA (ALUI/Nokia and Ericsson), currently targeted in Q4 2024. A new questionnaire about SNS technical, vision and market aspects will be launched among projects in April 2024. It will target SNS projects awarded in the 2022 and 2023 calls (Phase 1 and Phase 2). The questionnaire will gather more feedback concerning the market outlook for SNS in Europe. The results of this activity will be reported in WP1.

Notable efforts will be dedicated to promoting the SNS Stakeholder Map, the upcoming IAFAs, and the outcomes of the 2024 questionnaire in collaboration with WP2 and WP1.

3 Verticals and complementary domains engagement

3.1 Main activities M3-M12

This phase, spanning from Month 3 to Month 12, primarily focused on capacity-building actions and establishing a solid foundation to consolidate the pre-standardisation landscape. This groundwork was crucial for enabling SNS JU R&I projects to detect common requirements and create meaningful road maps and linkages. These efforts aimed to streamline and strengthen the alignment of the European Union's communication technology strategies with the evolving global standardisation agenda, particularly in the transition from 5G to 6G technologies.

The implemented activities mainly focused on gathering insights and highlighting key standardisation trends to align with 6G IA Pre-Standardization WG (section 27), which picked up the baton from 5G PPP to start its work with SNS JU R&I projects. Such an effort continues the work carried out for 5G development during the 5G PPP initiative. This alignment was key for ensuring that the European Union's communication technology efforts are synchronised with the global standardisation roadmap for 5G and the emergent 6G technologies from major standardisation organisations and regulatory bodies like ETSI, 3GPP, IEEE, ITU-R, and WRC.

As such, several open dialogues and alignments were carried out to synchronise activities and efforts better (see section 3.2.2). Part and parcel of this process were establishing a direct communication channel with ETSI, and the EC has been ongoing. This consisted of several alignment efforts and creating a joint repository mapping of SNS JU R&I standardisation interests (see section 3.2.3). Moreover, a close connection was created with the Pre-Standardization Working Group, gathering input from various projects regarding their standardisation-related activities.

The result a trends analysis identifying several standardisation and technological trends, which were categorised into common thematic areas (see section 3.2.3). Moreover, the Standards Tracker platform was created as an online tool consolidating key information on pre-standardisation trends from all SNS JU R&I projects and collecting a selection of relevant Telco standards (see section 3.3).

Additionally, an online workshop series was conceived and organised in collaboration with the HSBooster.eu project and ETSI in the context of IAFA#4 (see Section 2.2.2.1). This series of three events will address challenges in standardisation relevant to 5G/6G developments, featuring experts from the telecommunication standardisation field.

3.2 Pre-Standardisation activities and trends analysis

3.2.1 Pre-Standardization WG and Synergies

The 6G IA Pre-Standardization Working Group, already active during the 5G PPP, plays a crucial role in ensuring that the European Union's efforts in communication technologies are in sync with the global standardisation roadmap for current 5G and future 6G applications. This group's mission is to establish alignment and collaboration with key standardisation organisations and regulatory bodies, including ETSI, 3GPP, IEEE, ITU-R, and WRC. In a nutshell, its work involves crafting a comprehensive roadmap for 5G standardisation while also laying the groundwork for the forthcoming 6G technologies.

Such a roadmap is essential for addressing the critical needs of the European industry in communication systems, networks, and ICT systems. It aligns with the EC’s policy objectives to boost competitiveness and technological sovereignty, influencing the global standardisation ecosystem. This ecosystem has already achieved significant milestones in mobile and wireless communication systems, promoting an interoperability roadmap for the advancement of European network ecosystems.

As a result, the 6G IA Pre-Standardization WG activities align with the Single Basic Act on Joint Undertakings and focus on cooperation across various levels to achieve globally accepted standards.[6]

[6] For further information see https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R2085.

This cooperation involves direct SNS-related stakeholders and related non-SNS European and global activities, ensuring that the SNS JU standardisation roadmap is in harmony with the above-mentioned international standards.

The activities of the Pre-Standardization WG kick-started on 21 December 2023 with the first online meeting featuring SNS JU Phase 1 projects. Inputs from different projects about their standardisation-related road-mapping activities are collected quarterly and will be brought together in the Standards Tracker online tool developed by the SNS OPS consortium (see section 3.3).

3.2.2 Feedback collection from SDOs and EC

A preliminary mapping of SNS JU R&I projects standardisation interests, carried out following the information provided by the projects at the "ETSI Research Conference: Maximising the Impact of European 6G Research through Standardisation" organised in February 2023, was provided in D4.1. In the following month, an active dialogue was set up with the European Commission and ETSI to create a joint repository cataloguing relevant pre-standardisation activities carried out by Phase 1 R&I projects to align priorities and unify different datasets gathered through different information channels.

The result was the creation of a joint database set up on the SNS OPS BSCW workspace hosted by EURESCOM, allowing both members of the SNS OPS consortium, the EC and ETSI, to access it and update relevant information. The main information gathered by the database include:

- Project General Objectives,
- Technologies Covered,
- Map to ETSI Groups,
- Map to 3GPP Groups,
- ETSI Groups show interest in project,
- ETSI Support to proposal (LoS)
- ETSI mentioned in proposal
- ETSI Engaged with project
- Interactions with ETSI
- Targeted SDOs in SNS OPS Survey

3.2.3 Trends analysis

Based on the information gathered in the joint repository, the following thematic areas were identified:

- **Convergence of Terrestrial and Non-Terrestrial Network**s: integrating ground-based network infrastructures with non-terrestrial elements like satellites and high-altitude platforms. The aim is to enhance coverage, especially in underserved areas, and to offer robust, ubiquitous connectivity.
- **Sustainability and Energy Efficiency in Network Operations**: developing networks that are more efficient and environmentally sustainable. This includes efforts to reduce the carbon footprint of network infrastructures and operations, aligning with global initiatives like the European Green Deal.
- **Artificial Intelligence in Network Management and Security**: AI and machine learning are increasingly being used for network optimisation, resource management, and security enhancements. This includes AI-driven network orchestration, predictive maintenance, and privacy-preserving data handling techniques.
- **Advancements in Radio Access Network (RAN) Technologies** emphasise evolving RAN technologies, including massive MIMO (Multiple Input Multiple Output) architectures and energy-efficient hardware solutions. This trend is geared towards improving network capacity, spectrum efficiency, and reducing energy consumption.
- **Development of High-Capacity, Low-Latency Communication Solutions**: emerging technologies are focusing on delivering high data throughput (e.g., Terabit-per-second capacity) and ultra-low-latency communication, which are critical for industrial applications

and emerging use cases like augmented reality and autonomous vehicles.

- **User-Centric Network Designs**: a shift towards networks that are designed around user needs and environmental constraints, using AI to tailor network functions and optimise resource allocation. This includes creating customisable and flexible network infrastructures that adapt to user-specific requirements.

Several technological trends also emerged from this analysis. These were tentatively categorised into several key areas, such as network infrastructure, sustainable network management, advanced network technologies, AI/ML, security & privacy and emerging innovations. These are not mutually exclusive, as several projects manifested their interest in various trends.

Network Infrastructure and Connectivity:

- Satellite, High Altitude Platform Stations (HAPS), drones
- Non-Terrestrial Networks (NTN), Satellite Communications
- Radio Interface Technologies, including sub-Terahertz (sub-THz) and millimetre Wave (mmWave)
- Open Radio Access Network (ORAN)
- Self-Organising Networks (SON)
- Network of Sub-networks, Sidelink Technologies
- Radio Intelligent Surface (RIS)-aware Physical/Medium Access Control (PHY/MAC) protocols

Energy Efficiency and Network Management:

- Energy Efficiency solutions in networking
- Zero-touch automation and intention-based networking
- Cloud and Edge Computing for efficient network management

Advanced Network Technologies and Architectures:

- Distributed Multiple Input Multiple Output (dMIMO) and Advanced Antenna Systems
- Integrated Sensing and Communication (ISAC)
- System architecture advancements, including time-sensitive networking
- Deterministic Networks for Predictable Network Performance
- Mesh Networks and Meta-surfaces for advanced network topologies

Artificial Intelligence and Machine Learning:

- AI/ML in various aspects of network operation and management
- AI-driven radio interfaces and network orchestration
- Cloud-native AI/ML applications
- AI-native air interfaces for 6G networks
- Extended Reality (XR), Augmented Reality (AR), and Mixed Reality (MR) enhanced by AI

Security, Privacy and Trust:

- Blockchain Technology for distributed intelligence
- Secure AI (SAI) for trust, resilience, and privacy
- Privacy and Security solutions in networking

Emerging Technologies and Innovations:

- Optical Networking and Software-Defined Networking (SDN)
- Terahertz (THz) communications and Photonics
- Reconfigurable Intelligent Surfaces (RIS) in networking

Finally, the following SDOs, organisations, work groups and technical committees figured as the main target of SNS R&I projects:

3GPP (3rd Generation Partnership Project):

- SA1, SA2, SA3, SA5, SA6

- RAN1, RAN2, RAN3, RAN4
- RAN Work Group 1
- WG RAN1, WG S4
- TSG RAN / TSG SA

ETSI (European Telecommunications Standards Institute):

- OSM (Open-Source MANO)
- ENI (Experiential Networked Intelligence)
- EE TC (Energy Efficiency Technical Committee)
- NFV ISG (Network Functions Virtualisation Industry Specification Group)
- ZSM (Zero-touch network & Service Management)
- MEC (Multi-access Edge Computing)
- F5G (Fifth Generation Fixed Network)
- TFS (Teraflow SDN)
- RIS (Reconfigurable Intelligent Surface)
- NFV SEC
- INT (Integration)
- SAI (Securing Artificial Intelligence)
- ISG THz (Industry Specification Group Terahertz)
- ISG (Industry Specification Groups)

ITU (International Telecommunication Union):

- ITU-T SG5 (Study Group 5: Environment, Climate Change, and Circular Economy)
- ITU-R WP4B and WP5D
- ITU-T SG13
- ITU-T SG12
- ITU-R SG1
- ITU-R SG3

IETF (Internet Engineering Task Force):

- Operations Area WGs
- NMRG (Network Management Research Group)
- TEEP (Trusted Execution Environment Platforms)
- RATS (Remote AttesTation procedureS)
- CCAMP (Common Control and Measurement Plane)
- TEAS (Traffic Engineering Architecture and Signalling)
- DetNet (Deterministic Networking)
- raw (Reliable and Available Wireless)
- dmm (Distributed Mobility Management)
- Security area

IEEE (Institute of Electrical and Electronics Engineers):

- 802.1 TSN (Time-Sensitive Networking) WG
- 802.11
- 802.15 Standing Committee THz
- 802.15 Task Group 3ma
- 802 SC THz

O-RAN Alliance:

WG1, WG2, WG3, WG4, WG6, WG9

3.3 Standards Tracker

3.3.1 Platform's main aims

The Standards Tracker is an online platform designed to serve as a unified access point for SNS JU R&I projects to provide inputs on the pre-standardisation processes. The tool also functions as a repository of selected telecommunication standards to help researchers better navigate the dynamic standardisation landscape and relevant news reported by standardisation committees. Ultimately, the platform plays a crucial role in supporting the development of a European standardisation roadmap.

This tool is especially useful for EU researchers in the SNS JU, assisting them in creating and implementing their standardisation roadmaps. It helps them understand their contributions' timing, methods, and rationale, ensuring they are effectively organised for impact. Drawing on the latest news from SDOs and relevant updates from the SNS JU R&I community, the Standards Tracker encourages stakeholders to perform a needs and gap analysis. It also includes impact reports with infographics that illustrate data on stakeholder profiles by group, sector, organisation type, role, and location.

By providing a comprehensive view of stakeholder engagement and contributions, the Standards Tracker is vital in shaping a cohesive European standardisation roadmap, aligning with the goals of the SNS JU and the European Commission and supporting vertical industries and 5G/6G-related associations by providing updates about latest technological trends, helping them navigate complex processes and stage as well as define technical requirements and maximise impacts.

3.3.1.1 Previous versions

This online tool draws from previous versions resulting from pre-standardisation activities carried out by the Pre-Standardization WG during the 5G PPP initiative. The tool was launched and further refined as part of the Global5G.eu[7] CSA project and later on refined and rebranded as part of the 6GStart CSA project, including the latest updates in the transition between 5G PPP and SNS JU.[8]

3.3.2 Expert consultancy and platform improvement

As part of the effort to improve the current functionalities of the Standards Tracker, an application to EU-funded project HSbooster.eu's premium service was submitted on the 26 of May, 2023.

The assigned expert, Mulsim Elkotob (Principal Solution Architect at Vodafone), provided consultancy services in two different work modules. The first consisted of analysing the current Standards Tracker to understand its main strengths and weaknesses and suggest potential structural improvements. Once this part was finalised, a second step consisted of providing a selection of telco standards to populate one of the Standards Tracker main sections.

3.3.3 Platform technical details and preparation phase

The digital platform aggregates data about the SNS JU R&I projects' pre-standardisation actions, provides updates on relevant SDO activities and selects relevant Telco standards. All these content items are classified through a system of taxonomies that can be filtered while browsing the page through manual selection. A search bar also allows for the filtering and selection of content by keywords. The tool's primary goal is to simplify access to information about use cases related to these verticals, presenting it in an accessible and straightforward manner for external audiences. Overall, it is dedicated to illustrating the mutual benefits and advancements that will arise from the interaction between industry verticals and research and innovation developments in the upcoming years.

3.3.3.1 Technical Details

The Standards Tracker is envisioned as a constantly evolving, user-focused platform equipped with diverse search capabilities to enrich the user experience. This platform's design and development will be executed by the Trust-IT/COMMpla team, adhering to a systematic methodology to guarantee superior results, as illustrated in Figure 10.

[7] See more at https://global5g.org/online-tool-standards-tracker./
[8] Browse the updated version at https://standards-tracker.5g-ppp.eu/.

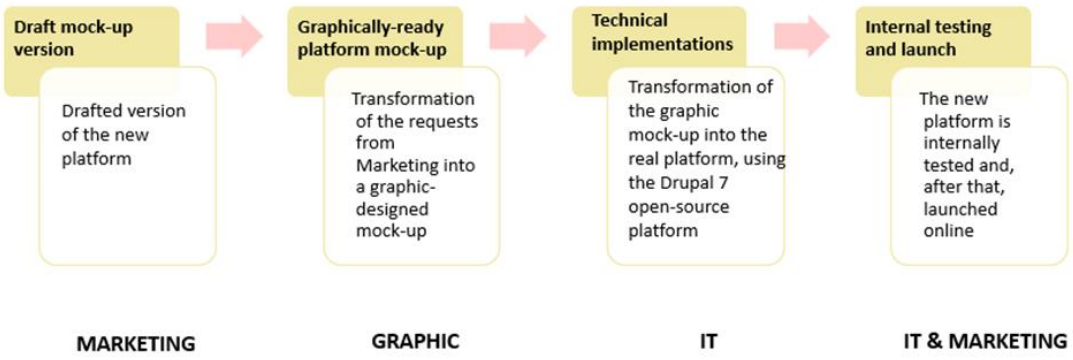

Figure 10: Platform creation internal process

The research team leads the initiative by crafting the platform's preliminary structure and design, ensuring alignment with the project's core goals and UX design principles. Following this, the graphics team leverages their skills to create an attractive mock-up. The technical team then plays a pivotal role in the ensuing stages of implementation and testing. During these phases, the research team offers ongoing feedback. Additionally, the collaborative use of the Figma software tool for UX/UI design promotes seamless interaction among the teams during the mock-up development stages.

3.3.4 Wireframes and Mockups

The digital platform is designed to aggregate data and provide a standardisation roadmap for the SNS JU R&I projects. Thus, its primary goal is to simplify access to information about relevant telco standards, relevant work from SDOs and selected telco standards, presenting them in an accessible and straightforward manner for external audiences. This tool is dedicated to illustrating the mutual benefits and advancements that will arise from the interaction between SDOs and research and innovation developments in the upcoming years.

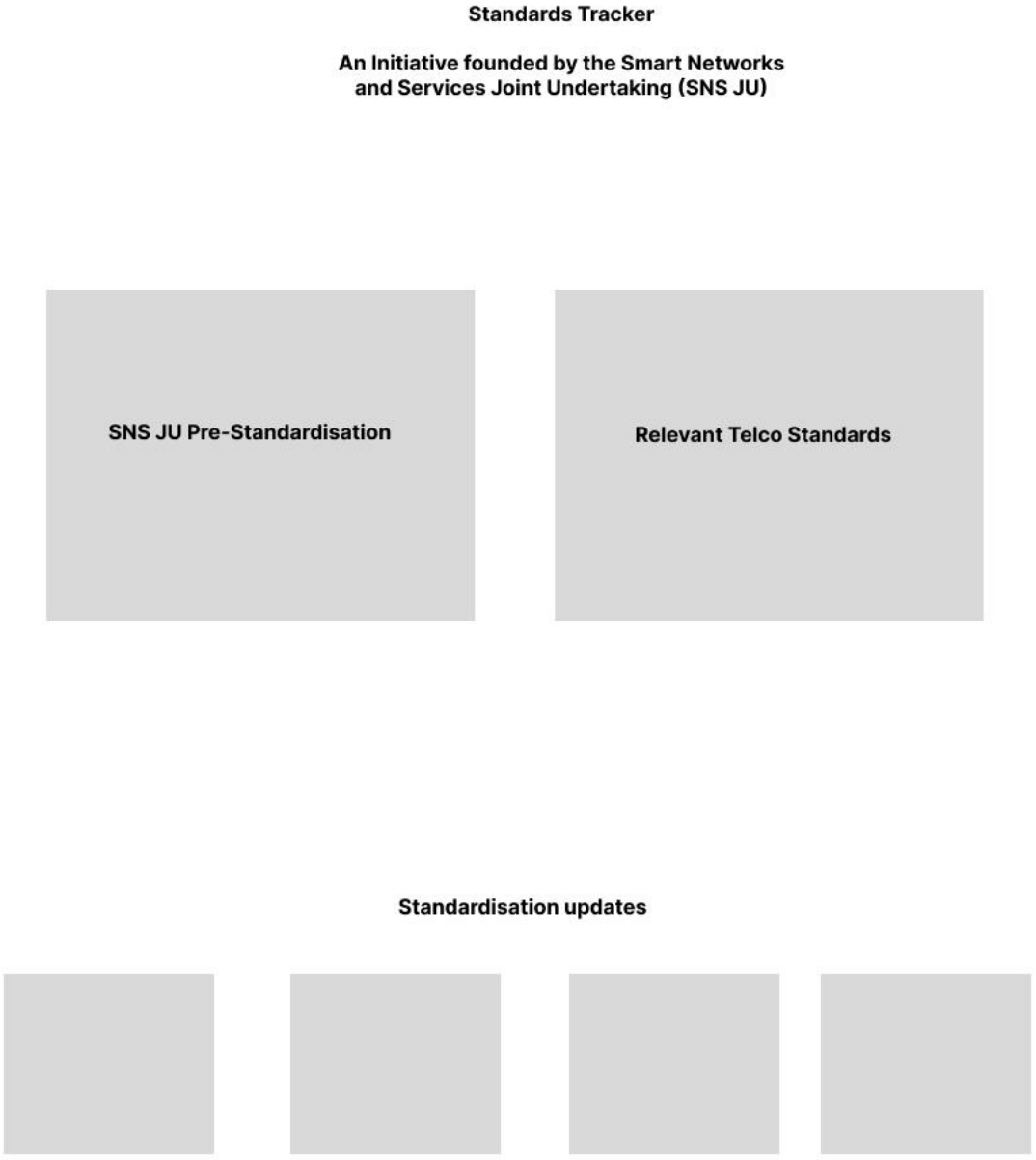

Figure 11: Standards Tracker – main page

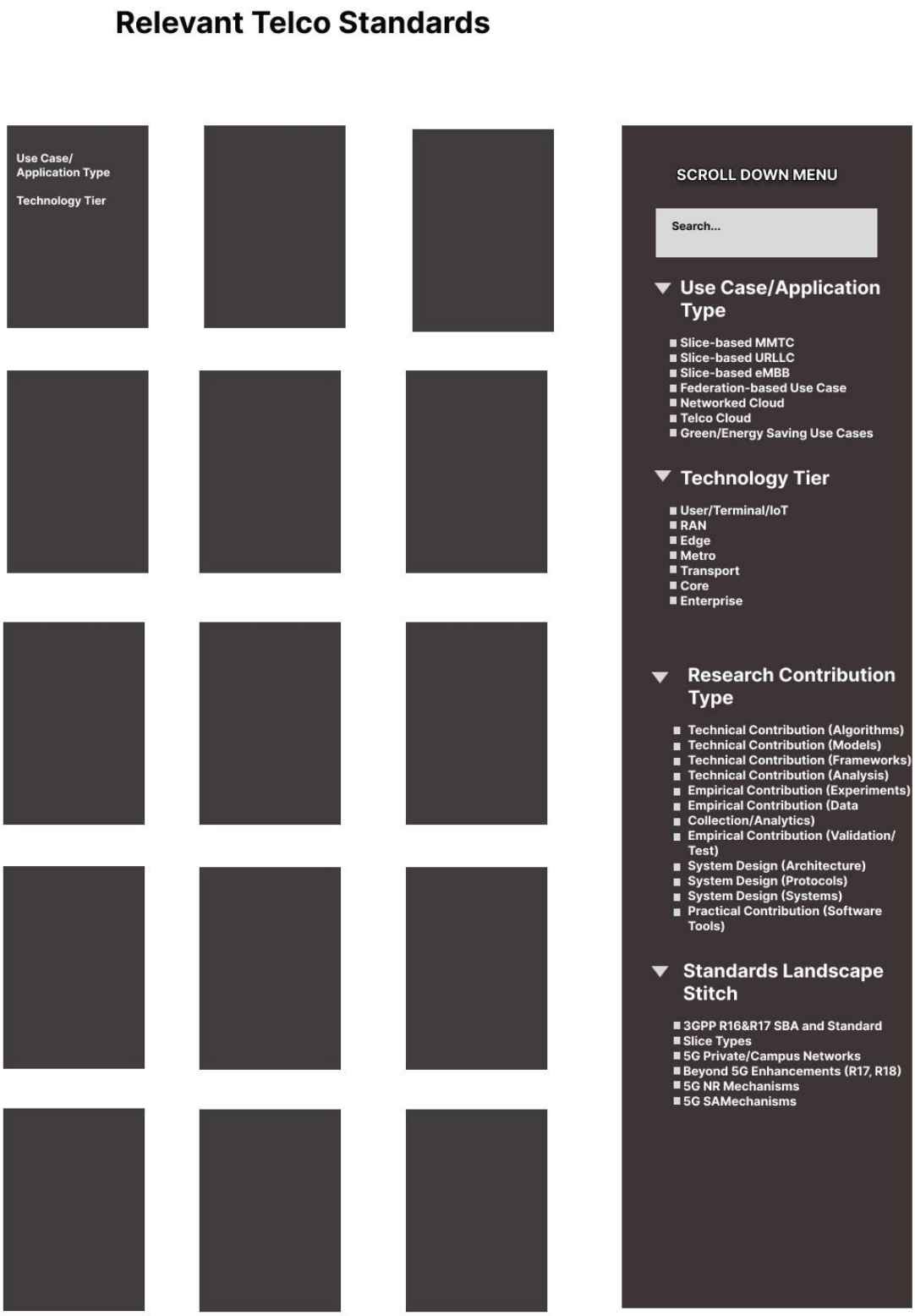

Figure 12: Standards Tracker – relevant telco standards main page wireframe

Figure 13: Standards Tracker – relevant telco standards single standards details wireframe

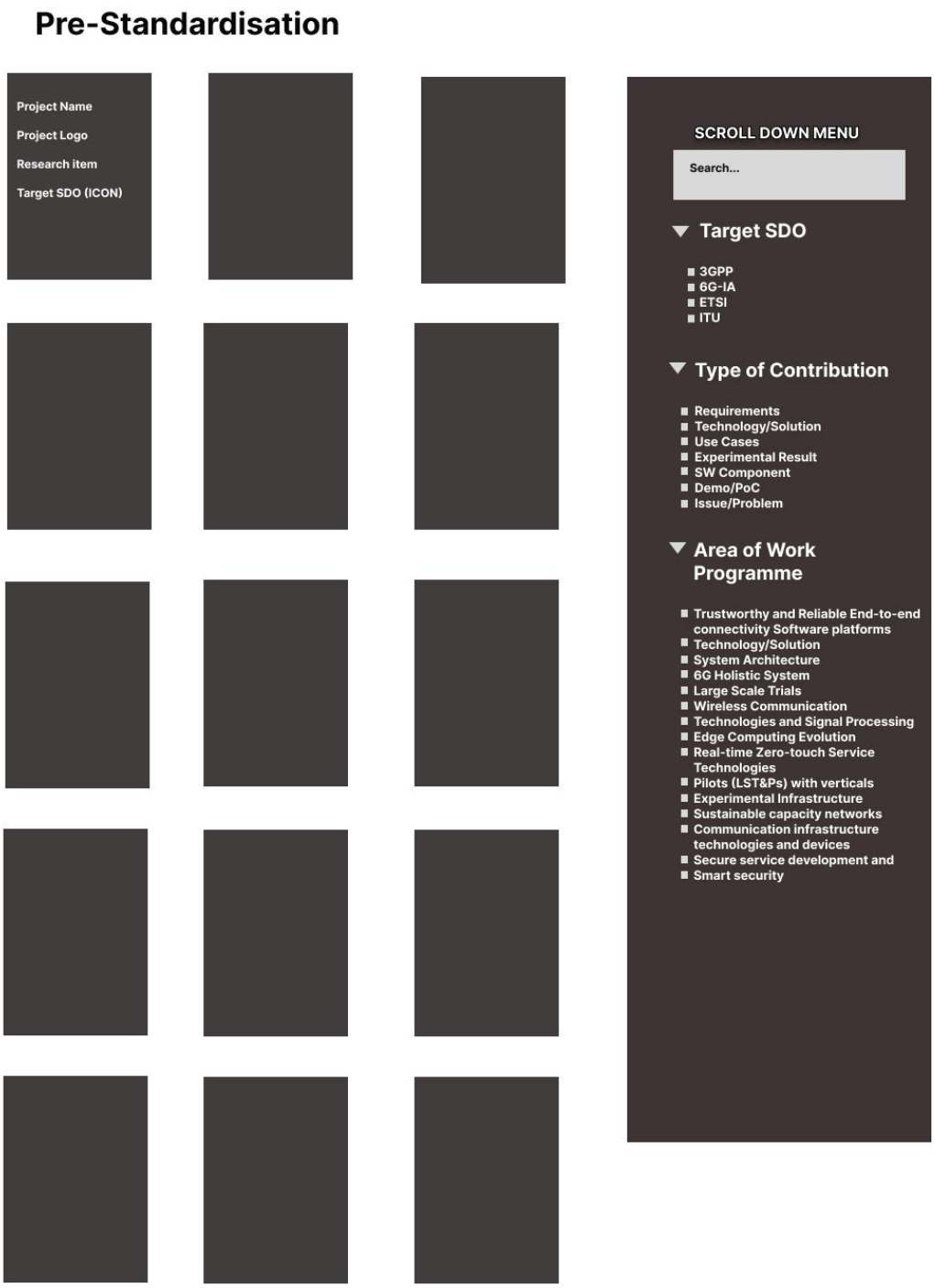

Figure 14: Standards Tracker – project's pre-standardisation updates main page wireframe

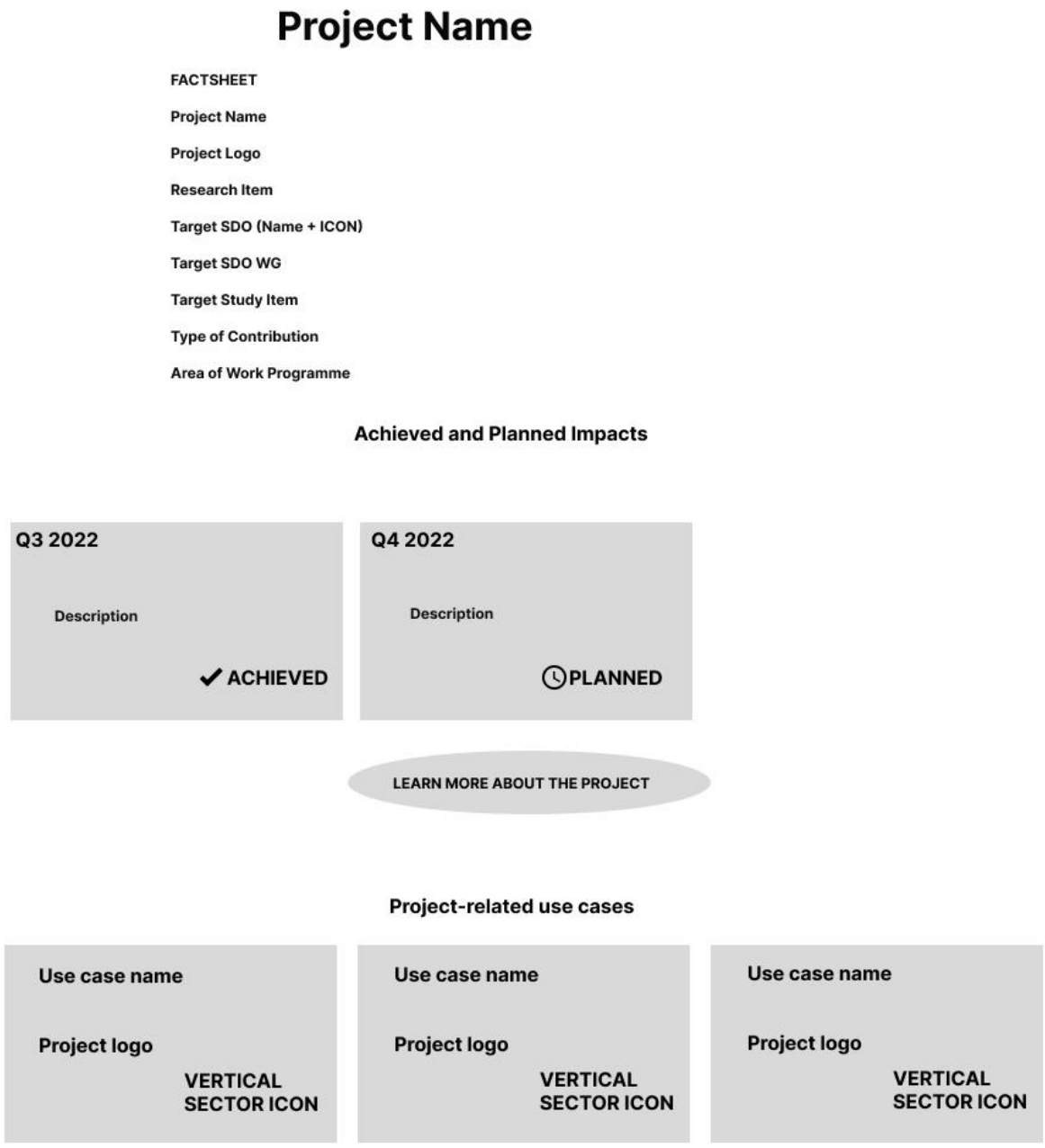

Figure 15: Standards Tracker – project's pre-standardisation updates single profile detail wireframe

The platform's initial page (Figure 11) will offer users a gateway to either relevant telco standards, pre-standardisation updates from SNS R&I projects, or a compilation of updates from relevant SDOs. From here, users will proceed to the first catalogues (Figure 12 and Figure 14), which detail telco standards and pre-standardisation actions. A dropdown menu will be available, providing various filters to tailor the content display based on criteria like vertical sector, country, experiment type, and functionality. Selecting an information card will lead users to a comprehensive information page (Figure 13 and Figure 15), which includes a detailed fact sheet about the chosen use case or association. SDO updates are instead provided in a content carousel placed on the initial page, ordered chronologically, and can be accessed by single-clicking on each item.

3.3.4.1 Platform Framework

The Standards Tracker platform will be constructed utilising Drupal 9, an open-source content management framework. This version of Drupal, being the most recent, offers a comprehensive range of capabilities, a decision influenced by its robust functionality and the support of a large, skilled developer community. Drupal is particularly beneficial for accommodating various user types,

ensuring strong security features, enabling API endpoints to share selected content, and facilitating content reuse and display outside the website.

3.3.4.2 Platform Tracking

In line with SEO principles, the platform's progress will be monitored through monthly website analytics using Google Analytics. This will provide detailed insights into the behaviour of visitors and users. Regular monitoring will also be employed to maintain platform performance and quickly address any issues, with Matomo tracking initial visitor engagement data like clicks and conversions. Post-launch, primary data will be reported in upcoming deliverables and project updates. Additionally, the use of Hotjar will offer valuable insights into user behaviour, utilising tools such as heatmaps, session recordings, and surveys to enhance user experience and guide improvements.

Both Matomo and Hotjar prioritise user privacy, comply with GDPR standards, and operate within the EU to adhere to strict data protection laws. This ensures responsible, transparent data collection and processing, safeguarding the privacy and rights of visitors and customers.

3.3.4.3 Platform Maintenance and Administration

Trust-IT and COMMpla tech teams are responsible for the website's maintenance and administration, encompassing hosting management, technical upkeep, monitoring, and managing technical tasks such as updating security patches. They also oversee the design and implementation of further platform developments, including new functionalities and sections as requested by the SNS OPS consortium and other SNS JU community members.

3.3.4.4 Platform Monitoring

The Standards Tracker platform and database instances are automatically monitored using Uptime Robot. This service checks site availability and sends email notifications to Trust-IT's Technical team in case of failures, also distributing alerts through other channels for immediate response.

3.3.4.5 Platform Hosting

Trust-IT will host the Standards Tracker on AWS virtual servers located in the Ireland region to keep all data within the EU. The platform's sub-domain, under the sns-ju.eu domain, will be https://sns-trackers.sns-ju.eu/standards-tracker.

3.3.4.6 Platform Disclaimer

The SNS OPS consortium disclaims responsibility for the accuracy of information published on the Standards Tracker, with each use case retaining rights and obligations towards end-users. The platform is committed to user privacy and data protection, adhering to GDPR and EU standards. A dedicated privacy policy page will outline data collection practices, purposes, user rights, and compliance with GDPR. Data will be stored only for the duration necessary for its intended purpose and in accordance with legal and project requirements, with obsolete data being periodically reviewed and permanently erased from the database.

3.4 Work plan M16 – M27

The next few months will see further capacity-building efforts aimed at consolidating knowledge and understanding about emerging telco standards in key vertical domains across the SNS JU R&I project community. A first step in this direction will be the refinement and improvement of the Standards Tracker, which will be populated with further content acquired from SNS JU R&I projects as they outline a standardisation roadmap. These insights will be gathered by SNS OPS partner Trust-IT, as the co-chair of 6G IA Pre-Standardization WG. This information will also be included in the joint database with ETSI and the European Commission.

In the M12-M15 time frame, efforts are focused on organising the first events to roll out the Standards Tracker in its preliminary version, a task currently in progress. The forthcoming M16-M26 period is planned for the further enrichment of the Standards Tracker, including the incorporation of significant

information from the Pre-Standardization Working Group and the continued database expansion in collaboration with ETSI. This phase is expected to lead to the organisation of standardisation events.

By M27, the final version of the Standards Tracker is scheduled to be released, marking the anticipated achievement of this significant milestone. Table 1 below summarises the main milestones and their current status.

Table 1: Past and future Milestones for the Standards Tracker Development

Period	Actions	Milestone	Status
M01-M06	Data collection & identify main trends and standardisation interests	Preliminary Mapping of Standardisation interests	Done
M07-M12	Attend relevant verticals & standardisation events	Collect data for publication	Done
M12-M15	Organise first events	Standards Tracker (preliminary version)	In progress
M16-M26	Enrich Standards Tracker, gather relevant information from Pre-Standardization WG, continue enrich database with ETSI	Standardisation events organisation	Forthcoming
M27	Release final version of Standards Tracker	Standards Tracker	Forthcoming

3.4.1 Pre-Standardisation event series

These activities have been further enriched and complemented by the online workshop series organised by SNS OPS as part of its IAFA initiative in collaboration with ETSI and HSbooster.eu as described in section 2.2.2.1.

4 SME engagement, support and entrepreneurship promotion

Chapter 4 presents the objectives, activities and achievements related to the small and medium-sized enterprises (SMEs) within the SNS ecosystem. It provides an overview on the set of actions implemented to create the conditions for a more inducive ecosystem that favours the equal participation of all actors in the SNS value chain.

4.1 Main objectives

The principal goal is to "boost the SME engagement in the SNS community by providing them with the best support possible, including the necessary assistance to overcome specific SME-related challenges, and promoting entrepreneurship".

The specific objectives and their status are described below.

- **Analyse SME involvement in the SNS JU calls for projects**

  The SNS JU set a target of 20% participation of SMEs. In the 2022 call, the SME participation reached 18.4%, and in 2023, the participation rose to 38%, exceeding the target. These do not include the SNS project open calls, many of which explicitly target SMEs and, therefore, most likely boost the numbers.

- **Support and expand the SME Working Group**

  SNS OPS continued to support the functioning of the NetworldEurope SME WG, in conjunction with the overall NetworldEurope, the European Technology Platform (ETP) for the telecommunications sector, and SNS strategy. Two email campaigns were launched to introduce the SME WG to the new SNS projects. Moreover, the SME WG Chair and vice-chair participated in various meetings, representing the WG and presenting their work.

- **Revise the strategy for promoting the skills and expertise of SMEs** within the SNS ecosystem to find new avenues to gain SMEs' visibility.

  Several activities were implemented to promote the skills and expertise of the SMEs. The publication of the 2024 SME WG Brochure and the promotional campaign to publicise it concentrated the main efforts in Year 1.

- **Strengthen the engagement with SMEs involved in vertical sectors and in complementary domains** (in liaison with Task 4.2), as well as **manage specific interactions with European SME initiatives** such as SCoDIHNet, as well as **relevant international actions supporting SMEs** in the SNS domain (in liaison with SNS ICE).

  The various IAFAs, the standardisation tracker and related activities, and the work with SCoDIHNet and the SME WG have all contributed to reinforcing the involvement of SMEs in vertical sectors and complementary domains.

4.2 Main activities

This section provides a detailed description of the main activities to promote SME engagement carried out during the first 15 months of the project.

4.2.1 Identify and engage SMEs new to the SNS ecosystem.

The analysis of the SMEs' participation in the 2022 and 2023 SNS JU calls showed that these accounted for 18.5% (EUR 44,070,384.13) and 27%, respectively.

SME participation in the SNS JU call 2022 (Phase 1)

In 2022, the SNS JU launched its first call for projects. A total of 35 projects were awarded, two of which were the Coordination and Support Actions (CSAs) SNS OPS and SNS ICE. Considering the

33 RIAs and IAs, 88 SMEs participated in the awarded projects. Of those, 41% (36) were members of the NetworldEurope SME WG.

Some 64 SMEs took part in one project, whereas the other 24 participated in more than one, adding to a total of 135 project participations. The average participation was approximately 1.5 projects per company. The highest number of project participation by one SME was seven.

Figure 16 showcases the number of projects in which SMEs took part during the first call of the SNS JU.

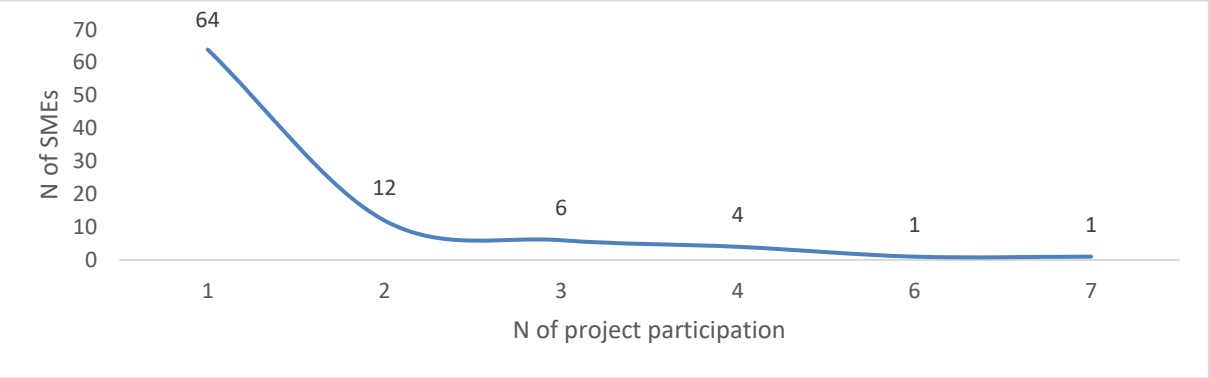

Figure 16: Number of SNS projects in which SMEs participated (2022 call).

Greece had the highest number of SMEs and participation in projects, with 15 SMEs partaking in 27 projects, averaging 1.8 projects per company in the SNS JU 2022 call. Second to it is Spain, with 13 SMEs and 17 participations. France and Italy had six SMEs each, with 11 and 13 participations respectively. Both countries, as well as Switzerland, rank higher than Green in terms of average participation, with over two projects per SME. Germany also had six SMEs but seven participations, Figure 17.

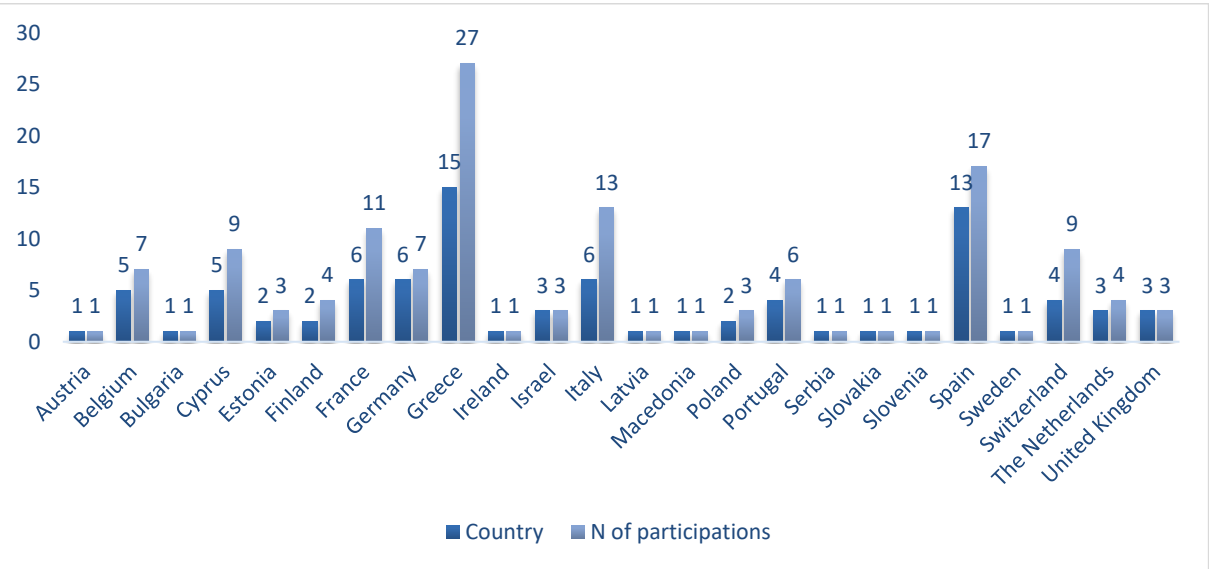

Figure 17: N of SMEs and project participation per country

The average number of SMEs per country was 3.7 due to the significantly higher participation of some countries. Austria, Bulgaria, Ireland, Latvia, Macedonia, Serbia, Slovakia, Slovenia and Sweden only had one SME and one project each. Estonia, Finland, Israel, the Netherlands, Poland and the United Kingdom had between 2-3 SMEs.

The funding received by SMEs represented 18.4% of the total budget. On average, each SME received EUR 500.799,82. The maximum funding received by an SME was EUR 2.979.850 million.

Greece accounted by approximately 22% of the SME total funding. At near EUR 10 million, Greek SMEs funding was almost twice than that obtained by Spanish ones, which rank second in terms of

funds, representing 13% of the total. Even though the number of Greek and Spanish SMEs was similar (15 vs 13), the participation of the former in different projects (27 vs 17) was much higher, which could be one of the reasons that explains this difference in funds.

Belgium was the third country with the highest funding, amounting to 9% of the total. Despite the number of Belgian SMEs (5) and their participation (7) being lower than other countries, especially compared to Greece and Spain, these attracted more funds. For instance, two out of the five SMEs accounted for 65% of the total funds received by Belgian SMEs. However, while one participated in three projects and therefore, had a budget aligned with the average, the other obtained almost EUR 1 million with only one participation.

France and Cyprus, obtaining over EUR 3 million each, ranked fourth and fifth in terms of funding, Figure 18. Both had a similar number of SMEs and participation in projects, with France`s figures slightly above.

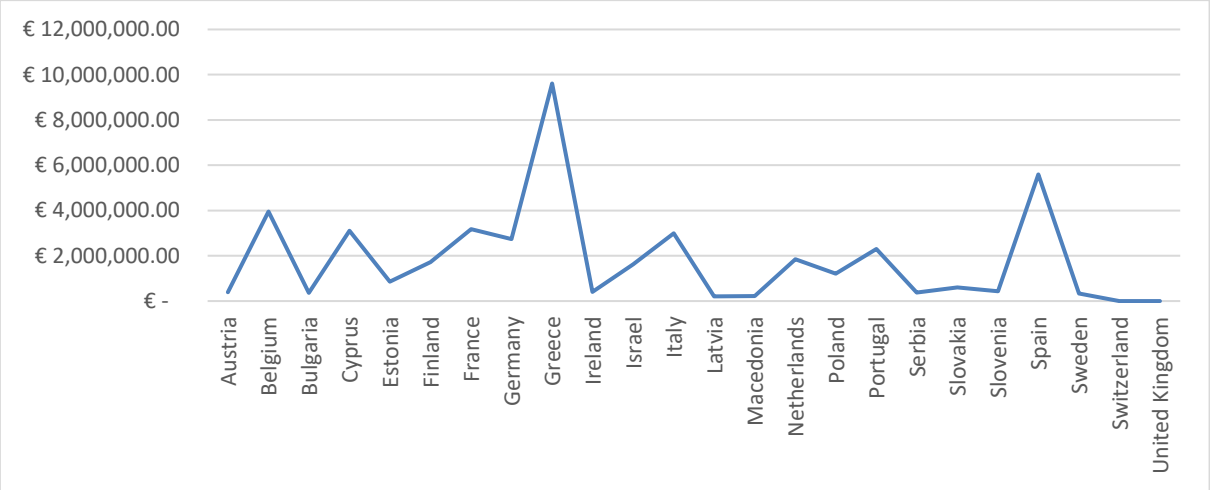

Figure 18: Total SME funds obtained per country in the SNS JU 2022 call

Given their lower participation, Latvia, Macedonia, Sweden, Bulgaria, Serbia, Austria, Ireland, and Slovenia received the lowest funding from the participating countries. None reached EUR 500,000.

Overall, southern European countries have a significant presence in relation to the number of SMEs involved in SNS projects, the number of projects in which SMEs participate and the funding obtained. Likewise, Belgium performed particularly well when compared to countries with similar numbers, such as Italy or Germany.

Most leading countries had one or two very active SMEs, which participated in various projects and concentrated most of the funding. The main exception is France, where the funding was distributed rather equally among all participating SMEs.

SME participation in the SNS JU call 2023 (Phase 2)

The SNS JU 2023 call awarded 27 projects, one of which was the Coordination and Support Action (CSAs) 6G4Society. A total of 75 SMEs are part of the projects awarded. Out of those, 26 are members of the NetworldEurope SME WG, whilst 30 hold a 6G IA membership.

In terms of the number of projects, 62 SMEs took part in one project, whereas 13 participated in more than one, adding to a total of 97 project participations. The average participation was 1.3. As in the 2022 call, the number of projects one SME participated in was seven.

Figure 19 shows the number of projects in which SMEs took part during the second call of the SNS JU.

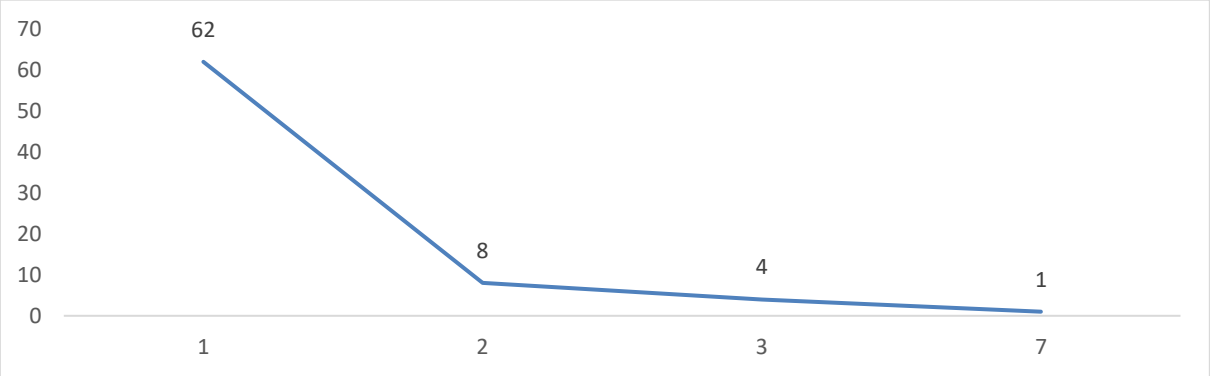

Figure 19: Number of SNS projects in which SMEs participated in the SNS JU 2023 call

Greece had the highest number of SMEs and project participation, with 12 and 15 respectively. While the number of SMEs was slightly lower than that of the 2022 call, the total projects was almost cut in half. France and Switzerland ranked second and third with 11 and seven SMEs and 13 and eight projects, respectively, as shown in Figure 20. Both countries increased their participation with respect to the 2022 call for projects.

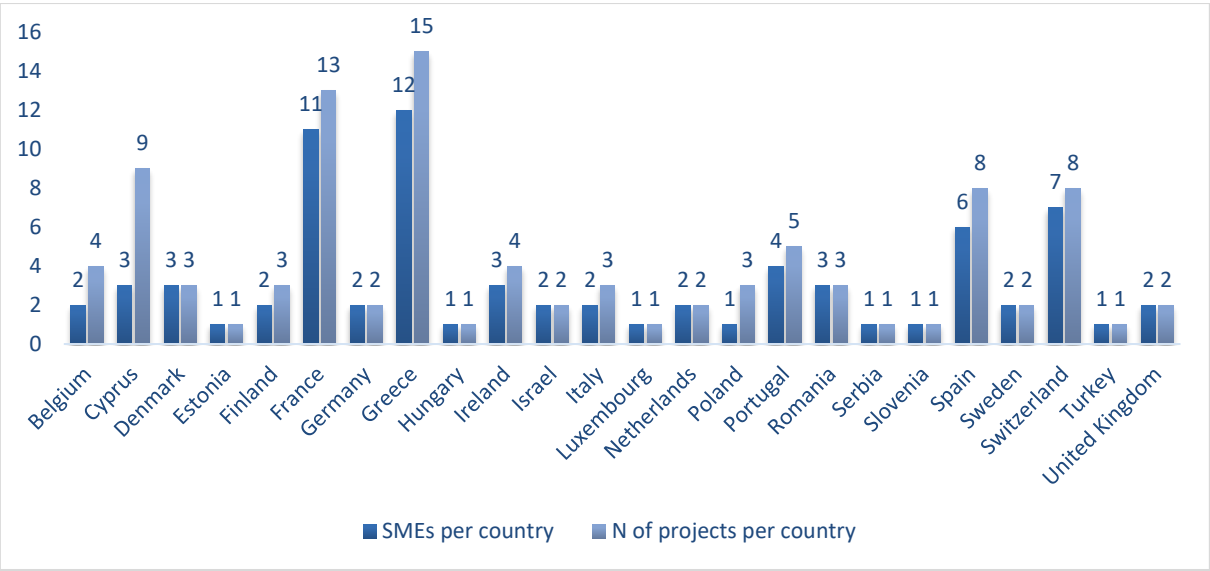

Figure 20: Number of SMEs and projects per country in the SNS JU 2023 call

Despite having a lower number of SMEs (3) than in 2022, Cyprus maintained the same participation in the 2023 call, with nine projects. This is the third highest number of projects, after France and Greece. Denmark, Hungary, Luxembourg, Romania and Turkey, which did not have any SME partaking in the 2022 projects, had one SME each, except for Denmark and Romania with three SMEs each.

In contrast, the participation of Spain, which ranked second in the 2022 call, was reduced by more than half both in the number of SME and projects. A notable decline in SME participation was also observed in Belgium, Germany and Italy. Although to a lesser extent, Estonia, Israel, the Netherlands, Poland and the United Kingdom also experienced a decrease in their participation. Finally, Austria, Bulgaria, Latvia, Macedonia, Serbia, and Slovakia, which were present in 2022, do not have any SME in 2023.

The average number of participating SMEs per country was approximately three. Out of 24 countries, 16 or 67% are below said average.

The total funding received by SMEs represented 27% of the total budget. On average, each SME received EUR 524,986.45. The maximum amount of funds received by an SME per project was EUR 1,343,590.00. A total of three SMEs surpassed EUR 1 million. Accounting for all the projects in which each SME participates, the maximum amount received by one SME was EUR 3,139,937.50.

Greece accounted for approximately 15.5% of the SME total funding, amounting to EUR 6.095.489,91 mil. French SMEs obtained EUR 5.288.085,00 million, representing 13% of the SME funds, and Spanish SMEs received EUR 4.328.277,00 million, 11% of the total SME budget, as show in Figure 21. A correlation between the number of SMEs and projects per country and the funding can be observed.

Cyprus obtained almost EUR 4 million in funding, whilst Denmark and Portugal surpassed EUR 2 million. Ireland was also close to reaching funding amounting to EUR 2 million. Except for Cyprus` participation in projects, the results were very positive when comparing them to countries with similar numbers of SMEs and projects.

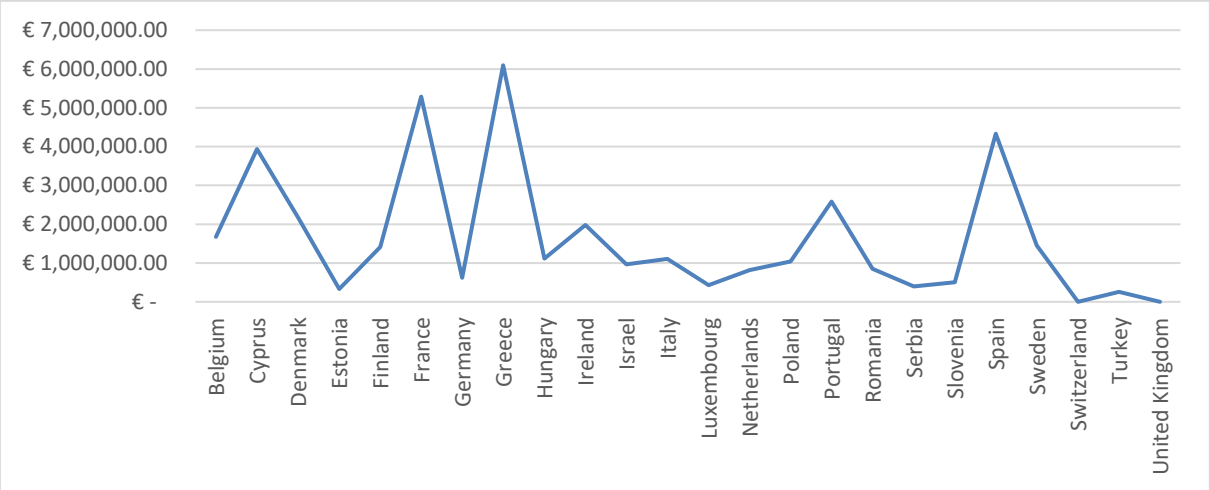

Figure 21: Total SME funds obtained per country in the SNS JU 2023 call

The funds attracted by Estonia, Luxembourg, Serbia, Slovenia and Turkey were below average.

Overall, as underlined in the 2022 call, the top countries had one or two SMEs that participated in various projects, concentrating most of the funding.

The 2022 and 2023 calls for projects: an overview

In the 2022 SNS call for projects, there were a total of 88 SMEs in 33 projects, whilst in 2023, there were 75 SMEs across 27 projects. Of those, 30 SMEs or 40% of SMEs, were part of a winning project in both calls.

A total of 29 countries were awarded projects in the 2022 and 2023 SNS calls. Nevertheless, in each call, there were 24 countries, and some that were present in 2022 did not participate in 2023 and vice versa. The distribution of SMEs across countries remained quite similar in 2022 and 2023, with some notable exceptions. In particular, Spain, Germany and Italy saw their number of SMEs reduced by more than 50%, whereas France and Switzerland experienced an increase in their number of SMEs, as illustrated in Figure 22.

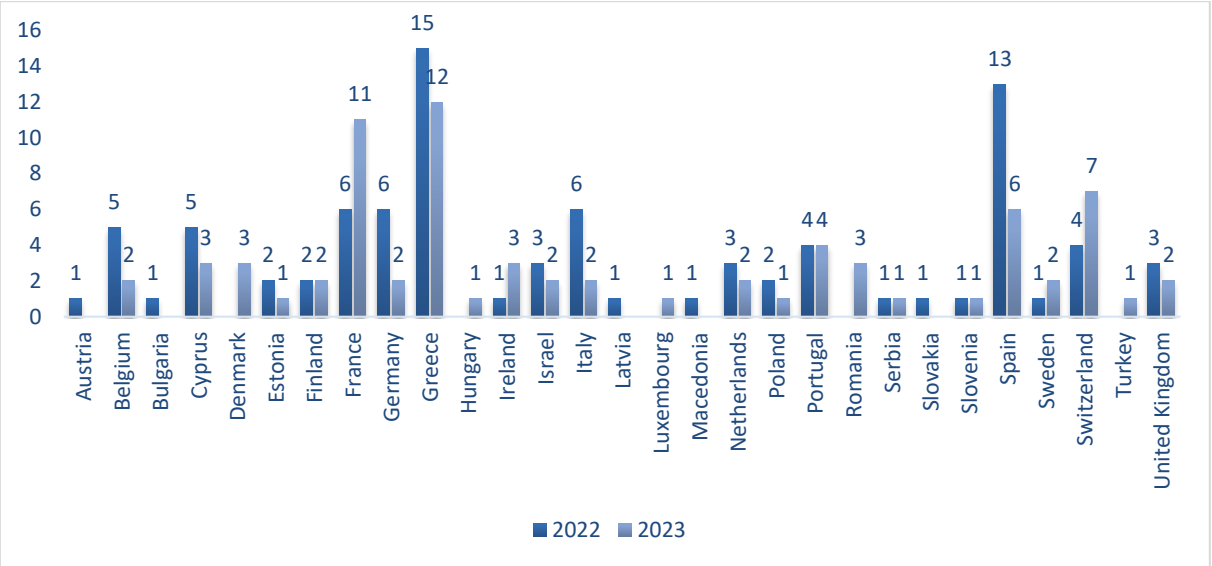

Figure 22: SMEs awarded projects in the SNS JU calls 2022 and 2023 per country

SMEs participated in 135 and 97 projects in the 2022 and 2023 SNS calls, respectively. Greece accounted for the highest number of projects in both calls, although participation in projects experienced a remarkable decline in 2023. Similarly, Spain, which ranked second in 2022 with 17 project participations, and especially Italy, ranked third with 13 project participations, decreased their involvement significantly. Even though German SMEs were not among the most active, they contributed to seven projects in 2022. However, their participation dwindled in 2023 with two projects.

Contrariwise, France and Sweden slightly increased their participation. Cyprus, Poland, Serbia and Slovenia maintained their numbers, as shown in Figure 23.

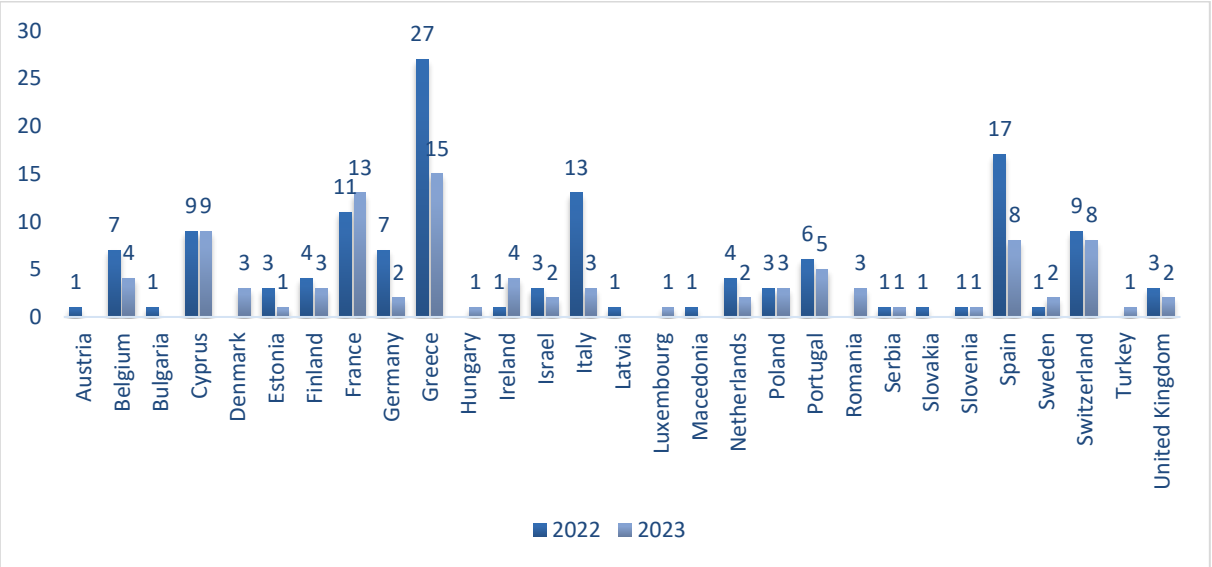

Figure 23: Number of projects in the SNS JU calls 2022 and 2023 per country

Figure 24 showcases how SME participation in projects followed a very similar pattern in the 2022 and 2023 SNS calls. Most SMEs only participated in one project, in particular, 73% in 2022 and 83% in 2023. The remainder of the SMEs participated in more than one project. In both calls, the highest number of projects in which one SME contributed was seven.

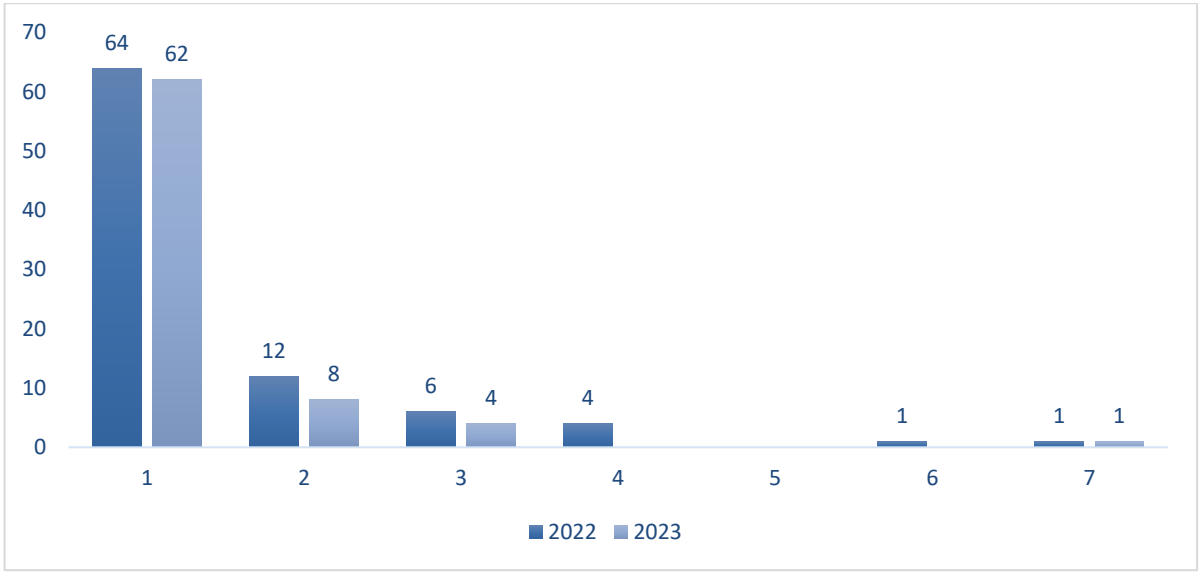

Figure 24: Number of projects participated per SME in the SNS JU calls 2022 and 2023

In the 2022 SNS call, the highest funding, obtained by Greece, amounted to EUR 9.611.848,62. Second to it was Spain with EUR 5.599.025. Belgium, Cyprus and France attracted EUR 3.951.162,50; EUR 3.111.705,50; and, EUR 3.171.212,88, respectively. Italy followed rather close with EUR 2.990.662,25. Germany and Portugal also obtained over EUR 2 million, as shown Figure 25.

Similarly to 2022, Greece also obtained the highest funding in the 2023 SNS call, with EUR 6.095.489,91. France followed with € 5.288.085, a 67% increase with respect to the last year. Spain attracted EUR 4.328.277. Even though this constitutes a decrease in funding, when compared to the decline in number of SMEs and project participation, the results remain rather positive.

In addition to France, Cyprus, Ireland, Poland, Portugal and Sweden also increased the amount of funds received. In particular, Sweden attracted more than 300% more funds. While Cyprus participated in the same number of projects (9) in both calls, the number of SMEs was much lower. Inversely, Portugal had the same number of SMEs (4), but one less project participation. In the case of Ireland and Sweden, both the SMEs and the contribution to projects increased.

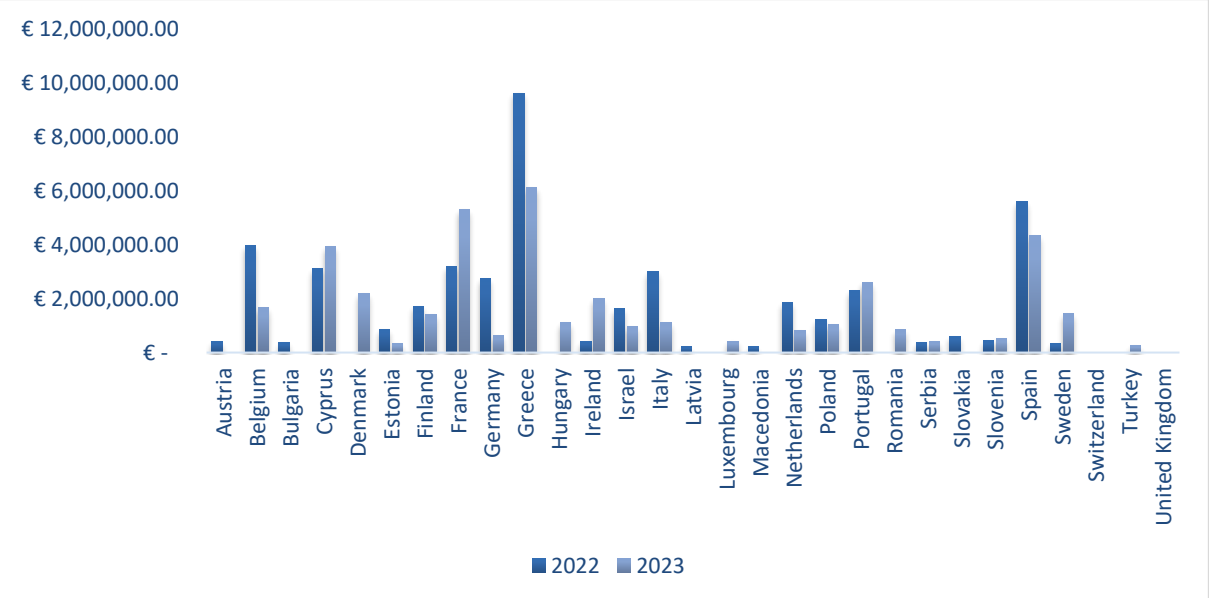

Figure 25: Funds obtained per country in the SNS JU calls 2022 and 2023.

There are notable similarities in both SNS calls, yet some differences in funding and participation can also be observed. Monitoring future calls will help to better understand trends, which could be used in policymaking.

An email campaign was carried out in February 2024 to introduce the WG to SMEs new to the SNS (calls 2022 and 2023) and not members of the WG yet. A total of 77 SMEs were contacted. It is too early to report any campaign results.

Moreover, the results of this analysis have been very helpful in identifying successful SMEs that can serve as inspiring examples to their peers. These are being invited to participate in different activities in the SME WG.

4.2.2 SME WG

The SME WG is central to the SNS engagement strategy relative to SMEs. During Year 1, the activities of the SME WG were carried out in the context of 6GStart; thus, they were reported in 6GStart D3.3 Stakeholder Engagement Final Report. The official handover was in December 2023 for all activities, except the publication of the new **"2023 European SME Expertise in 5G and Beyond"** brochure and accompanying success stories, released in February 2024.

SNS OPS continues to provide support to the SME WG. The WG met in January 2024 and March 2024. In the year's first meeting, the WG focused on the recently launched SNS 2024 call. An overview of the topics in the call and available tools and resources, such as the brokerage platform and the info days, were presented. In March 2024, the meeting touched on the SNS 2024 call. A comparison of the SME results in SNS calls 2022 and 2023, with a particular focus on the SME WG, was presented. Yet, the focus was on the special session titled **"Igniting Innovation: R&I Strategies and Entrepreneurship".** More details are provided in section 4.2.3.

Information is shared on a constant basis via the SME WG mailing list and its social media. The latter has proved to be very successful in boosting the visibility of the WG members' skills, expertise, activities and accomplishments. It also facilitates SMEs connecting with one another and with the NetworldEurope and SNS communities as a whole to diversify the information shared and follow the rapid developments in the state of the art of the industry.

The management of the SME WG membership has continued smoothly. The SNS OPS team handles the registration process, guiding newcomers and integrating them into the ongoing activities.

As of March 2024, there are 220 members, encompassing 191 SMEs, 25 research organisations, three industry members, and one association. The numbers are slightly lower compared to those in 2023 after updating the WG database. Considering the number of organisations instead of members, there are 150 organisations: 124 SMEs, 21 research organisations, four industry members, and one association.

SME WG: an overview

A questionnaire was carried out in 6GStart that helped to elaborate a general diagnosis of the SMEs' situation in the telecommunications sector, focusing on the SNS ecosystem. The results of the helped to identify the main interests and challenges of the WG members. Based on this, the team was able to build a work plan that addresses these subjects.

A total of 32 SME WG members – 30 SMEs and two research organisations – across 17 countries answered the questionnaire. Of those, 19% were micro-SMEs, 53% small companies and 28% medium ones. Even though a 21% participation rate is not enough to draw any conclusions, it is sufficient to identify common topics related to SMEs. A summary of the results is presented hereafter.

In 2022, 63% of the respondents participated in the SNS calls, and among applicants, 61% were awarded one or more projects. In 2023, the participation among the respondents decreased to 56%, of which 46% were awarded one or more projects. Approximately 81% of the respondents are planning to participate in the SNS call in 2024, Figure 26.

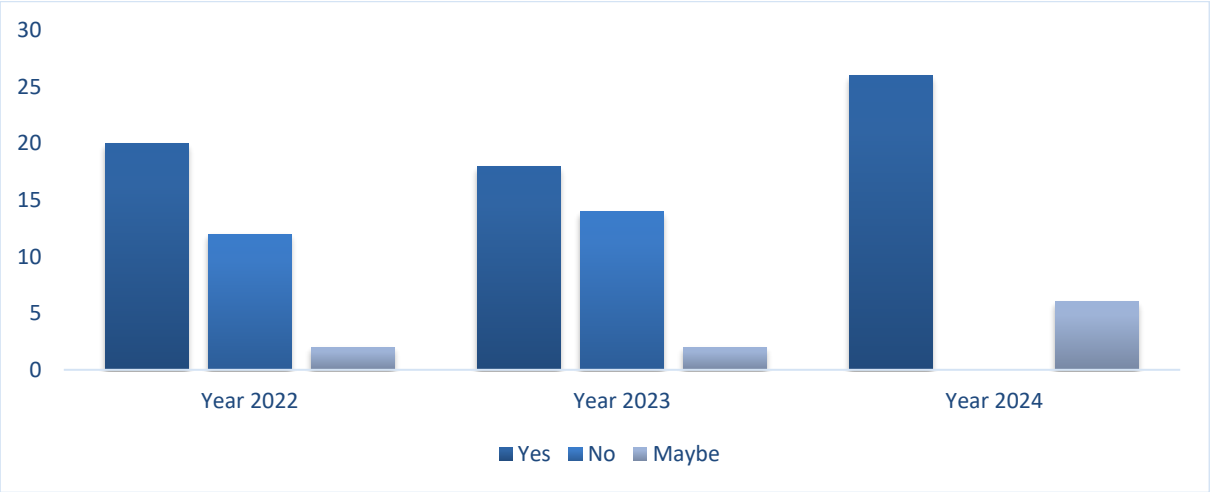

Figure 26: Participation of the SME WG in the SNS 2022 and 2023 calls and planned participation in 2024.

The participation in SNS projects' open calls was 59% among respondents. The top projects were FIDAL and 6G-SANDBOX, followed by TARGET-X and TrialsNet, and one application to IMAGINEB5G. All these projects had been invited to partake in the SME WG meetings to relay first-hand information about their open calls.

While respondents mentioned a wide range of benefits linked to their participation in the SNS JU and previous programmes, a number of substantial challenges were also cited. Addressing these bottlenecks is critical to ensure that all the innovation potential available is unlocked across the SNS value chain and that the work developed within the SNS JU is transferable, marketable and sustainable. A summary of the main benefits and challenges mentioned is provided below.

Benefits

- Being part of the development of cutting-edge technologies
- Access to networks for experimentation where technology can be tested and validated.
- Scientific and technical excellence on relevant topics
- Research and innovation funding to generate new technologies, solutions and services.
- Networking with other organisations and potential customers. Enhance visibility.
- Collaboration and positioning in the ecosystem
- Potential to enrich commercial products and services and target new markets and customers.
- Market insights and trends. IP creation
- Improvement of know-how, funding for the development of prototypes.

Challenges

- Building a consortium, identifying trustworthy and committed (leading) partners.
- Having a competitive R&D team with a specific technological orientation and focus supported by PoC achievements.
- Very competitive industry.
- Identifying calls aligned with the activity of the organisation, particularly with the proliferation of streams addressing very specific topics.
- Delivery of implementable solutions.
- Lack of information.
- Frequency licenses to do real-life experimenting.
- Time expenditure and high-risk costs during the proposal and project work.

SME WG members were also asked to assess some of the main elements of the SNS JU. Most of the elements were ranked between neutral and satisfactory. The openness of the SNS JU to the participation of SMEs is the highest ranked with 3.7, whilst the representation of the SMEs in the SNS JU GB is on the bottom with 3.3, Figure 27.

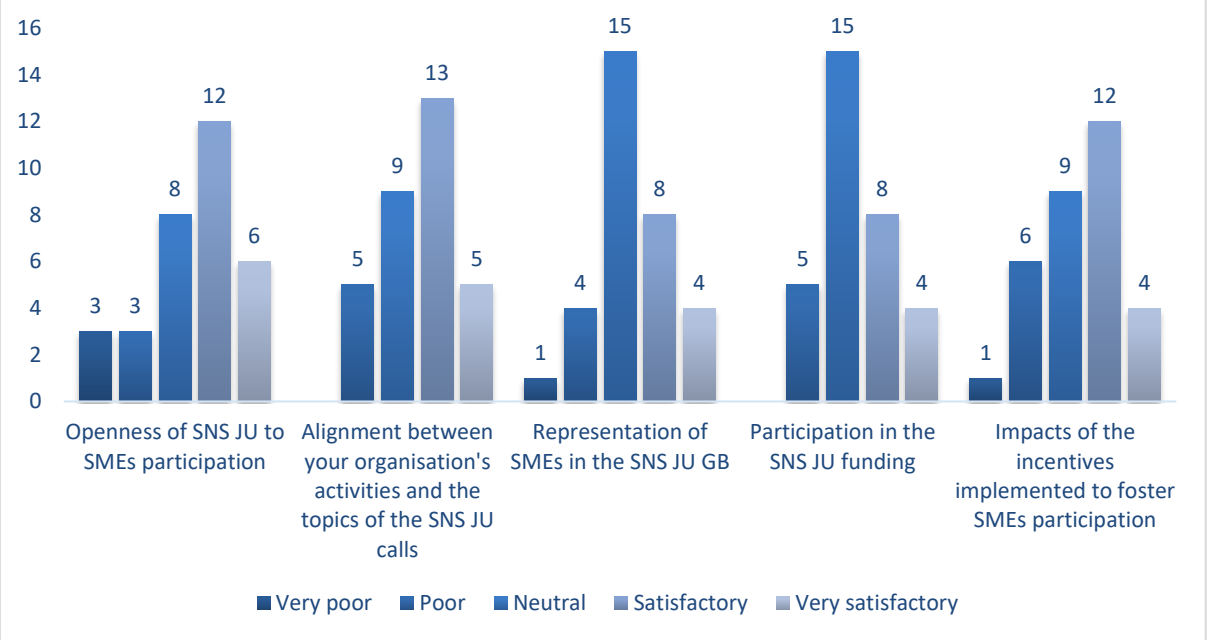

Figure 27: Assessment of the targets set in the SME WG 2020 position paper.

While the current baseline is mostly satisfactory, there is quite some work to do to support SMEs. One of the initiatives suggested by SMEs to boost their participation in the SNS JU is to establish a minimum threshold for SMEs' participation in the call requirements to secure their participation and a higher funding rate. The possibility of SMEs acting as project coordinators is very much limited and should be revised.

Other proposals to enhance the SME visibility and participation include improving the WG productivity in terms of impact creation, in alignment with the Horizon European and SNS activities, and effectively conveying this to the SNS ecosystem.

Representation and publications

The SME WG Chair attended the **SNS-I SB meeting** on the 12 of February 2024, where it presented the WG and its activities. An invitation was extended to the other WG chairs as well as to the SB and TB Chairs to join the SME WG meetings to present their work. Moreover, the project coordinators were encouraged to pass information about the WG to their SME partners.

The **"2023 European SME Expertise in 5G and Beyond"** brochure, alongside the latest NetworldEurope WG SMEs success stories, was published in February 2024. It comprises 81 company profiles and 14 success stories, as well as editorials by Jessica Carneiro and Nicola Ciulli, Chair and vi-Chair of the SME WG, respectively; Rui Aguilar, NetworldEurope Chair; and Colin Wilcock, Chair of the 6G IA Governing Board. The design of the Brochure was revisited.

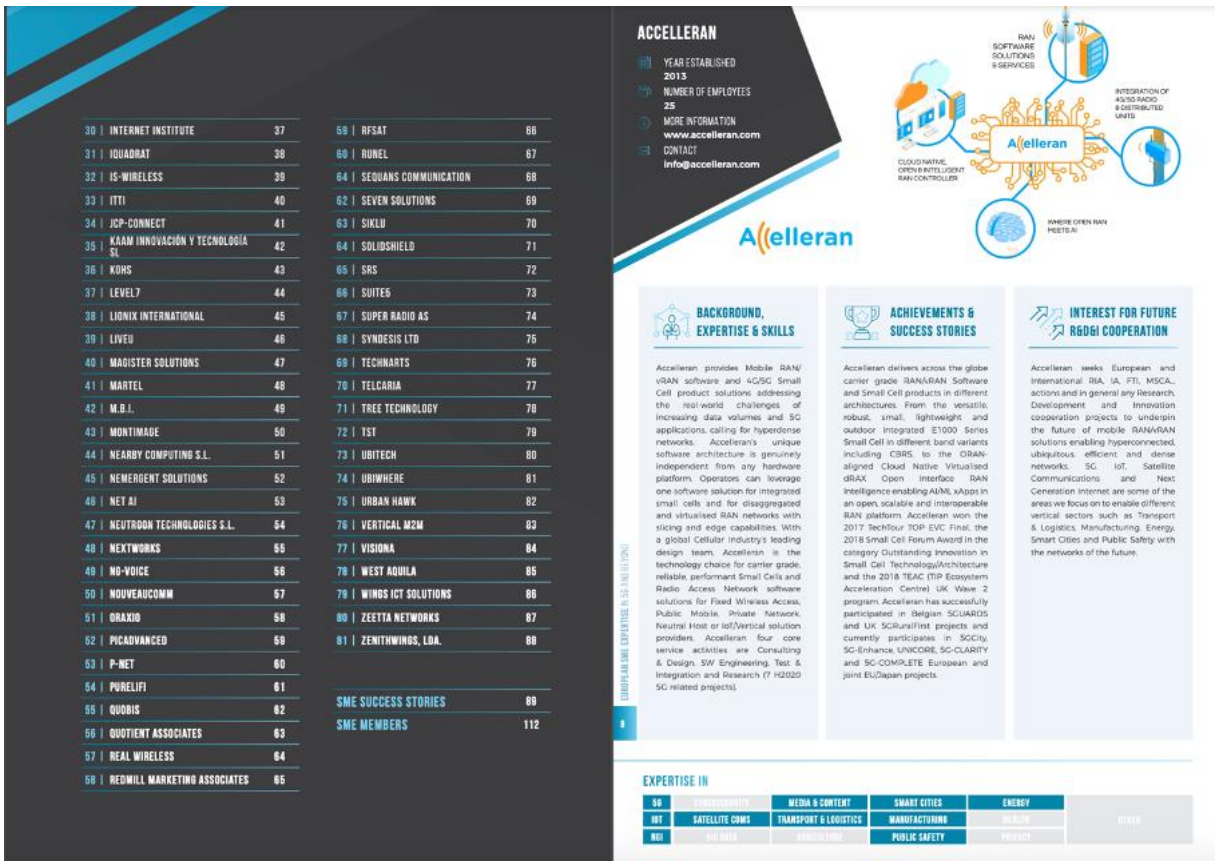

Figure 28: Snapshot of the SME brochure.

The Brochure is available on the "Find my SME" webpage on the NetworldEurope website, where it can be downloaded.[9] Likewise, the success stories can be accessed and downloaded individually. Since its publication, a social media campaign has been carried out to promote the brochure and the success stories. As of March 2024, the brochure had been downloaded 77 times since its publication, whilst the success stories had been downloaded 35 times.

The SME WG Chair also contributed to the **"SNS Journal 2024"**, which will be released later this year. The article provides an overview of the current state of the art of the SMEs and the SME WG, highlighting some of their accomplishments in research and innovation, particularly 5G PPP and SNS projects.

Various short articles about different topics being addressed in the SME WG were published in the **5G PPP and SNS newsletters and newsflashes**.

Website and social media

The SME WG social media strategy, in alignment with WP2, has been meticulously crafted to prioritise community building and engagement across various channels. With a concerted effort, we have successfully cultivated a vibrant online community with over 1,200 members centred around the SME WG's initiatives and the broader discourse on 6G technology. Our strategy focused on consistently publishing updates from SME WG members, sharing important industry news, and promoting key events related to 6G advancements. By fostering regular interactions and discussions, we aimed to not only disseminate valuable information but also stimulate meaningful dialogue within the community. This approach has proven instrumental in strengthening connections, fostering collaboration, and driving awareness of the SME WG's contributions to the evolving landscape of 6G technology.

The SME WG Group reached 1,051 followers on the X channel, a testament to the engaging content and active presence maintained with the publication of 1,110 posts.[10] Additionally, it has garnered a

[9] See https://www.networldeurope.eu/find-the-sme-you-need-new-page/.
[10] See https://twitter.com/NetworldEurope

dedicated following on LinkedIn, amassing 257 followers.[11] This significant increase in followers reflects the growing interest and engagement surrounding the SME WG initiatives and contributions within the industry. As the group continues to foster collaboration and share valuable insights, its reach and impact are poised to expand further, driving innovation and growth within the SME community.

As per the presence of the SME WG on the NetworldEurope website, the "Find the SME you need" page and the "SME WG" page continue to be amongst the most visited in the first quarter of 2024. The average engagement time is close to the one-minute mark for both pages, as shown in Figure 29 and Figure 30.

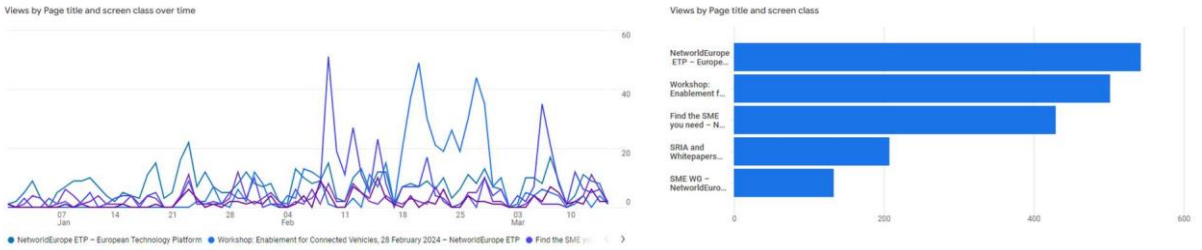

Figure 29: NetworldEurope website views from 01 January 2024 to 14 March 2024.

	Page path and screen class	Views	Users	Views per user	Average engagement time	Event count All events
		10,865 100% of total	1,469 100% of total	7.40 Avg 0%	2m 23s Avg 0%	19,151 100% of total
1	/	8,384	635	13.20	3m 50s	10,249
2	/workshop-enablement-for-connected-vehicles-28-february-2024/	502	242	2.07	1m 02s	1,812
3	/find-the-sme-you-need-new-page/	429	230	1.87	58s	1,740
4	/sria-and-whitepapers/	207	109	1.90	33s	886
5	/sme-wg/	133	64	2.08	53s	474
6	/satcom-wg/	120	92	1.30	54s	431
7	/our-members/	94	59	1.59	23s	295
8	/overview/	69	59	1.17	31s	202
9	/events/list/	53	31	1.71	29s	151
10	/how-to-join/	52	28	1.86	37s	154

Figure 30: NetworldEurope's website's most visited pages from 01 January 2024 to 14 March 2024

Some updates in the SME WG pages will be devised in 2024 to achieve a more dynamic and user-friendly interface.

4.2.3 Promotion of entrepreneurship in the SNS ecosystem

Entrepreneurship is promoted on an ongoing basis by all SNS OPS partners. The team regularly engages with different actors in the SNS ecosystem and beyond to foster a dynamic collaboration that leads to more stakeholders being involved in the said ecosystem.

The strong positioning of some SNS OPS partners is also an important driver for engaging new stakeholders in SNS activities. For instance, the relationship with diverse industrial associations and the activities addressing verticals and complementary domains, to mention some, have been important in attracting different types of actors at different levels.

The SME WG has also been essential in promoting entrepreneurship. It provides a space for members to present their work and achievements; it acts as a central point of information, gathering all news regarding calls, workshops and events, among other activities, as well as developments in the SNS community, including technology, policy and regulation; it fosters discussions by including speakers from different areas and projects; and, it facilitates that members learn about each other.

In March 2024, in the context of an SME WG meeting, a special online session titled **"Igniting innovation: R&I strategies and entrepreneurship"** was organised. Three of the most successful

[11] See https://www.linkedin.com/company/networldeurope-sme-wg.

WG SMEs in terms of participation in Horizon Europe, particularly 5G PPP and SNS JU, were selected to participate in the event: Simon Pryor represented Accelleran (Antwerp, Belgium), Dimitris Klonidis participated on behalf of Ubitech (Athens, Greece), and Sokratis Barmpounakis represented WINGS ICT Solutions (Athens, Greece).

Figure 31: "Igniting innovation: R&I strategies and entrepreneurship" banner.

Each SME presented their expertise, experience and R&I roadmap, focusing on their approach to Horizon Europe projects. This was followed by a discussion engaging all the participants in which different topics were addressed, from the internal organisation to the building of a strategic positioning in the community. Having different core activities - Accelleran is a vendor, Ubitech is a software house, and WINGS focuses on applications – highly enriched the exchanges. The event was attended by 25 participants.

The main takeaways of the session are summarised hereunder:

- It is fundamental to understand the role of your company, its core activity and strengths and how and where it can bring added value.
- Balancing the business or commercial aspect with the research one is essential. Innovation is vital to improving SME solutions and services. Thus, the SME needs to ensure it has the capabilities to leverage the outcomes of the projects into products, solutions or services.
- Funding is a means to achieve a goal and not the goal itself. Being part of a European R&I project requires fulfilling a specific role that helps advance the objectives set in the strategic roadmap.
- Sharing ideas, being flexible and showing responsiveness are key when networking. Likewise, once a project is awarded, commitment to a good job is essential to building a good reputation that will help to access new opportunities.
- The local footprint building a good network of contacts and clients, starting from the immediate ecosystem, will be highly valuable and will facilitate the expansion of said network to new actors and regions.
- Building a brand and promoting it is crucial. SMEs need to be active and present in the different communities, events, workshops and so on. The participation in the SME WG was underlined.
- Identifying complementary collaborators will help optimise networking efforts as actions can be targeted more effectively. Fostering effective cooperation with research institutions is critical for SMEs.

- Understanding the sector trends and reading the calls carefully is of utmost importance since both offer hints on what can make a proposal successful. Grasping these details can help to tackle some important points in the proposal that make a difference in the evaluation stage.

The recording of the session is available on the SME WG YouTube channel.[12] Moreover, the slides were distributed amongst the members of the WG. Given the positive feedback of the participants, similar activities will continue to be organised.

The SME WG has extended invitations to different SNS and 6G IA WGs to present their work during the meetings. This is expected to foster discussions about specific topics and further embed the SMEs in the SNS ecosystem. According to the feedback received by SMEs, the organisation of workshops focused on enhancing knowledge sharing and cross-sectorial fertilisation of ideas that can lead to novel insights and synergies is being considered. In particular, a workshop with WiTAR is being discussed.

As part of the promotion of entrepreneurship, SMEs will continue to be invited to present their achievements to inspire others.

4.2.4 Engagement with relevant SME initiatives: SCoDIHNet

SCoDIHNet is supporting the operation of the Digital Innovation Hubs that are involved in the Digital Europe program. One of the main objectives is to facilitate the Digitalisation of the European Industry, mainly the SMEs. In the ecosystem, there are two types of SMEs involved:

- SMEs which are developing and providing technical solutions
- and end-user SMEs that are willing to use these solutions.

SCoDIHNet is contributing with the DIHs to facilitate cooperation between these two sets of stakeholders at the regional level.

For this purpose, SCoDIHNet has developed a catalogue mapping technology providers, test beds, and DIHs at the regional level. This will help SMEs cooperate locally and facilitate the go-to-market.

A first version of this catalogue has been initiated by the 6GStart project with the 5G PPP SMEs, and an update of the catalogue is being made with the SNS JU SMEs (Figure 32).

[12] Learn more at https://www.youtube.com/watch?v=kiuloo8zk-0

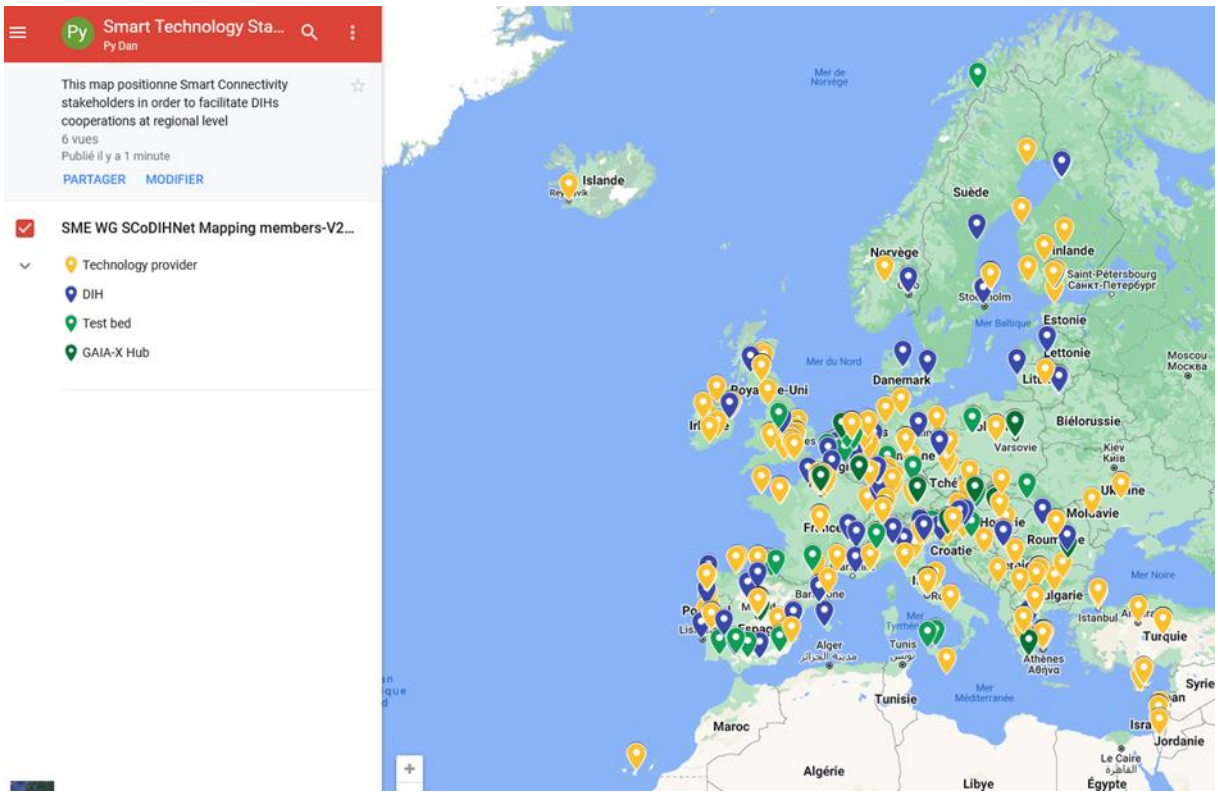

Figure 32: Technology providers / DIHs mapping at local level

SCoDIHNet has also established an MoU with the Enterprise Europe Network (EEN) in order to cooperate better at the regional level.[13] EEN has a specific group targeting digital SMEs that are interested in DIHs. The objectives of the cooperation are the following:

1. Collection of use cases and solutions from EEN members to complete the replicability catalogue
2. Mapping the technology providers with DIHs
3. Cooperation with the DTA
4. Participation of EEN members in SCoDIHNet.

SCoDIHNet has also cooperated with the European Startup Nation Alliance (ESNA) to help the local startups and the DIHs cooperate.[14] The ESNA aims to align the support of startups in Europe, taking advantage of the good practices put in place by regions. As DIHs are involved in the regional ecosystem, they are interested in establishing cooperation and working on the cooperation between DIHs and Startups. As several startups are involved in the Smart Connectivity domain, there is a huge potential for cooperation.

4.3 Work plan M16 – M27

The analysis of the SME participation in the calls 2024 and 2025 will be carried out. This will help monitor SMEs' involvement in the SNS JU programme over time, gaining a better understanding of the funds captured by SMEs, their origin, their participation in projects, and other factors. This information is valuable evidence for fostering the participation of SMEs through specific policies.

SNS OPS will continue to support the SME WG in its activities. The WG expressed its interest in receiving information from the Open Smart Networks and Services, Software Networks, Security, Trials, Vision and Societal Challenges, 5G for CAM, and 6G Architecture WGs. Therefore, this will be one of the primary goals in the upcoming months. Other activities considered include elaborating a position paper that boosts the impact of the WG in the community.

[13] About EEN see https://een.ec.europa.eu.
[14] About ESNA see https://esnalliance.eu/.

The preparation of the 2024 SME brochure will start in the last quarter of 2024. The procedure will follow a very similar approach to that implemented in 2023. Yet, the template provided to the SME WG members will be revised to potentially include more categories of technologies and verticals, according to the evolution of the SNS.

5 Working Group coordination

This section documents the activities of SNS OPS in supporting the various Working Groups of the SNS JU project, 6G IA, and NetworldEurope. The transition from 5G PPP to SNS JU encompassed specific support activities, as well as general ongoing support and maintenance[15].

It also documents the scope and key activities/achievements of each of the Working Groups for the reporting period of calendar year 2023. For simplicity for the reader, *all of the activities of the WGs* during this period, whether they were carried out under the auspices of 5G PPP or SNS JU, are reported, although only *support for these activities which came from SNS OPS* within SNS JU is documented here.

Under 5G PPP, there were two categories of WG supported by the relevant CSAs, plus the NetworldEurope WGs:

- **5G IA initiated WGs** were open to members of 5G IA, as well as to members of projects participating in 5G PPP on an ad hoc/invitation basis
    - Pre-Standardization; 5G Spectrum; Vision and Societal Challenges; Trials (public, open to anybody); Open Smart Networks and Services; Security; 5G for CAM
- **5G PPP project initiated WGs** were proposed by 5G PPP projects where a need was foreseen and were only open to those organisations participating in 5G PPP projects
    - 5G Architecture; Test, Measurement and KPIs Validation; Software Networks
- **NetworldEurope WGs,** although not formed by or reporting to 5G IA/5G PPP, there was close liaison and interworking between 5G PPP and NetworldEurope, and support has been given to these WGs from the 5G PPP CSAs
    - SME, Expert group, Satcom, Media (closed 2022)

Under the SNS JU, there are three categories of WGs, plus the NetworldEurope WGs.

- **6G IA initiated WGs** are open to members of 6G IA, as well as to members of projects participating in SNS JU on an ad hoc/invitation basis
    - The existing 5G IA initiated WGs have migrated from 5G IA ownership within the 5G PPP directly to 6G IA ownership within the SNS JU with only confirmation of their leadership and updates to their ToR required: Pre-Standardization; Spectrum; Vision and Societal Challenges; Trials; Open Smart Networks and Services; Security; 5G for CAM
    - New 6G IA WGs can be initiated as and when required by the 6G IA Governing Board (GB). So far, one new WG has been initiated by 6G IA on the topic of "Women in Telecommunications and Research" (WiTaR)
    - Although not strictly a WG, SNS OPS also supports the Verticals Engagement Task Force of the 6G IA as if it were a WG. A short report on this group is also included in this deliverable
- **SNS JU project-initiated WGs** will be proposed by SNS JU projects where a need is foreseen and will only be open to those organisations participating in SNS JU projects. Section 5.2 discusses the transition of project WGs from 5G PPP to SNS JU
- A new category of **"Strategic" WGs** has been introduced in SNS JU. These will be determined by the SNS GB, in which the EC is also represented, enabling the EC to suggest the formation of WGs to work on aspects for which some coordination appears required or beneficial from their point of view
    - Due to their confidential and potentially sensitive nature, these WGs are not discussed further within this public deliverable

[15] The activities supporting the WGs within 5G PPP, including the closure of 5G PPP project WGs, were supported by the 5G PPP 6GStart CSA project and, therefore, they are reported there.

- **NetworldEurope WGs**. The previous good relations between 5G IA/5G PPP and NetworldEurope are continuing between 6G IA/SNS JU and NetworldEurope, and SNS OPS offers support to NetworldEurope WGs, namely SME, Expert group, Satcom, and the more recently established "Enabling Technologies for Future Vertical Ecosystem Transformation" WG. The previous WG on "Media", supported by 5G PPP CSA projects, has closed

5.1 General support provided to WGs

The Working Groups have the following ambitions:

- To mobilise the community on strategic issues for 6G and SNS
- To facilitate community discussions and document achieved outcomes in the form of white/position papers or other types of documents.
- To proactively work with the community to establish roadmaps for key 6G technologies
- To proactively work with the community to identify requirements for experimental facilities
- To consider horizontal issues identified by the 6G international initiatives, including the SNS JU projects
- To ensure, in particular, that the standardisation issues for 6G networks are progressed within the SNS JU

A number of general support actions have been offered to all WGs and provided to those who require them. Specific activities have also been required to support the transition from 5G PPP to SNS JU.

- Communications infrastructure
- Document repository
- Publication Service
    - in order to support the transition from 5G PPP to SNS JU, it has been necessary to create a new infrastructure. WG-relevant aspects of this, such as email lists, document repositories and web presence for publishing white papers, etc., have had to be set up, and some content has had to be migrated from the old infrastructure.
- Audio and Video conference/WebEx/webinar facilities
- Election/Voting Support: it has been necessary to confirm or re-elect WG officers as a result of the transition from 5G PPP to SNS JU
- Organising and hosting Consultations (stakeholder, public etc.)
- Organising and hosting Workshops, Meetings and Webinars
- Collection, collation and distribution of regular activity/achievement updates and future plans from the WGs to enable coordination between WGs and strategic oversight by the 6G IA, SNS JU Steering Board and SNS JU Technology Board and, to a certain extent, with NetworldEurope
- Create and initiate a review of the WG Terms of Reference (ToRs). The CSA projects are responsible for ensuring that the appropriate governing body reviews the ToRs of WGs regularly. As a result of the transition from 5G PPP to SNS JU, it has been necessary to create new templates for ToRs and to work with the WGs to initiate the update of/development of new ToRs and seek their approval. This process should be completed within H1 of 2024

In many WGs, SNS OPS supports document preparation and news announcements. In the following cases, SNS OPS organisations supply the chair for the group, as well as chairing several Sub-Groups/Task Forces/work streams within WGs:

- 5G Architecture (chair)
- Pre-Standardization (vice-chair)

- Security (co-chair)
- SME (chair)
- Reliable Software Network (chair)
- Vision and Societal Challenges (vice-chair)
- Women in Telecommunications and Research (co-chair)

Although it is outside of the remit of SNS OPS to drive the content of work carried out within WGs, providing Chairs and other key personnel with WGs has been proven to be very beneficial in ensuring that the WGs are well directed along the roadmap of the SNS OPS, and are motived to contribute in a timely and constructive manner towards the overall goals.

5.2 Transition from 5G PPP to SNS JU

The 5G Public Private Partnership (5G PPP) was established in 2014 as part of the European Commission's Horizon 2020 Framework Programme to drive forward the European contribution to the development, standardisation and commercial launch of 5G technology. In its almost ten years of operation, 93 Research & Innovation projects were funded under the umbrella of 5G PPP, engaging 783 unique organisations around Europe from academia, industry (vendors, operators, application providers, etc.), SMEs and vertical sectors. The work carried out by these stakeholders resulted in more than 1200 standard contributions towards relevant SDOs and more than 2500 publications, showcasing the global impact of the 5G PPP programme.

5G PPP projects were organised in three distinct phases to reflect the technology development stage of each respective era. Accordingly, the nature of the projects shifted from ***Research*** in Phase 1 to ***Deployment*** in Phase 2, and then broader ecosystem engagement through ***Proof-of-concept and Trials*** in Phase 3. Irrespective of the Phase and the specific focus of each project, the 5G PPP programme was a pioneer as it established a unique collaborative project approach, where all projects would work together and build consensus to deliver a result greater than their sum. A well-designed structure of project hierarchy comprised of a Steering Board (SB), with the participation of all the project coordinators, a Technology Board (TB), with the participation of all the project technical managers, and dedicated Working Groups (WGs), allowed for the constructive cooperation of European experts on specific topics and provided strategic guidance on both technical and non-technical topics.[3]

Under the SB and TB guidance, the 5G PPP projects commonly addressed challenges and opportunities regarding novel technologies and approaches and designed and benchmarked elaborate trial facilities and experiments, resulting in communal insights. The impact of these collaborative activities can be witnessed by the more than 50 white papers authored jointly by 5G PPP projects. When the long-term research interests of multiple projects are aligned, a specific WG has been established to provide a dedicated space for the project experts to collaborate with a specific scope. While WGs were established in 5G PPP when the need arose and were closed again when their mission had been completed, there were three WGs active until the end of the collaborative activities in 5G PPP. These have been:

- **Architecture WG** (2015 - 2023): collaboration of 5G PPP projects to attain the European view on the overall architecture and the network domains of 5G networks. The WG has provided a consolidated view of the technical directions and concepts for the architecture design for 5G and beyond networks
- **Test, Measurement, and KPIs Validation (TMV) WG** (2019 - 2023): The TMV WG was established as part of the 5G PPP effort to promote commonalities across projects that have a strong interest in Testing & Monitoring (T&M) methodologies needed to provide support to the vertical use cases in 5G Trial Networks, including the development of test and measurement methods, test cases, procedures as well as the KPI formalisation and validation
- **Software Networks WG** (2018 - 2023): This WG focused on the deployment and use of SDN and NFV with high priority on cloud-native transformation. It also addressed issues relative to network exposure and Network Applications

Upon establishing the SNS JU in 2022 and launching its first 35 projects in January 2023, the successful cooperative model of the 5G PPP was selected as highly suitable for the SNS as well, and a transition period went into effect. The collaborative aspects among projects were further strengthened in SNS via the explicit mentioning of the operational rules and participation aspects of the common project bodies (SB, TB and WGs) in the SNS Collaboration Agreement.

In the first meeting of the SNS JU Steering Board in September 2023 in Athens, Greece, the 35 project coordinators of SNS Phase 1 projects agreed to migrate the three WGs from 5G PPP into SNS, as their mandate and scope of work were still very relevant. To assist in this transition, it was agreed that the same chairpersons would continue in their role until the WGs were fully operational and new elections held. As an exception to this, the Software Networks WG chairperson decided to step down due to a refocus of his work within his organisation, but a new chairperson was identified with the assistance of SNS OPS.

By the end of 2023, all 5G PPP collaborative bodies (SB, TB and WGs) had ceased their operations, while the respective SNS bodies had initiated their operations. The planned transition period during Q3-Q4 of 2023, during which both the 5G PPP and the SNS bodies were active, significantly contributed to the smooth transition, ensuring the graceful conclusion of the 5G PPP bodies, without any loss of information or unfinished tasks, while offering a "rolling-start" to the respective SNS bodies.

At the time of drafting this report (March 2024), all three WGs have been operating at full speed, while the SNS Steering Board agreed to consider creating an additional WG focused on hardware and devices, as multiple SNS Phase 1 projects address this topic, under the name ***Hardware Technologies WG***. This WG's mission statement, scope and Terms of Reference (ToR) are currently under development, and it is estimated that this WG could commence its operations in Q2 2024. Figure 33 depicts the timeline of the transition of the WGs from the 5G PPP to SNS JU.

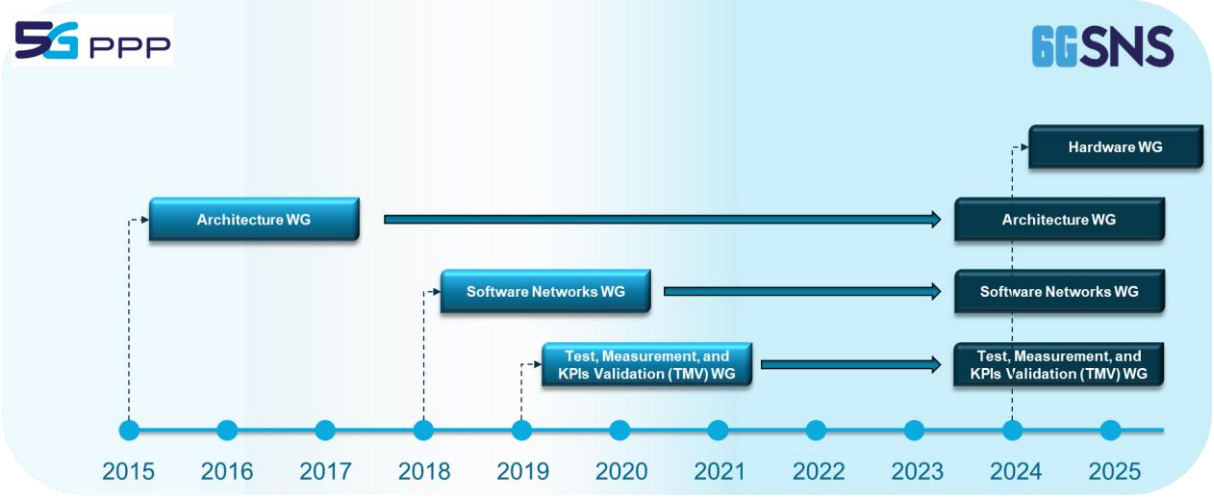

Figure 33: Timeline of WG transition from 5G PPP to SNS JU

5.3 Working Group reports

5.3.1 6G IA WGs

The Board of 6G IA has the power to establish and close Working Groups. 6G IA WGs are open to the Members of the Association and potentially to members of some running SNS JU Projects by invitation. As explained in Section 5.1, 5G IA WGs have been able to migrate directly to 6G IA during the reporting period. As a matter of pragmatism, this deliverable documents the highlights of the 5G/6G IA WGs during the whole reporting period, regardless of when they transitioned from 5G IA to 6G IA.

The IA WGs active during the reporting period were:

- 5G for Connected and Automated Mobility (5G for CAM)

- Open Smart Networks and Services
- Pre-standardization
- Security
- Spectrum
- Trials
- Vision & Societal Challenges
- Women in Telecommunications and Research (WiTaR)
    - This is a new WG established under the 6G IA, with no equivalent running previously under the 5G IA

In addition to the above, the Verticals Engagement Task Force has also been supported by SNS OPS in a manner similar to the WGs, although strictly speaking, it is not one.

5.3.1.1 5G for Connected and Automated Mobility WG

Chairs: Jesús Alonso Zarate (i2Cat), Markus Dillinger (Huawei)

Introduction

This Working Group focuses on 5G and beyond for Connected and Automated Mobility (CAM). It aims to become a meeting point and knowledge base for all activities related to CAM from a connectivity perspective, with a particular focus on 5G and beyond technologies. Among others, its participants represent those partners active in R&I projects funded by the European Commission with a particular focus or interest in CAM use cases and deployment. This WG constitutes a fundamental element between the 6G IA and the CCAM community.

Objectives:

- Objective 1: Become a knowledge base for the SNS JU community interested in CAM. Create a meeting point and a forum for discussion among all relevant EU CAM stakeholders from varied backgrounds (telecoms, automotive, application developers, etc.)
- Objective 2: Represent the 6G IA in the CAM domain and build bridges with related stakeholders and initiatives. Facilitate the communication between the SNS JU community and relevant stakeholders in the CAM community
- Objective 3: Contribute to the definition of Strategic Research Innovation Agendas and Work Programmes to ensure proper inclusion of 5G and beyond for CAM

Key Activities and Achievements

As 2023 was a transition period from 5G PPP to the SNS JU programmes, older 5G PPP-based projects were wrapping up their activities. Meanwhile, new CAM SNS JU projects were just commencing. The B5G/6G for CAM WG focused on introducing the new projects to the community and highlighting the lessons learned from the 5G PPP era while securing a smooth transition. More specifically, the WG:

- Met on a regular basis (bi-weekly) to discuss the results and lessons learned from outgoing 5G PPP projects
- Hosted bi-weekly presentations to introduce the new SNS JU projects working on CAM, present their scope, goals and targeted outcomes and provide links among the relevant stakeholders
- Collected and contributed relevant information about the CAM community by responding to relevant questionnaires, participating in information meetings and workshops and contributing to relevant white papers (e.g., the 5G PPP in Review paper)
- Regularly disseminates and promotes some of its key findings in the form of White papers or Dissemination brochures

- Contributes to building bridges with the CAM community and its related stakeholders: SNS JU, CCAM Association, 5GAA, etc.

The scope of the B5G/6G for CAM WG slightly changed within 2023 as all activities relevant to the update of the EU CAM Strategic Deployment Agenda (SDA) were undertaken by another collaborative body of the European Commission (EC). Hence, the 6G IA WG focused exclusively on Research & Innovation (R&I) aspects within the SNS JU and 6G IA communities. As mentioned, a twofold approach was followed in 2023, where the key achievements of 5G PPP CAM projects were highlighted to the community and the new SNS JU CAM projects were onboarded and presented. This approach led to the following key achievements:

- ***Support of final white paper from ICT-18-2018 projects***: 5G-MOBIX, 5G-CARMEN, and 5GCroCo projects pioneered the 5G-enabled cross-border corridor projects within 5G PPP and wrapped up their activities within 2023. After their successful conclusion, the B5G/6G for CAM WG facilitated the project partners to publish one last white paper entitled "*5G technologies for connected automated mobility in cross-border contexts*", summarising their key findings, main insights and suggested way forward. The white paper is publicly available via the 5G PPP website [4]
- ***Presentation of outcomes/results and key insights from still ongoing 5G PPP projects***: In a series of presentations hosted during the WG telcos (bi-weekly basis), the 5G PPP projects which were approaching their end, presented their key findings, trial results and relevant insights and discussed with the rest of the community their meaning, the lessons learned and the way forward. Several projects featured presentations: Vital-5G, 5GMETA, 5GMED, 5G-Blueprint, 5G Routes, 5G-IANA and 5G Rail
- ***Creation and publication of a white paper for the transition from R&I to Deployment*:** The B5G/6G for CAM WG organised and led the authorship and publication of a white paper focusing on the Trials and Pilots performed by the 5G PPP CAM projects, summarising their key findings and discussing the impact of such trials and pilots on the transition from R&I activities into actual deployments in the field and commercial solutions. The white paper, which was published in June 2023, is entitled "*FROM R&I TOWARDS ACTUAL DEPLOYMENT - UPDATE ON 5G TRIALS AND PILOTS FOR CONNECTED AND AUTOMATED MOBILITY: A perspective from the 5G-PPP and SNS JU Ecosystem*" and is available via the 5G PPP and SNS JU websites [5]
- ***Presentation of new SNS JU CAM projects***: During 2023, the first SNS JU projects addressing CAM use cases and aspects commenced their activities. The B5G/6G for CAM WG onboarded the representatives of these projects and organised respective presentations to introduce their goals, use cases and targeted outcomes to the community. Through this process, the respective CAM experts had the opportunity to liaise with the WG's stakeholders and receive feedback from the more experienced 5G PPP colleagues

Besides the above activities and achievements, the community of the B5G/6G for CAM WG also started working on a 2nd edition of the "*From 5G to 6G Vision: a CAM Perspective*" white paper within 2023 [6]. Relevant section editors have been appointed, and the process of collecting relevant topics to be included has been initiated. The WG is targeting June 2024 as the release date for this updated version.

5.3.1.2 Open Smart Networks and Services WG

Chair: Aitor Garcia Viñas (Vodafone)

Introduction

This WG promotes and supports the evaluation, adoption, deployment, and evolution of open solutions for 5G and beyond 5G/6G networks. The WG aims to promote and support the evaluation, adoption, deployment, and evolution of open, disaggregated, intelligent and fully interoperable networks as a key technology for future mobile networks (5G and beyond). For this purpose, the WG is aiming to bridge the open initiatives in the industrial domain with the ongoing or planned R&D and standardisation work (3GPP, O-RAN Alliance…), bringing together subject matter experts from the

academy (university, research institutes, etc.) and industry (operators, vendors, SMEs, verticals, etc.), aiming to accelerate the development of an EU wide open ecosystem of technologies that will include hardware equipment and software-defined, virtualised, and automated solutions.

Different open network sub-domains will be considered as part of this Working Group, including Radio Access Networks (RAN), transport, non-terrestrial networks (NTN), platforms, core and services where different members will have the capability to debate and interact on the specific topics that those domains may have.

Key Activities and Achievements

The WG has been structured in different open network sub-domains, including Radio Access Networks (RAN), transport, non-terrestrial networks (NTN), platforms, core and services. The different members debate and interact on the specific topics that those domains may have. Current members are present in the figure below. The transport subgroup has been developed recently, while the core and services are currently underused.

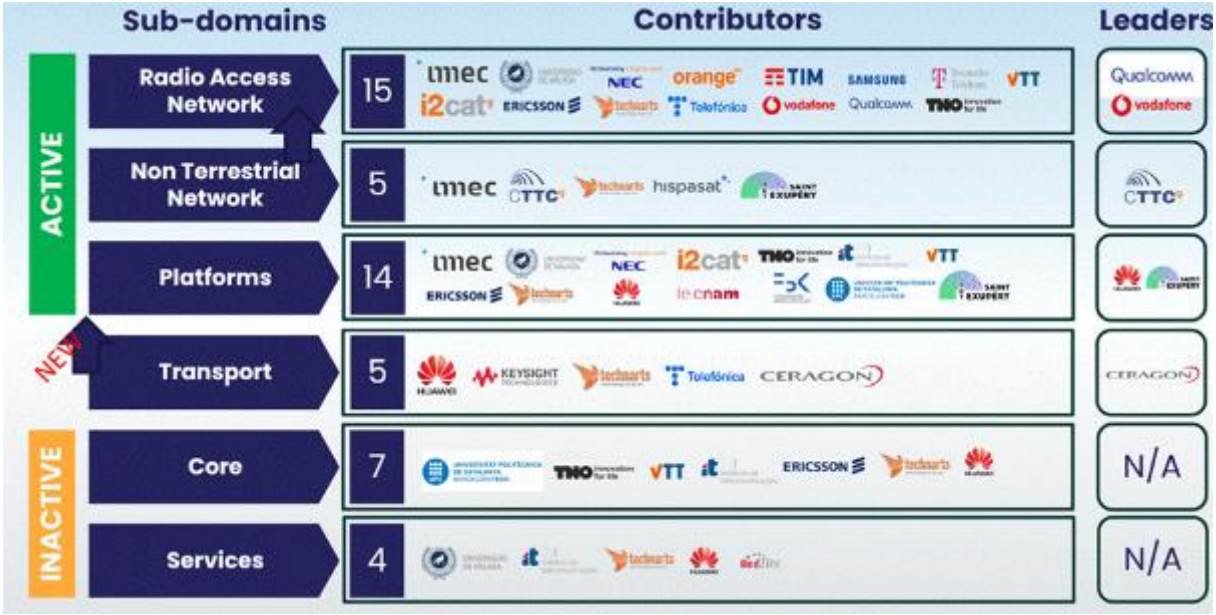

Figure 34: Open Smart Networks and Services WG structure

The WG has already developed several initiatives.

- Developed several white papers that have already been approved at the 6G IA level on RAN and other platforms
- Plan to contribute to funding content definition for the SNS
- Contributed to the EU/US TTC position paper on technology, with an O-SNS section
- Developed webinars and contributed to workshops for dissemination of the work performed.
- Performed several initiatives to align the interests and views of the WG members
- Analysed the relation between different domains and open-source solutions, as summarised in:

Table 2: Open Smart Networks and Services WG initiatives

Network Domain	Open Network Initiatives	Prominent Examples
Radio Access Network (RAN)	Open RAN	3GPP, TIP OpenRAN, O-RAN, Open RAN Policy Coalition
Transport	Open Transport	ONF ODTN, TIP OOPT
Platforms	Open Platforms on resource orchestration, SDN controller and infrastructure management	ONA, OSM, CORD, OpenShift, OpenBaton, ONOS, ODL, RYU, OpenStack, Kubernetes, ONAP

Network Domain	Open Network Initiatives	Prominent Examples
Core	Open Core	3GPP, OpenAirInterface OSA
Services/use cases	Open API	3GPP, OpenAPI, Sylva, Open Gateway, CAMARA

5.3.1.3 Pre-Standardization WG

Chairs: Riccardo Trivisonno (Huawei), Claudio de Majo (Trust-IT Services)

Introduction

The main objectives of the Pre-Standardization Working Group within the 6G IA framework focus on aligning with key standardisation and regulatory bodies, such as ETSI, 3GPP, IEEE, ITU-R, and WRC. The WG aims to identify these entities to ensure coherence and alignment in the standardisation process, particularly for the emerging 6G technology. To this end, the group is tasked with developing a comprehensive roadmap that addresses relevant standardisation and regulatory topics specific to 6G. This involves evaluating existing international roadmaps and proposing a new, aligned roadmap tailored to the 6G framework.

Additionally, the Pre-Standardization WG plays a crucial role in influencing the pre-standardisation landscape of 6G, as well as related research and development efforts. This includes proposing topics for standardisation and impacting the timing of research and development work programmes, such as those under the European Commission's Work Programmes (EC WPs). Through this strategic approach, the WG aims to ensure that European stakeholders maintain a leading position in the global standardisation process, which is vital given the fast-paced evolution of 6G technology.

Key Activities and Achievements

Throughout 2023, the Pre-Standardization WG contributed to several SDOs with different accomplishments and contributions to 5G standardisation.

Mission Critical Services (MCS) for PPDR Practitioners

- **Targeted SDOs:** 3GPP, specifically Working Groups SA1 (service requirements), SA6 (system architecture for MCS), SA3 (security), and CT1 (protocols)
- **Description:** Focusing on standardisation and enhancement of MCS, which includes Mission Critical Push To Talk (MCPTT), Mission Critical Data (MCData), and Mission Critical Video (MCVideo). This involves developing architectures, protocols, and security measures suitable for 5G systems to support public protection and disaster relief operations

NetApps for PPDR Practitioners

- **Targeted SDOs**: 3GPP, ETSI
- **Description:** Developing network applications (NetApps) tailored for PPDR practitioners. This includes integrating MCS standards and ensuring interoperability and support within 5G networks and beyond

5G applications for PPDR

- **Targeted SDOs**: 3GPP, ETSI, ITU
- **Description**: Focused on showcasing the capabilities and integration of 5G technologies in emergency scenarios, including the use of enhanced MCPTT and QCI for floor control signalling. This also involves conducting studies and developing architectures for mission-critical services support over 5G systems

6G Vision and Standardization

- **Targeted SDO**: 6G IA (6G Infrastructure Association)
- **Description**: Establishing a roadmap for beyond 5G technologies, incorporating inputs from various stakeholders, including those from the 5G-EPICENTRE, to shape the future standardisation and development of 6G

MCX ETSI Plug-test Events

- **Targeted SDO**: ETSI
- **Description**: Participating in and learning from MCX (Mission Critical Services over LTE) plug-test events organised by ETSI to enhance the interoperability and functionality of mission-critical services

Spectrum Engineering and Compatibility Issues

- **Targeted SDOs**: ETSI, specifically the ETSI SES (Satellite Earth Station and Systems)
- **Description**: Addressing spectrum engineering and space service compatibility, particularly focusing on the clarification of relations between ECC and SES as part of the 5G-Routes initiatives

Evolving Edge Applications Using Private 5G

- **Targeted SDOs**: ITU
- **Description**: Focused on evolving edge applications for vertical industries using private 5G networks, contributing to the ITU-T recommendations on autonomous networks and use cases for 5G systems

Contribution to 6G Vision and Roadmap

Inputs from various stakeholders, including those involved in the 5G-EPICENTRE, have been instrumental in shaping the early vision and standardisation efforts for 6G, highlighting the necessity for a unified approach to future telecommunications infrastructure.

Clarification and Resolution of Spectrum Issues

Contributions to discussions and standards regarding spectrum engineering, particularly in the context of 5G routes and the compatibility between different services, have led to clearer guidelines and an improved understanding of spectrum utilisation.

As for its main impacts, they can be summarised in the following categories:

Standardisation and Enhancement of Mission Critical Services (MCS): progress has been made in defining and enhancing MCS, particularly in areas such as Mission Critical Push-to-Talk (MCPTT), Mission Critical Data (MCData), and Mission Critical Video (MCVideo). This includes the development of service requirements, system architectures, security measures, and protocols within 3GPP. These efforts have contributed to establishing a more robust and interoperable framework for MCS, particularly tailored for public protection and disaster relief (PPDR) practitioners, ensuring that critical communication needs are met in emergencies.

1. **Advancements in 5G and Preparations for 6G:** contributions to the evolving landscape of 5G, including developing and testing network applications (NetApps) for PPDR, have been acknowledged. Additionally, inputs from various initiatives have been instrumental in shaping the vision and roadmap for 6G technologies, indicating a proactive approach toward the next generation of wireless communication systems
2. **Interoperability Testing and Plug-tests:** participation in ETSI plug-test events has led to improvements in interoperability and compliance with MCS standards. These activities have helped identify and resolve interoperability issues, enhancing the reliability and functionality of mission-critical services over LTE and 5G networks
3. **Spectrum Engineering and Compatibility:** efforts addressing spectrum engineering and compatibility issues, particularly in satellite earth station systems and 5G networks, have resulted in clearer regulations and guidelines. This includes clarifying relationships between different regulatory bodies and resolving compatibility issues, which is crucial for effectively allocating and utilising spectrum resources
4. **Edge Computing and Private 5G Networks:** contributions to the evolution of edge applications and the utilisation of private 5G networks have been recognised. This includes input into ITU-T recommendations, highlighting the importance of autonomous networks and the role of edge computing in enhancing the capabilities and efficiency of 5G systems for various vertical industries

5.3.1.4 Security WG

Chairs: Pascal Bisson (Thales), Antonio Skarmeta (University of Murcia)

Introduction

This Working Group aims to foster the development of a 6G Security Community made of security experts and practitioners who proactively discuss and share information to collectively progress and align on the field.

Activities include:

1. Organising specific communications and events (e.g. White papers, Workshops)

2. Interacting with other 5G PPP and 6G IA WGs whenever Security input is needed

3. Developing liaisons with other interested/interesting Security communities (e.g. ETPs, other PPPs such as Cyber Security/ECSO)

The overarching objectives are threefold:

- Work in a coordinated manner on 6G Security with a clear focus on areas of shared interest (e.g. 6G Security architecture, 6G threats and the solutions to get them tackled, 6G security automation), fostering new concepts and paradigms (e.g. Software-defined Security, Security as a service) while taking advantage of recent advances in all relevant disciplines (e.g. AI)
- Exchange ideas on the design of the security solutions (also relevant Standards and/or SDOs that apply) with the aim of getting them agreed upon and made interoperable
- Work on validation and/or adoption of the security solutions (in terms of usage to date and or to come)

The aim of the WG is thus to bring together the projects within the 6G IA that have a common interest in the development and progression of topics related to 6G security. The group will ensure, to as great an extent as possible, that the projects are working in a complimentary manner towards consistent goals, exchanging ideas, minimising the duplication of effort, contributing towards relevant standards and, where possible, cooperating on the development of compatible components, demonstrators, the exchange of expertise, experience, and results.

Key Activities and Achievements

The Security WG contributed to two international events during 2023:

- 2nd International Workshop on Edge Network Softwarisation ENS 2023[16]
- Symposium on Vision and Facts on 6G and Future Networks in Europe, with the IEEE Future Networks World Forum. The WG co-organised & co-chaired this event[17]

Following the transition from 5G IA/5G PPP to 6G IA/SNS JU, the WG spent some time developing a new work plan. The major points for 2024 are:

- Collaborate with the WG related to security aspects like WG Reliable Software Networks
- Identify the new projects in the SNS calls related to security aspects and create and promote a workshop in the context of a conference
- Collect and produce a report on the main challenges and trends identified by these projects in a white paper
- Identify projects outside of JU SNS which are relevant and worth liaising with
- Meeting with ECSO to resume collaboration
    - Contribute to updating the priority linked to the future communication infrastructure

[16] See https://sites.google.com/view/ens2023.
[17] Learn more at https://fnwf2023.ieee.org/program/symposiums/symposium-vision-and-facts-6g-and-future-networks-europe.

of the ECSO vision document

- A joint paper will be discussed to identify research challenges and link them to the operational and policy aspects

- Meeting with ENISA to define possible synergies
  - Possible focus document from ENISA in 6G security within 2024
  - Link with ENISA team about Certification to come for 5G, 6G

With targeted outputs of a brochure on security-related projects in 6G IA and a white paper on 6G Security Trends and Challenges.

5.3.1.5 Spectrum WG

Chair: Giovanna d'Aria (Telecom Italia)

Introduction

The Spectrum Working Group was originally set up under the 5G IA/5G PPP with the following objectives:

- Promote research results in the spectrum area obtained by 5G PPP/Horizon Europe projects as well as relevant FP7 projects
- Setting up a dialogue between 5G PPP projects concerning potential synergies and common interests across projects in spectrum-related issues
- Pursue the convergence of results on spectrum topics from the different projects to maximise the achievable outcome towards relevant technical bodies
- Establish a knowledge base from European and other Global project results concerning advances in spectrum research
- Liaise with spectrum groups or entities in regulatory bodies and industry associations
- Work for improved understanding of collaborative spectrum research importance

Key Activities and Achievements

The Working Group meetings have been suspended since July 2019, and the previously planned activities finished with WRC-19. The WG has reported no activities for this deliverable during the reporting period.

Due to the importance of this topic, the WG is kept dormant rather than being closed, and the 6G IA monitors whether there is a suitable time/need to reactivate it.

5.3.1.6 Trials WG

Chair: Carles Anton Haro (CTTC)

Streams Leaders

- 5G Private Trials/Observatory, led by Didier Bourse (Nokia) and Carole Manero (IDATE)
- 5G and Towards 6G Verticals, led by Valerio Frascolla (Intel)
- 5G Trials Cities, led by Jyrki Huusko (VTT)
- 5G International Cooperation, led by Mir Ghoraishi (Gigasys Solutions)
- The Smart Connectivity Digital Innovation Hub Network - SCoDIHNet, led by Pierre-Yves Danet (6G IA)

Introduction

The 5G Infrastructure Association launched the Trials Working Group in September 2016 after the publication of the 5G Manifesto of the industry in Europe and in the context of the 5G Action Plan of the EU Commission. According to the 5G Manifesto, the European industry was expected to develop a European trial roadmap for technology trials and Pan-European trials with vertical sector use cases.

Consequently, the 5G Infrastructure Association (now the 6G Infrastructure Association) decided to launch this WG to provide a neutral place for such discussions to take place. Due to the broad nature of the objectives of this WG, its activities are organised in several Streams. Streams are created and removed according to the activities that the overall WG requires, but they are quite stable (usually six or more months of operations). Each Stream is chaired by a Champion who steers and coordinates its activities, convenes telcos and meetings, produces the contributions of his/her Stream to the yearly work plan and periodic activity reports, and acts as the editor of the documents produced. The Trials WG organises regular plenary online meetings on a quarterly basis. The Trials WG also organises face-to-face meetings when needed. The Streams also organise meetings as required. The Trials WG Leadership Team is meeting online on a monthly basis.

Through its concerted efforts, the Trials WG plays a pivotal role in accelerating the development and adoption of cutting-edge technologies in the 6G landscape.

The overall objectives of the Trials WG are as follows:

- To develop a 5G, 5G Advanced and 6G European Trial Roadmap and leverage the knowledge gained for upcoming trial roadmaps for beyond 5G/6G systems to be addressed in the context of the Smart Networks and Services (SNS) partnership in Horizon Europe
- To facilitate the involvement of verticals in the Trials roadmap
- To discuss and define business principles underpinning the economic viability of trials
- To consider and coordinate the activity on trials and verticals with other relevant initiatives at the international level
- To investigate and propose how to link trials to upcoming calls for project proposals to be addressed in SNS
- To increase the visibility of the trials and pilots carried out by 5G Infrastructure PPP projects, with emphasis on 5G PPP/Phase 3 projects
- To keep track and disseminate to the broadest possible audience the work on verticals done by EU-funded projects
- To support the development of European strategic research and innovation agenda and liaise preparation of SNS Work Programmes in relation to trials and experimentations
- To facilitate the transfer of the developed and experimented solutions to the market using the Digital Innovation Hub (Digital Europe Programme, DEP)

Key Activities and Achievements

The main activities in the different WG Streams are listed below:

5G Private Trials/Observatory Stream

By leveraging insights gathered from the trials and engaging in knowledge-sharing activities, such as workshops, webinars, and key case studies (with the selection of four sets of Top 10 key T&Ps in the different brochures), the Stream aims to enhance the understanding of 5G technology's capabilities and potential applications in private settings. Through its efforts, the Stream seeks to accelerate the adoption of 5G technology in private sectors, drive innovation, and promote the development of use cases tailored to the specific needs of private enterprises and industries.

- Update/grade the clever/valuable interface between the 5G Private Trials Stream and the EU 5G Observatory and define the actions that could be developed in the Stream to complement the contractual actions developed in the 5G Observatory (e.g., potential contribution to the definition of the deployment new KPIs, bearing in mind current KPIs deficiencies to monitor network development, QoS, user experience)
- Synchronise with 5G Observatory colleagues on the forecasted/contractual development of the 5G Observatory
- Provide feedback and potential up-dates/grades and/or recommendations towards 5G Observatory colleagues on e.g., 5G and 6G Verticals Trials & Pilots and forthcoming 5G/6G

Verticals deployment, private Trials & Pilots, PPP Trials & Pilots Brochure n°4 not yet captured in the observatory (XML file/Observatory webpage) and/or 5G Observatory Quarterly Reports

- Monitor/contribute to/participate in activities or annual events organised by the 5G Observatory

5G and towards 6G Verticals Stream

The 5G and Towards 6G Verticals Stream plays a pivotal role within the Trials WG, focusing on exploring and advancing the integration of 5G and future 6G technologies across various vertical industries. Recognising the transformative potential of 5G and its evolution towards 6G, this Stream collaborates closely with vertical sectors such as healthcare, automotive, manufacturing, and smart cities to identify use cases, requirements, and challenges unique to each industry.

- Strengthen synergies with the other Streams of this WG, with forthcoming WGs of 6G IA/SNS and other relevant activities, e.g., the Vertical TF, to avoid overlaps and maximise joint impact
- Establish periodic alignments and devise common plans with WGs/Associations outside of 6G IA, e.g., NetworldEurope, AIOTI, BDVA/DAIRO, Trans-Continuum Initiatives, etc., dealing with vertical domains-related topics
- Contribute to all dissemination activities (white paper, workshops, special sessions, panels, brochures, etc.) to international venues to increase the visibility of the work of the Stream
- Liaise with the SNS CSAs and their activities concerning 5G/6G verticals

5G Trials Cities Stream

The 5G Trials Cities Stream is a pivotal component of the Trials WG, focused on advancing the deployment and testing of 5G technologies within urban environments.

- Strengthen the liaison between 5G Trials WG/6G IA and Smart City initiatives in Europe (e.g., EUROCITIES)
- Align and synchronise with the “5G and towards 6G verticals” Stream, especially on Smart City verticals
- Increase the awareness and visibility of Smart City trials in Europe and provide an information exchange channel for Smart City-related application use-case requirements and 6G IA/5G PPP

5G International Cooperation Stream

The 5G International Cooperation Stream serves as a vital platform within the Trials WG, dedicated to fostering collaboration and knowledge exchange on 5G technologies at an international level.

- Align with 6G IA on the potential role of the International Cooperation Stream
- Check with relevant international bodies, e.g., Beyond 5G Promotion Consortium (Japan), IMT2030 (China), 5G Forum (Korea), 5G Americas (USA) and TSDSI (India), on interest for collaborative activities
- Identify the interests of European players in the International Stream and their willingness to be active in it
- Encourage the engagement of SNS Stream C and D projects in the International Stream activities
- Organise dissemination activities to exchange views, success stories, best practices in the execution of T&P, and benefits/values of test-focused international collaboration with the participation of stakeholders/bodies from other regions in the world
- Liaise with the SNS-ICE CSA and their activities concerning international Trials & Pilots

SCoDIHNet Stream

The Smart Connectivity Digital Innovation Hub Stream's objective is to support the Digital Innovation Hubs (DIH) that have expertise in the Smart Connectivity domain (5G/5G, IoT, Security). The DIHs aim to facilitate the digitalisation of the European Industry, and they are supported by the Digital

Europe Programme (DEP) and the Member States (/Regions). Specifically, the goals of this Stream are as follows:

- Facilitate the transfer of SNS use cases/solutions from Trials and Pilots to the market via the DIHs
- Liaise the WG with the Digital Europe Programme
- Feed the SNS SRIA with end-user requirements coming from DIHs
- Synchronise with the Digital Transformation Accelerator
- Cooperate with the 5G4Smart Community projects to share access to the 5G infrastructures with DIHs
- Facilitate collaborations with other DIH Thematic networks
- Foster cooperation among DIHs
- Cooperate with Enterprise Europe Network and Europe Startup Nation Alliance regarding the activities of the Trials WG
- Support DIHs in their day-to-day operational work

Some of the key achievements of the Trials WG in 2023 are listed below (not an exhaustive list):

- Elaboration of the PPP Trials and Pilots (T&Ps) Brochure n°4: The PPP T&Ps Brochure n°4 has been converged and released on 29.11.23.[18] The Brochure n°4 leveraged the experience from the previous Brochures.[19] (including the call for inputs, selection by a panel of experts, and convergence of the project 2-page Flyers with project champions)
- In parallel, actions related to the development of the PPP T&Ps Summary Brochure will include all PPP T&Ps UCs, Verticals, Locations, and Dates for the complete PPP Programme. The Summary Brochure, taking into account the four sets of the key 5G PPP Trials & Pilots, is targeted to be released in Q1 2024
- Further interactions with the 5G Observatory team. 5G private trials are no longer collected by the 5G Observatory. However, the team tracks private 5G networks all over Europe. The 5G Observatory team will be highly interested in the WG helping to track 6G trials. Interactions with the 5G Observatory Team and inclusion of PPP/Trials WG Chair (Carles Anton) presentation during the Annual Observatory Workshop organised online on 26.10.23 to foster a sense of cohesion and dynamism among key stakeholders, facilitating the exchange of insights, expertise, and best practices. By actively participating in such collaborative initiatives, the Trials WG plays a vital role in nurturing ongoing dialogue and cooperation, ultimately driving progress and innovation in the field of telecommunications
- Launch of the Collabwith and DIHW are platforms to support the services to the DIHs: Marketplace, catalogues, news, and best practices
- Elaboration of a map of DIH ecosystem stakeholders to facilitate cooperation at the local/regional level
- Inclusion in the replicability catalogue of the use cases/solutions from 5G PPP and Call 1 SNS projects

5.3.1.7 Vision and Societal Challenges WG

Chair: Artur Hecker (Huawei)

Vice-Chair: Håkon Lønsethagen (Telenor)

SNSV SG Co-chairs: Artur Hecker (Huawei), Carlos J. Bernardos (Univ. Carlos III, Spain)

BVME SG Chair: Hanne-Stine Hallingby (Telenor)

[18]For further info see https://5g-ppp.eu/the-5g-ppp-infrastructure-trials-and-pilots-brochure-4-is-out/.
[19] Previous brochures are available for download here: https://5g-ppp.eu/flayer-brochure/.

SNVC SG Chair: Gustav Wikström (Ericsson)

MSI SG Chair: Carles Antón-Haro (CTTC)

Introduction

The 6G IA Vision and Societal Challenges (VSC) WG (formerly the 5G IA VSC WG) develops a comprehensive scientific, technological and socio-economic vision, first for the 5G PPP and now for the SNS JU in general and for the upcoming next-generation mobile system in particular.[20]

The VSC WG maintains a high-level technology roadmap, formulating a holistic view of the future networks, systems, and their typical environments. It engages the expert communities within the 6G IA, in the running 5G PPP and the SNS JU research projects, but also from partner organisations like NetworldEurope, NESSI and AIOTI. In other words, in addition to the development of technology, a particular accent of the work in the VSC WG lies in the socio-economic interactions between the actual technological system and its ecosystem. The main objectives of the WG are:

1. Develop a vision for Smart Networks and Services beyond 2030, covering both advanced research and societal challenges. This includes harmonisation of visions stemming from different sources and representing different points of view
2. Facilitate the creation and follow-up of pre-/portfolio-structuring models for the SNS JU Partnership calls, considering the experience developed in the 5G PPP, and analyse the mapping of 5G PPP and SNS JU partnership calls projects portfolios with the proposed models
3. Stimulate the liaison with member state initiatives on 5G, 6G and Smart Networks and Services.
4. Enable visions and validations of current and, as far as possible, future technology (5G, 6G, etc.) value propositions, business models and ecosystems
5. Stimulate discussion on value-driven research and value-related considerations for 6G, and channel a needs and value-based European view on 6G technologies for the 2030 time frame, considering global challenges

Key Activities and Achievements

While the WG identify relevant open research topics paving the way to the realisation of the formulated vision and service concepts, we also formulate key performance indicators (KPIs) for the functional and, whenever possible, extra-functional properties. It studies suitable economic models for all realisations and services, validates the latter as the technology matures over time and attempts to understand the value of the proposed system to society as a whole. With this, the WG analyses societal acceptance on the one hand and develops key value indicators (KVIs), i.e. estimation of the value of the technology for specific sectors (verticals) and the society, on the other.

Through its work, VSC WG directly contributes to the 5G PPP and SNS JU work programmes for the different phases. To be aware of and to be able to handle potential overlaps with national research initiatives within the EU member states, we involve a network of rapporteurs and produce a yearly report on the relevant research activities in each member state (research, validation, platforms, trials).

The Vision WG main activities are organised into sub-groups. There are 4 Sub-groups, namely:

- **The Smart Networks and Services Vision Sub-Group (SNSV SG)** develops the technological vision of the future mobile communication system. It analyses new technologies, approaches, and methods that are promising for 6G research at large. For this reason, SNSV often interacts with the expert community of the NetworldEurope ETP
- **The business Validation, Models, and Ecosystem Sub-Group (BVME SG)** is working on business validation, modelling and economic aspects of the existing and future technologies; it studies and analyses the impact of (new) technologies on the economic aspects within the current business ecosystem and vs., i.e. how economics can help technology, how changes in business would be beneficial, etc.

[20] See https://6g-ia.eu/6g-ia-working-groups/#vision.

- **The societal Needs and Value Creation Sub-Group (SNVC SG)** looks for how 6G will be beneficial for all other players on the market, including society at large. The SNVC SG analyses societal acceptance on the one hand and develops key value indicators (KVIs), i.e. estimation of the value of the technology for the society, on the other
- **Member State Initiatives in 5G/6G sub-group (MSI SG)** regularly verifies which important aspects of 6G research are covered and to what extent (and how) within the research programmes and initiatives of the Member States. It produces yearly member state reports

In the first part of 2023, the Portfolio Structuring and Analysis Sub-group (**PS&A SG**), led by Didier Bourse (NOKIA), was also active. The mandate was updated (focusing more specifically on the SNS JU Work Programme development and process facilitation) and moved to a specific Task Force (by a Core Team) directly under the 6G IA Governing Board. To embrace a large diversity of views, the VSC WG has worked in close alignment with other 5G PPP and 6G IA Working Groups and other organisations, most notably with the large expert community of NetworldEurope ETP, both through direct exchanges and through contributions to common white papers or the development and updates of an agreed Strategic Research and Innovation Agenda (SRIA).

The VSC WG has shed light on the complex interplay of technological, economic and societal developments through the results and outcomes of its various subgroups (SGs). The Smart Network and Services Vision (SNSV) SG handled a prior outcome worth highlighting, which helped develop and update a technology roadmap, culminating in the "European Vision for the 6G Network Ecosystem" white paper in June 2021.[7]

The following specific activities and achievements were conducted and obtained in 2023.

- The SNSV SG contributed to further dissemination and webinar for presenting the SRIA 2022, with a particular focus on system architecture. The SG initiated a white paper development activity on "Sustainable 6G" and initial preparations for updating the "European Vision for the 6G Network Ecosystem" white paper mentioned above
- The BVME SG has offered insights on business validation and ecosystems in the 5G domain, most notably through the finalisation of the white paper on "5G and Beyond 5G Ecosystem Business Modelling". Also, sustainability-oriented business modelling has been integrated to ensure sustainable growth of markets and ecosystems. This work allowed to contribute to the EuCNC workshop on Sustainability and delivered a presentation (pre-recorded) at the Mobile Korea Global 5G event: 5G Business Modelling and Monetisation
- The MSI SG has monitored and tracked relevant Member State initiatives, creating a list of contacts of the permanent representation offices of Member States in Brussels reporting on the most important 5G deployment-related activities in key European Member States and associated countries. The "2022 report" was developed and disseminated, which reports on "5G, beyond 5G and 6G Activities promoted by Member States". The SG engaged with the SNS JU community and attended a special session at EUCNC for the SNS JU SRG, acting as a facilitator. This SG work also resulted in a talk at an event on "National Initiatives: Discussion on different approaches to European collaboration for 6G research" at 5G Techritory
- The Societal Needs and Value Creation (SNVC) SG has focused on developing a concept of Key Value Indicators (KVIs), which is a method of gauging impact from technology use, on which the SG has published a white paper and arranged multiple workshops and seminars since the formation in late 2021. A key activity in 2023 has been the development and submission of an academic paper on KVI methodology. Furthermore, the SG organised a EuCNC workshop on KVIs and interacted with the Hexa-X-II project on the implementation of the KVI framework. The SG also edited a section on sustainability in the 6G IA - NGA position paper (EU-US Beyond 5G/6G Roadmap, capturing the views and priorities from Next G Alliance and the SNS JU)
- In addition, the PS&A SG has contributed to the definition of the project portfolios for the different PPP Phases while considering both European and Member State activities in the respective sectors and branches. The SG has developed and released a Heritage

Brochure/Figure summarising the interconnections between 5G PPP projects under three specific categories: (1) Projects follow-up, (2) Components use/re-use, and (3) ICT-19 Verticals Pilots/ICT-17 Platforms use

5.3.1.8 Women in Telecommunications and Research (WiTaR) WG

Chairs: Bahare Masood Khorsandi (Nokia), Marie-Helene Hamon (Orange)

Introduction

The "Women in Telecommunications and Research (WiTaR)" Working Group focuses on promoting gender equality, inclusion and empowerment in the 6G Research & Innovation (R&I) community. This WG was initiated as part of the European-funded flagship project Hexa-X in February 2021 and then was expanded for the participation of the whole 5G Infrastructure PPP community in June 2021.

The SNS WiTaR WG was launched in the autumn of 2023. The key purpose of this WG is to step forward into closing gender gaps and increasing women's participation in as many social fields as possible in the 6G R&I community. The road to gender equality is still a very long one, evidence that the participation of women in Hexa-X was only 20%. This captures the European industry and academia's need for a major change in relation to their policies that should be implemented to close the gender gap.

WiTaR seeks to break down barriers and inspire the next generation of women leaders in telecommunications and research by fostering a supportive and inclusive environment. Through its efforts, WiTaR aims to catalyse positive change and create a more equitable and diverse workforce in these vital sectors.

The five main objectives of the WiTaR WG are the following:

- Become the "reference" point in the SNS Programme and develop awareness across the overall SNS Members/Community to ensure a gender-balanced approach in European R&I activities
- Promote the visibility of women and their achievements and encourage them to engage in leadership positions
- Support role models for both soft and hard skills of junior researchers and students to contribute to 6G IA and SNS actions related to ICT Skills, ensuring that ICT missing Skills in the EU also systematically address missing ICT women skills
- Contribute to engaging more women in 6G research in various technical topics, particularly sustainability – Social work. This includes participation in panels, interviews, etc., as well as contributing to the definition of 6G use cases, ensuring the minimisation of bias and enriching the set of identified use cases
- Interact with SNS and 6G IA members, analyse potential gender-reported issues, and contribute to solving the issues

Key Activities and Achievements

The activities of the SNS WiTaR WG started in the autumn of 2023 (following previous PPP and SNS activities and achievements in the context of the PPP Hexa-X and SNS Hexa-X-II projects). The WG members meet on a monthly basis, discuss relevant open issues, address action points and agree on the way forward under the leadership of the appointed chair and vice-chairperson. Among the different activities:

- The WG collects and spreads relevant information through questionnaires, information meetings, workshops, and webinars
- The WG organises informal online meetings with in-house or invited speakers on relevant topics with the target of raising awareness and educating its members
- The WG also organises specific sessions, possibly with physical attendance, at events or conferences to share information, collect feedback, and stir discussion

- The WG disseminates and promotes some of its key findings in the form of Newsletters, social media posts and campaigns (LinkedIn) and online articles published on the 6G IA website

The key achievements of the WG since its launch in the autumn of 2023 are listed below:

- Establishment of a few sub-groups focused on various topics, e.g., digital presents, member expansion, identification of main community issues, events and workshops, etc.
- Development of the SNS WG and establishment of the WG digital presence, e.g., set up WiTaR web page, social media presence, etc. Few WG Members are responsible for regularly publishing updates based on the progress of the WG
- Expansion of the WG in terms of members. The main goal is to increase the number of members by 30% and expand to all projects and members in 6G IA and SNS JU
- Identification of the main issues of the community can be done by getting feedback directly or through tailored questionnaires. The target is to set up a workshop series (with invited speakers) on the highlighted topics
- Organisation of dissemination events and series of workshops with the goal of spreading awareness and education on particular topics

Before the official start of the SNS WiTaR WG, specific achievements can be highlighted for 2023, including (not exhaustive list):

- International Women's Day (IWD) campaign: On March 8th, 2023, WiTaR WG released its specific WiTaR postcard for International Women's Day, highlighting this is the best opportunity for the WiTaR WG to show their support toward the theme of IWD, embracing equity.[21] This is a tradition that the group put effort into during the first year of the establishment of WiTaR. A postcard accompanied by a special session on March 8th 2024, is being prepared. This postcard will be disseminated throughout all WiTaR social channels as well as 6G IA
- On 7th June 2023, WiTaR WG organised the 2nd Convened Session in EuCNC & 6G Summit 2023 in Goteborg.[22] This session was very successful and attended by 40+ participants

It has to be noted that WiTaR WG will organise the 3rd Convened Session during EuCNC & 6G Summit 2024 to be organised on 03-06.06.24 in Antwerp.

5.3.1.9 Verticals Engagement Task Force

Chair: Raffaele De Peppe (TIM)

Introduction

Although not formally a Working Group of the 6G IA the Verticals Engagement Task Force benefits from the same support and infrastructure as provided to the WGs, so is briefly reported below.

The Vertical Engagement Task Force has reported progress and updates in their recent achievements, particularly within the context of 2023 and plans for 2024.

Key Activities & Achievements:

The Task Force has actively participated in vertical events, attending eight in 2023 and planning for eleven in 2024. Notable events include key 6G IA events like EUCNC and 5G Techritory, with sessions covering all verticals. Specific vertical events attended include the Space (ESA Workshop), Transportation (ITS Congress), and Public Security (2 PSCE Conferences). For the upcoming year, three events have already been confirmed in the sectors of public safety, transportation, and manufacturing.

Partnerships Development:

[21] For more information see https://hexa-x.eu/witar/.
[22] For more information see www.eucnc.eu/2023/www.eucnc.eu/programme/special-sessions/convened-session-2/index.html.

In terms of partnerships, the Task Force has forged one new Memorandum of Understanding (MoU), reaching a total of eleven partnerships. Key sectors engaged through MoUs or Letters of Intent (LoIs) include Satellite (ESA), Public Safety (PSCE), Cybersecurity (ECSO), Media (NEM and 5GMAG), Automotive (5GAA), Manufacturing (5G ACIA), Transportation (ERTICO), and ICT (NGMN). Noteworthy is the association with AIOTI, ESA, the 6G Health Initiative, and PSCE, with PSCE being elected to the Board. The 6G Health Institute has become an Associate Member, with new partnerships like 5GMAG (EBU) and potential associations with Railway Associations (UIC, EIM) on the horizon. Two more MoUs are in the pipeline with the Railways Sector.

Research and Development Tools:

The task force is developing new vertical cartographies and maintaining the 5G PPP Verticals Cartography available on the 5G PPP website.[23] The SNS JU Vertical Engagement Tracker is now operational and is gradually incorporating data from various projects.[24]

Publications and Dissemination:

Eight white papers have been published, covering different vertical sectors to disseminate knowledge and findings. A brochure detailing Trials & Pilots is currently under development, with key dates set for the collection and evaluation of project inputs aimed at a release during MWC '24.

Analysis and Future Planning:

A Vertical Trends Analysis Paper has been finalised, focusing on monitoring and analysing vertical trends in collaboration with vertical partners, including desk analysis and assessment. This includes a compilation of key vertical use cases from both 5G PPP and SNS JU that are indicative of ongoing or future trends. The work plan for 2024 and beyond is currently being drafted, building on the foundations laid in 2023 and adapting to the evolving landscape of vertical integration and technology use cases.

5.3.2 SNS Project WGs

For background on the project WGs and the transition from 5G PPP to SNS JU, please see section 5.2.

The SNS project WGs created during the reporting period were:

- 6G Architecture
- Reliable Software Networks
- Test, Measurement and KPIs

These are the *de facto* successors of the 5G PPP project WGs, and in this section, we report on the activities carried out by both the 5G PPP and SNS JU project WGs together.

5.3.2.1 6G Architecture WG

Chair: Ömer Bulakci (Nokia)

Vice-Chair: Xi Li (NEC)

Introduction

The main objectives of the WG are to:

- Collect, analyse and consolidate information from relevant projects (SNS, other global projects and initiatives) on architecture research solutions and results (e.g. requirements for architecture in the 6G era and architecture solutions to meet those requirements)
- Liaise back the discussion findings to relevant SNS projects
- Facilitate consensus building on the 6G architecture, roadmap and migrations strategy
- Collaborate with other WGs on relevant subjects (e.g., Pre-Standardization WG to liaise with

[23] See https://verticals-cartography.5g-ppp.eu/.
[24] See https://verticals-tracker.sns-ju.eu/vertical-engagement-tracker.

relevant architecture standardisation bodies like 3GPP RAN, 3GPP SA2, ITU-R, ETSI, and industry associations like NGMN, whenever relevant and agreed by both WGs)

- Issue White papers and arrange events, e.g., workshops and webinars, to disseminate the findings to attain a global footprint

Key Activities and Achievements

- Continuing its two-year cycle, v6.0 of the White paper "6G Architecture Landscape – European Perspective" was released for public consultation in December 2022. Following analysis of the received comments, the White paper was revised, and the final version was released in February 2023
- The WG investigated different approaches to providing a higher level of detail of the concepts outlined in the White paper. Eventually, it was decided to join forces with the Hexa-X project to write a joint book, "Towards Sustainable and Trustworthy 6G: Challenges, Enablers, and Architectural Design"[25]
- A keynote presentation of the 6G white paper was given at the ICT Open Conference in April 2023.[26]
- The WG organised a special session at EuCNC'23 on "6G Architecture – European View"[27]
- The WG was also represented on the Achievements of the 5G PPP panel at the EuCNC'23 Convened Session on 5G PPP - The value generated for Europe[28]
- The WG has successfully proposed the next 6GArch International Workshop, which will be hosted at IEEE WCNC2024[29]

5.3.2.2 Reliable Software Network WG

Chair: Bessem Sayadi (NOKIA Bell-Labs France)

Vice-Chair: Marius Iordache (Orange)

Introduction

The purpose of this WG is to analyse and address the unification and applicability of key research topics related to Software Networking, including software-defined concepts, infrastructures, systems and components for Wire and- Wireless Networks, including Networked Clouds, IoT and Services, i.e. Software Defined Networks (SDN) and Network Function Virtualisation (NFV) as developed and promoted by the 5G PPP projects.

Having previously addressed Software Defined Networks (SDN) and Network Function Virtualisation (NFV) for 5G, then Cloud Native transformation of telecommunications networks, the main focus for 2022/2023 has been the platform approach, service exposure, open networks and Network Applications.

Key Activities and Achievements

- In addition to regular WG meetings where the project presents and discusses its activities and views, the WG has worked on V2 of the White paper and organised and participated in a number of technical workshops on specific topics, as presented below
- Published V2 of the White paper on Network Applications, "Network Applications: Opening up 5G and beyond networks" [8]. This paper focuses on the different technical aspects of Network Applications, new business models for all stakeholders, experimental facilities to support Network Applications, and new Network Intelligence (NI) solutions that can be

[25] Learn more at https://www.nowpublishers.com/article/BookDetails/9781638282389.
[26] Learn more at https://www.ictopen.nl/programme/beyond-6g-enabling-sovereign-and-sustainable-digital-society.
[27] Learn more at https://www.eucnc.eu/2023/www.eucnc.eu/programme/special-sessions/special-session-2/index.html.
[28] Learn more at https://www.eucnc.eu/2023/www.eucnc.eu/programme/special-sessions/convened-session-1/index.html.
[29] Learn more at https://wcnc2024.ieee-wcnc.org/.

enabled by using Network Applications. This white paper is the second published by the Software Network WG, and it goes into the details of the implementation of the two major network applications: "aaS" and hybrid models

- Organised a Special Session at EuCNC'23 on "Evolution of network exposure from 5G to 6G". The session, held on 7 of June 2023, was co-chaired by Bessem Sayadi (Nokia Bell-Labs, FR) and Vilho Räisänen (Nokia Bell Labs, FI). The special session introduced the business need for network exposure and shed light on technological solutions like the CAMARA project and the Network as a Code approach. The view from the standard perspective was also shared. The special session was designed to facilitate discussion and exchange of ideas and practices and successfully promote innovative solutions towards network exposure to support 6G requisites[30]
- The WG was also represented on the Achievements of the 5G PPP panel at the EuCNC'23 Convened Session on 5G PPP - The value generated for Europe[31]

5.3.2.3 Test, Measurement and KPIs Validation WG

Chair: Evangelos Kosmatos (WINGS ICT)

Vice Chair: Michael Dieudonne (Keysight Technologies)

Introduction

The purpose of the Test Measurement and KPIs Validation (TMV) Working Group is to bring together projects that have a common interest in topics related to the development of test, measurement and validation methods, test cases and procedures.

Test and Measurement (T&M) procedures, tools, and methodologies (testing, monitoring, and analytics) need to be agreed upon, and they should serve for the verification of the performance KPIs that 5G is promising to deliver, providing confidence to Mobile Operators and Verticals on the deployed 5G capabilities and services.

The objectives of the TMV group are:

- Demonstration of 5G KPIs (including 5G network E2E KPIs, 5G vertical service E2E KPIs)
- To be an enabler for trials/pilots (ICT-19)
- To achieve impact on standardisation addressing gaps with respect to the 5G PPP vision
- To leverage results from phases I and II in the scope of the WG
- To ensure the reproducibility properties of the experimentation
- To develop a common and agreed methodology for integration and deployment

The Group will identify specific areas in the relevant standards bodies (IETF, 3GPP, ETSI, etc.) that the projects should contribute to.

Key Activities and Achievements

- In addition to regular WG meetings where the project presents and discusses its activities and views, the TMV WG has been very active in planning a sequence of White papers based on discussions and workshops with 5G PPP/SNS JU projects, other WGs and external stakeholders, as outlined below
- The WG was represented on the Achievements of the 5G PPP panel at the EuCNC'23 Convened Session on 5G PPP, "The value generated for Europe"[32]

[30] Additional details are available at https://www.eucnc.eu/2023/www.eucnc.eu/programme/special-sessions/special-session-12/index.html
[31] See https://www.eucnc.eu/2023/www.eucnc.eu/programme/special-sessions/convened-session-1/index.html
[32] For more information see https://www.eucnc.eu/2023/www.eucnc.eu/programme/special-sessions/convened-session-1/index.html

- Published a white paper entitled "KPIs Measurement Tools – From KPI Definition to KPI Validation Enablement."[9] in May 2023. This white paper summarises the 5G Key Performance Indicators (KPIs) and the tools that have been identified and utilised in several ICT-17, ICT-19, and ICT-52 projects. In particular, the document lists the identified 5G KPIs with a brief and unified description, mapping them also to the measurement operations. Then, the tools recognised in the different projects are presented, including open-source, ad-hoc developed and proprietary tools. Each tool is presented, highlighting the main functionalities and the list of KPIs that can be measured. Finally, the data collection platforms and visualisation tools are reported, highlighting their features and the availability of plugins/APIs to connect other tools/frameworks
- Published a white paper entitled "Beyond 5G/6G KPI Measurements".[10] This white paper is the continuation of the 5G PPP TMV Working Group white paper entitled "Beyond 5G/6G KPIs and Target Values". The paper provided an early analysis of possible Beyond 5G/6G KPIs based on current work and perspectives from ICT-52 projects, seeking to understand the level to which existing definitions in standard documents will apply to 6G and to identify, at early stages, gaps and new candidate KPIs for being standardised for 6G systems. The intention of this white paper is to provide an analysis of the nature of the beyond 5G/6G KPIs identified in the previous white paper by further elaborating on the feasibility of these KPIs to be measured, on the methods and tools to be used for their evaluation, and on identifying challenges encountered, gaps identified and research steps to be followed on the measurement and evaluation methodologies to be used in the 6G era
- Contributed to a white paper entitled "5GPPP Trials Results 2022 – Key Performance Indicators Measured in Advanced 5G Trial Sites" with 5G IA.[11] The results presented in this white paper are based on the work carried out by 15 Phase 3 5G PPP R&I projects that engaged in 5G-enabled trials in 2022 and early 2023. These fifteen projects performed field measurements in 36 distinct 5G Trial Sites constructed across 14 European countries, during which a total of 50 vertical use cases were tested and validated via the implementation of about 80 distinct trial scenarios. A large variety of diversified 5G technologies, features and settings were used across the different projects, covering outdoor and indoor scenarios as well as stationary and mobile, different operational frequency bands and 5G system releases, architecture and configurations, as well as complementary technologies. The extensive set of parameters and configuration used during the 5G PPP Phase 3 trials proves the versatility of 5G networks and offers cumulative insights with regard to the expected 5G performance in diversified scenarios. The analysis validates the performance of 5G networks in the field (in terms of data rates and latency) while confirming the enhanced performance delivered by Stand Alone (SA) 5G networks and providing insights regarding the delivered field performance per vertical application
- Published a white paper entitled "Towards Sustainable and Trustworthy 6G – Challenges, Enables and Architectural Design".[12] This white paper is the continuation of the 5G PPP TMV Working Group white paper entitled "Beyond 5G/6G KPIs and Target Values" (2023). The latter provided an early analysis of possible Beyond 5G/6G KPIs based on current work and perspectives from ICT-52 projects, seeking to understand the level to which existing definitions in standard documents will apply to 6G and to identify, at early stages, gaps and new candidate KPIs for being standardised for 6G systems. The intention of this white paper is to provide an analysis of the nature of the beyond 5G/6G KPIs identified in the previous white paper by further elaborating on the feasibility of these KPIs to be measured, on the methods and tools to be used for their evaluation, and on identifying challenges encountered, gaps identified and research steps to be followed on the measurement and evaluation methodologies to be used in the 6G era. Capitalising on 5G PPP Phase 3 projects and the joint efforts between the Architecture WG and the flagship Hexa-X project, this book delves into the critical challenges and enablers of the 6G system, including new network architectures and novel enhancements as well as the role of regulators, network operators, industry players, application developers, and end-users. Accordingly, this book provides a comprehensive overview of the current research activities on 6G and sets a solid cornerstone towards a more connected, intelligent, and sustainable world

- Published a white paper along with the EMF Task Force entitled "Beyond 5G/6G EMF Considerations" in July 2023.[13] This white paper provides an overview of electromagnetic field (EMF) exposure topics related to wireless communications, particularly beyond 5G and 6G systems. The relevant standards and effects are summarised; additionally, ideas on what and how to measure EMF effects are put forward as the basis for further discussion and research. The available key performance indicators (KPIs) from the fifth generation Infrastructure Public Private Partnership (5G PPP) phase III projects with a focus on EMF are also consolidated with a view of how the KPIs are considered in the 5G system and how they may evolve in 6G systems[33]

5.3.3 NetworldEurope WGs

NetworldEurope is the European Technology Platform (ETP) for communication networks and services.[34] Enabling the interaction between users, communication networks and services fulfils society's requirements for interconnection. As such, NetworldEurope gathers almost 1,000 players across the whole sector value chain: industry leaders, innovative SMEs, and leading academic institutions.

In 2024, NetworldEurope will present its new Strategic Research and Innovation Agenda (SRIA) for communications networks and services, which will underpin the policy objectives and strategic guidelines for the sector. The vision and mission of NetworldEurope and the SRIA are aligned but also feed the Horizon Europe strategic orientations.

There are four Working Groups linked to the ETP, namely: the Expert Advisory Group, which advice NetworldEurope from a scientific perspective and advocates for the interests of the research community; the SatCom WG, which focuses on satellite communication systems; the SME WG represents the interests of SMEs in the sector; and, the Enabling Technologies for Future Vertical Ecosystem Transformation WG, which explores the potential cooperation with any kinds of stakeholders, from any research, technology or industrial sector, from any geographical region.

5.3.3.1 SME WG

Chair: Jessica Carneiro (AUSTRALO)

Vice-Chair: Nicola Ciulli (Nextworks)

The NetworldEurope SME WG is the voice of the NetworldEurope SME community. Its mandate is to help and support SMEs, improve their visibility, represent and ensure their interests, and monitor and analyse their participation in the sector.

Promoting the skills and expertise of the SMEs and supporting their involvement in collaborative projects with key industry players and leading research organisations are the core activities of the WG. Thus, the WG meets regularly, facilitates interactions, and shares information on relevant topics for the SMEs, opportunities, events, and participation in different forums. The SME WG works closely with 6G IA.

Detailed information about the SME WG activities can be found in section 4.2.2.

5.3.3.2 Expert Advisory Group

Chair: Ari Pouttu (University of Oulu)

Vice-Chair: Jyrki Huusko (VTT)

Introduction

The NetworldEurope Expert Advisory Group (EAG) is composed of about 250 experts in all the individual fields related to communication networks technology, mainly from academia and industry but also from SMEs.

[33] Additional details on the white papers can be found at https://5g-ppp.eu/white-papers/.
[34] NetworldEurope website: www.networldeurope.eu.

The main objectives and responsibilities of the Expert Advisory Group are:

- to consult and give advice to NetworldEurope from a scientific perspective and
- to advocate for the interests of the research community

Hence, this group mainly represents R&D centres and the academic domain.

Key Activities and Achievements

The most challenging and ambitious EAG activity every second year is the writing of the NetworldEurope Strategic Research and Innovation Agenda (SRIA).

From the Working Group's point of view, 2023 was a gap year in writing the SRIA2022, and the focus was mainly on internal planning, scheduling the work and arranging the SRIA2024 kick-off summit in early November. During the year, workshops were arranged to cover the presentation of SRIA2022. In addition, separate technology-oriented workshops were arranged to cover metaverse and optical network themes, and the Future Communications Summit was held to initialise discussion on future research challenges and themes.

On the 7th and 8th of November, 2023, NetworldEurope organised the 4th Future Communications Summit in Lisbon[43]. The summit was a launch event for writing the next revision of the Strategic Research and Innovation Agenda (SRIA), which is planned for 2024.

The EAG held the first SRIA2024 chapter editor meeting in conjunction with the Future Communications Summit. It was decided that the SRIA2024 writing process would follow the previous year's methods. The initial chapter editors for the technical annexe were also nominated, and it was decided that the editorial team would be supplemented at the beginning of 2024. It was agreed that each chapter editor should gather a team of contributors to the chapter topic to provide the content for the technical annexe.

During 2023, the Working Group arranged two SRIA2022 webinar sessions, the first on the 12th of January and the second on the 13th of January. The webinar focused on the SRIA technical annexe, and presentations were arranged to cover each chapter's technology themes. The chapter editors presented a condensed overview of the research themes, challenges, visions and foreseen key research topics.

During the first day, the presentations covered more system-level themes and challenges, including 1) System Services, Holger Karl; 2) System Architecture, Artur Hecker; 3) Network and Service Security, Emmanuel Dotaro; 4) Software Technologies, Josef Urban.

The second day focused on technology themes, including 1) Radio Technologies and Signal Processing; Wen Xu, 2) Non-Terrestrial Networks and Systems; Tomaso De Cola, 3) Optical Networks; Raul Muñoz, 4) Devices and Components; Andre Bourdoux, and 5) Future Emerging Technologies; Anastasius Gavras.

The presentations are available for the public on the NetworldEurope event web pages.[35]

The EAG-supported actions also included the "More Than Gigabit Broadband & Metaverse on the Move" workshop, which was held in Barcelona on the 1st of March.[36] The workshop was carried out in cooperation with CCSA in parallel with Mobile World Congress 2024. The focus of the workshop was to share current and future views about the real requirements of "Metaverse" and how different stakeholders are realising them. The workshop included two different discussion panels discussing current practices and plans and potential new requirements and challenges that the Metaverse may bring to mobile communications infrastructures. The presentations, as well as the workshop report, are available for the public on the website.

The third event supported by EAG was held on September 21st, and it focused on Future Optical Networks. The workshop contributed to identifying future optical innovation challenges that are being posed by the ever-increasing bandwidth demanded in optical infrastructure for the benefit of our society. The arranged panel discussions also touched on future emerging technologies, especially Quantum Internet and quantum networks, and optical networks' role. The workshop was jointly

[35] https://www.networldeurope.eu/event/networldeurope-sria-webinar-12-13-january-2023/.
[36] https://www.networldeurope.eu/event/workshop-more-than-gigabit-broadband-metaverse-on-the-move-1-march-2023-in-barcelona/.

organised with CCSA, and the material, including the presentations and final workshop report, is available publicly.[37]

5.3.3.3 SatCom WG

Chair: Tomaso de Cola (DLR)

Introduction

The Satellite Communication (SatCom) Working Group's mission is to develop the concept of "SatCom resources for Smart and Sustainable Networks and Services" and define the corresponding SatCom positioning in the 2020-2030 timeframe.

As such, the main objectives carried out by the Working Group are as follows:

- To define Vision and priorities for SatCom-related research topics: Among other fostering Fixed/mobile Satellite network convergence with 5G/6G network
- To analyse the EC policies and communications related to SatCom R&D, develop and convey the sector position towards the EU stakeholders
- To interface with European (such as DG Enterprise) and national organisations and other ETPs for space-related matters
- To foster the link between Research and standards (support related policy)
- To interface with the New-ETP Steering Board for harmonisation and coordination
- To define the positioning of SatCom within future smart networks, where innovations are required to develop techniques/technologies to ensure also sustainable ICT

The structure of the Working Group is as follows:

- Vision task force
    - To define Vision for SatCom-related research topics, among other things, fostering fixed/mobile satellite network convergence with 5G networks and beyond
    - Define and prioritise the SatCom-related research topics
    - Communicate the SatCom WG proposed inputs to the H2020 research plan to European and national bodies such as DG Connect, DG Enterprise, ESA and national space agencies, Eurospace and ESOA (objective is communication, endorsement by public bodies and duplication avoidance)
- Research strategy sub-group
    - Define and Prioritise the SatCom-related research topics
    - Communicate the SatCom WG proposed inputs to the H2020 research plan to European and national bodies such as DG Connect, DG Enterprise, ESA and national space agencies, Eurospace and ESOA (objective is communication, endorsement by public bodies and duplication avoidance)
- Policy & promotion sub-group
    - Promote the need for financial support for the European SatCom industry's research and innovation activities towards the European institutions
    - Analyse the EC policies/communication related to SatCom R&D and develop and convey the sector position to the EU stakeholders
- Standardization & regulatory sub-group
    - Foster the link between SatCom Research and standards (support related policy)
    - Support the standardisation activities carried out within 3GPP in the context of Non-

[37] https://www.networldeurope.eu/event/workshop-future-optical-networks-21-september-2023/.

Terrestrial Networks (NTN)

- Liaise with ETSI and other Standardisation bodies whenever relevant (e.g.TC-SES/ETSI)

Key Activities and Achievements

Following its contributions to the 2022 SRIA, the WG has been largely dormant. Yet, it has been developing a work plan for 2024, which includes contributing to the 2024 SRIA and other potential publications, such as a white paper reflecting the developments in NTN systems and their relevance to SNS.

5.3.3.4 Enabling Technologies for Future Vertical Ecosystem Transformation WG

Chair: Maziar Nekovee (University of Sussex)

Vice-Chair: Xulei An (Huawei)

Introduction

The Enabling Technologies for Future Vertical Ecosystem Transformation WG provides a forum for NetworldEurope to engage with stakeholders from vertical sectors, i.e. to

- focus on roadmaps, future/long-term requirements, technology and research aspects rather than prototypes and products
- extend the discussion and engagement globally
- focus on technology enables disruptive business transformation aspects

The scope of the Working Group encompasses:

- Technology aspects
  - development of vision on enabling technologies and architecture
  - exchange/sharing of long-term roadmaps from the vertical domains versus the communication domain with the view also to evolution beyond 5G and 6G
  - elicitation/exchange of user/functional requirements
  - compatibility/integration and transformation of architectures
  - blueprints for common reference points and interfaces
- Economic aspects
  - contributions for consideration of restructuring of business models in the telco and vertical ecosystem
  - future challenges and markets in the vertical sectors and relationships with communication domain stakeholders
  - sustainability, societal, economic and environmental aspects

The WG has two internal Task Forces

- TF 1 on Techno-economics and telco and verticals business disruption/evolution aspects
- TF 2 on Enabling technologies for (vertical) ecosystem transformation and federation

Key Activities and Achievements

- Published their first white paper, “Technologies & Standards to Enable Vertical Ecosystem Transformation in 6G.”[38]
- Panel contribution on “Achieving a global 6G ecosystem and standards” to WWRF 6G

[38] https://bscw.sns-ju.eu/pub/bscw.cgi/d95695/White%20Paper1_WG_Enabling_Technologies_final.pdf.

Huddle, 10 May 2023.[39]

- Co-organised "2nd Forum on Enabling Technologies and Requirements for Future Rail Transport Vertical (FutureRail)", 11 May 2023[40]
- Co-organised Special Session at EUCNC on "6G enabled Network Applications for the Future of Connected Robotics", 7 June 2023[41]
- Industry Special Session “6G Empowered Vertical Industries” at IEEE PIMRC, 6 September 2023[42]
- Contributed to the "4th Vision of Future Communications Summit", 7 November 2023[43]

5.4 Summary

In this deliverable, we have summarised the support activities provided by SNS OPS to the WGs of SNS JU, 6G IA, and NetworldEurope, as well as their activities from January to December 2023. Some of the highlights SNS OPS has supported the Working Groups in achieving include:

- Transition of 5G IA WGs to 6G IA WGs
- Creation of new 6G IA WG on Women in Telecommunications and Research
- Created three new SNS JU project WGs on Architecture, Reliable Software Networks, and Test, Measurement and KPIs Validation
- Creation of new electronic infrastructure to support the WGs and migration of information from 5G PPP
- Publication of 12 WG White papers
- WGs were keen to document the final outcomes and learnings of 5G PPP to maximise their impact and pave the way for SNS JU to build on their results
- Publication of the Open Access 6G book “Towards Sustainable and Trustworthy 6G – Challenges, Enables and Architectural Design.”[44]
- Organising, hosting and participating in a number of events, both in-person and online, including EuCNC, Globecom, IEEE, WWRF and SNS JU’s own events
- Publication of quarterly reports on the impact of 5G PPP into standards, including 3GPP, ETSI, and ITU
- SME participation of 18.5% in the 2022 SNS JU call and 27% in the 2023 SNS JU call
- Launch of Collabwith and DIHWare platforms to support services to the Digital Innovation Hubs

5.5 Work plan M16-M27

As SNS OPS is responsive to the needs of the WGs, there is no set work plan. However, some activities are already identified or can be anticipated:

- Support the finalisation of ToR for all 6G IA and SNS JU project WGs within H1 of 2024
- Support the creation of a new SNS JU project WG on Hardware Technologies

[39] https://wwrfhuddle.com/2023/
[40] https://www.featurerail.org/
[41] https://www.eucnc.eu/programme/special-sessions/special-session-9/
[42] https://pimrc2023.ieee-pimrc.org/program/special-sessions/#specialsession1
[43] https://www.networldeurope.eu/event/4th-vision-of-future-communications-summit-7-8-november-2023-lisbon/
[44] https://www.linkedin.com/posts/omerbulakci_towards-sustainable-and-trustworthy-6g-challenges-activity-7071829614435659776-DaGF/?utm_source=share&utm_medium=member_desktop

- Support the likely involvement of WGs in EuCNC
- Support the development and publication of a new SRIA
- Publish new white papers from WGs. Due to the start of the SNS project cycle, we may not expect as many white papers as during the previous period, but some are already anticipated, such as an updated Architecture white paper

6 Conclusions

This document provided a comprehensive overview of stakeholder involvement, interaction strategy, and plan status, with particular attention to the time frame between M5 and M15, specifically from June 2023 to March 2024. Picking up the baton from D4.1, the document developed the main strategy outlined in M6, describing the main actions and accomplishments carried out up to March 2024 as the project reached its mid-life stage.

To capture the blooming 6G research ecosystem, a critical stepping stone of the stakeholder engagement strategy was achieved by developing the new SNS stakeholder ecosystem map. The map identifies all key players in the SNS ecosystem and helps provide a better understanding of their roles, needs, and contributions to the ecosystem. Moreover, categorising stakeholders into three ecosystems – provisioning, user and enablers/facilitators – intends to illustrate the dynamic interplay among them. This facilitates designing tailored engagement approaches for each actor or group of actors, effectively fostering close cooperation.

In this respect, the Impact Assessment and Facilitation Actions (IAFAs) have been pivotal in establishing a cooperation framework with various partnerships and initiatives, contributing significantly to the SNS community's relevance within the broader European context.

The first report on the SNS market was completed, showcasing the foreseen market changes and growth potential from exploiting 5G/6G capabilities (D1.2).

The SNS OPS' engagement strategy addressing vertical and complementary domains has proceeded steadily, with several activities linked to capacity-building and establishing a solid foundation for pre-standardisation in the transition from 5G PPP and SNS JU R&I agenda. These efforts addressed the need to align EU communications technology strategies with global standardisation trends, ensuring synchronisation with global agendas.

Key activities included continuing the 6G IA Pre-Standardization WG's efforts, initially under the 5G PPP, to align with global standardisation bodies like ETSI, 3GPP, IEEE, ITU-R, and WRC. This alignment is vital for ensuring EU-sponsored R&D efforts are coordinated with SDO global roadmaps. In this context, significant achievements included establishing direct communication channels with ETSI and the EC, creating a joint repository, and mapping SNS JU R&I projects' standardisation interests.

A preliminary trends analysis of pre-standardisation activities identified key areas such as the convergence of terrestrial and non-terrestrial networks, sustainability in network operations, AI in network management, advancements in RAN technologies, high-capacity communication solutions, and user-centric network designs. These trends reflect the ongoing evolution and priorities within the telecommunications sector, emphasising the need for continued engagement and collaboration with standardisation bodies. This gap analysis and the inputs gathered from 6G IA's Pre-Standardization WG will constitute the breeding ground for creating the SNS Standards Tracker platform. This online tool will be launched by the spring of 2024 and will consolidate key pre-standardisation trends and relevant Telco standards information, fostering a clearer understanding of the standardisation landscape. Complementarily, in the context of the IAFA events series, online workshops were launched in collaboration with the HSBooster.eu project and ETSI to address standardisation challenges relevant to 5G/6G developments. These workshops aim to promote dialogue and exchange expertise in telecommunication standardisation.

A third programmatic thread concerned efforts within the SNS ecosystem to enhance SME engagement and entrepreneurship. A significant objective was to elevate SME participation in SNS JU calls, with the 2023 call exceeding the initial target by achieving a 27% participation rate. This uptrend reflects the effective strategies and support mechanisms catering specifically to SME-related challenges within the telecommunications sector. Support for the SME WG, acting as a primary platform to connect small businesses with other actors in the SNS ecosystem, has been crucial. Initiatives included email campaigns and meeting participation to boost SME visibility and engagement.

Efforts were made to promote the skills and expertise of SMEs, aiming to enhance their visibility within the SNS ecosystem. This involved publishing the "2023 European SME Expertise in 5G and Beyond" brochure and launching a promotional campaign, which contributed significantly to highlighting SME achievements and capabilities. In this context, the engagement with SMEs in vertical sectors was strengthened, leveraging platforms like SCoDIHNet to facilitate local collaborations and enhance the market presence of SMEs. This approach fostered regional collaboration and supported SMEs in leveraging cutting-edge technologies for business growth.

Finally, SNS OPS put into action a support mechanism for the set-up of SNS WGs. Such activities were articulated into three key moments:

- **Transition from 5G PPP to SNS JU** involved moving existing 5G PPP WGs to the new SNS JU structure, reflecting the industry's shift from 5G to 6G technologies. This transition required significant coordination, ensuring that leadership positions were confirmed or re-elected and that all relevant information, documentation, and infrastructure (such as email lists, document repositories, and web presence) were seamlessly transferred to support the ongoing and future activities of the WGs under the new SNS JU umbrella.
- **Establishment of New Working Groups**: several new WGs were initiated to address emerging areas within the 6G IA framework and the SNS JU projects. This includes the creation of groups focused on Women in Telecommunications and Research, highlighting a commitment to diversity and inclusion within the telecommunications research community. Additionally, new SNS JU project-specific WGs were formed, covering topics such as 6G Architecture, Reliable Software Networks, Test, Measurement, and KPIs Validation, reflecting the evolving research priorities as the industry moves towards 6G.
- **Support and Infrastructure for Working Groups**: SNS OPS provided crucial support to these WGs, including facilitating communication platforms, organising and hosting workshops, meetings, and webinars, and managing documentation and publication services. This infrastructure support was critical in enabling the WGs to function effectively, collaborate on research topics, and disseminate their findings and recommendations to the wider community.

6.1 Next Steps M16-M27

Looking ahead, the strategy for the SNS OPS WP4 for M15-M27 encompasses a comprehensive approach to fostering dynamic cooperation among stakeholders, enhancing the SNS stakeholder ecosystem map, and organising further Impact Assessment and Facilitation Actions (IAFAs). These efforts are aimed at gathering deeper insights and feedback on the European market outlook for Smart Networks and Services, which will contribute to a better understanding and integration of stakeholders, fostering an environment conducive to innovation and growth within the SNS ecosystem. Concurrently, there will be a focused effort on further developing and refining the Standards Tracker, enriching it with more comprehensive data from SNS JU R&I projects, and continuing the collaboration with ETSI and the European Commission. This includes organising standardisation events and further integrating the pre-standardisation work into the broader SNS JU ecosystem.

Additionally, the work plan includes continuous monitoring and analysis of SME participation in SNS JU calls to better understand and foster SME engagement. The SME Working Group will remain central to these efforts, with planned activities to ensure SMEs are well-represented and active within the SNS community. The preparation and dissemination of the upcoming 2024 SME brochure will further support this objective, highlighting the crucial role of SMEs in the innovation ecosystem. Lastly, SNS OPS will continue to provide tailored support to the Working Groups (WGs), facilitating the finalisation of Terms of Reference and supporting the creation of new WGs, such as the anticipated Hardware Technologies group. This support extends to assisting in major events like EuCNC24, focusing on fostering collaboration, driving innovation, and ensuring that the European telecommunications research community remains at the forefront of global advancements in network technologies and services.

This comprehensive approach should consolidate the foundations of SNS OPS stakeholder engagement strategy, ensuring that the transition from 5G to 6G is well-coordinated and that the community is well-positioned to tackle future challenges and opportunities in telecommunications.

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