NANCY

An Artificial Intelligent Aided Unified Network for Secure Beyond 5G Long Term Evolution [GA: 101096456]

Deliverable D1.7

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List of Acronyms

Acronym	Explanation
6G	Sixth-Generation
AI	Artificial Intelligence
B5G	Beyond Fifth-Generation
B-RAN	Blockchain-based Radio Access Network
E2E	End-to-End
FL	Federated Learning
GA	Grant Agreement
MANO	Management and Orchestration
MEC	Multi-access Edge Computing
MIMO	Multiple-Input Multiple-Output
ML	Machine Learning
MNO	Mobile Network Operator
PQC	Post-Quantum Cryptography
QKD	Quantum Key Distribution
RAN	Radio Access Network
SDN	Software Defined Networking
SDO	Standards Development Organisation
SSI	Self-Sovereign Identity
VNF	Virtualized Network Function

Executive summary

The NANCY project represents a pioneering effort to reshape wireless communication by integrating blockchain, artificial intelligence (AI), and multi-access edge computing (MEC) into beyond-fifth-generation (B5G) systems.

The present document represents deliverable D1.7 "Initial Standardisation Activities Report", which lays down the activities from Task 1.6 "Standardisation & Clustering Activities" as reported at the initial stage of the project. A second deliverable D1.10 "Final Standardisation Activities Report" will present the final status at the end of the project.

This document will first present the overview of the project, recalling its principal objectives and main technological concepts and architecture[1]. Then, it will identify a list of Standards and Industry Fora and will present the rationale behind this selection. The NANCY project's results will then aim to be transferred to the selected standard bodies or, at least, to be aligned with them. A standardisation roadmap will be defined with the details of identified initiatives and contributions and the involvement of the project partners. The progress of achievements of this roadmap is provided at the stage of this initial milestone, followed by an outline of the upcoming milestones and targets for contributing to standards development.

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[1] For a more complete analysis of the scope and objectives of the project, the reader is kindly asked to refer to NANCY deliverables D2.1 "Requirements Analysis" and D3.1 "Architecture Design".

1. Introduction

In the rapidly evolving landscape of wireless communication technologies, the development and deployment of next-generation networks, particularly beyond-fifth-generation (B5G) and sixth-generation (6G), demand a cohesive and standardised approach. Standardisation plays a pivotal role in ensuring interoperability, scalability, and widespread adoption of innovative solutions. This initial report aims to provide a comprehensive overview of the standardisation activities associated, and future envisioned efforts with our ambitious project focused on enabling personalized, multi-tenant, and perpetual protection wireless networking.

1.1. Significance of Standardisation

As the demand for wireless connectivity grows and novel technologies emerge, the need for standardized frameworks becomes increasingly evident. Standardisation not only facilitates the seamless integration of diverse technologies but also serves as a cornerstone for establishing a reliable foundation for the broader industry. By adhering to established standards, our project aims to contribute to the creation of a robust ecosystem that fosters collaboration, innovation, and the commercialization of advanced wireless networking solutions.

1.2. Project Overview

NANCY is centered around the development of three complementary technological concepts:

- Blockchain-based radio access network (RAN) technologies,
- Integration of machine learning (ML) and artificial intelligence (AI) for intelligent platforms,
- Exploitation of multi-access edge computing (MEC) for almost-zero latency and high-computational capabilities at the edge.

These concepts collectively aim to redefine the landscape of wireless networking by providing personalized, and intelligent resource management, while, at the same time, offering high security and privacy levels through quantum-safe mechanisms (e.g., quantum key distribution (QKD) and post-quantum cryptography (PQC)).

1.3. Rationale for Standardisation Activities

The NANCY consortium acknowledges the importance of engaging with key standards development organisations (SDOs) and industry fora. This report outlines our strategic approach to standardisation activities, elucidating our plans for contributing to open-source initiatives and collaborating with renowned bodies in the field. By aligning the activities with established standards, we endeavour to ensure the scalability, compatibility, and acceptance of our innovations within the broader wireless communication community.

1.4. Roadmap Overview

This document presents a roadmap that outlines the current progress, identified initiatives, and future milestones. The report not only serves as an initial documentation of our standardisation activities but also sets the stage for ongoing collaboration and contributions to the evolving landscape of selected standards.

2. Project Overview

2.1. Project Objectives

The primary objectives of NANCY serve as guiding principles, shaping the focus and direction of the standardisation efforts. These key objectives aim to address critical challenges in the wireless communication ecosystem and define the foundations for future advancements.

NANCY aims to introduce a secure and intelligent architecture for B5G wireless networks. This involves leveraging cutting-edge technologies, including high-secure blockchain, artificial intelligence, and multi-access edge computing, to create a network that is not only highly efficient but also personalized and perpetually protected.

To achieve the objectives, the consortium has identified and prioritized critical challenges within the wireless communication domain. These challenges include supporting heterogeneous networks, boosting dynamic scalability, developing theoretical frameworks for AI-assisted blockchain-based radio access networks (B-RANs), transitioning to post-quantum cryptography, reducing the total cost of ownership, and delivering a novel business model for the commercialization of B-RAN.

2.2. Technological Pillars

The project revolves around three core technological pillars that synergistically contribute to the realisation of our objectives. Each pillar brings a unique set of capabilities, ensuring a holistic and innovative approach to wireless networking.

2.2.1. Pillar I: Distributed and self-evolving B-RAN for dynamic scalability, high-security and privacy

The development of new radio access network (RAN) technologies using blockchain serves as the foundational pillar. This concept aims to boost the dynamic scalability of network capabilities by enabling the coordination of existing business and individual RAN infrastructures. The integration of PQC ensures high levels of security and privacy.

2.2.2. Pillar II: AI and ML for Intelligent Platforms

The integration of ML and AI will transform B5G RANs into intelligent platforms. This not only optimizes energy and cost efficiency but also introduces new service models for telecom and individual providers. The use of federated learning ensures ultra-secure connectivity and adaptive radio resource management.

2.2.3. Pillar III: Multi-access Edge Computing

Exploiting the opportunities emerging from MEC, our project aims to provide almost-zero latency and high-computational capabilities at the edge. This concept enhances the overall performance and responsiveness of the network, making it suitable for a wide range of applications with diverse requirements.

2.3. Novel RAN Architecture

To realize the innovative concept of our project, we have proposed a novel RAN architecture that integrates blockchain, MEC, and AI. This architecture is optimized through various components and approaches.

2.3.1. Experimental-Driven B-RAN Information Framework

The heart of our architecture is the experimental-driven B-RAN information framework. This framework allows the role of each network node to dynamically change from connectivity consumer to provider, enhancing flexibility and scalability.

2.3.2. B-RAN Particularities and Attacks Types Characterization

A thorough understanding of B-RAN particularities and potential attack types is crucial for ensuring the security and resilience of the network. This characterization serves as a foundation for robust security measures.

2.3.3. AI-Approaches for Optimization

The NANCY architecture incorporates AI approaches to optimize energy and cost efficiency, support a wide range of applications, and enable end-to-end (E2E) network optimization. This ensures that the network operates intelligently and efficiently.

2.3.4. Federated Learning Approaches

Federated learning approaches are employed for ultra-secure connectivity, optimal and adaptive radio resource management, and end-to-end network optimization. This collaborative learning approach enhances the network's capabilities while preserving privacy and security.

2.3.5. Offloading and Social-Aware Precaching Approaches

To support latency-sensitive applications, the NANCY architecture incorporates offloading and social-aware precaching approaches. These techniques ensure that the network is responsive to the diverse requirements of different applications and user scenarios.

2.3.6. Smart Pricing Policies

Smart pricing policies are introduced to open the door to new business models. By aligning pricing strategies with the innovative capabilities of the network, our project aims to create new opportunities for commercialization.

2.4. Results

Based on the description of works in the Grant Agreement, Table 1 shows the expected results for each of the aforementioned NANCY Pillars.

Table 1: NANCY Results

NANCY Results	
Pillar I	[R1] B-RAN architecture
	[R2] Novel trustworthy grant/cell-free cooperative access mechanisms
	[R3] A novel security and privacy toolbox that contains lightweight consensus mechanisms, and decentralized blockchain components
	[R4] Realistic blockchain and attacks models and an experimental validated B-RAN theoretical framework
	[R5] A novel Quantum safety mechanisms to boost end-user privacy
	[R6] Smart pricing policies
Pillar II	[R7] AI-based B-RAN orchestration with slicer instantiator

	[R8] A novel AI virtualiser for underutilized computational & communication resource exploitation
	[R9] Novel self-evolving AI model repository
	[R10] Experimentally driven reinforcement learning optimization of BRAN
	[R11] Semantic & goal-oriented communication schemes for beyond Shannon excellence
	[R12] An explainable AI framework
Pillar III	[R13] Next-generation SDN-enabled MEC for autonomous anomaly detection, self-healing and self-recovery
	[R14] A computational aware/provision scaling mechanisms and novel battery as well as computational capabilities aware offloading policies
	[R15] User-centric caching mechanisms

3. Standards and Industry Fora Identification

3.1. Identified Organisations

The consortium recognizes the importance of active collaboration with key SDOs and industry fora to ensure the successful integration and acceptance of our innovations within the wireless communication landscape. The selection of these organisations, shown in Table 2, has been guided by the need for alignment with industry best practices, ensuring widespread adoption, and contributing to the broader advancements in wireless communication technologies.

Table 2: Selected SDOs

Selected Organisation	Alignment with Industry Trends	Lead Partner
3GPP: 3rd Generation Partnership Project	As a global collaboration between telecommunications organisations, 3GPP plays a pivotal role in defining standards for mobile networks. 3GPP's work ensures interoperability and compatibility across different regions and vendors, facilitating a unified global mobile communication system. 3GPP continues to drive innovation in mobile technology, focusing on evolving existing standards and exploring new areas such as 6G, with an emphasis on sustainability, enhanced user experiences, and new industry applications.	TEI
IEEE: Institute of Electrical and Electronics Engineers	The Institute of Electrical and Electronics Engineers (IEEE) is a professional organization devoted to contributing to advancements of technology and innovation in several domains, which involve electrical engineering, electronics, computer science, and telecommunications. It has been acknowledged for the creation of technical standards of global calibre, publishing research, and providing educational resources and conferences to support professionals and industries around the world. IEEE's mission is to be a home to technological excellence and cooperation to positively contribute to humanity. Our project aims to actively participate in IEEE initiatives. This involvement ensures that our innovations align with globally recognized standards, fostering interoperability and future integration opportunities.	CERTH, INNO
NGMN: Next Generation Mobile Networks	The Next Generation Mobile Networks Alliance (NGMN) is a forum founded by world-leading Mobile Network Operators and open to all Partners in the mobile industry. Its goal is to ensure that next generation network infrastructure, service platforms and devices will meet the requirements of operators and ultimately will satisfy end user demand and expectations. The vision of NGMN is to provide impactful industry guidance to achieve innovative, sustainable and affordable mobile telecommunication services for the end user with a particular focus on Mastering the Route to Disaggregation / Operating Disaggregated Networks, Green Future Networks and 6G, whilst continuing to support 5G's full implementation. Collaboration with NGMN enables us to contribute to and benefit from the advancements in next-	TEI

	generation mobile networks, providing valuable insights for the deployment of our multi-tenant wireless networking solutions.	
IETF: Internet Engineering Task Force	The Internet Engineering Task Force (IETF), established in 1986, is a leading standards development organization dedicated to the advancement of the Internet. It plays a pivotal role in formulating voluntary standards that are widely adopted by Internet users, network operators, and equipment vendors, significantly influencing the Internet's evolution. The IETF's mission is to enhance the Internet's functionality. This is achieved by producing high-quality, relevant technical and engineering documents, including protocol standards, best current practices, and various informational documents. These efforts collectively aim to improve the design, usage, and management of the Internet, aligning with the IETF's overarching goal of making the Internet work better. Active participation in IETF allows us to align our project's goals with internet-related standards, ensuring seamless integration and compatibility with existing networking infrastructure.	SID, UMU
ONF: Open Networking Foundation	The Open Networking Foundation (ONF) is an operator-driven, community-led non-profit consortium fostering and democratizing innovation in software-defined programmable networks. Through ecosystem building, advocacy, research and education, ONF is accelerating the state-of-the-art in open networking and catalysing the creation and adoption of open disaggregated solutions leveraging open-source software. In particular, NANCY's developments in network orchestration should be aligned with ONF's mission.	UOWM
ISO / JAVACARD / GLOBALPLATFORM: International Organisation for Standardisation / JavaCard Forum / Global Platform	ISO, particularly in collaboration with JavaCard and GlobalPlaform, holds importance in our project's vision for secure Integrated Circuit Cards technologies. ISO/JavaCard/GlobalPlatform both created dedicated workgroups to extend the existing secure Integrated Circuit Cards technologies with quantum safe cryptography. NANCY's development in PQC must contribute and be aligned with these standards.	TDIS
WWRF: Wireless World Research Forum	The Wireless World Research Forum (WWRF) is a global platform uniting over 50 industry and academic organisations to address the wireless research challenge of 5G and Beyond 5G systems. WWRF has many technical working groups dedicated to exploring vertical industry requirements, such as connected vehicles, e-health, rail networks, and the water industry, as well as high-frequency usage above 5GHz and the impact of AI on communication networks. NANCY recognizes the value of participating in WWRF to share insights, contribute to discussions, and stay at the forefront of emerging wireless technologies	UOWM

O-RAN: Open Radio Access Network	The O-RAN Alliance is an industry alliance, founded initially by operators and then joined by vendors, system integrators, software component providers, and hardware component providers aiming to define Next Generation RAN Architecture and Interfaces, leading the industry towards open, interoperable interfaces and RAN virtualization. O-RAN is based on standardized open network interfaces, defined in 3GPP, O-RAN Alliance, IEEE, and other SDOs and industry fora. It is built on the 3GPP architecture and is interoperable with the Core and Transport network. Empowered by intelligence and openness, the O-RAN Architecture separates software and hardware (disaggregation), thus creating the foundation for building a virtualized RAN on open hardware and the cloud. (source: www.3gpp.org). Collaboration with O-RAN ensures that our project contributes to and benefits from the latest advancements in open and interoperable radio access networks.	OTE
OSM: Open Source MANO	Open-Source MANO (OSM) seems to be strategically aligned with the recent integration of AI in wireless communications, especially with 5G technologies and beyond. Due to the advancements of wireless networks in terms of network performance, quality of services, and automation, OSM provides an open-source MANO framework to support, manage, and orchestrate these AI-enabled network functions. In particular, OSM's architecture aims to offer a straightforward way to deploy and manage these AI-driven network functions, such as predictive analytics for traffic management, automated anomaly detection, prevention, mitigation, and resolution, and dynamic resource allocation and optimisation. As a result, the orchestration and management of these AI-enabled virtualized network functions (VNFs) help operators benefit from AI to accomplish greater efficiency, reduce operational costs, and improve user experience. It is worth noting that OSM offers multi-vendor interoperability, and, thus, it supports the integration of different AI solutions, offering significant adaptability, flexibility, and innovation. This makes OSM a key player in the development of intelligent, highly adaptive, and interoperable wireless networks. Our project actively engages with OSM to contribute to the development and adoption of open-source MANO solutions, ensuring the compatibility of our innovations	MINDS
SNS JU: Smart Networks and Services Joint Undertaking	The European Smart Networks and Services Joint Undertaking (SNS JU) is a Public-Private Partnership focused on promoting and advancing Europe's industrial leadership in 5G and 6G networks and services. The SNS JU finances projects that contribute to the development of a well-defined research and innovation plan and implementation schedule by involving a significant number of European partners and promoting international collaboration on different 6G activities.	8BELLS

	The primary objectives of the SNS JU are: To promote Europe's technological independence in 6G, the focus will be on executing the associated research and innovation program, which will result in the development and establishment of standards by approximately 2025. It promotes the readiness for the early implementation of 6G technology before the end of the decade. Engaging a wide range of stakeholders is crucial to tackling strategic aspects of the networks and services value chain. This encompasses a wide range of activities, including the provision of services through edge and cloud platforms, as well as identifying potential markets for new components and devices that go beyond smartphones. Accelerating the implementation of 5G technology in Europe with the aim of creating advanced digital markets and facilitating the transition to a digital and environmentally sustainable economy and society. The SNS JU is responsible for coordinating strategic direction for the appropriate programs within the Connecting Europe Facility, specifically focusing on 5G Corridors. Additionally, it plays a role in coordinating national programs, including those under the Recovery and Resilience Facility, as well as other European programs and facilities such as the Digital Europe Programme and InvestEU. Engaging in SNS allows us to actively contribute to the establishment of 6G standards and the advancement of intelligent network solutions.	
One6G: 1st 6G Summit	one6G aims to evolve, test, and promote next generation cellular and wireless technology-based communications solutions. By supporting global 6G research and standardisation efforts, the goal is to accelerate its adoption and overall market penetration, while addressing societal and industry-driven needs for enhanced connected mobility. This with the ambition to speed up the development of new services and applications in domains, such as advanced autonomous driving, advanced manufacturing, advanced wireless e-health, remote education, etc.	INNO
ECO6G: European COmmission 6G Initiative	The ECO6G project is meant to gather talks that "bring together experiences rooted in research, business and policy". Moreover, it "gives voice to policymakers, program leaders, industry representatives, and key academic players to explore the landmark actions and initiatives of this new connectivity paradigm". Therefore, it is an initiative to pave the way towards the 6G era.	I2CAT
BDVA/DAIRO: Data, AI and Robotics	The overarching objective of BDVA/DAIRO is to boost European Artificial Intelligence, Data and Robotics research, development and innovation and to foster value creation for business, citizens and the environment.	INTRA

	Thus, NANCY's purposes are closely aligned with these aims, with a special focus on the development of AI-powered mechanisms exploiting multi-source data in order to automatically manage Beyond-5G infrastructures and provide advanced services to end-users.	
NIST/PQC: National Institute of Standards and Technology / Post-Quantum Cryptography	Active engagement with NIST and PQC initiatives is critical for our project's transition from current cryptography-based systems to post-quantum cryptography. Collaboration ensures that our project follows the latest recommendations and advancements in post-quantum cryptography. Most existing digital security systems are based on cryptographic algorithms to guarantee the authentication, confidentiality and integrity functions. The arrival of quantum computing poses a threat to classical asymmetric cryptography (private-public key). It is still difficult to predict the date of large-scale deployment of quantum computers. However, experts predict it for the next 10 to 20 years. Major cybersecurity authorities are already recommending post-quantum migration plans: • European Commission ([2]): Establishment of a coordinated plan within 3 years for the transition to post-quantum cryptography • Progress of PQC standardisation work ([3]): first specifications end of 2024 by NIST • ANSSI ([4]): 3-step plan between today and 2023 including the principles of hybridization and crypto-agility • BSI ([5]): published recommendations toward migration of security systems to post-quantum cryptography taking the hypothesis that relevant quantum computers will be available in the early 2030s	TDIS
ETSI PDL: European Telecommunications Standards Institute. Industry specification group for permissioned distributed ledger	ETSI ISG PDL analyses and provides the foundations for the operation of permissioned distributed ledgers, with the ultimate purpose of creating an open ecosystem of industrial solutions to be deployed by different sectors, fostering the application of these technologies, and therefore contributing to consolidating the trust and dependability on information technologies supported by global, open telecommunications networks. While distributed ledgers are mostly known because of their use as cryptocurrencies, there are many other uses besides those, with examples such as the so-called smart contracts, support to digital identity attributes, object tracking, or the verification of service level agreements. This is of key importance to NANCY, especially regarding self-sovereign identity (SSI) functionalities of the platform.	NEC

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[2] Recommendation on a Coordinated Implementation Roadmap for the transition to Post-Quantum Cryptography | Shaping Europe's digital future (europa.eu)
[3] Post-Quantum Cryptography | CSRC (nist.gov)
[4] ANSSI views on the Post-Quantum Cryptography transition | ANSSI (cyber.gouv.fr)
[5] Quantum-safe cryptography – fundamentals, current developments and recommendations (bund.de)

W3C: World Wide Web Consortium	The World Wide Web Consortium (W3C) develops standards and guidelines to help everyone build a web based on the principles of accessibility, internationalization, privacy and security. Web standards are the building blocks of a consistent digitally connected world. W3C has published a "W3C Candidate Recommendation Draft 16 April 2024" Verifiable Credentials Data Model v2.0, which is of fundamental importance to the SSI-wallet that is being developed in NANCY.	NEC

3.2. Contribution to Project Results

Each organisation was chosen based on its potential contribution to specific aspects of our project. Table 3 shows the contributions according to project Results.

Table 3: Contribution to Project Results

Selected Organisation	Identified Standards / open-source initiatives	Contribution to Project Results	Lead Partner
3GPP	3GPP's work is organized into "Releases" with each Release containing a set of specifications that define new features and enhancements. Working groups (WGs) contribute to these Releases by drafting, reviewing, and finalizing the specifications. These WGs operate under the guidance of Technical Specification Groups (TSGs). All the TSGs and corresponding contributions are of interest to the project: • TSG RAN (Radio Access Network): Focuses on the radio aspects of the mobile network. • TSG SA (Service and System Aspects): Deals with the overall system architecture and service requirements. • TSG CT (Core Network and Terminals): Concentrates on the core network and terminal aspects.	[R1]: B-RAN architecture [R2]: Novel trustworthy grant/cell-free cooperative access mechanisms [R3] A novel security and privacy toolbox that contains lightweight consensus mechanisms, and decentralized blockchain components [R7]: AI-based B-RAN orchestration with slicer instantiator [R9]: Novel self-evolving AI model repository [R10]: Experimentally-driven reinforcement learning optimization of B-RAN [R13]: Next-generation SDN-enabled MEC for autonomous anomaly detection, self-healing and self-recovery	TEI
IEEE	IEEE 802.11 (WiFi) IEEE P3201- IEEE Draft Standard for Blockchain Access Control The standard establishes access control requirements for blockchain systems.	[R1]: B-RAN architecture	CERTH, INNO

	The standard addresses the following access control attributes of the system, including but not limited to: a) Node permissions - the permissions of block generation, block synchronization, block verification and broadcasting, and sending transactions. b) Smart contract access permissions - interface access control, user access control, and hybrid access control. c) User permissions - registered user permissions and unregistered permissions. The concept of role is applied to differentiate the permissions of registered users, which means permissions vary according to the role of a user. d) Global permissions - user access to deploy smart contracts, and to read smart contracts.	[R2]: Novel trustworthy grant/cell-free cooperative access mechanisms [R3]: A novel security and privacy toolbox that contains lightweight consensus mechanisms, and decentralized blockchain components [R4]: Realistic blockchain and attacks models and an experimental validated B-RAN theoretical framework [R11] Semantic & goal-oriented communications	
NGMN	Mastering the route to Disaggregation Leading in the development of open, disaggregated, virtualised and cloud-native solutions with a focus on the E2E Operating Model	[R1]: B-RAN architecture	TEI
IETF	ACE Working Group	[R2] Novel trustworthy grant/cell-free cooperative access mechanisms	SID, UMU
ONF	SD-RAN is building open-source components for the mobile RAN ecosystem, complementing O-RAN's focus on architecture and interfaces by building and testing O-RAN-compliant open-source components. This will foster the creation of true multi-vendor RAN solutions and help invigorate innovation across the RAN ecosystem.	[R1]: B-RAN architecture [R12] An explainable AI framework [R13]: Next-generation SDN-enabled MEC for autonomous anomaly detection, self-healing and self-recovery	UOWM
ISO / JAVACARD / GLOBALPLATFORM	• ISO/IEC JTC 1/SC 17/WG 4: Generic Interfaces and Protocols for Security Devices • Javacard Forum - Technical Committee Key Agility • Global Platform - Creating new agile protocols in preparation for future post-quantum migration	[R5]: A novel Quantum safety mechanisms to boost end-user privacy	TDIS
WWRF	WWRF publishes several whitepapers focused on wireless communication technologies. Also, several working groups have been established, covering a wide range of topics (e.g., architecture, vehicle communications,	[R1] B-RAN architecture [R12] An explainable AI framework [R14] A computational aware/provision scaling	UOWM

	radio technologies, cybersecurity, etc.). Of particular interest to NANCY are the following WWRF WGs: • Communication Architectures and Technologies • Radio Communication Technologies • Cybersecurity	mechanisms and novel battery as well as computational capabilities aware offloading policies	
O-RAN	O-RAN is the key enabler for RAN sharing and is focused on accelerating the introduction of virtualized network elements, openness, and intelligence of RAN management, while incorporating AI capabilities, in future communications. NANCY aims to incorporate blockchain and smart contract technologies into O-RAN medium access control (MAC) layer, which provides immutable and permanent records that can be audited by interested parties. Moreover, operators can dynamically sublease their resources to leverage existing infrastructure and allow other operators to enhance coverage and capacity using blockchain-enabled (B-RAN) sharing for 5G and beyond networks, where O-RAN is the basic architecture.	[R1]: B-RAN architecture	OTE
OSM	Integrating AI and Explainable AI (XAI) as Virtualized Network Functions (VNFs) within the Open-Source MANO (OSM) framework is essential for enhancing the capabilities of modern wireless networks. In particular, AI-driven VNFs can significantly improve network performance, operational efficiency, and user experience, while XAI VNFs have the potential to add a layer of transparency, and interpretability in order to help the operators understand the decision-making processes of AI models, thereby fostering trust and compliance with national and EU regulations. This integration will provide clear, interpretable insights into AI-driven operations, making OSM a transparent and privacy-preserving framework.	[R12] An Explainable AI Framework	MINDS
SNS JU	Strengthen Europe's position as a technological leader in future smart networks and services by enhancing	[R1] B-RAN architecture	8BELLS

	existing industrial capabilities and expanding the focus beyond 5G connectivity to include the full strategic value chain, encompassing cloud-based service provisioning, components, and devices. Harmonize the strategic plans of many industrial participants, encompassing not just the telecommunication sector, but also entities from the Internet of Things, cloud computing, and components and devices. Accelerate the development of European technological and scientific expertise in order to establish European dominance in the design and control of 6G systems by the year 2030. Enhance the implementation of digital infrastructures and adoption of digital solutions in the European markets, specifically by establishing a strategic coordination mechanism for the CEF2 Digital program and promoting collaboration between CEF2, DEP, and InvestEU within the Smart Networks and Services Joint Undertaking's scope and governance. Equip the European smart networks and services supplier business to capitalize on the future prospects arising from the advancement of vertical markets for 5G and subsequent 6G infrastructures and services in Europe; By 2030, aim to promote digital innovation that caters to the specific demands of the European market and public policies. This includes addressing the high standards set by various businesses and satisfying societal needs in areas like security, energy efficiency, and electromagnetic fields. Ensure that future smart networks and services are in line with Union policy objectives, such as the European Green Deal, network and information security, ethics and privacy, and a	[R2] Novel trustworthy grant/cell-free cooperative access mechanisms [R7] AI-based B-RAN orchestration with slicer instantiator [R8] A novel AI virtualiser for underutilized computational & communication resource exploitation	

	human-centric and sustainable internet.		
One6G	6G technology overview An overview of the key enabling technologies that constitute the pillars for the evolution towards 6G is investigated. They include Terahertz frequencies, 6G radio access, next generation MIMO, integrated sensing and communication, non-terrestrial networks, multimodal sensing, computing, communication and control for 6G remote operation, distributed and federated artificial intelligence, intelligent user plane and flexible programmable infrastructures. The key problems and difficulties are outlined, and a comprehensive overview of the state of the art in that technology is given.	All	INNO
ECO6G	From the conviction that we need a collaborative undertaking to shape the vision and research directions of 6G, ECO6G gives voice to policymakers, program leaders, industry representatives, and key academic players to explore the landmark actions and initiatives of this new connectivity paradigm. ECO6G is an initiative of the i2CAT Foundation.	Contribution to knowledge sharing, Co-creation of white papers, Keynotes & presentations	I2CAT
BDVA/DAIRO	Data and AI Technologies Task Force	[R9] Novel self-evolving AI model repository [R12] An explainable AI framework	INTRA
	Data Protection Task Force	[R2] Novel trustworthy grant/cell-free cooperative access mechanisms [R3] A novel security and privacy toolbox that contains lightweight consensus mechanisms, and decentralized blockchain components [R13] Next-generation SDN-enabled MEC for autonomous anomaly detection, self-healing and self-recovery	INTRA

NIST/PQC	NIST standardisation process of Post-quantum cryptography : NIST has asked for a 4th round selection of PQ algorithms on top the already selected algorithms during round 3	[R5]: A novel Quantum safety mechanisms to boost end-user privacy	TDIS
ETSI PDL	ETSI ISG PDL	[R3]: A novel security and privacy toolbox that contains lightweight consensus mechanisms, and decentralized blockchain components	NEC
W3C	Verifiable Credentials Data Model v2.0	[R3]: A novel security and privacy toolbox that contains lightweight consensus mechanisms, and decentralized blockchain components	NEC

3.3. Global Reach and Influence

The organisations presented in Table 4 have a global reach and influence, providing our project with a platform to contribute to and benefit from a diverse range of perspectives. This global collaboration is essential for the widespread adoption of our innovations.

Table 4: Global Reach of Influence

Selected Organisation	Global Reach and Influence	Lead Partner
3GPP	The 3rd Generation Partnership Project (3GPP) plays a pivotal role in the global telecommunications industry by developing protocols for mobile telephony. Its influence extends across various aspects of wireless communication, including network infrastructure, user equipment, and service capabilities. 3GPP's global reach is evidenced by its comprehensive membership, which includes telecommunications standards organizations from Europe, North America, Asia, and beyond. This broad participation ensures that the standards developed by 3GPP are globally applicable and widely adopted. 3GPP's specifications form the backbone of numerous mobile technologies, from 2G to 5G, and now in the development of 6G. These standards facilitate interoperability between devices and networks from different manufacturers and operators worldwide, enabling seamless global communication. Additionally, 3GPP's work on 5G standards has positioned it as a leader in the next-generation mobile network revolution, influencing not only telecommunications but also industries such as automotive, healthcare, and IoT (Internet of Things).	TEI
IEEE	IEEE is a vast community consisting of more than 450000 technology and engineering professionals united by a common desire to continuously learn, interact, collaborate and innovate. As one of the organisation's highest priority is the sharing of cutting-edge content for all of the technical fields of interest within IEEE, it sponsors over 2000 annual conferences and events worldwide and provides a wide range of quality publications that make the exchange of technical knowledge and	CERTH, INNO

	information possible among technology professionals. In addition, IEEE offers a number of ways to get involved with technical and local communities. These communities are active participants in research and authorship, conferences, and important conversations about today's most relevant technical topics locally and globally.	
NGMN	The NGMN Alliance comprises of Member, Contributor and Advisor Partners: Member Partners are Operators with over 200 networks serving more than 60 % of all global customers. Several industry standard bodies, groups and the NGMN Alliance work closely together to attain the goal of a coherent vision for the mobile evolution.	TEI
IETF	In-person participation at IETF meetings now averages between 1000 and 1500 participants, with hundreds of additional participants joining remotely. These meetings rotate around the globe. In any one year, over 7000 people actively participate in the IETF either by authoring a document, engaging in a mailing list discussion, or attending a meeting. The work of the IETF is to produce technical documents (RFCs) that define how Internet technology works in detail and can be operated and managed at scale. The majority of the IETF's work is done in WGs.	SID, UMU
ONF	ONF includes worldwide members like Cisco, Dell, Google, Microsoft, different international operators and many universities. ONF was instantiated in 2011 and its community standardised the OpenFlow protocol. As of today, and now that ONF's platforms have been proven and are being deployed worldwide, ONF is focused on expanding adoption and building developer communities.	UOWM
ISO / JAVACARD / GLOBALPLATF ORM	The global influence of standards organizations like ISO, Javacard, and Global Platform is vital for ensuring the security and interoperability of integrated circuit devices. ISO sets international standards for secure integrated circuits, ensuring consistency and trust across devices and applications worldwide. Javacard focuses on smart card technology, providing specifications for secure and interoperable smart card platforms. Meanwhile, Global Platform defines specifications for secure element management, promoting interoperability among different integrated circuit devices. By adhering to these standards, our project ensures compatibility with existing secure integrated circuit devices, facilitating seamless integration into the global wireless communication ecosystem.	TDIS
WWRF	WWRF has a global outreach, and its members include telecommunications operators, network equipment manufacturers, universities, and research institutes. Furthermore, WWRF organizes several physical meetings each year, enabling stakeholders and experts to meet and disseminate the latest research trends. Additionally, WWRF hosts multiple workshops, events, and online seminars focused on particular topics. Finally, the outcomes of WWRF involve whitepapers and special issues, summarizing the results that were presented in the WWRF meetings.	UOWM
O-RAN	O-RAN ALLIANCE's target goal is to re-shape the RAN industry towards more intelligent, open, virtualized and fully interoperable mobile networks. O-RAN specifications enable a more competitive and vibrant RAN supplier ecosystem with faster innovation to improve user experience. More specifically, ORAN aims to change the confidential	OTE

	nature of the RAN market, providing a more flexible and interoperable architecture. O-RAN architecture launched by several alliances of MNOs equipment vendors, academia, legislators, and policy-makers is focused on disaggregation and open interfaces creating a multi-vendor ecosystem that promotes innovation. ORAN use cases aim to leverage faster innovation and greater flexibility in B5G networks. Induced by virtualization and software defined networking (SDN), the boost the use of ORAN in 5G deployment. Spurred by virtualization of 5G networks and the advent of SDN they have proliferated the use of ORAN in 5G deployment, changing thus the telecommunication field.	
OSM	Currently, there are 43 registered members and 110 participants in OSM, spanning from universities, large companies, key industry players, and SMEs. Due to the progressively increased popularity of ETSI, OSM is constantly growing in participants and registered members, and, thus, the releases and improvements of its Open-source MANO framework and the corresponding architectural design are significantly influenced by the market, aiming to close the gap between the industry and research.	MINDS
SNS JU	Enable the advancement of technologies that can fulfill advanced communication needs, while promoting European expertise in smart network and service technologies and their progression towards 6G. This includes establishing strong European positions on standards, essential patents, and crucial requirements such as spectrum bands necessary for future advanced smart network technologies. Expeditiously advance the progress of energy-efficient network technologies with the objective of substantially diminishing the energy and resource usage of the entire digital infrastructure by 2030, while also reducing the energy consumption of key vertical industries that are supported by smart networks and services technologies. Facilitate the rapid advancement and extensive implementation of 5G technology by the year 2025, and subsequently, the establishment of 6G infrastructure in Europe. This will be achieved by actively encouraging the coordination and strategic assistance for the deployment of 5G technology in the context of Connected and Automated Mobility across international borders. The CEF2 Digital programme will be utilized, and deployment will be promoted under CEF2, DEP, and InvestEU initiatives. Promote the development of a resilient and varied supply and value chain that aligns with the 5G Cybersecurity toolkit. Enhance the Union's industry's position in the global smart network and services value chain by establishing a significant number of public and private participants, specifically by increasing the involvement of software and Internet of Things actors. This can be achieved by utilizing national initiatives and facilitating the emergence of new participants. Ensure compliance with ethical and security standards by incorporating them into the Strategic Research and Innovation Agendas and contributing to the Union's legislative process as necessary.	8BELLS
One6G	The one6G WG bring together top experts from governments, industry, and academia to foster an ongoing discussion on issues related to 6G. Their work is dedicated to/focuses on: (i) WG1: Use cases, KPIs and future market and business scenarios; (ii) WG2: Enabling technologies and system	INNO

	architecture; (iii) WG3: Communication and dissemination; (iv) WG4: Evaluation, testbeds and pilots.	
ECO6G	In a series of talks, ECO6G gives voice to policymakers, program leaders, industry representatives, and key academic players to explore the landmark actions and initiatives of the 6G connectivity paradigm.	I2CAT
BDVA/DAIRO	The influence of DAIRO is evidenced by having over 240 members all over Europe and a well-balanced composition of large, small and medium-sized industries as well as research and user organisations. It was established in 2014 as the private counterpart of the European Commission in the Big Data Value Public Private Partnership. Since then, the Association has served the community within and outside the scope of the Partnership and has been instrumental in developing research and innovation agendas and roadmaps, guidelines for industry and policymakers and in creating a forum for knowledge-sharing and discussions on Big Data, Data Value and AI at the EU level. It has been the private side of the H2020 partnership Big Data Value cPPP, is a private member of the EuroHPC JU and is also one of the founding members of the AI, Data and Robotics Partnership.	INTRA
NIST/PQC	Adhering to NIST's selection of Post-Quantum Cryptography (PQC) is crucial for ensuring the long-term security of wireless communication systems. NIST's rigorous evaluation process and global consensus-building guarantee the credibility of selected PQC standards. By aligning with NIST's recommendations, our project ensures compatibility with emerging global cryptographic standards, safeguarding networks against quantum threats while enhancing interoperability and trust across industries and jurisdictions.	TDIS
ETSI PDL	The European Telecommunications Standards Institute (ETSI) provides members with an open, inclusive and collaborative environment. This environment supports the timely development, ratification and testing of globally applicable standards for ICT-enabled systems, applications and services. ETSI is at the forefront of emerging technologies across all sectors of industry and society that make use of ICT. Its 850+ member organizations are drawn from over 60 countries and five continents.	NEC
W3C	Web inventor Tim Berners-Lee founded the World Wide Web Consortium in 1994 to ensure the long-term growth of the Web. W3C's strategic goals are: • Ensure efforts on accessibility and internationalization continue to achieve the goal of a web for everyone. • Ensure that the evolving web platform and Web technologies improve in integrity, security and privacy. We must revisit the current web platform and explore how we can responsibly improve personal privacy for users. • Evolve the extensible web architecture to empower industries and individuals to address the evolving user's needs. • Improve efforts on new technology incubation, making it more structured and improving consensus-building among key stake holders. • Achieve worldwide participation, diversity and inclusion, establishing W3C as representative of the worldwide community.	NEC

	- Further improve the environment for facilitating balance, equity and cooperation among the participants from different industries, user groups and organizational sizes. - Increase involvement of under-represented key stakeholders such as end users, content creators, developers etc. - Establish and improve collaborative relationships with other organizations in the domain of Internet and web standards	

4. Identified Initiatives and Contributions

Table 5 details the expected contributions to each initiative and the involvement of project partners.

Table 5: Initiatives and Contributions

Selected Organisation	Identified Standards / open-source initiatives	Contributions	Lead Partner
3GPP	Standards related to the following Technical Specification Groups: • TSG RAN (Radio Access Network) • TSG SA (Service and System Aspects) • TSG CT (Core Network and Terminals)	Monitoring activities to align the project results with the specifications.	TEI
IEEE	• IEEE 802.11 (WiFi) • P3201	CERTH is proposing two AI based software modules relevant to throughput prediction and outage probability estimation, which are directly relevant to Wi-Fi standards. INNO is monitoring the results of P3201 and aligns the development within NANCY with the standards. INNO will participate in P3201 providing information related to the NANCY network architecture, the blockchain role, and contributing to specification and requirements definition. Moreover, INNO will use P3201 as the baseline for the definition of NANCY components.	CERTH, INNO
NGMN	Mastering the route to Disaggregation	Evaluation of NANCY's architecture with the focus on main innovations to be eventually considered in the fora.	TEI
IETF	ACE Working Group	The ACE WG focuses on standardized solutions for authentication and authorization to enable authorized access to resources identified by a URI in constrained environments. UMU participates in this WG and has proposed an Internet-Draft document.	SID, UMU

ONF	SD-RAN	UOWM is monitoring the activities concerning the SD-RAN project in order to align the testbed with the latest guidelines and developments.	UOWM
ISO	ISO/IEC JTC 1/SC 17/WG 4: • ISO/IEC 7816-8 new Ad Hoc workgroup on crypto Agility	New Ad Hoc group created to work on a new agility enabling approach for hybrid certificate parsing by ICC. TDIS leads this ad hoc group	TDIS
	ISO/IEC JTC 1/SC 17/WG 4: • 7816-6:2023/AWI Amd 1: Interindustry data elements for interchange – PQC	ISO/IEC 7816-6 new Ad Hoc workgroup on PQC. TDIS leads this ad hoc group.	TDIS
	ISO/IEC JTC 1/SC 17/WG 4: • 7816-9:2017/AWI Amd 1: Commands for card management - PQC	ISO/IEC 7816-9 new Ad Hoc workgroup on PQC. TDIS leads this ad hoc group.	TDIS
Java Card	Javacard Forum - Technical Committee Key Agility	Introduction of Crypto agility: Ready for any type of key (legacy algorithms: Asymmetric and symmetric (RSA/ECC/HMAC/AES…), support of DES/3DES, introduction of NIST selected PQC algorithms (Dilithium, Falcon, Sphincs+, Kyber)	TDIS
Global Platform	Global Platform - Creating new agile protocols in preparation for future post-quantum migration	Specification Workgroup to extend existing specifications to support PQC algorithms	TDIS
WWRF	WWRF publishes several whitepapers focused on wireless communication technologies. Also, several WGs have been established, covering a wide range of topics (e.g., architecture, vehicle communications, radio technologies, cybersecurity, etc.).	UOWM is monitoring the activities of WWRF and its WGs. Also, UOWM aims to present the project and the key outcomes to a future WWRF meeting.	UOWM
O-RAN	ORAN alliance has published several reports regarding to future ORAN 6G architecture. The O-RAN.WG1.OAD-R003-v12.00 describes all O-RAN architecture elements and relevant interfaces that connect them .	Monitoring activities	OTE
OSM	Open Source NFV Management and Orchestration (MANO) software stack	MINDS participates in the OSM, following the latest releases and adopting the corresponding proposed practices. Furthermore, MINDS, through is strong connection with	MINDS

		universities and industry in Greece, will disseminate the latest OSM's releases, aiming to increase OSM members.	
SNS JU	Encourage Europe to maintain its position as a global leader in smart network and service technology by building on its existing industrial advantages and expanding its focus beyond 5G connectivity to encompass the entire strategic value chain, from device and component manufacturing to cloud-based service delivery; The telecommunications industry is just one of several industrial participants whose strategic roadmaps need to be aligned. Others include the cloud, the Internet of Things, and components and devices. Promote scientific and technological prowess in Europe so that the continent can take the lead in developing and perfecting 6G networks by 2030; Enhance the rollout of digital infrastructures and adoption of digital solutions across European markets. This can be achieved through establishing a framework for strategic coordination within the CEF2 Digital program, fostering synergies within CEF2, and collaborating with DEP and InvestEU on the Smart Networks and Services Joint Undertaking. In the long run, the growth of vertical markets for 5G and 6G infrastructures and services in Europe will create opportunities for the supply sector of smart networks and services. Get ready for this. Meet the demands of European markets and public policies through digital innovation by 2030; this includes the most stringent demands of vertical industries and society as a whole in areas like energy efficiency, electromagnetic fields, and	8BELLS is actively keeping abreast of the most recent releases and best practices in the field. By incorporating these suggested methodologies, 8BELLS guarantees the implementation of the most up-to-date and efficient tactics. Furthermore, they are committed to distributing these findings and understandings to all pertinent parties, guaranteeing that everyone involved is knowledgeable and may gain from the most recent progress and benchmarks. This proactive strategy not only improves the functioning of the organization but also promotes cooperation and the exchange of knowledge among stakeholders.	8BELLS

	security. The goals of the European Green Deal, a human-centered and sustainable internet, ethics, privacy, and the security of networks and information are all areas in which the future of smart networks and services should be in line with the policies of the European Union.		
One6G	6G technology overview (WG & WG2)	INNO is participating in meetings and monitors the results of One6G in order to align the work of NANCY.	INNO
ECO6G	i2CAT initiative, ECO6G, stems from the belief that a collaborative effort is essential to shape the vision and research directions of 6G. It provides a platform for policymakers, program leaders, industry representatives, and key academic players to discuss the landmark actions and initiatives of this new connectivity paradigm. ECO6G is spearheaded by the i2CAT Foundation.	Two interviews with: - Liliana Arroyo Moliner, Director General of Digital Society Government of Catalonia - Mischa Dohler, VP of Emerging Technologies at Ericsson Inc. Technical Advisory Committee of the FCC and on the Spectrum Advisory Board of Ofcom	I2CAT
BDVA/DAIRO	BDVA is an association and does not produce standards or open-source initiatives.	Other than internal WG discussions, BDVA organises multiple annual actions for information exchange, dissemination, panel discussions etc., such as Data Week, the Big Data Value Forum and more, to enable direct sharing of results in the European Community.	INTRA
NIST/PQC	NIST standardisation process of Post-quantum cryptography: NIST has asked for a 4th round selection of PQ algorithms on top the already selected algorithms during round 3	TDIS is submitting 2 additional candidate algorithms (VOX and PROV) [6]	TDIS
ETSI PDL	ETSI GR PDL 019 V1.1.1 (2023-05)	Work for R3 in NANCY is aligned with the ETSI GR PDL 019 V1.1.1 (2023-05). NANCY will produce an SSI-enabled wallet and a basic DID infrastructure which is aligned with the specifications.	NEC

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[6] [Post-Quantum Cryptography: Digital Signature Schemes | CSRC (nist.gov)](https://nist.gov)

W3C	Verifiable Credentials Data Model v2.0	Work for R3 in NANCY is aligned with the Verifiable Credentials Data Model v2.0 that was released in April 2024 (and consequently with previous versions). This document was published by the Verifiable Credentials WG as a Candidate Recommendation Draft using the Recommendation track. The WG is actively seeking implementation feedback for this specification, to which NEC may contribute.	NEC

5. Progress and Achievements

Table 6 provides the overview of progresses made in terms of standardisation activities and highlights the achievements or contributions made by the project partners to date.

Table 6: Progress and Achievements

Selected Organisation	Identified Standards / open-source initiatives	Progress and Achievements	Lead Partner
3GPP	Standards related to the following Technical Specification Groups: • TSG RAN (Radio Access Network) • TSG SA (Service and System Aspects) • TSG CT (Core Network and Terminals)	Observe and assess the development of the standards to determine how well NANCY's architecture and developments align with the 3GPP work.	TEI
IEEE	• IEEE 802.11 (WiFi) • P3201	Development of two AI models. The first one (Throughput Forecast Service) uses an LSTM model in order to predict future throughput values, while the second on (AI Probability Prediction Module) uses a ML XGBoost classification model in order to decide whether an outage is going to occur or not. INNO is monitoring the results of P3201 and aligns the development within NANCY with the standards.	CERTH, INNO
NGMN	Mastering the route to Disaggregation	Monitor and analyse the evolution of the initiative to evaluate the alignment of NANCY's architecture to proposed principles.	TEI
IETF	Internet-Draft: EAP-based Authentication Service for CoAP (draft-ietf-ace-wg-coap-eap-09)	UMU is the author of this document.	SID, UMU
ONF	SD-RAN	UOWM has deployed the SD-RAN to the Greek in-lab testbed in order to enhance its flexibility and provide additional O-RAN functionalities.	UOWM
ISO	ISO/IEC JTC 1/SC 17/WG 4: ISO/IEC 7816-8 new Ad Hoc workgroup on crypto Agility	TDIS leads this ad hoc group. Participate in workshops.	TDIS
	ISO/IEC JTC 1/SC 17/WG 4: 7816-6:2023/AWI Amd 1: Interindustry data elements for interchange – PQC	TDIS leads this ad hoc group. Participate in workshops.	TDIS
	ISO/IEC JTC 1/SC 17/WG 4:	TDIS leads this ad hoc group. Participate in workshops.	TDIS

	7816-9:2017/AWI Amd 1: Commands for card management - PQC		
Java Card	Javacard Forum - Technical Committee Key Agility	Participate in workshops.	TDIS
Global Platform	Global Platform - Creating new agile protocols in preparation for future post-quantum migration	Participate in workshops.	TDIS
WWRF	WWRF publishes several whitepapers focused on wireless communication technologies. Also, several working groups have been established, covering a wide range of topics (e.g., architecture, vehicle communications, radio technologies, cybersecurity, etc.).	UOWM is monitoring the activities of WWRF and its working groups.	UOWM
O-RAN	O-RAN.WG1.Use-Cases-Detailed Specification R003-v13.00O-RAN Architecture Description 11.0	Monitoring activities	OTE
OSM	Open Source NFV Management and Orchestration (MANO) software stack	MINDS is currently following all the releases, workshops, and white papers published in the context of OSM, and, simultaneously, is subscribed to the corresponding newsletter.	MINDS
SNS JU	Industrial strengths and the strategic value chain to 5G, including cloud-based service provisioning, components, and devices, must be strengthened to expand Europe's technological leadership in future smart networks and services. Telecommunications, IoT, cloud, and components and devices strategic roadmaps must align to construct 6G systems by 2030, European technology and science must be strengthened. The Smart Networks and Services Joint Undertaking's scope and governance include increasing digital infrastructure deployment and adoption in European markets through a strategic coordination mechanism for the CEF2 Digital program and fostering synergies	Monitor and analyse the progress of the endeavour to evaluate the compatibility of NANCY's architecture with the stated principles.	8BELLS

	between CEF2, DEP, and InvestEU. The initiative aims to help Europe's smart networks and services supplier industry capitalize on vertical 5G and 6G markets and facilitate digital innovation by 2030 to meet European market and public policy goals, including the most demanding vertical industry requirements and societal needs like security, energy efficiency, and electromagnetic compatibility. Future smart networks and services must also meet EU policy goals including the European Green Deal, network and information security, ethics and privacy, and a sustainable, human-centric internet.		
One6G	6G technology overview (WG & WG2)	Participation in meetings and sharing of the lessons learnt in NANCY.	INNO
ECO6G	N/A	2 interviews done so far: - Liliana Arroyo Moliner, Director General of Digital Society Government of Catalonia - Mischa Dohler, VP of Emerging Technologies at Ericsson Inc. Technical Advisory Committee of the FCC and on the Spectrum Advisory Board of Ofcom ECO6G: Shaping the R&I Vision of 6G - ECO6G	I2CAT
BDVA/DAIRO	N/A (BDVA is an association, not a standardisation body)	Monitoring activities	INTRA
NIST/PQC	NIST standardisation process of Post-quantum cryptography: NIST has asked for a 4th round selection of PQ algorithms on top of the already selected algorithms during round 3	TDIS is submitting 2 additional candidate algorithms (VOX and PROV)	TDIS
ETSI PDL	ETSI GR PDL 019 V1.1.1 (2023-05)	Monitoring activities. Work for R3 in NANCY (SSI-enabled wallet) is aligned with the ETSI GR PDL 019 V1.1.1 (2023-05).	NEC
W3C	Verifiable Credentials Data Model v2.0	Monitoring activities. Work for R3 in NANCY (SSI-enabled wallet) is aligned with the Verifiable Credentials Data Model v2.0.	NEC

5.1. SNS-JU and 6G-IA Working Groups Attendance

To be closely connected to the SNS-JU activities in fact of standardisation, some of the NANCY partners are participating in standardisation-related WGs promoted by the SNS JU. This effort, which was not originally planned in the GA, brings two major benefits. On one hand, it allows the SNS-JU to closely follow the standardisation activity carried out in the project and its impact. To this purpose, some tools have been put in place by the SNS-JU which will be presented in the section related to the Pre-Standardisation WG below. On the other hand, it allows the consortium's partners to be updated about any possible initiative promoted in the WG (like white paper, workshop, standard, etc.) that the project can contribute to.

There are four WG in which NANCY is participating that will be detailed below. Two groups, Pre-Standardisation and *Security* WGs have been established under the 6G-IA. While *6G Architecture* and *Reliable Software Networks* WGs have been mandated by the SNS-JU governance.

- **Pre-STD WG**: The main objectives of this WG are the identification of standardisation and regulatory bodies, the definition of a roadmap of relevant topics for 6G and raising awareness about standardisation. In this WG there's an important effort to track any activity of the participants linked to standardisation. To this aim, on a quarterly basis, a spreadsheet file is circulated by the WG chair which allows inserting and categorizing in a structured way any possible standardisation effort of the project. Once populated, the spreadsheet is then submitted by a project's representative to the WG chair, who collects the data and presents a comprehensive analysis of the collected data in one of the WG monthly calls. VOS and UOWM are attending the monthly calls and coordinating the submission of the tracking data.
- **Security WG**: This WG focuses on security, fostering new ideas and concepts connected to it, for instance, the integration of AI and other cutting-edge technologies and paradigms. NEC has joined the WG and presented NANCY, shaping the presentation around the security challenges of the project.
- **6G Architecture WG**: The main objective of this WG is the identification of architectural concepts and components with the aim of agreeing on a common European approach in fact of 6G architecture. UOWM is participating in this WG and has presented the project during one of the weekly calls.
- **Reliable Software Network WG**: This WG wants to assess state-of-the-art networking paradigms and techniques to reach a high degree of networking reliability. UOWM is participating in this WG and has presented the project during one of the weekly calls.

Finally, the NANCY project and its vision were also presented in a workshop jointly promoted by 6G-IA and 5G-MAG titled "Media Beyond 5G – Insights from European Projects".

6. Future Roadmap

Table 7 outlines the future roadmap for technology development and integration in alignment with standardisation activities and defines upcoming milestones and targets for contributing to standards development.

Table 7: Next Steps

Selected Organisation	Identified Standards / open-source initiatives	Next steps	Lead Partner
3GPP	Standards related to the following Technical Specification Groups: • TSG RAN (Radio Access Network) • TSG SA (Service and System Aspects) • TSG CT (Core Network and Terminals)	Continue to monitor the identified area of interest related to NANCY, to make possible a simple integration of the project results into a telecommunications network architecture that respects 3GPP standards.	TEI
IEEE	• IEEE 802.11 (WiFi) • P3201	Further evolution of the aforementioned AI models – investigation for additional datasets and possible development of a synthetic data set for throughput-related performance evaluation and network reliability via outage prediction. INNO will participate in the P3201 meetings and contribute to the document drafting.	CERTH, INNO
NGMN	Mastering the route to Disaggregation	Continue to monitor the identified focus area linked to NANCY architecture	TEI
IETF	Internet-Draft: EAP-based Authentication Service for CoAP (draft-ietf-ace-wg-coap-eap-09)	Continue the participation in ACE Working group	SID, UMU
ONF	SD-RAN	UOWM is monitoring the activities concerning the SD-RAN project in order to align the testbed with the latest guidelines and developments.	UOWM
ISO	ISO/IEC JTC 1/SC 17/WG 4 : ISO/IEC 7816-8 new Ad Hoc workgroup on crypto Agility	Target publication: 2026	TDIS
	ISO/IEC JTC 1/SC 17/WG 4 : 7816-6:2023/AWI Amd 1: Interindustry data elements for interchange – PQC	Target publication: 2026	TDIS
	ISO/IEC JTC 1/SC 17/WG 4 :	Target publication: 2026	TDIS

	7816-9:2017/AWI Amd 1: Commands for card management - PQC		
Java Card	Javacard Forum - Technical Committee Key Agility	Standard roadmap depends on JavaCard priorities	TDIS
Global Platform	Global Platform - Creating new agile protocols in preparation for future post-quantum migration	Standard roadmap depends on Global Platform priorities	TDIS
WWRF	• Communication Architectures and Technologies Working Group • Radio Communication Technologies Working Group • Cybersecurity Working Group	UOWM is monitoring the organization of future meetings and calls for presentations in order to present the project and its outcomes.	UOWM
O-RAN	ORAN will continue the development of technical specifications for O-RAN components, improving interoperability and ensuring that O-RAN technologies align with 5G standards. Moreover, it will pave the way for future B5G and 6G technologies by leveraging AI and ML for network automation and optimization.	Monitoring activities	OTE
OSM	Open Source NFV Management and Orchestration (MANO) software stack.	MINDS intends to actively participate in future workshops, and potentially present the advancements of NANCY.	MINDS
SNS JU	By improving industrial strengths and shifting the focus from 5G connectivity to a whole strategic value chain that encompasses cloud-based service provisioning, components, and devices, Europe can strengthen its technological leadership in future smart networks and services. This requires coordinating strategic roadmaps from telecommunications, Internet of Things, cloud, and component companies. It	8BELLS is currently overseeing the scheduling and coordination of upcoming meetings and presentations. Their goal is to discover potential situations when they might showcase the project and its results. 8BELLS intends to disseminate their efforts, conclusions, and the impact of their work to a wider audience, which includes stakeholders, industry experts, and possible partners. By adopting a proactive strategy, the project's accomplishments are shared and acknowledged in an effective manner, leading to increased	8BELLS

	seeks to lead 6G system development in Europe by 2030 through technological and scientific excellence. The initiative also aims to strengthen the deployment of digital infrastructures and digital solutions in European markets through strategic coordination mechanisms for the CEF2 Digital program and synergies within CEF2, DEP, and InvestEU under the Smart Networks and Services Joint Undertaking. Preparing the European smart networks and services supplier business for long-term potential from vertical markets for 5G and 6G infrastructures and services is another priority. The program seeks to enable digital innovation that satisfies European market and public policy goals, including vertical industry and societal needs in security, energy efficiency, and electromagnetic fields, by 2030. It also promotes aligning future smart networks and services with EU policy goals like the European Green Deal, network and information security, ethics, privacy, and a sustainable, human-centric internet.	participation and support from the community.	
One6G	6G technology overview (WG & WG2)	INNO will participate in the One6G meetings and contribute to the document drafting.	INNO
ECO6G	N/A	Next interview with Daniel Camps, Mobile Wireless Internet Area Director at i2CAT	I2CAT
BDVF/DAIRO	Does not apply to standardisation	Monitoring activities	INTRA
NIST/PQC	NIST standardisation process of Post-quantum cryptography: NIST has asked for a 4th round selection of	Awaiting evaluation result from NIST: expected result in 2025	TDIS

	PQ algorithms on top of the already selected algorithms during round 3.		
ETSI PDL	ETSI GR PDL 019 V1.1.1 (2023-05)	Monitoring activities. Work for R3 in NANCY (SSI-enabled wallet) will remain aligned with the ETSI GR PDL 019 V1.1.1 (2023-05). This shall include the NANCY implementation of a DID infrastructure.	NEC
W3C	Verifiable Credentials Data Model v2.0	Monitoring activities. Work for R3 in NANCY (SSI-enabled wallet) will remain aligned with the Verifiable Credentials Data Model v2.0.	NEC

6.1. SNS-JU and 6G-IA Working Groups: Future Actions

For the second half of the project, NANCY partners will closely follow the activities promoted in the SNS-JU and 6G-IA WGs and help disseminate their results via white papers and international workshops. This is planned to happen during the second half of the project when the consortium partners will have identified among all the standardisation initiatives, those where their acquired knowledge can concretely contribute. Moreover, the consortium plans to exploit the tools made available by the SNS-JU that have been deployed to provide more effective coordination of the standardisation activities across the various SNS projects. This is the case of the online tool that will be published at https://sns-trackers.sns-ju.eu which has the aim to consolidate the data collected in the Pre-STD WG, exposing in a succinct way the contributions on a per-project basis. Of much interest, the tool will also gather some input from standardisation experts that will identify possible actions that the projects can consider with the aim of maximising their standardisation impact.

7. Conclusion

Table 8 summarizes the key indicators of the standardisation activities at the stage of this first period of the NANCY project.

Table 8: Activities indicators

Type of activities	Number
Active contributions (submissions, workshops, professional interviews, development)	10
Monitoring activities	10

The indicators presented demonstrate significant progress in the initial phase of the NANCY project's standardisation activities. With 10 active contributions, the project shows a strong commitment to engaging with and influencing relevant standards bodies. Additionally, the monitoring activities highlight our proactive approach to staying informed about ongoing developments and ensuring alignment with industry standards. Proof of this is the spontaneous attendance of some of the partners in SNS-JU and 6G-IA WGs, whose points of interest are presented and discussed during the project's WP1 calls. These WGs, which are funded, mandated and coordinated by the SNS-JU (thus, indirectly, by the European Union), are valuable channels to stay informed and aligned with European directives and initiatives. This contributes to having an effective and well-coordinated cross-projects standardisation action.

Moving forward, addressing this gap will be crucial to ensure comprehensive engagement across all relevant standardisation areas. Overall, the initial indicators reflect a robust start, laying a solid foundation for achieving the project's long-term standardisation goals.