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Smart Networks and Services Joint Undertaking States Representative Group report 2023

Overview of Large National 6G Initiatives in EU Member States

This document represents the Smart Networks and Services Joint Undertaking States Representatives Group's (SRG) commitment to the Single Basic Act to report annually on its progress with regard to national 6G Research and Innovation activities, strategies and funding. This is an opportunity to describe the national policies in the scope of the Joint Undertaking (JU) and highlight specific ways of cooperation with the actions funded by the JU. In fact, several strategies have been put in place by some States – their rationale, objectives and funding are reported here; these strategies may lead to more detailed collaboration and combine with the efforts of the JU.

This report is based on a deliverable from the SNS-ICE project, which aims to list national initiatives. The SRG would like to thank the SNS-ICE project partners for their efforts. This report is intended to serve as a future reference, so that participating states and industry alike can follow the progress of ongoing collaborations.

This document lists the national strategies of several countries and aims to be updated on a regular basis. It also contains suggestions for future synergies at several levels, both between States and between States and the JU.

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Abbreviations List

Abbreviation / Term	Description
3GPP	3rd Generation Partnership Project
5G-PPP	5G Public Private Partnership
5GA	5G Advanced
6G-IA	6G Smart Networks and Services Industry Association
AI	Artificial Intelligence
B5G	Beyond 5G
CEF	Connecting Europe Facility
CFP	Call For Proposals
CSA	Coordination and Support Action
EM	Electro Magnetic
ERDF	European Regional Development Funds
EU	European Union
FNS	Future Network Services
ICE	International and European Cooperation Ecosystem
ICT	Information and Communication Technology
KPI	Key Performance Indicator
NTN	Non-Terrestrial Networks
R&D	Research and Development
R&D&I	Research and Development and Innovation
R&I	Research and Innovation
RCoF	Research Council of Finland
RESTART	RESearch and innovation on future Telecommunications systems and networks, to make Italy more smART
SDG	Sustainable Development Goals
SME	Small and Medium Enterprise
SNS	Smart Networks and Services
SNS JU	Smart Networks and Services Joint Undertaking
STEM	Science, Technology, Engineering and Mathematics
TRL	Technology Readiness Level
UN	United Nations

Introduction

While the Horizon Europe Smart Network and Services (SNS) programme issued its first call in January 2022, with 900 MEuro of European funding over the period 2021-2027 and at least the same contribution from industry for a total of 1.8bn€ investment mobilised, in several countries in Europe large national initiatives have also started with a combined funding budget of almost 2.5 Billion Euro. From the perspective of the SNS Programme, which has the goal to facilitate and develop industrial leadership in Europe in 5G and 6G networks and services, it makes sense to investigate how these national initiatives can make European 5G/6G research even stronger. The objective of this report is therefore two-fold; 1) presenting the large (i.e., >100 MEuro) national initiatives in the EU Member States and 2) thus enabling the identification of synergies with the SNS programme.

Within SNS, the SNS ICE project is a CSA that amongst others has the goal to establish dialogues with national initiatives targeting the exchange of information, plans, and priorities. This is to enable a better understanding of activities among the stakeholders involved and to potentially enable a better alignment of plans. As a first step to establish such dialogues, the SNS ICE project has established contacts with the different national initiatives. As a second step information was collected about these national initiatives based on publicly available information (e.g., based on presentations and websites). Thirdly, interviews were held, using a common interview template with representatives of each of the national initiatives. This report represents the information collected from public sources and from the interviews. It has been reviewed and updated with states representative's comments and it has included a broader spectrum of national initiatives (e.g. Ireland and United Kingdom).

In most EU Member States there are publicly funded 5G/6G R&D or trial activities. These may be EU funded through e.g., the Horizon Europe programme, Connecting Europe Facility (CEF) or European Regional Development Funds (ERDF). In this document however we have focused on initiatives that are funded by Member States national governments[1]. In several European countries, we see large national initiatives with budgets of hundreds of MEuros: Finland, France, Germany, Italy, Ireland, Spain, Sweden, the Netherlands, and the United Kingdom. We focus on these initiatives because the size of these large national initiatives becomes comparable with the budget of SNS. Note furthermore that in this overview we have concentrated on 5G/6G research and innovation funding that has a similar scope as the SNS programme. We have not included national funding for the roll out of 5G (e.g., Spain has funding calls for 5G deployments in rural areas and corridors), which would be more like the European CEF.

The budgets for these large national initiatives are made available by national governments, either through a ministry related to economy and/or telecommunications or a ministry related to education and research. Note that in Finland there are two initiatives, one funded from each type of ministry.

We see different ways how these large national initiatives are organized. In some cases, the national government directly issues calls for proposals. This implies a very direct control of funding by the government (e.g. in France and Spain). In other cases, a separate organisation is founded, which organises the national initiative as a program and distributes the funding (e.g. in The Netherlands and Italy). There is also a difference on the flexibility of budget allocation. In e.g. Germany, budgets are largely pre-allocated for the full duration of the program, whereas in France there are regular calls where priority can be given to specific topics per call. In Finland, with the Finnish Flagship, funding was allocated to the university of Oulu, who then decides on how the money is spent in a thematic approach. Another difference is that in some national initiatives, funding for individual projects is provided to a consortium of academia/industry, while in other national initiatives funding for individual projects is provided to a single university or research institute. We have tried in the interviews to see

[1] Note that there are also 5G/6G research activities that are funded by local/regional governments (e.g. regional governments, metropolitan areas, or municipalities). Some of these can be found in the Member States Initiatives report (https://5g-ppp.eu/report-in-5g-6g-member-states-initiatives/). None of these qualify a large initiatives.

what can be considered as a comparable as a project in the SNS context, but there are quite some differences between the different national initiatives.

These distinctions are relevant when trying to organise collaboration between the national initiatives and between the national initiatives and the SNS Programme. E.g., when a national initiative uses an approach similar to SNS with yearly calls, collaboration can be considered in the next call for projects. When the funding is assigned to a foundation or university for the duration of the program, there is less flexibility at least on the side of the national initiative to adjust distribution of funding. Similarly, organising collaboration between projects works best if there is a similar concept of what is a project.

In the interviews we have asked the national initiatives how they see collaboration with other national initiatives. Some national initiatives have already some measures in place or have taken collaboration into account in their organisation. Other national initiatives have a less clear vision on what they want to do to collaborate with other national initiatives.

To facilitate synergies between related activities in the large initiatives and the SNS Programme, we propose to use a categorization of activities inspired by the SNS work programme. This categorization consists of the following topics:

- 5G evolution R&I;
- System network architecture and Control;
- Edge and Ubiquitous computing
- Radio technology and Signal processing;
- Optical networks;
- Network and Service security;
- Non-terrestrial networks;
- Special purpose networks/sub-networks;
- Opportunities for devices and components;
- Micro-electronics;
- Experimental infrastructures;
- Trials and pilots with verticals;
- Human capital; and
- Policy aspects.

Good to note that Human Capital is not included in the SNS programmes, however, it is a part of several of the National initiatives. It relates to strengthening the academia to attract more students and researchers, and/or promotion of spin-off activities and start-up companies. We have asked each of the national initiatives to rate to what extend the topics above are covered in their national initiative. We are using a star rating, where 3-stars means ‘main focus area’, 2-stars is ‘relevant area’, 1-star means ‘also addressed’ and zero stars means ‘not addressed’.

The remainder of this document describes for each of the 9 countries how the projects are organized what the approximate budget is, and what kind of topics are addressed. For each of the national initiatives, there is also a section on the view from that national initiative on collaboration within Europe. In section 11, we have added a short overall perspective on collaboration, with an overview of all the topics addressed in the different national initiatives and goals and possible actions for collaboration that were collected in earlier discussions on collaboration between national initiatives.

Note that each of the sections on the national initiatives have been reviewed by the respective national initiative. This implies that the text reflects how the national initiatives want to portray themselves.

1 The Netherlands

1.1 Introduction

The Netherlands aims to work on 6G through a national programme called Future Network Services (TNO, 2023). The Future Network Services (FNS) programme is funded through the National Growth Fund, a fund of € 20 billion for the period 2021-2025 for investments in fields which have the highest potential for structural and durable economic growth. The Dutch government will invest up to 203 M€ in the Future Network Services programme. The programme aims to build a leading position in certain parts of 6G technology, which will strengthen the future earning power of the Dutch economy. Also the core values, 'digital autonomy', 'reliability', and 'sustainability' are important drivers behind the Future Network Services programme.

The proposal for a multi-year public-private Future Network Services (FNS) programme focusses on specific and connected topics in 6G: intelligent radio components and antennas, intelligent networks, and leading applications in key sectors. The details on how the work is organized within this programme can be found in the next section. The Table 1 below summarizes some key information for this programme.

KEY INFORMATION	
Responsible Ministry	Ministry of Economic Affairs and Climate Policy
Total Budget	315 M€ (203 M€ Governmental funding)
Expected Start Date	Q1 2024
Expected End Date	Q3 2030

Table 1: Key information on the Dutch National Programme

1.2 Funding

The FNS programme will be shaped around two phases; phase 1 runs from Q1 2024 up to the end of Q2 2026 with a budget of 61 million euros. Funding is made available to the programme by the Ministry of Economic Affairs and Climate Policy. At the end of phase 1, the programme is expected to undergo an evaluation and will report on the KPIs agreed upon with the ministry. Although 142 M€ of funding is already earmarked for the second phase of the FNS, the programme still needs to make a proposal for phase 2 and demonstrate at the end of phase 1 that it can indeed deliver on its promise of economic growth. Phase 2 of the programme will run from Q3 2026 till Q3 2030.

A certain amount of matched funding is expected from the partners within the programme, in line with EU state aid rules. Universities and research centres bring in almost no funding of their own (or a very small percentage) whereas industry is expected to match funding with on average with 50-75% private investment. SMEs enjoy special benefits and receive up to 70% public funding and are expected to bring in the rest of the investment themselves.

Within the second phase of the programme, the intention is to set part of the budget aside for different open calls. Funding needs to be matched by the partners selected. The scope of the open calls will be defined in line with the planned FNS activities. Furthermore, budget is reserved to support academic startups and SMEs, and for development of human capital.

1.3 Organisation of work

In FNS, three technical programme lines are linked by a fourth programme line aimed at strengthening the ecosystem.

The four program lines carry the following focus:

- **Intelligent Components**: This programme line is organised in four work packages, namely, Highly efficient transmitters, Joint communication and sensing technology, Over-the-air testing, and Optical wireless communication. This programme line is mainly driven by the microelectronics industry in the Netherlands.

- **Intelligent Networks**: This programme line in organised in three work packages. The first work package focuses on requirements, architecture and integration, WP2 focuses on 6G DevOps platform and digital twin, and lastly, WP3 will work on AI-assisted networking.

- **Leading Applications**: This programme line will focus on developing application demonstrators in various market sectors, such as, transport hubs, collaborative surgery, smart grid, wireless detection, 6G factory, e-commerce, and XR gaming. These are also the verticals or key industry sectors that the programme focuses on.

- **Strengthening the Ecosystem**: This programme line will strengthen the overall 6G ecosystem through various activities, such as, setting up a national 6G testbed, technology-policy co-development, supporting start-ups and SMEs, standardization and international collaboration, etc.

The four program lines have been summarized in the image below:

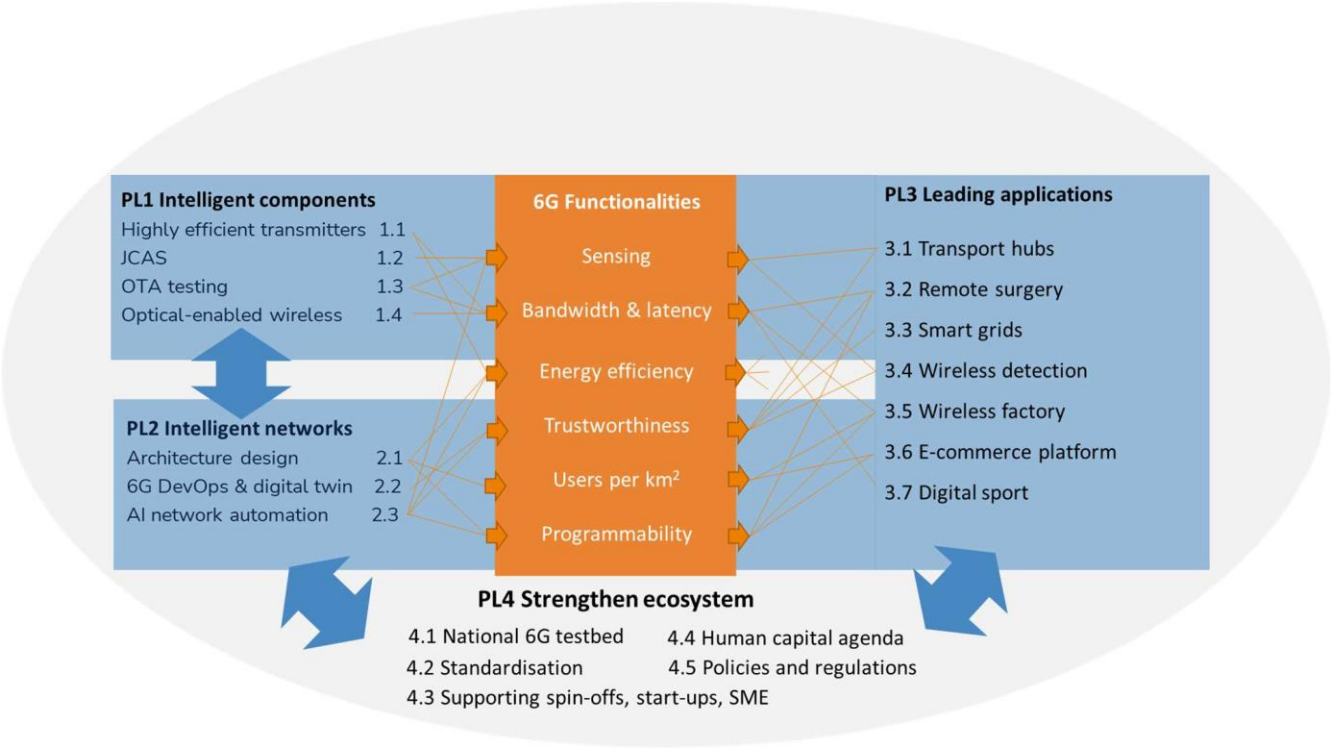


Figure 1: Overview of Program Lines

The overall management of the programme is done by a Programme Board under supervision of the Supervisory Board, which will decide on strategic matters and will provide advice and guidance. In addition to the Supervisory Board, there is also an Advisory Board that has been set up for broader consultation and project steering. The programme lines report directly to the Programme Board on progress, which in turn interfaces with the Advisory Board and the Supervisory Board.

The scope of the programme is more or less fixed, with an opportunity to add new topics or partners only through the open calls in phase 2.

FNS aims to contribute to standardization through a dedicated work package within programme line 4 on Standardization and International collaboration. In addition, it also aims to contribute to several existing open-source initiatives.

The overall project aims to achieve work within the TRL range of 2 – 6.

1.4 Topics covered

Using the categorization described in the introduction, we see the Future Network Services programme covering the following main topics.

Topic	Relative importance
5G evolution R&I	-
System network architecture and Control	***
Edge and Ubiquitous computing	**
Radio technology and Signal processing	***
Optical networks	-
Network and Service security	*
Non-terrestrial networks	*
Special purpose networks/sub-networks	*
Opportunities for devices and components	** (only on the network side)
Micro-electronics	***
Experimental infrastructure	***
Trials and pilots with verticals	***
Human capital	**
Policy aspects	**

Table 2: Topics covered in the Dutch national initiative

In addition to the above topics, FNS also works on several societal and policy aspects such as sustainability, earning power, digital autonomy (same as sovereignty) and trustworthiness. FNS will explore policy aspects such as spectrum, competition in network sharing, urban planning for 6G, etc.

Human Capital is also one of the focus areas within the programme. This is realized through an investment of several million euros into developing learning communities. This will be facilitated through a dedicated open call, which will allow companies to develop courses and trainings for this purpose. The programme also envisions to provide work for about 75 PhD candidates, which ultimately adds to the talent pool in the Netherlands in the future. The programme is also working with a specific organization to develop talent for all areas of technology and at all levels of education (vocational studies as well as university).

1.5 Perspective on Collaboration

The Future Network Services initiative has a dedicated work package for Standardization and International collaboration within the Programme line 4. This work package aims to facilitate at a program-level contacts with other national initiatives within and outside the EU in order to allow information sharing. The package also aims to organize and attend workshops to align goals and organize collaboration. FNS also plans use other projects such as the SNS-ICE to establish the right contacts and boost collaboration.

The FNS programme understands the value of collaboration and sees that as the only way to truly achieve a global 6G. In order for industry within a country to access the global 6G market, it must be aligned internationally, and work towards a shared vision on 6G. For Dutch industry it makes sense to start alignment with other European players.

2 Spain

2.1 Introduction

The Spanish national initiative on 6G, called UNICO 6G R&D, is a part of the Digital Spain 2026 initiative started by the Ministry for Economic Affairs and Digital Transformation as a part of the country's digital transformation roadmap. Within this roadmap, several plans have been launched at national, regional and local level. Initially the 'España Digital 2025' initiative was launched in July 2020, but in July 2022 it was updated to 'España Digital 2026'. For Research and Innovation (R&I), additional bottom-up funding in all digital areas is made available by the Ministry for Science and Innovation in the context of the Spanish 'Strategy for Science, Technology and Innovation 2021-27'. In both cases, the initiatives launched are synchronized with EU strategies / programs. (Ministry of Economic Affairs and Digital Transformation, 2023)

The first phase of public investments in digitalization of "España Digital 2026" is about 20.000 million €. Additionally, 11 strategic projects "PERTE" have been launched, with a public investment of more than 30.000 million €. These comprehensively cover the most relevant digital areas from different perspectives: R&I, technology uptake, deployment, skills, regulation and other investments. However, this report only focusses on the national developments with regards to research and innovation in 6G as well as certain expansions of the 5G technology, and thus will only focus on the UNICO 6G R&D programme.

KEY INFORMATION	
Responsible Ministry	Ministry for Economic Affairs and Digital Transformation
Total Budget	205 M€
Start Date	2021
Expected End Date	2026

Table 3: Key information on the Spanish national initiative

2.2 Funding

A total funding of 206 M€ is allocated to the UNICO 6G R&D programme and is distributed to the partners through the means of three open calls, one in 2021, 2022, and 2023 each. Within the 2021 call, a total amount 94.5 M€ was directed to selected entities. The call directly funded 9 public universities and 3 public research centres, all of which had participated in the 5G PPP programme. These entities had to subcontract to other companies a minimum of 70% of the funding received, out of which a minimum of 60% had to go to private companies, and a minimum of 15% had to go to SMEs.

Within the 2022 call, 13 M€ was awarded to private companies for R&D projects and 36 M€ to academia and research centres for equipment and infrastructure. The last call within the programme is in 2023 and carries a total budget of 62 M€. In the 2022 and 2023 calls there are specific areas/themes for R&D projects. Partners that receive the money are allowed to subcontract 50% of their funding, but they have no obligation to do so.

Public universities and research centers receive 100% funding, and thus do not need to provide any matched funding. Private companies have to match the funding received based on European regulations and contribute on average about 36% of funding. SMEs receive more funding than big private players and thus have to put up less of their own money.

Overall, within all the calls there are two subprograms, one for public academia and research centres meant only to fund equipment and infrastructure, and one for R&D projects by private entities. Proposals are accepted from individual applicants (i.e. only one company), but a subcontracting is also allowed for up to 50% of the project.

The funding received for the UNICO 6G R&D is from Recovery and Resilience plan fund (component 15, investment 6) from EU, and within Spain this is handled by the Ministry of Economic affairs and Digital Transformation.

2.3 Organisation of work

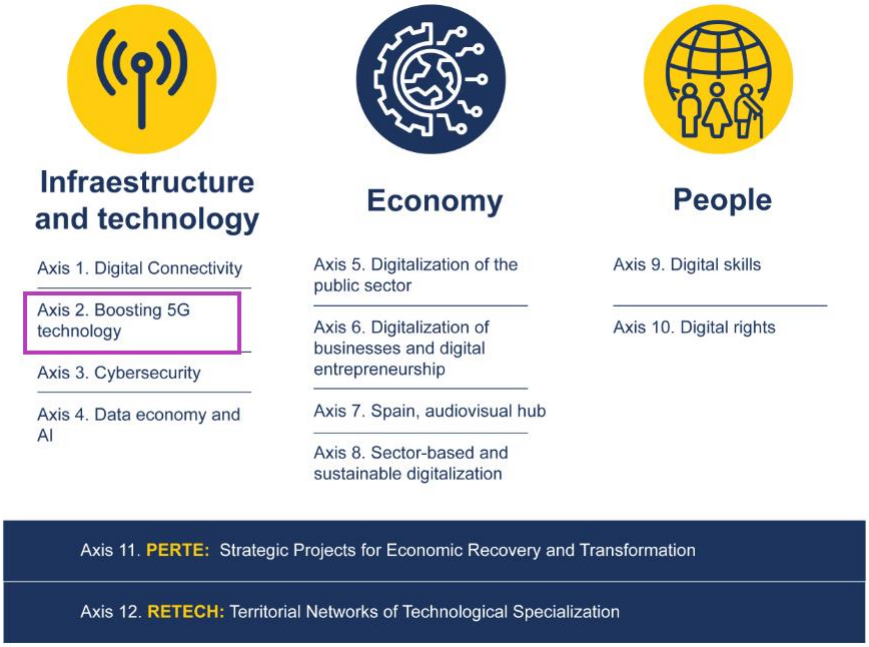


Figure 2: Organization of work within Digital Spain 2026

There are 10 axes planned to promote high-impact strategic projects through public-private collaboration and joint governance of the Nation and Autonomous Regions (Figure 2). These focus on a broad range of activities that are not all within our scope. But within Axis 2 on 'Boosting 5G Technology', there are several measures that are focussed on 5G (Figure 2), including R&D on 5G and 6G. This program carries the following goals:

- Achieve digital sovereignty for Europe
- Support at least 200 R&D&I projects to develop the ecosystem of 5G and 6G technologies
- Position Spain as a center of excellence in 5G and 6G R&D

The UNICO R&D 5G Advanced and 6G Program funds public research foundations, Spanish public universities and private organizations for the development of research and innovation projects. It plans to support the creation of a '5G+6G R&D&I ecosystem' that attracts investment, fostering the emergence of start-ups and innovative research companies that will develop products and services in 5G advanced and 6G. This is planned such that it is closely linked to the creation of stable and high-quality employment throughout the country. This program plans to bring about a significant improvement in energy efficiency and decarbonization in the long term, as well as fostering public-private collaboration to favour the creation of a research ecosystem and attract foreign talent. The goal of this initiative is to enable European players to develop R&D&I capabilities for 6G technologies as the basis for future digital services between now and 2030.

The UNICO R&D 5G Advanced and 6G Program is organized into three calls:

1. **2021 Call** – This call led to projects being awarded to 12 entities in Nov 2021 for a total amount of 94.5 M€. The duration of the projects will be 3 years with expected TRL levels of 2-4.
2. **2022 Call** – Through this call a total budget of 49 M€ was awarded to 48 projects. The duration of the projects will be up to 3 years with expected TRL levels of 3-6 .
3. **2023 Call** – This call was published in December 2022 and carries an indicative budget of 62 M€. The duration of the projects will be up to 3 years with expected TRL levels of 3-6

The work priorities within the programme are set through the Digital Spain 2026 agenda and the Implementation of the programme is overseen by the Secretariat of State for Telecommunications under the Ministry of Digital Transformation. Beneficiaries that have received the money have to submit a yearly report on milestones achieved, progress, updates, etc. to a dedicated unit that is following up on the progress of the project. There are no yearly evaluations done on whether projects are on the right track (e.g., to provide steering), but financial reporting is expected. Project evaluation is only done once, at the end of the project.

No there is no flexibility within the programme to add new topics or broaden the scope beyond the current call topics. The beneficiaries that have received the money have to get an approval from unit that is supervising when they outsource money to other partners, and this is done through a standard competitive procedure to ensure fair selection. Budget cannot be increased, and new partners cannot be added along the way (once a project has started). Project budgets are typically between 300K and 2M€ per project.

2.4 Topics covered

The UNICO R&D 5G Advanced and 6G Program covers the following topics with relative importance as specified:

Topic	Relative importance
5G evolution R&I	**
System network architecture and Control	**
Edge and Ubiquitous computing	**
Radio technology and Signal processing	**
Optical networks	**
Network and Service security	**
Non-terrestrial networks	**
Special purpose networks/sub-networks	-
Opportunities for devices and components	-
Micro-electronics	-(addressed in a different programme) PERTE Chip project (axis 11)
Experimental infrastructure	***
Trials and pilots with verticals	-(addressed in a different programme UNICO SECTORIAL 5G)
Human capital	*
Policy aspects	-

Table 4: Topics covered in the Spanish national initiative

The programme also focuses on the societal and policy aspect of Sovereignty. No specific funding is dedicated for this, and is covered within the overall scope of the projects. In addition, 3 M€ was set aside in the 2021 call for promoting telecommunications studies.

2.5 Perspective on Collaboration

The Spanish national initiative greatly values collaboration with the SNS. For this purpose, within the 2021 call there was an obligation imposed on the beneficiaries to contribute to the SNS JU work programme for at least 70% of the funds they've received from the national programme, after excluding the funding they've outsourced. Thus, they need to apply with a proposal to the SNS JU with a budget of at least 70% of the aid they've received through the national programme. No such condition was imposed in the 2022 and 2023 calls.

Currently, no collaboration has been initiated with other national initiatives within or outside the EU. The UNICO 6G R&D does not foresee any collaborations being initiated at the program level, but rather encourages partners within the projects to forge their own collaborations as they see fit.

3 Italy

3.1 Introduction

The national initiative from Italy is called RESTART: 'RESearch and innovation on future Telecommunications systems and networks, to make Italy more smART'. The programme is planned to run from Jan 2023 to Dec 2025, with a funding of 118 M€, and comprising of a total of 25 partners. (Fondazione Restart , 2023)

The RESTART partnership includes several research projects, to be jointly carried out by universities, research centres, companies and public administrations. The program includes the following activities: fundamental and applied research; technology transfer and exploitation of research results, including dissemination activities; support for the creation and development of start-ups and spin-offs from research, promoting the activities and services of incubation and venture capital funds; training led in synergy by universities and enterprises, with particular reference to SMEs, to reduce the mismatch between the skills required by enterprises and those offered by universities; PhDs program.

The focus of the project is the structural improvement of research and development in improving the ability to use telecommunications in a wide variety of sectors: agriculture, trade, energy, finance, industry, media, health, security, transportation, all while strengthening the link between scientific excellence and business.

KEY INFORMATION	
Responsible Ministry	Ministry of University and Research
Total Budget	118 M€ (116 M€ received from Ministry)
Start Date	Jan 2023
Expected End Date	Dec 2025

Table 5: Key information on the Italian National Initiative

3.2 Funding

The RESTART project is run by the RESTART foundation, which has been established as an independent legal entity with its own administration. While the total funding of the project is 118 M€, 116 M€ are provided by the Ministry of University and Research, while the remainder amount is coming from the private sector. The scope of this funding includes fundamental research, applied research as well as pre-competitive research.

The RESTART project started with an initial funding of 0% from the Ministry, and in regular cycles of 6 months receives more money from the Ministry, after an evaluation and reporting of the last phase. The RESTART project prepares reports on the work accomplished over the last period which are then submitted to external evaluators for feedback. These external evaluators have been selected by the Ministry. The reports together with the feedback is then submitted to the Ministry for review. If all is in order, money is released for the next phase by the Ministry.

The RESTART foundation only manages the project. Project R&D activities are carried out by partners that contribute also in-kind, such as through personnel, equipment, labs, etc.. There is no mandated matched funding expected by the partners, but the average trend shows that partners bring in about 20% of the funding in-kind.

The current funding of the RESTART project (till Dec 2025) is limited to the funding received by the Ministry as well as the contribution of the partners. However, if the foundation wants to continue beyond 2025, it will seek out other funding instruments in order to continue its work.

3.3 Organisation of work

RESTART is organized in a Hub and Spokes structure, where the Hub is the foundation itself and it manages and coordinates the Spokes that carry out the activities to achieve the project goals. There are 8 spokes related to eight major scientific themes. The whole organization will collaborate on the implementation of 32 research projects. The spokes can be seen in the Figure 3 below, and are as follows:

1. Spoke 1: Pervasive and Photonic network technologies and infrastructures
2. Spoke 2: Integration of networks and services
3. Spoke 3: Wireless networks and technologies
4. Spoke 4: Programmable networks for future services and media
5. Spoke 5: Industrial and digital transition networks
6. Spoke 6: Innovative architectures and extreme environments
7. Spoke 7: Green and smart environments
8. Spoke 8: Intelligent and Autonomous systems

Figure 3: Organisation of work in the RESTART programme

The 25 partners of the project are considered affiliates, and each affiliate is linked to one or more spokes. Funding is received by the hub, which transfers it to the spokes and to the affiliates. Similarly, reporting for the project starts from the affiliates, moves to the spokes and finally reaches the Hub.

The programme focusses on 7 missions, namely:

1. **Research:** The research mission comprises of 14 structural projects that define the research program and give a structure to the overall work, as well as 18 focused projects which are smaller endeavors. These smaller projects complete the structural projects towards more specific directions (industrial, theoretical).

2. **Laboratories, Proof of Concepts, Demonstrators:** The goal here is to enlarge existing laboratories and creating new, shared, ones.

3. **Innovation and Technology transfer:** This mission carries the goal to increase the TRL of results generated so as to transfer research results into innovation exploited in new products and solutions.

4. **Support to start-ups and spin-offs:** This mission will operate in three main directions, namely, provide cultural and educational instruments, issue program specific calls for research oriented to start-up creation, and offer specific support for the development of proof-of-concepts from initial ideas.

5. **Education and training activities**: Within this mission, RESTART will pursue three main interrelated objectives

    a. increase the number of students in STEM (Science, Technology, Engineering and Mathematics) and more specifically in telecommunications engineering and incentivize the access to PhD. programs
    b. foster the development of entrepreneur, transversal, and soft skills
    c. strengthen the linkage between ICT universities and industry to support the up-skilling and re-skilling process of students and employees.

6. **PhD programs:** This mission includes extensive recruitment, broader research areas, nation-wide cross-fertilization and innovation and product-oriented research training.

7. **Communication, standarisation and open-source solutions:** RESTART will publish and contribute to peer-reviewed publications in top refereed scientific journals and conferences capitalizing the experience from research partners. Blog posts, position papers, white papers, citizen factsheets, podcasts and other non-scientific publications will be also released.

Figure 4: Missions within the Italian initiative

The 14 structural projects are as indicated in the Figure 5 below:

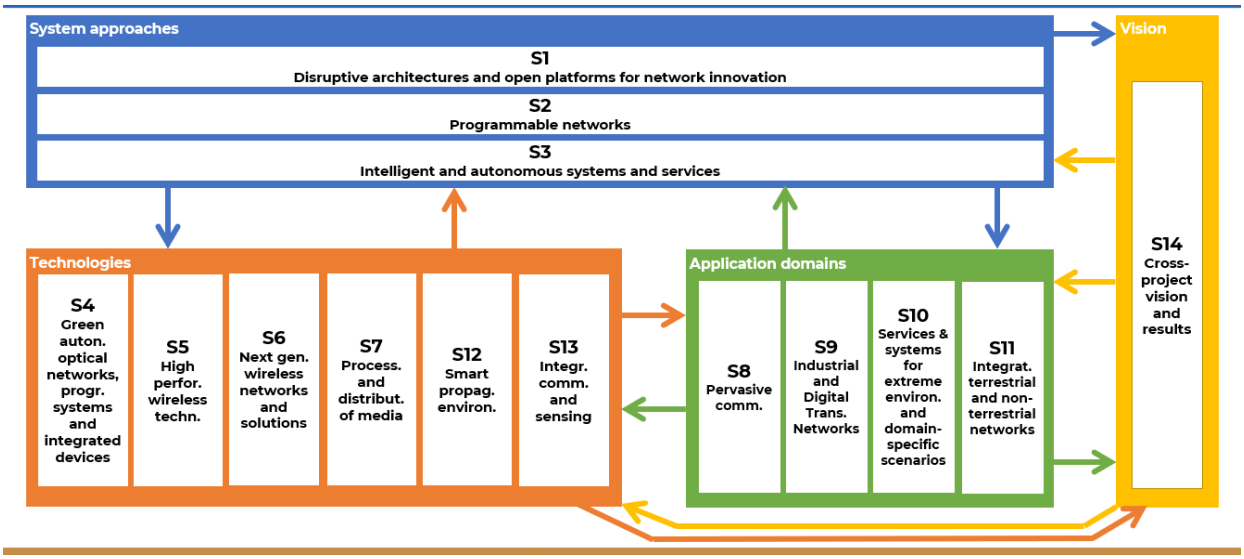


Figure 5: Structural projects within Italian initiative

In addition to the work structure described above, there are also open cascade calls. The topics for these cascade calls are decided by an international committee based on the input it receives from the various missions. The input provided by these missions should indicate the work topics which they feel still need to be addressed within their respective missions. This procedure allows for new topics to be introduced into the project, as well as new partners to join. Some of these open calls also specifically target SMEs and offer incentives for them to participate.

There is one call envisioned in 2023 and another one in 2024. The cascade calls offer a funding of 34 M€ from the overall budget. The entities which are awarded projects through one of these calls will become affiliates and will follow a similar reporting structure to the existing affiliates. In addition to the funding available for the cascade calls, there is also a contingency fund available within the project that allows for flexibility to include new topics in the future.

The overall project aims to achieve work within the TRL range of 2 – 6.

3.4 Topics covered

Using the categorization described in the introduction, we see the RESTART initiative covering the following main topics.

Topic	Relative importance
5G evolution R&I	***
System network architecture and Control	***
Edge and Ubiquitous computing	***
Radio technology and Signal processing	***
Optical networks	***
Network and Service security	* (also addressed in another national programme)
Non-terrestrial networks	***
Special purpose networks/sub-networks	***
Opportunities for devices and components	*
Micro-electronics	*

Experimental infrastructure	***
Trials and pilots with verticals	**
Human capital	*
Policy aspects	*

Table 6: Topics covered in the Italian national initiative

Aside from the topics addressed above, the project also focuses on sustainability (energy efficiency in particular) and sovereignty. These topics are included in the scope of many structural projects. Aside from this, the project also has a mission dedicated to human capital, which is funded directly.

3.5 Perspective on Collaboration

The RESTART project aims to establish collaborations with several other national/international initiatives and European programs in the future. These collaborations can be established both at a program and a project level.

4 France

4.1 Introduction

The French National Initiative is a part of the 'France 2030' recovery plan which has ecology, competitiveness and cohesion as its three main themes. While the plan aims to transform key economic sectors in the country including energy, automotive, aeronautics and space, the government says 5G and future telecommunications network technologies represent a key lever of competitiveness. Launched in 2021 by the French Ministry of Economy, Finances and Industrial and Digital Sovereignty, this initiative is coordinated at national level by the Directorate-General for Enterprise/Ministry of Economy and Finance, in collaboration with other competent ministries, government agencies and the national telecoms regulatory authority (ARCEP). (Gouvernement, 2023)

France 2030 has 10 objectives and 6 conditions for success which make up the plan. One of the conditions for success is to 'Master sovereign and secure digital technologies' and includes the following strategic priorities:

1. Capitalize on France's scientific excellence in the field of quantum technology to fulfil France's potential of becoming a leading technological and industrial player
2. Create a French and European technological alternative that makes France a sovereign economic power in the cloud
3. Develop expertise in the technological building blocks required for 5G and speed up the development of uses while meeting the requirements of 6G
4. Stimulate training, research and uses in artificial intelligence and its adoption by the whole of French society, in accordance with our values
5. Guarantee the security, environmental sustainability and availability of talent in all areas of digital technology (AI, cloud, telecoms, quantum computing, etc.)

KEY INFORMATION	
Responsible Ministry	Ministry of Economy, Finances & Industrial and Digital Sovereignty
Total Budget	735 M€ (Governmental funding)
Start Date	2021
Expected End Date	2030

Table 7: Key information on the French national initiative

4.2 Funding

The French national initiative started in 2021 and is funded with 735 M€ from the General Secretariat of the Prime Minister (SGPI), managed by Direction Générale des Entreprises (DGE) of the Ministry of Economy and the Ministry of Research. The whole initiative is divided in four axes (addressed in detail in section 4.2). The Axis 2 of the work focuses on the development of French sovereignty on telecom networks and is funded with 1 B€ with 360 M€ of public funding. The Axis 3 focuses on consolidation of research and development forces on future network technologies and carries a funding of 410 M€ including 203 M€ of public investment and 30 M€ dedicated to SNS. The funding is allocated for the whole duration of the programme from the onset.

With the Call for Proposals, co-funding is expected from the participants. Public funding for industrial research is between 65% and 100%, for academic developments. The Agence Nationale de Recherche (ANR) operates national academic calls for projects, and the funding varies between 30% and 100% for fundamental research projects and between 25% and 100% for experimental development projects. The funding comes from the national acceleration strategy for 5G and future networks technologies via the Banque Publique d'Investissement (BPI), from industrial chairs (Orange's chair on 6G and environmental developments). For industrial projects funding is between 50% and 80%, for experimental developments it is between 25% and 60%, and for academic actors/projects it is up to 100%. It is also possible for projects to take out loans/refundable advances (avances remboursables) from the BPI.

4.3 Organisation of work

The French Acceleration Strategy on 5G & Future Network Technologies as 6G is focused on the following goals:

- Development of 5G applications and increased usage of 5G based services by the French ecosystem and society;
- 5G acceleration of deployment and vertical services offer;
- Supporting French companies, including SME and start-ups, working in the telecom industry
- Strong support of R&D and standardization of future telecommunications network technologies, such as 6G;
- Joint European effort to ensure digital sovereignty;
- Development of human resources in the field of telecommunications.

The acceleration strategy is based on 4 axes:

- **Axis 1**: support for the development of 5G uses for the benefit of territories and industry;
- **Axis 2**: the development of French solutions on telecom networks;
- **Axis 3**: consolidation of research and development forces on future network technologies;
- **Axis 4**: strengthening the training offer.

Several projects along all the 4 axes have already been launched and some others will be launched soon. The axis 3 is the axis 4 is most related to 6G R&D and include projects such as:

- The PEPR (Programme et Equipement de Recherche Prioritaire) is a part of the third axis of the national strategy. It is backed by 65 million euros of public support and addresses topics such as enabling technologies for NAN and core networks in 5G+ and future networks such as agile network architectures, cloud based and mobile edge cloud based and SDN, interoperability of heterogeneous systems, new physical layer technologies such as signal processing algorithms, advanced & intelligent hardware, etc. Its goal is to ensure a cohesive research effort on future end-to-end telecom solutions and increasingly great involvement of industrial actors in R&D topics.

- Call for Proposals (CFP): Backed by 221 million euros of public support, CPFs focus on projects which foster an interest for 5G applications, 6G developments, cyber, backhaul and submarine networks. The projects submitted are collaborative and include both industrial stakeholders and academic entities.
  - France's latest CPF 'Innovative solutions (R&D of B5G, 6G, Future networks)' funds projects which mainly focus on 5G, 6G and hybrid solutions.
  - Frame xG. This project is the result of the CFP "Maturation and Pre-maturation". It focuses on technology transfer from research to industry via the creation of a patent factory. This project focuses on the transfer of technologies & the creation of companies, as practiced by research organisms and valorization structures on the one hand. On the other hand, Frame xG will provide guidance to national stakeholders with regards to the standardization of their IP assets.
- France 6G. Various themes and goals are set out as part of the France 6G initiative. That is, for example, the development of cohesive and structured national initiatives for 6G developments, from research to standards, facilitating the exchanges between the academic and the industrial worlds, providing guidance for standardization of IP assets.
  - Announced in July 2023, Ministry of Economy & Ministry of Research are creating a French hub to connect all projects linked to 6G in France, provide guidance regarding 6G developments and coordinate national actions to create a common national position for industrial stakeholders as well as academic.
    - Reinforce cooperation between national actors;
    - Strengthen IP assets valorisation held by stakeholders;

- Help solidify a national industrial and academic position regarding the development of certain matters.

Also the other axis have activities relevant such as:

- CFP on 5G experimentation: A total of 21 experimental platforms with 163 M€ of investment and 62 M€ of public support (in Axis #1)
- French – German CFPs on 5G private networks: A funding of 20 M€ on 8 projects with 27 companies/entities supported (in Axis #2).
- CFP Skills and Professions of the Future, including projects to design academic training courses of the future in the field of telecoms (in Axis #4)
- EDEC (Engagement du Développement de l'Emploi et des Compétences) is a project dedicated to the development of human resource in telecommunications area. Various stakeholders take part in it (Ministry of Economy and Finance, Ministry of Labour, Infranum, Afnum, industrial actors, laboratories).

In addition to the above, France national initiative also supports work done in the open-source domain. One of France's most active actors is Eurescom, which manages the Open Air Interface Alliance, develops network cores and RAN solutions. This solution is used by academics & startups to build their own activities. France also finances companies whose solutions are based on OAI.

The national initiative also has a heavy focus on industry 4.0. Previous programs in France have heavily contributed to the development of automotive industry, health, agriculture, transportation, mobility and aviation.

The 6G projects targeted by the PEPR vary from TRL 1 to 6, while the BPI's Call for Proposals vary from TRL 4 to 6, for the ANR this is TRL 1 to 4. The projects under France 6G work on TRL is 1 to 6.

4.4 Topics covered

Using the categorization described in the introduction, we see the France 2030 initiative covering the following main topics.

Topic	**Relative importance**
5G evolution R&I	***
System network architecture and Control	***
Edge and Ubiquitous computing	***
Radio technology and Signal processing	***
Optical networks	**
Network and Service security	** (addressed in the PEPR : "Network support to global security")
Non-terrestrial networks	***
Special purpose networks/sub-networks	***
Opportunities for devices and components	**
Micro-electronics	*** (addressed in the national strategy of Electronics)
Experimental infrastructure	*** (PEPR's project: "An open and integrative experimental infrastructure for 5G and Networks of the future")
Trials and pilots with verticals	*** (ex. Edge computing in the vehicular context)

Human capital	** (via the Work Group Innovation [GT Innovation] and the EDEC)
Policy aspects	**

Table 8:Topics covered in the French national initiative

The French national strategy also addresses sustainability issues, for example within the PEPR in 'Work Package 2: energy-efficiency of future network infrastructures' and 'WP3 : sobriety of EMF exposure and of energy consumption'. It also works on societal acceptance, cybersecurity and sovereignty concerns along with a focus on the development of human resources. France collaborates with the ecosystem to discuss the attractiveness of telecommunications ecosystem to student and workers.

4.5 Perspective on Collaboration

France views collaboration positively and aims to leverage collaboration for good results and faster development. Collaboration is initiated at the programme level and then implemented within the projects. There are collaboration agreements in place with Germany regarding 5G developments, including a joint CPFs (private networks & industrial 5G) with Germany. Both parties involved fund the activities carried out on their respective side. France 6G also encourages national stakeholders to engage with foreign entities and participate to regional and international programs.

While France values collaboration, it also faces some impediments. The timing of the national & European calls poses a problem since their processes are very different and require different forms of engagement. In order for smaller entities to participate to SNS, they need to be known and pulled into consortiums by bigger actors. This requires considerable efforts in terms of human and financial resources, which smaller stakeholders cannot partake in while applying to national calls. Additionally, in order to submit projects, companies need to deploy significant effort. The prerequisite to do so is to have access to considerable disposable resources, both human and financial. Smaller stakeholders do not necessarily have access to such resources.

An important benefit of collaboration with other initiatives and the SNS program is the opportunity to guide the work towards certain chosen and precise developments.

5 Finland

Within the Finnish R&D landscape, there are two large initiatives that are currently active:

- The 6G Bridge
- The 6G Flagship

There is also 6G Finland, an independent network of 6G excellence of key organizations that aims to build the nations' innovation, competitiveness and international standing. It is an active coalition of Finnish 6G R&D organizations, and handles several aspects of 6G technology, such as policy-related work in regards to spectrum sharing and frequency allocation. The coalition helps initiate dialogues with the government in order to realize regulation on several topics of importance for 6G technology. While the 6G Bridge and 6G Finland mostly focus on business and technology, the 6G Flagship focuses on science.

As 6G Finland is not a (large) national initiative that provides funding, it is not further considered here.

5.1 6G Bridge

5.1.1 Introduction

The 6G Bridge program aims to make Finland the global leader in providing new value with 5G Advanced and 6G technologies for sustainable industries and societies e.g. in smart cities, smart energy, smart ports and smart factories with different ecosystem players. While the 6G Flagship is focused primarily on fundamental research, 6G bridge reduces the gaps between fundamental research and applied research. The two national programmes do not compete with each other but rather offer complementary services and insights. (Business Finland, 2023)

The 6G Bridge offers the following program services:

- Business: innovation funding for Finnish companies for business development
- Internationalization services for Finnish companies
- Research: funding for Finnish research organizations
- Invest in Finland services for foreign companies
- Business: innovation funding for foreign companies that are register in Finland

The 6G Bridge focuses on verticals such as Health, Automotive, Manufacturing, Energy.

5.1.2 Funding

The 6G Bridge receives a funding of 130 M€ for a period of 4 years from the Ministry of Economic Affairs and Employment. This money is transferred by the Ministry to Business Finland, a service organisation supporting innovation in Finland, which then distributes the money to various projects in Finland working on 6G technology. Next to funding and managing the 6G Bridge programme, Business Finland offers over 50-80 other services and operates under a total yearly budget of approximately 600 M€. Currently 25 M€ out of the 130 M€ budget for 6G Bridge have been allocated to projects, with 105 M€ remaining.

The partners within the 6G Bridge projects are expected to bring in co-funding but the amount depends on the funding instrument that is being requested. There are two funding instruments available to projects – grants and R&D loans without any collateral requirement (usually for projects that are high TRL/closer to market). The amount of co-funding expected ranges from 25% - 60%, with SMEs receiving a maximum of 75% funding and thus needing to add only 25% of their own funding. For large private companies, the funding provided by Business Finland is about 40-50%. The co-funding by the parties always needs to be a cash contribution, as in-kind contributions do not count towards the co-funding.

The 6G Bridge programme does not directly report to the Ministry on its progress, but to the board of Business Finland. Business Finland in turn reports to the Ministry annually, however, not specifically on the progress of 6G Bridge but on overall KPIs that indicate the state of innovation within Finland. These could be KPIs such as impact

on economy through employment, R&D activities, investment in Finland, etc. Finland aims in the future to reach 4% of its GDP through R&D activities.

While the initial funding set out by the Ministry is 130 M€, it is not limited to that. If there are relevant projects that need funding, extra funds can be released. These extra funds can allow for new topics to be addressed and/or new partners to be added to 6G Bridge.

KEY INFORMATION	
Responsible Ministry	Ministry of Economic Affairs and Employment
Total Budget	130 M€
Expected Start Date	2023
Expected End Date	2026

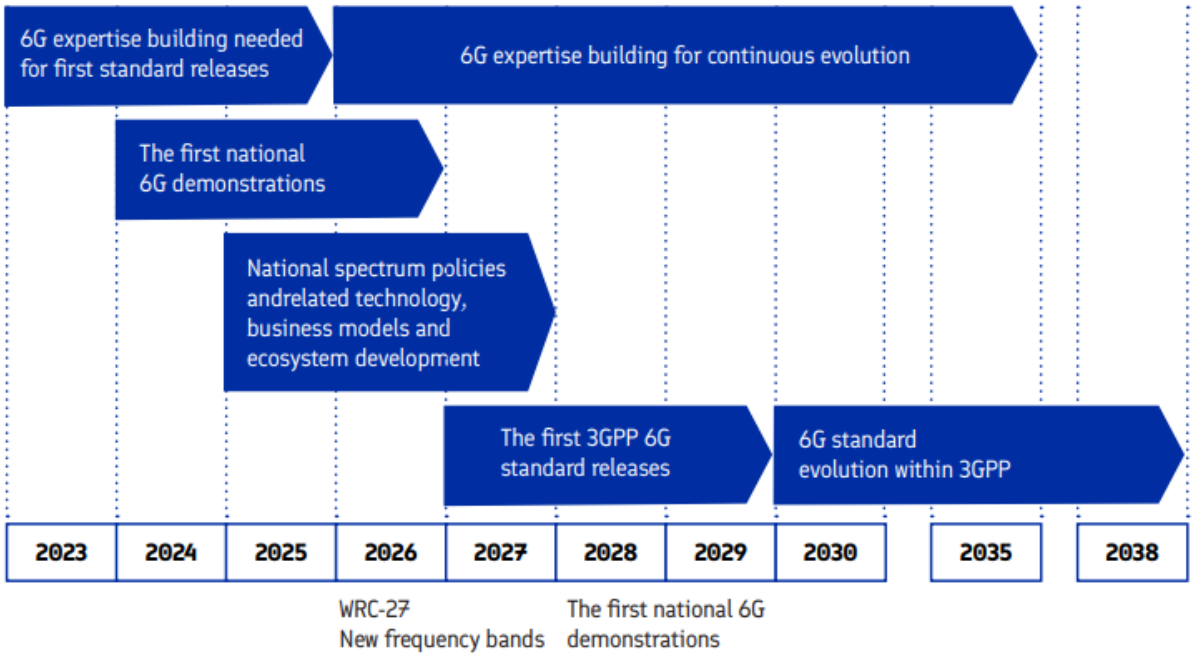
Table 9: Key information on the 6G Bridge initiative

5.1.3 Organization of work

The work within the 6G Bridge is guided by the Finnish national Strategic Research and Innovation Agenda which defines the framework for R&D&I activities. The Figure 6 below shows the 6G roadmap as set out by the SRIA.

The 6G Bridge program encourages Finnish researchers and companies to increase radically both national and international collaboration – also outside the EU. The program goals will be met e.g. by:

- Increasing ecosystem-driven collaboration in research and innovation for 5GA/6G
- Building future business ecosystems in 5GA/6G and attracting international investments
- Strengthening the key capabilities in 5GA/6G
- Fostering testing and experimentation facilities in 6G



2023 – 2025 **6G expertise building needed for the first standard release;** to lay the foundations for 6G basic system, standards, and first national 6G demonstrations etc.

2024 – 2026 **The first national 6G demonstrations;** demonstration of potential 6G technology enablers and sytem components, definition of end-to-end system KPI/KVI validation criteria etc.

2025 – 2027 **National spectrum policies and related technology, business models and ecosystems development**; technology development, setting national spectrum policies, contributions to global 6G regulations and further development of national ecosystem etc.

2026 – 2028 **6G standard first version within 3GPP;** contributions and development of first 6G standards, enhance ment of national 6G demonstration capabilities and use case demonstration of 6G basic system etc.

– 2035 **6G expertise building for continuous evolution;** building the expertise for 6G evolution, technology enabler development, research of use cases etc.

– 2038 **6G standard evolution within 3GPP;** contribution to standardization, development of technology enablers etc.

Figure 6: 6G Roadmap as set out by the Strategic Research and Innovation Agenda

The stakeholders of the 6G Bridge initiative includes 190 organizations, main industry ICT including companies such as Nokia and Ericsson, as well as other Finnish initiatives such as 6G Finland, 6G Flagship, 5G Momentum, Allied ICT Finland, Academy of Finland, Technology Industries of Finland.

The priorities set out by the SRIA along with the internal KPIs of Business Finland allow them to decide which projects are relevant and which are not. Projects can be carried out by a single entity or a consortium, and usually have a budget somewhere between 50k and 3 M€, with a typical length of 1-3 years. Projects are welcome to apply for funding at any time and are not bound by call deadlines. The projects cover a TRL range of 3-8.

Reporting by the projects towards Business Finland has to be done at minimum once at the half-way point and once at the close of the project. The reporting must include a financial update as well as an update on the progress. At the start of the project, Business Finland agrees on KPIs together with the project partners which forms the basis for evaluation of the project. Funding is not withheld based on poor performance, but poor performance may result in hesitation to fund further projects with the same partner/consortium. In general, Business Finland looks for high risk, high reward projects, which implies some projects will not be successful.

5.1.4 Topics covered

Using the categorization described in the introduction, we see 6G Bridge covering the following main topics:

Topic	Relative importance
5G evolution R&I	***
System network architecture and Control	***
Edge and Ubiquitous computing	***
Radio technology and Signal processing	***
Optical networks	-
Network and Service security	***
Non-terrestrial networks	**
Special purpose networks/sub-networks	***
Opportunities for devices and components	*
Micro-electronics	**
Experimental infrastructure	*
Trials and pilots with verticals	***
Human capital	**
Policy aspects	*

Table 10: Topics covered in the Finnish 6G Bridge programme

6G Bridge also focuses on policy and societal aspects such as sustainability and sovereignty. There is no dedicated funding for this within 6G Bridge, but is at the core of the whole development. Business Finland , 6G Flagship and 6G Finland collaborate on their views on policies for 6G. While the Ministry guides the overall policy aspects to be considered for 6G technology, Business Finland does not impose any rules on its projects and customers. The projects have their own freedom to pursue policy and societal topics in the manner they see fit.

Business Finland and its internal departments also work on human capital, however, this does not form a part of the 6G Bridge project. Work in Finland is one of the internal departments that focuses on attracting talent to Finland and its projects. Invest in Finland is another department that can aid with companies that would like to establish themselves in Finland. Other activities focusing on human capital include sharing knowledge with the community and matching research knowledge with industry, and also looking into software and tools needed for 5GA and 6G.

5.1.5 Collaboration

Business Finland (and in turn 6G Bridge) address collaboration at various levels – national, within the EU, and outside the EU. They actively participate in projects such as KDT, SNS, EUREKA, EUROSTAR etc. in order to work together with like-minded countries. MoUs have been signed with some countries as well as some states in the US, however, Business Finland prefers to realize collaboration through joint projects such as the ones mentioned above, bilateral calls such as under EUREKA or directly within another country to create joint projects for similar R&I.

6G bridge doesn't sign MoUs on its own, this is always done at the Business Finland level. If a project is started on 5GA/6G and funded by Business Finland, then it automatically falls under the scope of 6G Bridge.

Business Finland understands that a major benefit of collaboration is the accumulation of expertise from various countries, to solve the challenges of the future together. However, barriers to such collaborations are the difficulties in finding the right SMEs and deep-tech companies within other countries. It is hard to find the right match within another country and finding the right funding instrument for such collaborations is also a challenge.

5.2 6G Flagship

5.2.1 Introduction

6G Flagship is a part of the Finnish government's national research spearhead programme from 2018 to 2026. The goal is to create the essential 6G technological components, the tools, and the equipment to build a 6G Test Network, develop chosen vertical applications for 6G to accelerate societal digitization and continue to be a recognized vision leader and sought-after research partner in worldwide 6G research. The initiative is run by the Centre for Wireless Communications (CWC) at the University of Oulu in Finland. (University of Oulu, 2023)

KEY INFORMATION	
Responsible Ministry	Ministry for Education and Culture
Total Budget	250 M€ (19.7 M€ Governmental funding)
Start Date	2018
Expected End Date	2026

Table 11: Key information on the Finnish 6G Flagship initiative

5.2.2 Funding

The programme is funded by the Research Council of Finland (RCoF) for a period of 8 years with an amount of 19.7 M€. University of Oulu contributes 16 M€ to the programme, bringing the total dedicated funding to 35 M€. However, the project operates with a total budget of 250 M€. This is organized such that the rest of the funding is received from faculty of ITEE, external projects, such as those funded by Horizon Europe, SNS, Business Finland, private companies, etc. The dedicated funding of the 6G Flagship (35 M€) is not distributed via projects, but instead contributes to the salaries of the staff working on the programme, such as professors, post-doctoral researchers, PhDs, etc.

The funding received from the RCoF is divided over two grants for the whole duration, given out in three instalments. The first grant is for the first 4 years of the project for an amount of 9.1 M€, and then two instalments over a period of 2 years each contributing a total of 10.6 M€. Since this internal money does not fund any projects, there is no obligation for the partners within the externally funded projects to bring in any co-funding. The co-funding expectations of those projects are set by the body from which the funding is received.

The 6G Flagship has ambitions to continue its work beyond 2026 as well. There are currently discussions ongoing with the Ministry to explore options for additional funding. In case additional governmental funding is not available, the programme can still continue with additional funding received from University of Oulu and through the externally funded projects.

5.2.3 Organization of work

This programme carries the following goals:

- **6G Technology Enablers**: 6G Flagship will carry out technology and system pilots for selected verticals by co-creating with companies, ensuring timely relevant wireless expertise availability for industry needs, and enabling economic growth via an early adaption of critical smart society technologies.
- **6G Test Network Development**: creating a nationwide test network environment.
- **6G Vertical Applications**: to gain a deeper understanding of the selected vertical applications: health, energy, automotive, and industry, security and defense; what they will require and how they fit into the 6G ecosystem.
- **6G Vision Leadership**: assessment of future risks and possibilities.

The programme focusses on four strategic research areas, as described in the Figure 7 below.

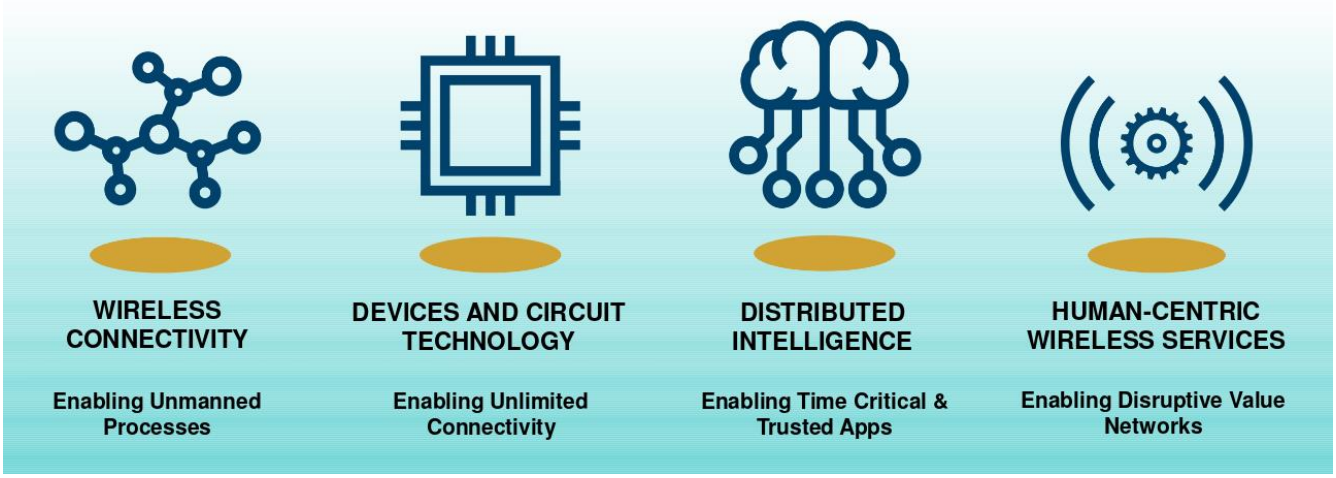


Figure 7: Strategic research areas within the Finnish 6G Flagship initiative

The strategic research areas are further subdivided in research themes as follows:

Strategic research areas	**Research Themes**
Wireless connectivity	Advanced networking technologies
	Wireless access technologies
	Massive wireless automation
Devices and circuit technology	Radio platforms
	Radio hardware
	Experiments and proofs of concept
Distributed intelligence	Computing on the edge-to-cloud continuum
	Distributed AI
	Multimodal sensing and modelling
Human-centric wireless services	5GTN to 6GTN (experimentation platform)
	Strategic vertical areas
	Sustainability, business, and regulation

Table 12: Research themes in 6G Flagship

The 6G Flagship currently has about 300 externally-funded projects under its umbrella; these are Horizon Europe projects, SNS, KDT, etc. 6G Flagship does not release any calls of its own; partners wishing to start projects must apply for other calls such as the ones mentioned above. As long as the work being done in the project aligns with

one of the strategic research areas, the project is accepted as a part of 6G Flagship. In the 6G Flagship ecosystem there are three different levels of partners: an affiliate, a project member and a co-creator i.e. strategic member. Only co-creators (strategic partners) are expected to bring money into the project, but this could also be money in the form of equipment instead of cash.

The 6G Flagship is guided by the 6G Flagship Steering Group and the Research Leadership Group. The Steering Group advises the programme from the point of view of the research strategy of the University of Oulu, but is not a decision-making body. The Research Leadership Group on the other hand makes operative decisions and defines and accepts proposed research agendas, including making changes to the usage of the budget. The individual projects, operating under the 6G Flagship umbrella, report on their progress to the particular Strategic Research Area they are linked to. The SRAs report to the Research Leadership Group, that in turn reports to the Steering Group. Every second year the 6G Flagship has to report to the RCoF on the progress of the programme.

The projects within 6G Flagship work within the TRL range 1 – 6.

5.2.4 Topics covered

Using the categorization described in the introduction, we see 6G Flagship covering the following main topics.

Topic	Relative importance
5G evolution R&I	***
System network architecture and Control	***
Edge and Ubiquitous computing	***
Radio technology and Signal processing	***
Optical networks	*
Network and Service security	***
Non-terrestrial networks	*
Special purpose networks/sub-networks	**
Opportunities for devices and components	***
Micro-electronics	***
Experimental infrastructure	***
Trials and pilots with verticals	***
Human capital	-
Policy aspects	***

Table 13: Topics covered in the Finnish 6G Flagship initiative

Sustainability and UN SDGs are the main driving factors in the research. There is a dedicated project (with its own funding) within the 6G Flagship umbrella, called the 6G-Enabled Sustainable Society (6GESS) program, which capitalizes on 6G Flagship's technological expertise to develop the scientific framework for a data-driven, hyper-connected future society. Additionally, the programme has one dedicated person who specializes in topics on sustainability. Sustainability is considered cross-sectional across all SRAs and verticals.

Human Capital is neither a research area nor a topic within the 6G Flagship, but it is addressed within the Human Centric Wireless Services strategic research area and its projects, where user need is taken into account. The programme also has a global pilot project (funded by the Ministry of Culture and Education) in countries like India, where education is one of the focus areas. The countries involved in these pilots bring their own funding as well.

5.2.5 Perspective on Collaboration

The 6G Flagship collaborates with many national and international partners as well as other national programmes though the 300+ projects under its umbrella. They cooperate widely with international science communities,

academia and universities across the globe, including many European countries, US, Brazil, Japan, Korea, China, India, Singapore, etc. These collaborations are realized mostly via joint projects and academic cooperations.

The starting point for these collaborations can be an MoU but as soon as it reaches to a joint project, project agreements come into place. Collaboration agreements are always drawn up at the programme level even though work is often pursued with one of the strategic research areas or one of the projects.

6G Flagship recognizes that by working together through collaboration, good results can be achieved faster and they can influence the upcoming standards. However, in some cases collaboration is quite challenging. Some national regulations could be a limiting factor. But a bigger challenge is that not every country, even within the EU, is at a position to start work on 6G yet. There are many countries that are still struggling with 4G deployments. Local readiness within Europe for 6G varies greatly, and this factor influences collaboration.

6 Germany

6.1 Introduction

The German national initiative on 6G or the German 6G Programme comprises different kinds of projects. The "6G Platform Germany" or more precisely the 'Platform for Future Communication Technologies and 6G (6G Platform)' acts as an umbrella project for the national program. It is intended both to make scientific contributions to the content design of 6G and to ensure the scientific-organizational support for the processes that are necessary for the successful implementation of the German 6G programme. The German 6G Programme was announced in April 2021 and is structured as follows:

- 6G Platform Germany, October 2021 –2025
- Four 6G Research Hubs, 2021 –2025
- Eighteen 6G Industry Projects, 2022 -2025
- Seven Projects on Resilience, 2023 –2025
- AI-NET, 2021 -2024
- Projects on high-speed networks for hyper connectivity, 2024 - 2027

KEY INFORMATION	
Responsible Ministry	Federal Ministry of Education and Research
Total Budget	700 M€
Expected Start Date	2021
Expected End Date	2029

Table 14: Key information on the German 6G initiative (status Sept 2023)

6.2 Funding

The 6G Programme is funded by the German Federal Ministry of Education and Research (BMBF). At the time of writing this report, the total budget of the programme was estimated to be 700 M€, however, since the programme continues to add new funding calls and projects, the final number cannot yet be ascertained.

The programme officially started in 2021, although the CELTIC-NEXT AI-NET project, which was included under the German 6G programme when the national initiative started, was already active before that. Currently the programme is expected to end in 2025, however, the projects being funded with the new instruments are expected to continue till 2029.

The hubs have a duration of 4 years and they received additional funding in 2022. Within the allocated budget, the budget is allotted on a yearly basis. The administrative framework for funding – in particular, the need for co-funding - follows the BMBF standard procedures. Universities don't need to co-fund, research institutes have differing rules, e.g., Fraunhofer doesn't need to provide co-funding, however, the German Research Center for Artificial Intelligence (DFKI) needs to provide co-funding. Private companies are subject to different rules but information on these rules is not public information. These rules also differ for big private companies versus start-ups, SMEs etc. Participation of SMEs is viewed positivity during the evaluation of projects. SMEs can – under specific conditions - receive a higher funding rate of the public funding than big companies , and hubs are encouraged to look for SMEs to be suppliers within the projects.

6.3 Organisation of work

Themes and topics for the projects within the scope of the German 6G Programme were defined based on the submissions received in response to open calls. These calls were pretty broad. The submissions were evaluated by an evaluation board and recommendations by this board were made towards the BMBF. However, the final decision of selection and fund allocation rests with the BMBF. There were several calls, including one call for a platform, one call for industry projects, one for research hubs, one for resilience projects, etc.

When a new project is added to the German 6G Programme, it could be linked to an existing project or a hub. A cooperation with the 6G-Platform is mandatory though. Whenever a new topic seems important and budget becomes available, calls might be put out. The new calls allow for new partners and new topics to be added to the current pool, and additional budget could be made available by the BMBF for this purpose.

The overall TRL covered within the German 6G Programme is 1-4, in exceptional cases up to 5. Regarding higher TRL in the areas of 5G evolution and with regard to policy aspects of future 6G, BMBF is closely working together with the German Federal Ministry for Digital and Transport (BMDV).

6.3.1 6G Platform

Main instrument of the 6G Platform are "Working Groups". Participation in these Working Groups is open to all participants from partners funded in the BMBF 6G Programme. This part of the programme was initially designed keeping in mind the structure of the 6G-IA / SNS JU working groups and tries to simplify the collaboration with 6G-IA, SNS-JU, and other national initiatives. Additional Working Groups are set up based on demand. Note that the 6G Platform is not some kind of supervision body for the German 6G Programme. It depends on voluntary contributions of the projects. All other projects have their own governance structure and they operate independently, i.e., there is no formal reporting to the 6G Platform project, although the 6G Platform aims to keep in touch with all projects.

1. **WG1 Science Communication**: This group is responsible for bilateral communication with all stakeholder groups relevant for 6G. An important motivation is to increase acceptance for 6G networks, services, and applications. Topics that get addressed are concerns about electromagnetic exposition, privacy issues, technological sovereignty, and participation (in particular in rural areas).
2. **WG2 Societal perspective**: This group will focus on sustainability and participation.
3. **WG3 Maximizing impact**: The focus here will be on involving vertical industries, SMEs, and management of innovation.
4. **WG4 Building a global 6G vision**: This group will focus on building the vision, use cases, and roadmaps for 6G.
5. **WG5 Security, Resilience, and Trustworthiness**

Additional working groups are currently set up.

6.3.2 6G Research Hubs

Within the German national 6G initiative, four 6G research hubs were started in 2021, with an overall budget of approximately 275 M€. These hubs comprise of about 160 research groups at overall 21 universities and 15 research institutes. More than 40 SMEs are already part of the research network. The Figure 8 below shows the location of the coordinating partners.

Figure 8: Research hubs within the German national initiative

6.3.3 6G Industry Projects

Within this part of the national initiative, 18 projects were started in 2022 all led by industry. This includes a total of around 70 industry partners, 20+ universities, and 9 research institutes. In total, the funding provided is approximately 150 M€.

Industry participation includes major infrastructure vendors, four major MNOs, test-and measurement equipment and service providers, major semiconductor manufacturers, OEMs in automotive, airplanes, drones, robots, automation equipment, commercial vehicles, medical equipment, infrastructure operators (factories, airport), and more than 40 small and medium companies with products completing the 6G ecosystem or benefiting from 6G connectivity.

The use case scenarios and application areas which will be in focus are:

- Campus networks (automation, campus logistics),
- Medical scenarios (hospitals, emergency, operation theatre)
- Mobility (automotive, commercial vehicles, drones)
- Global coverage (satellites, rural areas, in-X networking)

Germany also constantly evaluates the use-cases included and expands when needed. For example, in discussion with other national programmes Germany identified certain verticals they missed out on, such as tourism.

6.3.4 6G Projects on Resilience

These projects focus on the resilience of communication infrastructure and digital systems: System architecture, technologies and modules (Hardware and Software), and network management aspects are addressed. About 24 M€ of funding is provided by the BMBF.

Within this part of the initiative, seven projects were started in January 2023, addressing the cyber(-physical) resilience, security and protection of connectivity infrastructure, data, and data processing. The results from these projects will be input to 6G Platform Working Groups.

The resilience projects could achieve a TRL level 5, while the rest of the programme caps technology readiness at TRL 4.

6.3.5 Projects on High-speed networks for hyper connectivity

The funding call was released in March 2023. First projects are intended to start in the first half of 2024. The aim of the funding is to support research into new optical data transmission technologies that can be used to build

high-speed networks for the highly networked society in order to create favorable framework conditions for the development of innovative communication systems in Germany.

6.4 Topics covered

The German national initiative covers the following main topics, with the assigned relative importance:

Topic	Relative importance
5G evolution R&I	***
System network architecture and Control	***
Edge and Ubiquitous computing	***
Radio technology and Signal processing	***
Optical networks	***
Network and Service security	***
Non-terrestrial networks	***
Special purpose networks/sub-networks	***
Opportunities for devices and components	***
Micro-electronics	***
Experimental infrastructure	**
Trials and pilots with verticals	*
Human capital	**
Policy aspects	**

Table 15: Topics covered in the German national initiative

The experimental infrastructure within the German 6G programme focuses on building facilities to carry out experimentation on technologies and test certain applications, etc. The programme builds on existing experimental facilities to make them suitable for use within 6G. Trials and Pilots are not yet addressed within the programme, because there are no trials yet for 6G, but this topics remains in the scope for the future.

The German 6G programme already identifies the expressed need for information in 3GPP and will be contributing on topics such as channel models for 6G through the research output of the projects. During the pre-standardization phase, the projects will work mostly on the identification of requirements, use-cases, KPIs, etc. Although the programme itself does not itself engage in any standarisation work, at a later stage, the industry partners and some research partners will contribute to international standardization. Some partners aim to contribute to existing open source initiatives as well as provide its own open source products for results of the hubs.

The programme also focuses on several societal and policy aspects such as sustainability, sovereignty, privacy and data protection, EM compatibility, scientific communication and gaining acceptance, trustworthiness, gender equality(women in 6G). The 6G Platform has the dedicated responsibility of working on these topics. In addition, the hubs and industry projects also work on this and the platform has the task to bring it all together and harmonize it.

Human capital is one of the very strong motivations for the programme as Germany recognizes the need for good qualified talent. However, there are limited funding instruments dedicated to this, as this forms a part of the general activities of the research hubs. The research hubs offer opportunities to researchers from all over the world and also have budget for scientific exchange programs, workshops, conferences, etc.

6.5 Perspective on Collaboration

The German initiative addresses collaboration both via the 6G Platform as well as through their flagship project, 6G ANNA. Currently they have collaborations in place with several countries within Europe and outside the EU.

They have an MoU with 6G-IA, joint projects with Japan are under discussion, two workshops conducted together with Japan in Berlin and Tokyo, two more planned for 2024, a workshop at the EUCNC on non-terrestrial networks where they invited all parties working on NTN to contribute, planned workshops with Singapore. HEXA-X / HEXA-X II is always invited to the 6G Platform events and presenting their latest results. Further collaborations are planned. The collaborations are initiated mostly at a programme-level but the matchmaking is done at a project-level. Eurescom has been engaged as a subcontractor by the programme to help organize such matchmaking events to find fruitful collaboration opportunities.

Through collaboration the German national initiative aims for a harmonized view on 6G. In addition, they find it to be a useful tool in identifying overlapping areas of work and complementary activities within the projects of other countries. The programme identifies long legal procedures to be a barrier for establishing collaboration, but also recognizes these to be a necessary evil.

7 Sweden

Sweden has a collaborative approach to 6G R&D. The large initiatives in Sweden that relate to 6G are built on previous experiences of setting up collaborative programmes between the state and private sector stakeholders. There are two ongoing national initiatives and two that are in set-up phase. They all have a clear dimension of European and international collaboration.

The current active initiatives are:

- Advanced Digitalization
- R&D Competence Centres

The decided initiatives that are currently under set-up are:

- 6G R&D programme
- Centre for 6G R&D satellite communication

7.1 Advanced Digitalization

7.1.1 Introduction

The program is based on collaboration between the Swedish Government, mainly through the innovation agency Vinnova, and industry. The aim is to promote and accelerate the uptake of digitalization in Sweden and increase the industry´s ability to provide digital solutions of the future. The program is broad where 6G has a significant role.

The set-up of the program has the character of a partner organization with representatives from the Swedish state and industry with a dedicated support office. The industries represented in the board of the program are Ericsson, SAAB, ABB, Volvo Group, Swedish Science Parks and Incubators as well as the Association of Swedish Engineering Industries.

Advanced Digitalization offers the following program services:

- Open calls for collaborative research and innovation projects
- Test and demonstration facilities
- Model for integrated learning
- Arena for meetings to enhance take-up of R&D and best-practices

KEY INFORMATION	
Responsible Ministry	Ministry of Climate and Enterprise
Total Budget	210 M€
Expected Start Date	2023
Expected End Date	2027

Table 16: Key information on the Advanced Digitalization programme

7.1.2 Funding

The funding from the Swedish Government is 210 M€ 2023-2027. The budget and the official representation of Sweden is handled by the innovation agency Vinnova. The partners of projects will finance at least the same level, hence the total budget of Advanced Digitalization with funding from the private sector is 420 M€. The program office is financed by industry in addition to Vinnova.

The program started 2021 and so far, up until end of 2023, over 400 unique organizations have participated in 180 projects. 12 open calls have been launched.

7.1.3 Organisation of work

There are 4 advisory committees within the program that develops recommendations to the governing board of the program, primarily on implementation of calls and other R&I activities The advisory committees:

- Enabling technologies
- Electrification
- Digital infrastructure and communication
- Learning and skills

The program office handles external meetings, external communications and overall promotion of the program including results.

Vinnova is the agency handling budget allocation, calls, contractual agreements with participants in projects and follow-up of on-going projects. The programme aims to increase cooperation with other national programmes to strengthen synergies and to disseminate results as well as knowledge.

7.1.4 Topics covered

Using the categorization described in the introduction, Advanced Digitalization covering the following main topics.

Topic	Relative importance
5G evolution R&I	**
System network architecture and Control	***
Edge and Ubiquitous computing	***
Radio technology and Signal processing	*
Optical networks	-
Network and Service security	**
Non-terrestrial networks	*
Special purpose networks/sub-networks	***
Opportunities for devices and components	*
Micro-electronics	-
Experimental infrastructure	**
Trials and pilots with verticals	***
Human capital	**
Policy aspects	*

Table 17: Topics covered in Sweden's Advanced Digitalization Programme

7.1.5 Perspective on Collaboration

International collaboration is at the core of the industrial partner´s as they are multinational companies. In the program Advanced Digitalization itself there are links to programmes such as Chips JU and EUREKA.

7.2 6G R&D Competence Centres

7.2.1 Introduction

During 2023 totally 11 new R&D Competence Centres were decided for funding in a competitive national call. Vinnova, industry partners and universities together invest 100 M€ 2023-2028. The funding decision and contracts with the centres was made after international expert evaluation. Vinnova, the Swedish innovation

agency, handled the call. The goal of the Competence Centre program is to develop knowledge and new enabling technologies to accelerate the green and digital transition. There are 6 new 6G related R&D Competence Centres starting 2024.

7.2.2 Funding

The funding of each competence centre is divided:

- 1/3 from the Swedish Government through Vinnova
- 1/3 from the universities
- 1/3 from the participating industries and SMEs.

Each 6G related Competence Centre has a budget of 9 – 16 M€ 2023-2028 from Vinnova, universities and industries plus SMEs. The Vinnova budget is in the Table 18 below.

KEY INFORMATION	
Responsible Ministry	Ministry of Climate and Enterprise
Total Budget	20 M€
Expected Start Date	2023
Expected End Date	2028

Table 18: Key information on the 6G R&D Competence centres

7.2.3 Organisation of work

NextG2Com: A Competence Centre focused on advanced communication systems including radio-based communication and networks but also software, data, cyber security and applications. Host of the centre is Lund University.

The research is integrated into demonstrators and proof-of-concepts to ensure that research results are validated and implemented in practice. The partners of NextG2Com has relevant use-cases that are in-line with targets of Agenda2030.

There are 17 contractual partners in NextG2Com. Amongst them SMEs such as Sensative, Cognibotics and Codescene. Industry partners include Volvo Cars, Ericsson and Robert Bosch.

WiTech: A Competence Centre focusing on energy efficient semiconductors as well as advanced antennas and sensors to decrease environmental impact of wireless systems. Host of the centre is Chalmers University (Gothenburg).

There are 19 contractual partners in WiTech. Amongst them SMEs such as Qamcom, Low Noise Factory and Omnisys Instruments. Industry partners include Ericsson, SAAB and Volvo Cars.

SEDDIT: A Competence Centre focusing on sensor information and decision-making for Digital Transformation. Climate change and security is in focus by developing autonomous systems and mathematical methods. Host of the centre is Linköping University.

There are 12 contractual partners in SEDDIT. Industry partners include Scania, SAAB and Atlas Copco.

ACT: A Competence Centre focusing on advanced chip technology through new processes and methods. The research targets high-speed-electronics, opto-electronics and power electronics. Host is Lund University and KTH, Royal Institute of Technology in Stockholm.

There are 17 contractual partners in ACT. Amongst SMEs are NordAmps, AlixLabs and KISAB. Industry partners include Alstom Transportation, Ericsson and Volvo Cars.

SweWIN: Swedish Wireless Innovation Network. A Competence Centre with focus on sustainability and energy efficiency in wireless communication and applications based on sustainable materials. Host is KTH, Royal Institute of Technology in Stockholm.

There are 8 contractual partners in SweWIN. Amongst SMEs are BeamWave and Northern Waves. Industry partners include Ericsson, ABB and SAAB.

CoDig: Continuous Digitalization. A Competence Centre with a vision of a substantial increase of enterprises competitiveness through transformation of software intensive industries' to continuously delivering increased value based on next generation of data and communication infrastructure. Host is Chalmers University in Gothenburg

There are 16 contractual partners in CoDig. Industry partners include Ericsson, Grundfos and Siemens.

7.2.4 Topics covered

Using the categorization described in the introduction, Competence Centres in Sweden covers the following main topics.

Topic	Relative importance
5G evolution R&I	*
System network architecture and Control	***
Edge and Ubiquitous computing	**
Radio technology and Signal processing	***
Optical networks	*
Network and Service security	***
Non-terrestrial networks	*
Special purpose networks/sub-networks	***
Opportunities for devices and components	**
Micro-electronics	***
Experimental infrastructure	**
Trials and pilots with verticals	**
Human capital	***
Policy aspects	**

Table 19: Topics covered in Sweden's 6G R&D Competence Centres

7.2.5 Collaboration

International collaboration is at the core of the Competence Centers. Several have international partners on contractual basis. They are to a large extent the foundation for collaboration through projects in Horizon Europe, SNS JU, Chips JU, EUREKA etc. The Swedish Competence Centres are not visible through CORDA or in Grant Agreements with European Commission. Rather they are visible in CORDA through the legal names of the partners such as KTH, Chalmers, Lund University, Ericsson, Scania etc.

7.3 6G initiatives under set-up

Vinnova together with the Swedish Research Council has an assignment from the Swedish Government to start a 6G program 2024. Detail of implementation is in process and launch of program is scheduled Q2-2024.

6GSAT is an open call for a multidisciplinary research centre. Next generation of mobile communication system is now developed. 6G will be integrated with satellites in space. The focus of the centre is energy efficient integration of mobile communication and satellite communication. The plan is to start the centre 2025-Q1. Swedish Foundation for Strategic Research funds 6GSAT with 6 M€.

7.4 Other 6G initiatives

Vinnova has an assignment from the Swedish Government to finance and enable Strategic Innovation Programmes. Vinnova, the Swedish Energy Agency and Formas fund seventeen strategic innovation programs. One of the programs is Smarter Electronic Systems and there several cutting-edge collaborative projects have been financed in Radio technology and Signal processing, Micro-electronics, 5G evolution R&I, Edge and Ubiquitous computing and Optical networks. The program is however in a final phase of its life-time. There have been several 5G/6G related projects in other Strategic Innovation Programs such as in Process IT and Industrial Automation, Internet of Things and Production 2030.

Vinnova is engaged as the national Public Authority of Sweden in EUREKA Celtic Next. One of several international projects where Swedish participants receive funding from Vinnova is the Celtic Next flagship project AI-Net 2021-2024.

8 Ireland

Within the Irish R&D landscape, there are two large scale initiatives and several relatively smaller scale initiatives that are currently active, these are as follows:

- The Research Ireland CONNECT Centre for Future Telecommunications Networks and Services including its three constituent national initiatives affiliated to the Centre including Open Ireland, Radiospace and Entice experimental facilities.
- The Future Mobility Campus Ireland (FMCI)
- The Analog Devices International (ADI) Catalyst Centre
- The University of Limerick Smart Manufacturing Future Wireless Innovation Test-Bed facility and Cyber Skills: Mobile Cyber Range Virtual IT/OT facility

The CONNECT Research Ireland Centre is a key organisation that aims to build the nation's innovation, competitiveness, and international standing. The CONNECT Research Ireland Centre focuses mainly on science, while the Analog Devices Catalyst Centre, FMCI and the University of Limerick focus mainly on innovation, technology development and business.

8.1 SFI CONNECT Centre for Future Networks and Communications

8.1.1 Introduction

CONNECT is the world leading Research Ireland Centre for Future Networks and Communications. CONNECT is funded under the Research Ireland Centres programme, which has established a network of Research Centres focusing on key research areas in Ireland.

CONNECT brings together world-class expertise from twelve Irish academic institutions to create a one-stop-shop for telecommunications and future networks research, development and innovation. Since its inception is has engaged with over 40 companies including large multinationals, SMEs and start-ups.

It comprises a network of researchers who are dedicated to delivering outstanding results at the pace and standard demanded by industry, based across 12 Irish Universities including: Trinity College Dublin; Munster Technological University; Dublin City University; Maynooth University; Technological University Dublin; Tyndall National Institute Cork; University College Cork; University College Dublin; University of Limerick; South East Technological University; the National College of Art and Design, Dublin and the Dún Laoghaire Institute of Art, Design and Technology.

8.1.2 Funding

The CONNECT Centre received funding for a second phase of 39 M€ (including 9 M€ indirect costs) for a period of 6 years (1st January 2021 to 31st December 2026, inclusive, which may be extended to a date in 2028) from Research Ireland, which is an agency that is organised under and gets its funding from the Department of Further and Higher Education, Research, Innovation and Science (DFHERIS). One project associated to the CONNECT Centre, IrelandQCI, is additionally co-funded by the Department of Environment, Climate and Communications (DECC), currently with €5M research funding. This funding is used primarily on platform research and innovation in the following key areas of 6G and beyond telecommunications networks and services (which undergoes review and revision on a continuous basis) with the following research themes:

- Dependable Networks
- Sustainable IoT
- Link Performance
- AI-Driven Network Customisation
- Network Ecologies
- Smart Cities
- Connected Autonomous Vehicles

- Cybersecurity
- Quantum and Satellite Communication

The 12 university partners within the centre are expected to bring in cost-share funding such that the €30M direct costs constitute 40% of the total Centre Budget. The other 60% is made up of Non-(Irish)-Exchequer, Non-Commercial (NE-NC) funded projects (e.g. from Horizon Europe) (at least 30%), industry cash funding of collaborative research projects (at least 10%), other Irish Exchequer funding (not more than 10%) and a mix of over-target NE-NC and Industry Cash and In-Kind contributions constituting the balance.

The CONNECT Centre reports to Research Ireland by biennial Progress Report and International Review Panel Site Visit with written annual reports in the interim years, as well as filing a six-monthly Governance Report through the Provost of its legal Host Institution Trinity College Dublin, incorporating minutes of its Governance Board for that semester. CONNECT reports financially to Research Ireland every six months. CONNECT does not directly report to DFEHRIS, and only reports to DECC) on its progress on the single DECC-funded project. Its Governance Board comprises relevant leaders from Irish national government agencies responsible for industrial development and enterprise, academic research centres and industrial organisations, the Director and Deputy Directors, and a number of the Deans/VPs of Research of some of its member universities. It is also guided in its activities by its Scientific Advisory Board comprising leading international experts in Smart Networks and Services. It also has an Industry Advisory Board comprising experts from both multinational and Irish indigenous companies focussed on developing Smart Networks and Services.

KEY INFORMATION	
Responsible Ministry	Department of Further and Higher Education, Research, Innovation and Science (DFHERIS)
Other Key Ministry	Department of Environment, Climate Change and Communications (DECC)
Total Principal Award Budget	39 M€ 2021-2026 (plus 31 M€ earlier award 2015-2020); plus c. €30M under the name CTVR 2003-2014). Total Centre Budget from all sources is 2.5 times the Principal Award Budget.
Start Date	1st January 2015 as CONNECT; CTVR from 2003-2014
Current End Date[2]	31st December 2026, expected to extend to 2028

Table 20: Key information on the SFI CONNECT Centre initiative.

8.1.3 Organization of work

The funding from Research Ireland can be seen as the 'core' funding of the Centre. The €30 million direct costs funds an Operations Team (€8M), basic (blue sky) research projects (€15M), and a fund (€7M) to co-fund collaborative targeted research projects with industry partners, including multinationals and SMEs based in Ireland or elsewhere, and some city/county councils. The Operations Team deals with the administration of the Centre, such as reporting, but also for example business development to assist in attracting new industry partners and additional funds, which would then augment the research funding from SFI. This points notably to the Horizon Europe programme, including SNS JU, as Research Ireland and DECC, recognise the importance for the Centre and its researchers to take an active role in relevant European research and innovation programmes, and be a valued contributor with regards to research outputs from such programmes. For the sake of clarity, it is rather the individual academic institutions in CONNECT who are partners in e.g., a Horizon Europe project, not the Centre itself (which is not a legal entity). The research of the Centre is conducted through nine Working Groups, convened monthly by their co-chairs at which research progress and results are presented and reviewed.

[2] The CONNECT Centre is in the process of developing a long-term sustainability plan to sustain the centre into future decades after a transition period up to 2028, after which it will fund itself based on individual Research Ireland awards, Research Ireland Strategic Partnerships, European, International and Industry funding. The objective is to place CONNECT on a permanent footing as Ireland's centre for network research.

Each Working Group has a register of Principal Investigators (named senior professors on the Research Ireland award), Funded Investigators (academics in charge of Platform, NE-NC, or Targeted Project Centre Budget), Research Fellows (postdoctoral), Research Assistants, PhD students and CONNECT-designated Associate Investigators (academics who have yet to receive formal Centre Budget, and a register of project (including European and Industry projects) with primary assignment to it. Centre staff and students may belong to more than one working group. There is an annual Plenary Meeting, the most recent of which had 188 attendees from the Centre and 72 posters in additional oral presentations.

The Centre is involved in standardisation activities, e.g., ETSI, and is a participant in a number of industry groups and other transnational peak bodies. commercialises research outputs through ten spin-out companies and over 40 IP licences to companies.

8.1.4 Topics covered

Using the categorisation described in the introduction, we see CONNECT covering the following main topics:

Topic	Relative importance
5G evolution Research & Innovation	***
System network architecture and Control	**
Edge and Ubiquitous computing	***
Radio technology and Signal processing	***
Optical networks	***
Network and Service security	***
Non-terrestrial networks	-
Special purpose networks/sub-networks	*
Opportunities for devices and components	***
Micro-electronics	***
Experimental infrastructures	***
Trials and pilots with verticals	**
Human capital	*
Policy aspects	**

Table 21: Topics covered in the SFI CONNECT Centre

8.1.5 Collaboration

The Centre has strong collaborative links within and outside Europe, having executed or currently in over 40 EU funded projects (4 in SNS-JU to date). CONNECT has a US-Ireland programme (CoQreate) on quantum networking with the US NSF funded Engineering Research Center for Quantum Networks based at the University of Arizona, and under this mechanism, brings in the QTEQ group at Queen's University Belfast. CONNECT has its OpenIreland Open RAN research test-bed networked into the New-York based COSMOS test-bed. CONNECT also works closely in research support with HEAnet, DECC, Office of the Government CIO, and Government Networks

Generally speaking, the CONNECT Centre doesn't specifically organise the research collaboration in categories such as national, EU, and 'rest of the world' – the centre is operating in a truly global sense and is open to collaborations with other universities and with industry partners wherever they are placed in the world. CONNECT was designated by the Government of Ireland through DECC to propose and lead Ireland QCI, which plays an integral role in the EU's ambitions to build a pan-European Quantum Communication testbed. CONNECT members SETU (co-ordinator), TCD, Tyndall National Institute, UCD and Maynooth University collaborate in this project. The CONNECT Centre is indeed the Irish gravity point for research on 6G topics and the Irish 'interface' towards Europe and other countries and the partner of choice on all matters relating to Future Networks and

Communications. Other research infrastructure in sections 8.2, 8.3 and 8.4 is financed under separate awards, but lies within CONNECT.

8.2 SFI CONNECT Centre Open Ireland Experimental Facility

8.2.1 Introduction

OpenIreland, the reconfigurable 5G and beyond radio, optical, and cloud testbed headquartered at Trinity College Dublin, provides virtualized 5G radio, optical transmission equipment, software virtualisation, Cloud-RAN, Network Functions Virtualisation (NFV), and Software Defined Networking (SDN) technologies (including OpenFlow and Netconf) to support the experimental investigation of the interplay between future networks and new radio. The testbed, led by Prof. Marco Ruffini in the School of Computer Science and Statistics at Trinity College Dublin, includes indoor and outdoor 5G new radio, cloud, and optical transmission equipment deployed within Trinity College Dublin. OpenIreland also has dedicated dark fibre connecting it to the DCU Campus in North Dublin and to the Ireland National and Dublin metro networks from HEAnet, the Irish research and education network.

KEY INFORMATION	
Responsible Ministry	Trinity College Dublin and SFI CONNECT centre
Total Budget	2 M€ Including governmental funding and industry contributions
Start Date	2020 (First funds received by SFI under the research infrastructure grants)
Expected End Date	2035 (this coincides with the lifetime of the SLICES research infrastructure initiative)

Table 22: Key information on the Open Ireland initiative

8.2.2 Funding

The programme was initially funded by Science Foundation Ireland to Prof. Marco Ruffini, under the research infrastructure initiative. The testbed is now being maintained through a number of other projects funded by a number of agencies including SFI, the EU, and industry funding.

8.2.3 Organization of work

Open Ireland was funded as a once off grant for research infrastructure by Science Foundation Ireland (SFI). The funds were used to purchase and build the testbed infrastructure, which is located in Trinity College Dublin. SFI opens regular competitive calls for research infrastructure, which can be used to purchase new equipment, which will then added to the Open Ireland testbed. In general, equipment is added to the testbed through incoming funds from different projects. As Prof. Ruffini's work is in the area of optical and wireless networks, equipment purchased to cover these research topics is fully in line with the scope of Open Ireland.

In addition, since Prof. Ruffini is a PI in the SFI CONNECT centre, he is able to take advantage of administration personnel from the centre to run some of the aspect of the testbed. For example, CONNECT's admins were involved in covering some of the practices required to join the SLICES consortium.

8.2.4 Topics covered.

Using the categorization described in the introduction, we see it the covering the following main topics.

Topic	Relative importance
5G evolution Research & Innovation	***
System network architecture and Control	***
Edge and Ubiquitous computing	**
Radio technology and Signal processing	***

Optical networks	***
Network and Service security	-
Non-terrestrial networks	-
Special purpose networks/sub-networks	*
Opportunities for devices and components	**
Micro-electronics	-
Experimental infrastructures	***
Trials and pilots with verticals	**

Table 23: Topics covered in the SFI CONNECT Open Ireland Experimental Facility initiative

8.2.5 Perspective on Collaboration

Open Ireland is now part of the European SLICES initiative in digital sciences. SLICES aims at providing a large-scale scientific instrument to support the discovery process for the design of digital infrastructures. SLICES entered the ESFRI roadmap end of 2021, successfully transitioning from the design to the preparation phase.

Prof. Ruffini has already included Open Ireland in multiple collaborations with other entities worldwide through EU Horizon projects, bilateral SFI-US funding, and other collaborative initiatives and nationally through projects funded by SFI and by the Department of Enterprise, Trade and Employment – the Disruptive Technologies Innovation Fund.

Thus, the testbed has already been a key means to further experimental collaborative research on optical and wireless networking, and it will continue to be in the long-term future. Terms and conditions for the collaboration are described here: Terms of Use - OpenIreland Testbed - OpenIreland (atlassian.net).

8.3 SFI CONNECT Centre RadioSpace

8.3.1 Introduction

RadioSpace is a National 5G test centre, allowing experimental validation of radios (1-90GHz), over the air testing (6m x 6m x 10m chamber), supporting modulated signal generation and received signal analysis. Based at Maynooth University, it will be open to large industry and SMEs and start-ups, and will provide a unique, large scale, interference-free facility for scientists and engineers from industry and universities, in Ireland and internationally. It will be one of the first of its kind in Europe. The facility consists of a specially constructed anechoic chamber that provides perfect isolation for radio signals; nothing can enter and nothing can leave. This, with the advanced test equipment and specialist engineers, allows for very sensitive measurements to be made, essential for the development of modern wireless devices. RadioSpace connects industry and academic researchers with the aim of addressing the full range of challenges in developing new technologies and products for the next generation of wireless devices. RadioSpace is designed to provide a full range of services to developers of 5G mobile networks, IoT enabled products and future beyond 5G/6G and mmWave devices.

KEY INFORMATION	
Responsible Ministry	To be determined
Total Budget	€1.5 million
Start Date	To be determined
Expected End Date	To be determined

Table 24: Key information on the SFI CONNECT RadioSpace Experimental Facility initiative.

8.3.2 Funding

The programme is funded by 1.5 M€ for a period of 8 years.

8.3.3 Organization of work

This service is available to SMEs, and access can be facilitated via the Enterprise Ireland Innovation Voucher scheme. This ensures that both SMEs and larger organisations can avail of the technology and expertise of researchers in Maynooth University.

8.3.4 Topics covered

Using the categorization described in the introduction, we see RadioSpace covering the following main topics.

Topic	Relative importance
5G evolution Research & Innovation	***
System network architecture and Control	*
Edge and Ubiquitous computing	-
Radio technology and Signal processing	***
Optical networks	-
Network and Service security	-
Non-terrestrial networks	**
Special purpose networks/sub-networks	-
Opportunities for devices and components	**
Micro-electronics	*
Experimental infrastructures	***
Trials and pilots with verticals	***

Table 25: RadioSpace relevance to SNS JU

8.3.5 Collaboration

The RadioSpace centre address collaboration at various levels – national, within the EU, and outside the EU.

8.4 SFI CONNECT Centre Entice

8.4.1 Introduction

EnTICe (Energy harvesting Testbed for Integrated and Connected eSiPs) enables developers of materials, devices (energy transducers, storage devices, Power Management Integrated Circuits- (PMICs), sensors), firmware (e.g., energy efficiency, condition monitoring algorithms), Wireless Sensor Network (WSN) protocols and communications infrastructure to collaboratively test their technologies for ultra-low power wireless applications. An eSiP (energy source in package) concept has been developed to facilitate such collaborations.

The testbed is currently under construction and will be located in the Tyndall National Institute (TNI) in Cork city.

NI is a leading European deep-tech research centre in integrated ICT (Information and Communications Technology). Please note that this testbed facility is still under construction and key hardware and firmware for system integration and interoperability being developed, and further details will be provided once it is operational.

8.4.2 Funding

Funding will be provided by participating in relevant national and EU calls as appropriate. An initial funding has been provided by SFI CONNECT, as detailed in the following Table 26:

KEY INFORMATION	
Responsible Ministry	For example: Department of Environment, Climate and Communications
Total Budget	€120K
Expected Start Date	1 July 2022
Expected End Date	20 Sept 2025

Table 26: Key information on the SFI CONNECT Entice Centre initiative.

8.4.3 Organization of work

The core activity of creating the platform and architecture is sponsored by SFI CONNECT. We then seek national, EU and commercial funding via different mechanisms. Such projects are then associated/affiliated to SFI CONNECT. LoLiPoP IoT is one such example. Energy ECS started concurrently with SFI CONNECT and was retrospectively affiliated. Some additional SFI CONNECT funding may be added to foster collaborations.

8.4.4 Topics covered

Using the categorization described in the introduction, we see SFI CONNECT Centre Entice covering the following main topics:

Topic	Relative importance	Comment
5G evolution Research & Innovation	*	Can be applied to 5G or 6G to demonstrate its ability to improve energy efficiency for a given configuration (typically low data rate apps) but not core
System network architecture and Control	**	Good guide as to optimise architecture, especially, balance edge and core processing to minimise energy footprint
Edge and Ubiquitous computing	**	Ditto
Radio technology and Signal processing	-	
Optical networks	-	
Network and Service security	-	
Non-terrestrial networks	-	
Special purpose networks/sub-networks	-	
Opportunities for devices and components	**	Help design/select/compare and optimize system integration energy efficiency
Micro-electronics	**	Ditto
Experimental infrastructures	***	Testbed for HW & SW developers to co-develop their solutions to minimize energy footprint and react to energy available (primary battery harvested

		energy) versus processing needs, also how to build an appropriate WSN architecture that can adapt accordingly
Trials and pilots with verticals	**	For now, we are creating the building blocks and a small-scale network in EnTICe but we plan to build multiple testbeds, many for particular verticals, usually for other associated projects, e.g., EU Energy ECS (inter-modal transport) & LoLiPoP IoT (asset tracking in factories).
Human capital	-	
Policy aspects	-	

Table 27: Relevance importance of Entice to SNS JU

8.4.5 Collaboration

The testbed will collaborate with other National and EU funded centres and projects. At the moment the 2 primary collaborations are within the Chips Act EU projects Energy ECS (June 2021 - Nov 2024) where we are collaborating with Irish SME NetFeasa on a testbed on tracking dry containers at their R&D site in Ringaskiddy & LoLiPoP IoT (June 2023 - May 2026) where we plan to have testbeds on asset tracking at Boston Scientific Clonmel, DePuy Cork and ADI Limerick (CATALYST facility). In both projects we have also developed WSN battery life simulation models to predict and optimize WSN power consumption and optimize the use of ambient energies to extend battery life.

8.5 Future Mobility Campus Ireland (FMCI)

8.5.1 Introduction

Future Mobility Campus Ireland (FMCI) is developed to create and deliver future mobility testbed facilities – in real world, 'live' settings – giving technology companies, software developers and researchers the opportunity to test and enhance their innovations. A shared, COLLABORATIVE ECOSYSTEM that will bring expertise, minds, capability and advancements in future mobility – spanning Connected, Autonomous, Shared and Electric (CASE) vehicles.

Through collaboration and a shared vision that's about potential and possibilities, not profits, FMCI is shifting Ireland into a new space of smarter, safer, more sustainable transport for people and goods – transforming not just industry, but the way we live, every day.

Located in the Limerick-Shannon metropolitan area at the Shannon Free Zone in County Clare, FMCI comprises a road network that is retro-fitted with inter-connected, state-of-the-art sensing and telecommunication technologies. Fully-accessible and controlled via a dedicated control centre, FMCI facilitates the test and validation of mobility innovations – on the road and in the air – so everyone involved, from researchers to multi-national corporations, can trial, test and innovate solutions in a "laboratory with real life conditions."

8.5.2 Funding

Investment of around €5.5 million has been made in the state-of-the-art commercial campus, which is stimulating international investment and job creation, as well as consolidating Ireland's reputation for leadership in connected, automated, electrified, and shared mobility solutions.

KEY INFORMATION	
Responsible Ministry	Department of Enterprise, Trade and Employment through Enterprise Ireland, and financial contributions from the local authorities of Clare County Council, Limerick City and County Council, the Western Development Commission and industry partners.
Total Budget	5.5 M€
Expected Start Date	1st January 2019
Expected End Date	31st December 2024 - Ongoing

Table 28: Key information on Future Mobility Campus Ireland (FMCI)

8.5.3 Organization of work

The facility supports a range of parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups, and government entities. The Irish national government in-directly issues calls for proposals on a regular basis via funded organizations (of which, all have more than one funding stream) such as

- Enterprise Ireland
- Science Foundation Ireland
- Sustainable Energy Authority of Ireland

8.5.4 Topics covered

Using the categorization described in the introduction, we see FMCI covering the following main topics:

Topic	Relative importance
5G evolution Research & Innovation	*
System network architecture and Control	**
Edge and Ubiquitous computing	***
Radio technology and Signal processing	**
Optical networks	**
Network and Service security	**
Non-terrestrial networks	**
Special purpose networks/sub-networks	**
Opportunities for devices and components	***
Micro-electronics	*
Experimental infrastructures	***
Trials and pilots with verticals	***

Table 29: Topics covered in FMCI

8.5.5 Collaboration

The FMCI addresses collaboration at various levels – national, within the EU, and outside the EU. The facility supports a range of parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups and government entities.

FMCI also works with a range of Higher Education Institutes (both in Ireland and across Europe). Examples of this collaboration include joint submission of National and EU project proposals as well as dedicated project partnerships such as that with the Technological University of the Shannon (TUS) to develop and deliver a post graduate programme in Autonomous Vehicles, thereby securing the Mid West's position as a global leader in

this emerging sector. The programme will up-skill those already working in this cutting-edge sector, ensuring a skilled workforce for the future and using the most sophisticated infrastructure and autonomous vehicles available in Ireland as part of the training process. FMCI has also partnered with University of Galway in a Sustainable Energy Authority of Ireland (SEAI) funded project entitled, "Maas4IRL" This project aims to review the existing Mobility as a Service (MaaS) ecosystem implemented worldwide and develop recommendations on an optimal Maas for Ireland (MaaS4IRL). The outcome of this project is expected to bring a positive impact on the on both public and private transportation Ireland.

FMCI is currently coordinating an EU project entitled ÉALÚ-AER. ÉALÚ-AER is one of the first European Digital Sky Demonstrators to focus on U-space and Urban Air Mobility as part of the European ATM Master Plan designed by the SESAR Joint Undertaking (JU). SESAR JU aims at accelerating through research and innovation the delivery of an inclusive, resilient, and sustainable Digital European Sky.

FMCI is also currently leading an automotive data gathering project with 2 Irish HEIs as well as 2 automotive Tier 1 companies and several SMEs. This project will look at examining current data gaps in automotive dataset and the go about addressing these gaps through the use of FMCI test vehicles. The data will be made publicly available for research organisations and will be hosted at FMCIs on-premisses Petabyte datacentre.

8.6 Analog Devices International U.C (ADI) Catalyst

8.6.1 Introduction

Analog Devices, Inc. (ADI) is a global semiconductor leader that bridges the physical and digital worlds to enable breakthroughs at the Intelligent Edge. ADI combines analog, digital, and software technologies into solutions that help drive advancements in digitized factories, mobility, and digital healthcare, combat climate change, and reliably connect humans and the world.

In March 2022 ADI announced it will invest over €100 million in ADI Catalyst, a 10,000 sqm custom-built facility for innovation and collaboration located at its campus in the Raheen Business Park in Limerick, Ireland. This latest phase of expansion will also see the creation of hundreds of new jobs in the EU market as a reflection of ADI's continued commitment to expansion in Europe.

Designed to support breakthrough products, ADI Catalyst is a state-of-the-art collaboration accelerator where ecosystems of customers, business partners, research Institutes and suppliers come together to engage with ADI's team, technology, and expertise to rapidly develop industry-leading solutions. Utilizing technologies in simulated environments and real-world end applications accelerates the development and adoption of these innovative solutions. Catalyst will primarily focus on the development of software-enabled solutions and artificial intelligence (AI) innovations in areas such as Industry 4.0, sustainable energy, automotive electrification, and next generation connectivity such as 5G and 6G.

Figure 9 Photograph of 10,000 sq.-m Catalyst building

8.6.2 Funding

Investment of over €100M in ADI Catalyst has been made by ADI while also having a recently announced €630M investment under Europe's Important Projects of Common European Interest ME2 program (IPCEI) in the state-of-the-art commercial campus in Limerick, Ireland, which is stimulating international investment and job creation, as well as consolidating Ireland's reputation for leadership in connected, automated, electrified, and shared mobility solutions.

The ADI Catalyst and IPCEI ME2 Project is supported by the Irish Government through IDA Ireland.

8.6.3 Organization of work

The hub supports a range of parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups, and government entities. Open calls are announced on a regular basis.

8.6.4 Topics covered

Using the categorization described in the introduction, we see ADI Catalyst covering the following main topics:

Topic	Relative importance
5G evolution Research & Innovation	***
System network architecture and Control	**
Edge and Ubiquitous computing	**
Radio technology and Signal processing	***
Optical networks	*
Network and Service security	*
Non-terrestrial networks	-
Special purpose networks/sub-networks	*
Opportunities for devices and components	***
Micro-electronics	***
Experimental infrastructures	***
Trials and pilots with verticals	**
Human capital	-
Policy aspects	-

Table 30: Topics covered in ADI Catalyst

8.6.5 Collaboration

The ADI Catalyst facility addresses collaboration at various levels – national, within the EU, and outside the EU. The facility supports a range of parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups and government entities.

In addition to ADI Catalyst, Ireland is home to ADI's European Research and Development Centre, which has an established reputation for developing cutting-edge technology and includes the assignment of more than 1,200 patents. ADI launched its European manufacturing and R&D hub in 1976 in Limerick, Ireland, which remains ADI's European headquarters today. ADI employs more than 2,200 professionals across 14 European sites.

8.7 University of Limerick Smart Manufacturing Future Wireless Innovation Test-Bed facility

8.7.1 Introduction

The Future Wireless Innovation Testbed is located at the Confirm Centre for Smart Manufacturing, headquartered within the University of Limerick's Digital District in Ireland, which is one of the most advanced purpose-built manufacturing research facilities in the world. The new facility was designed and deployed to explore ideas and technologies for improving manufacturing environments towards creating smarter factories by utilising the latest wireless technologies such as 5G, 6G and Wifi6.

The Innovation Testbed was designed by firstly looking at the challenges manufacturing companies face that can benefit from enabling technologies such as 5G/6G/Wi-Fi, by specifically focussing on test use cases for real-world issues like industrial IoT, robotics and the deployment of mixed reality in manufacturing.

The Innovation Testbed promises fast connectivity, more bandwidth and low latency with support for tens of thousands of devices in a small location, all of which are attractive prospects to manufacturing facilities.

8.7.2 Funding

Investment of around €4.2 million has been made in the state-of-the-art Testbed, which consolidating Ireland's reputation for leadership in connected, automated, manufacturing environment solutions towards smarter factories.

KEY INFORMATION	
Responsible Ministry	Science Foundation Ireland (SFI) /Higher Education Authority (HEA)
Total Budget	4.2 M€
Expected Start Date	1st January 2020
Expected End Date	31st December 2025

Table 31: Key information on the Future Wireless Innovation Test-Bed facility initiative.

8.7.3 Organization of work

The facility supports a range of parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups, and government entities. Access is always available upon request and open calls are announced on a regular basis.

8.7.4 Topics covered

Using the categorization described in the introduction, we see the University of Limerick wireless testbed covering the following main topics:

Topic	Relative importance
5G evolution Research & Innovation	***
System network architecture and Control	**
Edge and Ubiquitous computing	***
Radio technology and Signal processing	***
Optical networks	**
Network and Service security	***
Non-terrestrial networks	**
Special purpose networks/sub-networks	**
Opportunities for devices and components	**
Micro-electronics	**

Experimental infrastructures	***
Trials and pilots with verticals	***

Table 32: Topics covered in Future Wireless Innovation Testbed facility

8.7.5 Collaboration

The Future Wireless Innovation Test-Bed facility address collaboration at various levels – national, within the EU, and outside the EU. The facility supports a range of parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups and government entities. A national 5G/6G/Wi-Fi test bed for digital manufacturing offers opportunities for both researchers and industry partners to explore new technologies, new applications, new products, new services, new processes that can be investigated and rigorously tested to ascertain their effectiveness and viability before coming to market and be a catalyst for increased collaboration between academia and industry that will benefit Ireland's research and innovation capabilities significantly.

- Demonstrate how 5G/6G/Wi-Fi technologies can solve real industry needs through specific scenario prototyping.
- Secure strategic competence development, leverage other national expertise (commercial, SFI etc.) and investment to help make Ireland a leader in 5G/6G/Wi-Fi.
- A quantified assessment of how Industry 4.0/Remote Manufacturing, made possible only by 5G/6G/Wi-Fi, increases productivity in the areas of Preventative Maintenance, Use of Robotics and Assisted Maintenance using AR.
- Cyber-security and spectrum resilience capabilities for 5G/6G/Wi-Fi networks to ensure 'security by design'.
- An initiative for industry transformation and increased competitiveness by digitalization.
- Ensure evolving 5G/6G/Wi-Fi networks match industry requirements.

8.8 University of Limerick/Cyber Skills: Mobile Cyber Range Virtual IT/OT facility

8.8.1 Introduction

Cyber Skills is a highly focused, collaborative initiative that addresses skill shortages in the Cybersecurity sector. Cyber Skills works with key industry partners to address their specific skills needs through flexible modes of delivery. This specialised education and training are designed with our Industry partners in order to find the most efficient way of up-skilling in targeted cyber security areas which can then be scaled up to reach 100's or 1000's of learners. This addresses national and regional skills shortages in a really fast changing technological environment and can be scaled regionally, nationally and even internationally.

Cyber Skills is coordinated across three different higher education institutes in Ireland. Lead by the Munster Technological University in close collaboration with University of Limerick & Technological University Dublin. International collaborating partners include, Rochester Institute of Technology (RIT), and The Commonwealth Cyber Initiative (CCI) in Virginia Tech.

8.8.2 Funding

The Higher Education Authority (HEA) Human Capital Initiative (HCI) funding launched in 2020 was an Irish government initiative, backed by an investment of €300m from the National Training Fund (NTF). The HEA-HCI funding has empowered universities across Ireland to bolster their staff/faculty and technical capacities to address industry skill gaps, including the IT-OT cybersecurity challenge.

From the €8.1M invested in the Cyber Skills initiative an investment of €0.5 million has been made in the University of Limerick in a state-of-the-art AIRBUS Mobile Cyber Range Testbed infrastructure. This investment

will consolidate Ireland's reputation for leadership in Cyber Security skills, research, and knowledge development.

KEY INFORMATION	
Responsible Ministry	Department of Further and Higher Education, Research, Innovation and Science, (Higher Education Authority)
Total Budget	8.1 M€
Start Date	1st January 2021
Expected End Date	31st October 2025

Table 33: Key information on the Cyber Skills Test-Bed facility initiative.

8.8.3 Organization of work

The facility can support a range of parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups, and government entities. Open calls for access to training opportunities in Operational Technology (OT) security are announced yearly on the websites https://www.ul.ie/gps/courses/ot-security-professional-diploma-ulwork and www.cyberskills.ie for other Cyber Security programmes. The programmes start in September each year and in some cases an additional start in January also applies.

Access to the Mobile Cyber Range infrastructure will be announced on a regular basis and details of these will be available later. The number of calls per year is yet to be determined as the infrastructure has just been commissioned but the current aim is to operate like the SNS JU with yearly calls.

8.8.4 Topics covered

Using the categorization described in the introduction, we see Cyber Skills covering the following main topics:

Topic	Relative importance
5G evolution Research & Innovation	-
System network architecture and Control	**
Edge and Ubiquitous computing	**
Radio technology and Signal processing	-
Optical networks	-
Network and Service security	***
Non-terrestrial networks	-
Special purpose networks/sub-networks	**
Opportunities for devices and components	*
Micro-electronics	-
Experimental infrastructures	**
Trials and pilots with verticals	**

Table 34: Topics covered in Cyber Skills Testbed facility.

8.8.5 Collaboration

The CyberSkills infrastructure addresses collaboration at various levels – national, within the EU, and outside the EU. Our international collaborating partners include, Rochester Institute of Technology (RIT), and The Commonwealth Cyber Initiative (CCI) in Virginia Tech.

The facilities available to Cyber Skills partners/collaborators supports a range of activities, including, training, test before investing, and cyber resilience analysis of their networks and business processes. These facilities are available to all parties including large and small-scale enterprise, from individual researchers to multi-national corporations, start-ups and government entities.

9 United Kingdom

9.1 Introduction

The UK is currently in a pre-election period. This submission sets out current government policy and funding initiatives relevant to 6G and other future communications technologies.

In 2023, the UK published a Wireless Infrastructure Strategy, which also contains a 6G Strategy, that set out the UK's priorities for the development in 6G. Alongside the 6G Strategy, the UK Spectrum Statement, also published in 2023, outlined how the UK Government would seek to ensure that effective use of spectrum and coordination across public and private sector use can help to maximise the value of existing spectrum and enable the development and deployment of advanced connectivity solutions. In addition, the UK's Science and Technology Framework identified future telecoms as a critical technology for the UK.

The Wireless Infrastructure Strategy outlined several key areas of activity related to 6G, including research and development; standards setting, patents, and standards; and building international alliances.

Figure 10 Key activity areas of United Kingdom related to 6G

The UK's 6G vision focused on the following desired outcomes:

- Digital Access: including through the provision of mobile coverage in hard-to-reach areas
- Open, secure, and resilient networks
- Spectrum utilisation
- Network of networks
- Sustainability
- 6G development process – continuous evolution

9.2 Funding Initiatives

9.2.1 Future Telecoms (Technology Missions Fund)

The UK government announced a package of measures in April 2023 to drive the deployment and adoption of fixed and wireless networks and to invest in the next generation of connectivity. This includes an initial investment of £70 million in a new Future Telecoms mission. A key element of the Future Telecoms mission is support for a series of university-led Future Telecoms Research Hubs.

These hubs bring together multiple universities and institutions around the country to conduct early-stage research into cutting-edge technologies. This work is coordinated by UK Research and Innovation (UKRI) and the Engineering and Physical Sciences Research Council (EPSRC).

The hubs are:

- PlaTform DrIving The UltimAte CoNnectivity (TITAN), led by the University of Cambridge
- Hub in All-Spectrum Commectivity (HASC), led by the University of Oxford
- Communications Hub for Empowering Distributed clouD computing Applications and Research (CHEDDAR), led by Imperial College London.
- Joint Open Infrastructure for Networks Research (JOINER), led by University of Bristol

The hubs draw together the existing portfolio of EPSRC investments in telecoms-related areas into a coordinated approach and provide the foundation for spinout companies and attract further industry investment in the UK's world-leading research base.

Support for early-stage research is complemented by funding for a range of application focused 'challenges', delivered via Innovate UK. This supports companies and researchers to accelerate innovative solutions to market and encourage disruptive collaboration across the UK's diverse Future Telecoms landscape. These competitions have covered challenges such as Network of Networks, Advanced Optical Networks and Next Generation Wireless, while also considering areas like performance, coverage, security, resilience, spectrum efficiency, cost-effective deployment, and energy efficiency.

Five competitions are currently planned or underway as part of the Future Telecoms (TMF) programme:

- Future Telecoms Challenge Small Business Research Initiatives (SBRI), allowed companies to bid for fully funded R&D projects up to £7m. 16 projects have shared a fund of £22m. The challenge winners were announced earlier this year.
- The first round of the Analysis for Innovators (A4I) competition was open until early January 2024. Businesses were able to apply for a share of up to £2.25 million to resolve productivity and competitiveness issues by working with top scientists and research facilities. An additional round of A4I is expected in the next financial year (2024-2025).
- The UK Fast Start Net Zero Living Digital competition opened in early January. This allowed small companies to deliver net zero solutions through data driven digital applications. It includes £500,000 specifically for Future Telecoms.
- Applications to join the Future Telecoms Innovation-to-Commercialisation of University Research (ICURe) cohort have opened. Successful teams will be able to explore the commercial potential of their research, including expert training and 12 weeks of market discovery to test key market assumptions.
- The New Innovators competition will provide a package (£500k) of targeted support to enable ambitious UK registered micro and small businesses to develop affordable, adoptable and investable innovations in the domain of future communication networks. We received 49 applications and expect to fund 10.

Through adopting this suite of approaches, the government aims to cover the full range of the innovation spectrum, from early-stage technologies through to commercialisation and market ready products and solutions.

9.2.2 The Future Open Networks Research Challange (FONRC)

The UK Government opened the Future Open Networks Research Challenge (FONRC) in July 2022. The Challenge will run until the end of March 2025.

The aim of this was to enable universities to work with large Radio Access Network (RAN) vendors, and other telecoms organisations, to conduct research and development to drive the openness and interoperability of future network architectures. The Challenge aimed to:

- Conduct research impacting future technology roadmaps with the goal that openness and interoperability are embedded in future network architectures and systems by default.

Challenge Winners:

- REASON (Realising Enabling Architectures and Solutions for Open Networks) (See consortia here).
- TUDOR (Towards Ubiquitous 3D Open Resilient Network) (See consortia here).
- YO-RAN (Yorkshire Open RAN) (See consortia here)

9.3 Topics Covered

More generally, our focus covers the following functional areas of performance of 6G:

- Coverage
- Security & resilience
- Spectrum managementand
- Cost-effective deployment
- Environmental sustainability

For example, our Future Telecoms 6G-Hubs focus on the following areas:

CHEDDAR Hub

- Emergent systems
- Sustainable systems
- Human-centric systems

HASC Hub:

- All-spectrum connectivity
- Efficient, reliable and resilient networks
- Trust and security

TITAN Hub:

- Aims to architect a seamless, open, and holistically integrated Network of Networks (NoN)

9.4 Perspective on Collaboration

The UK's association to Horizon Europe from 1 January 2024 presents a significant opportunity for the UK communications with technologies sector and pioneering organisations across Europe to collaborate via the Smart Networks and Services Joint Undertaking (SNS JU). The UK would be interested to understand other Horizon Europe members' priorities in order to identify potential synergies between national strategies.

10 Overview of the topics covered by the different national initiatives

Concerning the collaboration with or among the large national initiatives, it is important to identify what topics each of the national initiatives focuses on and common topics being addressed by multiple national initiatives. Based on the structured interviews with each of the national initiatives, we have summarized the relative importance of each item in a specific list of topics. Every national initiative was given the same list of topics to be scored by them, to make comparison feasible. An overview of the relative importance is presented in the Table 35 below.

Topic	Relative importance								
	Netherlands	Spain	Italy	France	6G Bridge Finland	6G Flagship Finland	Germany	Sweden Advanced Digitalization	Sweden 6G R&D centres
5G evolution R&I	-	**	***	***	***	***	***	**	*
System network architecture and Control	***	**	***	***	***	***	***	***	***
Edge and Ubiquitous computing	**	**	***	***	***	***	***	***	**
Radio technology and Signal processing	***	**	***	***	***	***	***	*	***
Optical networks	-	**	***	**	-	*	***	-	*
Network and Service security	*	**	*	**	***	***	***	**	***
Non-terrestrial networks	*	**	***	***	**	*	***	*	*
Special purpose networks/sub-networks	*	-	***	***	***	**	***	***	***
Opportunities for devices and components	**	-	*	**	*	***	***	*	**
Micro-electronics	***	-	*	***	**	***	***	-	***
Experimental infrastructure	***	***	***	***	*	***	**	**	**
Trials and pilots with verticals	***	-	**	***	***	***	*	***	**
Human capital	**	*	*	**	**	-	**	**	***
Policy aspects	**	-	*	**	*	***	**	*	**

Table 35: Overview of relative importance scores from the different national initiatives

11 European Collaboration

11.1 Goals of collaboration

While each country within the Member States has a different set of objectives and goals for their B5G and 6G programmes, it has also been recognized that several goals can be achieved through collaboration. The SNS programme can collaborate with the national initiatives to create a stronger 6G ecosystem, as well as collaboration between the different national initiatives can yield productive outcomes. Some of the goals that can be achieved via European collaboration have been identified as follows:

- Ensuring European leadership for 6G: This can be achieved through exchange of results to avoid duplication of 6G research work, aligning standardization input to get globally accepted results, and setting up EU federated infrastructures to demonstrate EU 6G technology.
- Improving the operation of digital industries: This can be achieved by increasing the uptake of 6G technology by the verticals, creating advanced infrastructure for the verticals to use, and engaging large industry players and well as SMEs to participate in 6G.
- Address societal needs and policy objectives: 6G technology across Europe should focus on addressing societal needs such as sustainability, technological sovereignty and resilience. The focus should also be on creating a knowledge base of education and training for all member states to access.

In addition to the goals identified above, collaboration between the national initiatives and the SNS should also focus on addressing challenges such as mobilizing the European stakeholders in a synchronized way, combining resources and creating a critical mass of European solutions and testbeds, and work on minimizing the technological gap among EU countries.

11.2 SNS-ICE proposed collaboration actions

During the National Initiatives co-creation event at 5G Techritory 2023, organized by SNS ICE, multiple experts from EU side (SNS JU, 6G-IA, SNS ICE) and representatives from the various National Initiatives (NI) brainstormed in sub-groups about the next steps that could reinforce collaboration on various fronts. Based on the output of these brainstorm sessions, as well as additional contacts that SNS ICE partners have maintained with EU partnerships, working groups and national representatives, a set of concrete recommendations were established for three main topics, which SNS ICE partners can follow up on. These proposed collaboration actions are described in the below sub-sections focusing on the ***What, Who*** and ***When***, in order to highlight a concrete way forward.

11.2.1 Exchange of Information

In multiple interactions with the National Initiative representatives, as well as during the SNS ICE Techritory 2023 event, it has been highlighted that an improved flow of information between the various EU instruments and (at least) the main EU Initiatives would be desirable. This concept describes the need for a designated convergence point where relevant information may always be available for interested parties, as well as an established way of communication for information exchange among the various EU and NI representatives. The goal of such a "mechanism" would be for NI representatives to be kept up to date with developments regarding SNS JU funded projects and other relevant EU R&I activities, while on the other hand EU officials and representatives would also have an easy way of discovering key information about specific National Initiatives and how these align with the EU roadmap. Further, this mechanism would include a common communications channel, where relevant information (e.g., on upcoming events, webinars/presentations, announcements, etc.) would be easily and efficiently exchanged among the various representatives, hence facilitating dynamic information exchange and ensuring that all key developments, results and events are known to all stakeholders.

With that in mind, the brainstorming session that took place during the National Initiatives co-creation event at 5G Techritory 2023, proposed some concrete steps forward to set in place such a mechanism. These steps were

subsequently discussed with the SNS OPS project as they implement most of the information exchange facilities within the SNS JU. The resulting key elements proposed are explained in Table 36.

Information Exchange – Brainstorm Session Outcome			
WHO (information/service to be provided)	**WHAT**	**DESCRIPTION**	**WHEN**
SNS ICE (Overall organization + Provision of SNS JU information) ***National Initiatives Representatives*** (Provision of relevant information from NI side)	**Overview shared document with**: - Catalogue of Experimentation Facilities - National Initiatives Key Info	A publicly shared overview document should be created which brings together key information both related to the SNS JU projects as well as related to the various national initiatives in the EU. More specifically the following elements of such a shared document were identified: ***Catalogue of Experimentation Facilities***: A catalogue of the available B5G/6G experimentation facilities around Europe (both from SNS JU projects and from national Initiatives) and their key characteristics should be available. This would offer a quick overview of the experimentation landscape in Europe and would provide relevant links for further, more detailed information ***National Initiatives Key Information***: A webpage containing key information about the main EU National Initiatives including research topics of focus, available testbeds, available funding, relevant links for more detailed information and contact persons for further inquiries.	Provision of information by SNS ICE, and NI by *end of March 2024*. Distribution of document by *end of April 2024.*
SNS ICE (Overall organization) ***SNS OPS*** (Provision of calendar)	**Online Calendar for upcoming Events**	A common online calendar where each party can enter relevant events, keeping other stakeholders aware of upcoming events. NI representatives and SNS JU representatives (SNS projects, 6G-IA, SNS JU office) may provide information on upcoming events / webinars / sessions, to	Common online calendar implementation by *end of April 2024.*

NI Representatives + SNS projects (enter relevant events on calendar)		create awareness and to allow other representatives to join open events.	
SNS ICE (email list creation)	**Common list of e-mail contacts**	A list of e-mail contacts containing key representatives from the SNS JU (SNS JU office, CSA projects, 6G-IA) and at least 1 representative from each main EU National Initiative, to facilitate communication among stakeholders and widescale reception of relevant announcements. This list can also be used for the organization of common events. Attention: caution should be taken by all participants in the list to not misuse the list with intensive messaging (spam) and to treat the list in accordance with GDPR rules.	Email list implementation by end of February 2024.

Table 36: Suggestions to improve information exchange

11.2.2 Aligned approach towards standardization (EU use case input)

As the research and innovation work towards the next generation networks is progressing around the globe, the availability of timely and effective inputs towards the relevant standardization bodies will become of utmost importance. One of the identified objectives is that SNS JU projects, interested National Initiatives and other European stakeholders can converge towards a certain with regard to specific key issues and to present a "common front" in the relevant standardization discussions: this will help to maximize the potential impact of EU-originated ideas/solutions within global standardization.

One such opportunity is the upcoming 3GPP Workshop to discuss the main use cases that will be considered for next-generation (6G) networks. This workshop, took place in Rotterdam from 8-10 May 2024 and has asked contributions from world / regional Research and Innovation strategies. This workshop was used to collect feedback and set the priorities with regard to the main use cases to be considered / targeted during the development of 6G features & technologies.

During the National Initiatives (NI) co-creation event at Techritory 2023, a group of experts from both the SNS JU and the National Initiatives brainstormed on ways to better prepare for this global workshop and on how the various EU stakeholders could potentially align, based on their respective work on 6G use cases, to maximize the impact achieved by the EU side during the global 3GPP workshop. The approach proposed in the table formed a canvas model for future collaboration between the SNS JU, its SNS projects and the National Initiatives in other relevant matters. The outcome of this brainstorming session and the agreed next steps are presented in Table 37.

Aligned EU approach towards global 3GPP workshop on 6G use cases	

WHO (information or service to be provided)	• ***SNS JU*** (SNS JU office + SNS ICE + 6G-IA)
	  ○ Lead the organization of this exercise, the preparatory work and organize the preparatory meeting
	• ***National / Sectoral Initiatives***
	  ○ Provide their experts and views with regards to the 6G use cases
	• ***SNS Projects***
	  ○ Provide input based on their work on 6G use cases
	• ***6G-IA Pre-Standardization WG***
	  ○ Provide consolidated input based on their expertise
	The SRG was informed about the process and the States representatives invited to share any information and useful contacts of the experts that could contribute to this process.

WHAT	***A consolidated European contribution to the 3GPP workshop on 6G Use cases***: The goal is to bring all relevant EU stakeholders and experts together, both from the SNS JU side as well as from the NI side, to discuss their priorities about the envisioned 6G use cases and to eventually agree on a common proposal to be supported towards the 3GPP workshop. Input from all the EU experts was consolidated and all relevant bodies (such as the SNS JU office, the 6G-IA Governing Board (GB), the SNS Steering Board /Technology Board, the SRG) should be included in the process. The resulting contribution to the 3GPP workshop should reflect the needs and priorities of all the key EU stakeholders and should be supported by all relevant EU bodies during the workshop.
WHEN	• ***November 2023 – March 2024***: Preparatory work, with offline alignment between experts/stakeholders, exchange of relevant documents and formulation of early draft of EU consolidated contribution. An information meeting was organised at the end of January 2024 to kick-start the process and collect feedback – deadline for feedback was set at mid-March. • ***15 April 2024***: Preparatory meeting to the 3GPP SA1 Use Cases workshop among all key stakeholders to discuss and generate stable draft of EU consolidated contribution. • ***8-10 May 2024***: Attendance of delegates (with designated Representative for the EU contribution and direct presentation to the 3GPP workshop, including promotion of EU consolidated contribution). Different sources appreciated the EU contribution and praised its in-depth and relevance to advance Use Cases definition in the context of global standardization.

Table 37: Ideas and actions to align the EU approach towards standardization

11.2.3 Identification of topics and areas for collaboration

Several National Initiatives are interested in collaborating with other national initiatives or with the SNS JU. It is however to be further researched what topics will make most sense to be addressed in synergies or reflect mutual interest. To follow-up on the National Initiatives workshop organised by the Italian National Initiative RE-START, it is proposed to organise another brainstorming workshop by SNS ICE where different National Initiatives could discuss what specific topics can benefit from joint activities. This is proposed and took place during the EUCNC|6G Summit 2024 in Antwerpen. Identified topics may lead to bilateral or multilateral joint project or could potentially be included in a future edition of the SNS JU work programme.

Identification of R&I topics for collaboration	

WHO	• ***SNS JU*** (SNS ICE + 6G-IA)
	  ○ Organization of a workshop
	  ○ Aim to get workshop on EUCNC agenda or co-located with EUCNC
	• ***Large and small National Initiatives***
	  ○ Provide input on possible collaboration topics

WHAT	***A workshop to identify topics for R&I collaboration***: The goal is to identify R&I topics where additional joint activities between national 6G initiatives or between national initiatives and SNS are beneficial. Topics may be identified that address a specific joint interest, or a gap, between national or EU 6G initiatives. Also, topics may be identified that are not currently in the 6G R&I programmes, but now with hindsight of the first years of 6G research, deserve to be addressed. The topics that are identified may lead to bilateral collaboration projects or could potentially be included in a future edition of the SNS JU work programme. The workshop should not be exclusive to the large National Initiatives only. Also, smaller National Initiatives should be invited to participate.
WHEN	• ***EUCNC June 2024***: The idea is to organize a physical workshop to enable brainstorming and discussion. The intention is to co-locate such a workshop with another event of interest to the R&I community (such as EUCNC). Co-locating with an event that already has many researchers attending will stimulate attendance to the workshop. On the other hand, June 2024 will be late to incorporate any results in the SNS JU 2025 work programme.

Table 38: Suggestions to find specific R&I topics for collaboration

11.3 Additional possibilities for collaboration

Next to the three main actions described in the preceding paragraphs, the co-creation event at 5G Techritory on National Initiatives also identified other possible collaboration actions. These were either identified based on the results of the special 2023 SRG workshop on synergies that kick-started the work, interviews and talks with National Initiatives, or presentations at the Techritory co-creation event. The following possible collaboration actions were not selected as one of the three main actions for SNS ICE to elaborate further. Nevertheless, they may be of interest to pursue, according to the SRG priorities.

- Building open and accessible connected infrastructures: Investing in infrastructures that may be used by several countries, such as an experimental test network for 6G, could be a great way to increase collaboration at a European level.
- Stimulate National Initiatives to consider not only R&I activities but also raising awareness on 6G: It was noted that during 5G R&I, insufficient resources and focus was laid on raising awareness among the general public, which led to a negative attitude towards the technology. For future technologies and their eventual adoption by the public, it is important to raise awareness in a timely and correct manner.
- Boost the engagement of (deep tech) SMEs: It is important to ensure that SMEs are able to take advantage of the national initiatives to become present at a pan-European level.
- Align timing of calls in national initiative with timing of SNS calls: It would be beneficial to align the timings of the calls such that these opportunities are exploited in an optimal manner.
- Use CELTIC-NEXT framework for specific collaborations between different countries: The CELTIC-NEXT already offers a framework that allows for specific collaborations, and leveraging this might be a great way to collaborate with other national initiatives.
- Leverage the SNS SRG: The State Representative Group consists of representatives from all member states of the EU and Associated Countries to Horizon Europe and meets regularly to discuss matters. This

is a common point where all countries convey and could serve as an excellent opportunity to discuss collaboration and derive actionable suggestions.

- Federating universities: universities are the breeding grounds of new ideas and federating universities could serve the larger purpose of more R&D&I collaboration on 6G.
- National initiatives should be able to participate in SNS / 6G-IA Working Groups: Representatives from the NI being included in the regular working groups of 6G-IA is an easy way to increase collaboration between SNS projects and national projects.
- Provide a solution for legal issues that can be a barrier for collaboration (e.g. collaboration agreements): the SNS office can provide a generic template for collaboration agreements, NDAs, etc., that is agreeable for all countries as well as for 6G-IA/SNS such that collaboration between them may be established swiftly and without bureaucratic delays.
- Member states report provides information on national and regional initiatives: This 6G-IA report is published on a yearly basis and provides a comprehensive overview of not only the large national initiatives but also other national and regional initiatives and can help identify suitable areas for collaboration.
- Allow SNS flagship projects to act as a communication booster between the SNS JU and the national initiatives (e.g., roadmaps, match-making opportunities, etc.): The flagship projects of the SNS, such as the HEXA-X projects, generally include contributions from many countries, and thus serve as an excellent platform for starting collaboration.

12 References

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Annex – results of the special SRG session on collaboration

At a special SRG session on collaboration with national initiatives 6th of June 2023 at the EUCNC conference in Gothenburg (see also section **Error! Reference source not found.**), a list of possible collaboration actions has been identified in group brainstorm discussions. These actions can be both at an SNS-level as well as the level of the national initiatives themselves. These actions are summarized below:

- Align strategies, where possible, to empower EU stakeholders and expand business models (e.g., technological sovereignty, policies on sustainability, societal challenges, etc.)
- Create a complete picture of the EU ecosystem on Smart Networks and Services (identify opportunities, strengths, gaps). The national initiatives can provide contact persons to facilitate this information exchange.
- Build open and accessible pan-European federated infrastructures.
- Disseminate 6G benefits to increase public awareness and engagement and attract new workforce to the ICT technologies. A wider set of actors needs to be engaged (e.g., from the social sciences).
- Steer national initiatives to consider providing resources not only on R&I activities but to raising awareness on 6G (citizens, verticals, etc.)
- Improve communication among the national initiatives and the SNS, through workshops, a common repository, newsletters, and match-making support.
- Exchange information on standardization priorities and opportunities.
- Design a framework to transform 6G knowledge and results into a format suitable for (life-long) learning and training.
- Best practices dissemination activities for verticals to increase their 6G uptake and the verticals' digitization process
- Plan for coordinated efforts on activities to ensure physical resilience of 6G.
- Boost the engagement of (deep tech) SMEs by helping them presenting their portfolio and giving them information on opportunities on SNS and national projects.
- Ensure that SMEs are able to take advantage of the national initiatives to become present at a pan-European level.
- Allow flagship projects to act as a communication booster between the SNS JU and the national initiatives (e.g., roadmaps, match-making opportunities, etc.)