



Annex II to the SNS JU Work Programme 2024

SNS R&I Work Programme 2024

Note: This Annex II is attached to the comprehensive Work Programme 2024 of the Smart Networks and Services Joint Undertaking (SNS JU) and it details the planned SNS R&I Work Programme for year 2024. This R&I WP for 2024 is published after approval of the SNS JU Governing Board and the related call 2024 is planned for opening in January 2024, with a deadline to submit proposals by mid-April 2024. In view of providing better, longer-term visibility and of exploiting complementarities, the SNS R&I WP 2024 has been conceived (pre-definition) jointly with that of 2023. The tentative topics of the SNS call 2024 were included in the Work Programme 2023-2024, such that applicants of call 2023 were aware of what was expected and could best plan, calibrate and focus their proposals.

Context and Objectives

The Research and Innovation Work Programme 2024 (R&I WP2024) of the Smart Network and Services (SNS) Institutional Partnership¹ supports the following Key Strategic Orientations (KSO), as outlined in the Horizon Europe (HE) Strategic Plan:

- **KSO A**, “Promoting an **open strategic autonomy** by leading the development of key digital, enabling and emerging technologies, sectors and value chains to accelerate and steer the digital and green transitions through human-centred technologies and innovations.”
- **KSO C**, “Making Europe the first digitally led circular, **climate-neutral and sustainable economy** through the transformation of its mobility, energy, construction and production systems”.

More specifically, the Horizon Europe SNS Partnership² targets a reinforced European leadership in the field of next generation network technologies (6G), connected devices and services, while accelerating European digital industry uptake and digitisation of economy and society. It aims at positioning Europe as a lead market and positively impact the citizen’s quality of life, by supporting relevant key Sustainable Development Goals (SDGs) while boosting the European data economy and contributing to ensure European sovereignty in critical digital supply chains.

Considering 6G international developments, the SNS Work Programme 2024 is still significantly focused on low TRL/medium to long-term R&I. However, the WP 2024 Stream B (6G technologies) will target higher TRLs compared to WP 2023.

¹ In this document (1) SNS Initiative corresponds to the set of SNS projects as defined in the SNS Collaboration Agreement and (2) SNS Programme corresponds to the SNS Work Programme.

² https://ec.europa.eu/info/files/european-partnership-smart-networks-and-services_en

Whilst 6G R&I and strategic programmes have been launched in many regions of the world with the objective of securing leadership on several technologies considered as strategic (notably in the USA, Japan, Republic of Korea, China, India) there is still no unified 6G vision nor any declared commercial deployment initiative. ITU is currently working on a unified 6G (IMT 2030) vision/Framework that should be available by the end of 2023 as well as the related KPIs. Visions of 6G take up ecosystems are also subject to intense R&I activities at this stage. From a standardisation perspective, it is expected that 6G standardisation study work will start around 2025, which provides a significant window of opportunity to refine in detail the early 6G study work addressing the multiple technologies that are called upon to realise future 6G systems. The WP 2024 is hence designed to further support the development of a top-class European know-how on these enabling technologies.

Within this broader context, the SNS R&I WP2024 addresses the technological and business realisation of the 6G vision, targeting massive digitisation of societal and business processes through intelligent connectivity across the human, physical and digital worlds³. The 6G R&I focus of WP2024 will complement system-oriented R&I, enabling technologies with dedicated prototyping and experimentation, that will have impact on standardisation activities, especially when time comes of standardisation “work items” (around 2027). This covers several facets:

a) Industrial, economic and business aspects

The work addresses notably:

- Moving beyond a simple increase in speed or performance of connectivity platforms, and beyond 5G capabilities bringing unique new service capabilities with wider economic implications. It requires capabilities for completely new services and applications, aligned with sustainability targets and a human-centric approach. This will eventually lead to 6G services, like the “Internet of Senses”, realizing a fusion between the communication and sensing environment, massively scalable immersive environments, like XR/VR, digital twins, and holographic type communication. The current basis for this 6G vision has initially been developed in the context of the EC H2020 5G Infrastructure PPP / ICT-52 projects, including the Hexa-X Flagship project⁴, and is currently being further elaborated in SNS Phase 1 projects including the new flagship Hexa-X-II project and in related national 6G programmes. These developments are to be harmonized to form the common European Vision of 6G. All new services have to be considered in relation to current and future social and economic values, productively driving innovation into areas of greatest benefit.
- The integration of future connectivity and service platforms into larger globally-applicable infrastructures, whilst preserving European competitiveness and sovereignty. The implementation of networks will increasingly take place across heterogeneous domains and the challenge will be to keep a strong EU influence whilst ensuring service delivery and control from an E2E perspective.
- Trust, security and communication privacy-enhancing technologies, processes and architectures that consider both human and technological aspects of trust, as required for massively heterogeneous, virtualised and software platforms of the future, as well as the associated enablers for such developments.
- Participation of new actors from, and beyond the verticals. Contributions from industry, RTOs, Universities and Small and Medium-sized Enterprises (SMEs) actors in the connectivity, IoT and cloud/IT domains are expected to be complemented by appropriate participation of the microelectronics and photonics industries, in view of their potential impacts in the standardisation process.

³ <https://5g-ppp.eu/wp-content/uploads/2021/06/WhitePaper-6G-Europe.pdf>

⁴ <https://5g-ppp.eu/> and <https://hexa-x.eu/>

- A stable experimental framework towards minimising R&I risk and validating core technologies and use cases.
- A unified consensus framework promoting a European approach towards 6G, that takes into consideration national specificities (e.g. current infrastructures, economic power, societal needs), facilitating international cooperation and placing Europe on par with other regions having started bold 6G initiatives.
- A strong European impact at future downstream 6G standardisation stages, including a Europe-wide consensus of 6G Key Performance Indicator (KPIs) and Key Value Indicators (KVI)s⁵ that will frame future developments in terms of the benefits gained. By the end of 2023 the consensus on KPIs will be outlined in key documents like the ITU IMT 2030 Vision/Framework document. Therefore, the SNS Programme described in WP2024 will focus on (1) the validation of the KPIs where a consensus has been established and (2) the further definition of the specific European KPIs that are not (yet) reflected in international consensus. The integration of concepts and technologies originating from the Cloud/IT/Microelectronics environments to support massive device (IoT) connectivity and ultra-reliable communications and services on top of enhanced mobile broadband services is continued in this WP2024. The target is to address a comprehensive value/supply chain materialised by an IoT device-connectivity-service platform.
- The stimulation of strategic alliances, with vertical (industrial) sectors to build and offer powerful and persuasive Business to Business (B2B) and Business to Consumer (B2C) propositions. This should leverage upon general, local, regional, or even global smart interconnected public and private networks and services. A strategic goal of the SNS Partnership is to empower many vertical domains with capabilities beyond what is currently possible with 5G networks. Participation and contribution of these actors to the SNS R&I WP are considered important, both to drive the requirements and to validate the technologies and their versatility in specific business contexts.

The work is also relevant in the context of several European policies⁶, most notably:

- Europe's Digital Decade, Path to the Digital Decade Policy Programme⁷ and the Gigabit Infrastructure Act⁸.
- EU Cybersecurity Act⁹ (Resilient Communication Privacy via Developing Proper Security Strategies), Network and Information Security (NIS2)¹⁰, EU Cyber Resilience Act¹¹.
- European Chips Act¹² (Microelectronic components).
- Artificial Intelligence (AI)^{13, 14}.

⁵ <https://hexa-x.eu/wp-content/uploads/2023/07/Hexa-X-D1.4-Final.pdf>

⁶ <https://digital-strategy.ec.europa.eu/en/policies>

⁷ https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en#the-path-to-the-digital-decade

⁸ <https://digital-strategy.ec.europa.eu/en/policies/eu-rules-reduce-cost-high-speed-broadband-deployment>

⁹ <https://digital-strategy.ec.europa.eu/en/policies/cybersecurity-act>

¹⁰ <https://digital-strategy.ec.europa.eu/en/policies/nis2-directive>

¹¹ <https://digital-strategy.ec.europa.eu/en/policies/cyber-resilience-act>

¹² <https://digital-strategy.ec.europa.eu/en/library/european-chips-act-communication-regulation-joint-undertaking-and-recommendation>

¹³ <https://digital-strategy.ec.europa.eu/en/policies/artificial-intelligence>

¹⁴ <https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai>

- Data, Cloud and Edge Computing^{15,16}.
- High Performance Computing (HPC)¹⁷.
- Internet of Things¹⁸.

b) Sustainability aspects

The 2030 Agenda for Sustainable Development and the related UN Sustainable Development Goals (SDGs)¹⁹ aim to strengthen the social, economic and environmental dimensions of sustainable development.

The objective is to support key United Nations Sustainable Development Goals (SDGs)²⁰, with SNS aiming to contribute mainly to:

- **SDG 8:** Promote sustained, inclusive, and economic growth: achieve higher levels of economic productivity through diversification, technological upgrading, and innovation.
- **SDG 9:** Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation, upgrade infrastructure and retrofit industries to make them sustainable with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.
- **SDG 11:** Make cities and human settlements inclusive, safe, resilient, and sustainable.
- **SDG 13:** Climate Action: Support smart low carbon lifestyles, monitoring emissions, and shaping demand in transport and energy, enabling resilient, dynamic, complex, and situationally aware communication in the context of increasing climate crises (vertical markets: transport, health, and public safety).

These SDGs are indicative and provided as an example to applicants. In addition, complementary societal issues, are targets of the SNS R&I WP.

Supporting KVIs such as safety, security, trustworthiness, inclusiveness, and sustainability are described in further detail below. Several factors form the basis for new research and innovation targets underpinning the evolution of 5G and the design of 6G networks. Some of them include full industry digitisation, supply chain resilience, and the need to address European and global societal challenges.

Beyond the above objectives reinforced by the European Green Deal²¹, which sets out a target for the EU to achieve climate neutrality by 2050, research on Smart Network and Services needs to address how 6G will be sustainable (“Sustainable 6G”) and how it will contribute to the sustainability of other sectors (“6G for Sustainability”).

A sustainable 6G infrastructure is a key objective of the SNS Partnership, and 6G should also become an enabler of sustainability, benefitting other sectors and verticals.

Given the prominence of the twin green and digital transition for the EU and how sustainable digital technologies could enable achieving the EU carbon-neutral objectives by 2050, the SNS R&I activities should take into account, when available, the results of the latest

¹⁵ https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_en

¹⁶ <https://digital-strategy.ec.europa.eu/en/policies/cloud-alliance#:~:text=Cloud%20and%20edge%20technologies%20are,on%20cloud%20and%20edge%20technologie>

¹⁷ https://eurohpc-ju.europa.eu/index_en

¹⁸ <https://digital-strategy.ec.europa.eu/en/policies/iot-policy>

¹⁹ <https://www.un.org/development/desa/dspd/2030agenda-sdgs.html>

²⁰ <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>

²¹ COM(2019) 640 final

developments in the field, e.g., the Digitalising the Energy Systems Action Plan²², and here in particular the Commission's work to explore the possibility to develop common indicators for measuring the environmental footprint of the electronic communication services (planned Q4 2023) and the establishment of an EU Code of Conduct for the sustainability of the telecommunications networks (planned Q4 2025).

Sustainability is increasingly becoming a key target for the design of 6G, driving the choice of technologies and conception of the system to reach effective 6G solutions, with reduced energy, climate and environmental impact. While already initially addressed in the SNS WP2022 and WP2023 (mostly focusing on energy efficiency and associated carbon emissions), a systematic approach to sustainability (including other sustainability requirements) should continue and be considered globally, also encompassing, for instance:

- Energy, climate and environmental sustainability, aimed at minimising impacts of technologies (e.g., energy consumption and energy efficiency, carbon footprint, use of renewable energies, material efficiency and circularity, including reuse, reparability, refurbishment, recycling and, use of other natural resources).
- Societal aspects, enabling people to engage, evolve, live healthy lives and ensuring their long-term social well-being by providing value to the society.
- Economic aspects, aiming at supporting long-term economic growth.

The heterogeneity of resources and services in 6G, comprising e.g., communication, computing, control, and sensing, calls for an end-to-end (E2E) cross-layer design and optimisation, taking into consideration the entire 6G network (core, transport/aggregation, access, and network equipment/devices) during the entire life cycle²³ with the parallel need of sustainability being an integrated network design criterion and supporting the sustainability-by-design approach.

Sustainability issues are reinforced in the WP 2024, notably through the call for a "sustainability lighthouse project", whose main mission is to systematically address technologies, design, system and governance issues that can significantly contribute to core sustainability goals.

c) Cybersecurity and Economic Security

Due to the potential use of 5G and 6G infrastructures for safety-related services and their relevance to public security and public order, it is essential to ensure the highest level of cybersecurity in this sector.

The 5G cybersecurity toolbox²⁴ foresees strategic measures to foster a sustainable 5G supply and value chain in order to avoid long-term dependency. In this context it identifies the specific strategic measures necessary for the Commission to ensure that participation in Union funding programmes in relevant technology domains will be conditional on compliance with security requirements, by making full use of - and further implementing - security conditions.

The recent Commission Communication on the implementation of the 5G cybersecurity toolbox (C(2023) 4049 final)²⁵ mentions that, consistent with certain Member States' application of the 5G Toolbox in the context of the cyber security of 5G networks, certain network suppliers represent higher risks than other 5G suppliers.

²² <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0552&qid=1666369684560>

²³ As referenced in the 6G book: <https://www.nowpublishers.com/article/BookDetails/9781638282389>

²⁴ <https://digital-strategy.ec.europa.eu/en/library/eu-toolbox-5g-security>

²⁵ <https://digital-strategy.ec.europa.eu/en/library/communication-commission-implementation-5g-cybersecurity-toolbox>

Furthermore, the same Communication states that “the Commission also intends to reflect this decision, in accordance with its competences under the respective governance rules, in all relevant EU funding programmes and instruments.”

More specifically as regards large-scale experimentation or piloting, according to Article 170 of the Council Regulation (EU) 2021/2085 establishing the Smart Networks and Services Joint Undertaking²⁶, actions involving network elements deployed for large-scale experimentation or piloting may have to follow security scrutiny assessments.

Beyond cyber-security, the Commission recently adopted its strategy to enhance European Economic Security²⁷ referring to a broader set of risks, including: (1) resilience of supply chains; (2) physical and cyber security of critical infrastructure; (3) technology security and technology leakage; and (4) weaponisation of economic dependencies or economic coercion. 5G/6G security is explicitly mentioned in this context of economic security.

In particular, risks related to technology security and technology leakage constitute risk to the EU’s technological advancements, technological competitiveness, and access to leading-edge technology, including through malicious practices in the digital sphere such as espionage or illicit knowledge leakage.

Therefore, because of the Commission’s decision on the aforementioned policy, proposals are expected to demonstrate EU added value, with special attention to the role of suppliers, and in particular of the high-risk suppliers mentioned in the Commission Communication C(2023) 4049, in R&I activities of this Work Programme. This concerns partnering of European entities with entities considered relevant in the context of at least one of the economic security risks mentioned above (e.g. technology leakage). It also concerns the funding of R&I activities of entities considered relevant in the context of at least one of the economic security risks mentioned above, even when R&I activities are carried out in isolation (e.g. potential increase of economic dependency by using EU funding).

In addition, proposals are expected to demonstrate that the economic security risks (e.g. technology leakage and supply chain risks) have been identified and addressed and that the management of project results, technologies and equipment in the proposed project comply with relevant security requirements.

d) Joint activities between Chips and SNS JUs

The European Chips Act, adopted by the Commission early 2022 aims to enhance Europe’s competitiveness and resilience in microelectronics technologies and applications, and help achieve both the digital and green transition. One of its objectives is to help Europe reach leadership in chips for digital connectivity infrastructures. Europe has a leading position in the global connectivity infrastructure market, while at the same time has strong dependencies on chipset vendors from outside the European Union.

In the above context and with the aim of reinforcing European strength in microelectronics and connectivity, the Chips and SNS JUs have been working towards synergetic and complementary activities in their respective Work Programmes with both constituencies encouraged to participate in the relevant projects funded.

In WP2024, in particular the SNS strand “SNS-2024-STREAM-C-01-01: SNS Microelectronics Lighthouse” aims to provide test/experimental platforms (by developing new or by extending existing relevant ones) where solutions from the micro-electronics domain developed either in the context of Phase 1 SNS WP, or Horizon Europe Cluster 4, and solutions developed under the Chips JU, will be validated in terms of performance and applicability for 6G networks. Potentially, this will also be extended to Photonics components and systems. Therefore,

²⁶ <http://data.europa.eu/eli/reg/2021/2085/oj>

²⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023JC0020>

solutions developed in projects funded under the Chips JU and the European Partnership for Photonics²⁸ projects could find their way into the afore-mentioned SNS topic.

e) Synergies between EU-Rail and SNS JUs

In accordance with the Council regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe (recitals 10 and 12 and Article 5(2) c)), to achieve maximum impact, the joint undertakings should develop close synergies with other Horizon Europe initiatives and other Union programmes and funding instruments, particularly with those supporting the deployment of innovative solutions. Following the identification of synergies between them, joint undertakings should determine budget shares, which should be used for complementary or joint activities between them. Under this basis, the EU-Rail and Smart Networks and Services (SNS) Joint Undertakings, based on an identified synergy area, agreed to launch a call “HORIZON-ER-JU-2024-FA2-SNS: EU-RAIL – SNS SYNERGY: Digital & Automated testing and operational validation of the next EU rail communication system”, with a contribution of up to EUR 1 000 000 from the SNS JU budget. The selection criteria and the call conditions can be found in the EU-Rail JU Work Programme “Europe’s Rail Work Programme 2023-2024”, that will be adopted and published in December 2023.

f) 2024 Work Programme Structure

The scope of the SNS WP2024 considers the full value chain. The NetworldEurope Strategic Research and Innovation Agenda (SRIA) 2022 is the foundation for the definition of the R&I technical themes of the SNS WP. The SNS SRIA is based on NetworldEurope ETP SRIA, and is further processed by prioritizing topics, including contributions from the 6G Smart Networks and Services Industry Association (6G-IA), the wider cloud (NESSI), IoT and edge (AIOTI), Satellite Communications (SATCOM) communities and the priorities of the European public sector. The SNS SRIA underpins the core technological topics to be addressed by the SNS JU as well as the higher-level objectives and the implementation of the 6G roadmap. The SNS SRIA, based on the NetworldEurope SRIA 2022, has been updated during 2023 and will follow the standard I SNS JU consultation process.

The proposed R&I WP24 includes the following three complementary streams²⁹:

- **Stream B:** it covers research for revolutionary and evolutionary technology advancements, in preparation for 6G and revolutionary and evolutionary advancements including IoT, devices and software. This Stream targets low to medium TRL in WP2024, although slightly higher TRL in WP 2024 compared to WP 2023, with the objective of delivering innovative solutions towards real-life sustainable networks in a long-term period, notably through PoCs.
- **Stream C:** it focuses on SNS Enablers and Proof of Concepts (PoCs) as considered in different use and problem contexts from different verticals, used to further develop and consolidate experimental infrastructure(s), in support of the various phases of the SNS Partnership. Stream C developments in WP 2024 will mainly focus on the integration of microelectronics and photonics, developed by related partnerships, in 6G experimental infrastructures.
- **Stream D:** it targets large-scale SNS Trials and Pilots with Verticals, including the required infrastructure. The aim is to explore and demonstrate technologies and advanced applications and services for the vertical domains. During the second SNS phase, Stream D projects are expected to mostly rely on SNS Phase 1 technologies

²⁸ Co-programmed European Partnerships for Photonics in Horizon Europe: <https://www.photonics21.org/>

²⁹ Stream A of the Phase 1 SNS WP (2021-2022) is not supported in SNS Phase 2 WPs (2023, 2024), being too late to further influence 5G Advanced standardisation.

and especially the infrastructures to be developed from Stream C projects. The goal is to gradually incorporate innovative 6G functionalities. From the societal point of view, stream D will highlight sustainability evaluations across verticals, validating exploitation of 6G across different vertical sectors.

The updated SNS roadmap (Figure 1) illustrates the phases of the Streams.

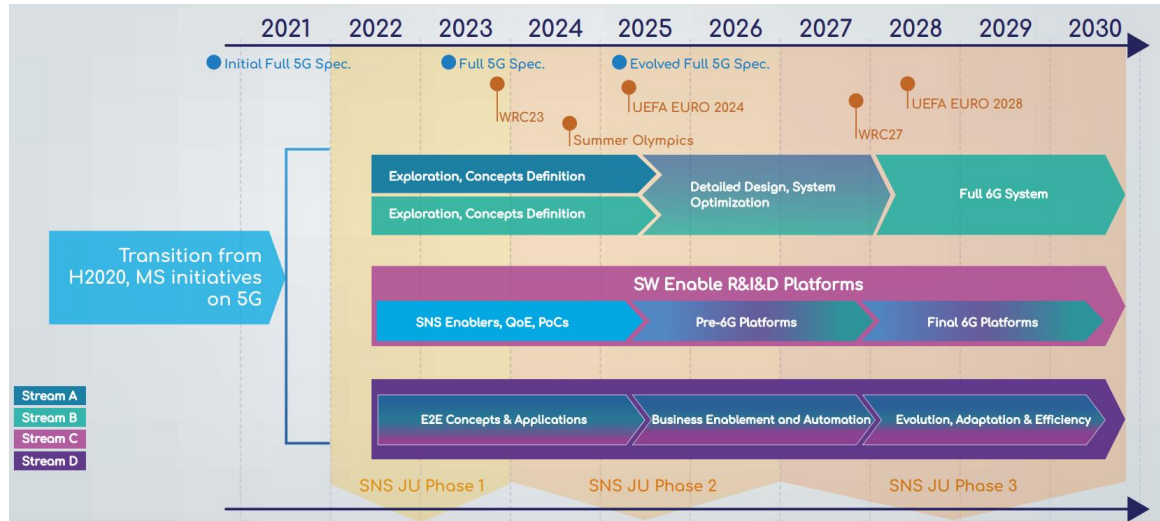


Figure 1: SNS Roadmap

Figure 2 presents how the outcome of each Stream is combined with other Streams activities and results during the following SNS Phases. Thus, it is envisioned that complementary results from the Streams may be re-used in subsequent Phases.

The arrows in Figure 2 illustrate how the outcomes of projects in Phase 1 will be used in Phase 2, and then could be used from Phase 2 to Phase 3. More specifically,

- Stream C Experimental Infrastructure technologies are expected to serve as the basis for the subsequent phase Stream D Vertical Pilot projects.
- 6G solutions and potential PoCs, to be developed in Stream A and B projects during Phase 1, are expected to contribute to the Experimental Infrastructure projects (Stream C) and Vertical Pilot projects (Stream D) of subsequent SNS JU phases. Note that Stream A will not be present in Phases 2 and 3, as 5G advanced solutions will be completed by then.
- Experimental Infrastructure projects (Stream C) and especially Vertical Pilot projects (Stream D) are expected to provide new requirements (e.g., KVs, KPIs) to Stream B projects of subsequent SNS JU phases. The further development of Stream C projects is expected to follow a spiral evolutionary approach, subject to the successful delivery of selected projects.
- The further development of Stream D projects is expected to follow a spiral evolutionary approach, subject to the successful delivery of selected projects.

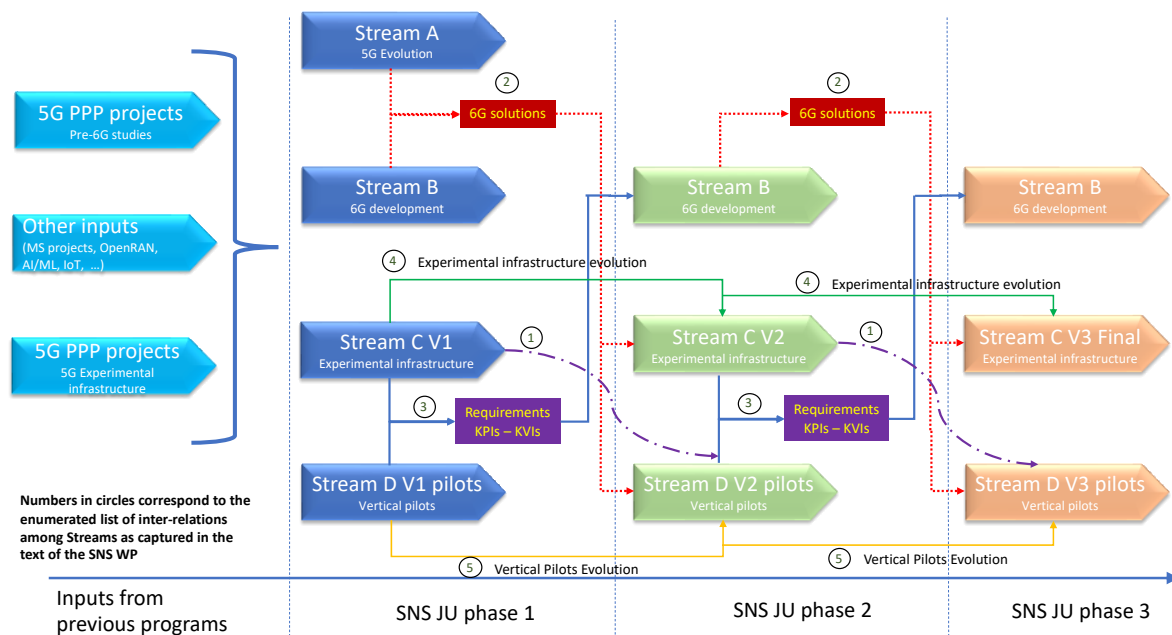


Figure 2: Interlinking of Streams into Phases

The R&I work of the Streams is expected to support and validate feasibility of a well-defined set of 6G KPIs emerging from the international agreements on 6G KPIs as available at the time of the start of the new projects, possibly complemented with ad-hoc KPIs not reflected in international settings like ITU, e.g., considered in the NetworldEurope SRIA KPIs, 6G KPIs produced by other projects, etc). In addition, definition and validation of KVis will show how the SNS projects contribute to societal impact, to vertical sector applications and to the European industrial competitiveness. Applicants are invited to get familiar with the European background work on KPIs and KVis.^{30, 31}

By the time of the implementation of the WP2024, multiple initiatives have already been launched in several Member States or Associated countries. These are expected to develop related operational and important results. Where applicable, applicants are encouraged to use results from such initiatives, to maximise the efficiency of public investments in Europe, which allow for synergies among different funding instruments and thus, create positive multiplier effects.

It is also important to note that projects of the various Streams will cooperate in the SNS Programme for issues of common interests with arrangements set out in a written Collaboration Agreement, to ensure a programmatic approach and achieve the SNS JU objectives.

Notes to applicants

For the implementation of this R&I Work Programme, provisions of the General Annexes to Horizon Europe³² 2023-2024 apply with some exceptions that are specific

³⁰ <https://5g-ppp.eu/wp-content/uploads/2022/05/What-societal-values-will-6G-address-White-Paper-v1.0-final.pdf>

³¹ https://hexa-x.eu/wp-content/uploads/2022/04/Hexa-X_D1.2_Edited.pdf and https://hexa-x.eu/wp-content/uploads/2022/03/Hexa-X_D1.3.pdf

³² https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/horizon-europe-work-programmes_en

to the SNS JU WP. These exceptions are detailed in the Appendix 1 to this Work Programme in addition to the Specific Conditions outlined for the definition of each funded topic under this Work Programme.

e) High-level perspectives on Work Programme 2025

The Call 2024 (part of the R&I WP 2023-24) is contributing to boost the 6G R&I, including a set of projects in Streams B, C and D. Is it envisioned at this stage that the SNS R&I WP 2025 will include the following orientations:

- Further Stream B Strands B01-01/02/03/04 (“Phase 2”) projects will be funded in the context of the forthcoming WP2025. Current options for Call 2025 Stream B Strands B01-01/02/03/04 projects include (1) large Projects (like in Call 2024) or (2) large Projects (like in Call 2024) and smaller projects (like in Call 2023 – lower TRL / Academic/RC led).
- Further Stream C projects will be funded in the context of the forthcoming WP 2025. Current options for Calls 2025 include focus on projects that will integrate solutions from previous SNS Calls, national initiatives and related partnerships if partners from such activities contribute to SNS projects, and also consider platforms that may require further investigation e.g., following on open principles.
- Further Stream D projects will be funded in the context of the forthcoming WP 2025. Current options for Calls 2025 may include the specification of prioritised Vertical per Call, or leaving the vertical topic fully open for the applicants. The final decision will be taken in 2024. Positioning of Stream D projects for strengthening the SNS (5G/B5G/6G) Provisioning Ecosystem^{33,34} will be considered.

The SNS R&I WP 2025-26 will further develop lighthouse projects, considering the policy priorities from the EC and key priorities expressed in the 6G-IA Position Paper, e.g., Microelectronics and Photonics, Cloudification/Softwarisation, AI/ML, creation of knowledge basis of experts, further advancement on sustainability.

NB: the above SNS R&I WP 2025 orientations are indicative and will be subject to further elaboration during 2024.

³³ https://5g-ppp.eu/wp-content/uploads/2021/09/White_paper_5G-Ecosystems_1-0-final.pdf

³⁴ https://5g-ppp.eu/wp-content/uploads/2023/05/White-Paper-5G-Business-Models_Final.pdf

HORIZON-JU-SNS- Stream B - Research for revolutionary and evolutionary 6G Technology and systems

Specific Challenges and Objectives

The Stream targets a higher TRL range, compared to the 2022 and 2023 calls, aiming to bring more mature results, including PoCs, and to support a significant impact on standardisation activities.

This Stream addresses the industrial, societal and technological long-term challenges related to the global introduction of 6G systems by 2030 including:

- **Reinforced European leadership in 6G technologies:** Smart Networks and Services including connectivity extended to devices, enabling technologies, and service infrastructures, underpinning the emerging 6G vision of intelligent inter-connectivity between the physical, digital, and human worlds, supporting massive digitisation of our economies and societies.
- **Further integration with verticals** and fine-tuning of network functionalities and interfaces to support specialized services.
- **Disruptive high-value applications** support, with performance requirements beyond those of current 5G capabilities (scalability and new KPIs and KVIs), especially for highly immersive and “digital twinning” applications.
- **Green transition** contribution with significantly lower energy needs for high-rate/performance connectivity and capabilities to decrease energy needs footprint of use cases.
- **SDGs** support and in particular connectivity and service availability (inclusive coverage), affordability (cost) and (safe) accessibility for a large and diverse number of people towards use cases demonstrating a range of societal, economic, and environmental goals of high public value (SDGs 8, 9, 11 and 13).
- **Innovative business models** based on managed end-to-end service provision over heterogenous business and technological domains.
- **Global Single standards** for 6G, enabling interoperability, economies of scale and of scope.
- **Mobilisation of the core EU networking and service industries**, in partnership with relevant academic, RTO and user actors, in view of downstream impact at standardisation level.

The Stream targets low to medium TRL (3-5) technology advancement and addresses an integrated ecosystem with IoT, devices hardware and software-based solutions. The comprehensive system target is based on a globally connected continuum platform with the convergence of networks and IT systems supporting future digital services.

The following specific objectives are relevant for this Stream:

- Availability of key technologies and open architectures with high potential for 6G standardisation and smooth migration from 5G.
- Further evolution of the 6G architecture investigating key topics from short-range communications up to non-terrestrial networks (NTN), for public and private networks, focusing on native AI solutions, advanced data transport schemes, defining new northbound interfaces, for a more efficient services-to-networks interoperation, as well as interfaces for inter-operator federation, digital twinning and integrated and dependable sensing and actuation networks.

- Network architecture solutions for optical, terrestrial and non-terrestrial networks including the integration of wireless and optical networks.
- Energy-efficient solutions from an architectural, hardware and software implementation perspective considering various aspects from optical networks to the interoperation of IoT devices with the network elements, short range networks.
- Developing leading 6G radio access network solutions capable of meeting the strictest 6G KPIs and KVIs, considering advances on cell free and extreme MIMO, joint communication and sensing, key functionalities in RAN (e.g., modulation, coding, synchronisation, multiple access etc.), machine learning physical layer evolutions, and seamless integration of multiple frequency bands.
- Validating bands with mobile allocation for potential 6G usage and advanced technologies for workable sharing scenarios where appropriate.
- Further advances on IoT devices that will support the demanding 6G smart services.
- Energy-efficient device, network, and service infrastructures, to deliver critical services in a sustainable manner. It also includes enablers and open APIs to improve the operation of verticals and significantly reduce energy/carbon footprint of use cases making use of the 6G connectivity platform (e.g., automotive, factories, healthcare, etc).
- E2E secured, trustworthy, resilient and reliable solutions that will also fulfil the requirements stemming from EU policies.
- Multi-layer Federated Cybersecurity Solutions including Security for terrestrial and non-terrestrial networks, Federated/hybrid classical/emerging security solutions, multi-layer cybersecurity protection and threat and risk assessment.
- Dynamic end-to-end distributed security for connectivity, devices and service infrastructures extending the current set of patchy technologies for service security, trust and resilience towards a comprehensive end-to-end framework across heterogeneous environments. This security “lifecycle” should be provisioned to account for distributed systems (e.g., asset orchestration and data aggregation), operational security, security quantification, and a strategy for ongoing security threat assessment.
- Fostering European capabilities in key technologies and notably AI/ML, software and security enablers, and advanced signal processing, paving the way towards advanced fully automated systems across all network layers. It includes the availability of open data sets originating from the projects.
- International Collaboration with Japan and the Republic of Korea on well-defined topics of mutual interest.
- Providing tangible breakthroughs on sustainability (both for Sustainable 6G and 6G for Sustainability), and consolidate the work started in the SNS Phase 1 and early Phase 2 projects on sustainability.
- Stimulation of international cooperation and international consensus on critical technologies.

Note 1: Cloud and edge-cloud technologies and software implementation of network/device are to be addressed with a clear strategy for EU supply capabilities and opportunities, including for security solutions, in the context of a future cloud continuum that may involve interoperation with non-EU systems such as the hyperscalers.

Note 2: Sustainability is an important element of Work Programme 2024 not only for the Lighthouse project but for all Stream B projects, so any results should also identify any impact/contribution they may have/bring on sustainability.

The Lighthouse project will help building, together with stakeholders, the European approach towards sustainability, notably by furthering the sustainability-by-design principle under all its different aspects, including from the design phase.

The Lighthouse project will provide a holistic sustainability perspective, building on the results and breakthroughs of other SNS Phase 1 and Call 2023 Stream B projects addressing sustainability dimensions (and indisputably with Hexa-X and Hexa-X-II), Call 2024 Stream D projects contributing to specific sustainability demonstration and quantification for the scientific/technological part and with Call 2023 Societal/Sustainability CSA project for the elaboration of subsequent guidelines and industry recommendations.

Note 3: Stream B activities are expected to demonstrate strong capabilities towards valorisation of results in relevant 6G standardisation bodies and explain how this will be reached. Considering that 6G standardisation is expected to start in 2025 and that the work of this WP is mainly expected to expand on early R&I work from previous phases (or initiatives outside SNS) to bring it into (or close to) a higher TRL PoC, it is expected that the basis for contribution to standards may come from earlier projects (within or outside SNS) whilst the PoC work of this work programme will be further valorised in the context of later standardisation stages and work items. For original work proposal that has no precursor R&I work, the approach to valorise results in a standardisation context will be clearly outlined. In addition, projects are expected to commit to an active participation in the pre standardisation collaborative activities.

Note 4: AI/ML open data sets from Stream B projects have to be made available through a common repository that may be openly accessed and used by other SNS projects over the programme lifecycle.

Concerning security, in this Stream, specific security issues are to be identified in the security section of part A of the proposal whilst mitigation measures should be outlined in the Annexed form to the proposal.

Implementation modalities are specified in the additional call conditions under Appendix 1.

HORIZON-JU-SNS-2024-STREAM-B-01-01: System Architecture - Standardisation and Follow-up/PoCs

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 8 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 16 million
<i>Type of Action</i>	Research and Innovation Actions
<i>Technology Readiness Level</i>	Activities are expected to start at TRL 2-3 and to reach TRL 4 by the end of the project, and if/where relevant up to maximum TRL 5 (mature 6G technologies and solutions for verticals). Some parts of the

	project may only target TRL 3 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

The target outcomes address consolidation of results in the field of:

- Architectures providing built-in capabilities/mechanisms that enable the seamless integration of multiple system segments (e.g., public and private, terrestrial and satellite, inter-operation among operators, computing and networking) and allow the establishment of innovative business models, including the migration and deployment models. Increased global resilience (at a technical and economical level) is expected to be a key outcome of these architecture innovations.
- Innovative solutions for native and trustworthy AI for telecommunication to support end-to-end operational processes.
- Mechanisms (e.g., Digital twinning frameworks) to be used for the improved management and operation of 6G networks.
- New communication mechanisms and methods that new system level communication concepts and associated protocols and methods that will enable optimized communications such as shared situational awareness and dynamic capabilities among all stakeholders (verticals, service providers and network operators) through appropriate interfaces including APIs.
- Enhanced data plane frameworks that guarantee economically and technically sustainable architectures with cross-flow resource management capabilities.
- Algorithms, software and hardware implementations paired with organisational processes where appropriate, which can be used for PoC and later trials systems.
- Dissemination of solutions for international consensus building, which can be exploited in standardisation activities.
- Contributions to international standardisation, considering also topics related to backward compatibility and further evolution of the 6G architecture.

Scope

The focus of this Strand is on several complementary issues mentioned below and applicants may select one or more of these issues.

- **New design approaches for 6G system architecture systems** in all aspects of control, data and management plane including further advances that emerge out of the collaboration of individual networks or subsystems owned by different stakeholders, at computing and networking levels. These subsystems may potentially include Non-Public Networks (NPN) - including short/extreme connectivity - and/or NTN segments. This may require rethinking key service and network interfaces, structure and enablers covering simplification, sustainability, energy-efficiency, resource or asset sharing, resource configuration orchestration and allocation, robustness, and security, federation and mobility across networks. For the new advanced 6G services, it is desirable to enhance networks with the capability to guarantee a certain performance (i.e., latency, reliability, throughput) across different operation conditions (e.g., using overlay time synchronisation). Negotiation, accounting and billing across multiple systems, as well proper authentication, authorisation are also in scope. The work

covers the migration/deployment strategies that may be most appropriate in EU deployment scenarios.

- **Native and trustworthy integration of AI for telecommunications**, including edge cloud continuum. Native integration of AI/ML is in scope to implement end-to-end adaptive decision-making ensuring conflict resolution and a high degree of trustworthiness while addressing privacy and explainability issues, operating at different time scales with expected impact on energy and network as well as other services' performance.
- **Network exposure to vertical application developers** including protocols, algorithms, architectures and solutions for user-to-systems interface. Allowing exposition of available resources and required/value-added service attributes (performance, security, sustainability) related to the user applications and getting semantic of the requirements from user applications explicitly or implicitly. Specific approaches for relevant vertical ecosystems are in scope.
- **Mechanisms, leading to partial or complete Digital network twinning, applied in 6G** including the dynamic virtual representation of critical components and systems, the simulation and modelling tools for large-scale real-time environments; derivation of network models (digital twins) from traffic analysis; These models should be created in a trustworthy (secure) and privacy preserving way. Digital twin models as a core for network planning, management and control are also in scope.
- **New Data Transfer Paradigms**, considering enhanced data plane (including IP framework evolution) techniques with deep Edge integration. In scope are considered Compute-Interconnection (CIC) architectural frameworks expected to enable data plane evolution that is economically and technically sustainable. Cross-flow and cross-endpoint data plane mechanisms and protocols for cross-flow resource and timing (latency) control.

The scope includes, where relevant, harmonisation/coordination with Member States or Associated Countries 6G initiatives. Any produced PoCs should be implemented in a way that their integration in SNS WP2025-26 Stream C and/or Stream D project will be possible (e.g., open-source solutions, appropriate documentation, support after the completion of the project).

HORIZON-JU-SNS-2024-STREAM-B-01-02: Wireless Communication Technologies and Signal Processing – Standardisation and Follow-up/PoCs

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 8 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 16 million.
<i>Type of Action</i>	Research and Innovation Actions

<i>Technology Readiness Level</i>	Activities are expected to start at TRL 2-3 and to reach TRL 4 by the end of the project, and if/where relevant up to maximum TRL 5 (mature 6G technologies and solutions for verticals). Some parts of the project may only target TRL 3 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

The target outcomes address:

- Methods for an efficient effective, affordable, and accessible use of frequency spectrum for joint communication and sensing built upon energy efficient radio solutions by meeting 6G technical KPIs.
- Optimized radio physical layer solutions increasing availability empowered by machine learning under varying, dynamic and/or unknown channel conditions. Machine learning should adapt physical layer approaches and parameters for best exploitation of the radio channel capacity.
- Development of algorithms and energy efficient implementations for massive MIMO systems to increase radio channel capacity, coverage improvements under difficult propagation conditions and very high accuracy in location and positioning.
- Further innovative 6G RAN design by combining different physical layer functionalities and antenna concepts to meet challenging 6G technical requirements towards extremely high-throughput/low latency, sustainable and computationally-affordable implementation of radio systems.
- 6G spectrum candidate bands characterisations and co-existence/sharing technologies and approaches with other systems.
- Combination of different frequency bands depending on the requirements of the applications (throughput, latency, radio range ...) and spectrum availability for optimum usage of the frequency spectrum and the minimisation of EMF effects.
- Algorithms, software and hardware implementations where appropriate, which can be used for PoC and later trials systems.
- Dissemination of solutions for international consensus building, which can be exploited in standardisation activities.
- Contributions to international standardisation.

Scope

The focus of this Strand is on several complementary issues mentioned below and applicants may select one or more of these issues. Topics can be proposed for any existing and potential future frequency band.

- **Novel techniques for integrated sensing and communication** to maximise the efficiency of spectrum usage and minimise resources (hardware, energy consumption) including accurate location and positioning. This topic may potentially include integrated waveform design (i.e. same waveform for both sensing and communication), integrated baseband and hardware design (front-ends, antenna systems and digital back-end), sensing algorithms, multi-band sensing technology cooperation, fusion with other sensing technologies, computing power, etc. Advanced

self-interference cancellation techniques for further increase of spectral efficiency and enhanced antenna beam management for environmental sensing will also be included.

- **Machine learning empowered physical layer evolutions** to enrich/complement conventional model-based physical layer optimisation. This includes the development of end-to-end vs. block-based AI/ML-based transmitter/receiver chains along with the analysis of inherent trade-offs, channel learning and prediction; learnt signal constellation, modulation types, and channel (de)coding schemes; pre-coder optimization under non-ideal or unknown channel conditions, adoption of AI/ML in multi-antenna systems, in-radio network AI computing via e.g., over-the-air/coded computing, as well as semantic-oriented communications and protocol learning. It is also in scope the use of AI/ML to compensate for the losses caused by non-linear effects and other hardware impairments, or to address performance vs. resource/energy consumption trade-offs in resource-constrained network elements or devices.
- **Cell-free and extreme exploitation of MIMO technologies potentially including reconfigurable surfaces** considering but not limited to topics related to channel modelling of ultra-massive MIMO; feeding and control of each antenna element in addition to channel prediction; real-time estimation and feedback of a large number of channel elements; space-time-frequency coding to exploit all diversities; solutions that can control electromagnetic exposure for the above mentioned ultra-massive MIMO systems; centralized and distributed algorithms for coordinated transmission/reception encompassing a very large/massive number of antennas and/or users and possibly including MIMO predistortion for wideband massive arrays; solutions leveraging on the availability of large antenna deployments to achieve extreme accuracy in positioning,
- **Key functionalities and technologies for 6G RAN system design**, including any of the following topics: new (adaptive) waveform designs, novel random and multiple access schemes, advanced synchronisation and channel estimation strategies, in-band full duplex transceivers including self-interference cancelation; enhanced non-orthogonal multiple-access schemes (e.g., NOMA, RSMA) possibly in combination with multi-antenna processing; enhanced modulation and channel coding approaches towards error-free, extremely high-throughput/low latency, sustainable and computationally-affordable implementation of radio systems.
- **Seamless integration of multiple frequency bands**: reuse of existing frequency bands via dynamic spectrum sharing between existing systems and forthcoming 6G systems and access to new frequency bands. The scope also includes the optimum access to frequency bands depending on the radio environment and service requirements including spectrum sharing and load balancing. Several bands could be used simultaneously. EMF issues should be addressed. The spectrum efficient framework may include unlicensed bands and potentially optical access. Open and disaggregated solutions may be also considered for this topic. The work includes a review and analysis of the 6G candidate bands (European focus), of their characteristics in terms of spectrum co-existence needs with other radio systems and the associated intelligent sharing technologies that may be needed.

The scope includes, where relevant, harmonisation/coordination with Member States or Associated countries 6G initiatives. Any produced PoCs should be implemented in a way that their integration in SNS WP2025-26 Stream C and/or Stream D project will be possible (e.g., open-source solutions, appropriate documentation, support after the completion of the project).

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 8 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 16 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Technology Readiness Level</i>	Activities are expected to start at TRL 2-3 and to reach TRL 4 by the end of the project, and if/where relevant up to maximum TRL 5 (mature 6G technologies and solutions for verticals). Some parts of the project may only target TRL 3 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

The target outcomes address:

- Advanced solutions and technologies for optical, terrestrial and non-terrestrial networks including the integration of wireless and optical networks.
- Energy-efficient solutions for optical networks from an architectural, switching, hardware and software implementation perspective.
- Unification of terrestrial and non-terrestrial networks (3D networking) in the overall architecture and the physical layer for a flexible access to different networks by end users, embedding, where relevant, AI in network and RAN procedures.
- Development of low-power communication systems, especially for short-range networks, to increase flexibility compared to cable systems and interconnections of multiparty edge/IoT systems, including support for zero energy devices and related energy-management solutions.
- Non-terrestrial – open and disaggregated where relevant – network architecture to optimize ubiquitous service provisioning, flexibility, scalability and cost efficiency. The function split between the ground segment and the space segment should support the technical 6G KPIs and sustainability in terms of energy consumption.
- Optimal combination of optical and wireless technologies and their integration in the overall network architecture for the best exploitation of the available frequency spectrum, minimisation of network deployment cost and reduction of the overall energy consumption.
- Algorithms, software and hardware implementations where appropriate, which can be used for PoC and later trials systems.
- Dissemination of solutions for international consensus building, which can be exploited in standardisation activities.

- Contributions to international standardisation.

Scope

The focus of this Strand is on several complementary issues mentioned below and applicants may select one or more of these issues.

- **Ultra-high energy efficiency especially in optical networks** including an optical end-to-end network architecture, that avoids unnecessary opto-electronic conversion and processing, and novel switching architectures operating over multiple wavelength bands and spatial dimensions and have a smart network fabric relying on software programmability and slicing, addressing multiple protocol layers and network domains. Energy-efficient transceivers that outsource power hungry functions to photonics. Intra-DC (data center) applications, where new switching concepts mixing optical and electronic switching technologies could lead to higher performance and lower power consumption. This topic may also consider disaggregated switching platforms. It could also consider optical network automation, potentially using AI/ML, to address flexible operation and resilience.
- **3D networking for 6G networks**, including topics related to unified TN/NTN architecture and air-interface (e.g., waveform design, multi-antenna solutions, next generation multiple-access and resource management); full network integration of all layers in the 3D reconfigurable (SDN) network; direct connectivity to smartphones, outdoor and indoor and in vehicle;; merging networking and computing; integrated and flexible air interface for multi services including ultra-accuracy of positioning, navigation and timing (PNT); embedding AI in network and RAN procedures (e.g., for beam management, radio resource allocation); development of new IP for space networks; new dynamic spectrum management and sharing across the network components; and support to massive IoT using both TN and NTN. Security aspects are also in scope.
- **Development of low-energy communication solutions** revolutionary new mechanisms for short range networks, and technologies that expand the current limitations of cabled media, and technologies that provide low-power answers to interconnection of multiparty edge/IoT resources. This topic considers new physical layers and associated protocols.
- **New IoT components and devices**, potentially including zero energy devices with on-demand wake-up feature integrated into edge IoT applications, energy harvesting and wireless power transfer and/or multi-modal devices. Different levels of IoT including ranging from body area networks to wide area networks can be addressed under this topic. The topic also includes multi-access capable end devices to deliver higher QoS, to handle the communication bottlenecks (both in the front- and the back-haul) in highly densely populated areas, and to fulfil Key Performance Indicators (KPI) of the applications requesting a huge amount of bandwidth, as handset devices being capable of making use of the most suitable available access technologies and bands is becoming more and more important.
- **Unified NTN service provision**, focusing on multi-layered NTN infrastructure service operations supporting secure service ubiquity, flexibility, scalability, and cost-efficiency, towards realisation of satellite-as-a-service. The work covers software-based non-terrestrial networks allowing full orchestration of the infrastructure resources (e.g., power, bandwidth, time, space dimensions, node, coverage, and topology) for a more flexible and dynamic system with overall better performance, efficiency, and security and sustainability. Disaggregation, and virtualisation considering the ground and non-terrestrial segment are in scope. It should enable integrated space and ground edge computing and in-space traffic decision procedures

allowing a ‘router in the space’. Intelligent and autonomous resource management is sought, towards zero delay infrastructure reconfiguration with optimum orchestration of the infrastructure/service resources underpinned by fully-flexible space-ground RAN functional splits.

- **Integration of Optical and Wireless Technologies** that may consider one for the following 2 different perspectives:
 - i) technologies enabling the coexistence of fronthaul and backhaul networks and supporting end-to-end, wireless, and all-optical networks including radio-over-fiber systems. This covers possible redesign of the backhaul/fronthaul application space such as packet switching with new packet friendly fronthaul interfaces in scenarios where many users generate a low amount of traffic data each, or multi-user mode (MU-MIMO) with an interoperable solution (Layer 2 and 3), reliability, durability, and energy efficiency.
 - ii) applicability of advanced light related technologies such as LEDs (light-emitting diodes), lasers, outdoor point-to-point devices (FSO — Free Space Optics), point-to-multipoint commercial applications (Li-Fi — Light Fidelity) or between devices (OCC – Optical Camera Communication) and Fiber Wireless Fiber (Fi-Wi), for the design of novel communication schemes, system architectures and protocols, in order to fully integrate these technologies in the communication infrastructure This requires advanced transmitter and detector technology and the development of optimised multiuser access and interference management.

The scope includes, where relevant, harmonisation/coordination with Member States or Associated countries 6G initiatives. Any produced PoCs should be implemented in a way that their integration in SNS WP2025-26 Stream C and/or Stream D project will be possible (e.g., open-source solutions, appropriate documentation, support after the completion of the project).

HORIZON-JU-SNS-2024-STREAM-B-01-04: Reliable Services and Smart Security–Standardisation and Follow-up/PoCs

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 8 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 16 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Technology Readiness Level</i>	Activities are expected to start at TRL 2-3 and to reach TRL 4 by the end of the project, and if/where relevant up to maximum TRL 5 (mature 6G technologies and solutions for verticals). Some parts of the

	project may only target TRL 3 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

The target outcomes address consolidation of results on:

- AI technology applied to security and service deployment in different aspects: i) secure and verifiable application of AI to enhanced service deployment in 6G; ii) consideration of potential security threats using AI; (trusted by people, systems and processes) AI for securing 6G control and management planes; to efficiently improve the security of distributed architectures and complex use environments.
- Beyond perimetric security strategies and disruptive security and reliability scenarios, including energy efficiency aspects. Holistic distribution of security in all its phases (protection, detection, response), with a particular focus on differentiated security architectures and cooperative security across domains, layers and stakeholders.
- Availability accessibility, and affordability of technologies supporting the necessary levels of trustworthiness, resilience, openness, transparency, and dependability expected under the EU regulations (such as GDPR and Cyber Security Act) across a complete service continuum, supporting complex human centric multimodal communications, including entangled devices.
- Availability accessibility, and affordability of technologies ensuring secure, privacy preserving and trustworthy services in the context of a programmable platform for the complete life cycle of services, accessed by multi-stakeholders and tenants including vertical industries as users, for increasingly dynamic scenarios considering interdependencies between components and cascade effects that may be produced separately Zero-touch security deployment solutions for virtualized and distributed environments, taking into account the varying computational capabilities and security requirements of their building blocks and their interactions with third-party entities.
- Quantum key distribution and post-quantum cryptography support ensuring long term security for 6G networks.
- Efficient run-time service development methodologies able to operate across multiple stakeholders in an efficient way, to provide complex, multi-technology, dynamic services.
- Service technologies for time-sensitive and computationally intensive applications, able to optimize deployment considering aspects as energy consumption, reliability and security levels.
- Algorithms, software and hardware implementations where appropriate, which can be used for PoC and later trials systems Dissemination of solutions for international consensus building, which can be exploited in standardisation activities.
- Contributions to international standardisation.

Scope

The focus of this Strand is on several complementary issues mentioned below and applicants may select one or more of these issues.

- **Exploitation of (distributed) trusted AI/ML for 6G infrastructures.** The topic deals with frameworks that will provide security for the whole AI life to assure for models and behaviours predictability, including the AI development and deployment environments, AI models vulnerability quantification, understandable AI considerations and protection measures on AI misuse.
- **Cooperative holistic E2E security and privacy solutions for 6G architectures,** including, but not limited to, zero trust frameworks. Human-centric security and privacy solutions should be incorporated in these E2E architectures. The whole sequence of security phases should be considered from identification of threats, protection, detection, response towards recovery. Recovery will contribute to the resilience of Digital infrastructure and services. Secure host-neutral infrastructure where multiple infrastructure providers are involved is also in scope.
- **Smart and trustworthy service frameworks,** aiming at creating a comprehensive service marketplace with secure lifecycle management, ensuring continuous security assessment. 6G network security must be continuously assessed for end-to-end provable security. Various methodologies, such as security composition, differential deployment, and incremental evolution, are considered. Service frameworks encompass software aspects such as secure deployment and up-dates. These technologies should support collaboration among stakeholders, interoperation with different service run-time systems, and provide abstractions of security levels allowing integration and end-to-end composition.
- **Efficient security and privacy enablers.** This includes enablers for technologies as multi-level Security; security segregation and spatial fragmentation; flexible profiling of 6G resources; privacy enhancing technologies; security and privacy quantification with relevant evaluation methodologies and means; Multi-stakeholder Moving Target Defence evolutions; fast and proactive security recovery techniques.
- **Zero-touch integrated security deployment,** considering virtualized environments and highly distributed infrastructures. In scope are: i) the design and implementation of ciphers that can adapt to varying computational resources, with overall security levels being efficiently achieved adequately including limitations from resource-constrained devices and environments; ii) mechanisms, potentially using AI, to isolate and harden third party Apps; iii) and mechanisms to limit the attack surface resulting from exposing network capabilities to external applications; iv) techniques to improve the reliability of disaggregated architectures implemented by multiple building blocks.
- **Integration of secured 6G communications via Quantum key distribution and post-quantum cryptography support** deals with ensuring long-term security for 6G networks in end-to-end network infrastructure, particularly considering 6G requirements. This includes the coexistence with optical communication networks, facing the related challenges, the design and evaluation of techniques to combat impairments of the quantum channel, as well as 6G security procedures for quantum secure protocols enhancement (e.g., in terms of secure key rate). In scope are also flexible and efficient quantum-safe solutions, which can be programmable by software, facilitating the applicability of QKD and an optimal resource usage, strengthening the security of 6G networks. The topic also addresses new software-defined networking architectures and functional requirements for classical channel and key joint management.
- **Timing sensitive, and time responsive software and related hardware technologies for distributed, multi-stakeholder multi-system service provision.** These technologies should intelligently incorporate different technologies across different service providers, dynamically managing service execution realisation across arbitrary levels of horizontal and vertical interoperability, and performing optimal

adaptation to the physical constraints. On scope are also interfaces for customer or user-centric policies, and distributed computing technologies, able to implement operational realisations by establishing consensus according to different priorities (e.g., cost, reliability, code footprint), and trading off service cost in this runtime process.

The scope includes, where relevant, harmonisation/coordination with Member States or Associated countries 6G initiatives. Any produced PoCs should be implemented in a way that their integration in SNS WP2025-26 Stream C and/or Stream D project will be possible (e.g., open-source solutions, appropriate documentation, support after the completion of the project etc.).

HORIZON-JU-SNS-2024-STREAM-B-01-05: International Collaboration – EU-JP

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 3.0 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 3.0 million.
<i>Type of Action</i>	Research and Innovation Action
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 2-4 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

- EU-Japan research collaboration for the evolution of Radio Access Networks (RAN), evolving following 6G standardization orientations, paving the way for future advancements towards AI-native radio access networks.
- Development, testing and evaluation of AI/ML algorithms for wireless networks to improve the performance of the system.
- Proof of concept architecture framework demonstrating the way forward for the required interoperability specifications, that future 6G RAN and integrated RAN-Core network approaches have to achieve.
- Alignment of views on radio interface concepts for future exploitation in international standardisation as well as contributions to standardisation bodies and fora, supporting global views on open standards and interoperability, with particular focus on developments ITU-T, ITU-R, 3GPP and other related standardization organizations.

Scope

This SNS International Cooperation activity targets a closer collaboration with Japan, in line with the objective outlined under the EU-Japan Digital Partnership. It builds on the interactions developed between EU stakeholders and the key associations and stakeholders in Japan.

The cooperation with Japanese stakeholders targets native and privacy-preserving AI platforms in direct connection to the related research and innovation work in Japan. The scope covers all following topics:

- AI-enabled radio access network (RAN) solutions including physical layer and signal processing technologies for 6G RAN such as distributed MIMO and user centric network, RIS implementations and AI-enabled integrated RAN/Core network functions. This domain will also allow to leverage the Open RAN/virtualisation experience of Japan towards interoperability alignment of architectural approaches in EU and Japan.
- Streamlined views on a) the use of AI and b) potential extensions on the radio interface.
- Impactful contributions to standardization bodies are also in scope of this project.

The scope includes availability of data sets, in compliance with the rules of data legislation, both existing and new ones created by the project, that may be used by researchers to validate AI approaches and inference rules applied to the selected solutions. Contribution to the framework and data access is expected to add value, notably for improvement and expansion of data sets, tools and algorithms for efficient new AI/ML solutions. Generation and exchange of data across EU-Japan stakeholders is in scope where possible and appropriate. Proposals on validation of AI techniques over experimental platforms, additionally providing the associated datasets, are in scope.

Applicants are invited to explain how the EU-Japan cooperation will be implemented, i.e., the target Japan initiative to collaborate with and the approach of cooperation to be deployed with Japan stakeholders. The retained project is expected to work with the relevant Japan funded initiative by MIC/NICT, the call of which will be announced by March 2024. Proposals should include description of specific cooperation activities to be carried out such as exchange of information and results, sharing of data, sharing of methodologies, researcher exchanges and visits, joint workshops, joint testbeds etc.

HORIZON-JU-SNS-2024-STREAM-B-01-06: International Collaboration – EU-ROK

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 3.0 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 3.0 million.
<i>Type of Action</i>	Research and Innovation Action
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 2-4 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

This SNS International Cooperation activity targets the Republic of Korea (ROK). It builds on the interactions developed between 6G-IA and the key associations and stakeholders as well as Korea's industry, research community, and academia. The targeted action in this Strand will focus on EU-ROK R&I developments. The cooperation with ROK will tentatively focus on RAN, considering ROK's terminals and devices industry capabilities. The action will focus on the integrated device-network approach demonstrating a number of 6G functional properties.

The following targeted outcomes are considered:

- EU-ROK research collaboration in targeting Radio Access Networks (RAN) and integrated device-network approaches, evolving through 6G standardization discussions and paving the way for future advancements towards AI-native radio access networks.
- Application of AI/ML algorithms to wireless networks for the automation of base station management, and to user terminal traffic, for optimizing various base station control parameters for network energy saving or network failure recovery.
- Definition of an architecture framework addressing interoperability needs, that future 6G products have to achieve. Contribution to interoperability specifications through related standardization activities for existing and new interfaces.
- Alignment of views on radio interface concepts to support demanding 6G applications and services for future exploitation in international standardization.

Scope

- Algorithms for 6G RAN that improve transmission performance and reduce complexity in wireless transmission through machine learning-based channel estimation, channel state information transmission, channel decoding, distributed MIMO and beam management.
- Procedures and protocols empowered by AI that improve efficiencies of the wireless communications through mobility management, wireless resource management, automated maintenance, and self-optimization of network parameters.
- Architectural framework addressing the interoperability needs for integrated device-network approaches that will use the specified AI/ML mechanisms demonstrating 6G functional properties. Specific focus will be placed on standardization opportunities to support such interoperability schemes.
- The project will focus on what the radio access network side will be able to deliver to terminals using AI solutions for demanding 6G application and services. The project should provide hooks that will allow viable streamlining of interfaces and mechanisms that are expected to be developed by mirror R&I activities in ROK where the focus could be on the devices' side.
- Target would be to streamline views on a) the use of AI and b) potential extensions on the radio interface.

The scope includes availability of data sets, in compliance with the rules of data legislation, both existing and new ones created by the project, that may be used by researchers to validate AI approaches and inference rules applied to the selected solutions. Contribution to the framework and data access is expected to add value, notably for improvement and expansion of data sets, tools and algorithms for efficient new AI/ML solutions. Generation and exchange of data across EU-ROK stakeholders is in scope where possible and appropriate. Proposals on validation of AI techniques over experimental platforms, additionally providing the associated datasets, are in scope.

Applicants are invited to explain how the EU-ROK cooperation will be implemented, i.e., the target ROK initiative to collaborate with and the approach of cooperation to be deployed with ROK stakeholders. The retained project is expected to work with relevant ROK funded initiatives such as project(s) on EU-ROK cooperation funded by [the Republic of Korea Institute for Information & Communications Technology Promotion (IITP) and the Ministry of Science and ICT (MSIT)]. In this context, proposals should describe joint research dissemination activities including joint research publications in renowned international conferences and journals. Furthermore, proposals should include description of specific cooperation activities to be carried out such as exchange of information and results, sharing of data, sharing of methodologies, researcher exchanges and visits, joint workshops, joint testbeds etc.

HORIZON-JU-SNS-2024-STREAM-B-01-07: Sustainability Lighthouse

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 13 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 13 million.
<i>Type of Action</i>	Research and Innovation Action
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 2-5 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

The Lighthouse project expected outcomes on both “Sustainable 6G” and “6G for sustainability” dimensions include:

- Technologies and architectures enabling to offer and manage a systemic approach to sustainability covering at least energy, climate and environmental aspects, considering trust and security, availability, coverage, and accessibility, while targeting economic viability. It includes characterisation of AI/ML technologies design, development and use and the related impact on sustainability also including sustainable AI/ML mechanisms. An end-to-end perspective is considered including specific focus on the design phase and the complete life cycle where appropriate.
- Consolidation of the work started in the SNS Phase 1 (e.g., Stream B System/Flagship Hexa-X-II project and Enablers projects) and early Phase 2 projects (use cases, KPIs/KVIs, dedicated technologies) and integration of their outcomes. Development of synergies with potentially any results from other R&I sources (e.g., other European and national projects) into a sustainability end-to-end set of tools, solutions and best practices.
- In liaison with the SNS Call 2023 Societal Challenges CSA (HORIZON-JU-SNS-2023-STREAM-CSA-01: SNS Societal Challenges), contribution to the 6G social and

societal acceptability with identification of key stakeholders to be engaged in specific interactions / expert groups (e.g., organisation of specific targeted workshops).

- Co-development of “6G for sustainability” use-cases and business models that consider local, regional, and national economics, jointly with different stakeholders, including verticals, demonstrating and ideally quantifying how 6G contributes to the various aspects of sustainability in non-telecom sectors, including public sector and aspects related to citizen engagement. Contribution on standardized evaluation methodology on how the use of information and communication technology solutions impact greenhouse gas emissions / environmental impact/ trust and security, cost performance of other sectors.
- Reference benchmarking scenarios, especially for implementation and operations, and for both sustainable 6G and 6G for sustainability, in view of further assessing sustainability gains of specific implementations and operations. It takes an E2E perspective, from service platform to devices.
- Co-definition of specific 6G implementation models with stakeholders and end-users that considering technical performance, sustainability, economic trade-offs (including e.g., physics laws, network densification, architectural aspects, infrastructure sharing, neutral hosts, brokers...) and societal perspectives, raising sustainability awareness including improved sustainability literacy and education for use of applications, services and platforms and developing related recommendations for 6G implementation, operation and usage.
- Derived methodologies, recommendations, guidelines and standardisation requirements covering the full life cycle where appropriate (energy and security in particular) and taking into account existing harmonisation perspectives originating from e.g. the EU Commission, GSMA, ETNO, NGMN.
- Integration testing, evaluation and end-to-end validation of the key technical solutions.
- Proof of concept on specific promising SNS Phase 1 technologies that will provide tangible results on environmental, societal and economic sustainable objectives.
- A strategic roadmap and a European strategy towards sustainability as integral part of the 6G standardisation (“sustainability by design”), furthering the characterisation of KVs, ideally as quantitative indicators, of various projects and aiming at contributing to the global 6G vision. This includes the development of solutions and inputs to standardisation bodies (including 3GPP, ETSI) and worldwide fora (e.g., NGMN, GSMA).

Scope

The Lighthouse project addresses both the “sustainable 6G” dimension and the “6G for sustainability” aspect as two related work areas. Sustainable 6G covers 6G system design with respect to related KPIs and KVs with the objectives of working out quantitative (scientific) measures for sustainability assessment where appropriate, to define benchmarking scenarios that allow to assess sustainability performance for specific 6G implementation scenarios, taking into account the contemplated 6G architectures. As a baseline, sustainable 6G deals with 6G capability to optimise the energy and resource consumption both from operational and non-operational perspectives (sustainable 6G) of 6G platform, to maximise security/trust performances, to optimise economic accessibility and coverage and to minimise use case operation costs. These are though not limitative.

“6G for sustainability” addresses the contribution (benefits and challenges) of 6G to the various aspects of sustainability in vertical sectors (also referred as enablement effect). It focuses on how 6G can enable the verticals to be more sustainable, how to measure it and

what research aspects still need to be tackled. This requires a deep knowledge of selected use-cases and their processes with potentially conflicting requirements (e.g. performance vs minimisation of energy consumption). Needed expertise should come from the selected sectors and stakeholders to make their processes more sustainable by means of 6G. Additional expertise beyond telecommunication and verticals sectors is expected.

Scientific/technological analyses of sustainability may then be used to define sustainability benchmarking or reference scenarios to validate specific implementation in a sustainability context. It is expected that the work under the Lighthouse project can then fuel industry recommendation, guidelines or standards.

“Sustainable 6G” and “6G for sustainability” should be equally addressed and will be considered through three dimensions of which: (i) environmental sustainability, targeting the minimisation of environmental impact, as a prominent issue (ii) societal sustainability, aiming at providing value to people and society also thanks to new use cases powered by 6G as well as the need to offer such services in a trustworthy, privacy-safeguarding and accessible way, and (iii) economic sustainability, where 6G will be an enabler for business value and could enable new business models. The targeted project scope includes:

- Environmental Sustainability (including energy, climate and environmental aspects)
 - Sustainable 6G: (1) Improving energy efficiency and total energy consumption. It includes network and device side, e.g. enabling more energy efficient network operations covering power usage monitoring, multi-criteria optimisation, self-diagnose & healing. Minimization of EMF effects (2) Investigating network-device performance versus energy consumption trade-offs, (3) Evaluation from a system and life cycle perspective, using environmental metrics and (4) Developing strategies to ensure that AI/ML technique to be used in future 6G networks are environmentally sustainable, (5) Address energy resilience where the network and services adapt dynamically to the availability of renewable energy. This work of technological nature will be complemented by an analysis on how to improve material efficiency and circularity.
 - 6G for Sustainability: (1) Technologies and architectures enabling use cases to be “service aware” vis a vis the network platform, such that intelligent sustainability decisions may be made at use case level (2) Propose guidelines, recommendations and good practices and (3) Evaluate potential CO2 and other GHGs reductions as well as any other (and other environmental impacts reduction) in other sectors. Such reduction, enabled by 6G, might be related, for example, to more efficient operation of large infrastructure or industrial process leading to energy reduction and/or natural resource impact. Another example could be a better lifecycle management, enabled by 6G and leading to increased lifetime and improved re-use, upcycling and recycling of specific goods. It includes benchmark and quantified indicators for selected representative use cases. It considers the broader governance and policy needs to support such actions towards sustainability.
 - Note that attention maybe paid to the rebound effects connected to the design and development of 6G systems, while considering e.g., inclusivity-coverage/production-emissions, economic viability/TCO-affordability aspects.
- Societal Sustainability
 - Improve the social footprint of 6G, such as: (1) Ensure key democracy values are preserved (Privacy, Trust, Resilience, Fairness, Digital Inclusion, Accessibility), (2) Focus on value for society and people, (3) Perform state-of-the-art analysis about the extent to which current networks and platforms address societal perspectives and (4) Elaborate on trends and drivers of societal digital inclusion with efficient solutions in all contexts.

- Investigate how 6G can create added value for the society: (1) Considering different gender perspectives & citizens' concerns and/or needs, (2) Answer how 6G does support social aspects, (3) Indicate 6G benefits for the end users & society and (4) Focus on inclusion and trustworthiness.
- Economic Sustainability
 - Improve the economic viability of 6G by ensuring its ability to operate with controlled deployment and operational cost to enable stakeholder to adapt themselves in accordance with foreseen value of 6G services: (1) Provide flexibility in infrastructure and resources management, (2) Evolutivity and ability to adapt to news services/requirements, (3) Follow modular architectures to ease evolutions.
 - Evaluate economic aspects of 6G to support long-term economic development of society: (1) Evaluation of 6G ability to impact economy at large considering cost and value associated with 6G, (2) Identify economic trends and drivers for 6G market disruptions, opportunity and risks, (3) Identify key stakeholders, roles, relation and business potential for 6G ecosystem in selected verticals, (4) Define business and revenue models and total cost of ownership of 6G for key stakeholders and (5) Assess business impact of social aspects and environmental sustainability, as mentioned in the above text.

This threefold approach will drive the design and integration of technical solutions into a sustainability end-to-end set of tools and solutions. The work hence covers:

- Validated technologies, systems and architectures needed to develop 6G as a sustainable platform, covering at least environmental sustainability, resource efficiency, cost, trust, security, and accessibility. Performance of key technologies in the sustainability context may be characterized as “standalone” but should preferably be demonstrated from an end-to-end perspective.
- Definition of sustainability framework as part of the network management functions capable of monitoring and piloting sustainable operations and service implementations.
- Reference sustainability scenarios and benchmarks, both for the 6G platform and for the targeted/supported use cases.
- Characterisation of sustainability KPI and KVI's, in view of their potential use at standardization level.
- Validation of critical technologies for the sustainability solutions in experimental platforms and use case pilots.
- Definition of the SNS approach towards sustainability.
- Definition of downstream recommendations and guidelines towards sustainability implementation and operations in deployment contexts.

The project should work complementary and take into consideration the breakthroughs and results from the projects under the HORIZON-JU-SNS-2024-STREAM-D-01-01: SNS Large Scale Trials and Pilots (LST&Ps) with Verticals call.

HORIZON-JU-SNS-2024-STREAM-B-01-08: Reliable AI for 6G Communications Systems and Services

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution in the range of EUR 6 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is in the range of EUR 6 million.
<i>Type of Action</i>	Research and Innovation Actions
<i>Technology Readiness Level</i>	Activities are expected to start at TRL 2-3 and to reach TRL 4 by the end of the project, and if/where relevant up to maximum TRL 5 (mature 6G technologies and solutions for verticals). Some parts of the project may only target TRL 3 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

The key expected outcomes include:

- Realistic applicability of AI at large scale in 6G networks for natively supporting AI architectures, common data sets and/or federated learning methodologies and assessment models, including re-training of models with the introduction/update of the data sets; AI/ML solutions that will have impactful contribution to standardisation activities; Interpretability solution exploring standard-compliance testing & debugging techniques.
- Development of curated data sets of realistic 6G scenarios (using new real and/or synthetic data sets) for reference usage in telecommunication research and standardisation, targeting their wide acceptance and future usage for benchmarking by future EU R&I activities.
- Analysis, aggregation and harmonisation of results from existing projects and creation of an overall framework for benchmarking and calibration, end-to-end testing and evaluation of AI solutions for 6G networks.
- Metrics and models to assess the pros and cons of AI technologies in telecommunications, including aspects as energy efficiency, explainability, reliability, safety and security, non-discrimination, privacy and performance as well as usability & accessibility for users. Specific focus should be on energy-efficiency and computational complexity that are still open issues for real-time hardware.
- Recommendations for policy and regulatory guidelines on the development and usage of AI solutions for network optimisations and provision of AI as a service.
- Development of a trustworthy AI framework which should be addressed in each stage of the AI system building (from data to model development etc.).
- Focus should be on implementation and connected to current standardization efforts and state-of-the-art Open Source frameworks and tooling.

Scope

The focus of this Strand is on several complementary issues and applicants may select several or all the below-mentioned issues. The main goal of this project is to fill the gaps and work on the end-to-end system integration of SNS AI/ML solutions, or national level developed AI/ML solutions and not to focus on dedicated AI/ML problems of specific network domains. The targeted project scope includes:

- Development of a reference framework for end-to-end AI usage for the telecommunications domain in relation to 6G, including methodologies for centralized, distributed and federated applications, reference use cases, data acquisition and generation, repositories, curated training and evaluation data, as well as the technologies and functionalities needed to use it as a benchmarking platform for future AI/ML solutions for 6G networks. The framework should be expandable so that future R&I actions can follow its directives and easily provide new use cases and data sets. Towards this end, the reference framework shall be hardware-agnostic, so that it can support heterogeneous hardware implementations.
- Development of appropriate data infrastructure and functionalities that will enable novel AI-based services as well as AI as a Service to vertical industries.
- Models for AI costs and benefits in telecommunications applications. Typical 6G metrics should be able to be evaluated, including but not limited to data rate, latency, density, energy efficiency, flexibility and performance, and/or security and privacy, but other value metrics can be considered as well.
- Solutions that will guarantee reliable use of the technology and build trust in 6G and services enabled by 6G. Associated topics include: i) AI environment (training, development, production) evaluation; ii) assessment models of reliable AI costs and performance value; iii) conflict resolution among local and global AI models, iv) Vulnerability assessment of AI models for different telecommunication applications potentially using friendly hacking means and v) Reliable and trustable AI life cycle, including the AI development and deployment environments.
- The framework should address a wide range of open issues indicatively and not limited to, e2e AI/ML conflict resolution, placement of AI at appropriate places inside the network (e.g., edge), provide energy friendly AI/ML solutions, how to handle vast amount of data for AI/ML purposes using computing/storage and network resources in a scalable way, and any other advances needed to support the overall goal. In addition, the AI/ML should be able to work across different/multiple network infrastructures, tools, apps, and data/communication needs.
- Where relevant, harmonisation/coordination with Member States or Associated countries 6G initiatives, as well as with the existing SNS EU-US cooperation initiative (HORIZON-JU-SNS-2023-STREAM-B-01-06: EU-US 6G R&I Cooperation). Any produced PoCs should be implemented in a way that their integration in future SNS WP2025-26 Stream C and/or Stream D project will be possible (e.g., open-source solutions, appropriate documentation, support after the completion of the project etc.).
- Production of data sets should cover as many areas as possible from the actual operation of 6G networks (user mobility patterns, RAN/Transport/Core data traffic patterns, network failures or security attacks, computing usage patterns etc.) including real and synthetic data, or even appropriately adapted data from open free data sets.
- Production of data sets and validation methodologies, contributing to 6G Human Centricity and Societal acceptance and in compliance with the rules of data legislation. Development of guidelines, for ethical considerations, and suggestions to regulatory frameworks are also desirable. Methods of accreditation of usage/compliance may also be considered to validate techniques of dataset production and dataset conformance.

- Development of solutions that will address the need for robust and trustworthy AI/ML validating the “quality” datasets from different scenarios, which influences the outcomes of the AI systems, as well as the corresponding outcome of AI.
- Verification and validation of AI techniques over experimental platforms, additionally providing the associated datasets.

Applicants are expected to provide details on the type and availability of the datasets to be produced and curated by the project. This includes, but is not limited to, whether they will be based on existing or new datasets, project partner(s) in charge of producing them, whether they will be based on real-world measurements or synthetic ones, etc; as well as their complementarity, availability of datasets beyond consortium partners.

HORIZON-JU-SNS - Stream C – Smart Network & Services experimental infrastructure

Specific Challenges and Objectives

The challenge is to make pan European platforms available that can be used to test and experiment candidate 6G technologies with capabilities to:

- Validate (TRL 5) / demonstrate (TRL 6) candidate 6G technologies, components and architectures at system or sub-system level paving the way towards their adoption at standardisation and at market level.
- Show the applicability of such technologies to efficiently support advanced application and use cases not supported by current 5G and 5G Advanced systems.
- Integrate advanced European micro-electronics components into an end-to-end 6G system. A related objective is to stimulate participation of the micro electronics industry in EU in the early stages of 6G standardisation to maximise EU position in 6G IPR (Standard Essential Patents (SEPs)).
- Validate/demonstrate the performance and benefits of the aforementioned components in realistic usage scenarios.

This topic will continue and enhance the work on experimental platforms of Phase 1 and Call 2023 with further implementation of 6G functionalities and, under the call 2024, with a particular focus on the integration of microelectronics components. The Stream offers opportunities to include additional platforms developed in other related Partnerships (e.g., Chips JU) or national initiatives, or Cluster 4 projects, (e.g. HORIZON-CL4-2022-DIGITAL-EMERGING-01-30 project) or previous SNS projects, if partners from such initiative contribute to SNS projects, e.g. by expanding the work of SNS platforms from previous calls.

The topic will potentially also further the microelectronic work on research areas initiated and to be developed by enabling technologies for Beyond 5G/6G RAN disaggregated architectures and also in other areas like cm Wave, sub-THz and THz communications, wireless transceivers, ultra-low power wireless, new antennas etc.

It must be noted that although Stream C intends to gradually develop experimental platform(s) over the different SNS phases, projects implemented under Phase 1 and Call 2023 and submitting a follow up in Call 2024 should not be considered as having any priority over new proposals.

The main objective of this topic is hence to further the development of EU wide experimentation platforms that can incorporate various candidate 6G technologies for their further validation and demonstration, with capabilities extended to the domain of microelectronics components.

Similarly, to Phase 1 and WP 2023, related objectives include:

- a) Reusability and evolvability of the experimental platforms over the lifetime of the SNS programme: Platforms or specific components can be (i) further extended to ensure a continuous integration of the most promising 6G technologies, (ii) capable of supporting downstream Stream D projects where appropriate.
- b) Accessibility and openness: Use of the platform in subsequent phases of the SNS by any consortium, requires using a modular implementation methodology and, potentially, open-source solutions with well-defined and documented technological and business interfaces.
- c) Directionality and optimisation of previous and related investments in Europe: 6G experimental platforms piggybacking on previous investments in Europe (e.g., SNS proof-of-concepts or platforms, or from the 5G Infrastructure PPP Work Programme, or Chips JU projects where relevant) may be considered including other technology-

oriented initiatives on open ecosystems (e.g., Open RAN). Leveraging 6G investments by Member States or Associated countries is also relevant in this context.

- d) Disruption friendly: Experimental facilities—should be capable of hosting possible upcoming 6G disruption and hence guarantee their future-proofness.
- e) End-to-end: The target experimental facility should preferably be capable of demonstrating E2E service capabilities and include a full value chain including IoT devices, connectivity, and service provision.

Concerning security, in this Stream, specific security issues are to be identified in the security section of part A of the proposal whilst mitigation measures should be outlined in the Annexed form to the proposal.

Implementation modalities are specified in the additional call conditions under Appendix 1.

HORIZON-JU-SNS-2024-STREAM-C-01-01: SNS Microelectronics Lighthouse

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 10 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 10 million.
<i>Type of Action</i>	Research and Innovation Action
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL up to 6 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

Expected Outcome

The main outcome will be the availability of an evolvable 6G experimental infrastructure for the duration of the SNS programme that covers as many capabilities as possible to:

- Validate/demonstrate 6G candidate microelectronics technologies and systems as part of a representative end-to-end 6G architecture building on advanced components/HW technologies, Support where possible the development of synergies with 6G platforms developed in EU Member States (MSs) or Associated countries at national level in the context of 6G national R&I programmes, or other relevant industrial/research centre/academic activities.
- Exploit the results and momentum of the EC 5G Infrastructure PPP ICT-42 COREnect CSA project, which has defined a roadmap for Microelectronic components for telecom systems and reinforced synergies with the Chips JU.
- Integrate the solutions for the Radio Access part of the network, considering available solutions for future network implementation especially in the context of a future 6G disaggregated RAN and of the 6G convergence/virtualisation of data processing across the complete delivery chain, from RAN to data centre.

- Validate/demonstrate the performance of key 6G candidate HW solutions, technologies, components, and architectures operating across various frequency bands. To that extent, technologies as identified notably under previous or current 5G PPP, SNS and Chips JU projects may be considered as a baseline. Support to impactful contribution to standards is expected.
- Support integration of key 6G related Chips JU developments, though integration of wireless/processing advanced components, or compute platform/programmable accelerators within the 6G experimental platform.
- Validate/demonstrate feasibility of “better than 5G / 5G Advanced” KPIs, related indicatively to capacity, ubiquity, speed, latency, reliability, density of users, location accuracy, energy efficiency, security, service creation time, network management CAPEX/OPEX. It includes capability to incorporate emerging 6G specific KPIs and the capability to address key KPIs as appropriate as developed by previous 5G PPP and current SNS projects. Support the demonstration of the feasibility of key societal requirements and objectives such as energy reduction at both platform and use case levels, EMF impact and acceptability, sustainability, social inclusivity, safety and security, trust and resilience. Other key societal indicators include coverage, accessibility and affordability of the technology.

Scope

The main target is the development of new, or evolution of existing, experimental platform(s), where solutions from the microelectronics domain developed either in the context of Phase 1 SNS WP, or Horizon Europe Cluster 4 WP, or the Chips JU will be validated in terms of performance and applicability for 6G networks. Microelectronics developments in the context of 6G national initiatives are also in scope. The experimental platform(s) are expected to mainly focus on the Radio Access Network computing and communication capabilities (potentially including solutions covering a wide spectrum e.g., from cmWave up to THz) providing solutions in key areas identified by the COREnect CSA project.

The scope of the project should include one or more of the topics below:

- Advanced baseband capabilities as needed in virtualised platforms from the device or network side, taking open approaches and RISC-V technologies as targets and supporting SoC’s implementations as well as AI Edge modules, integration of multiple technologies for JCAS, Flexible hardware platforms supporting virtualisation and programmability in a fully distributed edge environment, including hardware accelerators. The project should clearly identify how potential computing infrastructure will be used to cater for the needs of the communication infrastructure.
- Integration of the THz communications technology into a complete THz communication chain and demonstrator, in view of validating the technology in an end-to-end radio system context, focusing on the two main THz communications applications: Integrated Access Backhaul (IAB) with high capacity provided to a myriad of small/nano cells; direct short range high-capacity access as needed in specific industrial environments.
- The system validation in this platform context which may address an E2E x-hauling demonstrator prototype with extended transmission reach at Sub-THz frequencies (>140GHz). The idea is to push the disruptive THz components developed previously to higher TRL levels and demonstrate their capabilities in D-band (140-164GHz) or above with extended performances such as power amplifiers reaching high power saturation while keeping low power consumption and low noise amplifiers (LNA) with low noise figure and high gain. In the context of industrialisation, the purpose will be

also to showcase implementation of interconnected technologies in RFICs compatible with low RF loss at sub-THz frequencies operation.

- The potential inclusion of microelectronics solutions in the transport domain or unified solutions with NTN and support of the IoT-connectivity-service provision value chain as appropriate.
- The establishment of a bridge between the SNS JU and the Chips JU, offering on the one hand new requirements to the microelectronics domain while on the other hand providing validation results of the tested solutions to Chips JU so that these can be considered in the subsequent phases of the Chips JU. The scope of the project targets an active cooperation link between the two communities and serve as a catalyst for further related activities for the EU private and public sectors. The scope also covers prominent downstream 6G standardisation activities by the microelectronics industries and stakeholders.

Evaluation of core 6G technologies and architectures in the context of specific 6G use cases may be considered but is not mandatory. Support of AI implementations through the considered microelectronics focus of the project shall include availability of large-scale data sets and training sequences as part of open repositories available to the EU community at large.

The demonstration capabilities of the target platform(s) are to be assessed against a set of emerging KPIs and KVIs as typically defined by the 6G international community and on-going initiatives. Proposals should be flexible enough to accommodate new relevant KPIs as they become available from the wider 6G community and from potential use cases.

To provide the required openness to host vertical use case pilots it is desirable that the project platform(s) support open framework principles (e.g., both legal and technical like open APIs) enabling future vertical projects to access and use them. It is also strongly desirable that these facilities are built in a way that allows the evaluation of competing technologies where appropriate. Openness is also a key requirement for “partial implementation” of demonstration capabilities. In that case, well defined infrastructure and service interfaces will have to be defined in view of interoperability with complementary platforms.

It is important to note that the applicants will commit that the project result will be easily replicated in the same or additional locations/countries if the project platform(s) will be selected for large scale trials as part of forthcoming Stream D projects.

The target experimental project platform(s) and their modules should be open and accessible for a long enough period to allow for an easy handover from one phase to the other. Conditions should allow experimental project platform(s) to be easily reused under fair and reasonable conditions for subsequent phases of the SNS programme implementation.

In view of ensuring maximum take up of the validated technologies, proposals should include a significant representation of key European industrial supply side players, in partnership with relevant academic, RTO, user actors, with strong demonstrated impact at standardisation level.

HORIZON-JU-SNS - Stream D – SNS Large Scale Trials and Pilots (LST&Ps) with Verticals

Specific Challenges and Objectives

The objective is to validate 5G Advanced and 6G technologies in a user context to further enable downstream take up. This Stream targets:

- The validation of SNS KVs and KPIs in the context of very advanced digital use cases implemented through Large-Scale Trials and Pilots (LST&P).
- The identification of use case specific KVs and KPIs and how they may be matched by SNS platform KVs and KPIs.
- A structured feedback loop from vertical users towards SNS stakeholders, in view of ensuring the best match between 5G Advanced / 6G systems capabilities and users.
- An integrated validation approach, from 6G platform to use cases, leveraging existing (open) platforms (e.g., developed under Stream C).
- The evaluation, measurement and testing of ICT technologies enablement effect and impact in different and complex ecosystems.
- Accessibility and openness: The required targeted adaptations of the Stream C infrastructures/platforms as required to support specific Stream D use cases should be available in further phases of the SNS by any consortium, which requires using modular implementation methodology, potentially open-source solutions with well-defined and clearly documented technological and business interfaces.

The Stream contributes to the creation of ecosystems with verticals identifying real business pain points and how these can be addressed by advanced technological solutions.

A related target is to leverage relevant 5G Advanced / 6G solutions available from European initiatives, also at the national level (where possible and from partners at the national level that contribute to SNS projects), in this field. Stream D projects are thus expected to benefit from identified 6G enablers (i.e., technological: AI/ML, cybersecurity, HPC, advanced IoT solutions and societal value: inclusivity, energy efficiency, economic growth) and 6G solutions from previous SNS calls. When implemented over Stream C infrastructures or PoCs, it may be needed that platform enhancements are needed for the specific target use case. In this case, these Stream C enhancements are expected to follow the same requirements as expressed for experimental platforms, in particular openness, reusability, and accessibility.

The activity should also target visible and high-level exposure of European capabilities and leadership in technologies towards 6G through support of large showcasing events.

Key targets for Stream D, by decreasing order or priority, are to address (1) Sustainability-driven projects, that evaluate ICT technologies enablement effect and impact in and for vertical sectors and (2) KPIs and KVs oriented projects, targeting to validate significant network KPIs and KVs improvements towards 6G systems (e.g., KPIs such as throughput, latency, reliability, spectral efficiency, etc. KVs such decrease in greenhouse gases emissions, increased number of communities with access, re-usable infrastructure) in order to serve advanced and demanding use-cases and applications to be further developed by verticals sectors. Use cases that drive the 6G perspective, e.g., use-cases based on highly immersive digital representation of the physical world and of massive twinning, whilst leveraging the EU community active in this domain e.g., SMEs, are expected to be addressed in this phase.

The use cases to be addressed by the verticals are invited to consider how the 5G Advanced and 6G technologies they will use are embracing sustainability considered from an environmental, societal and economic sustainability perspective.

Concerning security, in this Stream, specific security issues are to be identified in the security section of part A of the proposal whilst mitigation measures should be outlined in the Annexed form to the proposal.

Implementation modalities are specified in the additional call conditions under Appendix 1.

HORIZON-JU-SNS-2024-STREAM-D-01-01: SNS Large Scale Trials and Pilots (LST&Ps) with Verticals

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 12-13 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 25 million.
<i>Type of Action</i>	Innovation Actions
<i>Technology Readiness Level</i>	Activities are expected to achieve TRL 5-7 by the end of the project – see General Annex B.
<i>Funding rate</i>	100% non-for-profit organizations, 70% for profit organizations

Expected Outcome

The key target of Stream D projects will be to qualify, quantify and test advanced 5G/6G technologies enablement effect and impact in and for vertical sectors. Apart from the verticals digitisation, a key focus will be placed on achieving tangible results on sustainability. Sustainability will be addressed from the environmental, societal and economic perspectives, considering specific related use-cases in relevant verticals sectors. The target applications are open to applicants to select from any already advanced 6G use cases that are in line with the 6G vision and ambitions³⁵. The advanced use-cases are targeted to demonstrate high value impact on environment or/and societal or/and economic sustainability perspectives. This phase of pilots is expected to leverage new sets of 6G capabilities and KPI support as they gradually become available over time. For these applications, it is particularly important to demonstrate that the underpinning 6G architecture and technologies can scale up to the new set of requirements, can be implemented across heterogeneous technological and business domains, and can support innovation through openness. These projects should aim to take advantage from developed platforms and/or elements from the SNS Phase 1 Stream C projects, platforms developed in the context of national initiatives or any other solutions that integrate and offer preliminary 6G network solutions. Moreover, Stream D projects need to plan for a strong collaboration link to the HORIZON-JU-SNS-2024-STREAM-B-01-07: Sustainability Lighthouse.

The key expected outcomes are:

³⁵ 6G-IA Vision Paper "European Vision for the 6G Network Ecosystem" (<https://5g-ppp.eu/european-vision-for-the-6g-network-ecosystem/>).

- Evaluation, measurement and validation of the sustainability impact of advanced 5G/6G technologies in different or complex ecosystems for environmental³⁶, societal and economic aspects and for specific use-cases
- Use case specific reference sustainability models with a description, which sustainability parameters are considered.
- Contribution to the further refinement of sustainable seamless E2E 6G test infrastructures with fine-tuned capability to integrate vertical use cases specific performance/KPI requirements, as applicable also across public and non-public networks and services.
- Validated infrastructure core technologies and architectures across the value chain in the context of vertical large-scale pilot use-case implementations and relevant deployment scenarios targeting tangible sustainability results.
- Viable business models for innovative digital use cases tested that will address clear sustainability targets across various vertical sectors.
- Support to impactful contributions towards standardisation bodies notably for 6G use cases and technologies, including KVIs.
- European 5G Advanced and 6G know-how showcasing. Visible events widely open and inclusively accessible to the public are particularly relevant.
- Stimulation of large industrial stakeholders, SMEs and the European Academic and Research community to engage in experimental activities in a timely fashion, aimed to validate technological trends for sustainability.
- Collection of requirements from verticals for sustainable solutions and collection of “lessons learned” to prepare for subsequent phases of the SNS programme.
- Contribution to a repository of open-source tools and modules that may be openly accessed and used by SNS projects over the programme’s lifetime.
- Contribution to SNS programmatic actions related to sustainability, in connection to 6G-IA and SNS Working Groups and contributions to the HORIZON-JU-SNS-2024-STREAM-B-01-07: Sustainability Lighthouse project is expected so that these projects contribute to the SNS wide vision and solutions on “6G for sustainability”.

Scope

The target 6G systems validation work through large-scale trials focusses on use cases related to “sustainable 6G” and “6G for sustainability” targeting environmental, economic and societal sustainability goals. The projects are expected to cover at least :

- Demonstration of clear benefits with stakeholders of the considered 5G advanced/ 6G technologies and architectures in terms of innovative 6G smart networks and services addressing multiple aspects (e.g., scalability, security, and performance improvements) in line with medium to long-term diverse socio-economic scenarios.
- Special focus on targeting and achieving, by the end of the project, tangible results for environmental (e.g., optimize energy consumption, minimize CO₂ emissions, etc.), societal (e.g., inclusiveness, EMF exposure, trustworthiness, privacy, technology acceptance, etc.) and economic aspects (e.g., viability for vendors, network operators

³⁶ For methodological approaches evaluating environmental (climate) impact proposers may consider the work of the European Green Digital Coalition (greendigitalcoalition.eu).

and vertical service providers benefits for local economies, potential new business entrants, affordability, etc).

The Large-Scale Pilots should be carried out from an end-to-end perspective, with representative technologies covering the full value chain, including devices, connectivity, and service delivery. They should demonstrate the integration of different IoT/cloud/edge/computing environments (public and/or private) towards a distributed environment and dynamic resource needs with a landscape unified management able to support the emergence of a European offer and capability.

The involvement of SMEs/scaleups/ startups is targeted in the projects. These actors are expected to play a key role in this process with new market-driven applications that can build value on the 5G/6G infrastructure. This support will be a critical enabler of European-led innovation, fast track adoption, and stimulation of private sector investment, across verticals.

The performance and sustainability capabilities are to be assessed against a set of well-defined KVIs and KPIs. The developing set of KPIs in the international context will be taken as a basis, also those of previous projects, notably for KVIs, and potentially further extend them. Proposals should clearly indicate the target set of KPIs and KVIs and how this breaks the state of the art. Performance improvement and sustainability aspects in all domains requires definition of a benchmark against which improvements may be evaluated. Cross project collaboration is needed to define such a benchmark that will be part of the target outcome KPI repository of the SNS Partnership. It is expected that software entities implement the target services in Open-Source Code and with open interfaces for further reutilisation in subsequent phases. Outputs of the work is expected to demonstrate the applicability of 6G KPI/KVI to specific use case requirements, i.e., to map those with higher level requirements at application level.

SNS LST&Ps are expected to attract the participation of vertical industries in view of stimulating a strong European participation in future downstream standardisation phases. Therefore, participation of industrial actors with demonstrated strong standardisation impact is desired.

The Stream D projects should aim to take advantage from developed platforms and/or elements from the SNS Phase 1 Stream C projects, platforms developed in the context of national initiatives or any other solutions that integrate and offer preliminary 6G network solutions. Moreover, Stream D projects need to plan for a strong collaboration link to the HORIZON-JU-SNS-2024-STREAM-B-01-07: Sustainability Lighthouse.

HORIZON-JU-SNS-STREAM CSA, Coordination and Support Action

Specific Challenges and Objectives

The SNS projects under Streams A to D are implemented as a coherent programme using complementary grants to ensure effective interworking and collaboration. The appropriate options of the Horizon Europe Grant Agreement are applied to facilitate this. These options in the SNS Project Grant Agreements require cooperation between all the SNS Research and Innovation Actions (RIA), SNS Innovation Actions (IA) and SNS Coordination and Support Actions (CSA) towards joint achievement and leveraging of the SNS programme results. Also, a consistent strategy for communicating these results with the rest of the world is needed as well as support to the SNS JU Office. Currently two CSA projects are supporting these activities and will be completed by the end of March 2025.

The SNS 2024 Work Programme foresees the need for a new CSA to perform the core activities of the SNS Programme organisation and operation of the working structures of the initiative, including the supporting infrastructures inherent within it, and the communication dimensions. This CSA project will also act as the Global ambassador for the SNS initiative.

The new CSA project will also:

- Monitor the openness, fairness, and transparency of the JU process, including sector commitments and leveraging factor.
- Ensure an effective “inclusiveness” policy to involve diverse sector players.

Considering the strategic support nature of the CSA’s, they should demonstrate a strong capability to tightly liaise with the JU Public and Private Members and to tightly integrate their work plan with the operational plans of the Public and Private Members of the JU and stakeholders at large.

In this topic the integration of the gender dimension (sex and gender analysis) in research and innovation content is not a mandatory requirement.

HORIZON-JU-SNS-2024-STREAM-CSA-01: SNS Operations and Output optimisation

Specific conditions	
<i>Expected EU contribution per project</i>	The Commission estimates that an EU contribution of around EUR 4 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
<i>Indicative budget</i>	The total indicative budget for the topic is EUR 4 million.
<i>Type of Action</i>	Coordination and Support Action
<i>Funding rate</i>	100% non-for-profit organizations, 90% for profit organizations

The prime objective of the coordination and support work is to facilitate the activities of the European SNS JU community and the related Work Programmes, building on the first phase activities, to integrate the second phase activities and prepare for subsequent phases.

In addition to this, the CSA project has a second prime objective to capture and promote the European view on 6G, publish and promote the achievements of the SNS projects and programme and monitor the development and impact of these results on the evolution of 6G in Europe over the life of the 6G SNS Programme. This work will also look to the future and consider what additional strategic actions are necessary to maintain the European momentum

and leadership in 6G and facilitate the uptake of 6G by the vertical sectors in Europe. The CSA should consolidate and further develop strategic promotion and communication activities to maximise the impact of the SNS JU.

The CSA project should build upon the solutions, communication frameworks and results of the SNS Phase 1 CSA projects so that there is a seamless handover of all SNS support activities under the new project as well as the communication links with global and European stakeholders.

A key activity will be to actively support national and international collaboration for 6G through promoting the SNS Programme views across the wider community of SNS JU stakeholders, including national authorities, European member states initiatives, peer initiatives (ESA, Eureka, etc.), peer Partnerships (e.g., HPC, Chips, AI, Data and Robotics, Photonics Europe, CCAM, etc.) and Associations (e.g., 5GAA, 5GACIA, etc.). Involving European standards communities and promoting international liaison and discussions are considered an important aspect of the European SNS JU initiative on the global 6G stage.

It is essential that the CSA facilitates the 6G SNS JU public results being made available so that the achievements can be peer reviewed by other regions and initiatives to ensure that they are respected and used for consensus building as a precursor to international standardisation. The 6G SNS liaison work will include the promotion and representation of the 6G SNS JU work in global fora. This will involve seeding 6G SNS JU programme and project presentations at international fora and, in selected cases, orchestrating demonstrations at intercontinental meetings.

The CSA should provide support services to the SNS JU related working groups where the community members and projects should be facilitated to produce consolidated views and position papers, which capture the experience of the programme and can greatly help generating consensus about the uptake and use of new technologies.

The CSA project should also orchestrate the EuCNC & 6G Summit conferences in 2025 and 2026.

The CSA project should demonstrate capability to leverage previous SNS investments in support of SNS operations.

Expected Outcome

The following expected outcomes should be addressed:

- A seamless support from Phase 1 CSA projects for the Smart Networks Services (SNS) institutionalised European partnership and the related programmatic organisation through cross SNS projects coordination.
- Organisation of the SNS as a coherent programme with clear links to the 6G Smart Networks and Services Industry Association and the EC via the partnership board and the JU Office and their strategic policies.
- Support for the identification of strategic R&I orientations including at global level, the coordination of R&I results/initiatives at EU scale including Member State level initiatives, the dissemination and web presence, the organisation of Europe's contribution to standards, and the identification of international cooperation priorities across key regions.
- Consolidation and further development of strategic promotion and communication activities, both at project and Office level.
- Organisation and support of the EUCNC & 6G Summit (EuCNC&6GS) conferences.

- Generation, publication, and promotion of common technical papers showing the work and consensus of the SNS projects, including the value and impact of engaging KVIs
- Maximised output and exploitation of SNS project results in key domains (e.g., standardisation, spectrum) through managed cooperation between projects on horizontal issues.
- Constituency building, stakeholder support, support to key international cooperation events; dissemination, support core inter-project cooperation activities, relevant stakeholder events; definition of future R&I actions.
- Assistance to Inter JU coordination and joint actions. Maintaining the dialogues with Peer Partnerships (e.g., HPC, Chips, AI, Data and Robotics, Photonics Europe, etc.) and Associations (e.g., 5GAA, 5GACIA, ECH Alliance, ERTICO, ECSO etc.) and organisation of dedicated workshops to ensure relevance and synergies in both directions. Assistance in the periodic update of the SNS SRIA.
- Maintaining a continual improvement process based on regular assessments of SNS KPIs and strategic actions via future workplans to improve the achievement of the SNS goals.
- Invite new community members to the dialogue and constituency building, including those with input towards policy, sustainability, and societal value from non-technical perspectives (relevant to the verticals), that will support the development and testing of effective KVIs.
- Increase of the active engagement of diverse vertical sectors in order to better integrate their individual requirements.
- Establishment of a continuous dialogue among the key actors taking part in Horizon Europe programme and those in the other regions programmes to reinforce collaboration and increase synergies, in particular to dialogue about the human-centred aspects of technology development.
- Maintaining the global 6G ecosystem engaging relevant initiatives and key actors from EU and the other regions/countries, collaborating on the evolution and positive impact of 6G.
- Reinforcement of strategic partnerships between EU and the other regions/countries for the definition of joint R&I actions in 6G areas of mutual interest through roadmapping.
- Assistance towards the definition and collection of 6G related KPIs and KVIs and their mapping to the 6G indicators of the other global regions.
- A high level of European participation in Global 6G Events.
- A strong cooperation with the operational process of the private Member of the JU, notably in support of R&I, events and stakeholder management at large.

Scope

The proposed CSA shall liaise with the SNS RIA and IA actions under all SNS Streams and the SNS JU to exploit synergies for:

- Stakeholder management towards R&I orientation and SNS cross-project coordination and cooperation (implementation of the cross-project cooperation contractual clause).
- Europe wide cartography of relevant Smart Network initiatives and identification of strategic cooperation opportunities, in particular with initiatives at Member State/regional level.

- Design upgrades and perform maintenance on the European SNS web site and program infrastructure (web sites, mail systems, repositories, etc.).
- Working group management and organisation for issues of common interest, supporting a common EU 6G vision and its technological realisation.
- Monitoring and communication with related European Member State initiatives.
- Monitoring and communication with peer JU Partnerships (e.g., HPC, Chips, AI, Data and Robotics, Photonics Europe, CCAM).
- Organisation, management and support of Ecosystem Assessment and Facilitation Actions (IAFA) as described in the SNS Partnership Proposal.
- Investigation of the business impact of key technological and policy decisions (e.g., net neutrality).
- Support to the promotion and communication towards the public at large of the SNS JU activities in line with the JU priorities.
- Creation and implementation of a strategic promotion programme for the European 6G SNS Programme.
- Promoting the 6G SNS initiative views to assert European leadership in the area across the wider community of 6G SNS stakeholders including:
 - National & Regional authorities.
 - Peer research initiatives (ESA, Eureka, etc.).
 - Peer Industrial Associations (e.g., 5GAA, 5GACIA, ECH Alliance, ERTICO, ECSO etc.).
 - The Smart Connectivity DIH Network (SCoDIHNet).
 - Other relevant 5G-related CSA (e.g., 5G GUIDE, etc)
 - European and Global standards communities and Global 6G discussions.
- International cooperation support with key third countries. It includes identification of international cooperation strategies with clear benefits to EU industrial stakeholders.
- Establishing and organising the EUCNC & 6G Summit (EuCNC&6GS) conference in 2025 and 2026.

Appendix 1: Additional Conditions of the SNS 2024 Call

Notes:

- i) The SNS 2024 call conditions are based on the “General Annexes for Horizon Europe call conditions 2023-2024”³⁷, with some exceptions and clarification that are specific to SNS and outlined in this Appendix to the Annex II to the SNS Joint Undertaking Work Programme 2024.
- ii) The conditions outlined in this appendix are complementary to the basic conditions outlined in the table provided in the definition of each funded topic of the SNS 2024 call.
- iii) The joint call “HORIZON-ER-JU-2024-FA2-SNS: EU-RAIL – SNS SYNERGY: Digital & Automated testing and operational validation of the next EU rail communication system” will be implemented by EU-Rail JU, with a contribution of up to EUR 1 000 000 from the SNS JU budget. The selection criteria and the call conditions can be found in the EU-Rail JU Work Programme “Europe’s Rail Work Programme 2023-2024”, that will be adopted and published in December 2023. The submission of proposals should be done through the above-mentioned EU-Rail JU Call.
- iv) Support to Stakeholders and applicants for this call will be provided through a regularly updated list of “Frequently Asked Questions”, FAQ’s, made available on the SNS JU website (link will be also available on the F&T portal).

Call identifier: HORIZON-JU-SNS-2024

Opening date: mid-January 2024

Type of call: single stage call

Submission of Proposals deadline: mid-April 2024 17:00:00 (Brussels local time)

Indicative budget: EUR 129 million

Estimated value of the In-Kind contributions to Operational Activities (IKOP) by the members other than the Union or their constituent entities: Minimum EUR 8 million. A minimum programme level IKOP contribution of 6% is targeted and proposals are expected to significantly contribute to this target (see section 1.4 for related evaluation sub-criterion).

NB: For proposals submitted under the various Streams of this work programme and considering past average participation per type of beneficiary (profit & not-for-profit members -or non-members- of 6G-IA) the table below outlines how the IKOP target at Programme level is converted in minimum values:

Streams / Topics	Indicative IKOP level as % of project budget to reach the objective.
HORIZON-JU-SNS-2024-STREAM-B (RIA)	
01-01: System Architecture	2,6%

³⁷ https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/horizon-europe-work-programmes_en

01-02: Wireless Communication Technologies and Signal Processing	
01-03: Communication Infrastructure Technologies and Devices	
01-04: Reliable Services and Smart Security	
01-05: International Collaboration – EU-JP	
01-06: International Collaboration – EU-KOR	
01-07: Sustainability Lighthouse	
01-08: Reliable AI for 6G Communications Systems and Services	3,6%
HORIZON-JU-SNS-2024-STREAM-C (RIA)	
01-01: SNS Microelectronics Lighthouse	3,6%
HORIZON-JU-SNS-2024-STREAM-D (IA)	
01-01: SNS Large Scale Trials and Pilots (LST&Ps) with Verticals (IA)	19,50%
HORIZON-JU-SNS-2024-STREAM-CSA (CSA)	
01-01: SNS Operations and Output optimisation	2,6%

Table App 1

In Kind Contribution to Operational Activities (IKOP) are defined in Article 2 (8) of the Council regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe³⁸ as follows:

in-kind contributions to operational activities mean contributions by private members, constituent entities or the affiliated entities of either, by international organisations and by contributing partners, consisting of the eligible costs incurred by them in implementing indirect actions less the contribution of that joint undertaking and of the participating states of that joint undertaking to those costs;

For all SNS streams applicants will be invited to fill a mandatory IKOP declaration table in the Application Form Technical Description (Part B).

Target for SME participation is at 20% at programme level. Proposals are expected to contribute to this target as appropriate, see section 1.4 for related evaluation sub criterion.

³⁸ <http://data.europa.eu/eli/reg/2021/2085/oj>

Indicative budgets by type of actions

Streams / Topics	Call 2024 Topic Budget (in M€)
HORIZON-JU-SNS-2024-STREAM-B (RIA)	
01-01: System Architecture	16.0
01-02: Wireless Communication Technologies and Signal Processing	16.0
01-03: Communication Infrastructure Technologies and Devices	16.0
01-04: Reliable Services and Smart Security	16.0
01-05: International Collaboration – EU-JP	3.0
01-06: International Collaboration – EU-KOR	3.0
01-07: Sustainability Lighthouse	13.0
01-08: Reliable AI for 6G Communications Systems and Services	6.0
HORIZON-JU-SNS-2024-STREAM-C (RIA)	
01-01: SNS Microelectronics Lighthouse	10.0
HORIZON-JU-SNS-2024-STREAM-D (IA)	
01-01: SNS Large Scale Trials and Pilots (LST&Ps) with Verticals (IA)	25.0
HORIZON-JU-SNS-2024-STREAM-CSA (CSA)	
01-01: SNS Operations and Output optimisation	4.0
HORIZON-ER-JU-2024-FA2-SNS	
EU-RAIL – SNS SYNERGY: Digital & Automated testing and operational validation of the next EU rail communication system	1.0 ³⁹
Total (M€)	129

Table App 2

Indicative timetable for the evaluation and grant agreement

Information on the outcome of the evaluation	Indicative date for the signing of grant agreements
Maximum 5 months from the final date for submission	Maximum 8 months from the final date for submission

³⁹ Contribution of up to EUR 1 000 000 from the SNS JU to EU-Rail JU. The modalities of this transfer will be detailed in an arrangement between both organisations.

1. Call management rules

The SNS JU operates under the Horizon Europe Rules for Participation, set out in Regulation (EU) (EU) 2021/695 of the European Parliament and of the Council of 28 April 2021 laying down the rules for participation and dissemination in "*Horizon Europe - the Framework Programme for Research and Innovation (2021-2027)*" and repealing Regulation (EU) No 1290/2013 and (EU) No 1291/2013 (EC) and (EU) No 1291/2013.

1.1. Admissibility

Part A of the General Annexes to the Horizon Europe Work Programme 2023-2024 shall apply *mutatis mutandis* to the SNS call 2024 covered by this Work Programme, with the following derogations to page limits:

The limit for a full proposal is **100 pages for RIAs** submitted under Stream B, C, **and for IAs** submitted under Stream D. Applicants are encouraged to modulate the page number of their proposals, from an indicative 70 pages for proposals with low number of partners and very specific focus up to maximum 100 pages for complex proposals covering multiple technological dimensions and with large number of partners.

The limit for a full application is **50 pages for submission of CSAs**.

1.2. Eligibility

Part B of the General Annexes to the Horizon Europe Work Programme 2023-2024 shall apply *mutatis mutandis* to the SNS call 2024 covered by this Work Programme, with the following amendments, mainly intended to support IKOP generation:

Actions	Restriction	Justification	Note
HORIZON-JU-SNS-2024-STREAM-B-01-07 and HORIZON-JU-SNS-2024-STREAM-B-01-08	At least half of the budget should be implemented by the SNS JU member (other than the Union) ⁴⁰ and their constituent or affiliated entities.	In line with Recital 21 and Article 5.2.(a) of the Council regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe. IKOP generation with long term commitment of partners and JU members other than the Union, but also of new players from non-telecommunication sectors (Sustainability, Artificial Intelligence) and verticals. In particular, the 6G related sustainability	Up to half of the budget fully open

⁴⁰ The SNS JU member other than the Union is the 6G Smart Networks and Services Industry Association (6G-IA) <https://6g-ia.eu/>

		and AI goals require to be established and steered with long term commitment of partners and from the JU members other than the Union.	
HORIZON-JU-SNS-2024-STREAM-C-01-01	At least half of the budget should be implemented by the SNS JU member (other than the Union) and their constituent or affiliated entities.	In line with Recital 21 and Article 5.2.(a) of the Council regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe. IKOP generation with long term commitment, including players from the microelectronics sector, and required stability as needed to develop the needed pan European test and experimentation infrastructure that spans the programme lifetime. It requires to be established and steered with long term commitment of partners and of JU member other than the Union. This is needed to prepare for the large-scale trials with sufficient stability. The activities are also supporting the objectives of the Chips Act, the IPCEI ME/CT and targets cooperation between SNS and Chips Joint Undertakings towards microelectronics for 6G.	Up to half of the budget fully open

HORIZON-JU-SNS-2024-STREAM-D-01-01	At least 70% of the budget should be implemented by the SNS JU member (other than the Union) and their constituent or affiliated entities.	In line with Recital 14, 21 and Article 5.2.(a) of the Council regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe. Large scale trials require take up commitments from JU private member constituents or affiliated entities. The Innovation Actions, with higher TRLs, will leverage and complement the programmatic large-scale platform for test and validation of critical technologies and will be enhanced over time. This requires a long-term commitment of the participating entities and from the JU member other than the Union.	Up to 30% of the budget fully open
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Table App 3

For the above Streams (Table App 3), applicants will be invited to fill a **mandatory table of compliance** at proposal stage in the **Application Form Technical Description (Part B)**.

Proposals that do not fulfil the above conditions, including the mandatory table of compliance, at the time of the proposal submission, will be considered ineligible and, therefore, will not be evaluated.

Gender equality plans and gender mainstreaming:

Provision of a gender equality plan for public bodies, research organisations or higher education establishments (including private research organisations and higher education establishments) applies as per Part B of the General Annexes to the Horizon Europe Work Programme 2023-2024. Additional gender issues (related to award sub-criterion consideration of the gender dimension in research and innovation content) shall be addressed as appropriate in case research results are expected to differ when applied to different gender populations of users.

1.3. Financial and operational capacity and exclusion

Part C of the General Annexes to the Horizon Europe Work Programme 2023-2024 shall apply *mutatis mutandis* to the SNS call 2024 covered by this Work Programme.

1.4. Award criteria

Part D of the General Annexes to the Horizon Europe Work Programme 2023-2024 shall apply *mutatis mutandis* to the SNS call 2024 covered by this Work Programme with the following complements:

For RIAs under Streams B, C and IAs under Stream D, the award criteria table is complemented as follows:

- Introduction in the impact section of a sub criterion assessing the proposal contribution to the reinforcement of an EU added value, with particular attention to EU economic security objectives as well as economic security risks and the role of certain suppliers, as mentioned in the Commission Communication C(2023) 4049, in R&I activities. For the assessment of this sub criterion, the mandatory security declaration annexed to the proposal (see Appendix A, section 1.9 ii)) will also be taken into consideration. If this sub criterion is not addressed in a sufficiently effective way, this shall be considered as a significant weakness.
- Introduction in the impact section of a sub-criterion assessing the proposal contribution to the overall SME objective as appropriate;
- Introduction in the impact section of a sub-criterion assessing the proposal contribution to the IKOP objectives;

	Excellence (The following aspects will be taken into account, to the extent that the proposed work corresponds to the description in the work programme)	Impact	Quality and efficiency of the implementation
Research and innovation actions (RIA) Innovation actions (IA)	<ul style="list-style-type: none"> - Clarity and pertinence of the project's objectives, and the extent to which the proposed work is ambitious and goes beyond the state of the art. - Soundness of the proposed methodology, including the underlying concepts, models, assumptions, inter-disciplinary approaches, appropriate consideration of the 	<ul style="list-style-type: none"> - Credibility of the pathways to achieve the expected outcomes and impacts specified in the work programme, and the likely scale and significance of the contributions from the project. - Suitability and quality of the measures to maximise expected outcomes and impacts, as set out in the dissemination and exploitation plan, including 	<ul style="list-style-type: none"> - Quality and effectiveness of the work plan, assessment of risks, and appropriateness of the effort assigned to work packages, and the resources overall. - Capacity and role of each participant, and the extent to which the consortium as a whole brings together the necessary expertise.

	<p>gender dimension in research <i>where relevant</i> and innovation content, and the quality of open science practices, including sharing and management of research outputs and engagement of citizens, civil society and end-users where appropriate.</p>	<p>communication activities.</p> <ul style="list-style-type: none"> - EU added value in the context of EU economic security objectives and economic security risks, including the consideration of supply chain and technology leakage risks. - Extent to which the members of the proposed consortium contribute to the expected level of in-kind contribution to operational activities to help reaching the target additional investments - SME Participation and opportunities to leverage project results. 	
Coordination and support actions (CSA)	<ul style="list-style-type: none"> - Clarity and pertinence of the project's objectives. - Quality of the proposed coordination and/or support measures, including soundness of methodology. 	<ul style="list-style-type: none"> - Credibility of the pathways to achieve the expected outcomes and impacts specified in the work programme, and the likely scale and significance of the contributions from the project. - Suitability and quality of the measures to maximise expected outcomes and impacts, as set out in the dissemination and exploitation plan, including communication activities. 	<ul style="list-style-type: none"> - Quality and effectiveness of the work plan, assessment of risks, and appropriateness of the effort assigned to work packages, and the resources overall. - Capacity and role of each participant, and the extent to which the consortium as a whole brings together the necessary expertise.

Table App 4

1.5. Documents

Part E of the General Annexes to the Horizon Europe Work Programme 2023-2024 shall apply *mutatis mutandis* to the SNS call 2024 covered by this Work Programme.

1.6. Procedures

Part F of the General Annexes to the Horizon Europe Work Programme 2023-2024 shall apply *mutatis mutandis* to the SNS call 2024 covered by this Work Programme with the following amendment related to the procedure to rank proposal with equal scores, used to establish the priority order:

- When two **RIA** proposals are equally ranked and that it has not been possible to separate them using first the coverage criterion, second the excellence criterion, and third the generic Impact criterion (i.e., after step 2 of the procedure outlined in part F of the General Annex), the level of SME participation will be taken as the next criterion to sort out the ties and if still un-conclusive, the level of IKOP will be considered as appropriate. If still inconclusive, the procedure outlined in part F of the General Annex will be resumed from step 3 onwards.
- When two **IA** proposals are equally ranked and that it has not been possible to separate them using first the coverage criterion, second the impact criterion, and third the excellence criterion (i.e., after step 2 of the procedure outlined in part F of the General Annex), the level of SME participation will be taken as the next criterion to sort out the ties and if still un-conclusive, the level of IKOP will be considered as appropriate. If still inconclusive, the procedure outlined in part F of the General Annex will be resumed from step 3 onwards.

1.7. Legal and financial set-up of the grant agreements

Part G of the General Annexes to the Horizon Europe Work Programme 2023-2024 shall apply *mutatis mutandis* to the SNS call 2024 covered by this Work Programme.

1.8. Specific conditions for actions implementing pre-commercial procurement or procurement of innovative solutions

Part H of the General Annexes to the Horizon Europe Work Programme 2023-2024 is not applicable to the SNS call 2024 covered by this Work Programme.

1.9. Other Specific Conditions

The following additional conditions shall apply for the call covered by this Work Programme:

i) **Project collaboration**

As part of the call conditions, participants of selected projects will be requested to cooperate in the SNS Programme for topics of common interests by signing the collaboration agreement referred in the specific provisions of the Model Grant Agreement (MGA).

ii) **Security provisions applicable to Streams B, C and D**

In order to meet the security requirements specified under the above section Context and Objectives (Cybersecurity and Economic Security), all proposals submitted in Streams B, C and D, shall have to include security declarations, which demonstrate that the economic security risks (e.g. technology leakage and supply chain risks) have been identified and addressed and that the management of project results, technologies and equipment (including software and services) in the proposed project comply with relevant security requirements. In addition, they should indicate that required documents, information and results produced within the proposed project will be duly protected and not lead to exposure of sensitive information in the cybersecurity or economic security context to entities not established in Member States or countries associated to Horizon Europe, or entities controlled from third countries. Particular attention should be paid to mitigating the higher risks associated with

certain network suppliers as mentioned in Commission Communication C(2023) 4049. As part of the security declaration the proposal shall contain information that:

(a) Demonstrates that any economic security risks including: 1. resilience of supply chains; 2. physical and cyber security of critical infrastructure; 3. technology security and technology leakage; and 4. weaponisation of economic dependencies or economic coercion, are taken into account and are properly addressed.

(b) Demonstrates that the infrastructure deployed within the proposed project shall remain, during the action and after its completion, within the beneficiary/beneficiaries and shall not be subject to control or restrictions by entities not established in Member States or countries associated to Horizon Europe, or entities controlled from third countries.

(c) Demonstrates that for any equipment to be deployed for the implementation of the proposed project and/or used for the management and operation of the resulting digital connectivity infrastructure, the required documents and information will be duly protected and not exposed to entities not established in Member States or countries associated to Horizon Europe, or entities controlled from third countries. Special care should be taken to satisfy the Commission Communication C(2023) 4049 requirements in relation to higher risks associated with certain network suppliers.

Based on this security declaration by the applicant, as well as the evaluation carried out by independent experts, the funding body may require security measures to be implemented in the project and/or carry out a security scrutiny focusing on the exchange of project information, documents and results considered as security-sensitive information among project partners.
