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IMPACT ASSESSMENT REPORT
Accompanying the document

Proposal for a COUNCIL REGULATION establishing the Joint Undertakings under Horizon Europe

European Partnership on Smart Networks and Services

{COM(2021) 87 final} - {SEC(2021) 100 final} - {SWD(2021) 38 final}

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Glossary

Term or acronym	*Meaning or definition*
EIT	European Institute of Innovation & Technology
R&I	Research and Innovation
SDGs	United Nations Sustainable Development Goals
SMEs	Small and Medium-sized Enterprises
TFEU	Treaty on the Functioning of the European Union

PART 1 - COMMON FOR ALL CANDIDATE INSTITUTIONALISED EUROPEAN PARTNERSHIPS

1. BACKGROUND AND CONTEXT TO EUROPEAN PARTNERSHIPS IN HORIZON EUROPE AND FOCUS OF THE IMPACT ASSESSMENT– WHAT IS DECIDED

1.1. Focus and objectives of the impact assessment

This impact assessment accompanies the Commission proposal for Institutionalised European Partnerships to be funded under Horizon Europe, the 2021-2027 Framework Programme for EU Research and Innovation (R&I).[1] It sets out to **help decide in a coordinated manner the right form of implementation for specific candidate initiatives** based on a common approach and methodology to individual assessments[2]. It also provides an **horizontal perspective on the portfolio of candidate European Partnerships** to identify further efficiency and coherence gains for more impact.

European Partnerships are initiatives where the Union, together with private and/or public partners (such as industry, public bodies or foundations) commit to support jointly the development and implementation of an integrated programme of R&I activities. The rationale for establishing such initiatives is to achieve the objectives of Horizon Europe more effectively than what can be attained by other activities of the programme.[3]

Based on the Horizon Europe Regulation, European Partnerships may be set up using **three different forms**: "Co-funded", "Co-programmed" and "Institutionalised". The setting-up of **Institutionalised Partnerships** involves new EU legislation and the establishment of dedicated implementing structures based on Article 185 or 187 of the Treaty on the Functioning of the EU (TFEU). This requires an impact assessment to be performed.

The Horizon Europe Regulation defines **eight priority areas,** scoping the domains in which Institutionalised Partnerships could be proposed[4]. Across these priority areas, **13 initiatives** have been identified **as suitable candidate initiatives** for Institutionalised Partnerships because of their objectives and scope. This impact assessment aims to identify whether 12 of these initiatives[5] need to be implemented through this form of implementation and would not deliver equally well with traditional calls of Horizon Europe or other lighter forms of European Partnerships under Horizon Europe. This means assessing whether each of these initiatives meets the necessity test set in the **selection criteria** for European Partnerships in the Horizon Europe Regulation, Annex III.

[1] Horizon Europe Regulation (common understanding), https://data.consilium.europa.eu/doc/document/ST-7942-2019-INIT/en/pdf

[2] Based on the European Commission Better Regulation framework (SWD (2017) 350) and supported by an external study coordinated by Technopolis Group (to be published in 2020).

[3] For further details on these points, see below Section 1.2.2.

[4] Set out in the Annex Va of the Horizon Europe Regulation (common understanding). https://data.consilium.europa.eu/doc/document/ST-7942-2019-INIT/en/pdf

[5] Only 12 are subject to this impact assessment, as one initiative on High Performance Computing has already been subject to an impact assessment in 2017 (SEC(2018) 47).

This assessment is done **without any budgetary consideration**, as the overall budget of the Multiannual Financial Framework of the EU – and hence of Horizon Europe – for the next financing period is not known at this stage.[6]

1.2. The political and legal context

1.2.1. Shift in EU priorities and Horizon Europe framework

European priorities have evolved in the last decades, and reflect the social, economic, and environmental challenges for the EU in the face of global developments. In her Political Guidelines for the new European Commission 2019 – 2024[7], the new Commission President put forward six overarching priorities, which reach well beyond 2024 in scope[8]. Together with the Sustainable Development Goals (SDGs), these priorities will shape future EU policy responses to the challenges Europe faces, and thus also give direction to EU research and innovation.

As part of the Multi-annual Financial Framework (MFF) 2021-27 the new EU Framework Programme for Research and Innovation **Horizon Europe will play a pivotal role for Europe to lead the social, economic, and environmental transitions needed to achieve these European policy priorities**. It will be more impact driven with a strong focus on delivering European added value, but also be more effective and efficient in its implementation.[9] Horizon Europe finds its rationale in the daunting challenges that the EU is facing, which call for "*a radical new approach to developing and deploying new technologies and innovative solutions for citizens and the planet on a scale and at a speed never achieved before, and to adapting our policy and economic framework to turn global threats into new opportunities for our society and economy, citizens and businesses*." While Horizon Europe continues the efforts of strengthening the scientific and technological bases of the Union and foster competitiveness, a more strategic and impact-based approach to EU R&I investment is taken. Consequently, the **objectives of Horizon Europe** highlight the need *to deliver on the Union strategic priorities and contribute to the realisation of EU objectives and policies, contribute to tackling global challenges, including the Sustainable Development Goals by following the principles of the Agenda 2030 and the Paris Agreement.* [10]

In this context, **at least 35 % of the expenditure from actions under the Horizon Europe Programme will have to contribute to climate action**. Furthermore, a **Strategic Plan** is co-designed with stakeholders to identify **key strategic orientations for R&I support** for 2021-2024 in line with the EU priorities. In the Orientations towards the first Strategic Plan for Horizon Europe, the need to strategically prioritise and "*direct a substantial part of the funds towards the areas where we believe they will matter the most*" is emphasised. The Orientations

[6] EU budget commitments to the European Partnership candidates can only be discussed and decided following the political agreement on the overall Multiannual Financial Framework and Horizon Europe budgetary envelopes. The level of EU contribution for individual partnerships should be determined once there are agreed objectives, and clear commitments from partners. Importantly, there is a ceiling to the partnership budgets in Pillar II of Horizon Europe (the legal proposal specifies that *the majority of the budget in pillar II shall be allocated to actions outside of European Partnerships*).

[7] https://ec.europa.eu/info/strategy/priorities-2019-2024_en

[8] 1.A European Green Deal; An economy that works for people; A Europe fit for the Digital Age; Promoting our European way of life; A Stronger Europe in the World; and 6.A New push for European Democracy

[9] EC (2018) *A Modern Budget for a Union that Protects, Empowers and Defends. The Multiannual Financial Framework for 2021-2027*. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2018) 321 final

[10] Article 3, Common understanding regarding the proposal for Horizon Europe Framework Programme.

specify, that actions under Pillar II of Horizon Europe "Global Challenges and European Industrial Competitiveness" will target only selected themes of especially high impact that significantly contribute to delivering on the political priorities of the Union. Most of the candidate European Partnerships fall under this Pillar.

1.2.2. Key evolutions in the approach to partnerships in Horizon Europe

Since their start in 1984 the successive set of Framework Programmes uses a variety of instruments and approaches to support R&I activities, address global challenges and industrial competitiveness. Collaborative, competition-based and excellence-driven R&I projects funded through Work Programmes are the most traditional and long-standing approach for implementation. Since 2002, available tools also include **partnerships**, whereby the Union together with private and/or public partners commit to jointly support the development and implementation of a R&I programme. These were introduced as part of creating the European Research Area (ERA) to align national strategies and overcome fragmentation of research effort towards an increased scientific, managerial and financial integration of European research and innovation. Interoperable and integrated national research systems would allow for better flows of knowledge, technology and people. Since then, the core activities of the partnerships consist of building critical mass mainly through collaborative projects, jointly developing visions, and setting strategic agendas.

As analysed in the **interim evaluation of Horizon 2020**[11], a considerable repertoire of partnership initiatives have been introduced over time, with 8 forms of implementation[12] and close to 120 partnership initiatives running under Horizon 2020 - without clear exit strategies and concerns about their degree of coherence, openness and transparency. Even if it is recognised that these initiatives allow setting long-term agendas, structuring R&I cooperation between otherwise dispersed actors, and leveraging additional investments, the evaluation points to the complexity generated by the proliferation of instruments and initiatives, and their insufficient contribution to policies at EU and national level.

Box 1 Key lessons from the interim evaluation of Horizon 2020 and R&I partnerships

- The **Horizon 2020 Interim Evaluation** concludes that the overall partnership landscape has become overly complex and fragmented. It identifies the need for rationalisation, improve their openness and transparency, and link them with future EU R&I missions and strategic priorities.

- The **Article 185 evaluation** finds that these public-public partnerships have scientific quality, global visibility and networking/structuring effects, but should in the future focus more on the achievement of policy impacts. From a systemic point of view, it found that the EU public-to-public cooperation (P2P) landscape has become crowded, with insufficient coherence.

- The **Article 187 evaluation** points out that Public-Private Partnership (PPP) activities need to be brought more in line with EU, national and regional policies, and calls for a revision of the Key Performance Indicators. As regards the **contractual PPPs (cPPPs)** their reviews identified challenges of coherence among cPPPs and the need to develop collaborations and synergies with other relevant initiatives and programmes at EU, national and regional level.

[11] Interim evaluation of Horizon 2020, Commission Staff Working Document, SWD(2017)221 and 222
Interim evaluation of the Joint Undertakings operating under Horizon 2020 (Commission Staff Working Document, SWD(2017) 339); Evaluation of the Participation of the EU in research and development programmes undertaken by several Member States based on Article 185 of the TFEU, Commission Staff Working Document, SWD (2017)340)

[12] E.g. initiatives based on Article 187 (Joint Technology Initiatives), Article 185 TFEU, Contractual Public-Private Partnerships (cPPPs), Knowledge & Innovation Communities of the European Institute of Innovation & Technology (EIT-KICs), ERA-NETs, European Joint Programmes, Joint Programming Initiatives.

Over 80% of respondents to the Open Public Consultation (OPC) indicated that a significant contribution by future European Partnerships is 'fully needed' to achieve climate-related goals, to develop and effectively deploy technology, and for EU global competitiveness in specific sectors/domains. Views converged across all categories of respondents, including citizens, industry and academia.

The impact assessment of Horizon Europe identifies therefore the need to **rationalise the EU R&I funding landscape**, in particular with respect to partnerships, as well as to **re-orient partnerships towards more impact** and delivery on EU priorities. To address these concerns and to realise the higher ambition for European investments, Horizon Europe puts forward **a major simplification and reform for the Commission's policy on R&I partnerships**[13]. Reflecting its pronounced systemic nature aimed at contributing to EU-wide 'transformations' towards the sustainability objectives, Horizon Europe indeed intends to make a more effective use of these partnerships with a **more strategic, coherent and impact-driven approach**. Key related changes that apply to all forms of European Partnerships encapsulated in Horizon Regulation are summarised in the Box below.

Box 2 Key features of the revised policy approach to R&I partnerships under Horizon Europe based on its impact assessment

- ✓ **Simpler architecture & toolbox** by streamlining 8 partnership instruments into 3 implementation forms (Co-Funded, Co-Programmed, Institutionalised), under the umbrella 'European Partnerships'
- ✓ **More systematic and transparent approach** to selecting, implementing, monitoring, evaluating and phasing out all forms of partnerships (**criteria** for European Partnerships):
  - The selection of Partnerships is embedded in the strategic planning of Horizon Europe, thereby ensuring coherence with the EU priorities. The selection criteria require that partnerships are established with stronger ex-ante commitment and higher ambition.
  - The implementation criteria stipulate that initiatives adopt a systemic approach in achieving impacts, including broad engagement of stakeholders in agenda-setting and synergies with other relevant initiatives to promote the take-up of R&I results.
  - A harmonised monitoring & evaluation system will be implemented, and ensures that progress is analysed in the wider context of achieving Horizon Europe objectives and EU priorities.
  - All partnerships need to develop an exit strategy from Framework Programme funding. This new approach is underpinned by principles of openness, coherence and EU added value.
- ✓ **Reinforced impact orientation:**
  - Partnerships are established only if there is evidence they support achieving EU policy objectives more effectively than other Horizon Europe actions, by demonstrating a clear vision and targets (**directionality**) and corresponding long-term commitments from partners (**additionality**).
  - European Partnerships are expected to provide mechanisms – based on a concrete roadmap - to join up R&I efforts between a broad range of actors towards the development and uptake of innovative solutions in line with EU priorities, serving the economy and society, as well as scientific progress.
  - They are expected to develop close synergies with national and regional initiatives, acting as dynamic change agents, strengthening linkages within their respective ecosystems and along the value chains, as well as pooling resources and efforts towards the common EU objectives.

Under Horizon Europe, a 'European Partnership'[14] is defined as *"an initiative where the Union, prepared with early involvement of Member States and/or Associated Countries, together with private and/or public partners (such as industry, universities, research organisations, bodies with a public service mission at local, regional, national or international level or civil society organisations including foundations and NGOs), commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake."*

The Regulation further specifies that European Partnerships shall adhere to the *"principles of Union added value, transparency, openness, impact within and for Europe, strong leverage effect on sufficient scale, long-term commitments of all the involved parties, flexibility in*

[13] Impact assessment of Horizon Europe, Commission Staff Working Document, SWD(2018)307.
[14] Article 8 and Annex III of the Horizon Europe Regulation (common understanding))

implementation, coherence, coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions."

1.3. Why should the EU act

1.3.1. Legal basis

Proposals for Institutionalised European Partnerships are based on:

1) Article 185 TFEU which allows the Union to make provision, in agreement with the Member States concerned, for participation in research and development programmes undertaken by several Member States, including participation in the structures created for the execution of those programmes; or
2) Article 187 TFEU according to which the Union may set up joint undertakings or any other structure necessary for the efficient execution of Union research, technological development and demonstration programmes.[15]

1.3.2. Subsidiarity

The EU should act only in areas where there is demonstrable advantage that the action at EU level is more effective than action taken at national, regional or local level. Research is a shared competence between the EU and its Member States according to the TFEU. Article 4 (3) specifies that in the areas of research, technological development and space, the EU can carry out specific activities, including defining and implementing programmes, without prejudice to the Member States' freedom to act in the same areas.The candidate initiatives focus on areas where there is a demonstrable value added in acting at the EU level due to the scale, speed and scope of the efforts needed for the EU to meet its long-term Treaty objectives and deliver on its strategic policy priorities and commitments. In addition, the proposed initiatives should be seen as complementary and reinforcing national and sub-national activities in the same area. Overall European Partnerships find their **rationale in addressing a set of systemic failures**[16]:

- Their primary function is to create a platform for a strengthened **collaboration** and knowledge exchange between various actors in the European R&I system and an enhanced **coordination** of strategic research agendas and/or R&I funding programmes. They aim to address **transformational failures** to better align agendas and policies of public and private funders, pool available resources, create critical mass, avoid unnecessary duplication of efforts, and leverage sufficiently large investments where needed but hardly achievable by single countries.
- The concentration of efforts and pooling of knowledge on common priorities to solve multi-faceted societal and economic challenges is at the core of these initiatives. Specifically, enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems are among the key objectives of these instruments. In the light of Horizon Europe, the aim is to **drive system transitions and transformations towards EU priorities**.
- Especially in fast-growing technologies and sectors such as ICT, there is a need to **react to emerging opportunities** and address systemic failures such as shortage in skills or

[15] Both Articles are under Title XIX of the TFEU - Research and Technological Development and Space.
[16] The Interim Evaluation of Horizon 2020 and the impact assessment of Horizon Europe provide qualitative and quantitative evidence on these points. Sections 1 and 2 of each impact assessment on candidate European Partnerships include more detail on the necessity to act at EU level in specific thematic areas.

critical mass or cross-sectoral cooperation along the value chains that would hamper attainment of future European leadership and/or strategic autonomy.

- They also aim to address **market failures** predominantly to enhancing industry investments thanks to the sharing of risks.

2. THE CANDIDATE EUROPEAN PARTNERSHIPS – WHAT NEEDS TO BE DECIDED

2.1. Portfolio of candidates for Institutionalised European Partnerships

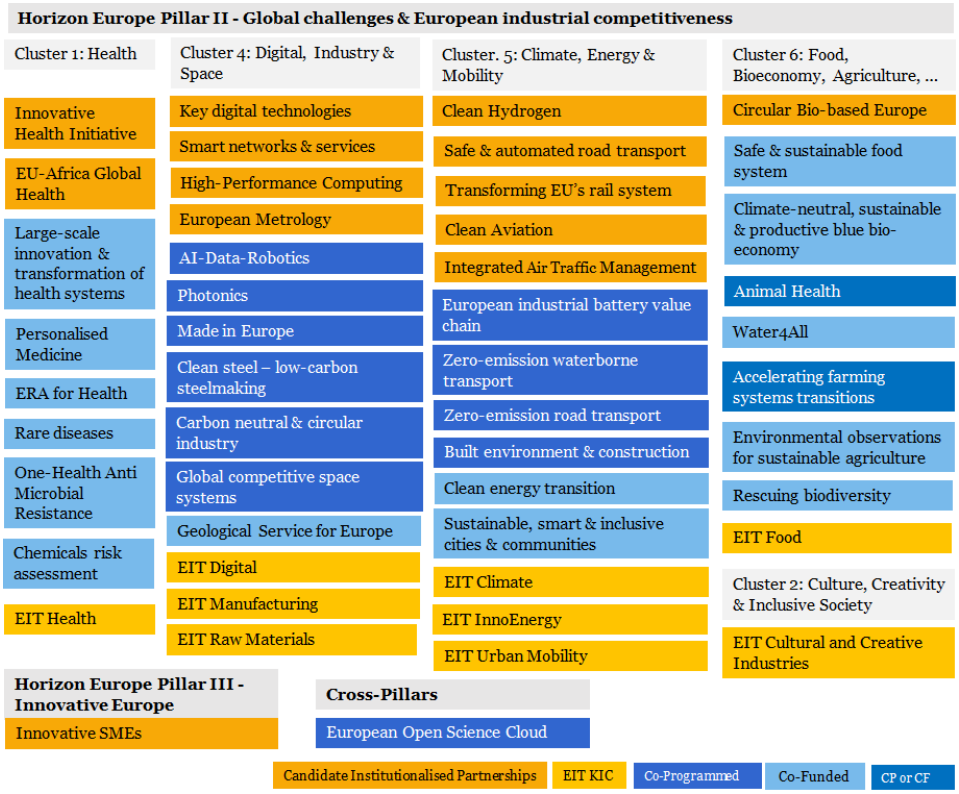
The new approach for more objective-driven and impactful European Partnerships is reflected in the way candidate Partnerships have been identified. It involved a co-design exercise aiming to better align these initiatives with societal needs and policy priorities, while broadening the range of actors involved. Taking into account the 8 areas for Institutionalised European Partnerships set out in the Horizon Europe Regulation[17], a co-design exercise as part of the Strategic Planning process of Horizon Europe lead to the identification of **49 candidates for Co-funded, Co-programmed or Institutionalised European Partnerships**[18]. Out of these, **13 were identified as suitable candidate Institutionalised Partnerships because of their objectives and scope**[19]. Whilst the Co-Funded and Co-Programmed Partnerships are linked to the comitology procedure (including the adoption of the Strategic Plan and the Horizon Europe Work Programmes), Institutionalised Partnerships require the adoption of legislation and are subject to an impact assessment. The Figure 1 below gives an overview of all candidate European Partnerships according to their primary relevance to Commission priorities for 2019-2024.

[17] Horizon Europe Regulation (common understanding), Annex Va.

[18] Shadow configuration of Strategic Programme Committee for Horizon Europe. The list of candidate European Partnerships is described in "Orientations towards the Strategic Plan of Horizon Europe" - Annex 7

[19] Only 12 are subject to this impact assessment, as one initiative on High Performance Computing has already been subject to an impact assessment in 2017 (SEC(2018) 47)

Figure 1 - Overview of the candidates for Co-Funded, Co-Programmed and Institutionalised European Partnerships according to Horizon Europe structure



Source: Technopolis group (2020)

There are only three partnerships for which implementation as an Institutionalised Partnership under Article 185 is an option, i.e. European Metrology, the EU-Africa Global Health partnership, and Innovative SMEs. Ten partnerships are candidates for Institutionalised Partnerships under Article 187. Overall the initiatives can be categorised into '*horizontal*' partnerships and '*vertical*' partnerships.

The **'horizontal' partnerships** have a central position in the overall portfolio, as they are expected to develop methodologies and technologies for application in the other priority areas, ultimately supporting European strategic autonomy in these areas as well as technological sovereignty. These 'horizontal' partnerships are typically proposed as Institutionalised or Co-programmed Partnerships, in addition to a number of EIT KICs, they cover mainly the digital field in addition to space, creative industries and manufacturing, but also the initiative related to Innovative SMEs. '**Vertical' partnerships** are focused on the needs and development of specific application areas, and are primarily expected to support enhanced environmental sustainability thereby addressing Green Deal related objectives. They also deliver on policies for more people centred economy, through improved wellbeing of EU citizen and the economy, like health related candidate European Partnerships.

2.2. **Assessing the necessity of a European Partnership and possible options for** implementation

Horizon Europe Regulation Article 8 stipulates that Institutionalised European Partnerships based on Article 185 and 187 TFEU *shall be implemented only where other parts of the Horizon Europe programme, including other forms of European Partnerships would not achieve the objectives or would not generate the necessary expected impacts, and if justified by a long-term perspective and high degree of integration.* At the core of this impact assessment is therefore the

need to demonstrate that the impacts generated through a Partnership approach go beyond what could be achieved with traditional calls under the Framework Programme – the Baseline Option. Secondly, it needs to assess if using the Institutionalised form of a Partnership is justified for addressing the priority.

For all candidate Institutionalised European Partnerships the options considered in this impact assessment are the same, i.e.:

- Option 0 – Baseline option – Traditional calls under the Framework Programme
- Option 1 – Co-programmed European Partnership
- Option 2 – Co-funded European Partnership
- Option 3 – Institutionalised Partnership
    - Sub-option 3a Institutionalised Partnerships based on Art 185 TFEU
    - Sub-option 3b Institutionalised Partnerships based on Art 187 TFEU

2.2.1. *Option 0* - Baseline option – Traditional calls

Under this option, strategic programming for R&I in the priority area will be done through the mainstream channels of Horizon Europe. The related priorities will be implemented through **traditional calls** of Horizon Europe covering a range of actions, mainly R&I and/or innovation actions but also coordination and support actions, prizes or procurement. Most actions involve consortia of public and/or private actors in ad hoc combinations, while some actions are single actor (mono-beneficiary). There will be no dedicated implementation structure and no support other than what is foreseen in the related Horizon Europe Work Programme. This means that discontinuation costs/benefits of predecessor initiatives should be factored in for capturing the baseline situation when relevant.

Under this option, strategic planning mechanisms in the Framework Programme will allow for a high level of flexibility in the ability of traditional calls to respond to particular needs over time, building upon additional input in co-creation from stakeholders and programme committees involving Member States. The Union contribution to addressing the priority covers the full duration of the initiative, during the lifetime of Horizon Europe. Without a formal EU partnership mechanism, it is less likely that the stakeholders will develop a joint Strategic Research Agenda and commit to its implementation or agree on mutual commitments and contributions outside their participation in funded projects.

2.2.2. European Partnerships

Under this set of options, three different forms of implementation are assessed: Co-funded, Co-Programmed, Institutionalised European Partnerships. These have **commonalities that cannot serve as a distinguishing factor in the impact assessment process**. They are all based on agreed objectives and expected impacts and underpinned by Strategic Research and Innovation Agendas / roadmaps that are shared and committed to by all partners in the partnership. They all have to follow the same set of criteria along their lifecycle, as defined in the Horizon Europe Regulation (Annex III), including ex ante commitment from partners to mobilise and contribute resources and investments. The Union contribution is defined for the full duration of the initiative for all European Partnerships. The Horizon Europe legal act introduces few additional requirements for Institutionalised Partnerships, e.g. the need for long-term perspective, strong integration of R&I agendas, and financial contributions.

Figure 2 - Key differences in preparation and implementation of European Partnerships

Type	Legal form	Implementation
Co-Programmed	Contractual arrangement / MoU	**Division of labour**, whereby the Union contribution is implemented through a Framework Programme and partners' contributions under their responsibility.
Co-Funded	Grant Agreement	Union provides co-funding for an **integrated programme with distributed implementation** by entities managing and/or funding national research and innovation programmes
Institutionalised based on Article 185/187 TFEU	Basic act (Council regulation, Decision by European Parliament and Council)	**Integrated programme with centralised implementation**

The main differences between the different forms of European Partnerships are in their preparation and in the way they function, as well as in the overall impact they can trigger. The Co-Programmed form is assessed as the simplest, and the Institutionalised the most complex to prepare and implement. The functionalities of the different form of Partnerships – compared to the baseline option – are presented in Figure 3. They relate to the types of actors Partnerships can involve and their degree of openness, the types of activities they can perform and their degree of flexibility, the degree of commitment of partners and the priority setting system, and their ability to work with their external environment (coherence), etc. These key distinguishing factors will be at the basis of the comparison of each option to determine their overall capacity to deliver what is needed at a minimised cost.

Figure 3 - Overview of the functionalities provided by each form of European Partnerships, compared to the traditional calls of Horizon Europe (baseline)

Baseline: Horizon Europe calls	Option 1: Co-Programmed	Option 2: Co-Funded	Option 3a: Institutio-nalised Art 185	Option 3b: Institutionalised Art 187
Type and composition of actors (including openness and roles)				
Partners: N.A., no common set of actors that engage in planning and implementation Priority setting: open to all, part of Horizon Europe Strategic planning Participation in R&I activities: fully open in line with Horizon Europe rules	Partners: Suitable for all types: private and/or public partners, foundations Priority setting: Driven by partners, open stakeholder consultation, MS in comitology Participation in R&I activities: fully open in line with Horizon Europe rules	Partners: core of national funding bodies or govern-mental research organisations Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: limited, according to national rules of partner countries	Partners: National funding bodies or governmental research organisation Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: fully open in line with Horizon Europe rules, but possible derogations	Partners: Suitable for all types: private and/or public partners, foundations Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: fully open in line with Horizon Europe rules, but possible derogations
Type and range of activities (including additionality and level of integration)				
Activities: Horizon Europe standards that allow broad range of individual actions Additionality: no additional activities and investments outside the funded projects Limitations: No systemic approach beyond individual actions	Activities: Horizon Europe standard actions that allow broad range of individual actions, support to market, regulatory or policy/ societal uptake Additionality: Activities/investments of partners, National funding Limitations: Limited	Activities: Broad, according to rules/programmes of participating States, State-aid rules, support to regulatory or policy/ societal uptake Additionality: National funding Limitations: Scale & scope depend on participating	Activities: Horizon Europe standards that allow broad range of individual actions, support to regulatory or policy/societal uptake, possibility to systemic approach Additionality: National funding	Activities: Horizon Europe standards that allow broad range of individual actions, support to regulatory or policy/societal uptake, possibility to systemic approach (portfolios of projects, scaling up of results, synergies with other funds. Additionality:

Baseline: Horizon Europe calls	Option 1: Co-Programmed	Option 2: Co-Funded	Option 3a: Institutio-nalised Art 185	Option 3b: Institutionalised Art 187
	systemic approach beyond individual actions	programmes, often smaller in scale		Activities/investments of partners/ national funding
Priority-setting process and directionality				
Priority setting: Strategic Plan and annual work programmes, covering max. 4 years. Limitations: Fully taking into account existing or to be developed SRIA/ roadmap	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Input to FP annual work programme drafted by partners, finalised by EC (comitology) Objectives & commitments set in contractual arrangement	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC Objectives & commitments set in Grant Agreement	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC Objectives & commitments set in legal act	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC (veto-right in governance) Objectives & commitments set in legal act
Coherence: internal (Horizon Europe) & external (other Union programmes, national programmes, industrial strategies)				
Internal: Coherence between different parts of the FP Annual Work programme can be ensured by EC External: Limited for other Union programmes, no synergies with national/regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Limited synergies with other Union programmes & industrial strategies. If MS participate, with national/ regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Synergies with national/ regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Synergies with national/ regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Synergies with other Union programmes and industrial strategies If MS participate, with national/ regional programmes & activities

Option 1 - Co-programmed European Partnership

This form of European Partnership is **based upon a Memorandum of Understanding or a Contractual Arrangement** signed by the Commission and the private and/or public partners. Private partners are represented by industry associations, which also support the daily management of the partnership. This type of partnership would allow for a large degree of flexibility for the activities, partners and priorities to continuously evolve. The commitments of partners are political efforts described in the contractual arrangement and the contributions from partners are provided in kind more than financially. The priorities for the calls, proposed by the Partnership's members for integration in the Horizon Europe's Work Programmes, are subject to further input from Member States (comitology) and Commission services. The Union contribution is implemented within the executive agency managing Horizon Europe calls for research and innovation projects proposals. The full array of Horizon Europe instruments can be used, ranging from research and innovation (RIA) types of actions to coordination and support actions (CSA) and including grants, prizes, and procurement.

Option 2 – Co-funded European Partnership

The Co-funded European Partnership is **based on a Grant Agreement** between the Commission and a consortium of partners, resulting from a specific call in the Horizon Europe Work Programme. This form of implementation only allows to address public partners at its core.

Typically these provide co-funding to a common programme of activities established and/or implemented by entities managing and/or funding national R&I programmes. The recipients of the EU co-funding implement the initiative under their responsibility, with national funding/resources pooled to implement the programme with co-funding from the Union. The expectation is that these entities would cover most if not all EU Member States. Calls and evaluations would be organised centrally, beneficiaries in selected projects would be funded at national level, following national funding rules.

Option 3 – Institutionalised European Partnership

This type of Partnership is the most complex and high-effort arrangement, and requires meeting additional requirements. Institutionalised European Partnership are **based on a Council Regulation (Article 187 TFEU or a Decision by the European Parliament and Council (Article 185 TFEU)** and are implemented by dedicated structures created for that purpose. These regulatory needs limit the flexibility for a change in the core objectives, partners, and/or commitments as these would require amending legislation. The basic rationale for this type of partnership is the need for a strong integration of R&I agendas in the private and/or public sectors in the EU in order to address a strategic challenge. It is therefore necessary to demonstrate that other forms of implementation would not achieve the objectives or would not generate the necessary expected impacts, and that a long-term perspective and high degree of integration is needed. For both Article 187 and 185 initiatives, contributions from partners can be in the form of financial and in-kind contributions. Eligibility for participation and funding follows by default the rules of Horizon Europe, unless a derogation is introduced in the basic act.

Option 3a - Institutionalised Partnerships based on Article 185 TFEU

Article 185 of the TFEU allows the Union to participate in programmes jointly undertaken by Member States and limits therefore the scope to **public partners** which are Member States and Associated Third Countries. This type of Institutionalised Partnership aims therefore at reaching the greatest possible impact through the integration of national and EU funding, aligning national strategies in order to optimise the use of public resources and overcome fragmentation of the public research effort. It brings together R&I governance bodies of most if not all EU Member States (legal requirement: at least 40% of Member States) as well as Associated Third Countries that designate a legal entity (Dedicated Implementation Structure) of their choice for the implementation. By default, participation of non-associated Third Countries is not foreseen. Such participation is possible only if it is foreseen in the basic act and subject to conclusion of an international agreement.

Option 3b - Institutionalised Partnerships based on Article 187 TFEU

Article 187 of the TFEU allows the Union to set up joint undertakings or any other structure necessary for the efficient execution of EU research, technological development and demonstration programmes. This type of Institutionalised Partnership brings together a stable set of **public and private partners** with a strong commitment to taking a more integrated approach and requires the set-up of a dedicated legal entity (Union body, Joint Undertaking (JU)) that carries full responsibility for the management of the Partnership and implementation of the calls. Different configurations are possible:

- Partnerships focused on creating strategic industrial partnerships where, most often, the partner organisations are represented by one or more industry associations, or in some cases individual private partners;

- Partnerships coordinating national ministries, public funding agencies, and governmental research organisations in the Member States and Associated Countries;
- Or a combination of the two: the so-called tripartite model.

Participation of non-associated Third Countries is only possible if foreseen in the basic act and subject to conclusion of an international agreement.

2.3. Overview of the methodology adopted for the impact assessment

The methodology for each impact assessment is based on the Commission Better Regulation Guidelines[20] to evaluate and compare options with regards to their **efficiency, effectiveness and coherence**. This also integrates **key selection criteria for European Partnerships**.

Box *2 Summary of European Partnerships selection criteria*[21]

- ***Effectiveness*** in achieving the related objectives and impacts of the Programme;
- ***Coherence*** and synergies of the European Partnership within the EU R&I landscape;
- ***Transparency*** & ***openness*** as regards the identification of priorities and objectives and the involvement of partners & stakeholders from the entire value chain, backgrounds & disciplines;
- Ex-ante demonstration of ***additionality*** and ***directionality***;
- Ex-ante demonstration of the partners' ***long term commitment***.

2.3.1. *Overview of the methodologies employed*

In terms of **methods and evidence used**, the impact assessments draw on an external study covering all candidate Institutionalised European Partnerships in parallel to ensure a high level of coherence and comparability of analysis, in addition to a horizontal analysis.[22] For all initiatives, the understanding of the overall context of the candidate institutionalised European Partnerships relied on desk research, including among others the lessons learned from previous partnerships. This was complemented by the analysis of a range of quantitative and qualitative evidence, including evaluations of past and ongoing initiatives; foresight studies; statistical analyses of Framework Programmes application and participation data, and Community Innovation Survey data; analyses of science, technology and innovation indicators; reviews of academic literature; sectoral competitiveness studies and expert hearings. The analyses included a portfolio analysis, a stakeholder and social network analysis in order to profile the actors involved as well as their co-operation patterns, and an assessment of the partnerships' outputs (bibliometrics and patent analysis). A cost modelling exercise was performed in order to feed into the efficiency assessments of the partnership options, as described below. Public consultations (both open and targeted) supported the comparative assessment of the policy options. For each initiative, up to 50 relevant stakeholders were interviewed by the external contractor (policymakers, business including SMEs and business associations, research institutes and universities, and civil organisations, among others). In addition, the analysis was informed by the results of the Open Public Consultation run between September and November 2019, the consultation of Member States through the Strategic Programme Committee and the online feedback received on the Inception Impact Assessments of the set of initiatives.

[20] European Commission (2017), Better Regulation Guidelines (SWD (2017) 350)
[21] For a comprehensive overview of the selection criteria for European Partnerships, see Annex 6.
[22] Technopolis Group (2020), Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe, Final Report, Study for the European Commission, DG Research & Innovation

A more detailed description of the methodology and evidence base that were mobilised, completed by thematic specific methodologies, is provided in Annexes 4 and 6.

2.3.2. *Method for identifying the preferred option*

The first step of the assessments consisted in scoping the problems that the initiatives are expected to solve given the overall economic, technological, scientific and social context, including the lessons to be learned from past and ongoing partnerships on what worked well and less well. This supported the identification of the objectives of the initiative in the medium and long term with the underlying intervention logic – showing how to get there.

Given the focus of the impact assessment on comparing different forms of implementation, the Better Regulation framework has then been adapted to introduce "**key functionalities needed**" - making the transition between the definition of the objectives and what would be crucial to achieve them *in terms of implementation*. The identification of "key functionalities needed" for each initiative as an additional step in the impact assessment is based on the distinguishing factors between the different options (see Section 2.2.1). In practical terms, each option is assessed on the basis of the degree to which it would allow for the key needed functionalities to be covered, as regards e.g. the type and composition of actors that can be involved ('openness'), the range of activities that can be performed (including additionality and level of integration), the level of directionality and integration of R&I strategies; the possibilities offered for coherence and synergies with other components of Horizon Europe, including other Partnerships (internal coherence), and the coherence with the wider policy environments, including with the relevant regulatory and standardisation framework (external coherence). This approach guides the identification of discarded options while allowing at the same time a structured comparison of the options not only as regards their effectiveness, efficiency and coherence, but also against a set of other key selection criteria for European Partnerships (openness, transparency, directionality)[23].

In line with the Better Regulation Framework, the assessment of the effectiveness, efficiency and coherence of each option is made compared to the baseline. Therefore, for each of these aspects the performance of using traditional calls under Horizon Europe is first estimated and scored 0 to serve as a reference point. This includes the discontinuation costs/benefits of existing implementation structures when relevant. The policy options are then scored compared to the baseline with a + and – system with a two-point scale, to show a slightly or highly additional/lower performance compared to the baseline. A scoring of 0 of a policy option means that it would deliver as much as the baseline option.

On the basis of the evidence collected, the intervention logic of each initiative and the key functionalities needed, the impact assessments first evaluate the **effectiveness** of the various policy options to deliver on their objectives. To be in line with the Horizon Europe impact framework, the fulfilment of the specific objectives of the initiative is translated into 'expected impacts' - how success would look like -, differentiating between scientific, economic/ technological, and societal (including environmental) impacts. Each impact assessment considers to which extent the different policy options provides the 'key functionalities needed' to achieve the intended objectives. The effectiveness assessment does not use a compound score but shows

[23] The criterion on the ex-ante demonstration of partners' long term commitment depends on a series of factors that are unknown at this stage, and thus fall outside the scope of the analysis.

how the options would deliver on the different types of expected impacts. This is done to increase transparency and accuracy in the assessment of options[24].

A similar approach is followed to evaluate the coherence of options with the overarching objectives of the EU's R&I policy, and distinguishes between **internal** and **external coherence**. Specifically, internal coherence covers the consistency of the activities that could be implemented with the rest of Horizon Europe, including European Partnerships (any type). External coherence refers to the potential for synergies and/or complementarities (including risks of overlaps/gaps) of the initiative with its external environment, including with other programmes under the MFF 2021-27, but also the framework conditions at European, national or regional level (incl. regulatory aspects, standardisation).

To compare the expected costs and benefits of each option (**efficiency**), the thematic impact assessments broadly follow a cost-effectiveness approach[25] to establish to which extent the intended objectives can be achieved for a given cost. A preliminary step in this process is to obtain a measure of the expected costs of the policy options, to be used in the thematic assessments. As the options correspond to different implementation modes, relevant cost categories generally include the costs of setting-up and running an initiative. For instance, set-up costs includes items such as the preparation of a European Partnership proposal and the preparation of an implementation structure. The running costs include the annual work programme preparation costs. Where a Partnership already exists, discontinuation costs and cost-savings are also taken into account[26]. The table below provides an overview of the cost categories used in the impact assessment and a qualitative scoring of their intensity when compared to the baseline option (traditional calls). Providing a monetised value for these average static costs would have been misleading, because of the different features and needs of each candidate initiative.[27] The table shows the overall administrative, operational and coordination costs of the various options. These costs are then put into context in the impact assessments to reflect the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution (cost-efficiency):

- The costs related to the baseline scenario (traditional calls under Horizon Europe) are predominantly the costs of implementing the respective Union contribution via calls and project, managed by the executive agencies (around 4%, efficiency of 96% for the overall investment).
- For a Co-Programmed partnership the costs of preparation and implementation increase only marginally compared to the baseline (<1%), but lead to an additional R&I investment of at least the same amount than the Union contribution[28] (efficiency of 98% for the overall investment).

[24] In the thematic impact assessments, scores are justified in a detailed manner to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation is provided of why certain scores were given to specific impacts, and why one option scores better or worse than others.

[25] For further details, see Better Regulation Toolbox # 57.

[26] Discontinuation costs will bear winding down and social discontinuation costs and vary depending on e.g. the number of full-time-equivalent (FTEs) staff concerned, the type of contract (staff category and duration) and applicable rules on termination (e.g. contracts under Belgian law or other). If buildings are being rented, the cost of rental termination also apply. As rental contracts are normally tied to the expected duration of the current initiatives, these termination costs are likely to be very limited. In parallel, there would also be financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. This is developed further in the individual efficiency assessments.

[27] A complete presentation of the methodology developed to assess costs as well as the sources used is described in the external study supporting this impact assessment (Technopolis Group, 2020).

[28] Minimum contributions from partners equal to the Union contribution

- For a Co-Funded partnership the additional R&I investment by Member States accounts for 2.3 times the Union contribution[29]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the national programmes, can be estimated at 6% of the Union contribution (efficiency of 98% related to the overall investment).
- For an Article 185 initiative the additional R&I investment by Member States is equal to the Union contribution[30]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 7% of the Union contribution (efficiency of 96% related to the overall investment).
- For an Article 187 initiative the additional R&I investment by partners is equal to the Union contribution[31]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 9% of the Union contribution (efficiency of 94% related to the overall investment).

Figure 4 - Intensity of additional costs compared with Horizon Europe Calls (for Partners, stakeholders, public and EU)

Cost items	Baseline: traditional calls	Option 1: Co-programmed	Option 2 Co-funded	Option 3a - Art. 185	Option 3b -Art. 187
Preparation and set-up costs					
Preparation of a partnership proposal (partners and EC)	0	↑↑			
Set-up of a dedicated implementation structure	0			Existing: ↑ New: ↑↑	Existing: ↑↑ New: ↑↑↑
Preparation of the SRIA / roadmap	0	↑↑			
Ex-ante Impact Assessment for partnership	0			↑↑↑	
Preparation of EC proposal and negotiation	0			↑↑↑	
Running costs (Annual cycle of implementation)					
Annual Work Programme preparation	0	↑			
Call and project implementation	0	0 In case of MS contributions: ↑	↑	↑	↑
Cost to applicants	Comparable, unless there are strong arguments of major differences in oversubscription				
Partners costs not covered by the above	0	↑	0	↑	↑
Additional EC costs (e.g. supervision)	0	↑	↑	↑	↑↑
Winding down costs					
EC	0				↑↑↑
Partners	0	↑	0	↑	↑

Notes: 0: no additional costs, as compared with the baseline; ↑: minor additional costs, as compared with the baseline; ↑↑: medium additional costs, as compared with the baseline; ↑↑↑: higher costs, as compared with the baseline.

The cost categories estimated for the common model are then used to develop a scorecard analysis and further refine the assessment of options for each of the 12 candidate Institutionalised Partnerships. Specifically, the scores related to the set-up and implementation costs are used in

[29] Based on the default funding rate for programme co-fund actions of 30%, partners contribute with 70% of the total investment.
[30] Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.
[31] Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.

the thematic impact assessments to consider the scale of the expected benefits and thereby allow a simple "value for money" analysis (**cost-effectiveness**)[32]. In carrying out the scoring of options, the results of fieldwork, desk research and stakeholder consultation undertaken and taken into account.

For the **identification of the preferred option,** the scorecard analysis builds a hierarchy of the options by individual criterion and overall in order to identify a single preferred policy option or in case of an inconclusive comparison of options, a number of 'retained' options or hybrid. This exercise supports the systematic appraisal of alternative options across multiple types of monetary, non-monetary and qualitative dimensions. It also allows for easy visualisation of the pros and cons of each option. Each option is attributed a score of the adjudged performance against each cri

As a last step, the alignment of the preferred option with key criteria for the selection of European Partnerships is described, reflecting the outcomes of the 'necessity test'. The monitoring and evaluation arrangements are concluding the assessment, with an identification of the key indicators to track progress towards the objectives over time.

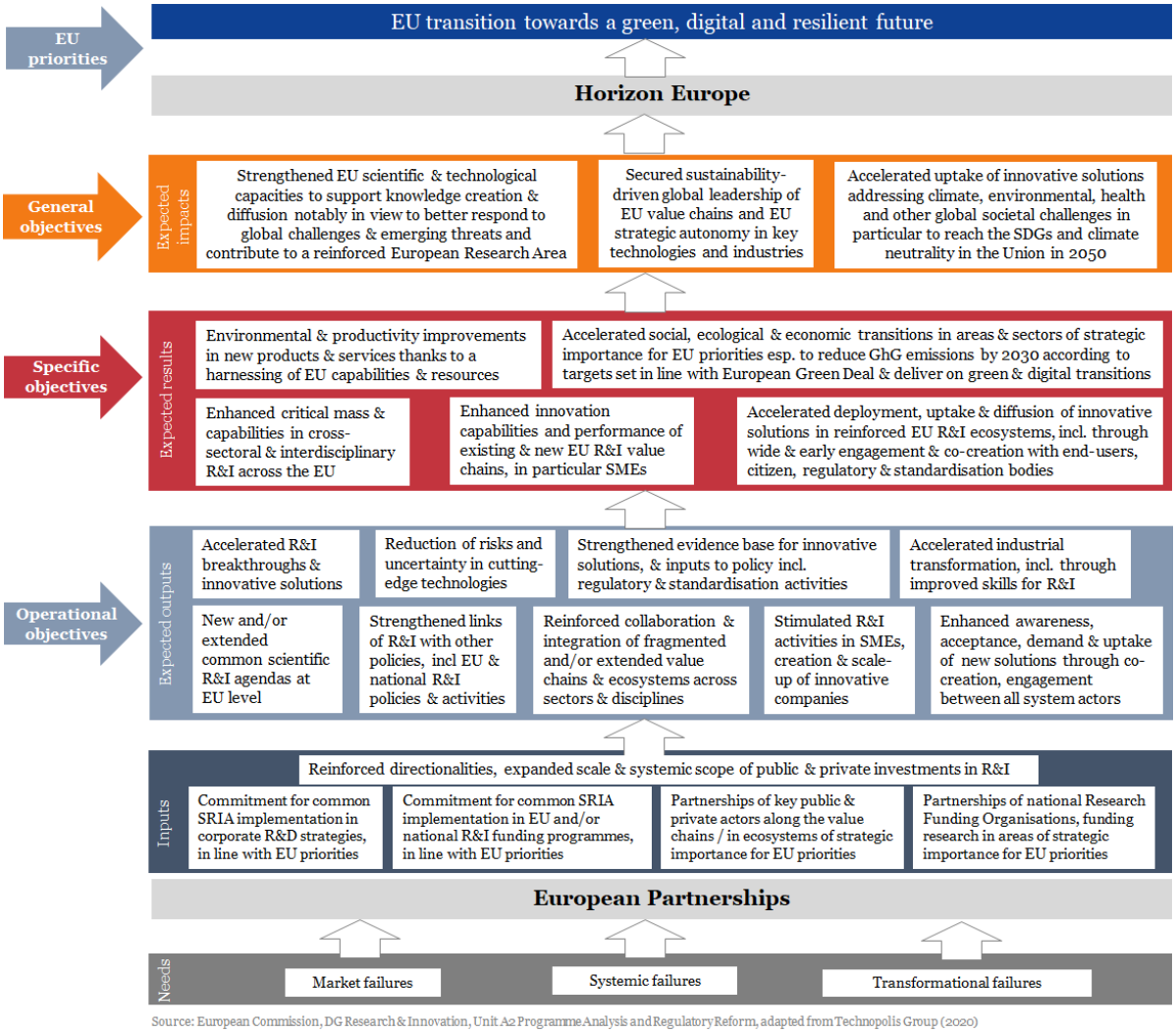
2.4. Horizontal perspective on candidate Institutionalised European Partnerships

2.4.1. *Overall impact orientation, coherence and efficiency needs*

The consolidated **intervention logic** for the set of candidate Institutionalised European Partnerships in the Figure below builds upon the objectives as reported in the individual impact assessments.

[32] More details on the methodology can be found in Annex 4.

Figure 5 – Overall intervention logic of the European Partnerships under Horizon Europe



Source: European Commission, DG Research & Innovation, Unit A2 Programme Analysis and Regulatory Reform, adapted from Technopolis Group (2020)

When analysed as a package the 12 candidate Institutionalised European Partnerships are expected to support the achievement of the European policy priorities targeted by Horizon Europe by pursuing the following joint general objectives:

a) Strengthening and integrating EU scientific and technological capacities to support knowledge creation and diffusion notably in view to better respond to global challenges and emerging threats and contribute to a reinforced European Research Area;
b) Securing sustainability-driven global leadership of EU value chains and EU strategic autonomy in key technologies and industries; and
c) Accelerate the uptake of innovative solutions addressing climate, environmental, health and other global societal challenges contributing to Union strategic priorities, in particular to reach the Sustainable Development Goals and climate neutrality in the Union in 2050.

In terms of specific objectives, they jointly aim to:

a) Enhance the critical mass and scientific capabilities in cross-sectoral and interdisciplinary research and innovation across the Union;
b) Accelerate the social, ecological and economic transitions in areas and sectors of strategic importance for Union priorities, in particular to reduce greenhouse gas emissions by 2030 according to the targets set in line with the European Green Deal, and deliver on the green and digital transition;

c) Enhance the innovation capabilities and performance of existing and new European research and innovation value chains, in particular SMEs;
d) Accelerate the deployment, uptake and diffusion of innovative solutions in reinforced European R&I ecosystems, including through wide and early engagement and co-creation with end-users, citizen and regulatory and standardisation bodies;
e) Deliver environmental and productivity improvements in new products and services thanks to a harnessing of EU capabilities and resources.

In terms of their operations, taking a horizontal perspective on all initiatives allows for the identification of further possible collective efficiency and coherence gains for more impact:

- **Coherence for impact:** The extent and speed by which the expected results and impacts will be reached, will depend on the scale of the R&I efforts triggered, the profile of the partners involved, the strength of their commitments, and the scope of the R&I activities funded. To be fully effective it comes out clearly that future partnerships need to operate over their whole life cycle in full coherence with their environment, including potential end users, regulators and standardisation bodies. This relates also to the alignment with relevant EU, national or regional policies and synergies with R&I programmes. This needs to be factored in as of the design stage to ensure a wide take-up and/or deployment of the solutions developed, including their interoperability.
- **Collaboration for impact:** Effectiveness could also be improved collectively through enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems. An adequate governance structure appears in particular necessary to ensure cross-fertilisation between all European Partnerships. This applies not only to initiatives where similar R&I topics are covered and/or the same stakeholders involved or targeted, but also to the interconnections needed between the 'thematic' and the 'vertical' Partnerships, as these are expected to develop methodologies and technologies for application in EU priority areas. Already at very early stages of preparing new initiatives**,** Strategic Research and Innovation Agendas and roadmaps need to be aligned, particularly for partnerships that develop enabling technologies that are needed in other Partnerships. The goal should be to achieve greater impacts jointly in light of common challenges.
- **Efficiency for impact:** Potential efficiency gains could also be achieved by joining up the operational functions of Joint Undertakings that do not have a strong context dependency and providing them through a common back-office[33]**.** A number of operational activities of the Joint Undertakings are of a technical or administrative nature (e.g. financial management of contracts), or procured from external service providers (e.g. IT, communication activities, recruitment services, auditing) by each Joint Undertaking separately. If better streamlined this could create a win-win situation for all partners leading to better harmonization, economies of scales, and less complexity in supervision and support by the Commission services.

2.4.2. *Analysis of coherence* of the overall portfolio of candidate initiatives at the thematic level

Looking at the coherence of the set of initiatives at the thematic level, the "**digital centric**" initiatives have a strong focus on supporting the digital competitiveness of the EU ecosystem.

[33] See Annex 6 for an overview of key functions/roles that could be provided by a common back office.

Their activities are expected to improve alignment and coordination with Member States and industry for the development of world-competitive EU strategic digital technology value chains and associated expertise. Addressing the Key Digital Technologies, the 5G and 6G connectivity needs as part of a Smart Networks and Services initiative and the underlying supercomputing capacities through a European High Performance Computing initiative present potential for synergies that can be addressed through cooperative actions (e.g. joint calls, coordinated support activities, etc.). They may as well profit from and contribute to Partnerships envisaged for Photonics, AI, data, robotics, Global competitive space system and Made in Europe, together with the EIT Digital. Synergies between these initiatives and several programmes (Digital Europe and Connecting Europe as well as cohesion programmes) are needed in areas where EU industry has to develop leadership and competitiveness in the global digital economy. They are expected to impact critical value chains including on sectors where digital is a strong enabler of transformation (health, industrial manufacturing, mobility/transport, etc.).

The **transport** sector face systemic changes linked to decarbonisation and digitalisation. Large scale R&I actions are needed to prepare the transition of these complex sectors to provide clean, safer, digital and economically viable services for citizens and businesses. Past decades have shown that developing and implementing change is difficult in transport due to its systemic nature, many stakeholders involved, long planning cycles and large investments needed. A systemic change of the air traffic network through an Integrated Air Traffic Management initiative should ensure safety and sustainability of aviation, while a Clean Aviation initiative should focus on the competitiveness of tomorrow's clean aircrafts made in Europe. The initiative for Transforming Europe's rail system would comprehensively address the rail sector to make it a cornerstone in tomorrow's clean and efficient door-to-door transport services, affordable for every citizen as well as the most climate-friendly mode of transport for freight. Connected and Automated Mobility is the future of road transport, but Europe is threatened to fall behind other global regions with strong players and large harmonised markets. The initiative Safe and Automated Road Transport would bring stakeholders together, creating joint momentum in digitalising road transport and developing new user-based services. Stronger links and joint actions will be established between initiatives to enable common progress wherever possible. The Clean Hydrogen initiative would be fundamental to that regard. Synergies would also be sought with partnerships driving the digital technological developments.

To deliver a deep decarbonisation of highly emitting industrial sectors such as the steel, transport and chemical industries would require the production, distribution and storage of **hydrogen** at scale. The candidate hydrogen initiative would have a central positioning in terms of providing solutions to the challenges for sustainable mobility and energy, but also is expected to operate in synergies with other industry related initiatives. The initiative would interact in particular with initiatives on the zero emission road and water transport, transforming Europe's railway system, clean aviation, batteries, circular industry, clean steel and built environment partnerships. There are many opportunities for collaboration for the delivery and end-use of hydrogen. However, the Clean Hydrogen initiative would be the only partnership focused on addressing hydrogen production technologies.

Metrology, the science of measurement, is an enabler across all domains of R&I. It supports the monitoring of the Emissions Trading System, smart grids and pollution, but also contributes to meeting demands for measurement techniques from emerging digital technologies and applications. More generally, emerging technologies across a wide range of fields from biotechnologies, new materials, health diagnostics or low carbon technologies are giving rise to demands requiring a world-leading EU metrology system.

The initiative for a **Circular Bio-based Europe** is intended to solve a shortage of industry investments in the development of bio-based products whose markets do not have yet certain long-term prospects. The **Innovative Health Initiative** and **EU-Africa Global Health** address the lack of investments in the development of solutions to specific health challenges. The initiative on **Innovative SMEs** supports innovation-driven SMEs in participating in international, collaborative R&I projects with other innovative firms and research-intensive partners. As a horizontal initiative it is expected to help innovative SMEs to grow and to be successfully embedded in global value chains by developing methodologies and technologies for potential application in the other partnership areas or further development by the instruments of the European Innovation Council.

The description of the interconnections between all initiatives for each Horizon Europe cluster is provided in the policy context of each impact assessment and further assessed in the coherence assessment for each option.

PART 2 - THE CANDIDATE EUROPEAN PARTNERSHIP ON SMART NETWORKS AND SERVICES[34]

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

1.1. Emerging challenges in the field

Smart Networks and Services (SNS) are the digital infrastructures that provide connectivity-based services to consumers and businesses ranging from mobile and fixed Internet access to professional digital services such as Machine-to-Machine communication or public safety services. They are composed of user devices, communication networks and service computing platforms. SNS will increasingly provide connectivity for industrial 'vertical' sectors such as transport, energy, manufacturing, health care and media. While SNS solutions based on the newest technology standard – 5G - will allow for first such industrial services in the next few years, 6G technology will provide another step change to mainstream such services in this and the next decade enabling the digital and green transition of the economy and society.

Such digital services are increasingly critical. The political guidelines of the new Commission identify related networks as crucial for Europe's technological sovereignty, which is gaining even further significance in light of the COVID-19 pandemic and the need to guarantee security of supply in critical sectors. Europe's capacity to set evolving 5G and later 6G standards will be of paramount importance in this regard. In particular, the role of equipment suppliers, which has been the most strategic issue related to the recent 5G cyber-security toolbox[35], needs to be reinforced.

The COVID-19 pandemic is posing enormous challenges to the health of our citizens and to our economic development. It has underlined how critical are communication networks for the functioning of our economy in times of crisis. SNS systems will further improve our capability to guarantee critical and essential digital services, enable remote healthcare and monitoring as well as rapid health crisis responses, e.g. based on big data and artificial intelligence tools that respect Europe's data protection rules. Finally, this initiative, in particular the piloting and deployment part of the partnership (using CEF2, DEP, and InvestEU), will lead to a major infrastructure investment programme, in support of sustainable economic recovery and is expected to provide for major opportunities for SMEs as part of new SNS-based digital ecosystems.

R&I initiatives on 6G are now starting in all leading regions world-wide. SNS systems based on 6G standards are expected to offer a new step change in performance to enable new critical applications such as real-time automation or extended reality as basis for advanced industrial services. There will also be an opportunity for new business models and players through architectures such as Open-RAN[36] and software networks, which will be an important basis for a competitive supply market in a multi-vendor environment as targeted in the 5G cyber toolbox. Moreover, the convergence with new technologies in the area of cloud and edge computing, AI, as well as components and devices beyond smartphones offer great opportunities for European players to seize new value chain opportunities. SNS are expected to significantly contribute to Sustainable Development Goals. Radically bringing down the cost of infrastructure with

[34] this is a working title which will be adjusted following high-level political guidance in time for the adoption of the Commission proposal

[35] COM(2020) 50 final

[36] More open and interoperable interfaces in Radio Access Networks (RAN) enabling more competition.

generalised software implementations will decisively contribute to advanced infrastructure availability. Connectivity and IoT will potentially enable distributed energy systems and grid transformation systems, supporting intelligent energy consumption in cities and ensuring optimization of energy production. They will also be able to facilitate precision farming and food monitoring for increased agricultural productivity and reduced need for scarce resources. IoT devices and smart systems will also enhance the efficiency of water usage, quality and the protection of oceans.

In relation to the green deal, SNS systems will be substantial contributor to reducing energy consumption and lower carbon emissions both as enabler for greening industrial sectors (ICT for green) and conceiving new technologies and for deploying greener networks.

1.2. EU positioning in the field

The European **SNS value chain** composed of connected devices, networks and related computing platforms has the following characteristics:

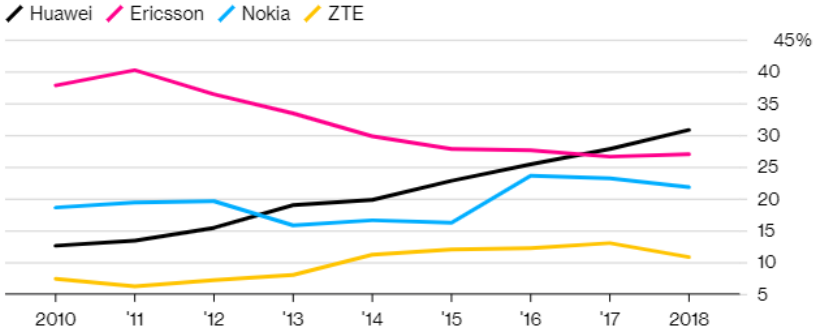
Devices: Europe has the scientific and technology knowledge but is no longer an important player in the smartphone market dominated by three global players (Apple, Samsung, Huawei) with a few additional Chinese ones emerging (Xiaomi, Oppo). Smartphones represent an important global market of €700 billion in 2019 without significant presence of European players. However, Europe maintains strong industrial assets for future generations of connected devices such as cars, drones, robots and agricultural sensors, which will be key for the industrial IoT.

Network services represent about €300 billion of revenues in Europe, about 27% of the global service revenues from service providers. This is a market with little growth at the moment, but new prospects of services to vertical industries may boost growth by 50% in 2026[37].Vertical markets are a strong opportunity, also to diversify the European digital dependence to communication services, which represent 50% of digital outputs in Europe against 25-30% in the US or Asia[38]. In the context of industrial applications, Europe is pioneering with more than 160 major 5G trials running today[39].

Network equipment: Europe remains a major player in the network equipment representing about 45% of the mobile infrastructure market, but is increasingly challenged by China, as shown by the Figure 5 below[40]. In some EU countries, Chinese vendors capture more than 40% of the telecom equipment market. Other upcoming challenges relate to the emergence of vendors originating from the IT industry (Cisco, Mavenir, Altiostar..) with potentially highly competitive offers for radio networks. EU industry is part of the Open-RAN initiative and has potential to benefit from these new opportunities.

[37] A.D. Little : the 5G business potential, 2017
[38] Impact Assessment Study for Institutionalised Partnerships under HE for SNS, final report.
[39] Source 5GObservatory.eu
[40]https://www.bloomberg.com/news/articles/2019-06-19/huawei-s-troubles-are-a-big-opportunity-for-ericsson-and-nokia

Figure 5: Evolution of mobile infrastructure market shares of the main networks equipment vendors



Cloud/Edge computing: the cloud computing service market in Europe is growing fast with €24 billion revenues in 2017 expected to reach €52 billion after 2020[41]. This market is though captured mainly by non EU platforms, with only one actor in the field (OVH). The same applies to cloud technology providers. Opportunities reside in edge computing[42], a new paradigm placing data processing close to the user to minimise latency and optimise user data control. It is expected to become a €13.8 billion market by 2024, with 40% of growth per year[43]. Europe may capture 27% of the market by 2024. Still, this requires solving technological issues, related notably to the security and energy consumption.

Software and IT services importance will grow for SNS. Europe has clear assets: Germany's SAP, France's Capgemini, Atos are all in the global top ten[44]. For IoT and cellular Machine-to-Machine (M2M), the Asia-Pacific and North America regions have now overtaken Europe former lead with large operators developing M2M services. Europe is ahead of North America for IoT in general and behind China. Asia-Pacific is expected to represent 57% of connections in 2030 against 16% for Europe, the second region in the world.[45]

In conclusion, the initiative intends to leverage EU industrial strengths in networking to stimulate industrial opportunities for devices and computing platforms, hence optimising also growth opportunities across the value chain for Europe.

Box 3 Support for the field in the previous Framework Programmes – key strengths & weaknesses identified

What was/is being done with EU research and innovation funding until now

Dedicated R&I activities related to communication networks have been supported since Framework Programmes 3 reflecting the strategic position of this industry for Europe. In recent years this was done mainly through the 5G PPP. This partnership between the European Commission and the 5G Industry Association, received €700 million of EU funding between 2014 and 2020 to deliver technologies and solutions for 5G mobile networks. Details on the way the partnership functions are available in Annex 6.

What has or is being achieved so far

[41] https://medium.com/@FIXER.Inc/european-cloud-market-the-hidden-opportunity-6368b5433fbb.
[42] Edge computing corresponds to the optimisation used in cloud computing where data is processed at the edge of the network
[43] https://fr.idate.org/produit/edge-computing-report/
[44] Ranking by 2017 turnover except smartphones (market share) - Digital Europe 2030, IDATE Digiworld (2019), based on Forbes
[45] IDATE Digiworld, World IoT Markets (2018) https://fr.idate.org/produit/iot-markets-4/

The main problem addressed by the 5G-PPP was the need for European industry to create critical mass and to be able to leverage large-scale investment in R&I on 5G technology, focussing mainly on the development of technology building blocks for the global 5G standard and its validation for a range of target use cases. It has allowed European actors to keep 55% of the Standard Essential patents out of the 4 global vendors of network infrastructures, and to be part of the leading regions of the world in this field.

What are the key areas for improvement & challenges not met

The proposed new initiative goes beyond this scope, and needs to respond to new strategic challenges. As SNS become increasingly critical for the functioning of all parts of the economy and society, mastering technologies for SNS and having European players well positioned on a global scale becomes a key issue of public policy. In this perspective, the competitiveness of European industry becomes a strategic challenge to be addressed.

New technological challenges emerging are briefly described in section 2.2.1 to 2.2.4

Furthermore, the initiative needs to address a range of other problems closely linked to the policy priorities of the new Commission, such as technology sovereignty, cybersecurity or low carbon emissions.

Such public policy concerns are not necessarily given the same priority by industry and, certainly, cannot be addressed by industry on their own. Therefore, a loose structure such as the 5G-PPP cannot be expected to deliver on the broad range of policy objectives that are increasingly crucial. Addressing these issues from a holistic and coordinated perspective notably requires a closer partnership with the strategic involvement of Member States.

A more strategic and formal partnership for SNS would be able to tackle these issues with an increased scope of the initiative, an increased set of industrial stakeholders, and the strategic involvement of Member States as part of the governance structure.

For example, the proposed initiative addresses the issue of technological sovereignty and how to stimulate it in a strategic domain, which is a key objective of the new Commission in this particular field and gained further importance in light of COVID-19, in relation of ensuring supply to key sectors. This topic will be addressed by extending the scope from connectivity to the broader strategic value chain including cloud-based service provisioning as well as components and devices. It will also seek to align strategic roadmaps of a wider range of industrial players, including the telecom industry as well as IoT and cloud actors, and to some extent actors from the microelectronics/component domain. The critical role of suppliers identified and addressed in the 5G cybersecurity toolbox will be a key preoccupation for upcoming network technologies such as 6G including the broader strategic value chain.

The initiative will also address energy efficiency and carbon neutrality objectives, as embodied by the Green Deal, which have not been sufficiently addressed by the 5G-PPP, such as reduction of the energy consumption of the connectivity platform itself, and directly supporting the reduction of the carbon footprint of vertical industries enabled by SNS systems.

Finally, the 5G-PPP was not designed to prepare and coordinate deployment programmes. The PPP structure is to not firm enough to align stakeholders towards a deployment agenda and the scaling-up of results that includes a broad range of stakeholders with sometimes diverging interests and that delivers not only for the commercial but also the public interest (e.g. enabling public safety or low-carbon services). In the proposed initiative a coordination mechanism for

CEF2 Digital as well as synergies with DEP and InvestEU are built-in, both as part of the scope and governance of the partnership, which is not possible under a co-programmed partnership. The infrastructure funded by activities in the scope of the partnership is indeed only a smaller part of the overall (private) 5G investment in the EU, focussing on market failure areas with cross-border dimension. However, such programmes are expected to play a major role in shaping cooperation models of 5G deployment and thereby unlocking the overall large-scale investment. This aspect is of particular importance in relation to infrastructure programmes supporting economic recovery post-COVID-19.

1.3. EU policy context beyond 2021

The proposed initiative has to be set in the context of **multiple European policies and priorities:**

- **Availability of advanced smart connectivity infrastructures**: The Gigabit Society package (COM(2016)587) adopted by the Commission in 2016 stresses the importance for Europe to benefit from an advanced digital communication infrastructure to move Europe into the Gbit/s era, and sets out deployment targets for 5G in Europe through the 5G Action Plan[46].

The broadband penetration impact on the per capita GDP is widely recognised[47]. Hence the proposed CEF2 Digital programme, which will be coordinated by the SNS initiative targets 5G deployments into lead markets to support European competitiveness and important societal issues, e.g. enabling reduction of road fatalities and of CO2 emissions by vehicles.

- **The Communication of 27 May 2020 on a European recovery post COVID-19[48]** has further emphasized the need to invest in more and better connectivity, with 5G having spill-over effects across the whole digital society and increase Europe's strategic autonomy. It calls for wider efforts to build infrastructure that can handle emerging and future processes and applications, to provide the necessary bandwidth for health, education, transport, logistics and media which are essential for our resilience, competitiveness and economic recovery.

- **Digitisation of the industry.** The Digitising European Industry package[49] acknowledges the key role of smart 5G communication infrastructures wide availability for the digitalisation and modernisation of sectors like transport, automotive, energy, healthcare and public administration.

-**Technology leadership, sovereignty and competitiveness perspective**: the need for Europe to master critical network technologies has been outlined by the European Commission on multiple occasions: the Industrial Policy communication adopted in 2017[50]; **the Recommendation on cybersecurity of 5G networks**[51] adopted in 2019; the Council conclusions of 3 December 2019[52], which "WELCOMES the ongoing preparation by the Commission, of a strategic European partnership on Smart Networks and Services", and also the European Political Strategy

[46] https://ec.europa.eu/digital-single-market/en/5g-europe-action-plan
[47] https://www.itu.int/dms_pub/itu-s/opb/pol/S-POL-BROADBAND.19-2018-PDF-E.pdf , WorldBank, OECD
[48] COM(2020) 456 final, "Europe's moment: Repair and Prepare for the Next Generation"

[49] https://ec.europa.eu/digital-single-market/en/policies/digitising-european-industry, April 2016
[50] https://ec.europa.eu/commission/news/new-industrial-policy-strategy-2017-sep-18_en stresses that 5G is the foundation of future business models
[51] https://ec.europa.eu/digital-single-market/en/news/cybersecurity-5g-networks: underlines that Europe should fully master the supply side chain as part of the renewed industrial policy
[52] https://www.consilium.europa.eu/en/press/press-releases/2019/12/03/significance-and-security-risks-of-5g-technology-council-adopts-conclusions/

Centre[53] calling for ambitious investments in 5G. The **strategic value chains** identified by the strategic forum put in place by the Commission to define industrial policy priorities for Europe are also relevant (Industrial IoT). The Communication adopted on 29 January 2020 **on the 5G cybersecurity toolbox** is particularly relevant as SNS intends major contributions to its objectives: standards to ensure end-to-end security, maintaining European supply capacities and diversification of actors in the supply chain. The partnership will have an important role to play to establish a dynamic multi-vendor environment and to tap into the potential of Open RAN and software implementations to incentivise existing and new competitive EU players.

- **The Communication of 27 May 2020 on a European recovery post COVID-19** has further emphasized the need for a stronger industrial and technological presence in strategic parts of the digital supply chain. In that context, it foresees recovery investment towards strategic digital capacities and capabilities, including 5G and 6G networks

- **Climate change and Green Deal**[54]: the growth of traffic on communication networks ranges from 50% to 100% per year[55] with strong impact on energy consumption of SNS platforms, expected to rise by a factor of 10 by 2030 and representing up to 10% of the overall energy demand[56]. SNS has the potential to decrease energy needs in vertical sectors, e.g. automotive or factories between 20 and 30%[57].

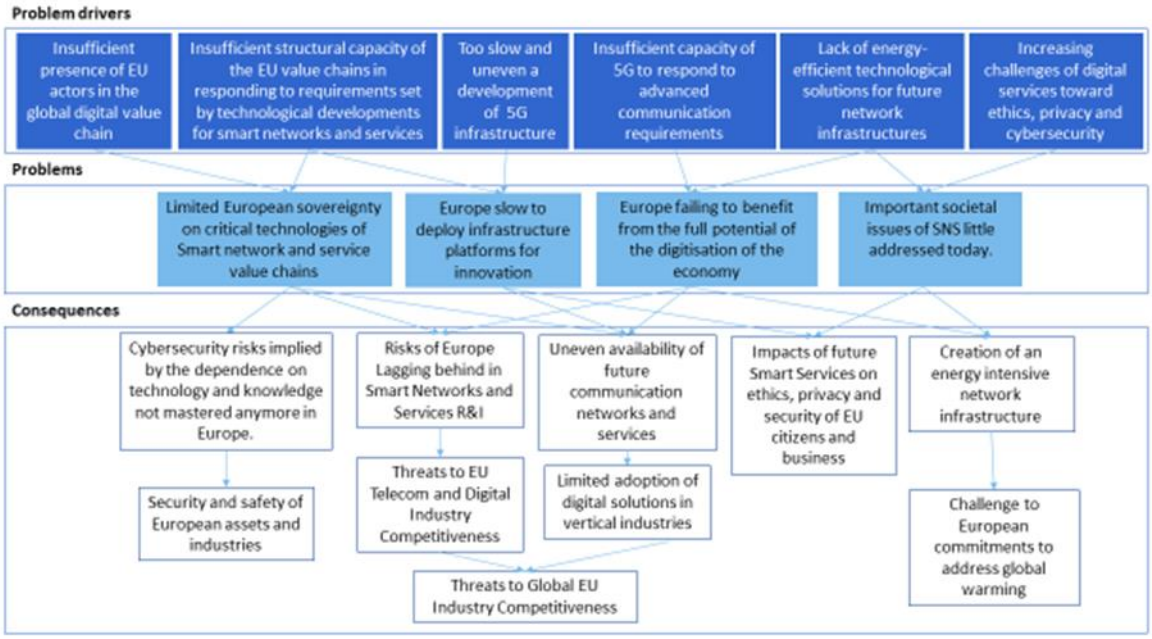
2. PROBLEM DEFINITION

2.1. What are the problems?

Given the scale of the challenges ahead for the transformation of the digital infrastructure, the current scientific, technological and economic positioning of Europe in the field, and the overarching EU policy context, a set of problems have been identified where EU research and innovation and EU deployment policies and programmes in the field of Smart Networks and Services would have a key role to play.

Figure 6: Problem tree for the initiative on Smart Networks and Services

[53] https://ec.europa.eu/epsc/publications/strategic-notes/rethinking-strategic-autonomy-digital-age_en
[54] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[55] https://www.statista.com/statistics/271405/global-mobile-data-traffic-forecast/
[56] Anders S. G. Andrae: "On Global Electricity Usage of Communication Technology: Trends to 2030"
[57] #SMARTer2030, GeSI report "ICT Solutions for 21st Century Challenges", page 63



2.1.1. Europe's lack of ability to benefit from the full potential of the digitisation of the economy

The economic potential in the field of SNS is huge. In 2035, they are predicted to enable $12.3 trillion of global economic output and the global SNS value chain is predicted to generate $3.6 trillion in economic output and support 22.3 million jobs in 2035[58]. Further estimates predict a global potential economic impact of IoT between €3.5 and €11 trillion per year by 2030 across multiple business domains[59].

These opportunities, largely represented by the Industrial IoT (IIoT), need SNS as a versatile "connectivity platform" that will become a constituent part of the business process. The Strategic Forum put in place by the Commission[60] also underlines the need for a better integration of several technological domains, notably cloud computing, connectivity and devices (robots, drones) to reach the full potential of industrial IoT. It also requires performance far beyond the capabilities of the current 5G solutions, e.g. in terms of positioning accuracy, response time, data rates, reliability or automation, which are not available today and will shape the essence of a next generation of mobile and cloud systems towards 6G.

The problem for Europe is hence to put in place the needed critical mass of stakeholders to support a coherent roadmap for SNS, create the needed deployment momentum, and avoid fragmentation. ***The Open Public Consultation confirmed that stakeholders from different technological horizons and different application and business model perspectives should be involved***. It needs to go beyond the current 5G-PPP efforts in this field, as the framework policy constraints surrounding use cases in terms of security, privacy, reliability, deployment and even business models require involvement and steering of public actors in the overall R&I process.

Synergies to avoid fragmentation have to be addressed in particular. ***The MS consultation led by DG RTD through the SPC*** (shadow programme committee) has shown that MS are largely

[58] https://cdn.ihs.com/www/pdf/IHS-Technology-5G-Economic-Impact-Study.pdf
[59] McKinsey: The Internet of Things, mapping the value beyond the hype
[60] Strengthening strategic value chains for a future ready EU industry, 6 Nov 2019.

supportive of the SNS domain (more than 80%) with 70 % having national programme related to SNS issues. Finland is the only MS that has so far labelled an initiative as "6G" but related problems are addressed in several MS, e.g. in Sweden, Germany, France, Spain, even if not as full blown dedicated national programmes. MS have different industrial/academic capabilities regarding SNS. MS with a strong supply side industry are interested from the onset in early R&D. Others are more interested in leveraging the technology to create ecosystems in vertical domains for downstream economic return. In order to motivate the involvement of a large number of MS it is necessary to cover a complete chain, from early R&I to trials and validation with a wide distribution of stakeholders.

2.1.2. Limited European sovereignty as regards critical technologies of smart network and service value chains

SNS technology becomes increasingly contemplated for numerous vertical digital use cases, but Europe has to rely on technologies developed elsewhere, putting European sovereignty at risk.

As outlined in section 1.2, Europe's main technological assets in the SNS value chain is the telecom supply industry, which is challenged both by global competition and by risks of control[61] by non EU actors. Devices and cloud computing are not mastered by Europe, but opportunities exist to develop EU industrial capabilities, through IoT devices and edge computing platforms. New industrial initiatives like Open RAN aiming at providing network functions through cloud based software implementations, a domain where EU industry has less assets today, is also an important area to develop capacities in Europe.

The problem is further aggravated by the trend to design connectivity systems through a vertically integrated perspective from device to service provision, pushed by the very high performance level required in industrial and professional use cases. Non-European actors, who already master vertically integrated value chains, may clearly be at an advantage. The pressure will only increase over time, as the international competition in this domain is fierce, with geo-political approaches promoted by some of our main competitors, looking for dominance of the full SNS value chain.

2.1.3. Europe slow to deploy infrastructure platforms for innovation

In the wake of early 5G developments, SNS are expected to become platforms for innovation, with a level of openness allowing innovators to develop new applications on top. In spite of technological excellence, the deployment of 5G infrastructure in Europe is not as fast as in other regions, due to fragmented regulation, as well as uncoordinated efforts of both industrial and institutional initiatives. This problem is amplified by the limited investment capabilities of European operators. However, new players in the vertical domains could potentially invest in new 5G infrastructure, but the complexity of integrating such technology with a complete connected ecosystem require significant time to fully validate the solutions in operational conditions.

[61] https://www.justice.gov/opa/speech/attorney-general-william-p-barr-delivers-keynote-address-department-justices-china

2.1.4. Important societal issues of SNS little addressed today

There is a potential conflict between the industrial incentive to develop and deploy SNS, and the concerns of European citizens about the impact of these infrastructures on the environment and on their fundamental rights.

Citizens are increasingly concerned about the use of personal data, by the electro-magnetic field exposure generated by wireless systems and such concerns are already slowing down the adoption of new technologies like 5G. Energy consumption is also an area of concern, as the cloud and network energy consumption may increase by a factor of 10 by 2030, reaching unsustainable levels in the absence of significant technological and operational improvement.

2.2. What are the problem drivers?

2.2.1. Insufficient capacity of 5G to respond to advanced communication requirements

Future digital use cases in professional environments will have very demanding connectivity and service requirements exceeding the most advanced capabilities of 5G roadmaps[62].
These future use cases include:

- Super-immersive multimedia and super-high definition video.
- Holographic telepresence. (up to 100 Gb/s needed, 100 times what 5G offers per user).
- XR Experience: virtual reality (VR), augmented reality (AR) and mixed reality (MR).
- Massive-scale communications (IoT) for anything and anywhere: 6G networks will support extreme massive connectivity.
- Smart City.
- Use cases requiring ultra-high precision 3D positioning, e.g. in factories.

For such a long term perspective, early requirement for future networks and services combining next generation cloud and 6G mobile systems are emerging, with performance improvement factors of at least 10 (positioning, latency) or 50 (capacity, speed) requiring major evolutions beyond the state of the art and across multiple industry sectors.

2.2.2. Insufficient presence of EU actors in the global value chain

The uneven presence of EU actors at each level of the SNS value chain threatens the future European technological sovereignty. This problem is fuelled by several factors:

A fragile position of European actors in the global digital ecosystem: European leadership in 5G R&D depends on a limited number of major 5G infrastructure manufacturers (Ericsson and Nokia) and an associated strong ecosystem of academics and R&I centres. However, reaching out more systematically to vertical industries is necessary to address comprehensive value chains. More collaboration is needed with cloud and device players, as new devices (such as IoT) provide an opportunity for Europe to regain a presence in the device industry as well as the software and cloud domain. This also requires strategic links with the microelectronics industry.

[62]See e.g ITU FG2030 White paper: https://www.itu.int/en/ITU-T/focusgroups/net2030/Documents/White_Paper.pdf

High risk R&D reinforces the risks for European actors: Connectivity and IT equipment sectors have high research intensity on average around 15% and going up to 30% for some actors63. This is comparable to other R&D intensive sectors such as semiconductors with R&D processes involving significant risks and important upfront investment. The stakeholders' consultation confirms the high risk R&D level of the domain, with particular relevance of public-private risk sharing approaches for long term R&D, as practiced by our main competitors (Asia and USA).

A need for critical mass in standardization: Since its inception end of 2015, the global 5G standardisation in 3GPP64 has generated more than 60,000 industry contributions and thousands of essential patents. European vendors are at the forefront for contributions and patents65 and have been supported by the 5G-PPP programme. However this place remain fragile, and Asia has a strong position on 5G patents and launched 6G programmes. Maintaining European position in global standardisation will require additional European participation, notably more massive involvement of vertical industries.

Stakeholder opinion

A key statement coming up from interviews commonly to all categories deals with the position of Europe lagging behind Asia and US. Indeed almost all interviewees mention the need to keep or regain European leadership in the value chain. Indeed, on network infrastructure, interviewees recognize the leadership of Europe with the presence of two champions. On the rest of the value chain, Europe has lost its position on devices but for most of interviews there could be an opportunity to gain a leadership position on other fields like IoT devices and other emerging technologies like edge computing considered as critical topic. Europe should have the capacity to both support areas where Europe is good at in the value chain and create European alternatives in the whole supply chain.

Also, interviewees from academia categories draw the attention on the necessity to invest more in research in Europe in order to develop its potential, to remain competitive and to avoid shortage of skills and lack of ventures and start-ups.

2.2.3. EU value chains are not integrated to include all actors important for the development of future smart networks and services

The future SNS will be a critical infrastructure to be developed with actors beyond the traditional telecommunication value chain, both from a technological and application perspective:

A future infrastructure relying heavily on multiple advanced digital solutions: The development of an infrastructure able to fit the needs of the future smart services requires cooperation with other field of research beyond pure connectivity infrastructure research (5G-PPP). This implies connection to R&I in IoT, edge computing, artificial intelligence, cybersecurity and cloud, and to address the raising importance of software technologies in networks.

An infrastructure critical for the adoption of digital solutions in many industries: SNS is set to become a critical infrastructure for numerous industries that are transforming themselves by

[63] Source: Strategy& PwC, The 2018 Global Innovation 1000 study, analysis of the 1000 largest corporate R&D

[64] 3rd Generation Partnership Project, the global standard development organisation for mobile coms. ETSI is member.

[65] Estimated that out of the 4 main vendors (Nokia, Ericsson, Huawei, ZTE) EU has about 55% of the essential patents

progressively adopting digital technologies. Future research on 5G, beyond 5G and 6G capabilities has to systematically take into account the requirements from the vertical players, beyond initial research on 5G. The integration of the vertical industries into smart networks and services research will need to be strengthened.

An infrastructure that will require structural changes in various value chains: Rapid changes triggered by the deregulation of markets affected the communication industry, increasing competition and technological innovation. As a result, the mobile ecosystem has transformed in a complex network of specific companies involved at different stages in the value chain. The increasing trend towards software implementation and openness of network functions and interfaces opens prospects for new supply side actors, and new business models to emerge.

These changes in the value chain can disrupt existing businesses, and threaten established European actors, but they also provide opportunity for Europe to reposition its industry and to take a larger part in the digital value chain by relying on its strong existing industries.

Stakeholder opinion

According to interviewees with no clear distinction of specific category of stakeholders, the value chain needs to evolve with players emerging from vertical industries. It will give the opportunity to provide new business models such as "Anything as a Service" model allowed by new technologies that provide flexible and open infrastructure.

2.2.4. Too slow and uneven development of 5G infrastructure

Leadership in technology and deployment through lead markets need to go hand in hand to ensure the development of a comprehensive European digital market. Deployment of 5G in Europe is though facing barriers:

Lack of investment in the deployment of the new infrastructure: China is expected to deploy hundreds of thousands of 5G base stations in the coming years. South Korea had already installed more than 90,000 5G base stations by October 2019. Ramp-up is going to be slower in Europe with only hundreds of 5G base stations installed at the same date, what may be due to limited investment capabilities of EU operators. This could be remedied by a new class of investors, like the industry verticals or new value chain actors.

Insufficient synergies between national and European initiatives supporting 5G as well as EU deployment programmes: beyond the European 5G Public Private Partnership (5G-PPP), many European countries have launched national R&D programmes, supporting 5G research and deployments, at national or regional level. They are generally restricted to national participants, and often overlapping with European programs. There is a risk of duplication, and missed opportunities for synergy and coordination. Moreover, deployment programmes such as CEF2 and DEP as well as InvestEU should be coordinated with R&I to achieve a coherent approach. More cooperation at European level would help to optimise the use of resources dedicated to SNS. A consistent strategy with Member States for these two pillars R&I and deployment has been missing to develop an impactful industrial policy in Europe in this field.

A lack of coordination of regulatory approaches, in particular spectrum management: Spectrum assignment remains a national prerogative. There is no formal coordination between EU Member States regarding spectrum assignment conditions. Early 2020, only 16% of the

pioneer bands had been assigned in the EU[66]. This hinders EU wide 5G availability. A common approach to developing a single market environment for large-scale investment in particular spectrum in Europe is beyond the remits of an R&I initiative. However, early technological and business awareness at the Member States level would help to develop a European common approach to spectrum matters and limit the risk for the industry.

Stakeholder opinion

According to the Open Public Consultation, business associations, SMEs and large organizations find very relevant the regulation in the field of radio spectrum allocation.

For several interviewees from different categories, a strong coordination in Europe is required for spectrum harmonization involving the implication of Member States very early in the program. Indeed the spectrum fragmentation in cost and allocation is seen as a key issue.

2.2.5. Increasing challenges of digital services toward ethics, privacy, and cybersecurity

The development of digital services poses several challenges for the EU citizen as to their privacy, data protection, cyber security or ethical concerns. Several fundamental human aspects can be challenged, such as: Identity and Reputation, Relationships, Culture, Motivation and Attention, Responsibility, Fairness, Safety and Privacy. Future integrated connectivity platforms will have to take into account such ethical/societal issues from the start and make them part of the design principle. This in turn requires inclusion of stakeholders with new competence profiles, which are currently not a part of industry initiatives like the 5G-PPP.

2.2.6. Lack of energy efficient technological solutions for future network infrastructures

The systematic inclusion of additional frequency bands to radio sites is expected to double the energy needed per site, a trend further intensified by expected network densification. Coupled with extended computing service platforms, reports indicate a 10 fold increase of network and computing energy consumption, without accounting for the devices. This is exacerbated by a lack of integrated industrial approach towards energy value chains.

2.3. How will the problem evolve?

Limited European sovereignty on critical technologies: in 20 years, the number of European telecom suppliers shrunk from 4 to 2, with increased competition mainly from China and low margins. Also, Europe lost the smartphone industry and failed to create an Internet service industry. Over the coming decade, this trend will be exacerbated. China, Japan, USA, Korea are all planning strategic 6G initiatives. Without a strong EU policy including R&I, European ability to compete is at risk. Market forces may not be sufficient: our main competitors are all considering SNS as a strategic industry and planning financial public support accordingly.

Europe slow to deploy infrastructures for innovation: this issues in the SNS domain is driven by regulatory and financial issues. On regulation, spectrum availability is key to lead deployment, as demonstrated by the aggressive 5G spectrum auction policy in the US. Without an early and coordinated European approach, there is a risk of a patchy "4G like" deployment of future infrastructures. On finances, European operators have lower revenues compared to US operators.

[66] 5GObservatory.eu

Investments by vertical industries, as planned in Germany for 5G, would provide new financing sources for deployment. An early involvement of these actors in the R&I process is hence key.

Europe failing to benefit from the full potential of the digitalisation: Reaping the full benefit of digitisation of the industry requires availability of technologies beyond the state of the art to address the most demanding use cases. Deploying such technologies in complex systems takes time and efforts. Should European research on the next step of telecommunication and digital services lag behind, the long term future deployments will be affected, limiting the availability of future infrastructure in Europe with negative impact on the industries requiring it. The development of capabilities of 6G networks and services is also essential to limit the energy need and environmental footprint of the network whilst enabling energy savings in other sectors.

Important societal issues not addressed: citizen concerns like security, trust, privacy, energy footprint or exposure to electromagnetic radiations will be even more exacerbated in the future. Translating these essential requirements into technology will provide a key competitive advantage to leading companies and regions in this field. Failure of European research to address these concerns and to bring them into products and services may leave European policy makers dependent from technological solutions specified elsewhere. Whilst regulation can provide an ex post solution, an early involvement of European public actors in the definition of future SNS provides opportunities to visibly address citizen concerns ex ante from a European perspective.

In conclusion, a coordinated EU policy converging visions and objectives across the multiplicity of SNS stakeholders would alleviate the potential negative problem evolution outlined above.

3. WHY SHOULD THE EU ACT?

EU action is based on two Treaty provisions: the EU is empowered to encourage an environment favourable to cooperation between undertakings and fostering better exploitation of the industrial potential of policies of innovation, research and technological development (Art. 173 of the TFEU). Art. 187 TFEU specifies that the EU may set up the structures needed for the efficient execution of EU research, technological development and demonstration programmes.

3.1. Subsidiarity: Necessity of EU action

SNS play a critical role for the competitiveness of the European industries. In Europe, the mobile communication sectors only generates an output of €550 billion (2017 figures) with an employment level of 2.5 million persons. The sector drives the competitiveness of multiple vertical industries (connected cars, smart factories) and has become key for social life.

The challenges faced by the sector are huge: **massive and risky investments** needed to develop new generation of SNS infrastructures, **massive competition** from non-European players in a domain considered strategic, **emergence of new business actors** and new business models, **increased need of public actors** to co-create future systems that will increasingly support areas of public interests (connected healthcare, smart energy grids, connected cars), raising societal concerns of European citizen. These add to the classical issue justifying actions at EU level in the field, such as global consensus on future standards, spectrum and EU wide deployment scenarios.

These issues suggest a rapid and coordinated response of the EU to keep and further improve its competitive position in SNS technologies and related industries. The positive experience from

5G-PPP is not sufficient to mobilise the larger spectrum of required stakeholders whilst avoiding fragmentation and duplications of resources at national level.

3.2. Subsidiarity: Added value of EU action

EU level can clearly drive European actors towards common visions, common technological roadmaps transforming eventually into global standards. This is key to generate economies of scale and economies of scope, limiting if not avoiding EU fragmentation of efforts and national solutions. In the SNS domain, the last 40 years have demonstrated with GSM, 3G, and 4G that a European approach is the only approach that makes sense to cater for citizen obvious requirements, such as interoperability and service portability across multiple providers' domains.

With the move towards industrial domains and vertical use cases, the value of common and standardised technologies translates into cost savings and capex optimisation.

In this domain, which is highly R&I and capex intensive, the European level is the best solution to keep pace with the investments in other regions, notably in Asia. It is also a must if Europe wants to keep a strong industry in this domain, in the context of US efforts to build their own alternative providers[67].

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objectives of the initiative

The general objectives address the problems identified in section 2. They take into account the stakeholders' positions expressed in the consultation, the partnership proposal from the industry and research community, from the ETP Networld2020 Strategic Research and Innovation Agenda[68], and from the Strategic Deployment Agenda (SDA) developed by stakeholders of the connected mobility domain. It has to be noted that even if the core of the initiative is on R&I, deployment aspects cannot be ignored, as industry innovation investments tend to relocate on lead market regions, so it is key to be a lead market in 5G to prepare 6G R&I investments in Europe.

4.1.1. Ensure European technological sovereignty in future smart networks and services

The initiative will address the issue of technological sovereignty and how to stimulate it in a strategic domain, which is a key objective of the new Commission in this particular field and gained further importance in light of COVID-19, in relation of ensuring supply to key sectors. This topic will be addressed by extending the scope from connectivity to the broader strategic value chain including cloud-based service provisioning as well as components and devices. It will also seek to align strategic roadmaps of a wider range of industrial players, including the telecom industry as well as IoT and cloud actors, and to some extent actors from the microelectronics/component domain. The critical role of suppliers identified and addressed in the 5G cybersecurity toolbox will be a key preoccupation for upcoming network technologies such as 6G including the broader strategic value chain.

[67] https://www.onmsft.com/news/microsoft-and-dell-among-companies-tapped-by-the-white-house-to-build-huawei-5g-network-competitor

[68] European Technology Platform NetWorld2020: https://www.networld2020.eu/sria-and-whitepapers/

4.1.2. Strengthen the uptake of digital solutions in the European markets

European excellence in SNS supply side requires development of a vertical market for 5G and later 6G infrastructure and services in Europe, preparing for the longer term opportunities of SNS. The automotive market will be targeted with deployment of 5G solutions over cross border corridors in line with the 5G Action Plan targets. A coordination mechanism for CEF2 Digital as well as synergies with DEP and InvestEU are built-in, both as part of the scope and governance of the partnership. The infrastructure funded by activities in the scope of the partnership is indeed only a smaller part of the overall (private) 5G investment in the EU, focussing on market failure areas with cross-border dimension. However, such programmes are expected to play a major role in shaping cooperation models of 5G deployment and thereby unlocking the overall large-scale investment. This aspect is of particular importance in relation to infrastructure programmes supporting economic recovery post-COVID-19.This objective would also contribute to SDG 8, SDG 9 and SDG 11.

4.1.3. Develop digital innovations answering European needs

The aim is to develop the technologies and services required for future SNS platforms. It builds on the most demanding requirements of vertical industries and leverages societal requirements (security, energy efficiency, EMF) as key drivers for competitiveness and differentiation Integration of emerging technologies like Artificial Intelligence to increase performances and entirely new application domains (Internet of senses[69]) is also targeted. It will advance European technological and scientific excellence and support European leadership **to deliver 6G systems by 2030**, and place Europe on par with nations having announced 6G initiatives (China, Korea, Japan, USA, and Taiwan).

4.1.4. Ensure the alignment of future smart networks and services with EU policy and societal needs

The aim is to support the core principles of human centric and sustainable Internet, by addressing ethics, privacy, cybersecurity, electromagnetic fields, and environmental impact from a complete system (data management) and downstream policy perspective. In the Green Deal context, it addresses both radical decrease of energy needs by SNS platforms and SNS contribution to decarbonise vertical sectors through process optimisation. This objective is in line with the political orientations of a "European Green Deal"[70]. The initiative will also address green deal objectives, which have not been sufficiently addressed by the 5G-PPP, such as reduction of the energy consumption of the connectivity platform itself, Electromagnetic Fields emissions and support of the reduction of the carbon footprint of vertical industries enabled by SNS systems.

This objective would contribute to SDG 10 (indirectly through lower cost of technology), SDG 12, and SDG 13.

These objectives contribute to the objective of Horizon Europe to deliver scientific, technological, economic and societal impact from the Union's investments in R&I to strengthen the scientific and technological bases of the Union and foster its industrial competitiveness at EU and national levels.

[69] Defined as the fusion of environment sensing and communication to provide a context information.
[70] https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf

4.2. Specific objectives of the initiative

In order to achieve the general objectives, seven specific objectives are defined. These specific objectives respond to each of the problem drivers discussed in Section 2.2. The list of specific objectives is the following.

- **Ensure the development of technologies able to meet advanced communication requirements:** the goal is to ensure European excellence for technologies and architectures required for SNS and evolution towards 6G. Typical measurable targets include data rates beyond 100 Gb/s, ultra-low sub millisecond latency, sub centimetre positioning accuracy, ultra-high reliability beyond 99,999%, wide area coverage alleviating digital divide, support of more than 1 million devices per km² for smart city scenario, integrated device to service security. Related objectives include strong European positions on standards, essential patents, and identification of key deployment needs, e.g. spectrum requirements for regulators

- **Accelerate the development of energy-efficient network technologies:** the goal is to ensure European solutions for architecture and technologies needed to significantly reduce the energy and resource consumption of the whole digital infrastructure from edge cloud services, to the communication network core, the radio access and ultimately to the connected devices. A ten-fold reduction compared to anticipated levels is targeted through reappraisal of integrated architectures networks-clouds and use of low energy technologies such as fibre or new radio spectrum. For SNS support to vertical sectors, a 30% energy decrease of key verticals is targeted.

- **Accelerate the development and widespread deployment of 5G and later 6G infrastructure in Europe:** the goal is to reach the 5G Action plan objective of 5G deployment along main transport paths by 2025 and 5G introduction in key vertical lead markets. In particular the CEF2 Digital programme is targeting at least 6,000 km of 5G deployment across cross border corridors, as seed initiative targeting places where market forces are not sufficient to ensure deployment. Other deployment programmes under CEF2 as well as DEP and InvestEU will be important to accelerate infrastructure investment and create 5G and later 6G ecosystems.

- **Support the transformation of the European value chains:** As promoted under the Cybersecurity toolbox, ***the goal is to stimulate a more diverse supply chain*** in Europe with more players on the infrastructure side. A related objective is to stimulate emergence of new deployment business models, beyond those of traditional service providers, based either on vertical industry deployment or on neutral host and drawing resources from multiple providers. ***Target is to have at least one European provider for software based connectivity*** and pilots for new deployment models, also outlining the related regulatory issues to tackle. This has strong standardisation implication.

- **Strengthen the positioning of EU industry in the global digital value chain:** the goal is to put in place a critical mass of public and private actors across the SNS value chain, in view of strengthening the EU industries in the global digital value chain, increasing the contribution from software and IoT actors, leveraging national initiatives and supporting the emergence of new actors such as new types of connectivity providers or devices producers. It targets development of commonly shared strategic R&I and deployment roadmaps, coordinated spin offs towards standardisation bodies and strong international

cooperation to stimulate global consensus and visions. Target: at least 30% of new actors expanding the current set of 5G-PPP beneficiaries.

- **Ensure alignment with ethical and security requirements:** the aim is to include societal and ethical issues as requirements from the onset into the strategic roadmaps with dedicated projects coordinating societal and ethical results developed by SNS as a whole, including at MS level and to map those with existing legislation or to propose new one's as appropriate.

4.3. Intervention logic of the initiative

The relationship between the general and specific objectives of the initiative on Smart Networks and Services is illustrated in Figure 7 below. It outlines a multiplicity of issues to address, including industry competitiveness, industrial policy and repositioning of Europe on strategic value chains and a reinforced EU sovereignty in critical technologies, fostering deployment of advanced infrastructures and addressing societal and challenges from a holistic perspective.

With these challenges in mind, the intervention logic is that the strategic partnership will make a major contribution to several key policies, and that this can not be left entirely to a bottom up industrial approach that leads primarily to a co-ordinated implementation of R&I projects, however excellent this may be from a technological and scientific perspective. The magnitude of the public policies addressed (including deployment in vertical sectors such as healthcare, mobility or energy) suggest a much stronger steering role for the public sector, including at Member State level.

Another dimension of the intervention logic is to engage a wider set of stakeholders from the industrial side, with a compelling roadmap that they can share and agree to, with a view to committing the necessary internal resources. The level of commitment required from the private sector can only be achieved if a long term vision and commitment can be demonstrated from the public side, such that the roadmap can be a mutually shared public-private framework for the full duration of the partnership.

Finally, the partnership needs to join the efforts at Member State level that will further guarantee the success of the initiative. The partnership will not be in a position to resolve fully all the issues at stake, but will place Europe on track to do so. This is particularly important for questions of sovereignty and for the emergence of new industrial players, which will need downstream actions at MS level similar to the IPCEI initiatives in the microelectronics or battery cases. This requires a clear strategic approach across all stakeholders, for which an initiative such as the current 5G PPP was not designed. The requirements and approach will be defined jointly at strategic level in the partnership. However, we recognise that the partnership cannot implement comprehensive reindustrialisation actions nor can it implement general binding legal requirements comparable to the EU legislative process. Whereas the joint approach in the partnership has the advantage of upfront support from a broad range of stakeholders, flanking downstream measures at MS level are still required. Equally, legal measures in the area of spectrum harmonisation, cyber-security or environmental requirements e.g. for networks and data centres, are expected to be a necessary complement. The joint work in the partnership can however prepare the ground for legal proposals and ensure that industrial policy considerations are well addressed.

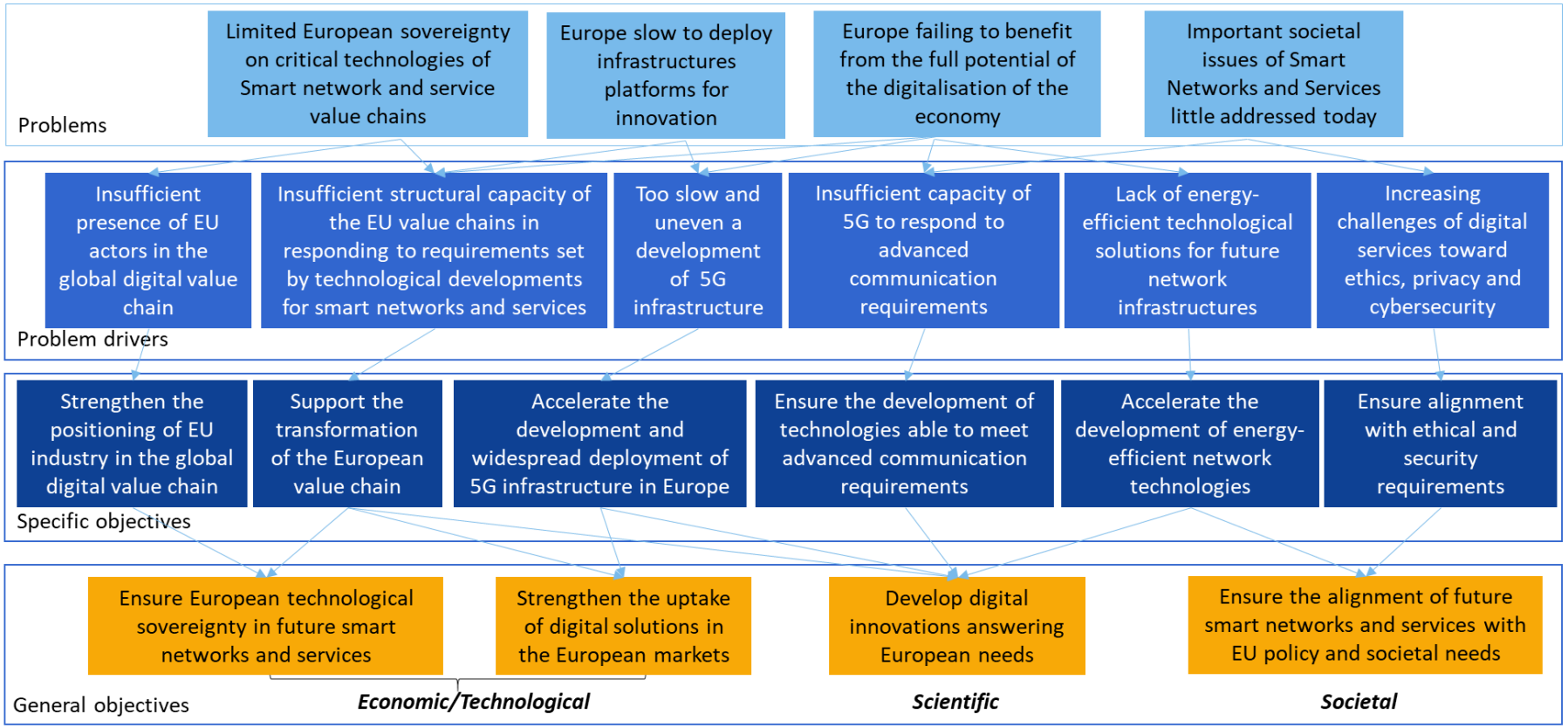
In practical terms, the mechanism used in the 5G-PPP to achieve ambitious leverage factors for large-scale investment in R&I in the field will be reinforced by a strong prior commitment of financial resources from the public side, and a commitment from industry to co-invest in light of

an R&I and deployment roadmap agreed between a broad range of stakeholders. In particular, stakeholders in the area of cloud computing and Internet-of-Things as well as components and devices will be brought on board of the partnership to address the full range of policy objectives through a comprehensive technology roadmap. Furthermore, public authorities in all Member States as well as technology suppliers and users are being mobilised to support the deployment agenda in view of the CEF2 Digital programme.

As regards public policy objectives, the specific legal basis (in case of an institutionalised partnership) will allow technological sovereignty aspects to be addressed, e.g. by taking into account principles of the 5G cybersecurity toolbox concerning the role of future suppliers, for instance by limiting or excluding non-European headquartered companies from certain calls and activities. In this respect, the initiative will have to balance the stronger role for governments with the continued primacy of European industry in controlling the partnership.

Public policy objectives such as the Green Deal will be emphasised in the R&I and deployment roadmaps as well as in the Work Programmes, e.g. in the form of concrete targets in terms of energy-efficiency or carbon-neutrality of future technologies as well as deployments. This can be achieved by strategic guidance from the Commission and Member States as part of the governance structure.

Figure 7 - Intervention logic for an initiative on Smart Networks and Services



How would success look like?

Should the initiative deliver on its specific objectives, it is expected that it would translate in practice into the following impacts:

Scientific impacts

- Generation of new knowledge
- Diffusion of applied knowledge
- Enhanced positioning of Europe in the S&T field

Should the initiative be successful, **the generation of new knowledge in the SNS field** would be achieved through the following:

- Enhanced performance requirements for long term connectivity, device and services with creation of new knowledge to meet the most advanced requirement of future digital use cases.

- The development of an energy efficient platform with major scientific breakthrough in the area of energy consumption notably fostering breakthrough all optical networks.

- The integration of new digital services for the industries undergoing a digital transformation will generate system and operational knowledge.

- The acceleration of the deployment of 5G infrastructure and later 6G solutions will create new knowledge.

- Ensuring compliance with European ethics and cybersecurity requirement will also contribute to scientific progress in mathematics, physics and social sciences

The generation of this new knowledge would contribute to **European competitiveness in the SNS field** through excellence of the European R&I. The initiative would also have important impacts on the **diffusion of more operational and applied knowledge** through several activities, notably:

- Operational knowledge on deployment and operation of future infrastructures.

- Applied knowledge through adoption of digital applications in various vertical industries.

Economic/technological impacts

- Enhanced competitiveness of European SNS Industry
- Increased innovation and research in the field of SNS
- Adoption of digital technologies in European industries
- Diminution of regulatory burdens on businesses

The initiative if successful would contribute to **an enhanced competitiveness of the European industrial ecosystem**, thanks to the large scale coordination and mobilisation of a critical mass of actors across the value chain, in close coordination with member States. **The adoption of digital technologies by European industries** would be stimulated through support of the development of new smart services, targeting explicitly

the vertical industries and making a large use of advanced digital solutions, by the development of new global standards and the deployment of early services.

Increased innovation and research in the field would be catalysed through bigger direct investment of the European industry in the field and the deployment of the new infrastructure. A leveraging factor of at least 7 is expected with industrial investments and additionally.

Finally the initiative would also have some impacts on **the regulatory burden for businesses**, through dedicated actions toward the harmonization of regulation and processes around spectrum assignment and usage. The use of untested spectrum beyond 100 GHz as targeted by SNS would be subject to upstream deployment, sharing and co-existence analysis to fuel European regulatory consensus at international levels.

Societal impacts

- Development of a human-centric internet
- Equal and safe access to a critical infrastructure
- Development of employments in field related to SNS
- Mitigate negative environmental impacts

Environmental impacts: Should the initiative be successful two main impacts are envisaged: i) reduction of the planned energy consumption of SNS platform by a factor of 10 compared to the planned evolution by 2030; ii) reduction of the energy footprint of the vertical sectors (factories, vehicles, healthcare, education) by 30% through better process and resource management. Where appropriate, companion legislation would be proposed, needing strong interactions with Member States. Another impact objective is the limitation of Electromagnetic Fields emissions and the coordination with Member States for measurements and public information approaches.

Social impacts: The ability to provide equal access to a critical infrastructure for EU citizens and businesses would be enhanced through higher competition on the supply side and decrease of infrastructure cost due to massive use of software solutions. Ecosystem developments favour job creation and innovative curricula to be developed through industry-academics partnership.

Impacts on fundamental rights: Positive impacts on fundamental rights would be expected from the development of digital services enabling users to fully control their identities and the data they produce or consume.

4.4. What is needed to achieve the objectives – Key functionalities needed

Given the focus of the impact assessment on comparing different forms of implementation, the identification of "key functionalities needed" allows making the transition between the definition of the objectives and what would be crucial to achieve them in terms of implementation. These functionalities relate to the type and composition of actors that have to be involved, the type of range of activities that should be performed, the degree of directionality needed and the linkages needed with the external environment.

4.4.1. Type and composition of the actors to be involved

As initiated by the 5G-PPP and confirmed by the public consultation, SNS need to pool a large critical mass of stakeholders to create an impactful European momentum on Next Generation Mobile and Cloud Systems, 6G.

The core targeted players are the industries and R&I players of the telecommunication value chain complemented with actors representing the Internet of Things, cloud systems, distributed and edge computing, cybersecurity and artificial intelligence. It includes hardware, software and component and equipment manufacturers, and communication service providers.

Vertical industries[71] contribute their advanced requirements, implement validation pilots, and experiments new business models based on alternative connectivity/service providers and data management schemes. Automotive is key for the targeted CEF2 Digital 5G deployment actions.

SME's and start-ups are called upon to benefit from technology transfer, develop and market specific technologies of the entire value chain, from devices to services.

Academics and research centres are key to support research labs of industrial actors and to propose innovative advanced solutions further de-risked by the initiative. In the openness context, academics also mastering social science and societal impacts on technology are called upon to drive ethics/societal related activities and maximise societal acceptability of technology.

International cooperation partners: are not specifically included in SNS but need to be regularly consulted to achieve global vision and standards, especially for what concerns 6G. Reciprocity will be a driver of more operational engagement of such partners.

Member States

The formal and close participation of the Member States as part of the governance structure ensures the possibility to define a top down strategic programming, and to enable synergies with national investments, through a coordinated approach. We foresee a guiding role for Member States in strategic matters that goes beyond the upstream advisory role as in the case of comitology, which is lacking in flexibility when it comes to new and rapidly emerging challenges. This guiding role will be very much needed, considering that for 5G PPP, there were multiple MS initiatives in this field leading to fragmentation and inefficiencies (FI, D, F, ES, S, SL, I, DK, LU, UK..).

The early involvement of MS creates a level of awareness that is key to prepare for deployment in Europe. Deployment of a new generation of connectivity platform requires national involvement in particular in areas of public interest such as 5G along transport paths and 5G cities and communities.

Member States steering is key to the success of the initiative, with upfront strategic guidance, advice on needed regulatory developments, and to support large scale EU wide

[71] E.g: automotive, factories, media, energy, healthcare, though not limited to those

implementation with access to national relevant facilities[72] to maximise ***directionality***. The participation of members Sates in the governance structure is hence needed

4.4.2. Type and range of activities needed

A comprehensive set of activities reaching beyond the sole R&I is planned to maximise impact and take up whilst fostering ***additionally*** and leveraging the public investments[73]:

Roadmap and work programme developments, through large scale consultations and downstream production of Strategic R&I agendas, Strategic deployment and exploitation agendas

R&I activities covering the long term R&I on component, technology and architectural needed to deliver the future 6G standards, the IoT devices operating with 6G and the computing service infrastructure, moving towards cloud native, open and full software implementations running on generic hardware. This is complemented with shorter term R&I on applications covering early deployment and novel usages to initiate the markets and prepare for longer term solutions.

Pilot and deployment actions include lead market development of 5G Corridors as planned under CEF2 Digital, other 5G deployment actions under CEF2, DEP and InvestEU, as well as longer term pilot actions trialling pre-6G technologies in dedicated demanding environments requiring large infrastructures (a factory, a stretch off motorway, an hospital). Such activities are typically supported by private investments beyond the seed public support and require coordination with Member States.

Standardisation and common specifications, coordinated exploitation of project results being submitted to standards through core industry contributions;

International alignment of vision and roadmaps, through dialogue with the main regions having launched similar initiatives targeting 6G;

Development of key regulatory issues notably for what concerns spectrum identification and usages[74], security standards and certification[75], energy efficiency and ethical aspects;

Coordination/synergy with relevant European initiatives, through platform of exchanges maximising directionality of the various programmes;

The partnership can realistically achieve the delivery of public policy objectives in its field of activity such as CEF2 Digital deployments or when setting requirements for next-generation technology standards. Since SNS standards such as 5G and later 6G are global standards prepared by the projects of the partnership, the impact of the partnership activities will be significant. There is also the potential that approaches of CEF2 Digital deployment projects defined in the SNS partnership will be a model for other deployment projects in Europe and globally.

[72] In the 5G PPP case, at least 10 MS developed 5G pilot facilities independent of EU actions, or only leveraged ad hoc by industry.
[73] The 5G PPP level with a leveraging factor of 7 is taken as a baseline objective.
[74] Target contribution bodies: RSPG, CEPT, ITU
[75] As contribution to the evolution of the 5G security toolbox released by the EC on 29 January

Such requirements and approaches will be defined jointly at strategic level in the partnership. However, we recognise that the partnership cannot propose general binding legal requirements comparable to the EU legislative process. Whereas the joint approach in the partnership has the advantage of upfront support by a broad range of stakeholders, flanking legal measures in the area of spectrum harmonisation, cyber-security or green deal requirements e.g. for networks and data centres are expected to be a necessary complement. The joint work in the partnership can however prepare the ground for legal proposals and ensure that industrial policy considerations are well addressed.

4.4.3. Priority setting and level of directionality required

Directionality is key and requires a common shared vision to reach the needed ambitious investment to ensure technological sovereignty in the domain[76]. At this stage, multiple fora are already working on such visions: the ITU FG 2030 focus group, the Finish 6G flagship, the IEEE Future Networks initiatives. Similarly, SNS is preparing a similar roadmap. It expands those already mentioned by taking an end to end value chain approach, tackling devices and edge computing. These are instrumental to provide clear investment directions with a 2030 horizon. Development of such visions and roadmaps are classical in this domain and are a must considering the 10 years needed to develop a new generation of connectivity infrastructure. ***A secured long term budgetary visibility also helps to reconcile two conflicting requirements: the need to have a focused vision and the need to involve a very large variety of stakeholders.***

4.4.4. Coherence needed with the external environment

Structured links to external actions are key to the success of SNS. At MS level, establishing links with initiatives like the 6G Flagship of Finland is targeted, and other similar national initiatives will be targeted. Given the wide scope of SNS, clear links have to be established with: the partnership on Key Digital Technologies (KDT) to develop the future generation of components needed for 6G, an issue not well addressed in 5G; the cybersecurity partnership, in view of developing the "landscape aware" security methodology in future systems; the partnership on High Performance Computing (HPC) to develop the enabling technologies for edge processing. SNS will then act as test/validation environment of technologies developed under these initiatives.

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

This section describes the specific functionalities that could be provided under the baseline scenario of traditional calls and the different options of different types of European partnerships.

5.1. Baseline option – Traditional calls under the Framework Programme

The baseline scenario used in this impact assessment is a situation without a Partnership and only traditional calls of Horizon Europe. Given that there is a predecessor Partnership as well as other funding sources in the area, these will continue generating effects even if there is no new Partnership. In particular it is expected that these already

[76] For 5G only, the sole government of South Korea (60 million people, 8 times less than Europe) invested $ 500 million public support over 6 years. This made possible the emergence of an infrastructure industrial capability (Samsung) that did not exist in 2013 at the start of the programme.

existing initiatives will still create effects on future Smart Networks and Services. This is taken into account in the effectiveness assessment.

In parallel, the baseline situation means that the current implementation structure of the Article 187 would be closed, which bears winding down and social discontinuation costs. There would also be financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. This is taken into account in the efficiency assessment.

This option cover calls under the Framework Programme and include activities ranging from research action to innovation actions. Coordination and support actions provide a loose ex post coordination framework. Resulting projects run mainly individually. The research agenda is based on a short-term (2 years) perspective through stakeholder consultation.

Table 2: Key characteristics of the baseline situation - Horizon Europe calls

	What is feasible under this option – functionalities of the option
Enabling appropriate profile of participation (*actors involved*)	• Even if a long term roadmap may be identified, extensive consultations are needed every 2 years to feed the bi annual work programme. Because the long term roadmap would be sliced up into 2 years period (assuming continuity would be granted) early commitment of a wide variety of stakeholders is difficult. In particular users and SME's will be more relevant towards the end of the programme rather than at the beginning when basic technological choices are investigated. • Synergies with CEF automotive actors are virtually not possible • Mobilisation of national programmes and actors can only be bottom up and ad-hoc
Supporting implementation of R&I agenda (*activities)*	• Implementation of R&I and demonstration/pilot actions are possible through regular Horizon Europe calls; • The needed continuity to deliver on 10 years roadmap is not granted, as it depends from bi annual work programme discussions. • The needed financial long term visibility to implement the full R&I cycle is not granted as it depends on bi annual work programme negotiations. • Only loose ex post coordination can be implemented, with little possibility to plan for spin off impact like contribution to standards or to spectrum allocation issues.
Ensuring alignment with R&I agenda (*directionality*)	• Work programmes need to reflect the requirement for R&I activity across TRLs, with input from representatives of all relevant stakeholders. • Specification of calls for activity at higher TRLs, particularly demonstration programmes, need substantial input from industry. • R&I activity would focus on the short to medium term needs of the industry, it may also include fundamental research, not connected to a long term roadmap • Alignment of initiatives across the Union including at MS level very difficult, risks of fragmented and patchy implementations with less interest from MS with little industrial capabilities in the field. • Integration with other programmes and synergies with other relevant initiatives (KDT, cyber, HPC) difficult to plan with a programmatic perspective. • Each project and activity would function individually without strong coordination.
Securing leveraging effects (*additionality*)	• Progress of R&I effort depend largely on EU funding, with no expectation of significant leveraging of industry support as actions are not included in a full EU level programme • Risks of additional activities being unrelated to actual Horizon Europe R&I.
Key differences compared to the current situation	• The existing 5G PPP is discontinued and its roadmap based piloting and coordination terminated leaving projects without coordination for standardisation, trials and input to regulation • The contribution from private side through the 5G Industry Association which coordinates activities has to be replaced by mechanisms to be funded under the Horizon Europe Programme.

5.2. Description of the policy options

Option 1 - Co-programmed European Partnership

This option is based on a memorandum of understanding between the European Commission and a European industry association[77]. The agreement is non-legally binding with "best efforts" KPI's and objectives from the involved stakeholders. The R&I is driven by a long term roadmap primarily defined by the industry and R&I stakeholders and target leveraging effects of at least 5 from the private side.

Table 3: Key characteristics of Option 1 – Co-Programmed European Partnership

	What is feasible under this option – functionalities of the option
Enabling appropriate profile of participation (*actors involved*)	• Participation of key stakeholders potentially contributing to the specification and delivery of the strategic R&I agenda is possible. • Work programme decided biannually impacts the long term visibility of the initiative and may affect commitment of stakeholders. • Limited synergies with CEF automotive actors. • Mobilisation of national programmes and actors only ad-hoc. • The partnership is likely to build upon the existing structure of the 5G-PPP but would have to include new stakeholders to fully cover the scope of the smart networks and services topic. • It offer the flexibility to change the profile of participation over time, with new partners joining to support new areas of activity in response to emerging results and changing priorities, but the long term roadmap ensure better participation from the start.
Supporting implementation of R&I agenda (*activities)*	• Implementation would rely on standard administrative infrastructure underpinning the open calls procedure, drawing on resources of relevant executive agencies and Commission IT systems. • Implementation of R&I and demonstration/pilot actions are possible through regular Horizon Europe calls. • The needed continuity to deliver on 10 years roadmap **is not granted**, as it depends from bi annual work programme discussions. • The needed financial long term visibility to implement the full R&I cycle **is not granted** as it depends on bi annual work programme negotiations. • Partial programmatic coordination can be implemented for spin off impact like contribution to standards or to spectrum allocation issues. across multiple projects but within the limits of the implemented roadmap actions.
Ensuring alignment with R&I agenda (*directionality*)	• Work programmes would need to reflect the requirement for R&I activity across TRLs, with input from the various partners to achieve an appropriate balance of activity directed towards different vertical markets (e.g. automotive, manufacturing, transport, health, energy). • The partnership would be responsible for ensuring that priorities for calls were specified in line with R&I priorities, including demonstration programmes. • Coordination with other initiatives at the European level (CEF, DEP, InvestEU), National and Regional level requires significant efforts. • Coordination with the initiatives (KDT, Cyber, HPC) left entirely to industry. • R&I activity aligned with the medium-term needs of the industry can be achieved.
Securing leveraging effects (*additionality*)	• Leveraging target defined and agreed from the onset. • Expected in-kind contributions from the private sector identified in the work programme. • Agreement to commit extra resources remains "best efforts" from the involved stakeholders.
Key differences	• Extension of the existing industry association of the 5G PPP with new set of stakeholders to

[77] The existing 5G Infrastructure Association is considered as the basis for a cPPP

compared to the current situation	address of a larger scope of topics to perform 6G R&I as well as – to a certain extent - deployment actions under CEF2 Digital. • Additional activities to be planned and reported instead of measuring a mere leveraging factor in H2020.

Option 2 – Institutionalised European Partnership under Article 187 TFEU

This option is based on Article 187 TFEU and requires a Council regulation to implement a Union body, which involve the European Commission, representative from the industry through an industry association Member States and associated countries. The agreement is fixed and legally binding.

The body provides the strategic orientation to work programmes based on a long term research and innovation agenda (5 – 7 years) following a strategic roadmap to develop 6G networks and services and of providing support for the deployment of 5G infrastructures. It runs the evaluations and decides on the projects to be implemented.

The initiative would benefit from EU funds and seek a leverage effect through the contribution of the industry.

Member States are planned to be strongly involved in the governance of the JU, in particular to provide strategic guidance, advice on specific decisions, and contribute to coherence and synergies with national initiatives. To limit administrative overhead, it is not planned that MS would co-finance the SNS partnership (except possibly in-kind contribution for specific areas).

The institutionalized partnership may also have a dedicated role to define framework deployment conditions namely regulation and legislation (e.g. in the fields of spectrum allocation and use, ethics and cybersecurity of digital services, energy consumption of network infrastructures).

Table 4: Key characteristics of Option 2 – Institutionalised European Partnership (Article 187 TFEU)

	What is feasible under this option – functionalities of the option
Enabling appropriate profile of participation (*actors involved*)	• Long term visibility provides incentives for mobilisation of large sets of stakeholders at each phase, from definition to implementation and exploitation. • The structure enables top down approach to involvement of national initiatives and actors. • Industry and MS participation maximise potential involvement of stakeholders.
Supporting implementation of R&I agenda (*activities)*	• A Joint Undertaking (Union body) would be established to coordinate the specification of R&I activity, manage implementation and report on the results. • R&I activities ranging from research action to research and innovation actions (including coordination and support actions) directly conform to industry strategic priorities. • Long term budgetary visibility ensures optimised planning of key R&I priorities including additionally aspects. • MS involvement maximise exploitation potential of demonstration and validation activities, in addressing regulation and standardization, and support to infrastructure deployment and access to finance.

Ensuring alignment with R&I agenda (*directionality*)	• The work programme is fully in line with the R&I priorities of the Union and the priorities identified by the industry, combining activity across the TRLs (including pilots) and with application in different vertical industries. • Alignment with MS initiatives and other initiatives (KDT, Cybersecurity, HPC) is facilitated with strategic top down approaches. • Commission participation in the partnership governance arrangements and approval of the work programme, with MS support, ensure alignment with overarching policy objectives and enable integration with other programmes. • Though full openness is the default, restricted calls may be conceived for specific key aspects of the roadmap touching upon sovereignty.
Securing leveraging effects (*additionality*)	• Legally binding funding requirements would be clearly defined at the outset, with private sector partners expected to provide between 50% and 75% of partnership resources through in-kind and/or financial commitments. • A contribution from the Member States in the form of in-kind contribution (such as access to spectrum frequencies and infrastructures) can, be strategically planned top down.
Key differences compared to the current situation	• Extension of the existing industry association of the 5G PPP with new set of stakeholders to address of a larger scope of topics to perform 6G R&I as well as deployment actions under CEF2 Digital. • Additional activities to be planned and reported instead of measuring a mere leveraging factor in H2020. • Integration of functions for strategic steering for 5G deployment through CEF2 and with MS guidance. • Stronger roles for industry and Member States with strategic coordination of EU R&I and policies towards 6G, including input to regulatory processes and societal issues. • Stronger long-term commitments of public and private partners allowing for longer term R&I roadmap implementation, including downstream exploitation activities. • Inclusion of broader public policy objectives in the roadmap and governance structure with involvement of Member States, which is increasing the wider strategic impact and ambition.

5.3. Options discarded at an early stage

Based on the initial impact assessment and on the analysis of the initiative problem drivers, objectives, and functionalities the option Co-funded European Partnership and Institutionalized Partnership under Article 185 is discarded for following reasons: it does not ensure the required level of industry participation - within the ICT sector, across sectors and across the value chain - to ensure technological sovereignty and rapid market deployment; there is no incentive for private additionality. Whilst the option was supported by 20% of respondents to the public consultation, it turns out that none of the respondent come from the public sector, whilst a very strong commitment is needed for such a public-public partnership. DG RTD consulted the Shadow Programme Committee of Member States mid-2019, and no MS suggested such an option, nor the key industry associations that are behind the SNS industry proposal.

6. HOW DO THE DIFFERENT POLICY OPTIONS COMPARE

Based on the objectives pursued by the initiative and the key functionalities identified to be able to achieve them, each option for implementation is assessed in terms of effectiveness, efficiency and coherence compared to the baseline scenario of traditional calls. The analysis is primarily based on the degree to which the different options would cater for the key needed functionalities. All options are compared to the baseline situation of traditional calls, which is thus consistently scored at 0 to serve as reference point.

6.1. Effectiveness

To be in line with the Horizon Europe impact framework, the fulfilment of the specific objectives of the initiative is translated into 'expected impacts' - how success would look like - differentiating between scientific, economic/technological, and societal (including environmental) impacts. This section considers to which extent the different policy options would allow delivering these expected impacts – confronting what is needed (functionalities) with what each form of implementation can provide in practice. The assessments in this section set the basis for the comprehensive comparative assessment of all retained options against all dimensions in Section 6.4, based on a scoring system[78].

Scientific impacts

Baseline – Horizon Europe traditional calls

Generation of new knowledge: conventional calls with traditional instruments of the Horizon programme are **fully compatible with ambitious research through a competitive process** at European scale.

Diffusion of applied knowledge: this option would lack the **synergies with larger deployments opportunities**, across projects, and large scale **connections with vertical industries.**

Positioning of Europe in the science and technology field of smart networks and services, this option is adequate as **traditional R&I instruments have demonstrated** their full ability to support high quality research and **open** downstream publications.

Option 1: Co-Programmed European Partnership

Generation of new knowledge, a co-programmed partnership based on the traditional instruments of Horizon programme has a full potential **to support ambitious research** at European scale. The partnership also bring **stronger coordination of the research, critical mass** and a better **link between the knowledge generated and the industrial needs**. It also encourage **stronger commitment** from the stakeholders. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

Diffusion of applied knowledge, this option allows **synergies with larger deployment opportunities**, and **connections with vertical industries**, through formal **liaison with other initiatives** bring a **stronger commitment from industrial players**. It potentially reduces academic participation but attracts top academics in strong industry partnership with focused scientific outputs. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

Enhanced positioning of Europe in the science and technology field of smart networks and services: this option is adequate as **traditional R&I instrument have demonstrated** their full ability to support high quality research and to support downstream open publications. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline, taking into account the quality of the academics attracted by industry.

[78] A more in depth and detailed analysis of each policy option is provided in Technopolis Group (2020)

Option 2: Institutionalised European Partnership under Article 187 TFEU

Generation of new knowledge: this option based on the traditional instruments of Horizon Europe has full potential to support **ambitious research** at the scale of Europe. The partnership also bring a **stronger coordination of the research** and a better **link of the generated knowledge with the industrial needs**. It also bring a **stronger commitment** from the involved stakeholders to the research activities. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

Diffusion of applied knowledge, this option allows critical mass, **synergies with larger deployments opportunities**, connections **with vertical industries**, and **liaison with other initiatives** and a **stronger commitment from industrial players**. **Long term planning visibility reinforces commitment** of an institutionalized partnership which may reinforce this impact. ➔The potential of the option to generate the expected impact is high (++) compared to the baseline.

Enhanced positioning of Europe in the science and technology field of smart networks and services, this option is adequate as **traditional R&I instrument have demonstrated** their full ability to promote high quality research and to support downstream open publications. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

NB; when moving from FP7 (normal calls) to H2020 with the 5G PPP, industry participation moved from 40% to 60%; with academic participation moving from 50% to 30%. On the other hand, the academic work has been much more focused by industrial requirements which has led to higher usability and relevance of the knowledge generated. When moving from option 1 (cPPP) to option 2 (institutional partnership), it is not expected that academic participation will further decrease, hence the potential generation of new relevant knowledge is similar for the two options, as well as the position of Europe in the S&T field. Usability and diffusion is higher for option 2 due to long term industry involvement.

Table 5: Overview of the options' potential for reaching the scientific impacts

	Option 0: HE calls	Option 1: Co-prog.	Option 2: Institutionalised Art 187
Generation of new knowledge	0	+	+
Diffusion of applied knowledge	0	+	++
Enhanced positioning of Europe in the S&T field	0	+	+

Notes: Score ++ : Option presenting a high potential compared to baseline; Score + : Option presenting a good potential compared to baseline; Score 0: Potential of the baseline

Economic/technological impacts

Baseline – Horizon Europe traditional calls

Competitiveness of European Smart Networks and Services industry: this option is based on **loosely coordinated R&I projects** and lacks critical mass and directionality. It potentially **lacks the stronger commitments of the industry,** and **the impact of potential synergies with deployment activities,** which is due to the lack of long term

visibility deriving from short term (2 years) cycles that are not aligned with long term industrial roadmaps.

Increased innovation and research in SNS: traditional R&I instrument have demonstrated their **ability to promote research and innovation** and a **dedicated initiative** in the field, even only supported by traditional calls is likely to have an effect in that dimension, though on very specific project related topics as deployment is limited

The adoption of digital technologies in European industries: traditional R&I through standalone projects may enable the **creation of digital services that can be adopted by vertical industries**. However, the research agenda, **lacking the commitments of industry** is likely to be randomly **aligned with the priorities of the industry**. The **participation of vertical industry stakeholders in calls is likely to be** ad-hoc with limited critical mass and both the potential for influencing standards and for **adoption of the innovation will remain limited.**

Regulatory/standards issues, this option would **lack the strong commitment** and critical mass needed **to influence policy and regulations** as additional activities outside of pure R&I. It is very unlikely that it could contribute to harmonization of regulations and processes around spectrum allocation and usage.

Option 1: Co-Programmed European Partnership

Competitiveness of European smart networks and services industry: a **strong commitments of industry is facilitated by a roadmap and SRIA ensuring R&I alignment with the industry needs**. **Synergies are possible with deployment activities** at scale as planned from a comprehensive roadmap which involves from the start **a critical mass of stakeholders**, with **opportunities for new entrants and SMEs** to participate in the value chain and contribute to sovereignty. Industry commitment is though not fully secured considering the lack of long term planning capabilities due to unpredictable call cycles (SNS infrastructure developments is an 8 to 10 years process) and content, and implementation trough an Agency process. Also, the **ability to establish top down strategic coordination and liaison** with related initiatives is limited. ➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

Increased innovation and research in SNS: the possibility to pool research results across projects through a federated initiative supported by **a research roadmap well in line with the industrial needs** stimulates the participation of the industry to the partnership and increase the potential research and innovation impact.➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

Adoption of digital technologies in European industries: this option could have some **impact**. **The commitment of industry** ensure **alignment of R&I with the industry needs**. The **participation of vertical industry stakeholders in calls can be achieved** (as shown in last calls of the 5G-PPP) increasing the potential for **adoption of the innovation.** However, **more synergies and coordination with deployment oriented and other initiatives** may be constrained. Long term planning lack of visibility due to call cycles and content as well as implementation through an Agency may affect impact industrial long term support and impact. ➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

Regulatory/standards issues: this option has good standard potential and **commitment** and **ability to influence policy and regulations** due to the involved critical mass of actors and additionality. It may contribute to the necessary harmonization of regulations and processes around spectrum allocation and usage. ➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

Option 2: Institutionalised European Partnership under Article 187 TFEU

Competitiveness of the European smart networks and services industry: this option maximises industry commitment and impact beyond the establishment of a commonly shared roadmap and SRIA because i) the long term visibility of an Institutional Partnership allows long term planning and industry commitments from the onset across all phases needed for an 8 to 10 years development; ii) industry is directly involved in the project selection, which reinforces directionality; iii) Member States tighter involvement makes top down strategic planning for coordination with MS developments possible; iv) the domain is sensitive for sovereignty and in addition to the default openness of the initiative, the institutional approach allows for calls with restricted participation which is needed to tackle cybersecurity issues in line with the 5G cybersecurity toolbox or to establish strategic links with key initiatives like KDT, HPC, cybersecurity. ➔The potential of the option to generate the expected impact is high (++) compared to the baseline.

Increased innovation and research in SNS: a **research strategic roadmap well in line with the industrial needs**, the maximised long term industrial commitment, the possible mobilisation of MS initiative, increase the potential research and innovation impact compared to traditional calls. The potential is further increased by the deployment plans promoting higher TRL technologies ➔ The potential of the option to generate the expected impact is high (++) compared to the baseline.

Adoption of digital technologies in European industries: is also maximised through the mobilisation of a critical mass of actors across the complete cycle, owing to the long term visibility provided by the institutional approach and the possibility to influence project selection. Stronger MS involvement is key to quickly diffuse technology at MS level through dedicated pilots in the MS's. Embedded deployment initiative (CEF2, DEP, InvestEU) require MS participation and offer synergy with R&I actions. Optimised participation and commitments also favour additional activities like standardisation, which are needed for deployment and adoption. ➔The potential of the option to generate the expected impact is high (++) compared to the baseline.

For regulatory/standards **long term commitment** from industry and public actors offer an **ability to influence policy and regulations**, contributing to harmonization of regulations on spectrum allocation and usage. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

Table 6: Overview of the options' potential for reaching the likely economic /technological impacts

	Option 0: HE calls	Option 1: Co-prog.	Option 2: Institutionalised Art 187
Enhanced competitiveness of European SNS Industry	0	+	++

Increased innovation and research in the field of SNS	0	+	++
Adoption of digital technologies in European industries	0	+	++
Diminution of regulatory burdens on businesses	0	+	+

Notes: Score ++ : Option presenting a high potential compared to baseline; Score + : Option presenting a good potential compared to baseline; Score 0: Potential of the baseline

Societal impacts

Baseline – Horizon Europe traditional calls

Human-centric internet, taking into account fundamental rights such as ethical, privacy and cybersecurity concerns: standalone projects can develop key technologies in these domains but would lack the additionality required to support downstream legislation for significant impact.

Equal and safe access of European citizens to a communication infrastructure that will prove critical for many digital services: the R&I activities may **enable the development of the technology** and can **support early prototyping.** However the **scale and scope** of these deployments is likely to be **limited**.

Development of employment in Europe in the SNS domain: the limited critical mass and long term commitment of the scheme entails limited impact on the framework conditions (standards, regulation, tech de-risking, business model validation) mainly covered through additional actions beyond R&I. Those are essential for large scale take up and employment impact.

Mitigation of environmental impacts requires industry wide adoption of technologies and standardised solutions that this option would not support, as elementary projects would lack the needed critical mass.

Option 1: Co-Programmed European Partnership

Human-centric internet, taking into account fundamental rights such as ethical, privacy and cybersecurity concerns may benefit from a roadmap and SRIA including **cybersecurity as a priority** in the future SNS and **the ethical impacts of related use cases**. The critical mass mobilised by the scheme favours downstream legislations and regulations to an extent as the lack of long term visibility limits additionality.➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

Equal and safe access of European citizens to a critical communication infrastructure for many digital services: this benefits from stronger focus on **large scale pilots' activities**, involvement of **vertical industries** and potential **liaison with deployment activities** to strengthen the access of European citizens and industries to a critical infrastructure. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

Development of employment in Europe: it requires take up of the technologies with framework conditions (standards, regulation, and technology de-risking, business model validation) mainly covered through additional actions beyond R&I. The critical mass and

mobilisation of resources of the scheme put in place through common roadmaps and SRIA. It supports the **position of European actors in the value chain**, and the **development of employment in SNS**. ➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

Mitigation of environmental impacts, requires industry wide adoption of technologies and standardised solutions. The critical mass of actors allows to develop the technologies to alleviate energy footprint in both the SNS and the vertical sectors. Full take up require additional take up conditions beyond R&I (standards, certification) and additional activities potentially limited by the lack of long term visibility on the implementation of the R&I roadmap. ➔ The potential of the option to generate the expected impact is good (+) compared to the baseline.

Option 2: Institutionalised European Partnership under Article 187 TFEU

Human-centric internet, taking into account fundamental rights such as ethical, privacy and cybersecurity concerns may benefit from a roadmap and SRIA including cybersecurity **as a priority** in SNS and including **the ethical impacts of future use cases.** The additional synergies with Member States initiatives and the long term visibility on the roadmap implementation guarantees the maximum critical mass effect which favours contributions towards needed downstream legislation ➔The potential of the option to generate the expected impact is high (++) compared to the baseline.

Equal and safe access of European citizens to a communication infrastructure that will prove critical for many digital services: this benefits from the stronger focus on **large scale pilots' activities**, involvement of **vertical industries**. Furthermore the long term visibility on the roadmap implementation maximises the ability of the institutionalized **partnership to better coordinate with other deployment oriented initiatives,** notably those led at Member States level. ➔ The potential of the option to generate the expected impact is high (++) compared to the baseline.

Development of employment in Europe: it requires take up of the technologies with framework conditions (standards, regulation, and technology de-risking, business model validation) covered through additional actions beyond R&I. The critical mass and mobilisation of resources of the scheme put in place through common roadmaps and SRIA, complemented with synergies with MS initiatives and long term planning of deployment pilot actions provides the framework to multiply R&I activities towards technology take up and favours SNS employment in Europe, through a virtuous circle of "technology push-market pull". ➔The potential of the option to generate the expected impact is high (++) compared to the baseline.

Mitigation of environmental impacts, requires industry wide adoption of technologies and standardised solutions. The critical mass of actors allows to develop the technologies to alleviate energy footprint in both the SNS and the vertical sectors. Full take up require additional take up conditions beyond R&I (standards, certification) and additional activities favoured by long term visibility on the implementation of the R&I roadmap. This may though be alleviated by the entailed traffic growth on SNS➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

Stakeholder opinion

The relevance of this topic has been asked among stakeholders through the Open Public Consultation especially regarding the concerns with using Smart Networks and Services

platforms for ethical, privacy, security, or EMF reasons. For a majority of respondents in several categories including academia, SMEs, large organizations, EU citizen the topic is evaluated as very relevant. For business association and public authority, the topic is seen as relevant but at a lower degree (which can be taken as a hint that this issue is unlikely to resolve only through market dynamics).

Summary

The Table below lists the scores of each of the policy options. The higher potential of option 2 compared to option 1 relates to i) the early MS involvement and strategic steering, that allow for early anticipation of the societal requirements whilst creating early awareness in MS towards the needed deployment policy/regulatory framework to put in place; ii) the integration of deployment actions under option 2, catalysing take up and related societal impact; iii) the industrial commitment to implement a longer term roadmap including deployment, deriving from the long term operational visibility and commitments certainty of the initiative.

Table 7: Overview of the options' potential for reaching the likely societal impacts

	Option 0: HE calls	**Option 1: Co-prog.**	**Option 2: Institutionalised Art 187**
Development of a human-centric internet	0	+	++
Equal and safe access to a critical infrastructure	0	+	++
Development of employments in field related to SNS	0	+	++
Mitigate negative environmental impacts	0	+	+

Notes: Score ++ : Option presenting a high potential compared to baseline; Score + : Option presenting a good potential compared to baseline; Score 0: Potential of the baseline

6.2. Efficiency

To compare the policy options in terms of efficiency, a standard cost model was developed for the set of candidate Institutionalised Partnerships. The model and the underlying assumptions and analyses are set out in the Common Part of this impact assessment, Section 2.3.2 and in the Methodology Annex 4. A dedicated Annex 3 also provides more information on who is affected and how by this specific initiative in line with the Better Regulation framework. The scores related to the costs set out in this context allow for a "value for money" analysis (cost-effectiveness) in the final scorecard analysis in Section 6.4.

In addition, for this specific initiative under the baseline scenario of traditional calls, there would be winding down and discontinuation costs for the existing implementation structure of the current 5G PPP initiative. These can be estimated at 6 to 7 FTE which would be transferred from the existing industry association to the Commission of its implementing body (see next section).

The score of the baseline scenario (traditional Horizon Europe calls) is set to 0 to be used as a reference point.

On this basis, the scores in terms of the costs of the different options range from a value of 0, reflecting the fact that the baseline option does not entail any additional costs

compared to the baseline situation, to a score of (-) when an option introduces limited additional costs when compared to the baseline and a score of (-)(-) when substantial additional costs are expected in comparison with the baseline. In case the scores are lower than for the baseline scenario, (+) and (+)(+) are used.

It is considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when one takes into account the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution. From this perspective, there are only one or two percentage points that split the most cost-efficient policy options – the baseline (traditional calls) and the Co-Programmed policy options – and the least cost-efficient – the Institutionalised Partnership option. Indeed, in terms of cost-efficiency, the Co-Programmed Partnership (Option 1) is 2 percentage points more efficient than the baseline; and an Article 187 Partnership (Option 2) is 2 percentage points less cost-efficient than the baseline. A score of + is therefore assigned for **cost-efficiency** to the Co-Programmed options and a score of (-) for the Institutionalised Partnership policy option[79]. However this scoring is based on the simplified assumption that we start from a greenfield site, i.e. there is no pre-existing established initiative. For the final assessment we need to keep in mind that, whereas, there may be an associated cost with discontinuing the 5G-PPP for the baseline, both the Co-Programmed Partnership (Option 1) and the Article 187 Partnership (Option 2) would benefit from existing structures (see next page on 5G-PPP discontinuation).

Table 8: Matrix on 'overall costs' and 'cost-efficiency'

	Option 0: HE calls	**Option 1: Co-prog.**	**Option 2: Institutionalised**
Overall cost	0	0	(-)(-)
Cost-efficiency	0	+	(-)

Notes: Score 0 = same costs as for the baseline; score (-) = limited additional costs compared with the baseline; score (-)(-) = substantial additional costs compared with the baseline

Costs of 5G PPP (current partnership) discontinuation.

The assumption behind the assessment of discontinuation of the 5G cPPP is based on the idea that the volume of budget remains similar, but handled through normal calls.

Running the action like a programme.

The currently existing 5G IA, the industry association, has a yearly budget of about 300 k€, financed by its members. This budget is used to organise the programme and all its stages: preparation of calls, mobilisation of stakeholders, organisation of projects around topics of common interests, joint events, publication of PPP level papers and dissemination, organisation of joint trials… In addition, each board member (10 in total) is allowed by his/her mother company to work up to 50% of his/her time for the 5G PPP. Altogether, this represent an overall commitment level that may be estimated to about 6 FTE (Full Time Equivalent). This industrial commitment mirrors the long term commitment of the Commission that announced from the onset an available budget of €700 million for the public side of the PPP.

Should the current structure be disbanded and not replaced by another partnership structure, and assuming that the Commission wishes to reach a similar level of

[79] The baseline (traditional calls) is scored 0, as explained above.

stakeholders commitments, coordination and impact, these 6 FTE would be transferred to EC staff.

In addition, implementing the programme as normal calls that are re-discussed every year without a long term visibility will require additional efforts from the Commission to redefine a roadmap every two years, whilst this is fully in the hands of the stakeholders at the moment, with supporting ETP NetWorld that organises the SRIA in partnership with the 5G-IA. This requires organisation of workshops, seminars, discussion between industry and academia. In that case, the efforts of extra constituency building, SRIA definition and follow up may be estimated of about 1 FTE.

For the operational implementation of the calls, the costs will not change if the budgets remain similar. Current level of budget represents in average two to 3 calls per years, fully implemented by Commission staff. If the normal calls without PPP is implemented, similar statutory staff involvement will have to be targeted. So this does not significantly change, also considering that under the current scheme, the retained approach has been to implement a limited amount of projects of large to very large scale which limits the number of projects and the cost of follow up.

In conclusion, it may be roughly assessed that the cost of discontinuing the current PPP implementation model to revert to normal calls renegotiated (from the existence and budget perspectives) could lead to an estimated 6 to 7 extra FTE's to keep the same budget efficiency in terms of coordination and programme impact.

6.3. Coherence

6.3.1. Internal coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with other actions, programmes and initiatives under Horizon Europe, in particular European Partnerships (internal coherence).

Baseline – Horizon Europe traditional calls

This option has a **limited ability to mobilise the broad ecosystem required** by the future development of SNS over a long duration. The participation of **core players from the industry and research communities** is **ensured** (past programmes, e.g FP7 have proven their ability to mobilise such actors) on a work programme basis, but only for the limited time and objectives corresponding to the implementation of specific projects. This also applies to the vertical industries, that may be mobilised ad how through a call but cannot be involved for a long term strategy and planning of the downstream deployment framework.

Similarly, **SMEs** would be involved ad-hoc, on a per call basis.

International cooperation may be envisaged per call, but the lack of long term visibility and predictability does not allow to build a European initiative that would be seen as the counterpart of the visible initiatives launched by China, Japan, and South Korea.

A **strong strategic focus** could be favoured by **a strong cooperation and coordination between the funded projects**, which though would lack the long term visibility of a partnership.

This option is the simplest with **governance issue** limited to cross projects coordination at best.

Option 1: Co-Programmed European Partnership

This option has **a good ability to mobilise the broad ecosystem required** by the future development of SNS on the basis of a shared roadmap and Strategic Research and Innovation Agenda (SRIA). The **participation of core players from the industry and research communities** may be **ensured on a long term basis** from the perspective of strategic planning and definition of the needed actions, as shown by the 5G-PPP. ***The unpredictable implementation cycles discussed every two years may though limit their commitments with engagement of the different communities*** (ICT tech, verticals, SME's) varying as a function of the planned calls, and limited ability to define a long term strategic plan with MS initiatives. The lack of long term budgetary and planning visibility may limit the impact of downstream additional actions like contribution to standards, spectrum regulation, and business models validation. Whilst these can be planned in advance, they also depend on the implementation of seed R&I actions that cannot be planned with a longer than 2 years cycle.

International cooperation benefits from the **strong positioning and visibility** of a partnership that visibly represents EU R&I in the field of Next Generation Mobile and Cloud Systems.

A **strong strategic focus**, is enabled by early planning and **cooperation and coordination between the funded projects,** though subject to short term implementation cycles. It is reinforced by **the participation of a dedicated industry association**. The participation of a **large and active ecosystem of actors** to the industry association enable **a strong strategic vision**, whose implementation is though not secured by a long term approach.

This option benefits from the **existing governance and process of previous partnerships** (such as the 5G-PPP). **Most industrial actors in the field of SNS** are **already accustomed** to the governance and functionalities of a co-programmed partnership. It can be rapidly operational and ensure an **efficient governance**. However, SNS has a higher ambition than the 5G-PPP (sovereignty across a complete value chain) and requires new actors. The existing industry association of the 5G-PPP has consequently to include a wider set of actors.

Stakeholder opinion

It is to be noted that in the interviews, a large number of actors involved in the 5G-PPP initiative supported this option mostly with regards to the governance aspects.

➔Overall, The potential of the option to generate the expected impact is good (+) compared to the baseline.

Option 2: Institutionalised European Partnership under Article 187 TFEU

This option has a good ability to mobilise the broad ecosystem required by the future development of SNS on the basis of a shared roadmap and Strategic Research and Innovation Agenda (SRIA). The participation of core players from the industry and research communities may be ensured on a long term basis from the perspective of strategic planning and definition of the needed actions, as well as at implementation level owing to the long term predictability offered by the scheme. It also maximises matching of implemented actions with the strategic roadmap considering the industry involvement in the selection of the funded actions. It also allows long term strategic planning with the MS initiatives and with other key initiatives like KDT, cybersecurity, and HPC through common calls. Commitment of stakeholders to the **institutionalized partnership structure** may depend on Member States role in the governance. This is seen as a

potential factor to **cause delays** in the gathering of the relevant stakeholders, but not as a factor that would significantly reduce the mid-long term ability of the institutionalized partnership to gather the right stakeholders.

SME participation rely mostly on the traditional Horizon instruments. It is facilitated by SME focused actions of the industrial roadmap and by the presence of SME representatives in the board of the industry association member of the partnership. SME participation in the current 5G PPP is of about 20%. Participation of SME's in the SNS field is very much correlated with the implementation of pilot and trial actions. SME tend to be less present in in depth research phases, but become very active when the technology gets closer to standards and actual implementation. SME participation hence requires a careful planning, with full implementation of a roadmap that ranges from early research to pilot and trials at EU scale. Option 2 is superior in that respect as the long term visibility and commitment towards implementation of a comprehensive roadmap maximises SME participation potential at each stage of the R&D cycle

International cooperation benefit from the **strong positioning and visibility** of a partnership that visibly represents the EU in the SNS domain. At implementation level, the institutional partnership allows to restrict some critical call (sovereignty, security) to specific industrial partners.

A strong strategic focus is enabled by early planning and cooperation between the funded projects. It is reinforced by the participation of a dedicated industry association. The participation of a large and active ecosystem of actors to the industry association enable a strong strategic vision, whose implementation is secured by a long term approach.

This option builds on the 5G-PPP industry association, duly modified to take on board the needed new players, which would eventually represent the industry side of the institutional partnership. It require the set-up of an active and efficient governance. Given the **broad range of stakeholders** to be mobilized and the **need of participation of Member States,** this option will require **dedicated efforts and negotiations** to ensure the **efficiency** of the governance structure. ➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

6.3.2. External coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with their external environment, including EU-level programmes and initiatives beyond the Framework Programme and/or national and international programmes and initiatives, but as well as with overarching framework conditions, such as regulation, standardisation, etc. (external coherence).

Baseline – Horizon Europe traditional calls

Regarding the ability to **establish liaison with related R&I initiatives** and in neighbouring domains (such as KDT, cybersecurity or HPC research), the initiative relies **solely on coordination and support actions** and on the willingness of the participants to exchange and collaborate, resulting in **a low level of liaison,** without any possibility of long term strategic planning

Furthermore, the initiative using traditional calls would have **no real ability to consistently coordinate** with the **initiatives from Member States** supporting R&I in the field of SNS. The **coordination with deployment oriented initiatives** (such as CEF2, DEP, and InvestEU) would be **very limited**.

Regarding the ability to establish liaison with **initiatives and actors** able to provide **funding and dedicated supports** to **start-ups and innovators**, an initiative under the traditional calls would have a **very limited impact**. The relatively **low visibility of the action**, will leave little space to attract funding and investment in the field.

Regarding the ability to **link and potentially influence** future **regulations** (in spectrum allocation and usage, energy consumption of future networks and services, or ethical and security issues), an initiative using traditional calls would have a **very limited impact**. It would lack the **critical mass of industrial participants** necessary to really have an impact on future legislations and regulations.

Option 1: Co-Programmed European Partnership

Establishing liaison with related R&I initiatives and in neighbouring domains (such as KDT, HPC, or cybersecurity), could rely **not only on coordination and support actions** but also on **potential actions at the level of the respective industry associations.** Long term strategic planning is possible but not matched by the short term implementation cycles lacking long term visibility.

The **ability to coordinate** with the **initiatives from Member States** supporting R&I in the field is limited as shown by the 5G-PPP. It remains ad-hoc, opportunity driven, without any possibility to establish a long term top down strategic planning. The **coordination with deployment-oriented initiatives** (such as CEF2, DEP, InvestEU) would also be **very limited**.

Liaison with **initiatives and actors** able to provide **funding and dedicated supports** to **start-ups and innovators**, the impact is limited and **depends on individual actors**. The **visibility of the partnership**, could be exploited to some extent to attract investment. However it would likely **lack the ability to set-up dedicated coordination**.

Regarding the ability to **link and potentially influence** future **regulations** (in spectrum allocation and usage, energy consumption of future networks and services, or ethical and security issues), moderate good **impact** is possible However the **critical mass and strong commitment of industrial participants** necessary to really have a strong impact on future legislations and regulations requires long term visibility of the roadmap implementation. ➔The potential of the option to generate the expected impact is good (+) compared to the baseline.

Option 2: Institutionalised European Partnership under Article 187 TFEU

Establishing liaison with related R&I initiatives and in neighbouring domains (such as KDT, HPC, or cybersecurity), could rely **not only on coordination and support actions** but also on **potential actions at the level of the respective industry associations.** Long term strategic planning is possible making joint calls possible at the level of the institutional partnerships concerned

The **coordination** with the **initiatives from Member States** supporting R&I in the field is possible with a top down strategic planning. T**he coordination with deployment oriented initiatives** (such as CEF2, DEP and InvestEU) would also be **possible,** ensuring **liaison with all development and deployment activities of smart networks and services at the local, national and European level.**

Establishing links with **initiatives and actors** capable of providing **funding and support** to **start-ups and innovators**, **depends on individual actors**. The **large visibility, and political weight of the partnership**, could though be exploited to attract investment (including on an international scale).

Furthermore, the **commitment** (including commitment to funding) of an institutionalized partnership would also **strengthen the leverage effect** as investors and industrials would be **more certain of the long term commitment** of the participants to the initiative.

Regarding the ability to **link and potentially influence** future **regulations** (in spectrum allocation and usage, energy consumption, or ethical and security issues), an initiative using an institutionalized partnership would have a **good impact**, maximised by the large critical mass of actors mobilised, the long term commitment, and the better matching of the roadmap with the implemented R&I actions. ➔The potential of the option to generate the expected impact is high (++) compared to the baseline.

Stakeholder opinion

According to the Open Public Consultation, business associations, SMEs and large organizations find very relevant the regulation in the field of radio spectrum allocation.

For several interviewees from different categories, a strong coordination in Europe is required for spectrum harmonization involving the implication of Member States very early in the program. Indeed the spectrum fragmentation in cost and allocation is seen as a key issue (very irregular depending on the countries).

Summary

Table 10, below, lists the scores of each of the policy options, based on the assessments above, and taking into account the support expressed by the different stakeholders.

Table 9: Overview of the options' potential for ensuring and maximizing coherence

	Option 0: Horizon Europe calls	**Option 1: Co-programmed**	**Option 2: Institutionalised Art 187**
Internal coherence	0	+	+
External coherence	0	+	++

Notes: Score ++ : Option presenting a high potential compared to baseline; Score + : Option presenting a good potential compared to baseline; Score 0: Potential of the baseline

6.4. Tabular comparison of options and identification of preferred option

Building upon the outcomes of the previous sections, this section presents a comparison of the options' 'performance' against the three dimensions of effectiveness, efficiency and coherence. In Section 6.4.1, we first compare the policy options against each other for each criterion in the effectiveness and coherence dimensions, resulting in a scorecard with scores from 1 to 3 where 3 stands for a substantially higher performance. Combined with the results from the comparative assessment for efficiency in Section 6.3, the final scorecard will allow for the identification of the preferred option in Section 6.4.2, taking all dimensions and criteria into account.

Effectiveness

Regarding the **scientific impacts**, the impact of the three considered options would be relatively close, due to the overall good capacity of traditional R&I instruments to ensure the generation of new knowledge and to enhance the positioning of Europe in the S&T field. However, the partnerships options (institutionalized and to some extent, the co-programmed partnership as well) would be able to achieve more thanks to better capacity to support the diffusion of knowledge through a better critical mass effect and connection with vertical industries. The partnership options (both institutionalized and co-programmed) would result in a higher impact in term of knowledge creation through a stronger commitment of industrial players to the R&I activities.

Technological and economic impacts: Option 0 ranks significantly lower than the other two options, with limited ability of R&I activities alone to have a strong economic impact beyond a mere increase of R&I in the field. Both partnership options (institutionalized and co-programmed) would be able to achieve more by harnessing a stronger commitment at scale from the industrial actors, including vertical industries. The ability to have a R&I agenda well aligned with industrial needs but also to liaise and support deployment oriented activities further support the partnership options (institutionalized and co-programmed). The institutionalized partnership would provide further impact by ensuring an even stronger longer term commitment of the stakeholders, implementation visibility and by its potential ability to influence R&I projects selection, policy and regulation that could diminish regulatory burdens on businesses. Sovereignty targets are also best addressed through possibilities of restricted actions to strategic EU partners.

Societal impacts: Option 0 (Horizon Europe calls) ranks also significantly lower than the other two options, because of the limited ability of R&I activities to have a strong societal impact without coordination with other actions. The Co-programmed option would provide good societal impact in the 3 considered dimensions. This is directly linked with the fact that the partnership would strengthen the deployment of the infrastructure. Option 2 (institutionalized partnership) would bring additional benefits by enabling an even stronger critical mass, long term visibility and implementation with potentially more coordinated deployment of the infrastructure and by a good ability to influence future regulations (which could be used to foster the development of a human-centric internet).

Coherence

The baseline option can be considered as significantly outranked by the two other options as the initiative would have difficulties to attract the broad range of stakeholders required. Option 1 and Option 2 (co-programmed and institutionalized partnerships) would be comparable in term of internal coherence with a better ability to attract the required stakeholders in the long term for option 2 but a more complex governance scheme.

Regarding the external coherence, the baseline option would have little impact, unable to reach out efficiently to other initiatives. Option 1 would provide some impact by a larger visibility and ability to reach out to other initiatives, but it would lack the benefits brought by the institutionalized partnership (option 2), which benefit from a very high , long term strategic planning and implementation capabilities across institutional partnership, ability to establish strategic synergies with other programmes Including at MS level.

Table 10: Overall scorecard of the policy options for all criteria

	Criteria	Option 0: HE calls	Option 1: Co-programmed	Option 2: Institutionalised
Effectiveness	**Scientific impacts**			
	Generation of new knowledge	0	+	+
	Diffusion of applied knowledge	0	+	++
	Enhanced positioning of Europe in the S&T	0	+	+

	Criteria	Option 0: HE calls	Option 1: Co-programmed	Option 2: Institutionalised
	field			
	Economic/technological impacts			
	Enhanced competitiveness of EU SNS Industry	0	+	++
	Increased innovation and research in the field of SNS	0	+	++
	Adoption of digital technologies in European industries	0	+	++
	Diminution of regulatory burdens on businesses	0	+	+
	Societal impacts			
	Development of a human-centric internet	0	+	++
	Equal and safe access to a critical infrastructure	0	+	++
	Development of employments in field related to SNS	0	+	++
	Mitigate negative environmental impacts	0	+	+
Coherence	**Internal coherence**	0	+	+
	External coherence	0	+	++
Efficiency	**Overall cost**	0	0	(-)(-)
	Cost-efficiency	0	+	(-)

Notes: Score ++ : Option presenting a *high* potential compared to baseline; Score +: Option presenting a *good* potential compared to baseline; Score 0: Potential of the baseline.

The scorecard of policy options shows that the baseline option performs less well against almost all dimensions and criteria compared to the Option 1 and Option 2. Even though it reached a higher score against the cost and cost efficiency criterion, this does not weigh up against its lower performance against the dimensions of effectiveness and coherence.

Stakeholder opinion

Stakeholder opinions from the open consultation and interviews favoured the known model of co-programmed partnership due to the successful implementation of the 5G-PPP, which was found to present significant added value compared to traditional calls.

However, the stakeholders are fully open and understand the advantages of the institutionalised model. For the 37% preferring a co-programmed model, it is to be noted that at least 6 organisations in the 5G PPP, representing a large majority of the Industry and the 5G Industry Association, chose “co-programmed” as preferred option, but with the comment that “this Partnership could be implemented equally as an Institutionalised Partnership”. This relativizes the raw statistics and shows support for an institutionalised approach, provided that its complexity and model for financial contributions are reasonable, which is the condition for stakeholders to sign up.

In particular, the main industry players and key associations that are needed to realise the ambitious scope of activities have shown openness to the institutionalised model. They have

understood its strategic character and their responsibility vis-à-vis EU policy objectives such as technological sovereignty and green deal.

The main reason provided by the key stakeholders why they did not express a clear preference in the first instance for the institutionalised options is the fact that concrete implementation conditions including the allocated budget have not been published. However, concrete implementation options for the institutionalised model have been discussed with these key stakeholders as well as Member States, and workable options for the governance structure and co-investment have been identified. We therefore conclude that the flexibility available to set up the institutionalised partnership will minimise the risk of stakeholders not subscribing to the model.

Comparison between the preferred option & the current partnership existing in the area taking into account lessons from past evaluations

What continues	What is different
• The connectivity focus of the 5G PPP (5G) • The 5G PPP stakeholders will continue to be highly relevant • The roadmap based from early R&I to trials and demos approach • The SME objective of the 5G PPP (20%) • The standardisation objective • The target to open new spectrum frontiers • The leveraging factor (7 for 5G PPP industrial players)	• **Much higher level of ambition (scope and policies)** • Full value chain approach, including capacity building in devices (IoT) and cloud • The sovereignty aspect, notably the support of the objectives of the cybersecurity toolbox is integrated to the SNS partnership • Societal aspects are integrated, notably SDG's such as "Infrastructure affordability" of SDG 9, Sustainable cities (SDG 11) or Climate actions (SDG 13). The latter is directly coupled with the Green Deal Policy, with two objectives: i) SNS platforms in support of energy efficiency ii) drastic reduction of SNS platforms energy requirements • Stakeholders are extended with IoT and cloud systems players • Member States are associated, as they are key to develop R&I and test/pilot infrastructures that can be leveraged at EU level, hence improving additionality • The JU model imposes a new governance, with a Governing board as specified in an implementing regulation • The restriction of the initiative to EU players, in view of sovereignty objectives is planned, the international cooperation is more selective, based on a case by case approach, whilst the 5G PPP had generated several Joint declaration of cooperation with 4 different nations • The deployment aspect is also addressed from a systematic perspective, with inclusion of 5G deployment actions (precursor to SNS/6G) along main transport paths, using the CEF2 tools as well as other 5G deployment programmes under CEF2, DEP, and InvestEU. The objective is to go beyond pilots, towards operational deployments • Additional activities are factored in from the onset to define the extra investments, e.g: standardisation, specific industry pilots building up on partnership pilots, international regulations (spectrum)

The scorecard also shows that benefits are clearly maximised under the institutionalized partnership option (option 2). In particular, compared with the other options, Option 2 would:

1. Provide greater effectiveness, especially in term of economic, technological and societal impacts by its ability to secure stronger long term commitment of the

involved stakeholders, to optimise the implementation of the R&I roadmap and to foster regulation and standardization activities.
2. Improve the external coherence by a good ability to reach out to other initiative and a strong ability to establish synergies with programmes led at the European, National or Regional level.
3. Offer a relatively good overall efficiency despite additional costs.

Summary Assessment

The Institutional Partnership is primarily motivated by the increasingly strategic role of the technology area for European society and economy.. Whilst the previous initiative was merely motivated by industry competitiveness in the 5G era, the SNS initiative needs to address a multiplicity of policies encompassing sovereignty across a value chain beyond mere connectivity, sustainable recovery post COVID-19 and Green Deal. This requires a more complex roadmap with several policy dimensions and a larger set of committed stakeholders where Member States have to be fully involved, with an adequate governance model with all parties on equal footing, especially for those aspects dealing with emergence of EU industrial capabilities in domains where the EU is less present. It will enable downstream relay actions at MS level similar to the IPCEI model in other strategic domains like components or batteries. Therefore, long term commitment by a broad set of stakeholders and strategic governance formally involving MS become key differentiators.

From a policy perspective, the two options (1 and 2) hence differ in their capabilities to deliver on the strategic objectives of the SNS initiative. The possibility for a more systemic approach and the ability to ensure synergies with other funds, particularly for deployment, the following are other key elements of differentiation:

Commitment of stakeholders

- A broader set of stakeholders to mobilise which requires the alignment to a common long term roadmap, considering that it takes about 10 years to develop a new generation of connectivity platform (from early R&D to deployment). **This requires long-term investment certainty** that only the institutional partnership may provide (Option 2). Option 1, with workplans discussed every 2 years without any visibility of the investments ex- ante will not provide the long term certainty and predictability needed to secure the right level of industry ownership and commitment;
- Long term visibility is further enhanced by the legislative approach towards a firm budgetary commitment on the public and the private side: a clearly identified contribution from the Union mapped with legally identified commitments from the private side, be it in kind or financial.

- In terms of external coherence, the long-term visibility of option 2 and the increased level of industrial commitment allows to plan consistently over time for key outputs such as contribution to standards, position on spectrum or in other regulatory fora. This is more difficult with option 1, where there is no Council Regulation in place setting the frame and the commitments might be put in question for every new work-programme, e.g. every 2 years with varying priorities and lack of commitment towards a mid to long-term roadmap

Close involvement of Member States

- The formal and close participation of the Member States as part of the governance structure ensures the possibility to define a top down strategic programming, and to enable synergies with national investments, through a coordinated approach. We foresee a guiding role for Member States in strategic matters that goes beyond the upstream advisory role as in the case of comitology, which is lacking in flexibility when it comes to new and rapidly emerging challenges. This guiding role is not formally possible with option 1, but will be very much needed, considering that for 5G PPP, we have noted multiple MS initiatives in this field leading to fragmentation and inefficiencies (UK, FI, D, F, E, S, SL, I, DK, LU..). In particular, European level leveraging of Member State infrastructures would significantly increase additionality.
- In the case of option 2, adherence to an industrial roadmap will be mirrored by an adherence to this roadmap by Member States initiatives. It will build on MS initiatives, as during MS consultations through the Shadow Programme Committee (SPC), 80% of MS have declared having SNS related R&I policies in place. This combined roadmap support (EU, industry, MS) will provide a powerful framework to federate long term commitment from industrial stakeholders whilst enabling MS budget investment efficiently complementing EU investments (additionality). Option one would be limited to provide this long term commitment.

- The early involvement of MS creates a level of awareness that is key to prepare for deployment in Europe. Deployment of a new generation of connectivity platform requires national involvement in particular in areas of public interest such as 5G along transport paths and 5G cities and communities. Option 2 is the option that maximises strategic involvement of MS and preparedness towards deployment of 5G and beyond, in view of maximising Europe wide impact.

- Similarly, the long-term visibility of Option 2 in terms of roadmap implementation allows the partnership to be defined from the outset with links to other relevant key initiatives, notably KDT (components), cybersecurity, EuroHPC. Here again, MS involvement from the outset with Option 2 would also allow a strategic steer of the cross cutting actions between these highly complementary initiatives and stimulate cross cutting investments at MS level in efficient synergy with the cooperating partnerships.

Possibility to derogate from standard rules for participation in R&I activities

As the political debate that developed over the security of 5G network equipment demonstrates, the issue of the cybersecurity of communications networks and services will be increasingly critical as they become central to the working of all facets of the economy and society.
So while this initiative has the vocation to maintain and extend Europe's leadership in the global market for smart networks and services, and to maintain cooperation and collaboration in the development of global standards, it may prove necessary to set rules for participation that are aligned with specific cyber-security principles or other strategic considerations. This would only be considered if necessary to ensure the security of systems being developed but also the technological capability of European industry to produce critical communications equipment and software. An institutionalised partnership with its strategic governance structure is better suited for such requirements. In particular, such strategic decisions would necessarily require the input and advice of Member States in the context of their responsibilities for security, and this would be facilitated by the institutionalised model.

7. THE PREFERRED OPTION

7.1. Description of the preferred option

Based on the above assessment, the preferred option is the institutionalised partnership under Article 187 TFEU. In the Table below, we indicate the alignment of the preferred option with the selection criteria for European Partnerships defined in Annex III of the Horizon Europe Regulation. As the design process of the candidate Institutionalised Partnerships is not yet concluded and several topics are still under discussion (such as governance model, legal act, private industry contribution and Member Sates contribution) at the time of writing, the criteria of additionality/directionality and long-term commitment are covered in terms of *anticipations.*

Table 11: Alignment with the selection criteria for European Partnerships

Criterion	Alignment of the preferred option
Higher level of effectiveness	The analysis presented in section 6 shows that an institutional partnership would have a higher effectiveness than the other options in achieving the objectives defined in section 4 through: • A stronger commitment from the whole ecosystem to a long term, sustained 6G strategy whilst leveraging national investments. This is needed considering the potential critical nature of the future network infrastructure and digital services for numerous European industries. • The necessary involvement of a broad ecosystem of stakeholders, ranging from incumbent in the field of smart networks and services to vertical industries that will be future adopters of the solutions developed and potential new entrants. This is needed considering the sovereignty objective and the need to cover a comprehensive value chain.
Coherence and synergies	• An institutional partnership allows to establish strategic liaison with other related initiatives and partnerships. The development of smart networks and services has to take into account and use numerous digital technologies (making liaison with the Key Digital Technologies initiative is important) and will serve as the backbone of the digital transformation of numerous industries (Automotive, Health, Transport, Energy, Manufacturing) requiring the set-up of important synergies with other programmes. • An institutional partnership allows a stronger top-down strategic liaison and coordination with R&I initiatives supported by national research programmes. • An institutional partnership allows a stronger liaison with deployment oriented initiative (at the European, National and Local level) which as presented above in section 3 and 4 cannot be decoupled entirely from R&I perspectives. • An institutional partnership allows a stronger ability to foster necessary regulations and legislative adaptation in the field of spectrum allocation and usage, energy consumption or ethics, privacy and cybersecurity.
Transparency and openness	• An institutional partnership allows, for more interdisciplinary research, highly needed for the future of networks and digital services, with coherent roadmap based plans • This option also foster the creation of new value chain opportunities (new connectivity providers, new connected device providers), creating higher opportunities for new entrants and SMEs.
Additionality and directionality	• The committed participation of a broad ecosystem of stakeholders developing and using the future SNS infrastructure is required to ensure a strong strategic focus. The institutional partnership optimises directionality with strategic planning with MS actions • Additionality is optimised through the long term commitment and visibility offered by the Institutional partnership, which allows strategic planning of long term beyond R&I actions. The 5G-PPP programme has shown a high leverage of industrial investment in R&I activities, (a factor of 10 for larger industries under phase 1 and 2, > 7 in average), which is taken as a basis.

Criterion	Alignment of the preferred option
Long-term commitment	• For an institutional Partnerships, established in accordance with article 187 TFEU, the financial and/or in-kind, contributions from partners other than the Union, will at least be equal to 50% and may reach up to 75% of the aggregated European Partnership budgetary commitments. Long term industry commitment is maximised through long term visibility enabling secure implementation of the strategic roadmap.

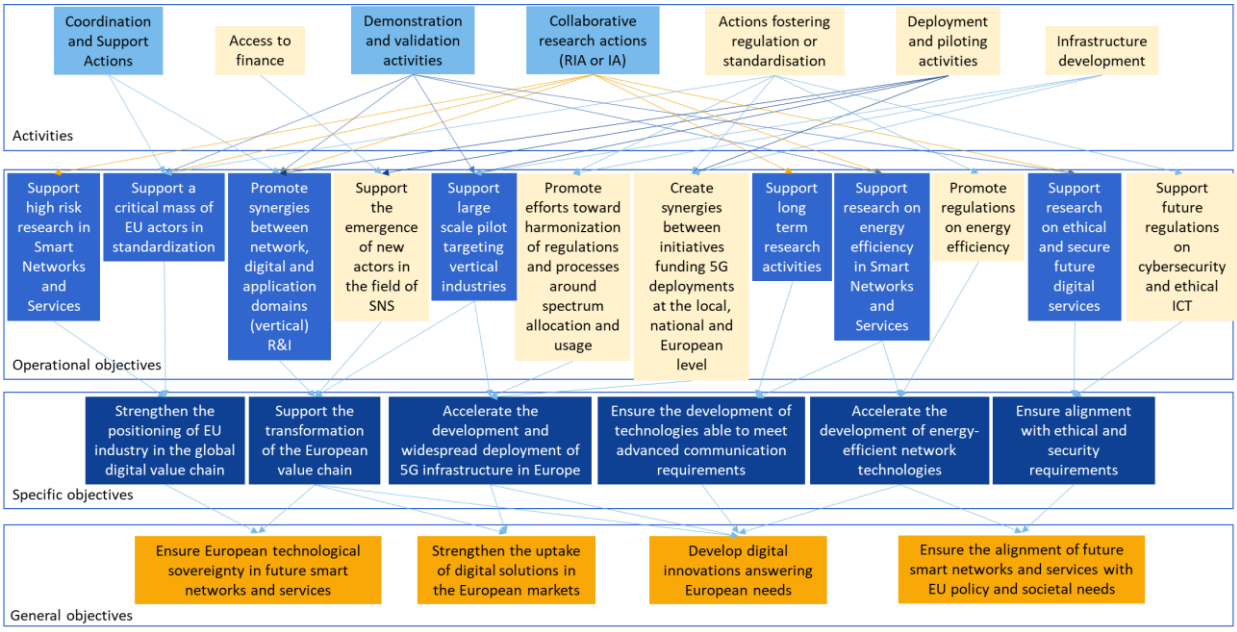
7.2. Objectives and corresponding monitoring indicators

7.2.1. Operational objectives

Several operational objectives have been identified which would enable the partnership to achieve its specific objectives, as shown in Figure 8 below.

The figure below, lists a range of actions and activities, going also beyond the R&I activities that can be implemented under Horizon Europe (highlighted in yellow). This reflects the definition of European Partnerships in the Horizon Europe regulation as initiatives where the Union and its partners "commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake."

Figure 8: Operational objectives of the initiative



We introduce here in more details the operational objectives we foresee for the initiative.

Support high risk research in smart networks and services towards 6G: dedicated support for research compensate for the high level of risk and high research intensity of the domain. An average leveraging factor of public investment of at least 7 is targeted.

A strong presence of European actors in standardization is necessary to ensure a critical mass of contributions. This is achieved as a spin-off of collaborative R&I, and demonstration activities, and actions fostering regulation and standardization. It is facilitated by the roadmap based approach of an institutional partnership. A target of 1000 contributions derived from the initiative is targeted, at least 40% of essential patents of future SNS infrastructures with the EU industry.

Promote synergies between network, digital and application domains (vertical) R&I: The value chain approach requires collaborative research across research fields (networking, devices, IT, verticals). This addresses the problem drivers (*An infrastructure relying heavily on advanced digital solutions)* and (*An infrastructure critical for the adoption of digital solutions in many industries)*. It leverages strategic links with other initiatives (notably KDT). Target: 40% of the future markets for connectivity infrastructures mastered by EU actors; at least one European supplier at each level of the value chain: devices; networks; edge computing.

Large scale pilots targeting the future application domains of smart networks and services are supported. These should target vertical industries such as: automotive, transportation, manufacturing, healthcare, and energy. It addresses the problem drivers described in section (*an infrastructure critical for the adoption of digital solutions in many industries*), (*an infrastructure that requires structural changes in various value chains*), and (*a lack of investment in the deployment of the new infrastructure*). Target: at least one large scale pilot per vertical with pan European footprint and leveraging trial capabilities developed at MS level. Regarding the automotive domain, at least 6000 km of cross border corridors covered by 5G is targeted.

Support long term research activities: dedicated activities targeting the longer term evolutions of communication networks and digital services, namely 6G capabilities. This would answer to the problem driver described in section (*Insufficient capacity of 5G to respond to advanced communication requirements).* It could be achieved through collaborative research actions.

Support research on energy efficiency in smart networks and services: research in the field of energy efficiency of the future networks, devices and applications is aimed at. This addresses the problem driver described in section. (*Lack of energy efficient technological solutions for future network infrastructures).* It targets an energy reduction factor of at least 10 for SNS platforms and at least 30% energy reduction in key use cases like factories, automotive, energy. At least 30% of the budget is related to Green Deal objectives.

Support research on ethical and secure future digital services: ensure that ethics, privacy and cybersecurity are integrated in the design of future smart networks and digital services. This addresses the problem driver described in section (*Increasing challenges of digital services toward ethics, privacy and cybersecurity).* **It supports future standards needed in the context of the 5G security toolbox and support the emergence of alternative value chains**. Target: Comprehensive architecture, technologies and standards for an end to end security; full characterisation of risks of data misuse in SNS.In the context of additionality, activities beyond R&I would also:

Promote emergence of new actors in the field: it covers the transformation of the value chain by promoting the emergence of new EU actors in the supply chain and the evolutions of the business models of existing actors (in both the connectivity value chain and vertical industries). This addresses the problem drivers defined in section (*an infrastructure that requires structural changes in various value chains*). It leverages two trends: the emergence of verticals or neutral hots as suppliers of SNS infrastructures; the softwarisation of SNS infrastructure with lower market entry barriers and potential of new actors to emerge. Targets: availability of European suppliers beyond today actors for the SNS value chain including providers of open solutions like Open RAN or Open Air

Interface cost level of European Radio Access and Core network offers comparable to those of Asian competitors.

Promote efforts toward harmonization of regulations and processes around spectrum allocation and usage: harmonization at the European level of the regulations and processes for spectrum allocation and its usage is sought. This would aim at answering the problem driver defined in section (*A lack of coordination of spectrum policies*). This requires strong contributions towards international bodies. Target: identification of 6G spectrum above 90 GHz, related allocation in ITU, definition of the assignment methods and technical characteristic to be used in licensing process (for licensed bands).

Promote regulations on energy efficiency: fostering regulations that promote energy efficiency and certifications. This would answer the problem driver defined in section (*Lack of energy efficient technological solutions for future network infrastructures)* Target: complement R&I on energy efficiency with specification of an SNS label of energy efficiency and corresponding standards.

Support future regulations on cybersecurity and ethical ICT: To promote a human-centric internet, and mitigate the impact of future digital services on cybersecurity, privacy and other ethical issues, the initiative should aim to foster regulations enforcing an ethical approach. This would answer to the problem driver described in section (*Increasing challenges of digital services toward ethics, privacy and cybersecurity)* Target: label and standards related to ethics and privacy. Compliance with the certification tool put in place in the context of the cybersecurity toolbox.

7.2.2. Monitoring indicators

In addition to Key Impact Pathways indicators set centrally in the Regulation of Horizon Europe, additional monitoring indicators have been identified to enable the tracking of progress of the partnership towards meeting its objectives. These are shown in the Table below. A monitoring system to assess the effectiveness of the initiative will particularly be looking at cost benefits and where relevant, the indicators listed below would be used as KPI. Additionally cost, investments levels by the private side should be measured.

One should further divide the KPIs in qualitative and quantitative KPIS or system/performance measurements. The following table present a set of indicators that may be used for SNS.

Table 12: Specific Monitoring indicators for SNS.

Impact Dimension		Short-term (typically as of year 1+)	Medium-term (typically as of year 3+)	Long-term (typically as of year 5+)
Scientific impact	Development of new innovations for smart connectivity value chains.	Number of publications, patents and standard contributions achieved by the partnership on beyond 5G capabilities	Number of publications, patents and standard contributions achieved by the on 6G capabilities	Number of publications, patents and standard contributions achieved by the partnership on 6G capabilities
	Lower energy consumption devices and infrastructures	Number of publications, patents and standard contributions achieved by the partnership on energy efficiency in connected devices and networked infrastructures	Number of publications, patents and standard contributions achieved by the partnership on energy efficiency in connected devices and networked infrastructures	Energy consumption of integrated smart connectivity platforms, including service and IoT component.
	Use of digital technologies in future smart connectivity	Number and share of projects including cross cutting research mixing network technologies with advanced digital solutions (A.I., Edge, etc.)	Number and share of projects including cross cutting research mixing network technologies with advanced digital solutions (A.I., Edge, etc.)	Uptake of advanced digital solutions and scientific results in future smart connectivity solutions.
	Vertical oriented applications in SNS	Participation of vertical industry representatives to R&I projects	Participation of vertical industry representatives to R&I projects	Uptake of smart networks and services in vertical industries
	cybersecurity by design	Number of publications, patents and standard contributions achieved by the partnership on Cybersecurity in smart networks and services	Number of publications, patents and standard contributions achieved by the partnership on Cybersecurity in smart networks and services	Number of publications, patents and standard contributions achieved by the partnership on Cybersecurity in smart networks and services

Impact Dimension		Short-term (typically as of year 1+)	Medium-term (typically as of year 3+)	Long-term (typically as of year 5+)
	Ethics by design	Number of publications, patents and standard contributions achieved by the partnership on Ethics and Privacy in smart networks and services	Number of publications, patents and standard contributions achieved by the partnership on Ethics and Privacy in smart networks and services	Number of publications, patents and standard contributions achieved by the partnership on Ethics and Privacy in smart networks and services
Tech. / economic impact	Investment of EU industry in SNS	Leverage effect, investment of EU SNS industry in R&I	Leverage effect, investment of EU SNS industry in R&I	Leverage effect, investment of EU SNS industry in R&I
	Contribution to standardization and patents	Share of EU actors contribution to standards and patents on smart networks and services	Share of EU actors contribution to standards and patents on smart networks and services	Share of EU actors contribution to standards and patents on smart networks and services
	Market share of EU actors	Market Share of EU actors in SNS	Market Share of EU actors in SNS	Market Share of EU actors in SNS
	Vertical oriented applications	Number of large scale pilots targeting vertical industries	Take-up of smart connectivity in vertical industries	Take-up of smart connectivity in vertical industries
	New smart connectivity providers across the value chain.		New businesses in EU as smart connectivity providers across the value chain.	New businesses in EU as smart connectivity providers across the value chain.
	Private investment in infrastructure deployment	CAPEX in network and service infrastructure deployment in Europe	CAPEX in network and service infrastructure deployment in Europe	CAPEX in network and service infrastructure deployment in Europe
	Deployment of 5G	Number of 5G subscription in Europe, Share of global 5G subscription. number of km served across main transport paths	Number of 5G subscription in Europe, Share of global 5G subscription. number of km served across main transport paths	Number of 5G subscription in Europe, Share of global 5G subscription. and number of km served across main transport paths
	Harmonization of regulations on spectrum	Share of 5G spectrum assigned new spectrum identified for 6G	Share of 5G spectrum assigned, new spectrum identified for 6G	Share of 5G spectrum assigned new spectrum identified for 6G

Impact Dimension		Short-term (typically as of year 1+)	Medium-term (typically as of year 3+)	Long-term (typically as of year 5+)
	Burden of spectrum allocation	Delay between identification of new spectrum and assignment of spectrum in Europe	Delay between identification of new spectrum and assignment of spectrum in Europe	Delay between identification of new spectrum and assignment of spectrum in Europe
Societal impact	Employment	New curricula in the field of smart networks and services	New curricula in the field of smart networks and services	New curricula in the field of smart networks and services
	Skills	Take up of digital skills and tools in EU Industries	Take up of digital skills and tools in EU Industries	Take up of digital skills and tools in EU Industries
	Ethics and privacy regulations	Set-up of regulations and legislations regarding ethics, security and privacy in the field of SNS	Set-up of regulations and legislations regarding ethics, security and privacy in the field of SNS	Set-up of regulations and legislations regarding ethics, security and privacy in the field of SNS
	Equal Access	Share of the EU population with access to 5G;	Share of the EU population with access to 5G	Share of the EU population with access to 5G
	Environmental Impact	Energy consumption of telecommunication networks, integrated smart connectivity platforms, including service and IoT component	Energy consumption of telecommunication networks, integrated smart connectivity platforms, including service and IoT component	Energy consumption of telecommunication networks, integrated smart connectivity platforms, including service and IoT component
	Environmental Impact	Lifecycle impact of connected devices	Lifecycle impact of connected devices	Lifecycle impact of connected devices

7.2.3. Evaluation framework

The evaluation of the Partnership will be done in full accordance with the provisions laid out in Horizon Europe Regulation Article 47 and Annex III, with external interim and ex-post evaluations feeding into the overall Horizon Europe evaluations. As set in the criteria for European Partnerships, the evaluations will include an assessment of the most effective policy intervention mode for any future action; and the positioning of any possible renewal of the Partnership in the overall European Partnerships landscape and its policy priorities. In the absence of renewal, appropriate measures will be developed to ensure phasing-out of Framework Programme funding according to conditions and timeline agreed with the legally committed partners ex-ante.