

EN

Horizon 2020

Work Programme 2018-2020

5.i. Information and Communication Technologies

IMPORTANT NOTICE ON THIS WORK PROGRAMME

This Work Programme covers 2018, 2019 and 2020. The parts of the Work Programme that relate to 2020 (topics, dates, budget) have, with this revised version, been updated. The changes relating to this revised part are explained on the Funding & Tenders Portal.

(European Commission Decision C(2020)1862 of 25 March 2020)

Table of contents

Introduction 6

Call - Information and Communication Technologies 10

Artificial Intelligence and Technologies for Digitising European Industry and Economy 10

ICT-46-2020: Robotics in Application Areas and Coordination & Support 11
ICT-47-2020: Research and Innovation boosting promising robotics applications 14
ICT-48-2020: Towards a vibrant European network of AI excellence centres 16
ICT-49-2020: Artificial Intelligence on demand platform 20
ICT-38-2020: Artificial intelligence for manufacturing 22
ICT-36-2020: Disruptive photonics technologies 24
ICT-37-2020: Advancing photonics technologies and application driven photonics components and the innovation ecosystem 25
ICT-50-2020: Software Technologies 27
ICT-01-2019: Computing technologies and engineering methods for cyber-physical systems of systems 30
ICT-02-2018: Flexible and Wearable Electronics 31
ICT-03-2018-2019: Photonics Manufacturing Pilot Lines for Photonic Components and Devices 33
ICT-04-2018: Photonics based manufacturing, access to photonics, datacom photonics and connected lighting 34
ICT-05-2019: Application driven Photonics components 36
ICT-06-2019: Unconventional Nanoelectronics 39
ICT-07-2018: Electronic Smart Systems (ESS) 41
ICT-08-2019: Security and resilience for collaborative manufacturing environments 43
ICT-09-2019-2020: Robotics in Application Areas 44
ICT-10-2019-2020: Robotics Core Technology 47

European Data Infrastructure: HPC, Big Data and Cloud technologies 48

ICT-51-2020: Big Data technologies and extreme-scale analytics 48
ICT-40-2020: Cloud Computing: towards a smart cloud computing continuum 50
ICT-11-2018-2019: HPC and Big Data enabled Large-scale Test-beds and Applications 52
ICT-12-2018-2020: Big Data technologies and extreme-scale analytics 54
ICT-13-2018-2019: Supporting the emergence of data markets and the data economy 55
ICT-15-2019-2020: Cloud Computing 57
ICT-16-2018: Software Technologies 59

5G 61

ICT-52-2020: 5G PPP – Smart Connectivity beyond 5G 62
ICT-41-2020: 5G PPP – 5G innovations for verticals with third party services 64

ICT-42-2020: 5G PPP – 5G core technologies innovation 65
ICT-53-2020: 5G PPP – 5G for Connected and Automated Mobility (CAM) 67
ICT-17-2018: 5G End to End Facility 69
ICT-18-2018: 5G for cooperative, connected and automated mobility (CCAM) 70
ICT-19-2019: Advanced 5G validation trials across multiple vertical industries 71
ICT-20-2019-2020: 5G Long Term Evolution 74
ICT-21-2018: EU-US Collaboration for advanced wireless platforms 75
ICT-22-2018: EU-China 5G Collaboration 76
ICT-23-2019: EU-Taiwan 5G collaboration 78

Next Generation Internet (NGI) 79
ICT-54-2020: Blockchain for the Next Generation Internet 80
ICT-55-2020: Interactive Technologies 83
ICT-56-2020: Next Generation Internet of Things 84
ICT-57-2020: An empowering, inclusive Next Generation Internet 86
ICT-44-2020: Next Generation Media 87
ICT-24-2018-2019: Next Generation Internet - An Open Internet Initiative 90
ICT-25-2018-2020: Interactive Technologies 94
ICT-26-2018-2020: Artificial Intelligence 96
ICT-27-2018-2020: Internet of Things 98
ICT-28-2018: Future Hyper-connected Sociality 99
ICT-29-2018: A multilingual Next Generation Internet 101
ICT-30-2019-2020: An empowering, inclusive Next Generation Internet 103
ICT-31-2018-2019: EU-US collaboration on NGI 105

Cross-cutting activities 106
ICT-45-2020: Reinforcing European presence in international ICT standardisation: Standardisation Observatory and Support Facility 106
ICT-32-2018: STARTS – The Arts stimulating innovation 108
ICT-33-2019: Startup Europe for Growth and Innovation Radar 110
ICT-34-2018-2019: Pre-Commercial Procurement open 112
ICT-35-2018: Fintech: Support to experimentation frameworks and regulatory compliance 113

International Cooperation activities 114
ICT-58-2020: International partnership building between European and African innovation hubs 114

Conditions for the Call - Information and Communication Technologies 117

Call - Digitising and transforming European industry and services: digital innovation hubs and platforms 124

Introduction 124

Support to Hubs 124
DT-ICT-03-2020: I4MS (phase 4) - uptake of digital game changers 126
DT-ICT-04-2020: Photonics Innovation Hubs 128
DT-ICT-05-2020: Big Data Innovation Hubs 129
DT-ICT-01-2019: Smart Anything Everywhere 131
DT-ICT-02-2018: Robotics - Digital Innovation Hubs (DIH) 133
DT-ICT-06-2018: Coordination and Support Activities for Digital Innovation Hub network 135

Platforms and Pilots 135
DT-ICT-09-2020: Boost rural economies through cross-sector digital service platforms. 138
DT-ICT-12-2020: AI for the smart hospital of the future 140
DT-ICT-07-2018-2019: Digital Manufacturing Platforms for Connected Smart Factories 142
DT-ICT-08-2019: Agricultural digital integration platforms 144
DT-ICT-10-2018-19: Interoperable and smart homes and grids 146
DT-ICT-11-2019: Big data solutions for energy 148
DT-ICT-13-2019: Digital Platforms/Pilots Horizontal Activities 150

Conditions for the Call - Digitising and transforming European industry and services: digital innovation hubs and platforms 152

Call - Cybersecurity 155

SU-ICT-01-2018: Dynamic countering of cyber-attacks 156
SU-ICT-02-2020: Building blocks for resilience in evolving ICT systems 158
SU-ICT-03-2018: Establishing and operating a pilot for a Cybersecurity Competence Network to develop and implement a common Cybersecurity Research & Innovation Roadmap 160
SU-ICT-04-2019: Quantum Key Distribution testbed 164

Conditions for the Call - Cybersecurity 166

Call - EU-Japan Joint Call 168

EUJ-01-2018: Advanced technologies (Security/Cloud/IoT/BigData) for a hyper-connected society in the context of Smart City 168
EUJ-02-2018: 5G and beyond 169

Conditions for the Call - EU-Japan Joint Call 171

Call - EU-Korea Joint Call 175

EUK-01-2018: Cloud, IoT and AI technologies 175
EUK-02-2018: 5G 176

Conditions for the Call - EU-Korea Joint Call 177

Other actions 181

1. External expertise 181
2. Digital Assembly Events 2018, 2019 and 2020 181
3. ICT conferences, studies and other activities 181
4. EUROSTAT 183
5. Framework Partnership Agreement in European low-power microprocessor technologies (Phase 1) 183
6. Fostering transnational cooperation between National Contact Points (NCP) in the area of ICT: follow-up project 185
7. "Digital Opportunity" pilot scheme 188
8. Inducement prize: Tactile Displays for the Visually Impaired 189
9. Inducement prize: Online security – Seamless personal authentication 190
10. Inducement prize: Zero Power Water Infrastructure Monitoring 190
11. Eurochain: Developing a European Public Blockchain Infrastructure that builds on the European legal framework 190
12. InnovFin Artificial Intelligence and Blockchain 191
13. Assessment of deployment and access-to-finance conditions in Artificial Intelligence and Blockchain 192

Budget 193

Introduction

Europe should step up its research activities in the areas building on the promising digital technologies which offer a significant competitive boost for our economies and respond to key societal challenges. For the 2020 Work Programme, the areas of Artificial Intelligence (AI), key technologies for digital transformation from photonics to software, advanced and smart connectivity with the emerging 5G, and Next Generation Internet including distributed ledger technologies and Blockchain are prioritised.

The actions foreseen in this work programme are strategic stepping stones in the direction of the next framework and will support Europe to take a bold lead in digital technologies by 2030. They also build ground for wide-spread deployment of digital technologies and thus provide means to respond to the challenge of digital transformation in line with the objectives of the proposed Digital Europe programme. The following technological areas cut across the different themes/topics:

Artificial Intelligence: AI is transforming our economies, societies and industry. Growth in computing power, availability of data and progress in algorithms have turned AI into one of the most strategic technologies of the 21st century. The stakes could not be higher. The way we approach AI will define the world we live in. Amid fierce global competition, the EU should be ahead of technological developments in AI and ensure that AI applications are swiftly taken up across its economy. This implies stepping up investments to reinforce and ensure closer cooperation between European AI excellence centres around agendas fixed together with industry. It also implies investment in R&I to bring rapidly the benefits of AI and robotics to all key sectors from manufacturing to health going through automotive and agriculture. The Work Programme dedicate close to 400 M€ to AI and robotics related activities including in addition to R&D, an emphasis notably on testing and experimentation and access to data with large scale pilots such as for smart hospitals and automated driving and with Innovation Hubs targeting SMEs.

The application of Digital technologies in areas of societal challenges like health, mobility, energy or security are also addressed under the relevant parts of H2020 with focus for 2020 on the applications of emerging technologies such as Artificial Intelligence. The same applies to the newly launched pilot on the European Innovation Council where disruptive AI technologies are addressed. Close to 120 M€ at least are expected to be devoted to AI under these other parts of H2020.

Projects financed by the EU in the field of Artificial Intelligence and robotics will ensure the development of trustworthy AI products and services and shall comply with relevant ethical principles that are supported by EU institutions.

Smart connectivity (5G) and advanced applications: the deployment and take up of densely connected 5G networks and systems open up new application areas. The work programme provide support to the experimentation facilities for third party experimenters, pilot validation of promising solutions, and possibilities for looking beyond 5G to prepare for

the realisation of Smart Connectivity systems as a basis for a Next-Generation Internet. The development and large-scale deployment of Connected and Automated Mobility (CAM) provides a unique opportunity to make our mobility system safer, cleaner, more efficient and more user-friendly. A collaborative network of cross-border corridors between European countries will enable a better environment for validating 5G technology. The ambition is to focus on these corridors in future EU automated driving projects in the area of digital policies, with links inter alia to cybersecurity, privacy, 5G, internet of things, data economy and free flow of data.

Next Generation Internet: a number of technological trends will reshape the internet over the next 10-15 years. The Next Generation Internet initiative aims at developing a more human-centric Internet, supporting values of openness, decentralisation, inclusiveness and protection of privacy and giving the control back to the end-users, in particular of their data. In addition to investment in advanced interactive technologies, 3D and augmented/virtual reality, particular emphasis is put on blockchain and distributed ledger technologies (DLT) that enable more decentralised, trusted, user-centric digital services, and stimulate new business models benefiting society and the economy. Blockchain-inspired technologies are being widely discussed around the world and are being tested across multiple industry sectors. In May 2017, in the Digital Single Market mid-term review, the Commission recognised blockchain-inspired technologies as having huge potential for our administrations, businesses and the society in general. Also, the Council conclusions of 19 October 2017[1] highlight blockchain, along with artificial intelligence, as "key emerging trends".

To ensure the wide uptake of latest digital technologies across the economy and society, the work programme foresees the support to the Focus Area Digitising and transforming European industry and services. This will be provided through Digital Innovation Hubs (DIHs) and cross-sectorial and integrated digital platforms and large-scale pilots for experimentation and co-creation with users.

This WP will also support core ICT industries through roadmap-based Public Private Partnerships (PPPs). The work will contribute to maintaining and developing the technology leading edge in key areas such as electronics, photonics, embedded systems, computing, robotics, big data or network technologies and systems, in which the EU has and should keep major strengths. The investment in this Work Programme are complemented by investments in the ECSEL Joint Undertaking where close to 200 M€ in 2020 are invested in components and systems including support to federating R&D projects in nano-electronics and in integrated and cyber-physical systems including large scale pilot lines and demonstrators accelerating the exploitation of research results. This investment in complemented by a similar amount from Member and Associated States and a double amount by industry bringing the total investment in ECSEL close to 800 M€ just for 2020.

The same applies to the investment in the EuroHPC Joint Undertaking that focuses on acquiring, making available and applying latest HPC technologies in key sectors. It supports R&I to ensure Europe’s presence in the supply chain of computing and data handling with

[1] https://www.consilium.europa.eu/media/21620/19-euco-final-conclusions-en.pdf

emphasis on low power technologies starting from the microprocessor up to the complete system and relevant software applications. EU investment in EuroHPC in 2020 will be close to 240 M€[2] to be complemented by a similar amount from Member and associated states.

All available demand-side instruments and accompanying measures will continue to be exploited in order to reinforce the involvement of end users, support digital entrepreneurship, strengthen support to start-ups and SMEs and as a result more effectively embed innovation in LEIT-ICT.

Security also remains a key transversal goal through a dedicated set of activities as well as a pervasive consideration for security issues throughout ICT research and innovation areas.

The international dimension of ICT activities is reinforced through joint calls with Japan and South Korea on a set of specific topics, dedicated twining activities on 5G with China and Taiwan, as well as additional support actions towards improved cooperation with the US on 5G and Next Generation Internet. Activities to reinforce the cooperation and strategic partnership with selected countries in Africa to support the strengthening of existing digital innovation hubs (DIHs) in Africa and to facilitate the collaboration between EU and African DIHs in order to strengthen a common EU-Africa innovation and start-up ecosystem.

Finally, the STARTS activity promotes silo-breaking collaboration between researchers, industry and artists to have European innovation profit from the out of the box thinking of artists.

Geolocation and earth observation data are playing an important role in digitisation. Wherever relevant, applicants are strongly encouraged to leverage data provided by the European satellite navigation systems Galileo and EGNOS, as well as the European Earth Observation programme Copernicus.

Interim Evaluation

This work programme takes into consideration and addresses the main findings of the Horizon 2020 Interim Evaluation. In particular, this Work Programme has a simpler and more coherent structure, in line with clear political priorities in the digital area. This will help increase impact and makes it easier to navigate for proposers. This is consistent with the Interim Evaluation's recommendation to 'simplify the work programme'. The work programme also reinforces international cooperation with Japan, South Korea, China, Taiwan and the US, a clear recommendation from the interim evaluation which noted a decrease in international participation as compared to FP7. This should help improve on the opening of the programme. This Work Programme responds to the need to deliver on the targets for sustainable development (in particular goal 9) through building resilient infrastructures, promote inclusive and sustainable industrialization and foster innovation.

Open research data

[2] Total EU budget for EuroHPC is 480 M€ over 2019-2020: 380 M€ from H2020, the rest from Connecting Europe Facility Programme.

Grant beneficiaries under this work programme part will engage in research data sharing by default, as stipulated under Article 29.3 of the Horizon 2020 Model Grant Agreement (including the creation of a Data Management Plan). Participants may however opt out of these arrangements, both before and after the signature of the grant agreement. More information can be found under General Annex L of the work programme

Contribution to focus area(s)

Focus Area 'Digitising and transforming European industry and services' (DT): EUR 461.00 million

Focus Area 'Boosting the effectiveness of the Security Union' (SU): EUR 152.00 million

Synergies with other funding opportunities

Project proposers should consider and actively seek synergies with, and where appropriate possibilities for further funding from, other relevant EU, national or regional research and innovation programmes (including ERDF/ESF+ or the Instrument for Pre-accession Assistance [IPA II]), private funds or financial instruments (including EFSI).

Examples of synergies are actions that build the research and innovation capacities of actors; mutually supportive funding from different Union instruments to achieve greater impact and efficiency; national/regional authorities actions that capitalise on on-going or completed Horizon 2020 actions aimed at market up-take/commercialisation.

In order to explore options for synergies, project proposers could seek contact with national/regional managing authorities and the authorities who developed the Research and Innovation Smart Specialisation Strategies (RIS3) [3]. For this purpose the 'Guide on Enabling synergies between ESIF, H2020 and other research and innovation related Union programmes'[4] may be useful. Horizon 2020 project proposals should outline the scope for synergies and/or additional funding, in particular where this makes the projects more ambitious or increases their impact and expected results. Please note, however, that while the increase in the impact may lead to a higher score in the evaluation of the proposal, the reference to such additional or follow-up funding will not influence it automatically.

Contribution to focus area(s)

Focus Area 'Digitising and transforming European industry and services' (DT): EUR 495.50 million

Focus Area 'Boosting the effectiveness of the Security Union' (SU): EUR 152.00 million

[3] http://s3platform.jrc.ec.europa.eu/map

[4] http://ec.europa.eu/regional_policy/sources/docgener/guides/synergy/synergies_en.pdf

Call - Information and Communication Technologies[5]

H2020-ICT-2018-20

Artificial Intelligence and Technologies for Digitising European Industry and Economy

In December 2018, the Member States and the Commission agreed to work together in a Coordinated Action plan [6] to develop an AI innovation ecosystem, where joint efforts strengthen excellence and competitiveness, help diffuse AI as widely as possible and ensure that it is aligned with EU values and citizens' aspirations. To be competitive in the development of AI, it is important for Europe to be able to spur developments through its world-leading research community, its strong industry, its robotics segment and its prominent business-to-business software and platforms. This requires significantly stepping up the investments by both public and private actors.

The Digitising European Industry [7] initiative aims to establish next generation digital platforms and re-build the underlying digital supply chain on which all economic sectors are dependent. The initiative should enable all sector and application areas to adapt, transform and benefit from digitisation, notably by allowing also smaller players to capture value. Digital Platforms are becoming a key factor in one sector after another, enabling new types of services and applications, altering business models and creating new marketplaces. Actions under this heading will provide extensive support to key DEI components in Artificial Intelligence, Robotics, Software technologies and Cyber-Physical Systems as well as photonics. Support to Micro-electronics and smart systems integration and embedded software, will continue through the ECSEL Joint Undertaking. In addition, innovation hubs and platforms, two key DEI objectives, will be supported through a Focus Area on Digitisation and Transformation of the EU industry, implemented in cooperation with other programme parts.

The digital transformation is a defining process of our time. The change and scale is unprecedented. Driven by the wide and rapid uptake of technologies such as Artificial Intelligence and new computing and communication paradigms, it touches on all sectors and

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5 Drawing on the success of actions of previous work programmes leveraging cascading grants to enable agility and reach out to new or key actors in the innovation chain (such as SMEs and mid-caps) not necessarily involved in standard EU R&I projects, part of the budget allocated to several actions of the Next Generation Internet topics will be dedicated to the support of experiments and smaller projects funded through financial support to third parties (in accordance with article 137 of the Financial Regulation). While their size will be small in comparison with standard Horizon 2020 actions, in line with article 23 (7) of the Rules for Participation the budget to be allocated per third party may exceed the default maximum amount foreseen in the Financial Regulation. Specific limits corresponding to the specific objectives to be addressed, and to the consequent expected scale and duration of the activities to be carried out by third parties are provided for the topics ICT-24-2018-2019, ICT-25-2018-2020, ICT-26-2018-2020, ICT-29-2018, and ICT-30-2019-2020.

6 A Coordinated Plan on Artificial Intelligence: COM(2018) 795 final

7 http://bit.ly/DigIndEU

all parts of the world. The use of Artificial Intelligence alone is expected to increase global GDP by close to EUR 13 trillion in the next decade.[8]

The challenge ahead is for the European economy to seize fully and swiftly these opportunities. This is essential to ensure Europe's mid and long term competitiveness with implications for overall welfare. The purpose of the topics proposed under this heading is to ensure European businesses is supported in further developing the building blocks of the digital transformation starting with Artificial Intelligence and robotics but also software and photonics technologies that complement the investment done in the ECSEL Joint Undertaking on components and systems.

Proposals are invited against the following topic(s):

ICT-46-2020: Robotics in Application Areas and Coordination & Support

Specific Challenge: While robots originated in large-scale mass manufacturing, they are now spreading to more and more application areas. In these new settings, robots are often faced with new technical and non-technical challenges. The purpose of this topic is to address such issues in a modular and open way, and reduce the barriers that prevent a more widespread adoption of robots. Four Priority Areas (PAs) are targeted: healthcare, inspection and maintenance of infrastructure, agri-food, and agile production.

In each of these PAs it is critical to develop appropriate autonomous capability that has impact on the efficiency of key applications in the PAs and moves beyond the current state of the art. This capability is built from core technologies and is proved and tested through pilot demonstrators that embed within real or near real environments.

User needs, safety, ethical, gender, legal, societal and economic aspects should be addressed in order to raise awareness and take-up by citizens and businesses. Privacy and cybersecurity issues, including security by design and data integrity should also be addressed, where appropriate.

Scope: **a) Research and Innovation Actions (RIA) - Robotics Core Technology**

Autonomy in robotic systems is built on a combination of four Core Technologies:

AI and Cognition: AI provides tools to make systems cognitive. Cognition equips robots with the ability to safely interact with people, their environments or other robots, to learn and to categorise, to make decisions and to derive knowledge.

Cognitive Mechatronics: Mechatronic systems where sensing and actuation are closely coupled with cognitive systems are expected to deliver improved control, motion, interaction (including all modalities), adaptation and learning, and safer systems.

[8] 14% of world GDP, Price Waterhouse Cooper report on *Sizing the prize: What's the real value of AI.(2017).*

Socially cooperative human-robot interaction: Cooperative human-robot interaction is critical in many work environments from collaborative support, e.g. passing tools to a worker, navigation in complex work environments, human-friendly and human assistive interactions, to the design of exo-skeletons able to provide motion that is sympathetic to the user.

Model-based design and configuration tools: Deploying robotics at scale in application areas where tasks need to be defined by the user requires easy-to-use configuration tools. Embedding and sharing of knowledge between tools is essential, as is standardisation across the interfaces to connect systems and modules (taking into account cybersecurity issues, including security by design and data integrity).

Proposals should address one of the four core technologies and target the development of core technology modules (modular, open and non-proprietary) and tool kits for use in deployable system platforms that meet the requirements of applications in the following four prioritised application areas: Healthcare, Infrastructure Inspection and Maintenance, Agri-Food and Agile Production. Proposals will be required to dedicate resource for connecting with the DIH actions arising from DT-ICT-02-2018.

The Commission considers that proposals requesting a contribution from the EU of between EUR 6 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Proposals are requested to specify the Core Technology in which their centre of gravity lies. At least one action in each Core Technology will be funded.

b) Innovation Actions (IA) - Robotics for agri-food, and agile production

Establish large-scale pilots capable of demonstrating the use of robotics at scale in actual or highly realistic operating environments; showcase advanced prototype applications built around platforms operating in real or near-real environments and demonstrate high levels of socio-economic impact.

Through large-scale pilots, proposals are expected to make a significant step forward in platform development in one of the two application areas:

- In the Agri-Food sector from farming to processing and distribution
- Agile Production.

Starting from suitable reference architectures, platform interfaces are defined, tested via piloting, and supported via ecosystem building preparing their roll-out, and are being evolved over time into standards.

Each proposal is expected to establish large scale pilots. They are expected to: consider utilising existing infrastructure and links to other European, national or private funding sources; identify the long-term sustainability of the pilot; develop scalable technical solutions capable of meeting performance targets; develop metrics and performance measures for the pilot; engage relevant industry stakeholders, including SMEs, in the provision and operation

of the pilot, paving the way towards establishing strong collaborations for innovative robotic applications in industry. Proposals will be expected to dedicate resources to disseminate best practice and coordinate access to platforms and demonstrators, in particular in connecting with the Robotics DIHs and Core Technologies actions and other relevant activities, in H2020 and beyond.

Pilots are expected to address both technical and non-technical issues, such as socio-economic impact, novel business models, legal and regulatory, ethical and cyber-security issues and connections to AI, Big Data and IoT. Where appropriate, applications should leverage synergies among EU satellite-based systems for navigation (EGNOS/Galileo), and/or observation (Copernicus) and communication.

The Commission considers that proposals requesting a contribution from the EU of between EUR 6 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. The objective is to fund at least 3 proposals per application area.

c) Coordination and Support Action (CSA) - Robotics

Proposals should address issues concerning the whole European robotics community and provide support actions that develop awareness and knowledge transfer. Proposals should consider the development of a high-level stakeholder forum and an associated communication strategy; the development of mechanisms that create a continuing discussion around legal and societal issues concerning AI-based robotics technology that leads to strategic development and the dissemination of best practice to robotics stakeholders and particularly to developers and policy makers.

Proposals should address the issues of socio-economic analysis, cyber-security, data protection, ethical and privacy issues that arise from the increased deployment of robotics to ensure that there is relevant and effective strategic development and best practice advice available to robotics stakeholders.

Proposals should address the public understanding of robotics through the development of news articles, public and media engagement and awareness activities.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 3 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Research and Innovation Actions:

- Improved technical capability in each of the core technologies over the current state of the art.
- A greater range of applications in the prioritised application areas that can be demonstrated at TRL 3 and above.
- The lowering of technical barriers within the prioritised applications areas.

Innovation Actions:

- Demonstration of the potential for robotics to impact at scale in the chosen application areas prioritised in this call.
- Reduction of technical and commercial risk in the deployment of services based on robotic actors within the selected application area.
- Greater understanding from the application stakeholders of the potential for deploying robotics.
- Demonstration of platforms operating over extended time periods in near realistic environments and promotion of their use.
- Develop the eco-system around the prioritised application areas to stimulate deployment.
- Contribution to the development of open, industry-led or de facto standards

Coordination and Support Action:

- Effective dissemination of knowledge surrounding non-technical aspects of robot deployment.
- Greater awareness of robotics among key stakeholders and policy makers.
- Improved understanding of legal, socio-economic and ethical issues and their impact on robotics deployment.

Type of Action: Research and Innovation action, Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-47-2020: Research and Innovation boosting promising robotics applications

Specific Challenge: Robotics enables a significant part of the economic impact of AI by delivering physical intelligence. Logistics, Healthcare, Agri-Food, Inspection and Maintenance, Mobility, Construction, Decommissioning; all require physical intelligence, for example in object manipulation. Physical intelligence is derived from combinations of underlying functional capabilities and developing these capabilities beyond the state of the art depends on fundamental R&D&I which crosses between technical domains, for example into materials research or human interaction. It is therefore important to enhance the capability of robots by exploring and developing the opportunities offered by novel technical developments related to physical intelligence.

Scope: Innovative approaches to hard research problems in relation to applications of robotics in promising new areas are particularly encouraged. Proposals are expected to enable substantially improved solutions to challenging technical issues, with a view of take-up in

applications with high socio-economic impact and low environmental footprint, where appropriate. Driven by application needs, the work can start from research at low TRL, but proposals are expected to validate their results in sufficiently realistic scenarios in order to demonstrate the potential for take-up in the selected application(s).

The call is open to the following research areas:

I. Development of autonomous robots at the micro- or millimetre scale capable of energy autonomy on the scale of hours or longer. Developing miniature robots is challenging and the potential of robotics at this scale has not been fully explored.

II. Integration and use of novel materials for service robotics, for instance active materials (e.g.: soft grippers). Current materials often limit the capability of robots, an exploration of how novel materials can reshape robots is an important innovation. In addition, material enabling the design of easy to maintain, upgrade and recycle robots, would also be an important innovation.

III. Beyond human speed, general purpose, dexterous manipulation of objects. Raising productivity in many processes will require robots to operate faster than humans in the same task.

IV. Application and integration of non-visual sensing novel for service robotics (including off-board, ambient and multi-scale sensing) to achieve new functionality. Many applications in service robotics need sense data beyond the visual; for example chemical, biological, and physical properties; integrating these non-visual data into interpretation and decision making can enhance tasks by taking them beyond human sensing limitations.

V. Development of intrinsically safe physical powerful robotic systems **with proximity sensing capability** for human-scale collaborative tasks. Developing intrinsically safe systems is critical to the uptake of collaborative robotics where robots need to be capable of applying working forces that can potentially cause injury to humans.

VI. Development of variable autonomy systems that significantly extend and enhance the operator’s awareness of the working environment. Sharing autonomy between a human operator and a robot can speed up operations and raise productivity.

Proposals are expected to be inspired by, and demonstrate the capability to address, real end user needs, respecting ethical, legal and social aspects, as appropriate. Proposals will be expected to plan efforts to connect and cooperate with the DIHs, Platforms and other relevant activities of this work programme, as appropriate. Proposals will be expected to deliver integrated TRL 4 demonstrations that show step change performance improvement over the current state of the art in the chosen area.

The Commission considers that proposals requesting a contribution from the EU between EUR 2 and 3 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Strengthening European excellence in Robotics S&T
- Boosting the use of robotics in promising application areas
- Opening up new markets for robotics
- Lowering barriers in the deployment of robotics-based solutions.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-48-2020: Towards a vibrant European network of AI excellence centres

Specific Challenge: To ensure European strategic autonomy in such critical technology as AI, underpinning most of our future professional and private activities, with huge potential socio-economic impact, it is essential to reinforce and build on Europe's assets in AI, including its world-class researcher community, in order to stay at the forefront of AI developments.

As stated in the communication from the European Commission on Artificial Intelligence for Europe and the coordinated action plan between the European Commission and the Member States, while Europe has undeniable strengths with its many leading research centres, efforts are scattered. Therefore joining forces will be crucial to be competitive at international level. Europe has to scale up existing research capacities and reach a critical mass through tighter networks of European AI excellence centres. The objective is to foster cooperation among the best research teams in Europe, joining forces to tackle more efficiently major scientific and technological challenges in AI hampering deployment of AI-based solutions.

Scope: **a) Research and Innovation Actions (RIA)**

As announced in the Communication on Artificial Intelligence for Europe, the Commission will invest in strengthening AI research excellence centres across Europe and facilitate their collaboration and networking. The objective of this action is to develop networks of excellence centres aiming at boosting the research capacity in Europe and the status of Europe as a research powerhouse for AI, and making it attractive for scientists and new talents. This initiative is also expected to contribute to the development of ethical and trustworthy Artificial Intelligence, the trademark for AI "made in Europe".

Such networks are expected to mobilise researchers to collaborate on key AI topics, to reach critical mass on these topics and to increase the impact of the funding in progressing faster in joined efforts rather than working in isolation, with fragmented and duplicated efforts.

Objectives of the Networks:

- Up to four networks will be selected, focusing on scientific or technological major challenges, with the primary goal to reinforce Europe's capacity and progress in critical technologies.

- In addition, building on existing efforts by the AI-on-demand platform and in cooperation with the coordination and support action of this topic, these networks will develop mechanisms to spread the latest and most advanced knowledge to all the AI-labs in Europe and prepare the next generation of talent in AI. Such mechanisms will have to be defined in the proposal.

- Another objective is also to develop synergies and cross-fertilization between industry and these networks of excellence centres, in particular through internships of academic staff (at all levels) in industry, or PhD programmes with industry.

- The set of networks will form a common resource and will become shared facility, as a virtual laboratory offering access to knowledge and expertise and attracting the talents. It should become a reference, creating an easy entry point to AI excellence in Europe and should also be instrumental for its visibility.

Composition of the Networks:

- Each network should be driven by leading figures in AI from major excellent research centers, bringing the best scientists distributed all over Europe. They will bring on board the necessary level of expertise and variety of disciplines and profiles to achieve their objectives.

- Industrial participation will be ensured through industrial research teams and also in bringing expertise to identify important technological limitations hampering deployment in industrial context. Such industrial involvement will thus help defining the research priorities of the network and will raise new research questions.

- Each network will have to demonstrate access to the required resources and infrastructure to support R&D, such as data, HPC (central, GPUs, edge computing), storage, robotics equipment, IoT infrastructure, support staff and engineers to develop experiments, etc. All available data sources, including Copernicus data where relevant, should be made use of.

Activities of the Networks: for each of the following activities, the most appropriate mechanisms should be selected and detailed in the proposal:

- In order to structure the activities, the proposals will focus on important scientific or technological challenges with industrial relevance and where Europe will make a difference, either in building on strengths, or strengthening knowledge to fill gaps critical for Europe.

- Based on these challenges, the networks will develop and implement common research agendas. The main vision and roadmap with targets within the projects, as well as

methodology to implement and monitor progress will have to be specified in the proposal and can be further developed during the project.

- Progress will be demonstrated in the context of use-cases, also helping to foster industry-academia collaboration.
- Strong links will be developed among the members of the networks, notably through collaborative projects, exchange programmes, or other mechanisms to be defined by the consortia
- The proposals should define mechanisms to foster excellence, to increase efficiency of collaboration, and to develop a vibrant AI network in Europe.
- Each network will disseminate the latest and most advanced knowledge to all the academic and industrial AI laboratories in Europe, and involving them in collaborative projects/exchange programmes. (This could involve projects defined initially or via financial support to third parties [9] [10], for maximum 20% of the requested EU contribution).
- Each network will develop interactions with the industry (inside the consortium and beyond), in view of triggering new scientific questions and fostering take-up of scientific advances
- Each network will develop collaboration with the relevant Digital innovation Hubs, to disseminate knowledge and tools, and understand their needs.
- Proposals will include common academic/industrial PhD programmes and post-PhD programmes with a focus on industrial challenges. The ambition is to establish a unique and world-recognised brand for a European programme for industrially-oriented PhDs in AI and to keep researchers in Europe after they complete their PhDs.
- These networks should also foster innovation and include mechanisms to exploit new ideas coming out of the network's work (for instance via incubators).
- Overall, each proposal will define mechanisms to become a virtual center of excellence, offering access to knowledge and serve as a reference in their chosen specific field, including activities to ensure visibility.

Technology focus:

Collaborative projects carried out in networks should focus on one or several of the following topics and would involve the necessary competencies available in the network to address these:

[9] The task may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes.

[10] The use of Financial Support to Third Parties for such activities is optional, up to consortia to select the most efficient solution to reach this dissemination objective.

- Advances in foundations of AI (e.g.: learning and reasoning approaches) and approaches for trusted AI solutions (including explainable AI, unbiased AI, safety, reliability, verifiability etc.),
- Developing the next generation of intelligent robots,
- Advanced perception or interaction with humans (for human-centered AI) and environments,
- AI at the edge and hardware for AI.

Synergies with the AI-on-Demand platform:

The AI-on-demand platform should serve as the backbone of these networks in:

- Providing tools and algorithms, data, support services, also to the research community;
- Establishing the link to the community at large in order to spread the knowledge and develop collaborations.

The networks will aim at strengthening the AI-on-Demand-platform in enriching its capacity in terms of tools, competencies, services, to make it the reference and quality label for resource in AI. Being the one-stop-shop for AI resource in Europe, the tools, algorithms, resources developed in the networks of excellent centres will be made available to all via the AI-on-Demand platform.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 12 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and Support Action (CSA)

The coordination and support action will help develop synergies and exchange between the selected projects, and with other relevant projects, such as the AI-on-demand platform, and the community at large, both academic and industrial. It will support the running projects in allowing economies of scales regarding common activities run by the individual networks (e.g.: organization of events, logistics support for calls for FSTP, exchange mechanisms among labs, etc.), exchanges of best practices to reinforce and optimize cooperation, etc.

It is also expected to support the RIA projects in their dissemination activities towards industry, users, and citizens. Diversity and gender aspects should be addressed, when relevant.

In addition, due to the importance of equipping the professionals with the right skills in order to maximise the benefits offered by AI-based system, this action will support the academia, in cooperation with industry, via organisation of workshops, and other appropriate approaches, to identify AI courses and modules that could be integrated in non-ICT education master programmes, and corresponding mechanisms to foster such integration.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 2 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Make Europe a research powerhouse for AI;
- Increase Europe's attractiveness for scientists, so that it notably becomes the nest for future generations of scientists and breakthrough in AI;
- Ensure Europe's leadership in key strategic research topics,
- Strengthen the AI-on-Demand platform with algorithms, tools solutions developed by the actions funded under this topic;
- Foster mobilization and commitment from the community, including high level experts to contributing to the AI-on-Demand platform, making it the reference resource for European researchers, developers, integrators and users;
- Reinforce Europe’s research capacity in AI;
- Pave the way to enrich the education offer in order to equip a broad range of non-ICT professionals with the necessary AI skills, to make the best of this technology.

Type of Action: Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-49-2020: Artificial Intelligence on demand platform

Specific Challenge: The challenge is to fully exploit the potential of AI in the economy and society. Building notably on Europe's Scientific and Technology strengths in the field, the supported activities should reinforce industrial competitiveness across all sectors including for SMEs and non-tech industries and help address societal challenges (e.g. ageing, transport, gender equality). The ambition is to bring AI technologies and resources to integrators and innovators in all sectors and actively engage with a wide user community, to foster adoption of AI, via use-cases experiments.

AI-on-demand platform: consolidation and exploitation --

Scope: This topic builds on the AI-on-demand-platform funded in ICT26-2018-20, a reference access point gathering and providing access to AI-related knowledge, algorithms and tools and access to related infrastructures, equipment, and data resources, offering also experts support to potential users of AI in order to facilitate the integration of AI into applications, making it a compelling solution for users, especially from non-tech sectors.

This activity aims at consolidating the eco-system by bringing in a larger user community, especially from the non-tech sector, and by reinforcing the service layer of the platform. At this stage, it will be particularly important to refine mechanisms to ensure the platform's long-term sustainability. The platform should provide a good European coverage, both in terms origin of the resources made available on the platform, but also in terms of users of the platform, making sure its resource is available everywhere in Europe.

The objectives:

- Reinforce the service layer of the AI-on-demand-platform funded in ICT26-2018-20 to facilitate the use and uptake of the platform resources.

- Reaching out to new user domains and boosting the use of the platform through use cases and small-scale experiments. The task will involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. Minimum EUR 2 million funding should be dedicated to it, with EUR 50.000 to 200.000 per third party (amount higher than EUR 60.000[11]should be justified, based on need of expensive hardware or infrastructure for instance). The selection process should prioritise projects maximising the impact of the platform and demonstrating the benefit of AI in products, processes or services. Particular attention will be paid to SMEs and low-tech sector, which can best benefit from the support offered by the platform. The selected projects should also cover a wide spread of application sectors, to demonstrate the versatility and scalability of the platform offer.

Proposals will ensure continuity with the project selected under ICT26-2018-20, having access to all the knowledge and offer needed to fully exploit it and be able to build on it. The improvements resulting from the selected projects should be made available and open to the community via the platform, to allow full exploitation, and also further developments by entities outside the consortia, building on these results.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Enriching and optimising the AI on-demand platform service offer and reinforcing its sustainability

- Boosting the deployment of AI-based solutions and services, enabling a larger user community to reap the economic benefits of AI, especially SMEs and non-technology sectors

Type of Action: Innovation action

[11] With a limit of EUR 200.000

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-38-2020: Artificial intelligence for manufacturing

Specific Challenge: State-of-the-art AI technologies need to be integrated with advanced manufacturing technologies and systems in order to exploit their potential in manufacturing and process industry. AI systems cooperating with humans can improve production planning and execution, and can help to improve quality of products and processes.

To widely deploy these technologies, specific attention has to be given to standardisation, synchronising EU and Member States activities, and to international collaboration.

Scope: **a) Research and Innovation Actions (RIA)**

The focus is on integrating state-of-the-art AI technologies in the manufacturing domain, for example in agile production processes and predictive quality, taking into account the domain-specific requirements in terms of time criticality, safety and security, finding effective ways for collaboration between humans and AI systems, and exploiting the strengths of both humans and machines while keeping the human in control. Ethical principles, as expressed by the high-level expert group on Artificial Intelligence [12] should be followed and recommendations for instantiation in the manufacturing domain should be developed. Proposers are encouraged to build on existing results from artificial intelligence research, for example ICT-26-2018-2020.

Proposals must develop innovative concepts and tools that take into account the status and availability of all relevant production resources, learn from past experiences, and deal effectively with unforeseen events. If appropriate, AI techniques should be combined with digital twins and real-life feedback from the shop floor or production facility to improve quality of products and processes. Generative design approaches for products and processes are encouraged.

Developed technologies and solutions should be demonstrated in at least two different realistic manufacturing use cases of significant economic value. If applicable, legal obstacles to implementation of the proposed solutions should be identified.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 6 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and Support Actions (CSA)

Standardisation

Proposals are expected to extend, further develop, and support the implementation of a model for the synchronisation of standardisation activities on AI and related digital technologies in

[12] https://ec.europa.eu/digital-single-market/en/news/ethics-guidelines-trustworthy-ai

manufacturing at large, at the Member State level and at the European level – and in a global context, taking into account legal and ethical issues where relevant. Proposals need to build on previous activities, such as the results of the Joint MSP/DEI Working Group on standardisation in support of Digitising European Industry[13].

Cooperation EU-Japan

Proposals are expected to support possible cooperation with Japan, in areas relevant for AI-driven innovation in manufacturing and digital industrial platforms. Proposals will assess opportunities, and kick-off cooperation activities, by organising contacts between researchers and companies from EU and Japan working on AI applications for manufacturing, encouraging the exchange of information on the respective research programmes and technological results. Proposals shall foresee twinning with entities participating in projects funded by Japan to exchange knowledge and experience, exploit synergies and develop recommendations for further sustainable cooperation and collaboration activities.

The Commission considers that proposals requesting a contribution from the EU of EUR 0.5 million would allow these areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. One coordination and support action will be supported for each of the two areas above.

Expected Impact: Research and Innovation Actions

- Products and services usable in a wide range of manufacturing processes leading to agile production processes and improved quality of products and processes
- Humans working together with Artificial Intelligence systems in optimal complementarity

Coordination and Support Actions

- Increased synchronisation and cooperation on AI and related digital technologies in manufacturing, with higher global impact

Proposals need to describe how the proposed work will contribute to the impact criteria above, provide metrics, the baseline and targets to measure impact.

Type of Action: Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

[13] https://ec.europa.eu/digital-single-market/en/news/second-workshop-standardisation-support-digitising-european-industry-initiative

ICT-36-2020: Disruptive photonics technologies

Specific Challenge: The challenge is the development of advanced photonics technologies which have the potential to revolutionise an existing application sector or to create completely new applications and markets.

Scope: The focus is on the following themes (sub-topics):

i. **3D light field and holographic displays:** Actions should develop innovative photonics components and systems which enable 3D light field or holographic displays for use in mixed-reality applications such as automotive, healthcare, telecommunication, entertainment and gaming. In addition, the display components actions may also develop sensors and actuators for necessary support functionality such as sensing, connectivity, user interaction, and scene recognition etc. Actions must include validation in application settings.

ii. **Packaging and module integration for photonic integrated circuits (PIC):** Development of novel packaging, assembly, module integration technologies or novel testing approaches offering breakthrough advances for the automated, flexible, low-cost, high volume, scalable production of PIC-based photonic components or modules. Actions should demonstrate the technical and industrial feasibility of the proposed technologies or approaches through a functional demonstrator.

iii. **Light to Fuel:** Development of photonics devices at TRL level 5-6 for the direct and efficient (>5%) conversion of solar energy into chemical fuel. Actions may also include R&D into catalyst development and disruptive material and device concepts where appropriate. Actions should demonstrate technical and economic feasibility.

iv. **Next generation biophotonics methods and devices as research tools to understand the cellular origin of diseases:** Actions will focus on photonics-based in-vivo/in-vitro imaging systems and techniques which deliver greatly increased penetration, resolution, sensitivity, specificity and depth of focus. Real time data handling and processing may also be addressed as appropriate. Actions should include medical/clinical doctors or research laboratories with relevant experience.

At least one proposal will be selected to cover each of these themes.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 6 million would allow these to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should describe how the proposed work would contribute to the listed corresponding expected impacts and metrics, including the baseline and the targets to measure impact.

- Actions should enable European system manufacturers to bring to market highly competitive products by integrating 3D light field and holographic visualization

solutions for systems and user-centric services in different areas, and to build a Europe-centred value chain from the domestic manufacturing of components and software up to the system integrators and end users.

- Approaches must deliver a reduction in production costs by an order of magnitude, enabling the introduction of PIC technology in new markets.
- The projects should demonstrate the efficient conversion of solar energy into chemical fuels, with a device efficiency of >5% and payback period of <10 years. This should enable Europe taking the lead in creating a multi-billion industry, and give independence from imported energy.
- Significant gain in understanding of inter- and/or intra-cellular processes; strengthen Europe's industrial position in the biophotonics-related market for microscopes and research and development tools.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-37-2020: Advancing photonics technologies and application driven photonics components and the innovation ecosystem

Specific Challenge:

The advancement of photonics depends on core photonics technology which can be applied in many different application areas. The challenge is to develop and apply core photonics technology for the next generation of devices (including components, modules and sub-systems) in order to drive innovation in key application areas, which are significant current or future markets and where photonics can bring a key competitive advantage.

Innovative photonic sensing solutions can contribute to reducing food production losses and food wastes, estimated in Europe at about 300 kg per capita, and to increasing food safety for the end consumer along the food production chain from farm to fork.

Increased pollution of air, soil and water is raising new concerns regarding the safety of the environment and its potential risks for European citizens' health. Distributed smart photonic sensor networks involving public participation through community-based monitoring could assist in creating inventories of emitted pollutants, identifying pollution hotspots, and alerting citizens in real time on potential health risks.

Scope: The focus is on the following themes (sub-topics):

a) Research and Innovation Actions (RIA)

i. **Flexible Farm-to-Fork Sensing:** Development of an innovative smart photonic sensor solution, utilizing an appropriate bandwidth between the ultraviolet (UV) and the far infrared

spectral range for monitoring food quality with respect to microbiological and chemical contamination along the farm-to-fork food production chain. The targeted solution should combine photonic sensing technology with advanced data analysis techniques and be portable, easy-to-use, flexible, and broadly adaptable for usage on farms, in food processing, wholesale and retail. Actions should focus on the following areas: (1) food production by small/medium-sized farms; (2) novel types of food production, such as aquaponics; (3) on-site food processing and vending (e.g. on farms or local food markets). The developed solution must be demonstrated in real settings involving relevant stakeholders along the food supply chain, from food producers to end consumers.

ii. **Novel Photonics Integrated Circuit (PIC) Technology building blocks**: Major advances in photonic integrated circuit technology through the development of building blocks with significantly enhanced or novel functions. These should form part of comprehensive integration platforms for established or new important application fields, enabling the platform to meet the demands of application roadmaps concerning relevant features like sensitivity, energy efficiency, speed and chip density. Developments should be based on a generic platform approach, i.e. support the single-chip integration of complex functions through a design flow based on generic building blocks separated from production. Actions should include a validation of results with fabricated PIC prototypes.

b) Innovation Actions (IA)

iii. **Smart Photonic Sensing for Environmental Pollution Detection:** Prototyping, demonstration and validation in real settings of an innovative, cost-effective, portable, smart hyperspectral sensing system operating in the visible to mid-infrared spectral range, for pollution detection in environmental sensing applications. The system should be based on a miniaturised optical setup and feature broad sensorial response curves with high measurement precision in the diagnostic wavelength range, in combination with massive Cloud-based data analysis capability using advanced Deep Learning algorithms and Big Data sensor signal repositories for comprehensive chemometric analysis.

c) Coordination and Support Actions

iv. **An industrial strategy for photonics in Europe**: the objective is to support the development and implementation of a comprehensive industrial strategy for photonics in Europe which strengthens the links to the end user industries. The action should include the development of strategic technology road-maps, strong stakeholder engagement (in particular Photonics21 stakeholders, National Technology Platforms, regional Clusters, end-user industries), coordination of regional, national and European strategies and priorities, and development and dissemination of financing models to facilitate access by companies to different sources of finance.

To ensure domain coverage, at least one proposal will be selected to cover each of these themes. As it is necessary to coordinate strategy efforts singly, no more than one action will be funded for theme iv).

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 million for themes i and ii; EUR 4 and 7 million for theme iii, and up to EUR 4 million for theme iv would allow these to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should describe how the proposed work will contribute to the relevant expected impacts and metrics, including a baseline and the targets to measure impact. Respectively:

i.

1. Increased food yield, quality and safety, and significant reduction of food waste along the farm-to-fork food production chain with cost-effective and easy-to-use analysis and quality-control tools;

2. Strengthening small/medium-scale farming and local or novel ways of food production and processing by ensuring high food quality standards at lower resource usage and competitive costs.

ii. Reduction of the research and development costs of advanced PICs in a wide range of application areas.

iii. Large-scale adoption of affordable, Cloud-connected, smart photonic sensing systems for pervasive, Community-based environmental pollution monitoring and real-time citizen alert on local pollution levels and related health risks

iv.

1. Reinforced value chains and deployment of photonics technologies by stronger cooperation of photonics stakeholders, clusters and end-users;

2. Increased competitiveness of the European photonics sector and improved access to risk finance for the photonics sector in Europe.

Type of Action: Innovation action, Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-50-2020: Software Technologies

Specific Challenge: The increased complexity of present and emerging ICT systems poses several challenges at software and hardware level including new requirements in terms of integration and cybersecurity. Users require seamless connectivity, abundant computing power and unlimited access to data independently of the underlying infrastructure. Increased levels of adaptability is becoming more and more essential in modern ICT systems in order to manage the needs of highly complex and dynamic environments pushing for continued

development and operation (DevOps). Increasing trust, security, reliability while keeping system performance and reducing energy consumption has become non trivial, in a world where billions of devices processing zetabytes of data have to be managed and increased transparency in algorithmic decision making is required. It is therefore required to find new ways of managing this unprecedented complexity in software systems throughout shortened lifecycle: from requirements analysis and design, to development and testing and up to deployment and operations across highly heterogeneous and dynamically self-reconfiguring systems.

Scope: **a) Research and Innovation Actions (RIA)**

Proposals will address at least one of the following two areas:

1. Development tools & methods for interoperable, adaptive, secure and trustworthy software. Introduce effective processes and tools for building trustworthy software that adopt to rapidly changing requirements while maintaining key qualities (reliability, availability, performance, security, privacy etc.). They will consist of:

    a. New programming models and software engineering tools with increased validation, verification and testing capabilities for ensuring trustworthiness while incorporating inherent semantic reasoning, self-learning and self-healing mechanisms. Focus should also be given to transparent and unbiased algorithmic decision making for the end-users (including transparency for regulatory control purposes) and the integration of evaluation and control functions in the algorithms by design.

    b. Advanced development environments addressing the increasing complexity of modern software based systems, facilitating faster software development and increased integration between continued development and operations, while maintaining reliability, and clearly indicating and confronting with cyber-threats and weak points in terms of cybersecurity.

2. Advanced Software systems and architectures:

    a. Self-managed software facilitating the semantic adaptation of entities to dynamically changing contexts and coping with different situations, cyberattacks and hardware and software failures.

    b. Software systems that effectively deal with resources complexity and volatility. Proposed solutions should address the operation in highly heterogeneous environments with wide geographic distribution, loose, weak or unreliable connectivity between key service components, unpredictable affinity to data sources and cyber-dangerous environments. The focus should be in optimizing and pooling resources across disparate infrastructures to deliver prescribed levels of quality of service and security.

The proposals should demonstrate the applicability and viability of the proposed solution across multiple application domains. The use and development of open source software will be encouraged where appropriate to further promote openness, facilitate the sharing of project results and accelerate innovation in Europe through the introduction of novel products and services.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and Support Actions (CSA)

Coordinate stakeholders in the area of software technologies, digital infrastructures and cybersecurity. Act as support to R&D programmes/activities by disseminating project results and organising scientific and policy events, developing research and innovation roadmaps.

The Commission considers that a proposal requesting a contribution from the EU of EUR 1 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: **a) Research and Innovation Actions (RIA)**

- Increased capacity of the European software industry to exploit the capabilities of software-defined infrastructures at middleware and application layer.
- Improved reliability and cybersecurity of software developed with those tools, which will result in the reduction of loses for software failures or attacks. Investing in the best tools to fight the aforementioned challenges is multiplied has a wide effect
- Expand research and innovation potential in software technologies & infrastructures while overcoming fragmentation in the European supply base, optimizing investments and use of resources to yield multi-domain software-based products and related software services.
- Contribute to EU's technology independence in Software.

b) Coordination and Support Actions (CSA)

- Creation of a sustainable European forum of stakeholders representing the Software research, industry and end users.

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-01-2019: Computing technologies and engineering methods for cyber-physical systems of systems

Specific Challenge: Cyber-physical Systems of Systems (CPSoS), like transport networks or large manufacturing facilities, interact with and are controlled by a considerable number of distributed and networked computing elements and human users. These complex and physically-entangled systems of systems are of crucial importance for the quality of life of the citizens and for the European economy. At system level the challenge is to bring a step change to the engineering techniques supporting the design-operation continuum of dynamic CPSoS and to exploit emerging technologies such as augmented reality and artificial intelligence. At computing level the challenge is to develop radically new solutions overcoming the intrinsic limitations of today's computing system architectures and software design practices.

Scope: **a. Research and Innovation Actions**

The focus is on dependable physically-entangled systems for applications in industrial sectors. Work is complementary to the initiative on European low-power microprocessor technologies, which addresses technology for HPC applications, and to the ECSEL programme, which addresses computing for CPSoS at higher TRL.

Computing software and systems design for physically-entangled systems supporting the creation of reliable, robust and energy-aware solutions for autonomous and safety-critical systems. The issues of energy efficiency, testability, trust and cyber-security should be considered, as well as the support of different levels of criticality on the same computing platform where needed.

Models, tools and methods for design-operations continuum of dependable CPSoS supporting the complete lifecycle of Cyber-Physical Systems of Systems (CPSoS), from requirements capture to design, test, operation and decommissioning. Projects shall focus on autonomic solutions capable of guaranteeing the overall reliability and security even when the components or subsystems are not fully reliable and unforeseen conditions emerge in the course of operation.

Projects will target TRLs 2-5, and will deliver a working prototype tested in at least two different use cases, demonstrating improvement over the state of the art in industrial and professional domains. The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. In each area at least four proposals will be funded.

b. Coordination and Support Activities

The objective is to structure, connect and cross-fertilise the European academic and industrial research and innovation communities in Embedded Computing and Cyber-Physical Systems. The action should implement technology watch, facilitate take-up of technologies in real-world use cases and support know-how transfer. Activities will include constituency building,

clustering of related projects, liaison with related programmes such as ECSEL and EUREKA, impact analysis, communication of project results, pre-normative activities and road-mapping for future research and innovation. One proposal will be funded.

Expected Impact: Proposals should address one or more of the following impact criteria, providing metrics to measure success where appropriate:

- Availability of innovative technologies supporting compute-intensive applications in industrial and professional domains, demonstrating significant and measurable improvement over the state of the art.
- Availability of engineering practices and tools for CPSoS, resulting in a demonstrable improvement in quality and cost of development and operation for large SoS.
- Increased synergies and collaboration between industrial and academic communities; dissemination of high-quality roadmap for future research and innovation activities in the relevant areas.

Type of Action: Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-02-2018: Flexible and Wearable Electronics

Specific Challenge: Flexible and Wearable Electronics combines new and traditional materials with large-area processes to fabricate lightweight, flexible, printed and multi-functional electronic products. The challenge is to tap open opportunities in existing and emerging markets by pushing technology barriers further and demonstrating innovative use in sectors that could benefit from such innovations.

Scope: To fully exploit the potential of Flexible and Wearable Electronics and overcome barriers of manufacturability, challenges need to be addressed in materials, processes for large-area fabrication and quality control, integration technologies, and demonstrating innovative and sustainable products for professionals and consumers. This topic will support advances in device technology and related manufacturing processes.

Proposals can address one or more of the following topics:

Enhancing manufacturability: Addressing advances in combined organic and printed electronics and large area deposition technologies resulting in multi-functional components; and/or equipment and processes for large-scale fabrication, mass-customisation and characterisation as well as textile compatibility, whenever relevant.

Integration technologies: It addresses the development of new concepts for the integration of transducers, energy and data storage elements, logic, displays and light sources, as well as new interconnection technologies.

Device demonstration: Prototype validation in specific applications of flexible and wearable electronics. Consideration to be given to the integration of electronic devices in connected wearable and portable settings (e.g. textiles, flexible or stretchable substrates), interconnection, compatibility with low-cost manufacturing, efficient energy scavenging and storage, functional performance, and durability/reliability. Privacy and security, liability and free flow of data as well as recyclability and waste management should be considered where relevant.

It is expected that projects addressing manufacturability would demonstrate production capability in a laboratory environment (TRL 4).

For integration and device demonstration, it is expected that technologies are validated in laboratory or relevant environments (TRL 4-5), and that industrial exploitation is clearly identified.

The Commission considers that proposals requesting a contribution from the EU between EUR 2 and 4 million would allow this area to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

To complete this effort and strengthen the value chain, from materials to devices, a jointly funded topic with NMBP [14] will support projects spanning from material improvement (electrical performance, processibility, stability and lifetime during device operation), to prototyping of advanced large area electronic products - TRL 3 to TRL 5. This topic will be implemented through Innovation Actions (see topic DT-NMBP-18-2019 Materials, manufacturing processes and devices for organic and large area electronics (IA)).

Expected Impact: Proposals should address some of the following impact criteria and provide metrics to measure and monitor progress:

- Technology leaps related to improved performance (functionalities, autonomy, reliability, manufacturability and cost…) and contributing to European leadership in large area, flexible and wearable electronics .
- The emergence of new products based on the combination of printed and large area processed electronics.
- Increased R&D cooperation in technology device development and related manufacturing processes.
- Developing further manufacturing capabilities in Europe.
- Creating new opportunities for digitisation in other sectors and including new actors in the ecosystems (designers, artists…),
- Increased industrial investments in flexible and wearable electronics.

[14] Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, and Biotechnology. Part of LEIT (Leadership in Enabling and Industrial Technologies) in Horizon 2020.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-03-2018-2019: Photonics Manufacturing Pilot Lines for Photonic Components and Devices

Specific Challenge: Photonics is driving innovation in many different application areas. The challenge is to help European companies become more competitive by improving their business/production processes as well as products and services by means of photonics technology. The aim is to accelerate the design, development and uptake of photonics technology, by a wide range of industrial players, in particular SMEs by providing low-barrier access to volume production of advanced photonics components available to a wide range of industrial players, in particular SMEs which would otherwise not have easy access. Photonics Manufacturing Pilot Lines should form the basis for future Photonics Digital Innovation Hubs.

Scope: The focus is on **Manufacturing Pilot Lines**: actions should provide open access to manufacturing of advanced photonics components and systems and offer related services including design and characterization. They should cover all stages of manufacturing through to testing, provide a low entry barrier access to low and medium production volumes and the processes used should be scalable to high production volumes. Actions should include a validation of the pilot line offer with involvement of externals users in pre-commercial production runs. Activities should aim at long-term sustainability, including development of or integration into photonics innovation hubs.

Actions should make use of existing infrastructure and develop close links with on-going European and national initiatives in order to maximise impact. Proposals must present industrially relevant business cases for the manufacturing pilot line, a plan for long-term sustainability and a credible strategy for future high volume production in Europe at competitive cost.

Actions must address one or more of the following technologies.

1. **Indium Phosphide (2018 call):** providing open access to photonics integrated circuits based on Indium Phosphide, going beyond multi-project wafers and offering generic solutions for a wide class of applications.

2. **Silicon Photonics (2018 call):** providing open access to photonics integrated circuits based on Silicon Photonics, going beyond multi-project wafers and offering generic solutions for a wide class of applications.

3. **Next generation free-form optics (2019 call):** maturing a technology platform and providing access to optics with free-form shapes and exceptional surface finish, exploiting new optical materials and/or combining and integrating

diffractive/refractive/reflective optical components, to obtain improved performances and capabilities.

4. **Advanced optical medical device technologies for medical diagnostics (2019 call):** maturing a technology platform and providing access to novel, reliable, robust optical based devices for in-vivo and/or in-vitro medical diagnosis.

At least one proposal will be selected to cover each of these technologies. The Commission considers that proposals requesting a contribution from the EU between EUR 8 and 15 million would allow these to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should describe how the proposed work will contribute to the listed corresponding expected impacts and include baseline, targets and metrics to measure impact.

- Improve significantly the uptake of photonics technology by end-user industry, in particular SMEs, enabling a demonstrably more competitive European industry.
- Greatly accelerate the time to market.
- Create sustainable manufacturing capability in Europe.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-04-2018: Photonics based manufacturing, access to photonics, datacom photonics and connected lighting

Specific Challenge: Photonics research in Europe is widely recognized for its excellence; researchers however experience difficulties in demonstrating their conceptual breakthroughs. The challenge is to reinforce the innovation ecosystem by providing access to advanced photonics technology to researchers and thereby accelerating the deployment of the next generation of disruptive photonics technologies.

Photonic integration combined with cost-effective assembly and packaging processes enables a drastic level of miniaturization, reducing the costs of implementation and energy consumption. The challenge is to build capabilities for automated mass manufacturing of datacom photonics in Europe.

LED/OLED lighting is now becoming the dominant lighting technology and the market focus is shifting from energy efficiency to additional smart features. The challenge is the integration of lighting with the Internet of Things, offering new functionalities beyond illumination.

The development and application of innovative photonics based manufacturing solutions will open new ways of producing more goods with fewer raw materials, less energy and less

waste. The challenge is to develop systems which deliver improved accuracy, power and control and which will enable the next generation of manufacturing in a range of industrial sectors.

Scope: The focus is on the following themes:

a) Innovation Actions

i. **Access to advanced photonics for researchers:** The objective is provide photonics and non-photonics researchers with a one-stop-shop access to a wide range of existing cutting edge technology platforms as well as services needed to facilitate their use (such as design, measurement and packaging).

ii. **Enabling automated mass-manufacturing of datacom photonics products:** Actions should demonstrate automated manufacturing of optical transceivers with transfer rates above 1Tb/s at competitive costs according to the interconnection distance. Actions should cover all manufacturing steps of proven designs from chip manufacturing to photonic/electronic integration through to packaging and testing, and final demonstration in a real environment. Standardisation should be addressed.

iii. **Connected Lighting:** The action should focus on integrating lighting infrastructure with the Internet of Things and demonstrating new functionalities such as visible light communication for indoor positioning and broadband data communication. Development and integration of new technologies as security and multicast communication into open architectures must be demonstrated in real environments. Standardisation of a reference architecture must be one of the main goals of the action.

Maximum one proposal will be selected to cover each of the themes i and iii. The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 6 million would allow these themes to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

b) Research and Innovation Actions

i. **Highly Productive Ultra-Short Laser Systems for Fast Materials Processing:** the development of ultra-short pulse laser systems with pulse durations in the nanosecond regime down to the femtosecond regime and with average beam power levels of at least 1kW enabling fast materials processing with minimal heat impact on the work piece. Pulse energies and wavelengths must be appropriate for the intended application. Proposals may include also the related monitoring and closed loop control aspects. The developed system should be demonstrated with a relevant industrial application.

ii. **Tailored Laser Beams for Laser-based Manufacturing**: new methods and schemes of beam shaping providing the optimal energy delivery on the work piece with a high spatial and temporal resolution. Proposals may include also the related monitoring and closed loop control aspects. The developed system should be demonstrated with a relevant industrial application.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 6 million would allow these themes to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should describe how the proposed work will contribute to the listed corresponding expected impacts and include baseline, targets and metrics to measure impact.

a) Innovation Actions

i. A strengthening European innovation ecosystem and improved cross fertilisation between photonics and other technology areas.

ii. Reduced manufacturing cost of PIC-based optical transceivers with transfer rates above 1Tb/s enabling massive deployment in datacenter environments (<1€/Gbps between racks and <0.1€/Gbps inside racks).

iii. Enabling Europe to maintain and build on its leading position in innovative lighting solutions by making lighting part of the Internet of Things and unlocking new application domains.

b) Research and Innovation Actions

i. Strengthening industrial manufacturing based on ultra-short pulse lasers and extending its field of applications by simultaneous improvement of precision and productivity; significant contribution to the digitization of European industry.

ii. Substantial contribution to digital photonic production with increased productivity, flexibility and customized products ("first time right") at significantly reduced costs.

Type of Action: Innovation action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-05-2019: Application driven Photonics components

Specific Challenge: Photonic technologies for health applications is a very promising field, where the EU has produced significant results during the past decades; however, industrialization is still lagging behind. The challenges are to develop methods that provide the clinicians with photonics enabled tools to improve or to assess the successes of therapies and to transform low TRL technologies into robust medical devices answering to clinician needs.

Photonic circuits are typically employed in combination with high performance electronics, micro-optics while the thermal management and the efficient integration of these technologies is accordingly of major importance. The challenge is to create and develop advanced

techniques for intimate integration of sub-systems incorporating multiple technologies enabling application across multiple domains.

The European continuous process industries as well as the piecewise manufacturing sector are facing the continuous struggle to keep a leading role in the worldwide competition. The challenge is to deploy photonic sensor technologies for the exact monitoring of process and product parameters so as to optimize those processes, saving resources whilst guaranteeing optimum product quality.

Scope: The focus is on the following themes:

Innovation Actions

i. **Photonics devices to support monitoring therapeutic progress:** Actions should develop reliable (high sensitivity, specificity and accuracy), safe to operate, cost-effective and fast photonics enabled devices to support assessing the effects of treatments of major diseases like cancer (excluding skin cancer), infectious, degenerative and cardiovascular diseases, including determining individual dispositions (eg methods to assess drug resistance) and monitoring of therapy progress. The feasibility and validity of the proposed approach should already have been validated in clinical settings. A medical equipment manufacturer should drive the action, and physicians/clinicians/surgeons must be closely involved. Validation should take gender specificities into account. Small scale clinical studies should be included, but clinical trials are excluded.

ii. **Sensor-Based Optimization of Production Processes:** Sensor-Based Optimization of Production Processes: Actions should address prototyping, demonstration, optimization and validation in real industry settings of highly advanced smart broadband multimodal photonic sensing solutions operating in the spectral range from the ultraviolet to the far infrared, and intended for improving production process through the monitoring of relevant process and product parameters (e.g. physical, chemical, imaging, geometrical and environmental). The focus is on cost-effective process-integrated solutions that are optimized in terms of speed, quality, and resource efficiency. The solutions should also address embedded pre-processing and suitably interpreting the acquired raw data for the optimization of the processes.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 6 million would allow these themes to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

Research and Innovation Actions

i. **Photonics System on Chip/ System in Package for optical interconnect applications:** Actions should address advanced techniques for the intimate combination of photonic integrated circuit technology with other enabling circuits, devices and mother boards to realise major advances in the capability, performance and complexity of photonic system-on-chip and system-in-package components targeting photonic interconnect

applications in the network, datacentre and consumer communication space. A holistic approach from design through to test is required. The targeted component technologies need to have demonstrable performance advantages in terms of speed, energy efficiency, cost and reliability and fit in the system and network architecture roadmaps of vendors.

ii. **Photonics systems for advanced imaging to support diagnostics driven therapy:** Actions should research ground-breaking, reliable (high sensitivity, specificity and accuracy), safe to operate, cost-effective and fast photonics enabled imaging system to support diagnostics during intervention and treatments of major diseases like cancer (excluding skin cancer), infectious, degenerative and cardiovascular diseases. Physicians/clinicians/surgeons and a medical equipment manufacturer must be closely involved from requirement specifications to validation in clinical settings. Validation should take gender specificities into account. Clinical trials are excluded.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 6 million would allow these themes to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

Coordination and Support Actions

i. **Fostering careers in photonics**: Actions should reach out to STEM graduates/PhD students and young postdocs in order to encourage more of them to pursue a career in photonics. Actions should help make students more industry ready and should provide the appropriate training, encourage innovation and entrepreneurship. Gender issues must also be addressed.

The Commission considers that proposals requesting a contribution from the EU between EUR 1 and 1.5 million (for theme i) would allow this to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should describe how the proposed work will contribute to the listed corresponding expected impacts and include baseline, targets and metrics to measure impact.

Innovation Actions

i. Strengthened Europe industrial competitiveness in the biophotonics related market.

ii. Increased competitiveness of the European production industry and significant contribution to the digitization of European industry.

Research and Innovation Actions

i. European industrial leadership in photonic systems integration and photonic interconnect technologies and applications, enabling the penetration of high-value markets.

ii. Increased European competiveness in the biophotonic areas and more effective medical interventions and treatments.

Coordination and Support Actions

i. More and better prepared professionals in the photonics sector.

Type of Action: Innovation action, Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-06-2019: Unconventional Nanoelectronics

Specific Challenge: The challenge is to maintain Europe's position at the forefront of advanced nanoelectronic technologies developments. This is essential to ensure strategic electronic design and manufacturing capability in Europe avoiding critical dependencies from other regions. Advanced nanoelectronics technologies enable innovative solutions to industrial and societal challenges.

Scope: Projects will aim at demonstrating the viability of new approaches to computing components. The focus should be on demonstrating new concepts at transistor or circuit level which bring the potential of highly improved performance for generic or specific applications. This can be based on materials, computing unit architecture (transistor or beyond) as well as at circuit level. Still the focus is on devices and components, as well as related processing technologies.

The concept validation should be addressed in a controlled environment at a limited scale (laboratory, research line) amenable to transfer to larger scale developments in industrial environments (pilot lines, etc.).

Innovative concepts include, but are not limited to, the design, processing and integration of devices based on new approaches, e.g. spintronics, neuromorphic, resulting in computing devices and circuits. Proposals are expected to prove the industrial relevance of the intended approach.

The scope of the call covers Research & Innovation Actions on

- Energy-efficient computation devices beyond the current CMOS paradigm. These can address steep slope devices, quantum bits implemented in solid-state, spintronic-based devices, single electron devices, nanomechanical switches, etc.

- Energy-efficient computation circuit architectures. These can be based on the devices above but approaches based on neuromorphic computing or other hardware implementation are relevant.

- Specific technological developments may include (i) promising approaches for 3D stacks, both sequential and monolithic to address challenges of compactness, heat dissipation, reduced interconnect length, and (ii) development of cryogenic electronics to support advances in applications to computing (superconducting, quantum computing) or constraints faced in space. The aim is the demonstration of functionality at circuit level by integrating the adequate functional blocks.

- Design for advanced nanoelectronics technologies. Focus will be on design-technology solutions for energy efficiency, high reliability and robustness. All above topics can be addressed as well as the issues related to improving the devices and circuits in the advanced technology nodes.

The proposed demonstrations are expected to be validated in laboratory (TRL 4).

Proposal are also expected to specify the road to industrialisation and establish links to applications likely to benefit from the development.

In line with the strategy for EU international cooperation in research and innovation (COM(2012)497), international cooperation is encouraged, in particular with countries that have substantial research in the area (e.g. Japan, South Korea, Taiwan and the USA).

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should address one or more of the following impact criteria and provide metrics to measure and monitor success.

- Identify applications likely to benefit from the intended approach with indication of key parameters (power, energy-efficiency, size, frequency, and cost) and quantitative targets to be achieved (figures of merit).

- Contribute to the mid-term viability of the European Nanoelectronics industry ensuring that new technologies with high potential for computing emerge in time to be taken up by industry.

- Sustain the technological integration requirements by focussing on challenging 3D integration issues as well as for electronics at cryogenic temperature.

- Contribute to the European industry capability to design advanced circuits for its needs.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-07-2018: Electronic Smart Systems (ESS)

Specific Challenge: The challenge is to develop and validate a new generation of cost-effective ESS technologies integrating hardware technologies across multiple fields eg, multi-modal sensing, actuating, advanced processing, and secure wireless transmission (to network or local infrastructures). Access to advanced electronics technologies by SMEs and academia is a complementary challenge supporting digitisation of industry.

Scope: **Research and Innovation Actions**

It is expected that proposals focus on only one of the two areas underneath (a or b).

a) Technological breakthroughs for future ESS leading to further miniaturisation, new functionalities, improved power consumption, autonomy, adaptation and reliability, and secure operation in real environments:

- Development and integration of micro- and nano- sensor and actuator systems in ESS, including sensors exploiting emerging paradigms (e.g. 2D and 1D nanomaterials, spintronics) for ultra-high sensitivity and low power, and MEMS/NEMS-based sensors,

- Demonstrating ESS that brings intelligence and real-time reconfiguration if required to the IoT edge with integration of sensor systems, processors, computing and networking elements with improved energy efficiency and sustainability,

- Advancing comprehensive design, integration and packaging technologies.

It is expected that, while proposed ESS technologies are to be validated via demonstrators operating in laboratory environments (TRL 4), industrial exploitation and application perspectives are clearly identified.

b) Advances in bio-electronics smart systems: Enhancement of the technical capabilities of bio-electronics and connected Bio-electronics and Micro-Nano-Bio Systems through cost-effective miniaturisation, manufacturing and demonstration, leading to high performance in specificity/sensitivity, reliability, time to results and manufacturability. This includes modular approaches with integration of standard components and interfaces as well as platforms where material, IT, communications and sensing/analysis modules are interchangeable. Portability, wearability, biocompatibility, and operation in remote and low resource settings should be considered. Needs of users, both men and women, markets and business cases should be clearly addressed.

Projects should start from experimentally proven concepts and deliver prototype(s) validated in relevant environments (TRL 5).

Issues related to security, safety, privacy, standardisation, interoperability, certification, life cycle, regulation compliance and ethics are to be considered where appropriate (for a and b).

The Commission considers that proposals requesting a contribution from the EU between EUR 2 and 4 million would allow these areas to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

Innovation Actions

c) Innovation Action on Access[15] to Nanoelectronics and Electronics Smart Systems: In the context of Digital Innovation Hubs (DIH) the goal is to support electronic components, sensors, smart devices and systems, including advanced nanoelectronics and integrated smart systems (e.g. Micro-Nano BioSystems). Focus is on (i) access to advanced design and manufacturing for academia, research institutes and SMEs, and (ii) Rapid prototyping production for SMEs and deployment to market. This service also includes activities such as technical support and training.

The Commission considers that proposals requesting a contribution from the EU of up to 8 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Coordination and Support Actions

d) Support Action on Electronics

- Reinforced collaboration & cross-fertilisation between projects and representatives of the Electronics areas addressed, namely (i) Nanoelectronics, (ii) Electronics Smart Systems and (iii) Flexible and Wearable Electronics;

- Increased outreach of these actions across Europe, their industrial perspective;

- Establishing of International cooperation in the field;

- Monitoring of technology advances and developments in the field and analysing the European ecosystems (available research infrastructures, competence centres, education, public procurement...) to determine the strengths and possible gaps.

- Elaborating technology and application roadmaps that identify new opportunities for users and suppliers.

The Commission considers that proposals requesting a contribution from the EU of up to 1 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should address some of the following impact criteria and provide metrics to measure and monitor progress:

- European Technology leadership in ESS and bio-electronics systems performances (functionalities, size, reliability, manufacturability, cost…)

[15] Including EuroPractice-type actions

- Improving ESS manufacturing capabilities in Europe,
- Increasing ESS and bio-electronics systems Market penetration in emerging digital economy sectors,
- Creating new opportunities for digitisation in traditional sectors and improving user acceptance
- Attract a substantial number of new users, from industry (in particular SMEs and mid-caps) and academia, to advanced technologies.
- Increased industrial investments and open innovation marketplace for ESS and bio-electronics technologies.
- Increased cooperation and synergy across electronic technology areas, promoting joint, multi-disciplinary initiatives.
- Stimulating the involvement of industry in longer term research and innovation activities.

Type of Action: Innovation action, Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-08-2019: Security and resilience for collaborative manufacturing environments

Specific Challenge: As addressed in the multi-annual roadmap[16] of the FoF cPPP, physically-entangled systems used in manufacturing environments have some specific requirements in terms of reliability and security, which are now challenged by the need for manufacturing facilities to be digitally connected with external partners in the value chain. While free flow of data is a primary requirement for digitisation of industry, it poses significant challenges in terms of data security, which cannot be solved easily because the factory of the future must exchange digital information with the outside world just like raw materials and components. There is a need to develop practically usable solutions which can guarantee an adequate level of security without limiting the capability to exchange data and information both on the manufacturing floor and beyond the factory.

Scope: Proposals need to develop tools and services guaranteeing an adequate level of data security for digital collaboration between manufacturing environments and value chains. Solutions need to be practically usable in real manufacturing facilities, taking into account the operational requirements needed for factory usage in real-world conditions, including reliability and resilience. Issues of threat detection and implementation of countermeasures should be addressed, as well as evolution and real-time response when needed. Semi-

[16] See roadmap document "Factories 4.0 and Beyond" on http://www.effra.eu/

autonomous or fully autonomous solutions, requiring little or no local supervision are encouraged.

Proposals will target TRL 5 to 7, and will include at least one use case which will demonstrate measurable and significant improvements over state of the art tools and methods under real-world conditions. The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 6 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Take-up by industry of practically usable solutions which guarantee significantly increased cyber-security levels in daily operations for manufacturing facilities and other actors in the value chains.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-09-2019-2020: Robotics in Application Areas[17]

Specific Challenge: While robots originated in large-scale mass manufacturing, they are now spreading to more and more application areas. In these new settings, robots are often faced with new technical and non-technical challenges. The purpose of this topic is to address such issues in a modular and open way, and reduce the barriers that prevent a more widespread adoption of robots. Four Priority Areas (PAs) are targeted: healthcare, inspection and maintenance of infrastructure, agri-food, and agile production.

User needs, ethical, legal, societal and economic aspects should be addressed in order to raise awareness and take-up by citizens and businesses. Privacy and cybersecurity issues, including security by design and data integrity should also be addressed, where appropriate.

Scope: **a) Research and Innovation boosting promising robotics applications**

Innovative approaches to hard research problems in relation to applications of robotics in promising new areas are particularly encouraged. Proposals are expected to enable substantially improved solutions to challenging technical issues, with a view of take-up in applications with high socio-economic impact. Driven by application needs, the work can start from research at low TRL, but proposals are expected to validate their results in realistic environments in order to demonstrate the potential for take-up in the selected application(s).

The call is open to all robotics-related research topics and to all new application areas. Excluded are the four priority areas which are already covered elsewhere in this work programme: healthcare, inspection and maintenance of infrastructure, agri-food and agile

[17] This topic continue in 2020 under ICT-46-2020: Robotics in Application Areas and Coordination & Support

production. Proposals will be expected to plan efforts to connect and cooperate with the DIHs, Platforms and other relevant activities of this work programme, as appropriate.

The Commission considers that proposals requesting a contribution from the EU between €3 million and €5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Innovation Actions - Robotics for infrastructure inspection and maintenance

Establish large-scale pilots capable of demonstrating the use of robotics at scale in actual or highly realistic operating environments; showcase advanced prototype applications built around platforms operating in real or near-real environments and demonstrate high levels of socio-economic impact.

Through large-scale pilots, proposals are expected to make a significant step forward in platform development in the area of infrastructure inspection and maintenance. Starting from suitable reference architectures, platform interfaces are defined, tested via piloting, and supported via ecosystem building preparing their roll-out, and are being evolved over time into standards.

Each proposal is expected to establish large scale pilots. They are expected to: consider utilising existing infrastructure and links to other European, national or private funding-sources; identify the long-term sustainability of the pilot; develop scalable technical solutions capable of meeting performance targets; develop metrics and performance measures for the pilot; engage relevant industry stakeholders, including SMEs, in the provision and operation of the pilot. Proposals will be expected to dedicate resources to disseminate best practice and coordinate access to platforms and demonstrators, in particular in connecting with the Robotics DIHs and Core Technologies actions and other relevant activities, in H2020 and beyond.

Pilots are expected to address both technical and non-technical issues, such as socio-economic impact, novel business models, legal and regulatory, ethical and cyber-security issues and connections to Big Data and IoT.

The Commission considers that proposals requesting a contribution from the EU between €7 million and €9 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

c) Robotics Competitions

Competitions aims at reducing technical and commercial risks by allowing commercial and technical performance data to be gathered and assessed. They provide a real or near-real operating environment for long-term trials and the testing of deployment strategies.

Proposals (CSA) should address the delivery of challenge-led, robotics competitions focusing on the four application areas prioritised: Healthcare, Infrastructure Inspection and Maintenance, Agri-Food, and Agile Production. Besides the technological objectives,

proposals are also expected to stimulate public engagement and engage with the Robotics DIHs. Proposals should address all aspects of running competitions as public events**,** and engage with the media and public. Proposals should seek to mobilise external partners in sponsoring and setting up the competitions.

Expected Impact: a)

- Strengthening European excellence in Robotics S&T
- Boosting the use of robotics in promising application areas
- Opening up new markets for robotics
- Lowering barriers in the deployment of robotics-based solutions.

b)

- Demonstration of the potential for robotics to impact at scale in the chosen application areas prioritised in this call (infrastructure inspection and maintenance).
- Reduction of technical and commercial risk in the deployment of services based on robotic actors within the selected application area.
- Greater understanding from the application stakeholders of the potential for deploying robotics.
- Demonstration of platforms operating over extended time periods in near realistic environments and promotion of their use.
- Develop the eco-system around the prioritised application areas to stimulate deployment.
- Contribution to the development of open, industry-led or de facto standards

c)

- Greater public exposure to actual robotics capability.
- Greater engagement with competitions from commercial organisations in the four prioritised application areas: Healthcare, Infrastructure Inspection and Maintenance, Agri-Food and Agile Production.

Type of Action: Innovation action, Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-10-2019-2020: Robotics Core Technology[18]

Specific Challenge: Autonomy in robotic systems is built on a combination of four core technologies:

AI and Cognition: AI provides tools to make systems cognitive. Cognition equips robots with the ability to interact with people and environments, to learn and to categorise, to make decisions and to derive knowledge.

Cognitive Mechatronics: Mechatronic systems where sensing and actuation are closely coupled with cognitive systems are expected to deliver improved control, motion, interaction, adaptation and learning, and safer systems.

Socially cooperative human-robot interaction: Cooperative human-robot interaction is critical in many work environments from collaborative support, e.g. passing tools to a worker, to the design of exo-skeletons able to provide motion that is sympathetic to the user.

Model-based design and configuration tools: Deploying robotics at scale in application areas where tasks need to be defined by the user requires easy-to-use configuration tools. Embedding and sharing of knowledge between tools is essential, as is standardisation across the interfaces to connect systems and modules (taking into account cybersecurity issues, including security by design and data integrity).

Scope: Proposals should address one of the four core technologies and target the development of core technology modules (modular, open and non-proprietary) and tool kits for use in deployable system platforms that meet the requirements of applications in the following four prioritised application areas: Healthcare, Infrastructure Inspection and Maintenance, Agri-Food and Agile Production. Proposals will be required to dedicate resource for connecting with the DIH actions arising from DT-ICT-02-2018.

The Commission considers that proposals requesting a contribution from the EU of between €5 million and €10 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Improved technical capability in each of the core technologies over the current state of the art.
- A greater range of applications in the prioritised application areas that can be demonstrated at TRL 3 and above.
- The lowering of technical barriers within the prioritised applications areas.

Type of Action: Research and Innovation action

[18] This topic continue in 2020 under ICT-47-2020: Research and Innovation boosting promising robotics applications.

The conditions related to this topic are provided at the end of this call and in the General Annexes.

European Data Infrastructure: HPC, Big Data and Cloud technologies

The European Cloud Initiative calls for the creation of a leading-class European Data Infrastructure (EDI) as an essential component to exploit the data revolution in Europe and contribute to global growth. The aim of the activities under this heading is to enable the creation of a world-class High Performance Computing (HPC)/Big Data (BD) ecosystem based on European leadership in HPC, Cloud and Big Data technologies. This ecosystem will strengthen the European technology supply in these areas and will provide innovative, usable and competitive solutions that satisfy the demands of users of the European Data Infrastructure.

A synergetic approach to support the creation of a European Data Infrastructure and a European Data Economy is promoted, complementing the relevant activities in the e-Infrastructures and FET work programmes 2018-2020.

The Copernicus Data and Information Access Services (DIAS) will contribute to EDI by making Copernicus' huge amount of data available within an efficient computing environment.

The topics ICT-14-2020: Co-designing Extreme Scale Demonstrators (EsD) and Framework Partnership Agreement in European low-power microprocessor technologies (Phase 2) have been removed from the Work Programme in view of the transfer of High Performance Computing activities in 2019 and 2020 to the EuroHPC Joint Undertaking.

ICT-51-2020: Big Data technologies and extreme-scale analytics

Specific Challenge: Rapidly increasing volumes of diverse data from distributed sources create challenges for extracting valuable knowledge and commercial value from data but at the same time have huge potential towards more accurate predictions, better analytics and responsible AI. This calls for novel methods, approaches and engineering paradigms in machine learning, analytics and data management. As the success will require not only efficient data processing/management but also sufficient computing capacity and connectivity, a coordinated action with the appropriate technology areas (e.g. AI, analytics, software engineering, HPC, Cloud technologies, IoT and edge/fog/ubiquitous computing) is necessary and will contribute to a European leadership in these areas.

All grants under this topic will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

Scope: **a) Research and Innovation Actions (RIA)**

Developing new methodologies and engineering solutions addressing industrial and/or societal challenges. Proposals should cover at least one of the following technology areas (but may additionally cover others): machine learning/deep learning (especially on distributed data

sets), architectures for collecting, managing and exploiting vast amounts of data; system engineering/tools to contribute to the co-design of federated/distributed systems (to involve all stakeholders/technology areas); new methods for extreme-scale analytics, deep analysis, precise predictions and automated decision-making; novel visualization techniques; data fusion and data integration technologies; standardized interconnection methods for efficient sharing of heterogeneous data pools, seamlessly using distributed tools and services.

The data assets must be sufficiently large, realistic, available to the project and described in the proposal. The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 6 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and Support Action (CSA)

To ensure coordination between the different existing and emerging activities in HPC/BD/Cloud/AI technologies, including Public-Private Partnerships, digital innovation hubs, and relevant national and regional initiatives, in particular the European Network of National Big Data Centres of Excellence[19]. This action is expected to support the transition towards the activities in the Horizon Europe programme.

The Commission considers that proposals requesting a contribution from the EU of EUR 1.5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: **a) Research and Innovation Actions**

- Increased productivity and quality of system design and software development thanks to better methods, architectures and tools for complex federated/distributed systems handling extremely large volumes and streams of data;
- Demonstrated, significant increase of speed of data throughput and access, as measured against relevant, industry-validated benchmarks;
- Demonstrated adoption of results of the extreme-scale analysis and prediction in decision-making, including AI (in industry and/or society)

b) Coordination and Support Action

- Effective cooperation of the participating initiatives and platforms as measured by the jointly participating relevant members/users, countries/regions/cities and projects, and the organisation of common events and joint initiatives, resulting in an increased prevalence of data value chains and related technologies (HPC/BD/Cloud/IoT/AI) in the national and regional strategies.
- Smooth transition to Horizon Europe activities.

[19] http://www.big-data-networks.eu//

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-40-2020: Cloud Computing: towards a smart cloud computing continuum

Specific Challenge: **Cloud computing is changing from a pure elastic provisioning of virtual resources (or platforms) to a transparent and adaptive hosting environment that fully realizes the "everything as a service" provisioning concept, from centralised cloud to the edge, and from network and computing infrastructure up to the application layers.**

The challenge is to develop comprehensive cloud solutions and testbeds combining various execution platforms for ubiquitous and seamless execution computing environments as a foundation for a complete computing continuum. This requires novel solutions for federating infrastructures, programming applications and services, and composing dynamic workflows, which are capable of reacting in real-time to unpredictable data sizes, availability, locations, and rates. This will provide application developers with greater control over network, computing and data infrastructures and services, and the end-user will benefit from seamless access to continuous service environments. Such solutions should also address security, semantic interoperability, heterogeneous data integration, organisation and linking, data protection, performance, resilience and energy-efficiency requirements to respond to the future digitisation needs of industry and the public sector. Addressing these challenges will also be part of and contribute to the technological ambitions of the Next Generation Internet (NGI).

Scope: **a) Research and Innovation Actions (RIA)**

Proposals will address at least one of the following areas:

i. Advanced cloud technologies and testbeds combining aspects of network, computing and data/information resources (i.e., next generation networks, novel datacenter architectures, fog/edge computing and sensor networks, large-scale analytics and simulation, public, hybrid, multi-cloud computing, etc.) to provide complete solutions encompassing network, computing and data services. The key aspect of these advanced cloud technologies is to seamlessly combine computation resources all along the data path and support the complete service lifecycle (i.e. from the end-user request/context to creation of workflows, monitoring of execution platforms, application deployment and adaptation while optimising the execution).

ii. Advanced Cloud Data Privacy and Security techniques taking into account issues such as integrating data protection principles, unifying security policies across cloud services and applications, defining personal data semantics, managing data locality, migration and latency.

iii. Novel programming models and semantically interoperable services to support dynamic environments that respond intelligently to changes in application behaviour or data variability; automatic deployment and continuous dynamic composition of semantically annotated services; adaptability of services to different resources & usage contexts; automatic reasoning, scheduling and deployment of workflows on top of the resulting infrastructure.

The proposals should demonstrate the applicability and viability of the proposed solution across multiple application domains.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and Support Actions (CSA)

Proposals in this action will address the following:

- Coordinate stakeholders in Cloud Computing and act as support to R&D programmes/activities by disseminating project results and organising scientific and policy events, developing research and innovation roadmaps, and addressing pre-standardisation initiatives.

The Commission considers that proposals requesting a contribution from the EU between EUR 400.000 to 600.000 would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: **a) Research and Innovation Actions (RIA)**

- Contribute to the development of an ecosystem and testbeds that will respond to the future digitisation needs of industry and the public sector;
- Assist the development of new cloud-based services and infrastructures in Europe and foster an industrial capability in the cloud computing sector;
- Create new opportunities to encourage European-based providers, in particular SMEs, to develop and offer cloud-based services based on the most advanced technologies;
- Leverage research and innovation projects to support the development and deployment of innovative cloud-based services and next generation applications, for the public and private sectors (including standardisation and applications for AI, Big-Data and other sector-specific applications).

b) Coordination and Support Actions (CSA)

- Creation of a sustainable European forum of stakeholders representing the Cloud Computing research, industry and users.

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-11-2018-2019: HPC and Big Data enabled Large-scale Test-beds and Applications

Specific Challenge: The Internet of Things and the convergence of HPC, Big Data and Cloud computing technologies are enabling the emergence of a wide range of innovations. Building industrial large-scale application test-beds that integrate such technologies and that make best use of currently available HPC and data infrastructures will accelerate the pace of digitization and the innovation potential in Europe's key industry sectors (for example, healthcare, manufacturing, energy, finance & insurance, agri-food, space and security).

Scope: a) **Innovation Actions (2018 call - deadline in April 2018)** targeting the development of large-scale HPC-enabled industrial pilot test-beds supporting big data applications and services by combining and/or adapting existing relevant technologies (HPC / BD / cloud) in order to handle and optimize the specific features of processing very large data sets. The industrial pilot test-beds should handle massive amounts of diverse types of big data coming from a multitude of players and sources and clearly demonstrate how they will generate innovation and large value creation. The proposal shall describe the data assets available to the test-beds and, as appropriate, the standards it intends to use to enable interoperability. Pilot test-beds should also aim to provide, via the cloud, simple secure access and secure service provisioning of highly demanding data use cases for companies and especially SMEs.

b) **Innovation Actions (2018 call - deadline in November 2018)** targeting the development of large-scale IoT/Cloud-enabled industrial pilot test-beds for big data applications by combining and taking advantage of relevant technologies (Big Data, IoT, cloud and edge computing, etc.). The aim is to develop industrial pilot test-beds addressing data flows from a very large number of distributed sources (such as sensors or IoT applications/infrastructures and/or involving remote data storage/processing locations) and clearly demonstrate how they will generate innovation and large value creation from such data assets. The industrial pilot test-beds shall also address the relevant networking connectivity and large-scale data collection, management and interoperability issues. The data assets available to the test-beds should be described in the proposal. Pilot test-beds should also aim to provide, via the cloud, simple secure access and secure service provisioning of highly demanding data use cases for companies and especially SMEs.

a) is called in the 2018 call with a deadline in April 2018. b) is called in the 2018 call with a deadline in November 2018.

For all subtopics a), b) above:

Proposals should be led by and show strong industrial commitment. They should explain how the proposed activities will be industrialized and have impact on the competitiveness and leadership of European industry. They should target a wide participation and/or applicability and use of the targeted industrial pilot test-bed by industrial members/users from different

countries and regions. They should also define quantifiable outputs and impact Key Performance Indicators, in particular related to the "Expected Impact" of the topic.

The Commission considers that proposals requesting a contribution from the EU between EUR 12 and 13 million for subtopic a), and EUR 15 and 18 million EUR for subtopic b) would allow these areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Proposals could seek synergies and co-financing from relevant national / regional research and innovation programmes, including European Structural and Investment Funds (ESIF) addressing pre-identified smart specialisation priorities at regional / national level. Proposals combining different sources of financing should include a concrete financial plan detailing the use of these funding sources for the different parts of their activities.

All grants under both subtopics will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

Expected Impact: Proposals should address the following impact criteria, **providing metrics to measure success** where appropriate:

- Demonstrated increase of innovation and productivity in the main target sector of the Large Scale Pilot Action;
- Increase of market share of Big Data technology providers if implemented commercially within the main target sector of the Large Scale Pilot Action;
- Effective integration of HPC/BD/Cloud/IoT technologies in the main target sector(s) of the Large Scale Action, resulting into integrated value chains and efficient business processes of the participating organizations;
- Widening the use of and facilitating the access to advanced HPC, big data and cloud infrastructures stimulating the emergence of the data economy in Europe;
- Stimulating additional private and public target investments in HPC and Big Data technologies from industry, Member States and Associated Countries, and other sources, as referred to in the contractual arrangements of the HPC and/or the Big Data Value Public Private Partnerships.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-12-2018-2020: Big Data technologies and extreme-scale analytics[20]

Specific Challenge: Rapidly increasing volumes of diverse data from distributed sources create challenges for extracting valuable knowledge and commercial value from data. This calls for novel methods, approaches and engineering paradigms in analytics and data management. As the success will require not only efficient data processing/management but also sufficient computing capacity and connectivity, a coordinated action with all related areas (e.g. analytics, software engineering, HPC, Cloud technologies, IoT) is necessary and will contribute to a European leadership in these areas.

Scope: a) **Research and Innovation Actions** developing new big data analytics methodologies and engineering solutions addressing industrial and/or societal challenges. Proposals may cover (but are not limited to): architectures for collecting and managing vast amounts of data; system engineering/tools to contribute to the co-design of secure federated/distributed systems (to involve all stakeholders/technology areas); new methods for extreme-scale analytics, deep analysis, precise predictions and decision making support; novel visualization techniques; standardized interconnection methods for efficient sharing of heterogeneous data pools, seamlessly using distributed tools and services.

The data assets should be available to the project and described in the proposal. The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 6 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) **One CSA** to ensure coordination between the different existing activities in HPC/BD/Cloud technologies, including Public-Private Partnerships, digital innovation hubs, and relevant national and regional initiatives, in particular the European Network of National Big Data Centres of Excellence[21].

The Commission considers that proposals requesting a contribution from the EU of EUR 1 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

All grants under this topic will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

Expected Impact: a)

- Increased productivity and quality of system design and software development thanks to better architectures and tools for complex federated/distributed systems handling extremely large volumes and streams of data;
- Demonstrated, significant increase of speed of data throughput and access, as measured against relevant, industry-validated benchmarks;

[20] This topic continue in 2020 under ICT-51-2020: Big Data technologies and extreme-scale analytics
[21] http://i-know.tugraz.at/european-network/

- Demonstrated adoption of results of the extreme-scale analysis and prediction in decision-making (in industry and/or society)

b)

- Effective cooperation of the participating initiatives and platforms as measured by the jointly participating members/users, countries/regions/cities and projects, and the organisation of common events and joint initiatives, resulting in an increased prevalence of data value chains and related technologies (HPC/BD/Cloud/IoT) in the national and regional strategies.

Type of Action: Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-13-2018-2019: Supporting the emergence of data markets and the data economy

Specific Challenge: The lack of trusted and secure platforms and privacy-aware analytics methods for secure sharing of personal data and proprietary/commercial/industrial data hampers the creation of a data market and data economy by limiting data sharing mostly to open data. This need strongly emerges from recent evidence from stakeholders, both for personal data platforms[22] and for industrial data platforms.[23,24,25] The lack of ICT and Data skills seriously limits the capacity of Europe to respond to the digitisation challenge of industry. Specific attention needs to be put in involving SMEs and give them access to data and technology. IT standardisation faces new challenges as technologies converge and federated systems arise, creating new gaps in interoperability.

All grants under this topic will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

Scope: a) Innovation Actions for setting up and operating platforms for secure and controlled sharing of "closed data" (proprietary and/or personal data). The actions should address the necessary technical, organisational, legal and commercial aspects of data sharing/brokerage/trading, and build on existing computing platforms. Proposals shall address one or both of the following sub-topics:

- *Personal data platforms* shall ensure respect of prevailing legislation and allow data subjects and data owners to remain in control of their data and its subsequent use. Solutions should preserve utility for data analysis and allow for the management of privacy / utility trade-offs, metadata privacy, including query privacy. Solutions should

22 See a Commission paper on "Personal information management services – Current state of service offers and challenges" analysing feedback from public consultation

23 See "Industrial Data Platforms – Key Enablers of Industry Digitization", IDC study report 28/7/2016

24 See "Report on the alignment of priorities and programmes and mobilisation of investments towards platform/standardisation initiatives" DEI Working Group 2 "Strengthening Leadership in Digital Technologies and in Digital Industrial Platforms across Value Chains in all Sectors of the Economy", to be published in April 2017.

25 See European Commission Staff working document accompanying the communication "Building the European Data Economy", published in January 2017.

also develop privacy metrics that are easy to understand for data subjects and contribute to the economic value of data by allowing privacy-preserving integration of independently developed data sources.

- *Industrial data platforms* shall enable and facilitate trusted and secure sharing and trading of proprietary/commercial data assets with automated and robust controls on compliance (including automated contracting) of legal rights and fair remuneration of data owners.

The actions are required to link to and bring in industrial data providers (not necessarily as consortium members) that will populate the platforms. Conditions of use and practical arrangements of data sharing should be regulated.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 6 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Research and Innovation Actions to advance the state of the art in the scalability and computational efficiency of methods for securing desired levels of privacy of personal data and/or confidentiality of commercial data, particularly when they are combined from multiple owners. Proposals shall also analyse and address, as appropriate, privacy/confidentiality threat models and/or incentive models for the sharing of data assets.

c) **CSA** proposals are invited to cover both of the following tasks:

- Support the emergence of a data economy by ensuring SME inclusion, entrepreneurial support and trust-building, address the data skills gap. The CSA action shall liaise with and complement related initiatives[26], and shall support and work in collaboration with the platforms under ICT-13 a).

- In line with the Communication on ICT Standardisation Priorities for the Digital Single Market[27], promote standardization, interoperability and policy support in the field of data and federated/networked computing systems.

One CSA will be funded. The Commission considers that proposals requesting a contribution from the EU of EUR 3 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: a) and b)

[26] Such as the European Data Science Academy (EDSA), the network of European Centres of Excellence in Big Data, the BDVe project.

[27] https://ec.europa.eu/digital-single-market/en/news/communication-ict-standardisation-priorities-digital-single-market

- Personal data protection is improved, and compliance with the General Data Protection Regulation (and other relevant legislation) is made easier for economic operators
- Citizens' trust is improved as privacy-aware transparency and control features are increasingly streamlined across data platforms and Big Data applications.
- Better value-creation from personal and proprietary/industrial data.
- 20% annual increase in the number of data provider organisations in the personal and industrial data platforms
- 30% annual increase in the number of data user/buyer organisations using industrial data platforms
- 50% annual increase in number of users (data subjects) in the personal data platforms
- 20% annual increase in volume of business (turnover) channelled through the platforms

c)

- Demonstrated success stories among clients as a result of the services offered by the CSA and at least 50 clients (e.g. start-ups, SMEs) served annually in partner finding, matchmaking, venture capital raising, training, coaching etc.
- Improved standardisation and interoperability especially in the context of cross-sector applications and technology convergence (data, Cloud, IoT, connectivity a.o.)

Type of Action: Research and Innovation action, Coordination and support action, Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-15-2019-2020: Cloud Computing[28]

Specific Challenge: Develop competitive cloud solutions based on advanced cloud platforms and services and cloud-based software and data applications, as well as the opportunities brought by considering the edge devices capacities. Such solutions should also address stringent security, data protection, performance, resilience and energy-efficiency requirements to respond to the future digitisation needs of industry and the public sector. Addressing these challenges will also be part of and contribute to the technological ambitions for the Next Generation Internet (NGI) and the Internet of Things (IoT).

Scope: *a) Research and Innovation Actions (RIA)*

Proposals will address at least one the following areas:

[28] This topic continue in 2020 under ICT-40-2020: Cloud Computing: towards a smart cloud computing continuum.

i. New modelling techniques and mechanisms are needed to compose and coordinate resources across heterogeneous clouds, including micro local clouds, private enterprise clouds, aggregated and hybrid cloud models facilitating interoperability and data portability between cloud service providers. Techniques that guarantee privacy, security, identity are essential.

ii. Edge computing (fog computing) technologies that integrate the limited memory, storage and computation of fog nodes that are closer to where data are generated into the cloud architecture and allow to make intelligent decisions when to move computation from the edge to the cloud, while taking into account the network capabilities as well as the security and/or sensitivity of data.

iii. New management strategies aimed to design and develop an efficient, coordinated, robust, secure and service agnostic management of the set of resources brought by combining cloud, IoT, Big Data and fog computing. Solutions for consistent resources categorization, abstraction and monitoring are fundamental. Proposed solutions should also envision the development of novel collaborative (sharing) scenarios and innovative service execution approaches that allow the dynamic allocation of cloud services to improve performance, and to facilitate automatic discovery and composition of cloud services at IaaS, PaaS and SaaS levels (Infrastructure, Platform and Software as a Service). The provision and its user-friendly combination, usage and orchestration of such services should particularly look at SMEs and public sector users.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and Support Actions (CSA)

Proposals in this action will address the following:

- Facilitate awareness of stakeholders in research and policy matters related to Cloud Computing.
- Coordinate stakeholders in Cloud Computing and act as support to R&D programmes/activities by disseminating project results and organising scientific and policy events, developing research and innovation roadmaps, and addressing pre-standardisation initiatives.

Expected Impact: *a) Research and Innovation Actions (RIA)*

i. Contribute to the development of an ecosystem that will respond to the future digitisation needs of industry and the public sector;

ii. Assist the development of new cloud-based services and infrastructures in Europe and foster an industrial capability in the cloud computing sector;

iii. Create new opportunities to encourage European-based providers, in particular SMEs, to develop and offer cloud-based services based on the most advanced technologies;

iv. Leverage research and innovation projects to support the development and deployment of innovative cloud-based services and next generation applications, for the public and private sectors (including standardisation and applications for Big-Data and other sector-specific applications).

b) Coordination and Support Actions (CSA)

- Creation of a sustainable European forum of stakeholders representing the Cloud Computing research, industry and users.

Type of Action: Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-16-2018: Software Technologies

Specific Challenge: New advances in ICT technology influence the way software is developed. Software is increasingly becoming a pervasive and enabling technology and the impact of software defined infrastructures in the software development & management processes will span across multiple technology domains (e.g HPC, IoT, Big Data, Cloud, Artificial Intelligence). There is a need for novel and generic software engineering methods and tools that are applicable across different domains and that are complemented by domain-specific software related activities such as those proposed in the past and current H2020 ICT-LEIT Work Programmes.

Future software technologies need to address the transition from modern development processes towards a new paradigm which treats software, data, computing and communication resources as abstract elements. This will enable data to flow freely over heterogeneous infrastructures in a scalable, distributed and human-understandable fashion. To this end, the degree of abstraction in all these elements must be increased without losing controllability or correctness. The challenge would be to support the full software lifecycle in adopting this new paradigm.

In this fast evolving landscape, there is a need for increased software development productivity which can be fulfilled through the exploitation of reusable code and software components from existing code bases (either as open source software or proprietary software shared among closed ecosystems).

Scope: a) **Integrated programming models & techniques for exploiting the potential of virtualised and software defined infrastructures**: (Research and Innovation Actions)

Proposals will address at least one of the following areas:

- Code and resources (data, computing and networking) abstraction: Advances in how to abstract code and data beyond simple semantic annotations that are expressive, machine-readable and carrying out additional information about execution requirements, network topologies, data sources, etc. The concepts must allow (de)composition and transformation of all aspects involved in the code, including (de)composition of non-functional properties, conversion to different target platforms, restructuring and reinterpretation of data.

- Advanced software systems development: Methods for describing software, data and requirements that are necessary to advance software application development for software defined infrastructures. Such methods should enable flexible (de)composition and interoperability of software and data at run-time, thereby adhering to relevant operational constraints and business requirements. To enable development of such complex structures of code and data, programming models must become more abstract and easier to use, following the principles of human thinking, rather than conventional algorithms.

The proposals should demonstrate the applicability and viability of the proposed solution across multiple application domains.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Software ecosystems exploiting the potential of existing code bases. (Innovation Actions)

Proposals in this action will address the following area:

- Development platforms and techniques for code re-usability, providing the necessary mechanisms for ensuring software quality (development, verification, validation and/or qualification tools), supporting software reusability (storing, tracking, searching and analysing software artefacts) and sustainable community building. Attention should be given in the handling of cross-platform dependencies and in the quality management of software built from diverse components.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

c) Coordination and Support Actions

Proposals in this action will address one of the following areas:

- Implement support actions which will help H2020 projects in the area of software technologies to establish their software ecosystems, transform their initial software development results into exploitable and viable solutions, showcase best practices of

code reusability, facilitate community building and promote reuse of the code by new initiatives.

- Coordinate stakeholders in Software Technologies and act as support to R&D programmes/activities by disseminating project results and organising scientific and policy events, developing research and innovation roadmaps.

The Commission considers that proposals requesting a contribution from the EU between EUR 400.000 to 600.000 would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

a) Research and Innovation Actions (RIA)

- Increased capacity of the European software industry to exploit the capabilities of software-defined infrastructures at middleware and application layer.

- Expand research and innovation potential in software technologies while overcoming fragmentation in the European supply base, optimizing investments and use of resources to yield multi-domain software-based products and related software services.

b) Innovation Actions (IA)

- Expand innovation potential in software technologies while overcoming fragmentation in the European supply base, optimizing investments and use of resources to yield reusable software-based products and related software services.

c) Coordination and Support Actions (CSA)

- Creation of a sustainable European forum of stakeholders representing the Software research, industry and end users.

Type of Action: Coordination and support action, Innovation action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

5G

The third phase of the 5G Public Private Partnership (5G PPP) targets technology validation in a system context and for multiple use cases, with performances well beyond those of early 5G trials ongoing or planned by private actors with "non standalone" 5G implementations. It targets innovative 5G validation with "vertical" use cases in line with the 5G Action Plan adopted by the Commission. These objective remain valid under this Work Programme which also aims at leveraging 5G technologies towards downstream innovation both at service and product levels, at maintaining a significant long term commitment to prepare for 5G "Long Term Evolution" and to bridge into smart connectivity platforms, which are expected to

emerge during the next multi-annual financial framework (MFF). Work is also expected to leverage international cooperation towards industrial consensus on 5G key aspects such as interoperability, architecture, standards, spectrum, and deployment while preparing for a longer term vision of connectivity in the next decade.

Activities under this heading are intended to support EU 5G policy as outlined in the context of the 5G Action Plan[29] *whilst implementing the last phase of the 5G cPPP roadmap. They should significantly contribute to building a first class European industrial supply side for core 5G technologies with global market footprints and notably for network technologies and systems. They will support the emergence of new innovative market players taking advantage of the growing adoption of distributed cloud computing technologies in 5G networks and making possible open innovation at service level. The work also supports the needed transformation of the telecom industry with a growing part of the activities moving from hardware to software in the context of an increased virtualisation of networks. In the context of the EU standardisation and spectrum policies, the work contributes to the emergence of global standards and globally harmonised frequency bands for 5G, in the context of related developments at the level of global bodies like 3G PP and ITU. This 5G PPP phase also aims at developing "lead" markets involving cooperation models with key vertical sectors contributing to the wider policy objectives of industry digitisation in the Digital Single Market. It will contribute to the successful implementation of 5G-based cross-border corridors for Connected and Automated Mobility in the EU and prepare for future deployment phases under the next MFF.*

Complementary grant agreements will be implemented across projects originating from RIA, IA and CSA implemented under ICT-17-2018, ICT-18-2018, ICT-19-2019, ICT-20-2019, ICT-41-2020, ICT-42-2020, ICT-52-2020, ICT-53-2020 through use of the respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement.

ICT-52-2020: 5G PPP – Smart Connectivity beyond 5G

Specific Challenge: The challenge is to go well beyond the 5G capabilities developed under 3G PPP release 16 that will become available early 2020. It also looks beyond 5G to prepare for the realisation of Smart Connectivity systems as a platform for a Next-Generation Internet, which should support a highly flexible connectivity infrastructure that can dynamically adapt to changing requirements of innovative applications whilst facilitating user data control and innovation friendly implementation of relevant legislation. This requires a full value-chain approach towards seamless and secure end-to-end interworking with computing resources (e.g. distributed data centres, edge computing) and with a range of innovative devices.

Scope: The work covers the long term transformation of networks into a distributed smart connectivity platform with high integration with (edge) computing and storage resources. Work should lead to solutions where processes and applications are dynamically supported depending on the information flows and application requirements. It should enable novel interaction between human and digital systems based on new terminal types embedded in the

[29] *Doc COM(2016) 588: 5G for Europe, an Action Plan*

daily environment, e.g. in cars, doors, mirrors, appliances, and new interfaces recognising gestures, facial expressions, sound and haptics. Work should lead to smart connectivity infrastructure with adaptive topologies that supports a virtually infinite capacity and perceived zero latency, highly diverse device densities and highest reliability and availability[30]. It should lead to professional grade of security and privacy whilst bringing down OPEX, CAPEX, and energy consumption. Focus is notably on:

- Provision of seemingly infinite network capacity including innovative spectrum use and management, usability of new bands and radio technologies towards cell free networks including scalable cell-free Massive MIMO, usage integration and optimised management of optical resources, as well as architectures enabling hyper dense ambient networks.

- Support for imperceptible latencies through flexible connect-compute technologies and architectures enabling optimised distribution of the latency budgets as a function of the application requirements.

- Provision for smart connectivity of massive amounts of things and systems in a scalable, interoperable and cost-efficient way. Energy efficiency and paradigms where consumption moves from connectivity to computing (e.g. Mobile Edge Computing) will be considered.

- Support for novel architectures and protocols for adaptive networks, including peer-to-peer, meshed and relay-based, for new mobility paradigms, taking advantage when relevant of cognitive operations making use of Artificial Intelligence and Machine Learning mechanisms, taking a full end-to-end value chain approach, including terminal and application management. Resilience against attacks on Artificial Intelligence and Machine Learning mechanisms are in scope.

- Provide personalised, multi-tenant and perpetual protection based on security, privacy and trust mechanisms required in highly virtualised and software environments, taking into account an end-to-end perspective including hardware security capabilities as well as software processes. Blockchain technologies may be explored in that context.

Proposals may focus on one or several of the above indicative sub-topics, and will bridge towards preparing evolution paths for R&I on smart networks and services in future programmes.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 and 12million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. In particular, initiatives with strong structuring effects across a large set of key industry

[30] The 5x9 availability level of 5G is being perceived as insufficient in some industrial environments, e.g. in factories for high accuracy robot control, telesurgery, or some high end applications of connected cars

stakeholders and programmatic impact for future European actions in the domain of Smart Network and Services may target the higher budget range.

Expected Impact:

- Smart connectivity technologies for platforms integrating ubiquitous connectivity, storage, and computing resources opening for new service and business models.
- Smart connectivity platforms integrating technologies and architectures towards perceived zero latency.
- Network scalability towards a high number of resource-constrained (IoT) devices, multiplicity of service requirements, and new user-controlled connectivity paradigms.
- Characterisation and availability of secure and trusted environments for software based virtualised networks, including underlying hardware limitations and enabling trusted multi-tenancy.
- Innovative radio spectrum use, novel strategies for coverage/service extension, support of novel wireless technologies and use cases through platforms, usability of today unexplored spectrum.
- Heterogeneous networks with dynamic topologies for advanced mobility solutions.
- Dynamic scalability of network capabilities through availability of managed and enhanced optical resources.
- Characterisation of AI and blockchain technologies in the connectivity domain, notably for network/service management and security.
- Significant reduction of total cost of ownership through improved operational and capital expenditure efficiency, and energy consumption.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-41-2020: 5G PPP – 5G innovations for verticals with third party services

Specific Challenge: Software networks provide high flexibility through implementation of virtual network functions (VNFs). VNF's may be chained across several domains to create Network Applications (NetApps) tailored to the requirements of specific tenants, as demonstrated under previous 5G PPP phases. This requires open platforms that provide access to networks resources which can then be used to develop NetApps supporting requirements and developments from specific vertical sectors.

Scope: Experimentation facilities able to provide enhanced experimentation infrastructures on top of which third party experimenters e.g. SMEs or any service provider and target vertical

users will have the opportunity to test their applications in an integrated, open, cooperative and fully featured network platform running across multiple domains where needed, and tailored to specific vertical use case.

The objective is to focus on innovation for operations and secure/trusted service provisioning taking advantage of experimental facilities featuring virtualised and software implemented functions and representative of a redesigned virtualised access/core network. The facilities should provide opportunities for SMEs and developers to experiment their applications in the context of specific vertical use cases on open experimental network platforms, and to create 5G open source repositories for wide use and towards standards development. Typical vertical use cases include connected and automated mobility, smart factories and industry 4.0 use cases. Furthermore, healthcare, PPDR, energy, media though other verticals may be considered.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 6 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

i. Expected Impact: Testing and validation of NetApp solutions on top of a 5G virtualised experimental environment with different implemented functions and vertical-specific configurations.

ii. NetApps secure interoperability beyond vendor-specific implementation across multiple domains and availability of related standards or reference implementations.

iii. Open-source repository of network applications that can be further leveraged by other developers.

iv. Creation of third party markets for start-ups and SMEs. 50% of SMEs are targeted for this action.

v. Relevant 5G PPP KPI: Service creation time in minutes.

vi. Generation of results that may be appropriate for transfer towards an incubator or a start up, either within the project or outside of the projects in follow up actions.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-42-2020: 5G PPP – 5G core technologies innovation

Specific Challenge: 5G offers prospects for a range of new technologies and hardware devices to enter the market and to create economic opportunities for new and innovative market actors. The challenge is hence to reap the fruits of earlier R&D investments in these enabling technologies to support the emergence of new markets and new market actors in Europe.

Scope: **a) Innovation Actions (IA)**

Enabling technologies: The key 5G technological blocks under consideration are primarily hardware-based and include, but are not limited to, phase array antenna, array processors, millimetre wave devices and subsystems, photonics based devices, baseband processor platforms, low-cost access points, new generation of 5G terminals notably for future Connected and Automated Mobility, in order to provide opportunities for innovative high-tech SMEs access to new markets through pilot validation of promising solutions. A special emphasis will be put on new types of IoT devices demonstrating the use of 5G connectivity functionalities addressing requirements of one or several vertical industry sectors.

The actions go beyond individual components and also address integration and validation of technologies as part of an overall architecture representing a subset of 5G network functions. Their added value is in the validation of the target component as part of its integration into an overall architecture representing a subset of 5G network functions.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 6 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and support actions (CSA)

Enabling technologies applicable to connectivity systems are increasingly important in the context of strategic autonomy. Europe is not anymore leading connectivity technologies that are applied at terminal/device level (e.g. advanced processor and ancillary device technologies) or at network level, such as the needed hardware processing/ acceleration that are increasingly needed to deploy real time virtualised functionalities. Whilst new opportunities have been opened by future connectivity systems that operate at millimetre or higher frequencies, Europe has not prominently positioned itself on these new markets, in spite of significant know-how acquired with military and space systems.

Against this background, the objective of the target support actions are:

- definition of the expected core hardware components of future connectivity systems where Europe should seize opportunities and strengthen its capabilities, taking into account the characteristics and architectures, including security, of future connectivity platforms;
- definition of the required R&I and investment requirements related to the identified domains;
- definition of related industry roadmap in partnership among relevant EU actors, both from industry and academia;

The Commission considers that a proposal requesting a contribution from the EU of EUR 1 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: **a) Innovation Actions (IA)**

- support to the emergence of a European offer for new 5G core technologies at TRL 7 or beyond.
- support to the emergence of new actors in the related markets.
- creation of high tech start-ups or of new business opportunities for established SME's.
- strong SME participation is targeted.

b) Coordination and support actions (CSA)

- Cross industry availability of a European roadmap for hardware enabling technologies supporting European strategic autonomy objectives for connectivity platforms.

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-53-2020: 5G PPP – 5G for Connected and Automated Mobility (CAM)

Specific Challenge: The challenge is to qualify and characterise the latest version of 5G specifications as available from 3G PP release 16 early 2020 (5G NR-V2X and beyond) in the context of advanced use cases deployment in Europe of CAM that may also benefit from Artificial Intelligence (AI) solutions. It targets use cases beyond C-ITS safety applications in view of enabling use cases in the context of complete connectivity-enabled ecosystems around cars and vehicles. It supports the realisation of the strategic objective of having all major transport paths covered with 5G connectivity by 2025[31] through cross-border trials along major transport paths planned for CAM deployment ("5G corridors"[32]) and paves the way towards operational deployment as envisaged with the Connecting Europe Facility proposal[33]. The work is also relevant to cross border railway corridors in view of providing services to trains, including in the context of the planned Future Railways Mobile Communication Systems (FRMCS) planned to replace GSM-R around 2030.

Scope: The validation of the latest available 5G specification in the context of innovative CAM applications under realistic conditions and seamlessly functioning across borders. This is realised through cross-border trials along 5G corridors[34] covering significant portions of roads or railways and including the core technological innovation expected from 5G release 16 including positioning services, or beyond. Relevant work takes a broad innovation

31 Communication of the Commission "A 5G Action plan for Europe", COM(2016) 588

32 Corridors as referred to in the "Letter of Intent" signed by 27 EU Member States, see https://ec.europa.eu/digital-single-market/en/news/eu-and-eea-member-states-sign-cross-border-experiments-cooperative-connected-and-automated

33 https://ec.europa.eu/transport/themes/infrastructure/news/2018-05-02-mff_en

34 See list of available corridors at : https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1528878837354&uri=CELEX:52018PC0438

perspective covering use cases in the vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian (V2P), and vehicle-to-network (V2N) domains including the supporting service infrastructure. The work covers the key 5G innovation in support of innovative CAM ecosystems, notably at radio, RAN and core network levels. It also includes supporting innovations in the area of Artificial Intelligence (AI) to enable advanced CAM use cases managing a broad range of relevant data sets based on connectivity and sensors. It is based on a multi-tenant business architecture that optimises the return on investments and the efficiency of the deployed connectivity and service infrastructure, while considering the opportunity of a European cloud supporting Europe-wide roaming of CAM services. Beyond technological validation, the proposed pilots will allow to better understand the roles, relations and responsibilities of market players and public authorities within the CAM ecosystem.

The work is also expected to provide a clear co-existence between multiple technologies (IEEE 802.11p, C-V2X, 5G-V2X) and migration path towards the use of 5G as the technology for CAM. It targets implementation across different business domains through coverage of cross border 5G corridors as supported by groups of neighbouring Member States. Projects should complement the deployment plans for the 5G CAM trials along the cross-border corridors in scope of the project with long-term roadmaps for the deployment of the 5G infrastructure along the relevant corridors in view of larger-scale testing and early introduction of 5G-based CAM services along these corridors.

The work may include advanced services on board of international trains covering passenger services, train traffic management services, as well as other operational services in preparation for the advent of the FRMCS, including migration from previous generation issues (GSM-R) and spectrum sharing aspects. Aspects of service and infrastructure sharing or coordination for both the automotive and railway use cases, notably in cities, is in scope, as well as multimodal solutions for passengers with the view to offering business continuity to users of the different means of public and private transportation.

The Commission considers that proposals requesting a contribution from the EU of between EUR 7 and 10 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Proposals may cover the automotive case only, the railway case only, or both.

Expected Impact:

- Validation of latest version of 5G technologies and architecture in a CAM context, including validation of innovative business models and applicable standards.
- Validated cost/benefit analysis of cross border 5G deployment enabling CAM along 5G corridors potentially including several business domains.
- Characterisation of 5G Release 16 or beyond for the most advanced CAM use cases (see through, sensor sharing, high density platooning, etc.) including innovative spectrum use.

- Validation of sustainable models combining 5G and AI features to support most advanced CAM use cases.
- Technological validation of 5G introduction for train/railways use cases including FRMCS aspects, migration, spectrum, and co-existence issues with the automotive case.
- Development of a sustainable model for a pan-European cloud infrastructure supporting CAM services at European scale.
- Support to sustainable deployment models paving the way towards deployment actions across pan European 5G corridors envisaged for CEF[35] Digital.
- Participation of key European industrial partners of both the ICT and the automotive sectors and with high standardisation impact is desired.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-17-2018: 5G End to End Facility

Specific Challenge: The challenges consist in providing an end to end facility that can i) demonstrate that the key 5G PPP network KPIs can be met; ii) be validated and accessed and used by vertical industries to set up research trials of innovative use cases, to further validate core 5G KPIs in the context of concurrent usages by multiple users.

Scope: The target 5G end to end network facility covers[36] fixed/multi radio access, backhaul, core network, service technologies and architectures targeted for 5G including end to end virtualisation and slicing as key component to support vertical use cases.

The objective is i) to validate the 5G network KPIs through representative network trials, as defined by the 5G PPP; ii) to prepare an extensive validation platform for verticals use cases. The facility allows to validate early versions of the standards and to prepare for later "forward compatible" versions. Such facility may be based on the interworking of several experimental platforms existing in Europe. It requires availability of an openness framework (both legal and technical, e.g. open APIs) enabling "vertical" projects to access and use it. It also requires a methodology to consistently compare technologies where appropriate.

The Commission considers that proposals requesting a contribution from the EU of between EUR 15 and 20 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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35 Connecting Europe Facility proposal of the Commission to be implemented as part of the next Financial Framework, over the period 2021-2027

36 Satellites and/or copper solutions are in scope as appropriate for relevant 5G-PPP KPI's.

Expected Impact: - Demonstrated feasibility of 5G PPP KPIs[37] beyond 4G evolution (NB-IoT, 4G LTE-A-PRO), including at least KPIs for capacity, ubiquity, speed, latency, reliability, density of users, location accuracy, energy efficiency, service creation time, network management capex/opex. It requires clear analysis of the state of the art and how 5G goes beyond.

- Demonstration of innovative radio spectrum use and sharing applicable to 5G spectrum use, including - if appropriate - licensed, unlicensed or licensed-shared access.

- Validation of a representative end to end 5G architecture including end to end service provisioning with slicing capabilities and solving slicing issues between core and access.

- Demonstrated impactful contribution to standards. Participation of key European industrial partners with high standardisation impact is desired.

- Availability of 5G facility that may be further used for validation through specific vertical use cases and/or for large scale showcasing events.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-18-2018: 5G for cooperative, connected and automated mobility (CCAM)

Specific Challenge: The challenge is to qualify 5G as a core connectivity infrastructure to address vehicle-to-everything (V2X), both from a technological and from a business perspective, for the higher automation levels (4, 5) defined by the automotive industry (SAE) and for new mobility services. Demonstrating the benefits of 5G connectivity should support innovative business models as "revenue generators", opening the door to private investments and to a broader digitisation of the automotive sector. It supports the realisation of the strategic objective of having all major transport paths covered by 5G connectivity in 2025[38] through cross-border trials along roads planned for CCAM deployment ("5G corridors"[39]).

Scope: It covers the applicability of 5G connectivity to "Cooperative, Connected and Automated Mobility" (CCAM) V2X use cases, taking a broad service approach, including and reaching beyond the safety/efficiency use cases of C-ITS. It aims to qualify and quantify from a business perspective the added value of cellular connectivity compared to pure meshed connectivity or to purely disconnected scenarios, and to enable a wide range of services to connected vehicles in support of innovative business models enabled by 5G connectivity (e.g. new mobility scenario, car as cellular relay node). It takes forward cellular connectivity for vehicles, targeting use cases which are difficult or impossible to realise from a technical or

[37] See 5G KPI in the cPPP contractual arrangement at www.5G-PPP.eu
[38] Communication of the Commission "A 5G Action plan for Europe", COM(2016) 588
[39] Corridors as referred to in the "Letter of Intent" signed by 27 EU Member States, see https://ec.europa.eu/digital-single-market/en/cooperative-connected-and-automated-mobility-europe

business viewpoint with existing technology and requiring improved performance of typical parameters such as low latency, reliability, security, location, throughput, security.

Validation of 5G in a broad CCAM context is realised through **cross border** trials along 5G corridors covering significant portions of roads and including the core technological innovation expected from 5G, such as (but not limited to) New Radio, new frequency bands[40], C-RAN, Mobile Edge Computing, network virtualisation, new network architecture, cross domains data flows. Specific requirements of 5G technologies for connected, cooperative and automated driving will be determined. Results of the pilots are used to define options for deployment, taking into account the evolution from earlier cellular technology (e.g. LTE-V2X), and possible co-existence with other technologies (e.g IEEE 802.11p). Cost/complexity assessment of the various technology deployment options is in scope and identifies who has to invest and who will benefit commercially.

The Commission considers that proposals requesting a contribution from the EU of between EUR 12,5 and 25 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: - Validation of 5G technologies and architecture in an "extended CCAM" context, including validation of innovative business models and applicable standards.

- Validated cost/benefit analysis of **cross border** 5G deployment enabling CCAM along 5G corridors potentially including several operator's domains.

- Availability of deployment scenarios and strategies with broad base industry and administration consensus.

- Identification of spectrum and standardisation gaps with impact at the level of standardisation (taking into account related developments at 3G PP RAN Level) and spectrum allocation bodies. Participation of key European industrial partners of both the ICT and the automotive sectors and with high standardisation impact is desired.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-19-2019: Advanced 5G validation trials across multiple vertical industries

Specific Challenge: The challenge is to get the European 5G Vision of "5G empowering vertical industries[41]" closer to deployment with innovative digital use cases involving cross industry partnerships. It requires technological and business validation of 5G end to end connectivity and associated management from two perspectives: i) within the set of requirements specific from one application domain; ii) across all sets of heterogeneous

[40] 3,5 Ghz band is the target option for V2N applications, though other bands may be considered

[41] 5G PPP White Paper "5G empowering vertical industries, see 5G-PPP.eu.

requirements stemming from concurrent usages of network resources by different vertical domains.

Scope: **a) Trials** of various scales, depending on the target technology, in view of demonstrating that performance conforming to 5G PPP KPIs requirements are met in the context of specific vertical use cases. Target 5G technologies and architectures should also support specific performance requirements stemming from the considered vertical use case.

In addition, 5G technology and architecture trials are also targeting concurrent usage of resource by multiple verticals, addressing the 3 classes of ITU requirements[42] (eMBB, mMTC, URLLC use cases). In practice, the 5G infrastructure (RAN, back/fronthaul, Core) will be shared among multiple verticals and applications, each asking for independent service guarantees and very different service requirements. Operations of one application in one vertical domain should not affect the performance of other domains/applications. The trials should hence demonstrate that 5G architecture and technologies (notably slicing and virtualisation) enabling multi domain management of resources, beyond the *ETSI NFV Management and Orchestration (MANO)* and with cross domain orchestration capabilities are in line with these concurrent performance requirements.

Trials leverage results of 5G PPP phases 1 and 2 and go beyond the proof of concepts of phase 2.

Vertical use cases may focus on those outlined in the 5G PPP White paper "5G empowering vertical industries" (Automotive, smart factories, energy, media, smart healthcare) though other may be considered (e.g. PPDR[43]). High density location and very high data volumes applications should be covered, as typically encountered with media/content applications in large events.

Trials are preferably implemented over the 5G end to end platforms developed under **ICT-17-2018**, and may contribute to 5G demonstration in the context of large showcasing events.

The Commission considers that proposals requesting a contribution from the EU of between EUR 10 and 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b. Coordination and Support Actions

5G PPP projects under ICT-17-2018, ICT-18-2018, ICT-19-2019, ICT-20-2019 are implemented as a programme through the use of complementary grants. The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will be applied. This requires cooperation of the implemented 5G Research and Innovation Actions (RIA) and Innovation Actions (IA) towards joint leveraging of results. The proposed CSA shall liaise with the 5G RIA and IA actions to exploit synergies for:

[42] See ITU Recommendation M2083
[43] Public Protection and Disaster Relief systems beyond TETRA/TETRAPOL capabilities

- Management and orchestration of 5G PPP project cooperation for horizontal issues of common interests (adherence to KPIs, security, energy efficiency, spectrum, standardisation, societal impact of 5G…) in support of the commitments of the 5G PPP contractual arrangement and mapping the strategic programme of the 5G industrial Association.

- Portfolio analysis, coverage, mapping and gap analysis, roadmaps for key PPP technologies and for experimental requirements and facilities, also taking into account national developments.

- Proactive support to key international co-operation activities with a proactive strategy to leverage relevant 5G PPP project outcomes in the context of key standard developments and of relevant spectrum related bodies.

- Organisation of stakeholder events, including reaching out to users and key verticals.

- Monitoring of the openness, fairness and transparency of the PPP process, including sector commitments and leveraging factor.

- Maintenance of the "5G web site".

The Commission considers that proposals requesting a contribution from the EU up to EUR 2 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: **a) Advanced Trials**

- Validated core 5G technologies and architectures in the context of specific vertical use cases and deployment scenarios, from high to low density regions.

- Validated core technologies and architecture for differentiated performance requirements originating from eMBB, mMTC, URLL use cases, notably for end to end slicing and virtualisation.

- Viable business models for innovative digital use cases tested and validated across a multiplicity of industrial sectors, including demonstration of required network resource control from the vertical industry business model perspective.

- Impactful contributions towards standardisation bodies, involving vertical actors, for what concerns the second phase of 5G standardisation. Participation of key European industrial partners with high standardisation impact is desired.

- Validation of relevant KPIs[44] with services linked to specific vertical sectors.

- Europe 5G know how showcasing.

b) **Coordination and Support Actions**

[44] See 5G PPP KPI definition in the cPPP Contractual Arrangement, www.5G-PPP.eu

- Organisation of the 5G PPP as a programme with clear links to the 5G Infrastructure Association.

- Maximised output and exploitation of 5G PPP project results in key domains (standardisation, spectrum) through managed projects cooperation on horizontal issues.

- Constituency building, stakeholder support, support to key international cooperation events; dissemination, support to core international cooperation activities, to relevant stakeholder events; definition of future R&I actions.

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-20-2019-2020: 5G Long Term Evolution[45]

Specific Challenge: Whilst 5G early introduction targets "local" network improvements (e.g. at radio access level), the longer term vision targets the realisation of pervasive mobile virtual services, through a network managing compute, storage and transport connectivity functions[46] in an integrated way. The challenge is to transform the network into a low energy distributed computer, where processes and applications are dynamically created, moved and suppressed, depending on the information flows, customer needs, and where new terminal types in cars, objects, appliances, and new interfaces based on gestures, facial expressions, sound and haptics may be the basis of the interaction between humans and the infosystems.

Scope: Proposals may cover only one strand or cut across several strands.

- Strand 1: Extension of virtualisation technologies and architectures for Network Management to support i) recursive deployments of functional components for multi-tenancy; ii) high device heterogeneity through virtualisation of resource-constrained devices with load reduction approaches and new network control solutions to effectively handle the authentication, naming, addressing, routing and related functions for massive number of terminals; iii) end to end resource self-configuration and management according to service, traffic, channel or mobility conditions; iv) SDN intelligent network interface selection; v) ultra-dense network deployment with massive user generated traffic; vi) unified management of compute, storage and connectivity resources.

- Strand 2: Security[47]: hardware, software technologies and architectures, level of abstraction for information sharing enabling tenants workloads to trust the host systems. It enables trusted deployment of critical workloads across infrastructure and for infrastructure owners, differentiated services offers to tenants, whilst also improving their own control of their systems, vulnerabilities and compromises. It covers Trusted Execution Environments (TEEs)

[45] This topic continue in 2020 under ICT-52-2020: 5G PPP – Smart Connectivity beyond 5G

[46] As defined under the ETSI Standardisation framework for Network Function Virtualisation initiatives (ETSI-NFV)

[47] This should be covered as part of an integrated Network management system.

secure provisioning and their remote management, with categorisation of sensitive operations supporting trust domain definition and set up, with real -time identification of possible compromises or security breaches.

- Strand 3: Radio network enabling technologies, architectures and advanced signal processing targeting i) differentiated service requirements, including broadcast/multicast and strategies for spectrum sharing and usage optimisation in licensed and unlicensed bands; ii) terminals as moving nodes for coverage or service extension; iii) network assisted self-driving objects with optimised information fusion/processing from maps, sensors, and events communication; iv) simplified access points through distributed computing and optimised function placement; v) ultra low latency services; vi) applicability of mmWave frequency bands to use cases beyond eMBB; vii) usability of novel spectrum at Teraherz frequencies (incl. visible light communications).

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: - Evolution of networks towards OTT like platforms integrating connectivity, storage and computing resources opening for new service models to telecom/ISP providers - (Strand 1).

- Network scalability towards high number of resource constrained devices, multiplicity of service requirements, and new connectivity paradigms (user controlled) – (Strand 1).

- Characterisation and availability of secure and trusted environments for software based virtualised networks, enabling trusted multi-tenancy - (Strand 2).

- Improvements of radio spectrum usage, novel strategies for coverage/service extension, support of novel use cases and mobile edge cloud applications, usability of today unexplored spectrum - (Strand 3).

- Dynamic scalability of network capabilities through availability of managed and enhanced resources - (Strands 1 and 3).

- Network energy consumption reduction, a factor of at least 10 is targeted - (Strands 1 and 3).

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-21-2018: EU-US Collaboration for advanced wireless platforms

Specific Challenge: Both the EU and the NSF address the challenges of advanced wireless research beyond 5G focusing on game changing technologies for wireless communications, capitalizing on existing testbeds and projects, to reach further connectivity frontiers.

Scope: To establish collaborative transatlantic work on advanced wireless platforms addressing the use of new ranges of frequencies from mmwave bands up to Terahertz bands, massive antenna arrays, new radio and signal processing techniques, optimised new usage of Spectrum and platform or testbeds for experimental research. To develop research roadmaps, workshops, scientific exchanges, development of tools for experimentations, opens source software tools and repositories, prototyping and evaluation, tools for probing and data analytics, emulation, management and cross Atlantic technology trials.

Proposals shall foresee twinning with entities participating in projects funded by USA to exchange knowledge and experience and exploit synergies. In particular twinning with entities participating in projects funded by the NSF under the Programme for Advanced Wireless Research (PAWR) should be addressed. The Commission considers that proposals requesting a contribution from the EU of up to EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Support to advances in Wireless knowledge and reinforced cooperation with the US through common transatlantic experiments linking platforms and testbeds, fostering common scientific roadmap, developing new tools and potential options for standards ahead of worldwide competition for beyond 5G connectivity systems and services.

Bridge EU and US research communities addressing this topic. In the case of US, the target community is the NSF community addressing the new "Programme for Advanced Wireless Research" (PAWR)[48].

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-22-2018: EU-China 5G Collaboration

Specific Challenge: The next phase of 5G activities running during the 2018-20 period is expected to cover, both in EU and in China, technologies and systems demonstrations and trials. The challenge is hence to demonstrate technologies and system interoperability for a number of core applications of interest in the two regions.

Scope: The scope is to conduct 5G trials addressing two specific scenarios: scenario n°1 - enhanced Mobile Broadband (eMBB) on the 3.5GHz band, which is a priority band in the two regions for early introduction of very high rate services; and scenario n°2 - Internet of Vehicles (IoV) based on LTE-V2X using the 5.9 GHz band for Vehicle-to-Vehicle (V2V) and the 3.5 GHz band for Vehicle-to-Network (V2N). The overall goal is to evaluate in real setup innovative end-to-end 5G systems built on the outcomes of the previous phases of the 5G R&I. More specifically, the optimisation of the band usage in multiple scenarios with different coverage is a key target, so as the validation of the geographic interoperability of the

[48] See Programme and budget at https://www.nsf.gov/cise/advancedwireless/

3.5 and 5.9 GHz bands for these use cases. Both scenarios shall be implemented in both regions (EU and China) through testbeds with interoperability forming the core of the R&I work.

The underlying trials' testing facilities shall implement the latest mature and broadly commonly agreed 5G systems, network architectures and technologies spanning from the core/transport networks, the radio access, up to the service, orchestration, management and security components. The trial facility shall not be restricted to innovative 5G radio access technology, but should include and enable the evolution of 5G networks innovations in network slicing, virtualisation, cross-domain orchestration, in view of supporting resource control from multiple tenants. In EU, trials are preferably implemented over the 5G end-to-end platforms developed under ICT–17-2018.

The 5G trials' infrastructures shall facilitate the testing and validation of innovative applications for each of the defined scenarios, including efficiency solutions in the areas of spectrum usage, energy consumption and costs.

As per cPPP objectives, relevant industries and organisations are expected to have a sizeable share of the proposals participation. Teams including mobile operators, vendors (for both scenarios) and car companies (for scenario n°2 IoV) together with SMEs, academia and research institutes may be considered.

Proposals shall foresee twinning with entities participating in projects funded by China to exchange knowledge and experience and exploit synergies. This topic is calling for bilateral project twinning with the National Science and Technology Major Project (NSTMP) "mirror project" launched by China in 2018. Proposals shall foresee all the mechanisms, including budget provisions, to enable close collaboration with the "5G Major Project" that will be funded by China. The two twining projects (EU/China) will be requested to define and use unified trial specifications, unified trial frequency bands and to share data. Joint deliverables, like joint tests reports, white papers, publications and standard contributions, will also be expected. In addition, the 5G trials' infrastructures shall be deployed in one or more cities in each region (EU/China).

The Commission considers that proposals requesting a contribution from the EU up to EUR 6 million for a period between 24 and 36 months would allow this area to be addressed appropriately. This does not preclude the submission and selection of proposals with a different budget or duration.

Expected Impact: - Holistic 5G networks implementations based on the latest 5G innovations and evaluated in the two prominent usage scenarios.

- 5G RAN for the specified bands validated in real world environments.

- Global interoperability demonstrations for 5G networks.

- Joint contributions to global 5G standards specifications in relevant organisations (e.g. 3GPP, ITU-R), especially in view of 5G phase 2 standardisation (beyond eMBB), and to harmonized spectrum bands.

- Successful showcasing events with, ideally, joint demonstration across regions.

- New or reinforced cooperation between 5G R&I stakeholders from EU and China, with a focus on private companies (industry, telecom operators, SMEs).

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-23-2019: EU-Taiwan 5G collaboration

Specific Challenge: This activity, integrated end-to-end network for 5G trials, is to test 5G systems for specific applications and it follows up on the first targeted opening call with Taiwan in which 5G research and demonstration facilities offered by Taiwan towards collaborative 5G research with the EU.

The integrated end-to-end network for 5G trials activity is to utilize the infrastructure of the integrated 5G access/core networks in test beds, in Europe and Taiwan, to verify the requirements of 5G technologies in joint trials for specific applications such as AR/VR for entertainment, V2X communications, utilities, e-Health, drone, factory of the future (though not limited to those) featuring high peak data rates and network density, ultra-low latency, and high reliability.

Scope: The scope is to conduct 5G trials addressing technology and business validation of 5G end-to-end connectivity and associated management from applications in Taiwan that will support the development of mmWave, massive MIMO, new air interfaces, multi-user access and other technologies, aiming to increase the network capacity in an ultra-dense network and to provide access for a massive number of devices.

Proposals are encouraged to consider network virtualization approaches such as SDN/NFV and network slicing to make the best use of the resources for services with a reduction in CAPEX and OPEX.

The targeted 5G technologies and architectures should support the specific performance requirements stemming from the considered vertical use cases. The trials should go beyond proof of concept and leverage the results of related 5G PPP projects and Taiwan’s 5G Program.

The Commission considers that proposals requesting a contribution from the EU of up to 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Validation of core 5G technologies and architectures in the context of specific vertical use cases.
- Leverage cooperation towards industrial consensus between EU and Taiwan on 5G key aspects such as standard, spectrum, architecture and interoperability.
- Accelerate the pre-commercialization trials of the use cases introduced by IMT-2020 (eMBB, mMTC, URLLC).

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Next Generation Internet (NGI)

A number of technological trends will thoroughly reshape the internet over the next 10-15 years. Europe should drive this technology revolution in line with its values such as openness, inclusion, protection of data and privacy thereby contributing to making the future internet more trustworthy and human-centric. An internet for the people, that contributes to a more sustainable and inclusive society.

- **Blockchain and Distributed Ledger Technologies** are major disruptive technologies that can radically change both the foundations of the internet but also the reliability of Internet transactions. They have the potential to decentralise the governance of data on the Internet, to provide end-users with full control of their personal data and privacy, to help preserve the integrity of content, to create new trust models and to offer clear audit trails of transactions.
- Future **Interactive Technologies** will allow users to access, process and deliver information in more natural, efficient and less intrusive ways, providing enhanced and personalized experiences;
- **Internet of Things** technologies and applications are changing the way users, services and applications interact with the real world environment in a trusted way.
- **Future social networks, media and platforms** will transform the way we produce, consume and interact with content, services and objects, within and across users' groups and will become the way our societies operate for communication, exchange, business, creation and knowledge acquisition.
- The Next Generation Internet will be **multilingual** and **inclusive**. Advances in **language technologies** will help eliminate language barriers. NGI technologies will also help to provide a new quality in Digital Learning as smart, open, inclusive and **personalised learning** solutions will be tailored to each individual’s needs, competences and abilities.
- In addition, cutting across technologies, the **Open Internet Initiative**, based on an agile and flexible programme approach, will focus on research teams, developers, hi-tech

start-ups, SMEs and social innovators, and will rapidly explore promising technological avenues for the Internet of the future.

The topics addressed here form a coherent and integrated package. They are linked to other parts of the programme such as 5G, Cloud, Software and Artificial Intelligence.

ICT-54-2020: Blockchain for the Next Generation Internet

Specific Challenge: The Next Generation Internet initiative aims at developing a more human-centric Internet supporting values of openness, decentralisation, inclusiveness and protection of privacy and giving the control back to the end-users, in particular of their data. It should provide more transparent and accessible services, more intelligence, greater involvement and participation, leading towards an Internet that is a true engine of growth and social progress.

Blockchain and distributed ledger technologies (DLT)[49] have the potential to enable more decentralised, trusted, user-centric digital services, and stimulate new business models benefiting society and the economy as stressed by the European Parliament resolution on the topic[50]. These technologies will create opportunities to enhance services and processes in both the public and private sectors, notably providing better control of data by citizens and organisations, reducing fraud, improving recordkeeping, access, transparency and auditability, within and across borders. As a key component of the Next Generation Internet initiative, the specific challenge is to foster research and innovation at technology, infrastructure and application levels to position Europe at the forefront of the blockchain revolution.

This topic contributes to the European Commission strategy on blockchain. The first milestones of this strategy were the launch of the European Blockchain Observatory and Forum[51], which aims to accelerate blockchain innovation and the development of the blockchain ecosystem within the EU, and the European Blockchain Partnership, signed by 26 Member States and Norway, to cooperate in the establishment of a European Blockchain Services Infrastructure.

The Research and Innovation Actions mentioned below are complemented by a blockchain pre-commercial procurement action, which is presented under the “Other actions” part of the Work Programme.

Scope: Research and Innovation Actions (RIA) will be called for in the following three sub-topics. Proposals should address only one of these sub-topics.

i. Advancing research on Blockchain and Distributed Ledger Technologies

[49] In the context of this topic and in the remaining part of the text, the term blockchain refers both to “blockchain and distributed ledger technologies”

[50] European Parliament resolution P8_TA-PROV(2018)0373 "Distributed Ledger Technologies and blockchains: building trust with disintermediation

[51] www.eublockchainforum.eu

Conducting research, proofs of concepts, piloting, testing and benchmarks to improve and further develop advanced blockchain technologies, for example regarding energy efficiency and sustainability, consensus protocols, a priori usage control, scalability and throughput, security, privacy, robustness, interoperability, cryptography, smart contracts, governance, compliance to regulatory frameworks. This action should contribute to standardisation activities.

ii. Fostering trust in internet information exchange and content with blockchain

Develop decentralised blockchain-based solutions that can be scaled in a sustainable manner, combined with the use of trustworthy electronic identification, authentication and verified pseudonyms, to preserve the integrity and reliability of information and content, including the underlying sources, on the internet. Two use cases: a) develop and implement new transparent and accountable reputation-based models to increase trustworthiness of the information exchange on the internet and social networks and b) provide solutions for transparency, trustworthy transactional content handling, on the internet and social networks.

iii. Bringing forward the emergence of collective intelligence on the internet:

Develop approaches for scientific understanding and technology-based stimulation of collective intelligence on social media and the internet to foster trustworthy knowledge and information sharing, and to enhance social inclusion. Two use cases: a) develop new community-based service models on social networks that exploit collective intelligence to provide enhanced community services, and increase the availability of trustworthy content and b) in the context of collective intelligence develop and implement new concepts for connecting people and smart objects/agents/AI on social media. Approaches for both use cases must be rooted in scientific analysis of collective behaviour (taking into account gender difference, where relevant) and network mechanisms, harness decentralised technologies such as P2P or blockchain for governance and support a dependable collective memory.

Each RIA in the three sub-topics above, through an agile and flexible process, will support third party projects from outstanding academic research groups, hi-tech startups, SMEs and other multidisciplinary actors, so that multiple third parties will be funded in parallel contributing to the research and innovation area. The RIA will provide the programme logic and vision for the third-party projects, ensure the coherence and coordination of these projects, provide the necessary technical support, as well as coaching and mentoring, in order that the collection of third party projects contributes towards a significant advancement and impact in the research domain. The focus will be on applied research that is linked to relevant use cases and that can be further developed into viable solutions. Apps and services that innovate without a research component are not covered by this model.

Beneficiaries shall make explicit the intervention logic for their specific sub-topic, their capacity to attract relevant top talents, to deliver a solid value-adding services package to the third-party projects, as well as their expertise and capacity in managing the full life-cycle of the open calls transparently. They should explore synergies with other research and

innovation actions, supported at regional, national or European level, to increase the overall impact.

RIAs should encourage open source software and open hardware design, open access to data, standardisation activities, access to testing and operational infrastructure as well as an IPR regime ensuring lasting impact and reusability of results.

For grants awarded under this topic for Research and Innovation actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.

The Commission considers that proposals with an overall duration of 24 to 36 months and requesting a contribution from the EU of EUR 8 million for sub-topic i); and EUR 6 million for each sub-topic ii) and iii) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other durations or amounts. As the primary purpose of the action is to support and mobilise internet innovators, a minimum of 70% of the total requested EU contribution should be allocated to financial support to the third parties. For ensuring focused effort, third parties will be funded through projects typically in the EUR 50 000 to 200 000 range per project, with indicative duration of 12 months.
In line with Article 23 (7) of the Rules for Participation, the amounts referred to in Article 204-205 of the Financial Regulation may be exceeded in order to achieve the objective of the action up to a maximum funding per third party of EUR 500 000.

Expected Impact: Proposals should provide appropriate metrics for the claimed impacts.

- Shape a more human-centric evolution of the Internet.
- For sub-topic i): Reinforcing the European Blockchain ecosystem and excellence in research.
- For sub-topic ii): Scalable blockchain based solutions for ensuring trustworthy content and information exchange
- For sub-topic iii): Service models for community services building on collective intelligence and novel approaches for connecting people and smart objects/agents to stimulate use of collective intelligence
- Promoting interoperability and strengthening the role of Europe in international standardisation.
- Create a European blockchain ecosystem integrating research and innovation communities.

- Generate new business opportunities and new Internet companies with maximum growth and impact chances.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-55-2020: Interactive Technologies

Specific Challenge: Interactive Technologies such as Augmented (AR) and Virtual Reality (VR) are set to transform the ways in which people communicate, interact and share information on the Internet and beyond. This will directly impact a larger number of European industries ranging from manufacturing, data life cycle, healthcare, engineering, to education, entertainment, media and culture, enabling new business opportunities. The challenge is to forge a competitive and sustainable ecosystem of European technology providers in Interactive Technologies.

Scope: The full scope of the EU intervention in this areas includes: 1/ support a pan-European coordination effort to strengthen the collaboration among the constituency (ICT-25-2018); 2/ improve competiveness through research into future high-quality multi-sensorial interactive hardware and multi-user interaction systems (ICT-25-2018) and 3/ increase the European innovation capacity through the development of new authoring tools and the access to a broader community which will be the objective of this specific call through Innovation Actions.

The uptake of Interactive Technologies in various industrial and societal domains

To maintain competitiveness and allow the European industry to embrace these new technologies, the objective of the proposal should be either to:

- develop *authoring tools* for automated interactive content creation that can be used also by non-expert users on various platforms and environments; The authoring tools are expected to:
    - rely on less manual input enabling quicker content creation
    - manage large quantities of data
    - allow higher fidelity
    - allow improved immersion, engaging all senses
- or develop *solutions* in key sectors such as in manufacturing, automotive, healthcare or cultural and creative industries or in sectors where the use of such technology is not mainstream.

Focus should be on developing richer virtual environments, new user interfaces and improved immersion maximizing the feeling of presence.

Proposals should ensure that the targeted industries have a leading role in the design of solutions and guarantee the take up of the technology. Actions are expected to engage and contribute to the exchange platforms developed in the frame of the CSA on Interactive Technologies funded under H2020 ICT-25-2018 eXtended Reality for All (XR4All – GA 825545).

The Commission considers that proposals requesting a contribution from the EU of between EUR 1.5 and 2 million with a duration from 12 to 24 months would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Increase in the use of Interactive Technologies in the industrial and societal domains.
- Increase in the number of European SMEs and start-ups who benefit from technology transfer.
- Increase in market opportunities in the Interactive Technologies sector for European SMEs.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-56-2020: Next Generation Internet of Things

Specific Challenge: Internet of Things (IoT) technologies and applications are bringing fundamental changes to all sectors of society and economy and constitute an essential element of the Next Generation Internet (NGI). The challenge is to leverage EU technological strength to develop the next generation of IoT devices and systems which leverage progress in enabling technologies such as 5G, cyber-security, distributed computing, artificial intelligence (AI), Augmented Reality and tactile internet. In addition it is important to build and sustain a competitive ecosystem of European technology and system providers in IoT as well as ensuring end-user trust, adequate security and privacy by design.

Scope: The scope is to develop and demonstrate novel IoT concepts and solutions to underpin the NGI vision and make provision for predicting future events, trigger actions and moving decisions to the point of interest in order to better serve the end-user

a) Research and Innovation Actions (RIA)

Proposals must provide reference implementations in terms of a dynamically configured infrastructure and integration schemes for smart devices into self-adaptive, robust, safe,

intuitive, secure and interconnected smart network and service platforms. Reference implementations should include proof-of-concept, demonstrations and validation, driven by realistic use cases with advanced needs in areas such as wearables, transportation, agriculture homes, health, energy, and manufacturing.

Proposals should clearly explain how access to the necessary infrastructure for leveraging key technologies such as 5G, edge computing and distributed AI will be ensured. The action may involve cascading calls through financial support to third parties in line with the conditions set out in Part K of the General Annexes, duly justified as a means to achieving the overall objectives. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 50.000 to 150.000[52] per party but smaller amounts may also be justified). Maximum 30% of the requested EU contribution requested by the proposal should be allocated to this purpose.

Proposals must address all the following challenges (sub-topics):

- **Next generation IoT architectures** with a focus on user-aware, **self-aware** and **semi-autonomous IoT systems.** This should also address new real-time capable solutions, which solve performance challenges such as streaming and filtering at the edge, latency and network constraints. A further challenge is to make use of distributed AI, address security, privacy and trust requirements by design and allow for new de-centralised topologies and governance.

- **Interoperability** to cope with the increased complexity of connecting vast numbers of heterogeneous devices with increasing demands for data sharing, protection of privacy, data monetization and **contractual arrangements** (e.g. blockchains/DLTs) for secure and trusted interaction.

- **Intelligent IoT devices supporting the proposed use cases and** drawing from applicable results in micro-nano-bio technologies, including resource-aware hardware/software concepts, low power processor platforms integrating computing, networking, storage and acceleration elements, new communication schemes and topologies that range from the cloud continuum towards mesh, and securing computing and communication at device level with constrained resources.

- **Tactile/contextual Internet of Things** based on human-centric sensing/actuating, augmented/virtual reality and new IoT service capabilities such as integration with parallel and opportunistic computing capabilities, neuromorphic and contextual computing.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 and 8 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

[52] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

b) Coordination and Support Action (CSA)

A support action will support measures for further development of IoT ecosystems, partnerships, stakeholders networking, contribution to pre-normative activities and to standardisation, development of business models, innovation activities and skills building.

It will liaise also with NGI and other initiatives of the work programme that are relevant to IoT related research and innovation activities.

The Commission considers that proposals requesting a contribution from the EU of EUR 2 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Contribution to human-centred IoT evolution improving usability and user acceptance, notably through strengthened security and user control.
- Contribution to emerging or future standards and pre-normative activities
- Long-term evolution of next-generation IoT infrastructures and service platforms technologies and contribution to scientific progress enabling novel, future semi-autonomous IoT applications.
- Propose novel and disruptive business models
- Mobilise key IoT players in security and privacy
- Maintain an active ecosystem of all relevant IoT stakeholders[53]

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-57-2020: An empowering, inclusive Next Generation Internet

Specific Challenge: As the digital transformation of society accelerates, the use of mobile devices and applications can significantly improve the daily life of citizens. Leveraging on multidisciplinary expertise drawing on knowledge from both the technological and human sciences, novel technologies, such as automatic translation as well as speech and sign recognition and synthesis, could offer inclusive human-centric solutions facilitating communication between people with and without hearing impairments.

Scope: Develop novel mobile applications translating between speech and sign languages to assist people with hearing impairments. The projects should leverage on current state-of-the-art in translation between all official spoken and sign languages of the EU Member States and

[53] Building on existing networks such as AIOTI, BDVA, 5GPPP

associated countries for efficient and effective use on mobile devices. Projects should explore how end-users can best interact and cooperate with the application and how the system adapts to users in real-life conditions and prevents unintended gender bias in translation. The resulting applications should be open source, robust, cost-effective and validated across a wide spectrum of users. Priority will be given to projects addressing a wide range of languages, in particular under-resourced languages.

The Commission considers that proposals requesting a contribution from the EU between EUR 2 and 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Improve multilingual speech processing and sign language detection on mobile devices, and deploy solutions allowing wide take up by people with hearing impairments.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-44-2020: Next Generation Media

Specific Challenge: The rise of the digital era has brought novel immersive, accessible, and personalized user experiences to media, thereby disrupting traditional media. Today, media form a complex ecosystem of users and producers, audiences and performers with interchangeable roles where traditional boundaries of media are blurring. In this process, media has also become a key element in societal discourses. The challenge for the traditional media sectors is to compete in this extended ecosystem and to meet user expectations by rapidly embracing new technologies for creation, management, and distribution of content. The rise of digital also means that creative minds in culture including artists have an influential role in shaping the development or the use of technologies for media, as they are often being the first to embrace technological innovation in their work. Hence, another challenge for the media industry is to embrace these new viewpoints and actors.

Scope: Innovative solutions 1) to facilitate the integration of emerging technologies such as 5G, Cloud, the Internet of Things, Virtual/Augmented Reality, smart objects, wearables, data analytics, artificial intelligence, etc. in next generation media that overcome traditional boundaries and sectors; 2) to help the new media ecosystem become more adaptive and inclusive, and better promote content, e.g. with new online strategies and business models or new forms of content creation/distribution/presentation; 3) to support synergies across media, operators, technologists and cultural/artistic actors, in order to develop a network of stakeholders which, building on the existing STARTS (Science+ Technology+ ARTS) network, will explore innovative paths for the next generation of media.

Proposals are invited against at least one of the following three subtopics:

a) Innovation Action (IA)

i. Business Innovation Ecosystems

Develop new business innovation ecosystems by using approaches, such as a sandbox, for technology-driven innovation in media, e.g. for new business models, through at least two incubators (project component), financed through the action and hosted in existing operational environments. These incubators have to be interlinked and should foster technology-driven innovation for open and interoperable media with a particular focus on SMEs and start-ups. The incubators shall also exploit synergies with non-media sectors. Each incubator will, through the project financing, host third party projects selected by open calls, provide access to relevant infrastructures and services as well as internal support. The action shall carry out two open calls, attracting submissions from at least from five different European regions (the first shall be entirely defined in the proposal; the second shall include the lessons learned from the first one). Typically, each third-party project will last from 5 to 12 months with a size from EUR 50.000 to 350.000[54]. Actions should provide specific, mentoring and coaching to third party projects, connect high-performers to the venture capital market through dedicated tasks, and cooperate with actions of the subtopic ii through a specific task). At least 70% of the requested EU contribution shall be allocated to financial support for these third-party projects. Financial support to third parties should be in line with the conditions set out in Part K of the General Annexes. Criteria used to evaluate proposals should be clearly specified.

ii. New User Driven and Enriched Experiences in Future Media

Contribute to the creation of a user driven, fair, sustainable and technologically advanced media ecosystem by the development, demonstration and validation of new services and solutions through large scale demonstrators, pilots or close-to-market prototypes focused on one or more of the following themes:

- Exploiting solutions for platforms enabling all-Internet Protocol content value chain and new business opportunities based on cross-media and cross-sectorial data analytics; for content distribution solutions that facilitate the availability of European content online, also tackling cross-border content restriction issues.
- User driven, immersive and accessible media services;
- Transmedia and cross media experiences and services;
- Immersive and interactive experiences in publishing;
- Agile media rights management and content identification solutions to improve online content distribution.

[54] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

Subtopic ii. will cooperate and work closely with subtopic i. and vice-versa versa through a specific task.

b) Coordination and Support Action (CSA)

Starts – Technology and Arts Alliance as Driver for Next Generation Media

This subtopic will ensure a networked approach to next generation media that thrives from synergies of cultural, media and technology actors. The main activity is to create a network of actors from across Europe and if appropriate international partners (media industry, innovation hubs, technology and cultural/art institutions, civil society) to foster synergies between art, media and technology in order to create new uses and forms of media and employ media as a social catalyst; in the spirit of digital innovation hubs develop a strategy how to promote local art-technology centers and artist residencies that bring together these actors.

Additionally, this subtopic will support activities to organise the next annual European STARTS prizes that unites technology, arts and media. The support action will ensure publicizing the prize, handling of submission and evaluation in a scalable manner, and the award ceremony. There will be two annual prizes (EUR 20.000 each) covering different aspects of STARTS: one on artistic exploration where appropriation by the Arts has altered (the use, deployment, or perception of) technology and one on collaboration of ICT and the Arts (technological or artistic) that open new pathways for innovation and/or society in particular in context of regional development. Organize itinerant exhibitions and performances the will stimulate new alliances between art, technology and media and help promote novel role of media in societal context.

This action allows for the provision of financial support to third parties in the form of prize in line with the conditions set out in Part K of the General Annexes.

The Commission considers that proposals with an overall duration of 30 to 36 months and requesting a contribution from the EU of EUR 5.5 million for sub-topic a)i., EUR 5 million for sub-topic a)ii. and EUR 2 million for subtopic b) would allow this specific challenge to be appropriately addressed. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one proposal for subtopics a)i. and b), and two proposals for subtopic a)ii. will be selected.

Expected Impact: Concrete development towards a user-driven and user-centric media value chain triggered by an alliance of media producers, media users, technology and cultural players.

- Validated new media services tested in real operational environments.
- Improved users' experiences and new solutions for access to media content
- Open and interoperable solutions enabling a genuine Digital Single Market for media.

- Improvement of the technological transfer from European technological SMEs to the media value chain.
- An enhanced and enriched media ecosystem.

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-24-2018-2019: Next Generation Internet - An Open Internet Initiative

Specific Challenge: This initiative aims at developing a more human-centric Internet supporting values of openness, cooperation across borders, decentralisation, inclusiveness and protection of privacy; giving the control back to the users in order to increase trust in the Internet. It should provide more transparent services, more intelligence, greater involvement and participation, leading towards an Internet that is more open, robust and dependable, more interoperable and more supportive of social innovation.

Scope: Involving today's best Internet innovators to address technological opportunities arising from cross-links and advances in various research fields ranging from network infrastructures to platforms, from application domains to social innovation. Beyond research, the scope includes validation and testing of market traction with minimum viable products and services, of new economic, mobility and social models, and involves users and market actors at an early stage. Multi-disciplinary approaches are encouraged when relevant. Eventually this initiative should influence Internet governance and related policies.

a) Research and Innovation Actions

Each Research and Innovation Action (R&I Action) will focus on a given research domain supporting the objective of a human-centric Internet. It will build a European ecosystem of researchers, innovators and technology developers by selecting and providing financial support to the best projects submitted by third parties in a competitive manner.

Through an agile and flexible process, 'R&I Actions' will focus their support on third party projects from outstanding academic research groups, hi-tech startups and SMEs, so that multiple third parties will be funded in parallel contributing to the same research area, using short research cycles targeting the most promising ideas. Each of the selected third parties projects will pursue its own objectives, while the 'R&I Action' will provide the programme logic and vision, the necessary technical support, as well as coaching and mentoring, in order that the collection of third party projects contributes towards a significant advancement and impact in the research domain. The focus will be on advanced research that is linked to relevant use cases and that can be brought quickly to the market; apps and services that innovate without a research component are not covered by this model.

Beneficiaries shall make explicit the intervention logic for their specific research domain, their capacity to attract top Internet talents, to deliver a solid value-adding services package to

the third party projects, as well as their expertise and capacity in managing the full life-cycle of the open calls transparently. They should explore synergies with other research and innovation actions, supported at regional, national or European level, to increase the overall impact.

For grants awarded under this topic for Research and Innovation actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.

For the call closing in 2018 'R&I Actions' in the following three sub-topics will be called for. Proposals should address only one of these sub-topics.

i) Privacy and trust enhancing technologies: as sensors, objects, devices, AI-based algorithms, etc., are incorporated in our digital environment, develop robust and easy to use technologies to help users increase trust and achieve greater control when sharing their personal data, attributes and information.

ii) Decentralized data governance: leveraging on distributed open hardware and software ecosystems based on blockchains, distributed ledger technology, open data and peer-to-peer technologies. Attention should be paid to ethical, legal and privacy issues, as well as to the concepts of autonomy, data sovereignty and ownership, values and regulations.

iii) Discovery and identification technologies: to search and access large heterogeneous data sources, services, objects and sensors, devices, multi-media content, etc. and which may include aspects of numbering; providing contextual querying, personalised information retrieval and increased quality of experience.

For the call closing in 2019 'R&I Actions' in the following three sub-topics will be called for. Proposals should address only one of these sub-topics.

i-b) Strengthening internet trustworthiness with electronic identities: addressing critical challenges related to increasing trust in the internet such as authentication, authorisation, traceability, privacy and confidentiality in personal and non-personal interactions. This topic will engineer federated and/or decentralised technologies for supporting internet-wide e-identities with various levels of identification, reputation and trust, to serve as a basis for new business models for verifying and valuating personal data. Proposers should pay attention to the following dimensions: scalability, ease of use, deployability, sustainability, standardisation and compatibility with the eIDAS framework[55].

ii-b) Service and data portability: this topic will address the challenge of personal data portability on the internet as foreseen under the GDPR[56] and the data porting and service

[55] Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market

[56] Regulation (EU) 2016/679

provider switching as foreseen in the proposed free flow of non-personal data regulation[57]. The topic should cover the separation of data from the services provided to the end-users, with a view to ensure seamless combination of internet services and frictionless switching. Attention should be paid to technological developments, standardisation of personal profiles, practical handling of data sets mixing personal and non-personal data, operational and business models, as well as techno-legal constraints and the simplification of end-user contracts and terms of use.

iii-b) Open Internet architecture renovation: supporting communities of developers in ensuring Internet architecture evolution towards better efficiency, scalability, security and resilience. Auditing, testing and improving protocols and open source software and hardware that are used to manage the Internet, with renewed design goals such as isolation of contingencies, redundancy and self-repair, disruption tolerance, transparency, better real-time behaviour and energy efficiency. Ability to roll-out at Internet scale should be assessed as part of the proposed solutions.

'R&I Actions' should encourage, when relevant, open source software and open hardware design, access to data, standardisation activities, access to testing and operational infrastructure as well as an IPR regime ensuring lasting impact and reusability of results.

The Commission considers that proposals requesting a contribution from the EU of EUR 7 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. As a reference, 80% of the EU funding should be allocated to financial support to the third parties, through projects typically in the EUR 50 000 to 200 000[58] range with duration of 9 to 12 months. Each 'R&I Action' is expected to run several cycles of third party projects, which requires an overall duration of 24 to 36 months.

In the call closing in 2018, at least one proposal will be selected in each of the three sub-topics. In the call closing in 2019, at least one proposal will be selected in each of the three sub-topics (i-b, ii-b and iii-b).

b) Coordination and Support Actions

Coordination and Support Actions are called for in the following three sub-topics. Proposals should address only one of these sub-topics. At least one proposal will be selected in each of the three sub-topics.

iv) 'Technology Strategy & Policy': will engage leading-edge Internet stakeholders and will identify emerging research trends and policy needs, through a continuous public online consultation, open stakeholder engagement, fora and debates, and data analysis. It should also use the most innovative approaches and technologies, and unconventional ways to maximise involvement of those stakeholders who are new to community programmes and who will

[57] Proposal for a Regulation of the European Parliament and of the Council on a framework for the free flow of non-personal data in the European Union (COM(2017)495)

[58] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

actually drive the evolution of the Internet. It should map and cooperate with national/regional initiatives and global activities where relevant. Driven by actors with a solid background and standing in today's NGI community, it aims at sustainability right from the beginning. It will be the intellectual spearhead of the 'Next Generation Internet – An Open Internet Initiative' and will closely engage with the other actions supported in this topic.

These activities could partially be implemented through small prizes; the maximum budget the project can devote to prizes is Euro 300.000. For grants awarded under this sub-topic beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of prizes. The respective options of Article 15.2 and Article 15.3 of the Model Grant Agreement will be applied.

The Commission considers that proposals with a duration of three years and requesting a contribution from the EU of EUR 3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other durations or amounts.

v) 'Technology Harvest & Transfer': will support 'R&I Actions' and their third parties in ensuring the best use of the outcomes created by delivering specific exploitation strategies, including follow-up investment opportunities, industry relations, IPR/knowledge transfers, tech-transfer services to digital innovation hubs, mentoring / coaching services and linkage to national IPR exploitation programmes, in a most innovative and effective way. It will also support impact assessment at the level of the 'Next Generation Internet – An Open Internet Initiative' topic.

The 'Technology Harvest & Transfer' action shall start no earlier than 6 months after the start of the first 'R&I Actions' in 2018. The Commission considers that proposals with a duration of three years and requesting a contribution from the EU of EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other durations or amounts.

vi) 'Outreach Office': will execute the programme communication strategy, branding and marketing activities, including extensive online and social media presence and events, establishing a positive brand image among young researchers, innovators, policy makers and people at large. Centralised, more efficient and professional, it will lead communications towards the outside world but also coach all actions under this topic in effective communications and marketing.

The Commission considers that proposals with a duration of three years and requesting a contribution from the EU of EUR 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other durations or amounts.

Expected Impact: Proposals should provide appropriate metrics for the claimed impacts.

- Shape a more human-centric evolution of the Internet.

- Create a European ecosystem of top researchers, hi-tech startups and SMEs with the capacity to set the course of Internet evolution.
- Generate new business opportunities and new Internet companies with maximum growth and impact chances, notably through the creation of startups and their scaling up in Europe.
- For sub-topics i, ii, iii, i-b, ii-b and iii-b: Integrating research and innovation communities; development of common visions and enhanced science – industry collaborations in each of the technology domains.
- For sub-topic iv: European research and innovation leaders driving the debate for a human-centric Internet research and policy strategy.
- For sub-topic v: New Internet applications / services, business models and innovation processes strengthening the position of European ICT industry in the Internet market.
- For sub-topic vi: global visibility in the media of the debate on a human-centric Internet; citizens' priorities influencing the evolution of the Internet.

Type of Action: Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-25-2018-2020: Interactive Technologies[59]

Specific Challenge: Interactive technologies such as Augmented (AR) and Virtual Reality (VR) are set to transform the ways in which people communicate, interact and share information on the internet and beyond. This will directly impact a larger number of European industries ranging from the cultural and creative industries, manufacturing, robotic and healthcare to education, entertainment and media, enabling new business opportunities. The challenge is to forge a competitive and sustainable ecosystem of European technology providers in interactive technologies.

Scope: The scope includes: 1/ support a pan-European coordination effort to strengthen the collaboration among the constituency; 2/ increase the European innovation capacity through the development of new authoring tools and the access to a broader community;

a) Interactive Community Building (CSA)

To better coordinate stakeholders the focus should be on:

- elaborating a common research agenda and a technology transfer strategy;

[59] This topic continue in 2020 under ICT-55-2020: Interactive Technologies

- building a platform to gather and share knowledge, algorithms and tools for the development and use of new interactive technologies. This may include the development of a dedicated open operating system;

- providing broad access and technical support for the platform as well as promoting its existence and establishing links with other existing platforms;

- supporting research and development teams in the integration of their tools into the platform. The task may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. Maximum 2M€ funding could be dedicated to it, with EUR 50.000 to 100 000[60] per third party.

This action should result in a unique access point for innovators, SMEs and industrial companies interested in taking-up European interactive technologies in their product and services development. The Commission considers that proposals requesting a contribution from the EU of EUR 3 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Future interaction (RIA)

To strengthen European research and industrial capacities the research and innovation actions should focus either on:

- Better exploiting opportunities offered by **multi-user interactions**, researching and developing technologies augmenting human interaction in groups within both professional and private contexts.

- Or developing future interactive systems offering **higher quality experiences**, for instance through systems which are mobile, support additional senses, have higher accuracy or incorporate bio or environmental sensors.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: a) Establish a sustainable competitive ecosystem of European technology and solution providers for interactive technologies.

b) Strengthening European research and industrial capacities to develop future interactive devices.

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

[60] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

ICT-26-2018-2020: Artificial Intelligence[61]

Specific Challenge: Artificial Intelligence (AI) is a key technology for the further development of the Internet and all future digital devices and applications. Driven by the wider availability of large amounts of data and increasingly higher performance computing and networking, AI brings additional autonomy to all types of physical and virtual artefacts and opens the door to a wave of innovations and opportunities. It is already transforming important sectors ranging from data analytics and Web platforms up to driverless vehicles and new generation of robots for our homes, hospitals, farms or factories.

The challenge is to fully exploit the potential of AI in the economy and society. Building notably on Europe's Scientific and Technology strengths in the field, the supported activities should reinforce industrial competitiveness across all sectors including for SMEs and non-tech industries and help address societal challenges (e.g. ageing, transport). The focus is on R&I areas in AI where collaborative work at European level can make a difference amidst the fierce world-wide competition in the field. The ambition is therefore to make AI technologies and resources available to developers and innovators in all sectors and actively engage with a wide user community, including non-AI experts.

Scope: The ultimate goal is a European AI-on-demand platform mobilising the European AI community to support businesses and sectors in accessing expertise, knowledge, algorithms and tools to successfully apply AI thereby generating market impact.

The platform should:

- serve as a central point to gather and provide access to AI-related knowledge, algorithms and tools;
- support potential users of AI in order to facilitate the integration of AI into applications;
- facilitate the interaction with existing data portals needed for AI algorithms, and resources, such as HPC or cloud computing, and support interoperability.

Research and Innovation Action - Building a European AI on-demand platform

The goal is to develop a European AI ecosystem bringing together the knowledge, algorithms, tools and resources available and making it a compelling solution for users, especially from non-tech sectors. The action should build on and link to existing relevant initiatives, including for instance existing platforms, data repositories, cloud computing, HPC. Proposals will be expected to plan efforts to connect and cooperate with the DIHs, Pilots and other relevant activities of this workprogramme, as appropriate. The action called for is expected to include the following activities:

- Mobilising the European AI community including researchers, businesses and start-ups to provide access to knowledge, algorithms and tools;

[61] This topic continue in 2020 under ICT-49-2020: Artificial Intelligence on demand platform

- Defining sustainable processes and structures (governance, access, business models, licensing, etc.) as well as developing a suitable software infrastructure (APIs and tools to aggregate existing tools and algorithms and to make them easily deployable in applications, as well as to access data and computing resources);

- Filling important technology gaps through challenge-based and/or user-driven research and innovation efforts. These efforts could have an application or technology focus, covering major domains such as robotics, IoT, CPS, intuitive interfaces, personalised applications, healthcare, manufacturing or agriculture;

- Gathering user requirements: based on representative set of its future users (researchers and industry). In particular, the research and innovation efforts expected from this action will have strong synergies with the platform building (providing user requirements, guiding its development, exploiting its resources, and contributing to its content) but additional efforts might be necessary to ensure that the needs of the various types of potential users of the platforms are represented;

- Putting in place a comprehensive service layer to facilitate the use and uptake of the platform both by end-users and researchers;

- Reaching out to new user domains and boosting the use of the platform. The task may involve financial support to third parties to fund promising projects (selected through open competitive calls) exploiting the resources and services offered by the platform to foster technology transfer of AI-based solutions, in line with the conditions set out in part K of the General Conditions. Maximum 3M€ funding could be dedicated to it, with EUR 50.000 to EUR 200.000 per third party[62];

- Developing a Strategic Research and Innovation Agenda for AI including ELSE (Ethical, Legal, Socio-Economic) aspects, taking into account and building on relevant initiatives and strategies (e.g.: Big Data PPP, Robotics PPP, AIOTI , CPS (CyPhERS), cybersecurity cPPP).

The Commission considers that proposals requesting a contribution from the EU of up to 20 million € would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Building a sustainable AI-on-demand platform, becoming a reference, mobilising the entire European AI community, and ensuring a leading position for Europe in AI.

- Reinforcing European excellence and leading position worldwide in major research and application domains, especially through the research and innovation efforts to fill important technology gaps.

[62] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

- Boosting technology transfer of AI, especially towards SMEs and non-technology sectors, and disseminating the economic benefits of AI to a large user base.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-27-2018-2020: Internet of Things[63]

Specific Challenge: Internet of Things (IoT) technologies and applications are bringing fundamental changes to all sectors of activity and are therefore an essential element of the Next Generation Internet. The challenge is to leverage EU technological strength to develop the next generation of IoT devices and systems that build on enhanced sensing/actuating, reasoning capabilities and computational power to the edges, but also new capabilities on the backend, such as artificial intelligence, deep semantic interoperability and novel contractual arrangements like Blockchains.

Scope: **Coordination and Support Actions**

A support action which will support IoT policies under the Digitising European Industry strategy especially in the context of human-centered IoT. In particular, it should analyse and evaluate security and privacy concepts across on-going and new European projects and initiatives in the IoT Focus Area and carry out trend scouting for future research and innovation policy through liaising with academic, industrial and policy stakeholders. The approach should include to build and sustain a vibrant network of IoT technology providers in Europe as well as ensuring the end-user trust in the security concerns as well respect for privacy.

The CSA will analyse and compile trends in IoT research and innovation with the aim to define research roadmap for future IoT related activities. The CSA shall evaluate and take into account emerging business models and shall support consensus building both with suppliers and users across Europe. It shall disseminate and seek support for results from a broad range of stakeholders in the IoT domain and relevant areas of the Next Generation Internet (NGI) initiative.

The Commission considers that proposals requesting a contribution from the EU of **EUR 1.5 million** would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Broad consensus on a strategy on human-centred IoT evolution improving usability and user acceptance, notably through strengthened security, privacy and user trust.

[63] This topic continue in 2020 under ICT-56-2020: Next Generation Internet of Things

- Identified roadmap that enables taking the right measures to put Europe in the lead for IoT research and innovation through a long-term evolution of IoT platform strategy and through scientific progress enabling novel, future semi-autonomous IoT applications.

- Capacity to create and sustain a vibrant technology cluster involving all stakeholders including industry, technology, and end-users.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-28-2018: Future Hyper-connected Sociality

Specific Challenge: Future social networks, media and platforms will become the way our societies operate for communication, exchange, business, creation, learning and knowledge acquisition. The challenge is to mobilise a positive vision as to the role that Social Media will increasingly play in all these areas, and to overcome today's critical issues about trust and governance through democratic reputation mechanisms, and user experience.

Scope: Analysing and building the foundation of next generation Social Media platforms towards a "Global Social Sphere", based on peer-to-peer/decentralised, community approaches and free/open source principles. This foundation shall enhance the role of prosumers, communities and small businesses, mastering technological barriers, introducing innovative and participatory forms of quality journalism, and using various data in a secure manner. These activities should contribute to overcome the current accumulation of power by central intermediaries often located outside Europe. Proposals are invited for one of the following four subtopics:

Innovation Action

Trustful and Secure Data Ecosystem for Social Media and Media.

a) Content verification - Development of intermediary-free solutions addressing information veracity for Social Media. The solutions to be developed shall contribute to the understanding of information cascades, the spreading of information and the identification of information sources, the openness of algorithms and users' access to and control of their personal data (such as profiles, images, videos, biometrical, geolocation data and local data). Proposals are expected to develop and pilot solutions with a large existing community of citizens, and consortia may include inter alia partners from media, social media, distributed architectures, security and blockchain developers. Linked to this and in order to allow mastering better the complexity for users of Social Media, a Digital Companion interaction component may also be realised. The actions on this subtopic will cooperate for setting-up the basis of an observatory as described in d).

b) Secure Data Ecosystem - Creation of media and social media data business and innovation ecosystem to ensure privacy and secure sharing, as well as fair trade of federated

media relevant data produced by media, social media and operators from other industrial sectors across Europe. The involvement of non-media sectors is considered critical to achieve volume and variety of data sets comparable with the ones of leading content aggregators. The action should address the necessary technical, organisational, legal and commercial aspects of data sharing/brokerage/trading to enable data-driven services. The action must also develop pilots to demonstrate the potential and sustainability of the federated data solution.[64]

Research and Innovation Action

c) Support of new Social Media initiatives, and transition to peer-to-peer federated social networks based on smart decentralised architectures. This should be carried out by multidisciplinary and cross-sectorial consortia (technologist, sociologists, artists,…), including inter alia academic and industry partners focussing on web media, platform and application development. Proposals should include the creation of an open decentralised platform exploiting the added value derived from data aggregation and data analytics, exploring possible applications of blockchain technologies and enabling the development of innovative services and novel forms of distribution of media content. This includes research and innovation on open API, interface design, content production, consumer/prosumer business models including crowd-sourcing models for identification and rewarding of user generated content, open management and portability of profiles, gaming and art aspects. Proposals may also consider aspects of a “Social Networks of Objects", integrating latest European advancements on smart objects, big data, autonomous systems, real-time geolocation[65] and augmented/virtual reality. Proposals should include demonstrations and validation, also leveraging on concepts and technologies addressed elsewhere in the NGI programme.

Coordination and Support Action

d) Support of Social Media ecosystem community building between different Social Media actors such as developers, designers, users of all ages, artists, entrepreneurs, researchers, at European and national level, also linking to important international initiatives. This should include a dynamic app-based tool for community-mapping and an analysis of a future hyper-connected society, considering societal, economic, educational, legal and community-based self-regulation aspects. In addition, the action shall establish with actions on Content Verification under subtopic a) the basis for an observatory on information veracity and best Social Media practices.

The Commission considers that proposals requesting a contribution from the EU of maximum 2,5 MEUR for subtopic a), 5 MEUR for subtopic b) and c) and 1 MEUR for subtopic d) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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64 This action is to be followed up in the Big Data Innovation Hubs, planned for 2020, with a subtopic aiming at incubating ideas for data driven services and tools able to improve the media value chain.

65 Where use is made of geolocation, data from Galileo and EGNOS should be used wherever relevant.

At least one proposal will be selected for subtopics a) and b). Proposals should clearly state which subtopic they address.

Expected Impact:

- Increased trust and improved governance and value for Social Media and Media
- New federated Social Media platforms and innovative media data driven services
- Societal change towards digital literacy and citizen participation

Type of Action: Innovation action, Research and Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-29-2018: A multilingual Next Generation Internet

Specific Challenge: The activities under this topic will support technology-enabled multilingualism for an inclusive Digital Single Market. Every European should be able to access content and engage in written and spoken communication activities without language being a barrier. Content and services, such as those provided by public administrations, are not available in multiple languages. Linguistic fragmentation means that many citizens and businesses cannot fully engage in online activities and benefit from online content and services. The sheer volume of content, the diversity of content types and modalities as well as the diversity of languages in Europe makes the effective roll-out and provision of multilingual solutions challenging.

Scope: The actions will address technological challenges (for language resources and interoperable language tools) and support coordination and networking by exploiting excellences and synergies with activities carried out in the Member States and Associated Countries. They will push research results to those who need them and support technology transfer and breakthroughs.

a) Innovation Action: A European Language Grid

The action shall:

i. develop the architecture and components for a public, open and interoperable grid connecting resources and tools, sharing and combining resources to support effective development and deployment of language technologies (software and services) across Europe. It shall provide easy access to basic natural language processing tools and services for European languages. The action shall cater for both consolidation of existing and a seamless inclusion of new resources and tools available for free or/and for a fee, enabling providers to control access rights reflecting their policies. The end-users of the grid shall be closely involved in the process.

ii. coordinate the work of the European Language grid and all actions supported under this topic and address the interoperability issues. It shall identify barriers for deploying multilingual services and establishing language infrastructure at European scale, including any skills gap. The action shall address legal and organisational obstacles, facilitate coordination between various European, national and regional activities through a structured dialogue and the establishment and exchange of best practices.

iii. pilot the European Language Grid in specific sectors of high commercial and/or societal impact, through small scale demonstrators geared towards an innovative integration of language technologies in specific operating processes/operations. The action shall provide facilities for collaboration, technical and linguistic guidance, access to open-source tools and open language resources (available through the grid), access to venture capital, and promotion and dissemination events. The results of all small scale demonstrators should be made available through the European Language grid under appropriate licensing conditions. The action shall select these small scale demonstrators through the use of financial support to third parties. Up to 30% of the EU funding of the action should be allocated to the financial support of these third parties, typically of the size of EUR 100 000 to 200 000 per third party[66] and a duration of about 9 to 12 months. Financial support to third parties should in line with the conditions set out in Part K of the General Annexes.

iv. establish competence centres / nodes in Member and Associated States. It shall build on the previous EC-funded actions within the FP7, H2020 and CEF[67].

The Commission considers that proposals requesting a contribution from the EU of about 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) **Research and Innovation Action: Domain-specific/challenge-oriented Human Language Technology.**

The actions shall

Advance the state of art in Human Language Technologies through well-identified mission-oriented challenges involving researchers and industrial users of language technologies. Each proposal should address a specific sector of high commercial and/or societal impact or a technological challenge common/relevant to several sectors. Proposers should include a detailed analysis of the expected advances in terms of language technology-related research The actions should address concrete real-life issues defined by industrial users. The proposals must convincingly argue the demand for the proposed solution and provide clear indicators to benchmark the research results. The projects shall create a sustainable ecosystem of multilingual applications and services tailored for the specific needs of the addressed sector.

66 In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

67 https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/eTranslation

The Commission considers that proposals requesting a contribution from the EU of about 3 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Provide European research and language technology industry with a better access to and usage of quality language resources and tools;
- Increase in the quality and coverage of multilingual solutions used by industrial players in sectors relevant to the emergence of the Digital Single Market;
- Increase in the uptake of language technologies in Europe in various sectors;
- Cost savings for private and public sector users of language technology solutions.

Type of Action: Research and Innovation action, Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-30-2019-2020: An empowering, inclusive Next Generation Internet[68]

Specific Challenge: Every citizen, from all walks of life, should be able to fully take part in the Digital Single Market. This means that the Next Generation Internet will have to empower users, including its most vulnerable or disabled one, to have access to the same digital learning opportunities, in forms that are accessible, perceivable and understandable by everybody.

Scope: The objective is to support actions on smarter, open, trusted and **personalised learning** solutions to optimise digital learning and to allow learners to engage and interact with content and with peers.

a. **Innovation Action: Digital Learning Incubator**

The objective of this action is to advance **personalised and inclusive digital learning** through a fast-paced adoption cycle of technological and methodological solutions. The work will build on cross-links and advances in the various NGI technologies (such as machine-learning, AR/VR, AI) research fields and foster synergies between all the relevant market players, researchers and educational agents working on promising and innovative products. The action will be based on a "push and pull" strategy whereby the research actors push the best research projects to enter the innovation cycle and the market actors pull for the ideas with best market traction.

The action will:

[68] This topic continue in 2020 under ICT-57-2020: An empowering, inclusive Next Generation Internet.

- set up an Incubator bringing together all relevant stakeholders to form strategic alliances that can jointly achieve fast-paced breakthroughs in the area of personalised and inclusive learning online. The Incubator will allow fast-track experimentations in form of small scale projects, providing access to knowledge, research prototypes, learning resources and data to parties interested to conduct these experimentations.

- launch open calls for highly promising small scale projects to work on a topic/challenge set out in a roadmap. It shall foresee suitable arrangements for oragnizing the corresponding competitive evaluation and selection.

The action shall select these small scale projects through the use of financial support to third parties. Up to 90% of the EU funding of the action should be allocated to the financial support of these third parties, typically of the size of EUR 100 000 to 200 000 per third party[69] and a duration of about 9 to 12 months. Financial support to third parties should in line with the conditions set out in Part K of the General Annexes.

The Commission considers that up to 1 proposal requesting a contribution from the EU of around 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and support action in the area of Digital Learning

The action will:

- stimulate the collaboration between all EU-funded FP7 and H2020 projects on digital learning, analyse the outcomes and best practices carried out in these projects, support the dissemination of their results as well as ensure their integration within the Next Generation Initiative and link with other support measures.

- identify: a) emerging research challenges, notably those arising from digital certification of learning outcomes and blockchain technologies and their uptake for a more inclusive and personalised learning; b) address legal, organisational and technological challenges underpinning the uptake of the proposed solutions, notably in relation to their scalability; c) make policy recommendations in view of the priorities of the next programme for research, innovation and deployment.

The Commission considers that proposals requesting a contribution from the EU of around 1 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Increase in the overall uptake of technology for personalised and inclusive learning for all, regardless of their age, gender or other socioeconomic factors.

[69] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

- Increase in the number of distributed learning solutions for children with special educational needs.

- Increase in the number of start-ups/SME's deploying personalised and inclusive learning solutions to the market.

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-31-2018-2019: EU-US collaboration on NGI

Specific Challenge: Building upon the EU-US collaboration in previous work programmes in the area of research experimentation, the aim is to reinforce cooperation and strategic partnerships in the area of Next Generation Internet, to establish a continuous dialogue among the key actors in the US and European programmes and to implement focused projects for joint developments. Proposals shall foresee twinning with entities participating in projects funded by the US to exchange knowledge and experience and exploit synergies. This collaboration will be implemented in accordance with the "Implementation arrangement between the European Commission and the government of the United States of America for cooperation between researchers funded separately by the European Union's and the United States framework programmes on research and innovation" signed on 17 October 2016[70].

Scope: **a) Coordination and Support Actions**. Proposals should cover one of the following two areas of this sub-topic:

- Organise workshops and other support activities: to facilitate the coordination of research and innovation initiatives in the EU and US, and to promote collaboration between the research groups. Create a Next Generation Internet open ecosystem engaging relevant initiatives and key actors from the EU and the US.

- Fellowship programme: support 3 to 6 months fellowships for Internet researchers notably from hi-tech startups, SMEs, mid-caps, research centres or academia to broaden the understanding of different approaches, perspectives and values, in view to then contribute to concrete NGI services and products 'Made in Europe'. The project will only provide financial support for travel and subsistence, and only citizens of the EU and associated countries will be eligible for funding. For grants awarded under this topic for the fellowship programme beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied

The Commission considers that proposals requesting a contribution from the EU of EUR 1 million for the first area of this sub-topic (Organise workshops and other support activities)

[70] http://ec.europa.eu/research/iscp/pdf/policy/eu-usa_implementing_arrangement_2016.pdf

and of EUR 1.5 million for the second area of this sub-topic (Fellowship programme) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one proposal will be selected in each of the two areas of this sub-topic.

b) Research and Innovation Action.

Common experiments by EU/US teams on emerging topics for the Next Generation Internet / Tomorrow's Internet programmes on top of EU/US experimental platforms.

For grants awarded under this topic for Research and Innovation actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied. Only organisations established in the EU and associated countries will be eligible for European Commission funding.

The Commission considers that proposals for Research and Innovation actions requesting a contribution from the EU of EUR 3.5 million would allow this specific challenge to be addressed appropriately. As a reference, 80% of the EU funding should be allocated to financial support for the third parties. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Proposals should provide appropriate metrics for the claimed impacts.

- Enhanced EU – US cooperation in Next Generation Internet, including policy cooperation.

- Reinforced collaboration and increased synergies between the Next Generation Internet and the Tomorrow's Internet programmes.

- Developing interoperable solutions and joint demonstrators, contributions to standards

- An EU - US ecosystem of top researchers, hi-tech startups / SMEs and Internet-related communities collaborating on the evolution of the Internet.

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Cross-cutting activities

ICT-45-2020: Reinforcing European presence in international ICT standardisation: Standardisation Observatory and Support Facility

Specific Challenge: Standards and interoperability for digital technologies play a crucial role as a foundation of an effective Digital Single Market. There are ever more bodies and

organisations involved in ICT standard setting around the world. The challenge is to improve cooperation, reinforce the involvement of European specialists and increase the focus in order to ensure that the EU's priorities and the DSM perspectives are sufficiently represented in the entire spectrum of organisations.

Scope: The aim is to reinforce the EU and associated states presence in the international ICT standardisation scene, by setting up a standardisation observatory and a facility supporting the participation of key European specialists (especially from SMEs and Academia) in key international and global SDOs and consortia.

Key tasks to be carried out are:

- Mapping of the relevant activities in international ICT standardisation where reinforced European resources are needed. When relevant hosting standardisation meetings and workshops in Europe.
- Setting up of a management facility to support participation and leadership (e.g. chairing of technical committees) of key European specialists (incl. from SMEs and academia) in those organisations and technical bodies identified. The aim should be to achieve critical mass from industry, including SMEs and Startups, and academia for emerging standardisation activities.
- Liaise with relevant on-going developments in EU and national funded R&I projects, in particular with projects having identified standardisation output or with potential relevant results, including as well other coordination and support actions, and relevant PPPs.

This action allows for the provision of financial support to third parties in line with the conditions set out in Part K of the General Annexes, in particular regarding the participation of European specialists in international SDOs. The consortium will define the process for an open call allowing the funding of the key European specialists to participate in international ICT standardisation activities to fulfil the scope of the call. The consortium will also define the process for an open call that will lead to a selection of an additional pool of experts that may be needed to evaluate the applications for funding specialists. In addition ad-hoc selection processes may be required. Financial support for these specialists will be typically in the order of EUR 1.000 – 10.000 per action by third party.

The proposal should take into account the previous activities carried out on the observatory and facility for funding experts within the topic ICT-40-2017 implemented by the StandICT.eu project (see http://www.standict.eu).

The Commission considers that proposals should cover a period of at least three years. The Commission considers that a proposal requesting a contribution from the EU of EUR 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: Identification of ICT standardisation areas which need European intervention and proposal of actions to address them;

- Engagement of required stakeholders and experts to ensure lasting impact;
- Increase the influence or Europe into international ICT standardisation, ensuring promotion of European requirements and interests;
- Set-up of a facility to support participation of European specialists in international ICT SDOs and technical bodies.
- Increase the participation of European specialists in international ICT Standardisation activities to support European interests, including in leadership positions.
- Getting working items at the right time into the right technical bodies in international SDOs, fora and consortia.
- Synergies with other similar initiatives or European players including from EU (and national) funded R&I projects
- Common positions of European stakeholders in international ICT standardisation.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-32-2018: STARTS – The Arts stimulating innovation

Specific Challenge: The ever-increasing role of technology in our daily life offers huge potential for added value for our society. Artists can help unleash this potential. They can help shape a better relation of technology and humans and stimulate human-centred innovation through their transversal competencies and unconventional thinking. The challenge of the S+T+ARTS=STARTS program – innovation at the nexus of Science, Technology and the Arts - is to better address innovation in industry and society by engaging artists in European R&I projects to explore unconventional art-inspired solutions to industrial/societal problems.

Scope: The topic will support art-driven innovation in European R&I projects by inclusion of artists in research consortia.

a) STARTS lighthouse pilots (RIA instrument) will explore art-inspired solutions to industrial/societal challenges in two chosen areas. Pilots will engage industry, technology, end-users, and artists in a broad artistic exploration of technologies with the aim of creating novel products, processes and services that respond better to human needs. The added value of artistic practices to realise unexpected solutions via artistic exploration must be clearly put forward in the two light house pilots.

(i) Lighthouse pilot in 'art-inspired interactive human-centred environments' created by digital objects and novel media, like IoT, augmented reality or social media. The pilot will explore how these digital objects and media can lead – via artistic exploration – to novel experiences and new models for creativity and thereby to unexpected solutions for challenges in the city, in the home or for mobility.

(ii) Lighthouse pilot in 'art-inspired urban manufacturing' driven by de-centralised digitally-enabled production systems and co-creation in urban environments. The pilot will explore how digitally-enabled small-scale production/manufacturing systems and networks combined with artistic exploration and creativity in design and process - can revive the social, ecological and economic urban space and lead to unexpected products and services in an urban environment.

It is expected to fund one lighthouse pilot in each of the two chosen areas (i) and (ii). For grants awarded under this topic for Research and Innovation Actions at least 30% of the EU funding requested shall be allocated to contributions to the work by artists and creatives.

For grants awarded under this topic for Research and Innovation Actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied. Third party support is expected to help cover the work of artists and creatives.

b) Coordination and Support Action (CSA instrument) to create a STARTS ecosystem by coordinating artistic and innovation relevant aspects of the two lighthouse pilots and of other European/international R&I projects that put artists and creatives at the centre of innovation. Tasks comprise analysing and helping implement best practices for including artists in R&I, organising events, providing online spaces for artists and technologists to meet, presenting the results from art-technology collaborations in exhibitions that are highly visible in the art world and in industry, and assisting European research teams to learn from art and design thinking as a strategy for innovation.. It is expected to fund one Coordination and Support Action.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 4 million for each of the two light house pilots for Research and Innovation Actions and of up to EUR 1 million for maximum one Coordination and Support Action would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. All proposals under a) and b) should target a duration of 3 years.

Expected Impact:

- The demonstration of value-added to industry and society in having artists contribute to the development of radically new products, services and processes.
- Signalling effect for future uptake of art-driven solutions to concrete industrial and societal challenges and art-driven user-centred products and services.

- Efficient working models how art-technology collaboration can contribute to innovative processes in research, industry and society.

- Burgeoning STARTS ecosystem involving industry, technology, research, end-users, societal stakeholders, and the Art world that reconciles and unites the goals and thinking of industry and technology with that of the Art world.

Type of Action: Coordination and support action, Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

ICT-33-2019: Startup Europe for Growth and Innovation Radar

Specific Challenge: The challenge is to scale up innovative businesses across the EU, detect high potential innovations and support innovators in going to market. Actions under this heading reinforce the Startup Europe and Innovation Radar initiatives and link to the activities of the European Innovation Council in a complementary way by targeting exclusively ICT innovators that are not supported by the EIC.

Scope: Actions should help startups and scaleups achieve market success and mature the innovation excellence of high potential innovators. Actions should support the creation of new jobs and high growth businesses and support their growth on a pan-European and international level. Innovators identified, promoted and supported by the Innovation Radar are expected to enrich and benefit from the Startup Europe ecosystem[71][72][73]. Projects should demonstrate sustainability of proposed actions beyond the life of the project. Where appropriate, the projects should seek synergies with ESIF funds or ESIF supported actions in order to improve the synergies between H2020 and ESIF.

a. Innovation actions

Connecting local deep-tech startup ecosystems and supporting cross-border activities: among the 4-5 startups ecosystems connected by each project, at least half of them will be located in less developed ecosystems. Actively connect them to the **Startup Europe one-stop-shop** and involve the Digital Innovation Hubs to support individual ecosystems. Cross-border activities will include: connecting deep-tech entrepreneurs with e.g. potential investors, business partners, accessing skills and services helping startups soft land in new markets. Particular focus will be placed on stimulating partnerships between scaleups and corporates with a view to procurement. Special attention will be placed to support digital startups and scaleups wherever situated in Europe, to access public procurement opportunities across borders.

b. Coordination and support actions

71 https://ec.europa.eu/digital-agenda/en/innovation-radar

72 http://ec.europa.eu/digital-agenda/about-startup-europe

73 This includes ICT innovators in EU-funded PCP and PPI procurements in the ICT domain. Innovators targeted by the Innovation Radar include startups, SMEs, spinoffs and research teams.

- Provide targeted and tailored go-to-market support to SMEs, startups, scaleups, spinoffs and market-oriented researchers, who are supported by EU funded ICT projects[74] and are delivering market-creating innovations that have scale-up potential.

- Insight and intelligence from the Innovation Radar is to be used to detect EU-funded innovators who face the biggest market opportunities (enhancement of Innovation Radar data by merging with relevant third party data sources is welcomed).

- Support for innovators is expected to include mentoring, coaching, investor readiness training, coaching on how to bid for public procurement sales opportunities, connecting innovators with potential customers, business partners and investors (Business Angels, Venture Capital, Crowdfunding and other relevant forms of financing).

Expected Impact: Proposals should address the following and provide appropriate metrics for measuring success with respect to a defined baseline:

a. Innovation actions

- Increased connectedness among members of deep-tech startup ecosystems and their companies (startups and scaleups) and to the larger European business ecosystem seeking maximum synergies

- Increased access to customers, private and public, better access to qualified employees, access to the right combination of finance and prospects for scaling up across border;

- Stimulate European investments in deep-tech digital sectors through increasing the number of cross-border investments; demonstrate sustainability of proposed actions beyond the life of the project.

b. Coordination and Support actions

- Increase the number of digital technology based spin-offs, startups and scale-ups or successfully transferred technology from EU funded projects;

- Enable innovative ICT based companies or technology to reach investment maturity and market introduction readiness, and/or winning for the first time public procurement contracts across the EU.

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

[74] From Framework Programme 7, Competitiveness and Innovation Program and Horizon 2020 programme.

ICT-34-2018-2019: Pre-Commercial Procurement open

Specific Challenge: The challenge is to enable public procurers to collectively implement PCPs in order to close the gap between supply and demand for innovative ICTs. The objective is to bring radical improvements to the quality and efficiency of public services by encouraging the development and validation of breakthrough solutions through Pre-Commercial Procurement[75].

Scope: **PCP actions** targeting consortia of procurers with similar procurement needs that want to procure together the development of innovative ICT based solutions to modernize public services whilst creating growth opportunities for industry and researchers in Europe in new markets. This topic is open to proposals for PCP actions in all areas of public sector interest requiring innovative ICT based solutions. It is open both to proposals requiring improvements mainly based on one specific ICT technology field, as well as to proposals requiring end-to-end solutions that need combinations of different ICT technologies.

Proposals shall demonstrate sustainability of the action beyond the life of the project. Activities covered shall include cooperation with policy makers to reinforce the national policy frameworks and mobilise substantial additional national budgets for PCP and PPI, as well as awareness raising, technical assistance and/or capacity building to other procurers beyond the project to mainstream PCP/PPI implementation and to remove obstacles for introducing the innovative solutions to be procured into the market.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Specific requirements for PCP actions are described in part E of the General Annexes of the Work Programme.

Expected Impact:

- Reduced fragmentation of demand for innovative solutions;
- Increased opportunities for wide market uptake and economies of scale for the supply side through the use of joint specifications, wide publication of results and where relevant contribution to standardisation, regulation or certification.

Type of Action: Pre-Commercial Procurement

The conditions related to this topic are provided at the end of this call and in the General Annexes.

[75] https://ec.europa.eu/digital-single-market/en/pre-commercial-procurement

ICT-35-2018: Fintech: Support to experimentation frameworks and regulatory compliance

Specific Challenge: "Fintech" is at the confluence of various digital technologies, financial areas and the entrepreneurial landscape, with many startups and scaleups proposing disrupting services. The challenge is to increase the role Europe play in Fintech so that EU startups can better scale-up across Europe and at global level. Facilitating the interactions between innovators, supervisors and regulators is particularly relevant in this context.

Scope:

- Bring together a group of regulatory or supervisory bodies, and other relevant organisations to investigate new approaches for piloting innovative Fintech solutions, anticipating risks, and facilitating the operations of Fintech firms that want to grow and scale-up across Europe.

- Build capacity and expertise regarding new technologies and models to support early understanding for regulators or supervisors and to offer specific advice to Fintech firms that want to grow and scale-up across Europe. Such regulatory advice would be provided by pools of experts. It should in particular support common understanding and interpretation of data-related policies and rules.

- Support the cross-border networking of ecosystems, hubs and accelerators focusing on Fintech, in particular to help startups appraise regulatory issues, to engage with other stakeholders like established financial or insurance firms and to identify opportunities for innovation procurements in Fintech.

- Envisage possible actions and technical solutions to evaluate the impact of regulation and facilitate regulatory compliance in financial areas. This could concern in particular initiatives based on distributed ledger technologies, advanced regtech solutions or algorithmic regulation.

Expected Impact:

- Reinforce the position of Europe amongst leaders in Fintech, encouraging cross border collaboration and practical approaches for Fintech experimentation frameworks; enabling Fintech firms to grow and scale-up across Europe.

- Develop common understanding, interpretation and expertise regarding technology evolution and Fintech-related regulations and policies, in particular those concerning data.

- Put Europe in the lead for innovating in regulation, appraising the impact of regulation and facilitating regulatory compliance.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

International Cooperation activities

ICT-58-2020: International partnership building between European and African innovation hubs

Specific Challenge: To reinforce cooperation and strategic partnership with selected countries in Africa to support the strengthening of existing digital innovation hubs (DIHs) in Africa and to facilitate the collaboration between EU and African DIHs in order to strengthen a common EU-Africa innovation and start-up ecosystem

Targeted countries: Low and middle income countries[76] *in Africa*

Scope: **a) Innovation Action (IA)**

Cooperation on developing and strengthening of digital innovation hubs in Africa a**ctions will address**:

1. reinforcing the development and establishment of Pan-African networks of Digital Innovations/Tech Hubs through strengthening local digital innovation and startup ecosystems by:

    i. providing technical capacity building and technology transfer to local SMEs, local governments and projects focused on digitalisation and the uptake of digital innovations such as the use of open data, artificial intelligence, cybersecurity, blockchain technologies;

    ii. fostering the development of an enabling environment for digital start-ups through establishing networks between fast growing companies, startup founders, local governments, academic institutions, early stage investors and corporates;

    iii. providing capacity-building programmes, focused on digital and entrepreneurship skills specifically targeted to marginalised youth, women and vulnerable groups;

2. developing a mutually beneficial cooperation between African and European Digital Innovation Hubs to strengthen the long-term sustainability of DIHs by:

    i. supporting local youth employment by developing collaborative projects, that match the demand for qualified digital skills in Europe with the existing ICT professionals in Africa;

    ii. facilitating a network between African and European innovative entrepreneurs and start-ups with the goal to support start-up incubation, mentoring programs and facilitate increased investments in African start-ups and EU-African joint ventures;

[76] *See World Bank country classification*

iii. carrying out capacity-building activities, such as Summer Academies bringing together successful entrepreneurs with African and European start-ups and ICT professionals;

iv. facilitating linkages and partnerships with African diaspora communities in Europe with the goal to better support the creation and development of digital startups and SMEs in Africa

The activities will complement other European initiatives under the DCI and the ENI, such as the EU/DE/FR initiative on a Digital Innovation Bridge that will support the scale up of African startups.

Proposals should be submitted by a partnership complementing each other with a particular focus on the participation of relevant Member States or associated countries digital Innovation/tech Hubs, as well as African digital Innovation/tech Hubs. Due to the specific challenge of this topic, in addition to the minimum number of participants set out in the General Annexes, proposals shall include at least one participant from a low or middle income country in Africa.

The Commission considers that proposals requesting a contribution from the EU between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b) Coordination and Support Action (CSA)

The aim is to foster coordination between actions taken in Africa and the EU to implement the recommendations of the EU-AU task force on digital economy, in particular in the area of research and innovation, through support to, engagement with, and monitoring of ICT-related activities and organisation of events in a critical mass of African countries.

Activities will include:

- supporting initiatives in Africa on the digitalisation of economy and society, including common Research, Development and Innovation priorities;
- supporting research and innovation capacity and societal challenges in participating African countries and future cooperation opportunities;
- promoting awareness of cooperation opportunities, including under the Horizon 2020 and Horizon Europe programmes;
- disseminating results from EU support activities (including AfricaConnect and Digital4Development).

The activities of the CSA should be carried out over the remainder of the current EU financial framework (incl. Horizon 2020) and the initial phase of the new financial framework of the EU. Actions should take account of the networks and achievements of similar past or ongoing

support actions for Africa while focussing on the scaling up of digital technology and services in the EU financial cooperation with Africa under the new financial framework. The partnership should include relevant stakeholders Member States or associated countries from the public and private sectors, including Research and Innovation systems. The partnership should as well include relevant African stakeholders from the public and private sectors, including Research and Innovation systems. Due to the specific challenge of this topic, in addition to the minimum number of participants set out in the General Annexes, proposals shall include at least one participant from a low or middle income country in Africa.

The Commission considers that proposals requesting a contribution from the EU of around EUR 1 million for a duration of three years would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: **a) Innovation Action (IA)**

- Further development of digital innovation hubs to the support of digitalisation of SMEs and traditional sectors in Africa contributing to a vibrant digital economy and new job opportunities;
    - Strengthening of innovation ecosystems for digital startups at the local level;
    - Support of youth employment programs by facilitating collaboration between European and African DIHs and startups;
    - Enhancement of entrepreneurial and innovation skills of ICT professionals and start-ups in selected African countries;
- Sustainable uptake of results within the targeted countries, beyond the project completion date;
- Reinforced international dimension of the ICT and Innovation aspects of Horizon 2020 and contribution to the implementation of the EC digital for development strategy ;
- Reinforcement of strategic partnerships between EU and African Digital Innovation Hubs in areas of mutual interest.

b) Coordination and Support Action (CSA)

- Strengthening cooperative research and innovation linkages;
- Reinforced international dimension of the ICT and Innovation aspects of Horizon 2020 and contribution to the implementation of the EC digital for development strategy;
- Reinforcement of strategic partnerships between EU and African in ICT areas of mutual interest.

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Conditions for the Call - Information and Communication Technologies

Opening date(s), deadline(s), indicative budget(s):[77]

Topics (Type of Action)	Budgets (EUR million)			Deadlines
	2018	2019	2020	
Opening: 31 Oct 2017				
ICT-17-2018 (RIA)	60.00			31 Jan 2018
ICT-22-2018 (RIA)	6.00			
ICT-02-2018 (RIA)	30.00			17 Apr 2018
ICT-03-2018-2019 (IA)	30.00			
ICT-04-2018 (IA)	25.00			
ICT-04-2018 (RIA)	30.00			
ICT-07-2018 (IA)	8.00			
ICT-07-2018 (RIA)	39.00			
ICT-07-2018 (CSA)	1.00			
ICT-11-2018-2019 (IA)	50.00			
ICT-12-2018-2020 (RIA)	30.00			
ICT-12-2018-2020 (CSA)	1.00			
ICT-13-2018-2019 (RIA)	10.00			
ICT-13-2018-2019 (CSA)	3.00			
ICT-16-2018 (CSA)	1.00			
ICT-16-2018 (IA)	9.00			
ICT-16-2018 (RIA)	10.00			

[77] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
The Director-General responsible may delay the deadline(s) by up to two months.
All deadlines are at 17.00.00 Brussels local time.
The budget amounts for the 2020 budget are subject to the availability of the appropriations provided for in the draft budget for 2020 after the adoption of the budget 2020 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

ICT-18-2018 (IA)	50.00			
ICT-21-2018 (CSA)	2.00			
ICT-24-2018-2019 (RIA)	21.50			
ICT-24-2018-2019 (CSA)	7.00			
ICT-25-2018-2020 (CSA)	3.00			
ICT-26-2018-2020 (RIA)	20.00			
ICT-27-2018-2020 (CSA)	1.50			
ICT-28-2018 (IA)	10.00			
ICT-28-2018 (RIA)	10.00			
ICT-28-2018 (CSA)	1.00			
ICT-29-2018 (RIA)	18.00			
ICT-29-2018 (IA)	7.00			
ICT-31-2018-2019 (CSA)	2.50			
ICT-32-2018 (CSA)	1.00			
ICT-32-2018 (RIA)	8.00			
ICT-34-2018-2019 (PCP)	6.00			
ICT-35-2018 (CSA)	2.50			
Opening: 26 Jul 2018				
ICT-11-2018-2019 (IA)		40.00		14 Nov 2018
ICT-19-2019 (CSA)		2.00		
ICT-19-2019 (RIA)		90.00		
ICT-25-2018-2020 (RIA)		20.00		
Opening: 05 Sep 2018				
ICT-23-2019 (RIA)		4.00		15 Jan 2019
Opening: 16 Oct 2018				
ICT-01-2019 (RIA)		38.00		28 Mar 2019
ICT-01-2019 (CSA)		2.00		

ICT-03-2018-2019 (IA)		30.00		
ICT-05-2019 (IA)		30.00		
ICT-05-2019 (CSA)		1.50		
ICT-05-2019 (RIA)		45.00		
ICT-06-2019 (RIA)		30.00		
ICT-08-2019 (RIA)		11.00		
ICT-09-2019-2020 (IA)		28.00		
ICT-09-2019-2020 (CSA)		2.00		
ICT-09-2019-2020 (RIA)		20.00		
ICT-10-2019-2020 (RIA)		42.00		
ICT-13-2018-2019 (IA)		48.00		
ICT-15-2019-2020 (RIA)		28.50		
ICT-15-2019-2020 (CSA)		1.50		
ICT-20-2019-2020 (RIA)		44.00		
ICT-24-2018-2019 (RIA)		21.50		
ICT-30-2019-2020 (IA)		7.00		
ICT-30-2019-2020 (CSA)		1.00		
ICT-31-2018-2019 (RIA)		3.50		
ICT-33-2019 (IA)		10.00		
ICT-33-2019 (CSA)		1.50		
ICT-34-2018-2019 (PCP)		6.00		
Opening: 09 Jul 2019				
ICT-45-2020 (CSA)			4.00	13 Nov 2019
ICT-48-2020 (RIA)			48.00	
ICT-48-2020 (CSA)			2.00	
ICT-53-2020 (IA)			30.00	
ICT-55-2020 (IA)			17.00	

ICT-38-2020 (RIA)			47.00	16 Jan 2020
ICT-38-2020 (CSA)			1.00	
ICT-42-2020 (IA)			48.00	
ICT-42-2020 (CSA)			1.00	
ICT-44-2020 (IA)			15.50	
ICT-44-2020 (CSA)			2.00	
ICT-50-2020 (CSA)			1.00	
ICT-50-2020 (RIA)			29.00	
ICT-51-2020 (CSA)			1.50	
ICT-51-2020 (RIA)			30.00	
ICT-54-2020 (RIA)			20.00	
ICT-56-2020 (CSA)			2.00	
ICT-56-2020 (RIA)			46.50	
Opening: 19 Nov 2019				
ICT-36-2020 (RIA)			47.50	22 Apr 2020
ICT-37-2020 (IA)			15.00	
ICT-37-2020 (RIA)			29.00	
ICT-37-2020 (CSA)			4.00	
ICT-40-2020 (CSA)			0.60	
ICT-40-2020 (RIA)			19.40	
ICT-41-2020 (IA)			49.00	
ICT-46-2020 (RIA)			41.50	
ICT-46-2020 (IA)			41.50	
ICT-46-2020 (CSA)			3.00	
ICT-47-2020 (RIA)			20.00	
ICT-49-2020 (IA)			30.00	
ICT-52-2020 (RIA)			55.00	

ICT-57-2020 (RIA)			7.00	
ICT-58-2020 (IA)			10.00	
ICT-58-2020 (CSA)			1.00	
Overall indicative budget	514.00	608.00	719.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme. The following exceptions apply:

ICT-17-2018, ICT-18-2018, ICT-19-2019	The limit for a full proposal is 100 pages.
ICT-31-2018-2019	For the fellowship programme only citizens of the EU and associated countries are eligible for the financial support to third parties.
ICT-58-2020	Proposals shall include at least one participant from a low or middle income country in Africa[78].

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme. The following exceptions apply:

ICT-22-2018	Criterion 3 "Quality and efficiency of the implementation": additional evaluation sub-criterion: Credibility and quality of the proposed collaboration mechanisms to effectively and efficiently carry on joint research activities and deliver joint outcomes with the twinning project from China.
ICT-23-2019	Due to the specific scope of this topic, in addition to the minimum number of participants set out in the General Annexes, proposals shall include at least two participants from Taiwan.

[78] See World Bank country classification

	Proposals will only be selected on the condition that the eligibility of Taiwanese partners is validated by Taiwan Government prior to technical review.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant guide published on the Funding & Tenders Portal.

Grant Conditions:

ICT-17-2018, ICT-18-2018, ICT-19-2019, ICT-20-2019-2020, ICT-41-2020, ICT-42-2020, ICT-52-2020, ICT-53-2020	**Complementary grant agreements** will be implemented across projects originating from RIA, IA and CSA implemented under these topics through use of the respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement.
ICT-24-2018-2019, ICT-26-2018-2020, ICT-32-2018, ICT-48-2020, ICT-54-2020, ICT-56-2020	For grants awarded under this sub-topic for Research and Innovation actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.
ICT-24-2018-2019, ICT-44-2020	For grants awarded under this sub-topic for Coordination and Support Actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of prizes. The respective options of Article 15.2 and Article 15.3 of the Model Grant Agreement will be applied.
ICT-25-2018-2020, ICT-31-2018-2019, ICT-45-2020	For grants awarded under this sub-topic for Coordination and Support Actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.
ICT-29-2018, ICT-30-2019-2020, ICT-44-	For grants awarded under this topic for Innovation actions beneficiaries may provide support to third parties as described in

2020, ICT-49-2020	part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.
ICT-34-2018-2019	The funding rate for Pre-Commercial Procurement (PCP) actions is limited to 90% of the total eligible costs (PCP is procurement of R&D services) to leverage co-financing from the procurers.

Consortium agreement:

All topics of this call	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - Digitising and transforming European industry and services: digital innovation hubs and platforms[79]

H2020-DT-2018-2020

Introduction

In April 2016, the Commission issued a communication[80] outlining its strategy for allowing the European Union to fully seize the opportunities offered by digitisation across industrial and services sectors. Beyond the support to key technological areas, an essential aspect is to foster the uptake of digital technologies and innovations, as well as synergies with other key enabling technologies.

The **'digitising and transforming European industry and services' focus area** ambitions to support Horizon 2020's contribution to the implementation of this strategy, through projects cutting across technological boundaries and reinforcing links between LEIT and Societal Challenges.

To that end, the focus area will be mainly implemented with the two following types of activities:

1. **digital innovation hubs**, which provide easy access to the latest digital innovations and experimentation facilities to potential users,
2. **cross-sectorial and integrated digital platforms** and **large-scale pilots** for experimentation and co-creation with users.

For more details about the impact of the focus area, please refer to the annex 1 of the general introduction to the work programme.

Support to Hubs

The Digitising European Industry Strategy[81] aims to ensure that any business in Europe has access to a Digital Innovation Hub at 'a working distance'. A Digital Innovation Hub (DIH)

79 Drawing on the success of actions of previous work programmes leveraging cascading grants to enable agility and reach out to new or key actors in the innovation chain (such as SMEs and mid-caps) not necessarily involved in standard EU R&I projects, part of the budget allocated to digital innovation hubs as well as to platforms and pilots actions under this call will be dedicated to the support of experiments and smaller projects funded through financial support to third parties (in accordance with article 137 of the Financial Regulation). While their size will be small in comparison with standard Horizon 2020 actions, in line with article 23 (7) of the Rules for Participation the budget to be allocated per third party may exceed the default maximum amount foreseen in the Financial Regulation. Specific limits corresponding to the specific objectives to be addressed, and to the consequent expected scale and duration of the activities to be carried out by third parties are provided for the topics DT-ICT-01-2019, DT-ICT-02-2018, DT-ICT-03-2020, DT-ICT-04-2020, DT-ICT-05-2020, DT-ICT-07-2018-2019, DT-ICT-08-2019, DT-ICT-10-2018-2019, DT-ICT-11-2018-2019.

80 COM(2016)180 final – 'Digitising European Industry - Reaping the full benefits of a Digital Single Market'

81 https://ec.europa.eu/digital-single-market/en/digitising-european-industry

helps companies become more competitive by improving their business/production processes as well as products and services by means of digital technology. DIHs offer services to test and experiment with advanced technologies, to manufacture innovative products or act as broker between user companies and technology suppliers.

Many components of Digital Innovation Hubs already exist supported for examples by Member States, regions or the knowledge and innovation communities (KIC) of EIT. Through the focus area on 'digitising and transforming European industry and services', the European Commission is adding value to these investments by supporting highly innovative experimentation with a cross-border dimension. To qualify for support, the following is required:

1. Consortia participating in the call should demonstrate that they are deeply rooted in innovation ecosystems that offer digital transformation services to companies in their proximity. They should provide a clear analysis how the proposed project will add value to an already existing service offer, and how it is aligned with the national or regional digitisation of industry initiative .

2. Every project should support a critical mass of dedicated highly innovative, cross border experiments bringing together technology suppliers and users. At least 50% of the budget should directly benefit SMEs or slightly bigger companies. For grants awarded under topics DT-ICT-01-2019, DT-ICT-02-2018, DT-ICT-03-2020, DT-ICT-04-2020, DT-ICT-05-2020 beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.

3. Activities should aim at long-term sustainability and include a business plan for the digital innovation hubs, a plan to attract investors, to address training and skills development needs and dissemination. Established networks reaching out to SMEs like the Enterprise Europe Network, cluster organisations registered at the European Cluster Collaboration Platform and the NCP network[82] should be used.

4. Selected projects are expected to collaborate on building a network of Digital Innovation Hubs, covering most regions in Europe.
   In addition to the topics described underneath hubs will also be called in the topic **DT-RUR-12-2018: ICT Innovation agriculture – Digital Innovation Hubs for Agriculture**[83]**.**

Proposals are invited against the following topic(s):

[82] https://www.ideal-ist.eu/

[83] Topic published under the Societal Challenge 2 Work Programme "Food Security, sustainable agriculture and forestry, marine, maritime and inland water research and the bio economy".

DT-ICT-03-2020: I4MS (phase 4) - uptake of digital game changers

Specific Challenge: The challenge is to accelerate the design, development and uptake of advanced digital technologies by European industry – especially SMEs and mid-caps –, notably in sectors where digital technologies are underexploited. SMEs and mid-caps in the manufacturing sector need support in the use of secure digital technologies in their production processes, products and business models to enable personalised products and to facilitate cost-effective small-scale production.

Scope: **a) Innovation Actions (IA)**

As Phase 4 of I4MS[84], this topic calls for Digital Innovation Hubs that strengthen European SMEs and mid-caps by experimenting and testing in one or more of the following areas. Proposers are requested to identify which of these is the centre of gravity of their proposed project. Proposals should cover the manufacturing sector at large, including discrete manufacturing, continuous production, and construction. If appropriate, building ecosystems around digital industrial platforms driven by European actors should be supported.

- **Smart modelling, simulation, and optimisation for digital twins**

Experimentation of novel modelling, simulation, and optimisation techniques, possibly combined with high-performance computing and data analytics, for digital twins covering the full lifecycle of products and systems.

- **Laser based equipment in advanced and additive manufacturing**

Actions will focus on assessment of technologies, systems, and processes and on digitisation opportunities, including the link between design tools and production and quality assurance. Actions should include the identification of high-potential business cases and support for the development of business models.

- **Innovative Artificial Intelligence in manufacturing**

Experimentation of innovative Artificial Intelligence techniques in manufacturing, aggregating and analysing data from multiple sources, including e.g. MES (manufacturing execution systems) data, real-time process analytical data, in-line quality control, sound, video and olfactory input. Proposals are encouraged to build on the results of topic ICT-26-2018-2020.

- **Cognitive autonomous systems and human-robot interaction**

Experimentation with cyber-physical systems in production environments, with special focus on reduction of waste, energy and resource consumption and efficient logistic processes. Adoption of robots safely cooperating with humans to support their work, improving both the efficiency and the working conditions and taking into account gender issues. In this topic, proposals should include partners that facilitate creation and experimentation with and by the

[84] See http://www.i4ms.eu

arts[85] to ensure human acceptance of digital technologies in manufacturing and to stimulate new products and services.

- **Widening Digital Innovation Hubs**

Experimentation through Digital Innovation Hubs in regions which are so far underrepresented[86] in Smart Anything Everywhere and I4MS, building on the work by projects "Smart Factories in new EU Member States"[87] and "DIHELP"[88]. The objective addresses all technology areas mentioned above and the technologies addressed in Smart Anything Everywhere and related areas[89]. The hubs should strongly collaborate with other Innovation Actions funded under the Hubs part of the Focus Area, e.g. through joint highly innovative cross-border experiments.

Proposals should focus on minimising the entry barriers and demonstrating the clear added value of technologies, making SMEs and mid-caps more competitive by transferring innovative solutions into the wider manufacturing community. Special attention should be given to security considerations and to the development of skills.

All proposed innovation actions may involve financial support to third parties (typically in the order of EUR 20.000 to 100.000 per third party). For this topic, the four requirements described in the introductory section "Support to hubs" have to be applied.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 8 million would allow each area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. To obtain an adequate coverage of all areas, at least one innovation action is supported for each of the areas, with the exception of the Widening Digital Innovation Hubs area, for which one innovation action is supported.

b) Coordination and Support Action (CSA)

The action will support the network of Digital Innovation Hubs and help achieve broad coverage in technological, application, innovation, and geographic terms, and link up with regional/national innovation initiatives, and other Digital Innovation Hubs. The action should build on the previously developed tools and innovation portal and aim to further improve them for the benefit of new Innovation Actions. The actions should also help in sharing best practices, dissemination, brokering between users and suppliers, leveraging investment and training and organise events. For these support actions, close cooperation is required with the European Factories of the Future Research Association (EFFRA[90]), and other CSAs funded

85 Building on activities developed as part of the STARTS initiative in DG CONNECT (ICT-32-2018 and www.starts.eu)
86 See http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool
87 https://smartfactories.eu/
88 DIH Enhanced-Learning Programme, https://dihelp.eu/.
89 Technology areas addressed are: Cyber-physical and embedded systems, Customised low energy computing powering CPS and the IoT, Flexible and Wearable Electronics
90 See https://www.effra.eu/

under the Digital Innovation Hubs part of the Focus Area "Digitising and transforming European industry and services".

The Commission considers that proposals requesting a contribution from the EU of up to EUR 1 million would allow this area to be addressed appropriately.

Expected Impact: Proposals should address all of the following impact criteria, providing metrics to measure success when appropriate.

- Attract a significant number of new users of advanced ICT in the manufacturing sector, and more innovative technology suppliers, in particular SMEs and mid-caps.
- A sustainable network of Digital Innovation Hubs, providing European added value to investments done at national and regional level in Digital Innovation Hubs and reaching a high leveraging effect on other sources of funding, in particular regional and national funding.

Type of Action: Coordination and support action, Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-04-2020: Photonics Innovation Hubs

Specific Challenge: The challenge is to provide a sustainable ecosystem of research and innovation support for the benefit of SMEs facilitating a broad uptake and integration of photonics technologies. These Photonics Innovation Hubs will help speed up the uptake of photonics technologies in order to make European industry more competitive and foster new business and business models. Business cases must be industrially relevant and should include industrialisation steps to technology and market readiness levels of 7 - 8.

Scope: The focus is on the following theme

Open access to Photonics Innovation Hubs: One-stop-shop access, supported through a network of competence centres, to services and capabilities such as expertise, training, prototyping, design, engineering, business support, financing advice and pilot manufacturing for first users and early adopters enabling the wider up-take and deployment of photonic technologies in innovative products. Actions must build on relevant previous European initiatives and existing infrastructure at European and regional level, demonstrate a record of accomplishment in supporting industry, in particular SMEs. Actions should also address skills development as well as support to the development of new innovation hubs.

The Commission considers that either proposals covering a range of photonics technologies and requesting a contribution from the EU of up to EUR 9.5 million, or a single proposal requesting a contribution of the EU of up to EUR 19 million covering the greatest possible range of photonics technologies, would allow addressing the challenges appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other

amounts. For this topic, proposals have to comply with the four requirements described in the introductory section 'Support to Hubs'. Proposals may envisage to use EU funding for financial support to third parties with a maximum amount of EUR 150.000[91] per third party.

Expected Impact: Proposals should describe how the proposed work would contribute to the listed corresponding expected impacts and metrics, the baseline and the targets to measure impact.

- Significantly improved uptake of photonics technology by end-user industry, in particular SMEs, enabling a demonstrably more competitive European industry.
- Creation of a sustainable network of Digital Innovation Hubs, providing European Added Value to investments done at national and regional level in Digital Innovation Hubs and reaching a high leveraging effect on other sources of funding, in particular Regional and National funding.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-05-2020: Big Data Innovation Hubs

Specific Challenge: The challenge is to break "data silos" and stimulate sharing, re-using and trading of data assets by launching a second-generation data-driven innovation hub, federating data sources and fostering collaborative initiatives with relevant digital innovation hubs. This shall promote new business opportunities notably for SMEs as part of the Common European Data Space.

All grants under this topic will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

Scope: This topic calls for Digital Innovation Hubs that strengthen European SMEs and empower European citizens by supporting them to use and combine data sources from different sectors and communities (e.g. retail, tourism, manufacturing, finance and insurance, media, healthcare, consumer support, transport, energy, public administration…) to develop innovative products and services. Special attention should be paid to fostering and facilitating the "fitness to the market" of the new solutions and data-driven business concepts, and to introducing best practices to sectors whose business models are not yet data-driven.

- Sub-topic 1: Federate and network the relevant actions and initiatives[92], especially digital innovation hubs (including national and regional hubs), that contribute to the creation of

[91] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 204-205 of the Financial Regulation may be exceeded, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

[92] Including iSpaces and other relevant actions of the Big Data Value Association (www.bdva.eu), the European Open Science Cloud (www.eosc-portal.eu/), and the European Data Portal (www.europeandataportal.eu/).

a Common European Data Space. Targeted organizations and individuals, especially SMEs, web entrepreneurs and start-ups, will be attracted to use federated data sources (including data platforms), digital infrastructures, tools and methods as accelerators for developing innovative products and services based on data sharing across sectors and borders. The federating hub is expected to run specific communication and training activities (e.g. on tools, data sources and stakeholder needs) and address, where appropriate, data standardization and interoperability issues.

- Sub-topic 2: Select, launch and incubate innovation experiments in view of bringing to the market new solutions and services based on secure and trusted data value chains, such as those based on actions resulting from ICT-14-2016-2017 and ICT-18-2016. Appropriate computing infrastructure, tools and support services (e.g. for GDPR compliance and data mentoring) must be made available by the Innovation Actions. Each experiment may involve support to third parties as a mini project following an open call, up to the amount of EUR 120.000[93] for each such project.

- Sub-topic 3: Select, launch and incubate innovation experiments for data driven services and tools able to reshape the media value chain, including social media. Experiments should involve one or both of the following aspects:

    1. to explore new ways in which citizens can exploit data to better target and extend the reach of user generated content so as to increase content diversity, transparency and accountability, in a way that enables bottom-up quality journalism, science education or digital democracy.

    2. to explore new ways in which artists and more generally the creative sectors could be integrated in the development of innovative data exploitation for content creation[94].
    For both aspects, experiments will consider the application of innovative business models and the necessary aggregation and secure handling of data available from sources such as sensors, observation data, visual data or social media supported by AI systems. Each experiment may involve support to third parties as a mini project following an open call, up to the amount of EUR 80.000[95] for each such project.

One innovation action will be selected for sub-topic 1 and sub-topic 3. Innovation Actions are expected to collaborate closely with the CSAs under ICT-51-2020 and ICT-13-2018.

One innovation action will be selected for sub-topic 1 and one innovation action for sub-topic 3. At least one innovation action will be selected for sub-topic 2. Innovation Actions are expected to collaborate closely with the CSAs under ICT-51-2020 and ICT-13-2018.

93 In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

94 Building on activities developed as part of the STARTS initiative in DG CONNECT (ICT-32-2018 and www.starts.eu)

95 In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

The Commission considers that proposals requesting a contribution from the EU of EUR 8 to 12 million for sub-topic 1, EUR 5 to 7 million for subtopic 2, and EUR 5 million for sub-topic 3 would allow the sub-topics to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Substantial increase in the total amount of data shared and exchanged in the federated incubators, including closed/proprietary/industrial data;
- At least 150 SMEs and web entrepreneurs, including start-ups, participate in federated incubators, with an average 30% annual increase in the sales of the incubated companies;
- Improved service quality and user satisfaction resulting from optimized data-driven processes and business models.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-01-2019: Smart Anything Everywhere

Specific Challenge: "Smart anything everywhere" stands for the next wave of products that integrate digital technology. The challenge is to accelerate the design, development and uptake of advanced digital technologies by European industry - especially SMEs and mid-caps - in products that include innovative electronic components, software and systems, and especially in sectors where digital technologies are underexploited[96].

Scope: **a. Innovation Actions SAE**

As Phase 3 of Smart Anything Everywhere, this sub-topic calls for Digital Innovation Hubs that strengthen European SMEs and mid-caps by experimenting and testing with one or more of the following technologies, or by supporting them to manufacture these products. Projects should also support eco-system building for promising platforms developed in earlier R&I products.

- Area 1: Cyber-physical and embedded systems: the goal is to help businesses from any sector uplift the quality and performance of their products and services by including (semi)-autonomy, paying special attention to security and privacy and to the collaboration between humans and machines.
- Area 2: Customised low energy computing powering CPS and the IoT: the goal is to help businesses who are developing products for situations where high computing capacity and low energy would be a competitive advantage.

[96] For an overview of already existing projects in this initiative see www.smartanythingeverywhere.eu/

- Area 3: Flexible and Wearable Electronics: the goal is to help businesses in further maturing, innovating and validating their products with thin, organic and large area electronics technologies, including wearable, portable and embedded objects. Focus is on i) access to design, technology and prototyping which are ready to use, and ii) application experiments driven by concrete user requirements and business cases.

- Area 4: Widening Digital Innovation Hubs: it addresses all three technology areas mentioned above and the technologies addressed in I4MS [97]. It calls for Digital Innovation Hubs in industrial regions which are so far underrepresented in Smart Anything Everywhere and I4MS[98], and builds upon a mentoring programme developed by I4MS[99]. These hubs should strongly collaborate with other Innovation Actions funded under SAE and I4MS, e.g. through joint highly innovative cross-border experiments.

All proposed innovation actions may involve financial support to third parties (typically in the order of EUR 20 000 – 100 000[100] per third party).

For this topic, the four requirements described in the introductory section 'Support to Hubs' have to be applied.

The Commission considers that proposals requesting a contribution from the EU of up to 8 million would allow all areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one innovation action is supported for each area.

b. Coordination and Support Activities SAE

The action will support the SAE network and help achieve broad coverage in technological, application, innovation, and geographic terms, and to link up with regional/national innovation initiatives, and other Digital Innovation Hubs. Its tasks and services shall include maintaining a single innovation portal, sharing of best practices, dissemination, brokering, leveraging further investment and training. For these support actions, close cooperation with ECSEL, and other CSAs funded under the Digitising European Industry focus area is looked for.

Expected Impact: Proposals should address all of the following impact criteria, providing metrics to measure success when appropriate.

- Attract a significant number of new users of advanced ICT in the manufacturing sector, and more innovative technology suppliers, in particular SMEs and mid-caps.

97 www.i4ms.eu. Technology areas addressed are: Robotics, Analytics, simulation and artificial intelligence, Additive Manufacturing, Laser based manufacturing equipment

98 see https://ec.europa.eu/futurium/en/content/digital-innovation-hubs-catalogue-project-0

99 http://dih.i4ms.eu/

100 In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

- Creation of a sustainable network of Digital Innovation Hubs, providing European added value to investments done at national and regional level in Digital Innovation Hubs.
- Availability of Digital Innovation Hub services across Europe and its regions with strong industrial capacities

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-02-2018: Robotics - Digital Innovation Hubs (DIH)

Specific Challenge: The challenge is to provide a sustainable ecosystem of robotics stakeholders covering the entire value network to facilitate and accelerate a broad uptake and integration of robotic technologies, and supporting the digitisation of industry through robotics.

Scope: **a. Innovation Actions**

Proposals should address the provision of a network of robotics Digital Innovation Hubs (DIH) in the four prioritised application areas (PAA) of Healthcare, Infrastructure Inspection and Maintenance, Agri-Food and Agile Production. Proposals are expected to: develop a network of DIHs, address the delivery of services (technical and non-technical); provide access to best practice and research results in robotics relevant to the chosen application area; contribute to common system platforms, engaging in the development of industry-led standards and developing and disseminating standards demonstrators; facilitate access to pilots and collaborate with all the robotics actions funded in the WP and beyond, as appropriate.

Proposals are also expected to connect, share expertise, and closely collaborate with the DIHs in the other PAAs via the Central Robotics DIH CSA (see below). DIHs should address ethical, data privacy and protection issues, and consider cyber-security issues (including security by design). DIHs should support the development of use-case demonstrators at TRL 5 and above, preferably based on open system platforms.

Proposals are expected to contribute to a Working Group that connects the actions funded in this WP with the Central Robotics DIH CSA to disseminate best practice, to coordinate access to technology, resources, demonstrators and open platforms, and to facilitate the cross development of platforms.

Proposals are expected to use financial support to third parties (FSTP) to support industry, in particular SMEs, in their digital transformation, through for instance, demonstrators and platforms development, technology transfer experiments, or other services (technical or non-technical), as appropriate. FSTP should comply with the conditions set out in part K of the General Annexes of the Work Programme. At least 50% of the budget is expected to be

dedicated to FSTP and the maximum amount of FSTP is EUR 300.000[101] per third party for the entire action duration. For innovation actions of this topic, the four requirements described in the introductory section 'Support to Hubs' have to be applied. The Commission considers that proposals requesting a contribution from the EU of EUR 16 million for DIHs in each Priority Area would allow this topic to be addressed appropriately. However, this does not preclude submission and selection of proposals requesting other amounts.

At least one action in each Priority Area will be supported.

b. Coordination and Support Activities

Proposals should address the provision of a Central Robotics DIH CSA, to support and cooperate closely with the PAA-oriented DIH actions, to network them, to coordinate their activities and to develop synergies among them.

Proposals are expected to disseminate best practices in developing pilots, demonstrators and open platforms, and championing the development of open industry-led system platform standards.

The Commission considers that proposals requesting a contribution from the EU of EUR 2 million for the Central Robotics DIH CSA would allow this topic to be addressed appropriately. However, this does not preclude submission and selection of proposals requesting other amounts.
One Central Robotics DIH CSA will be supported.

Expected Impact:

- Increased deployment of robotics in each PAA.
- Formation of supply chains around platforms and modules that straddle PAA
- Introduction of cross-industry-based standards for modules and systems
- Generation of new businesses based around platform supply
- The development supply chains.
- Leveraging effect on other sources of funding, in particular regional and national funding

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

[101] In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

DT-ICT-06-2018: Coordination and Support Activities for Digital Innovation Hub network

Specific Challenge: The challenge is to coordinate Digital Innovation Hubs across Europe

Scope: The action will link up sectorial and technological hubs with regional/national innovation hubs to improve collaboration, reinforce specialisation and offer the best possible support for SMEs and mid-caps everywhere in Europe. The action will include the organisation of workshops, conferences and dissemination material, and the development of a business model for collaboration among DIHs. The action will contribute to a catalogue of Digital Innovation Hubs which is currently under development[102]. For this support action, close cooperation with other CSAs funded under the Digitising European Industry focus area is required.

Expected Impact:

- Creation of a sustainable network of specialised Digital Innovation Hubs, where public investments are serving several regions of Europe.
- Reinforced links with other bottom-up initiatives, supported by regional, national and European policies and funds.
- Increased number of services and applications operated by European companies, especially small businesses and entrepreneurs.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Platforms and Pilots

The Digitising European Industry initiative includes the launch of a set of initiatives supporting the building of the digital industrial platforms of the future[103]. European industry needs to come to agreements on functions and interfaces for those platforms, reference architectures and interaction protocols that have the potential to create markets and market opportunities leading to ecosystems and standards.

Proposals are expected to make a significant step forward in platform building, interoperability between existing platforms, integration of relevant digital technologies such as IoT, AI, photonics, robotics, cloud and Big Data, and validation via pilots and experimentation facilities. Starting from suitable reference architectures, platform interfaces

102 https://ec.europa.eu/futurium/en/content/digital-innovation-hubs-catalogue-project-0
103 COM(2016) 180 final, 19 April 2016

are defined, tested via piloting, supported via ecosystem building to prepare their roll-out, and evolved into standards.

Various platform development activities exist at EU or national level, e.g. the Reference Architectural Model Industrie 4.0 (RAMI 4.0) and the Industrial Data Space. To develop the next-generation digital platforms, proposals need to bring various initiatives together and act as linking pins. Proposals should build on existing platforms, pilot sites, testbeds, and experimental environments that have been developed in these various initiatives when applicable[104].

Proposals need to address all of the following four activities, namely platform building, large-scale piloting, ecosystem building, and standardisation.

In platform building, proposals need to develop next-generation digital platforms, which build on the state-of-the-art, reuse what is available, and integrate different technologies, such as IoT, AI, robotics, cloud and Big Data. Platforms should aim at openness and interoperability between platforms to avoid lock-in, preventing dominant positions of individual players, and comply with standards and regulation. Proposals need to target solutions for SMEs and mid-caps, taking into account interoperability with emerging and future solutions. This may require the mapping of reference architecture models for integrating existing sectorial platforms. The interfaces of the platform need to be described via open specifications and reference implementations need to be developed. A major aim is to offer platform functionalities that can be generically reused in multiple contexts to support various types of applications and services.

In large-scale piloting, pilots are set up that make use of the digital platforms, develop prototype applications on top of the platforms, and validate the platforms in both reduced, controlled environments and in real-life use cases. Pilots may adapt platforms to specific application needs and validate their relevance for such needs, in order to foster take-up and large scale deployment. The pilots should cover innovative application scenarios with high socio-economic impact. Demonstration of cooperation between large-scale pilots in different domains and combination of services from different sectors/domains are welcome. The key need is to deliver interoperable solutions that provide an experience that customers or businesses require, to test them in complex regulatory environments, and to give guidance for secure and safe implementation.

In ecosystem building, the take-up of digital platforms is fostered by expanding the ecosystem of players involved and through opportunities for entrepreneurs by promoting new market openings allowing also smaller and newer players to capture value. For instance, small and innovative ICT players can develop services/applications with a clear societal and economic value, on top of the digital platforms. Moreover, additional small-scale pilots can be conducted by SMEs, validating the digital platforms and prototype applications. Experiments

[104] Relevant ongoing initiatives at EU level include the set of Large Scale Pilots called for under the Internet of Things Focus Area in 2016 (IoT-01-2016) and the Factories of the Future projects under FoF-11-2016.

running on top of the pilots, under specific scenarios, will allow for the validation and acceptance by any actors in the ecosystem and users in particular.

In standardisation, contributions should be made to suitable standardisation bodies or pre-normative activities, as outlined in the Communication on Priorities of ICT Standardisation for the Digital Single Market[105].

Projects for grants awarded under topics DT-ICT-07-2018-2019, DT-ICT-08-2019, DT-ICT-09-2020, DT-ICT-10-2019, DT-ICT-11-2019, DT-ICT-12-2020, and DT-TDS-01-2019 (located in the SC1-Health, demographic change and wellbeing part of the Work programme) should support a critical mass of large-scale piloting and ecosystem building activities. For these grants, beneficiaries may strengthen these activities by providing financial support to third parties in line with the conditions set out in part K of the General Annexes of the Work Programme. Consortia need to define the selection process of organisations, for which financial support will be granted (typically in the order of EUR 50 000 – 150 000 per third party[106]). Maximum 20% of the EU funding can be allocated to this purpose. The financial support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.

Proposals should contain an outline business case and industrial exploitation strategy. They also need to define clear business models and justify how the results support those business models.

Expected Impact

Projects are expected to have a high impact on citizens, industry, businesses or public services. In particular:

- Increased prospects for future digital industrial platforms by validation of technological choices, sustainability and reproducibility, of architecture models, standards, and interoperability, as well as of verification of non-functional characteristics such as security and privacy.
- Strengthened links with other, bottom-up programmes and initiatives, supported by regional, national and European policies and funds.
- Increased number of services and applications operated by European companies, especially small businesses and entrepreneurs.
- Significant and measureable contribution to standards or pre-normative activities.
- Increased number of platforms, applications, business processes and innovative business models validated via large-scale piloting.

105 COM(2016) 176 final, 19 April 2016

106 In line with Article 23 (7) of the Rules for Participation the amounts referred to in Article 137 of the Financial Regulation may be exceeded when this is necessary to achieve the objectives of the action.

- Emergence of sustainable ecosystems around digital platforms.

Proposals should describe how the proposed work will contribute to the impact criteria above, in addition to the expected impacts under the specific topic addressed, and provide KPIs, the baseline and targets to measure impact.

Proposals are invited against the following topic(s):

DT-ICT-09-2020: Boost rural economies through cross-sector digital service platforms

Specific Challenge: Rural areas represent most of Europe's territory (91%) and population (59%). When measuring against socio-economic indicators rural areas tend to lag behind urban areas. Lower population and business density make it more challenging to develop private businesses and public services in rural areas.

Rural areas are key to solve many of the big societal challenges such as climate change or the sustainable provision of food, biomass and energy. European rural areas are places of great assets and they can become more attractive if the provision of jobs, basic services, including health and care, connectivity, smart transport, and energy solutions, as well as a favourable climate for entrepreneurship, are ensured. Among the priorities to be addressed, overcoming the digital divide between rural and urban areas and developing the potential offered by increased connectivity and digitisation of rural areas must receive particular attention.

In particular, one key challenge is to overcome the barrier of missing interoperability of smart object platforms and service platforms that share and exploit data between them. This should trigger the emergence of a dynamic rural ecosystem, which in turn can lead to the development of cross-platform applications that ultimately contribute to increasing economic growth in rural areas and support their contribution to tackling societal challenges.

Scope: Proposals are expected to develop and demonstrate cost-efficient and flexible cross-domain applications through large-scale pilots. These should build on an open, API-based, interoperable and federated IoT architecture and include a reference implementation supporting flexible integration of heterogeneous services. Pilots should bridge the interoperability gap of the smart object platforms and create markets for service - and application providers as well as platform operators, supported by a vibrant ecosystem of developers, service providers and user communities.

In developing the pilots, proposals are expected to address all of the following aspects:

- The integration of data and information across different platforms for sustainable and efficient service provision, where appropriate based on Artificial Intelligence. The approach should showcase platform interoperability in line with relevant standards.

- To develop an open marketplace with an open application interface for cross-cutting services to cater for new business opportunities

- Reference implementations including proof-of-concept, large-scale demonstrations and validation leveraging on platforms developed elsewhere

- To create innovation ecosystems based on 'Platforms for Connected Smart Objects and Services', to support citizens and businesses for a multiplicity of novel applications.

- The development of pilots demonstrating benefits, cost-efficiency, flexibility and realistic business models required in rural areas around existing infrastructure, and to utilise links to other European, national or private funding sources to leverage infrastructure delivery.

- Potential application areas could include one or more of the following: public services, energy, autonomous robotics transport, logistics, education, tourism, health and care. The applications should support the implementation of the smart villages concept[107] oriented towards relatively underdeveloped and remotely located rural areas and communities. Innovative and technical inspiration could be sought in previous work in the following domains: smart cities, smart living and ageing well, smart - and/or social farming, forest management, distributed energy, smart logistics and mobility and e-governance.

Pilots should follow an evolutionary agile, well-delineated, and lean approach. The developed platforms should be concurrently validated in at least three large-scale regional pilots in rural settings involving partners with strong relation to public authorities. The Pilots should propose scalable technical solutions capable of meeting social and economic targets relevant to boost new rural services and business.

Key performance indicators should be defined to measure progress on citizen's benefits in rural areas, quality of life, economic growth, job creation, new business development etc.

Proposals may involve financial support to third parties, particularly for SMEs. Conditions for third parties support are set out in Part K of the General Annexes. Consortia need to define the selection process of organisations, for which financial support will be granted. Maximum 20% of the EU funding can be allocated to this purpose. The financial support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.

The development of the pilots should follow a participatory approach using where appropriate well-functioning existing societal groups (including for example Local Actions Groups, Rural networks, public administrations responsible for Rural Development Policies) and liaise with territorial digital dynamic development. Proposal should develop strategic approaches that will help policy makers, rural actors, citizens and project promoters on the ground to deliver results, considering the comparative strengths and needs of their respective territory, to improve the implementation of EU policies in rural areas. When necessary, internet providers should be involved in the project to ensure connectivity, which is a prerequisite for rural ICT exploitation.

[107] https://enrd.ec.europa.eu/smart-and-competitive-rural-areas/smart-villages/smart-villages-portal_en

For this topic, the four activities described in the introductory section 'Platforms and Pilots' must be applied. Pilot projects are expected to contribute to the consolidation and coherence work that will be implemented by the CSA supporting the activities defined under the topic "DT-ICT-13-2019: Digital Platforms/Pilots Horizontal Activities".

The Commission considers that proposal requesting a contribution from the EU of up to EUR 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude the submission and selection of proposal requesting other amounts.

Expected Impact: For this topic, the impact criteria described in the introductory section 'Platforms and Pilots' have to be applied in addition to as many as possible contributions to the following impact criteria:

- Validate the brokerage platforms illustrated by an increase of cross-cutting applications and services
- Demonstrate and show-case cross-sectorial platforms interoperability.
- Demonstrate the benefits of data sharing across platforms from different sectors.
- Exploration and validation of new industry and business processes and innovative business models validated in the context of the pilots.
- Overcome the digital divide between rural and urban areas, and to develop the potential offered by connectivity and digitisation of rural areas.
- Improve quality of life in rural areas, higher standard of living and services for citizens.
- Creation of opportunities for entrepreneurs, notably SMEs, by promoting new market openings, providing access to valuable datasets and direct interactions with users, creating new businesses in rural areas.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-12-2020: AI for the smart hospital of the future

Specific Challenge: European health and care systems face a number of challenges linked to the ageing of the population and an increase in the prevalence of chronic conditions. With budget constraints, the health and care systems face rising cost pressures for systems and problems of sustainability. There is a consensus that health systems need to undergo adaption if they are to adequately respond to future population health needs.

New digital technologies will play a role in transforming health and care systems. In particular, artificial intelligence and robotics, have the potential to transform health and care facilities across their range of functions from the clinical aspects (screening and prevention,

diagnosis, treatment, surgical support) to organisational and logistical aspects (such as the management and distribution of medicines and wider supplies across the facility). Given that health facilities such as hospitals consume the major proportion of resources available to health and care budgets, efficiency gains in these facilities may support sustainability of the system as a whole.

Innovative AI based systems (robotics, big data, machine learning, autonomous systems, conversational agents, etc.) have shown considerable promise so far, however their effective use in the delivery of health and care depends on their successful integration (and acceptation) within existing health and care facilities such as hospitals, primary care centres and care homes.

Therefore, piloting at scale is needed to prove the transformative impact of AI. Pilots need to be embedded in operational health and care settings and built around well specified open physical and digital[108] platforms that are able to demonstrate operational and economic benefits sufficient to justify wider uptake by health and care policy makers.

AI in this context has the potential to deliver integrated physical and digital services that address a wide range of healthcare applications, for example in patient care, diagnosis, treatment and in hospital based laboratory and support services. Ethical, privacy and trust aspects should be addressed, as appropriate.

Scope: Devise in-facility pilot demonstrators that deliver innovative AI-based solutions in a health and care setting such as a hospital, primary care facility or care home. Pilots should enable or support clinical, diagnosis and treatment, etc. carried out with clinical outcomes comparable to human delivered procedures and with comparable results.

Proposals may address any aspect of health facility operations across their range of functions, such as diagnostics, treatments, logistical aspects, etc. Proposals must indicate how their proposed solution will perform when measured against particular health and care metrics suitable for the aspect of operations chosen. Proposal should be developed with health and care facility partners and consider wider dimensions such as how they will work within the broader aspects of impact on resources, staff training and alignment with existing practice. The deployed solutions should build AI-based systems that combine digital and physical services that support individualised and integrated care solutions in care facilities, such as hospitals, clinics, primary care centres, rehabilitation centres, care homes, etc..

Proposals must clearly demonstrate, in context, the integration of autonomous smart components unpinning AI that physically affect the working environment together with those that gather and process data and must clearly show how, in a health and care context, direct and positive impact on effectiveness and efficiency are expected to be achieved.

Proposals must integrate health and care partners in the design of the pilot, the development of performance indicators, as well as to allow access to the relevant operational environment.

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[108] Physical components are those that have a physical effect on the working environment, and digital components are those that gather, process or communicate data.

Proposals must demonstrate likely "at scale" benefits in efficiency or cost reduction and demonstrate the effectiveness of any novel service models in providing economic justification for scale-up investment. Proposals should also identify opportunities for the development of European standards that enable wide spread adoption and new market creation.

Privacy and cybersecurity issues, including security by design and data integrity should also be addressed, where appropriate.

Proposals must seek to align with the European Digital Innovation Hub networks and platforms funded under DT-ICT-02-2018: Robotics - Digital Innovation Hubs (DIH).

When assessing proposals, the Commission will take into account the value of having a spread of projects addressing different health and care functions (for instance, surgery, rehabilitation, logistics in hospital, etc.).

The Commission considers that proposals requesting a contribution from the EU between EUR 7 and 10 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Emergence of European-led AI based pilots for the smart hospital of the future, enabled by open system platforms
- Demonstration of effectiveness, in use, of AI based technologies, such as smart robots, in a range of healthcare tasks
- Engagement of healthcare policy makers, investors, stakeholders and through the pilot.
- Effective basis for developing deployable applications
- Reaching a high leveraging effect on other sources of funding, in particular regional and national funding
- Contributing to trust and acceptance building in the AI technology among all stakeholders (including patients, their formal and informal caregivers, decision makers, etc.).

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-07-2018-2019: Digital Manufacturing Platforms for Connected Smart Factories

Specific Challenge: Digital manufacturing platforms play an increasing role in dealing with competitive pressures and incorporating new technologies, applications and services. Advances are needed in digital manufacturing platforms that integrate different technologies, make data from the shop floor and the supply network easily accessible, and allow for

complementary applications. The challenge is to fully exploit new concepts and technologies that allow manufacturing companies (especially mid-caps and SMEs) to fulfil the demands from changing supply and value networks.

Scope: a) Innovation Action - Develop and establish platforms for the connected smart production facilities of the future including their supply chains, driven by EU actors and safeguarding European interest in an area of key importance for the European economy. Proposals need to address at least two industrial sectors with several different use cases, especially in their piloting activities. In accordance with the strategy defined in the multi-annual roadmap[109] of the FoF cPPP, proposals should target at least one of the following 'grand challenges':

1. Agile Value Networks: lot-size one (2018 call)
2. Excellence in manufacturing: zero-defect processes and products (2018 call)
3. The human factor: human competences in synergy with technological progress (2019 call)
4. Sustainable Value Networks: manufacturing in a circular economy (2019 call)

Reference implementations are preferably developed in open-source, with (as far as possible) one permissive open-source licence to be selected for all open-source components. Where applicable, APIs and SDKs are made available to third party developers to develop complementary applications.

For the Innovation Actions in this topic, the four activities and impact criteria as described in the introductory section 'Platforms and Pilots' have to be applied. For large-scale piloting and ecosystem building activities, proposals may involve financial support to third parties, as explained in the introductory section 'Platforms and Pilots', to support SMEs in piloting and developing prototype applications on top of digital manufacturing platforms.

b) Coordination and Support Activities are needed to cross-fertilise the Industrial Platform communities, allowing for easier take-up of digital technologies from ongoing and past research projects to real-world use cases, and supporting the transfer of skills and know-how between academia and industry in both directions. Coordination and Support Activities are targeted in the 2019 call.

The Commission considers that proposals requesting a contribution from the EU up to EUR 16 million for Innovation Actions and up to 2 M€ for one CSA would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one innovation action is supported for each 'grand challenge'. Maximum one proposal will be selected for the CSA.

Expected Impact:

[109] See roadmap document "Factories 4.0 and Beyond" on http://www.effra.eu/

- Significant increase in the options for SMEs and mid-caps to integrate different technologies, unlock the value of their data, deploy complementary applications, and to become a more responsive link in changing supply and value networks.

- Strengthened competitive position of European platform providers.

- Increased cooperation between industrial and academic communities; increased synergy and collaboration between projects.

Type of Action: Innovation action, Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-08-2019: Agricultural digital integration platforms

Specific Challenge: Agricultural research and innovation supports the sector in coping with a complex mix of challenges it is facing, including for example the pressures on natural resources and farm revenues. Knowledge creation and accessible information systems and tools to monitor, gather, transform and above all share vital information between key stakeholders can help the sector to become more sustainable. However, as well as the potential for new knowledge, a substantial part of the existing knowledge and its underpinning information flows, has yet to be exploited to its full potential. The resulting performance gap has strong social, ecological and economic implications. An improved functioning of the agricultural knowledge and innovation systems is needed, for timely innovation and to speed up the rate of knowledge creation. One of the most important constraints concerns the limited interoperability and lack of openness of different technical systems, thus limiting the choices farmers can make between suppliers of new technologies. An enhanced interoperability would allow for increased data sharing and the resulting knowledge generation. Another main constraint is the lack of information on the effectiveness of new technologies which slows down their take up.

Scope: Pilots should address all of the below aspects:

- Building platforms integrating different technologies like Internet of Things (IoT) devices, cloud, photonics, networks, geolocalisation (including through Galileo and EGNOS (the European Geostationary Navigation Overlay Service)) and robotics combined with applications based on data analytics and knowledge management. There is a need for a wide adoption of open, interoperable standards to ensure that all connected systems can talk to each other, allowing the farmers and relevant other stakeholders to pick and choose the most appropriate combination of tools from different suppliers. Pilots will validate the means to achieve high level of interoperability of different systems through reference architecture, semantics technologies and standardisation framework that demonstrate communication exchange of data across different systems and platforms.

- Sharing data and generating knowledge via capturing and translating more and precise information. High precision data capturing and a high degree of data sharing should serve as basis for decision support systems delivering tailored advice at farm level, complementing and/or extending advisory services. The core technical enablers for analysing the amounts of data will be low-maintenance, robust and scalable monitoring and communication systems as well as artificial intelligence and semantics technologies. These services should include direct and detailed feedback to the farmers on appropriate practices and management strategies.

- Developing decision support systems that will include, but are not restricted to, a benchmarking system on the productivity and sustainability performance of farms, services, technologies and practices. For this purpose data models and semantic standards need to be defined to elicit performance indicators and derive decision making, as well as allowing sharing the data from the different farms.

Pilots in the selected areas should clearly cover the supply and demand sides. For large-scale piloting and ecosystem building, projects in this topic may involve financial support to third parties to extend the digital innovation space for farmers, advisory services and innovators, based on a network of farms and in close cooperation with existing agricultural knowledge and innovation infrastructures of the different Member States and Associated Countries and regions. For farmers, the platforms should have a mass-tailored advisory and knowledge dissemination service, including economic and technical benchmarking. It shall cover a large number of farms, including small farms. Advisory services based on local eco-systems should be investigated and linked in the pilots. For innovators, the platforms should work as test-bed, testing and benchmarking new technologies and services. This should be made possible by allowing for recruiting pilot farms and/or making available the necessary data.

Proposals should fall under the concept of multi-actor approach[110] and allow for strong involvement of the farming sector in the proposed activities. Projects are required to develop adequate data governance model(s) defining the terms for access to data owned by another party. Activities should allow for a wide geographic coverage within Europe. In addition, proposals shall cover at least three sub-sectors (e.g. arable crops, livestock, vegetable and fruit production).

For this topic, the four activities and impact criteria described in the introductory section 'Platforms and Pilots' have to be applied. Pilot projects are expected to contribute to the consolidation and coherence work that will be implemented by the CSA supporting the activities defined under the topic "DT-ICT-13-2019: Digital Platforms/Pilots Horizontal Activities".

The Commission considers that proposals requesting a contribution from the EU up to EUR 15 million would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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110 For further information on the multi-actor approach concept please refer to the Introduction to SC2 Work Programme

Expected Impact:

- Demonstrate measureable benefits from intensified data and information flows across a wide range of farm types, notably small farms;
- Improved and inclusive information flows and management within and among the targeted agricultural sectors based on transparent and fair data governance practices;
- Identification of user needs, validation of user acceptance, especially demonstration of viable concepts addressing privacy, security, vulnerability, liability and trust in connected data spaces;
- More information on environmental, social and economic performance of technologies, practices and management, increasing their respective adoption;
- Creation of opportunities for entrepreneurs by promoting new market openings, providing access to valuable datasets and direct interactions with users, expanding local businesses to European scale;
- Exploration and validation of new industry and business processes and innovative business models validated in the context of the pilots.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-10-2018-19: Interoperable and smart homes and grids

Specific Challenge: When energy production is becoming decentralised and ICT is increasingly present in homes, the integration of renewable energy sources (RES) and promotion of energy efficiency should benefit from smarter homes, buildings and appliances, as well as (the batteries in) electric vehicles. Smart homes and buildings are one crucial element because system integration and optimisation of distributed generation, storage and flexible consumption will require interoperable smart technologies installed at building level. Internet of Things (IoT) enables a seamless integration of home appliances with related home comfort and building automation services allowing to match user needs with the management of distributed energy across the grid, and to gain access to benefits from Demand Response. Novel services should lead to more comfortable, convenient and healthier living environment at lower energy costs for consumers whilst enabling an active participation of consumers in the energy system and energy markets.

Scope: The aim of the pilot is to exploit IoT reference architectures models that allow for combining services for home or building comfort and energy management, based on platforms that enable the integration of relevant digital technologies like IoT, AI, cloud and big data services and where applicable, combined with blockchain technologies. Energy services, where appropriate, can be combined with additional non-energy services and foster

the take-up of smart energy communities (in particular peer-to-peer energy markets). The aim is also to demonstrate platforms through a large-scale pilot for experimentation and co-creation with users under real-life conditions in interaction with the electricity and wider energy system, and to demonstrate the benefits of energy management through IoT application and services for the users. The envisaged architecture should allow for third party contributions that may lead to new value added services both in energy and the home/building domain.

This shall be done by developing interoperability and seamless data sharing, through aligning existing standards from the utility and ICT domains, across the devices and systems to enable innovative building energy management services, with the aim to save costs to consumers, to facilitate the integration of renewable energy from distributed intermittent sources and to support energy efficiency. The pilot needs to demonstrate plug-and-play energy management solutions within the home, by taking into account legacy of existing smart home or building solutions, mapping their approach to common architecture models and implementing relevant standards (such as SAREF). Pilots need to ensure interoperability in the communication interfaces between smart devices and from the smart device to the gateway/energy manager and/or to the cloud, i.e. a service provider that uses the data generated from the device, so that smart home services can also be used for the benefit of the electricity and wider energy system. Selected pilots should promote the use of these interoperable solutions as widely as possible involving many different types of appliances (e.g. including white-goods, heating, cooling and ventilation, home & building automation energy management, metering and control, batteries, photovoltaic panels, charging for electric vehicles), and explore the need for further standardisation and legislation. Pilot work plans should include feedback mechanisms from the users to allow adaptation and optimisation of the technological and business approach to the particular use case.

The selected large-scale pilot shall in particular address all of the following issues:

- demonstrate scalability and stimulate spill-over effects; demonstrate that such platforms lead to a marketplace for new services in EU homes and buildings; identify best-practices, inter alia for consumer involvement, in installation, and in sales packages of devices and services;

- for large-scale piloting and ecosystem building, proposals shall involve financial support to third parties, in particular SME's and start-ups, to support the incorporation of users of the pilots, developers of additional applications, replication of the pilots through new sites or new connected devices, and complementary assessment of the acceptability of the use case where appropriate;

- the selected project shall cover the whole value chain for IoT-based services: appliance manufacturers and technology providers, ICT suppliers, energy suppliers, as well as independent aggregators or energy service companies (ESCOs), and one or more grid service operators (transmission system operators (TSOs) and distribution system operators (DSOs));

- the selected project is expected to contribute to the consolidation and coherence work in cooperation with similar EU-funded projects[111] through the BRIDGE initiative [112] and the CSA supporting the activities defined under "DT-ICT-13-2019: Digital Platforms/Pilots Horizontal Activities a)" below by contributing their results of horizontal nature (interoperability approach, standards, security and privacy approaches, business validation and sustainability, methodologies, metrics, etc.);

- link with Member States' and Associated Countries' initiatives in this area.

For this topic, the four activities and impact criteria described in the introductory section 'Platforms and Pilots' have to be applied. The Commission considers that proposals requesting a contribution from the EU up to EUR 30 million for Innovation Actions would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Increasing number of energy apps/services and home devices and appliances that are connected through the Internet allowing to shift consumption according to wholesale market or grid-constraints-related price signals.

- Validation of user acceptance, as well as demonstration of viable concepts that ensure privacy, liability, security and trust in connected data spaces.

- Accelerated wider deployment and adoption of IoT standards and platforms in smart homes and buildings in Europe and development of secure, cost-effective and sustainable European IoT ecosystems and related business models.

- Demonstration that such platforms lead to a marketplace for new services in EU homes and buildings with opportunities also for SMEs and start-ups.

- Contribution to increasing the use of renewable energy and increased energy efficiency, offering access to cheaper and sustainable energy for consumers and maximising social welfare.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-11-2019: Big data solutions for energy

Specific Challenge: Tomorrow's energy grids consist of heterogeneous interconnected systems, of an increasing number of small-scale and of dispersed energy generation and consumption devices, generating huge amounts of data. The electricity sector, in particular,

111 Wherever appropriate, actions should seek synergies from other R&I initiatives like LC-SC3-EE-13-2018-2019-2020, LC-SC3-EC-1-2018-2019-2020, LC-SC3-ES-5-2018-2020.

112 http://www.h2020-bridge.eu/

needs big data tools and architectures for optimized energy system management under these demanding conditions.

Scope: **Innovation Actions** targeting large-scale pilot test-beds for big data application in the energy sector. The aim is to develop/pilot and deploy a reference architecture for large-scale multi-party data exchange, management & governance and real-time processing (including distributed/edge processing) in the energy sector and to translate this reference architecture into an open, modular data analytics toolbox for the safe and effective operation of grids and provision of innovative energy services. The reference architecture should ensure compatibility with legacy formats, interfaces and operating systems of the energy system, allow replication and scale-up, be compliant with applicable EU standards, and should enable the integration of relevant digital technologies like IoT, AI, cloud and big data services. The analytics toolbox shall be able to handle a wide variety of data and support the development of a wide range of energy services, at least to increase the efficiency and reliability of the operation of the electricity network (e.g. by predictive maintenance), to optimize the management of assets connected to the grid (in particular small-scale/renewable electricity generation and those used for demand response), to increase the efficiency and comfort of buildings, and to de-risk investments in energy efficiency (e.g. by reliably predicting and monitoring energy savings). Proposers should demonstrate that they have access to appropriate large-scale and realistic datasets, and should involve as many as necessary of the following types of participants: network operators, suppliers, independent aggregators, ESCO's, power exchanges, building management and renovation sectors, software integrators/developers. Proposals should address, as appropriate, analytics, simulation, prediction, cloud computing. Projects shall collaborate with EU-funded projects through the BRIDGE initiative [113].

For this topic, the four activities and impact criteria described in the introductory section 'Platforms and Pilots' have to be applied.

The Commission considers that proposals requesting a contribution from the EU of around 10 million EUR would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

All grants under both subtopics will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

Expected Impact: Proposals should address the following impact criteria, **providing metrics to measure success** where appropriate:

- Effective integration of relevant digital technologies in the energy sector, resulting in integrated value chains and efficient business processes of the participating organizations;

[113] http://www.h2020-bridge.eu/

- Enhancing energy asset management, increasing consumer participation and innovative network management, creating new data-driven business models and opportunities and innovative energy services;

- Contribution to increasing the use of renewable energy and increased energy efficiency based on optimised energy asset management, offering access to cheaper and sustainable energy for energy consumers and maximising social welfare;

- New data-driven paradigms for energy management systems able to deal with increased complexity of the energy systems;

- Improving availability of big data and big data management & analysis facilities for real-life scale research, simulation and test purposes.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

DT-ICT-13-2019: Digital Platforms/Pilots Horizontal Activities

Specific Challenge: Coordination and Support activities are needed to support the operation of the pilot projects under the Platforms and Pilots topics in this Focus Area, and to support exploitation of the outcomes of these projects. These activities are expected to identify synergies among the pilot projects of the Focus Area, to promote cross-fertilisation, and to exchange best-practices and lessons learned. There is a need to increase coverage in technological, application, innovation, and geographic terms of these projects, as well as improve their engagement with relevant external stakeholders, and their links with regional/national and other European initiatives.

In addition, coordination and support activities are needed to pave the way for future digital industrial platforms in another promising sector, the construction sector. There is major improvement potential in optimising resource use, environmental performance, health, comfort, and resilience to climate change.

Scope: a) **Support pilot activities and knowledge transfer across different sectors**: Coordination of the selected platform and pilot projects under the topics of this Focus Area, and where applicable with similar initiatives in Member States and Associated Countries, and with standardisation initiatives and support in ecosystem building to increase the impact of the overall set of projects. Exploitation of synergies between technology-based platform and pilot activities such as IoT and data value chains and the sector-specific platform and piloting projects of the Focus Area related to issues such as architecture, interoperability and standards approaches. Exchange on requirements for the development of common methodologies for design, testing and validation and for success and impact measurement. Furthermore, proposals need to promote the results obtained, support the enlargement of the ecosystems around the projects, facilitate the access for entrepreneurs/API developers/Makers and SMEs in general, and support the transfer of skills and know-how to industry.

b) **Legal, regulatory and security support:** Further development and exploitation of security and privacy mechanisms towards best practices for digital platforms and pilots including contribution to pre-normative activities and to standardization; regulatory and legal support in relation to data ownership and protection, security, liability, across sector legislations. The corresponding activities will be developed and addressed in the pilots and consolidated at programme level under this horizontal support activity line.

c) **Preparation of a digital industrial platform for the construction sector:** proposals should bring together relevant stakeholders and define a reference architecture for a digital industrial platform for the construction sector that increases productivity and optimises material usage in the construction sector, including for SMEs. It needs to take into account the recently developed framework with core indicators to assess the environmental performance of buildings, including circular economy aspects[114]. Proposals should take stock of other ongoing initiatives, promote mutual learning and coordination, and identify knowledge and intervention gaps. Widespread use of Building Information Modelling and building passports will promote information sharing about different resources and their life cycles, re-use of materials, productive processes, including improved engineering, procurement and supply chain management and are therefore part of the scope.

Proposals should address only one of the above-mentioned subtopics a), b), or c). The Commission considers that proposals requesting a contribution from the EU up to EUR 2 million for a) and EUR 1 million for each of b) and c) would allow above areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. At least one coordination and support action is supported for each of the areas above.

Expected Impact:

- Tangible contributions from European key players to actively engage with the platform building process;
- Efficient information sharing across the programme stakeholders for horizontal issues of common interests;
- Maintaining and extending an active eco-system of relevant stakeholders, including start-ups and SMEs;
- Validation in usage context of usability, risk and security assessment and identification of gaps related to trust, security and privacy, respect for the scarcity and vulnerability of human attention, and liability and sustainability;
- Strengthening of the role of EU on the global scale, in particular in terms of standardisation activities and access to foreign markets;

[114] http://ec.europa.eu/environment/eussd/buildings.htm

- Increased prospects on productivity improvements in the construction sector, and on a contribution to a more sustainable construction sector.

Type of Action: Coordination and support action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Conditions for the Call - Digitising and transforming European industry and services: digital innovation hubs and platforms

Opening date(s), deadline(s), indicative budget(s):[115]

Topics (Type of Action)	Budgets (EUR million)			Deadlines
	2018	2019	2020	
Opening: 31 Oct 2017				
DT-ICT-02-2018 (IA)	64.00			17 Apr 2018
DT-ICT-02-2018 (CSA)	2.00			
DT-ICT-06-2018 (CSA)	1.00			
DT-ICT-07-2018-2019 (IA)	48.00			
Opening: 26 Jul 2018				
DT-ICT-08-2019 (IA)		30.00 [116]		14 Nov 2018
DT-ICT-10-2018-19 (IA)	15.00 [117]	15.00		
DT-ICT-13-2019 (CSA)		4.00		
Opening: 16 Oct 2018				
DT-ICT-01-2019 (IA)		48.00		02 Apr 2019
DT-ICT-01-2019 (CSA)		1.00		
DT-ICT-07-2018-2019 (IA)		45.00		

[115] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
The Director-General responsible may delay the deadline(s) by up to two months.
All deadlines are at 17.00.00 Brussels local time.
The budget amounts for the 2020 budget are subject to the availability of the appropriations provided for in the draft budget for 2020 after the adoption of the budget 2020 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

[116] of which EUR 15.00 million from the 'Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy' WP part.

[117] of which EUR 15.00 million from the 'Secure, clean and efficient energy' WP part.

DT-ICT-07-2018-2019 (CSA)		2.00		
DT-ICT-11-2019 (IA)		30.00 [118]		
Opening: 09 Jul 2019				
DT-ICT-03-2020 (CSA)			1.00	13 Nov 2019
DT-ICT-03-2020 (IA)			70.00	
DT-ICT-05-2020 (IA)			30.50	
Opening: 19 Nov 2019				
DT-ICT-04-2020 (IA)			19.00	22 Apr 2020
DT-ICT-09-2020 (IA)			30.00 [119]	
DT-ICT-12-2020 (IA)			40.00 [120]	
Overall indicative budget	130.00	175.00	190.50	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant guide published on the Funding & Tenders Portal.

Grant Conditions:

118 of which EUR 15.00 million from the 'Secure, clean and efficient energy' WP part.
119 of which EUR 15.00 million from the 'Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy' WP part.
120 of which EUR 15.00 million from the 'Health, demographic change and wellbeing' WP part.

DT-ICT-01-2019, DT-ICT-02-2018, DT-ICT-03-2020, DT-ICT-04-2020, DT-ICT-05-2020, DT-ICT-07-2018-2019, DT-ICT-08-2019, DT-ICT-09-2020, DT-ICT-10-2018-19, DT-ICT-11-2019, DT-ICT-12-2020	For grants awarded under this topic for Innovation actions beneficiaries may provide support to third parties as described in part K of the General Annexes of the Work Programme. The support to third parties can only be provided in the form of grants. The respective options of Article 15.1 and Article 15.3 of the Model Grant Agreement will be applied.

Consortium agreement:

All topics of this call	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - Cybersecurity

H2020-SU-ICT-2018-2020

Within the next decade cybersecurity and privacy technologies should become complementary enablers of the EU digital economy, ensuring a trusted networked ICT environment for governments, businesses and individuals. The EU ambition is to become a world leader in secure digital economy. The compliance of the European infrastructures, products and services with relevant directives/regulations (e.g. NIS[121], eIDAS[122], GDPR[123], proposal for an e-Privacy regulation, proposal for a Cybersecurity Act[124]) and standards will promote trust and confidence to the European consumers and providers/suppliers, paving the way for a competitive, trustworthy Digital Single Market.

The Communication on Strengthening Europe's Cyber Resilience System and Fostering a Competitive and Innovative Cybersecurity Industry[125] shaped the main related challenges and several strategic initiatives to address them. The Cybersecurity contractual Public Private Partnership (cPPP) was established in July 2016 aiming at building trust among Member States and industry by fostering cooperation at early stages in the research and innovation process and helping to align demand and supply. It has been an important mean of consultation providing input for H2020 WP2018-2020 and it will facilitate the engagement of end-users in sectors that are important beneficiaries and customers of cybersecurity solutions (e.g. energy, transport, health, finance) towards defining and providing to the industry their sector-specific digital security, privacy and data protection common requirements. The topics below belonging to this Cybersecurity call are part of the contribution of the Commission to the cybersecurity cPPP. They also contribute to the Focus Area "Boosting the effectiveness of the Security Union".

The European Commission has recently adopted a proposal for a Regulation of the European Parliament and of the Council establishing the European Cybersecurity Industrial, Technology and Research Competence Centre and the Network of National Coordination Centres[126] to support the development of the technological and industrial capabilities necessary to autonomously secure its digital economy and increase Europe's competitiveness with regard to cybersecurity and privacy. Four pilot projects are launched under Horizon2020 LEIT ICT,

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121 Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union.

122 Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC.

123 Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

124 Proposal for Regulation of the European Parliament and of the Council on ENISA, the "EU Cybersecurity Agency", and repealing Regulation (EU) 526/2013, and on Information and Communication Technology cybersecurity certification ("Cybersecurity Act")

125 Brussels, 5.7.2016 COM(2016) 410 final.

126 COM(2018)630

as a result of the 2018 call for the topic SU-ICT-03-2018 "Establishing and operating a pilot for a Cybersecurity Competence Network to develop and implement a common Cybersecurity Research & Innovation Roadmap". Proposals should therefore foresee actions to collaborate with these four projects and also with similar ongoing projects funded under H2020, and take account of the results and work done in other relevant H2020 projects on cybersecurity/privacy.

For more details about the impact of the focus area, please refer to the annex 1 of the general introduction to the work programme.

Proposals under this call may be subject to security scrutiny if they could potentially lead to security-sensitive results that should be classified (see guide for classification).

Proposals under this call should consider the relevant human factor and social aspects when developing innovative solutions.

Proposals are invited against the following topic(s):

SU-ICT-01-2018: Dynamic countering of cyber-attacks

Specific Challenge: The prevention of and the protection against attacks that target modern ICT components, complex ICT infrastructures and emerging technologies (e.g. IoT) remains a difficult task. The complexity of heterogeneous collections of hardware and software components finds its roots in the diversity of development contexts and of levels of maturity, in the growing means of networked interactions, in the massive exchange of information and data, and in the varied schedules of systems lifecycles that generate highly dynamic behaviours. The increase of encrypted flows over the Internet should lead to adopt new techniques for detection of suspicious cyber activities and traffic patterns, and for classification of flows, while keeping privacy and confidentiality. Another relevant challenge is to use machine learning and analytics for cybersecurity.

Scope: Proposals are invited against at least one of the following two subtopics:

a) Cyber-attacks management - advanced assurance and protection

Innovative, integrated and holistic approaches in order to minimize attack surfaces through appropriate configuration of system elements, trusted and verifiable computation systems and environments, secure runtime environments, as well as assurance, advanced verification tools and secure-by-design methods. This may entail a whole series of activities, including behavioural, social and human aspects in the engineering process until developed systems and processes address the planned security/privacy/accountability properties.

Proposals should explore how recent progress in artificial intelligence, in deep learning and in other related technologies can be used to provide breakthroughs in the fight against cyber-attacks (e.g. recognition of malicious activities on the network). Deep learning applications may also be used for cyber threat intelligence in anticipation of cyberattacks to identify

malicious activity trends in the cyber space and correlate with attackers' information, tools and techniques.

Proposals may also cover secure execution environments not only including the execution platforms themselves plus the operating systems, but also the mechanisms (e.g. security supporting services, authentication/access control mechanisms) that ensure an adequate level of security, privacy and accountability in the execution of all processes.

Proposals are encouraged to provide mechanisms for informing the users on their security/privacy levels, for providing warnings and assisting them in handling security and privacy related incidents.

b) Cyber-attacks management – advanced response and recovery

Innovative capabilities to dynamically support human operators (e.g. Incident Response professionals), in controlling response and recovery actions, including information visualization. The capabilities should include the assessment how attacks propagate in a particular infrastructure and/or across interconnected infrastructures (e.g. attack-defence graphs) and what the best measures are to withstand and recover from a threat/attack, including the convergence with measures beyond cyber that can be needed (e.g. security policies).

Proposals should address the use of -and the contribution to- appropriate threat intelligence sources as well as the share of information with relevant parties (e.g. industry cooperation groups, Computer Security Incident Response Teams - CSIRTs).

Proposals should explore forensics, penetration testing, investigation and attack attribution services -local or remote- to achieve proper identification and better protection against future attacks and zero-day vulnerabilities. Approaches can include the combination of massive data and logs collection from various sources (e.g. network traffic, dark web) to facilitate investigation on security alerts and to find suspicious files trajectories in order to have the most appropriate response. Efficient utilization of both structured data (e.g. logs) and unstructured data (e.g. data coming from social networks such as pictures, tweets, discussions on forums) should be addressed.

Applicants should also consider the efficient handling (e.g. classification, anomaly detection) of encrypted network traffic and in particular where data stays encrypted, while keeping compliance with end user's privacy requirements.

Proposals need to consider dynamic, evidence based security and privacy risk assessment methodologies and management tools targeting emerging/advanced technologies (e.g. IoT, virtualised and service-oriented systems/networks).

Proposals are encouraged to provide mechanisms for informing the users on their security/privacy levels, for providing warnings and assisting them in handling security and privacy related incidents.

The outcome of the proposal is expected to lead to development up to Technology Readiness level (TRL) 6; please see Annex G of the General Annexes.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

For grants awarded under this topic for Innovation Action the Commission or Agency may object to a transfer of ownership or the exclusive licensing of results to a third party established in a third country not associated to Horizon 2020. The respective option of Article 30.3 of the Model Grant Agreement will be applied.

Expected Impact: Short/medium term

- Enhanced protection against novel advanced threats.
- Advanced technologies and services to manage complex cyber-attacks and to reduce the impact of breaches.
- The technological and operational enablers of co-operation in response and recovery will contribute to the development of the CSIRT Network across the EU, which is one of the key targets of the NIS Directive.

Long term

- Robust, transversal and scalable ICT infrastructures resilient to cyber-attacks that can underpin relevant domain specific ICT systems (e.g. for energy) providing them with sustainable cybersecurity, digital privacy and accountability.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SU-ICT-02-2020: Building blocks for resilience in evolving ICT systems

Specific Challenge: Algorithms, software and hardware systems must be designed having security, privacy, data protection, fault tolerance and accountability[127] in mind from their design phase in a measurable manner, taking into account future-proof, advanced cryptographic means. Relevant challenges include: (a) to develop mechanisms that measure the performance of ICT systems with regards to cybersecurity and privacy and (b) to enhance control and trust of the consumer of digital products and services with innovative tools aiming to ensure the accountability of the security and privacy levels in the algorithms, in the software, and ultimately in the ICT systems, products and services across the supply chain.

Scope: Proposals are invited against at least one of the following three subtopics:

[127] "Accountability" in the meaning ISO IEC/2015.

a) Cybersecurity/privacy audit, certification and standardisation

Innovative approaches to (i) design and develop automated security validation and testing, exploiting the knowledge of architecture, code, and development environments (e.g. white box) (ii) design and develop automated security verification at code level, focusing on scalable taint analysis, information-flow analysis, control-flow integrity, security policy, and considering the relation to secure development lifecycles, (iii) develop mechanisms, key performance indicators and measures that ease the process of certification at the level of services and (iv) develop mechanisms to better audit and analyse open source and/or open license software, and ICT systems with respect to cybersecurity and digital privacy. These approaches may be accompanied by creating information bases to measure and assess the security of digital assets. Proposals should make use of existing standards to the extent possible, and should strive to contribute to relevant standardisation efforts.

b) Trusted supply chains of ICT systems

Innovative approaches to (i) develop advanced, evidence based, dynamic methods and tools for better forecasting, detecting and preventing propagated vulnerabilities, (ii) estimate both dynamically and accurately supply chain cyber security and privacy risks, (iii) design and develop security, privacy and accountability measures and mitigation strategies for all entities involved in the supply chain, (iv) design and develop techniques, methods and tools to better audit complex algorithms (e.g. search engines), interconnected ICT components/systems (v) devise methods to develop resilient systems out of potentially insecure components and (vi) devise security assurance methodologies and metrics to define security claims for composed systems and certification methods, allowing harmonisation and mutual recognition based primarily on evidence and not only on trust.

The trusted supply chain for ICT systems/components should be considered by proposals in its entirety, in particular by addressing the IoT ecosystems/devices that are part of the supply chain.

c) Designing and developing privacy-friendly and secure software and hardware

Innovative approaches to establish methods and tools for (i) security and privacy requirements engineering (including dynamic threat modelling, dynamic attack trees, attack ontologies, dynamic taxonomies and dynamic, evidence based risk analysis), (ii) embedded algorithmic accountability (in order to monitor the security, privacy and transparency of the algorithms/software/systems/services), (iii) system-wide consistency including connection between models, security/privacy/accountability objectives, policies, and functional implementations, (iv) metrics to assess a secure, reliable and privacy-friendly development, (v) secure, privacy-friendly and accountability-enabled programming languages (including machine languages), hardware design languages, development frameworks, as well as secure compilation and execution, (vi) novel, secure and privacy-friendly IoT architectures enabling consistent trustworthy and accountable authentication, authorization and accounting services across IoT devices/ecosystems with enhancement of Public Key Infrastructures (PKIs) aiming to support PKI services (e.g. registration, revocation) for IoT devices.

For each of the sub-topics above, the outcome of the proposals is expected to lead to development up to Technology Readiness level (TRL) 5.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

For grants awarded under this topic for Research and Innovation Action the Commission or Agency may object to a transfer of ownership or the exclusive licensing of results to a third party established in a third country not associated to Horizon 2020. The respective option of Article 30.3 of the Model Grant Agreement will be applied.

Expected Impact: Short/medium term

- Improved market opportunities for the EU vendors of security components.
- Increased trust both by developers using/integrating the ICT components and by the end-users of IT systems and services.
- Protect the privacy of citizens and trustworthiness of ICT .
- Acceleration of the development and implementation of certification processes.

Long term

- Advanced cybersecurity products and services will be developed improving trust in the Digital Single Market.
- The use of more harmonized certification schemes will increase the business cases for cybersecurity services as they will become more reliable.
- Validation platforms will provide assessments with less effort compared with nowadays and assure a better compliance with relevant regulations and standards.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SU-ICT-03-2018: Establishing and operating a pilot for a Cybersecurity Competence Network to develop and implement a common Cybersecurity Research & Innovation Roadmap

Specific Challenge: EU's strategic interest is to ensure that the EU retains and develops essential capacities to secure its digital economy, infrastructures, society, and democracy. Europe's cybersecurity research, competences and investments are spread across Europe with too little alignment. There is an urgent need to step up investment in technological advancements that could make the EU's digital Single Market more cybersecure and to overcome the fragmentation of EU research capacities. Europe has to master the relevant

cybersecurity technologies from secure components to trustworthy interconnected IoT ecosystems and to self-healing software. European industries need to be supported and equipped with latest technologies and skills to develop innovative security products and services and protect their vital assets against cyberattacks. This should contribute inter alia to achieve the objective of European strategic autonomy.

The Public Private Partnership on Cybersecurity[128] created in 2016 was an important first step aiming at triggering up to EUR 1.8 billion of investment. However, the scale of the investment under way in other parts of the world suggests that the EU needs to do more in terms of investment and overcome the fragmentation of capacities spread across the EU. In this context in a recent Joint Communication[129] the Commission announced the intention to create a Cybersecurity Competence Network with a European Cybersecurity Research and Competence Centre.

Scope: The objective of this topic is to scale up existing research for the benefit of the cybersecurity of the Digital Single Market, with solutions that can be marketable. For this, participants should in parallel propose, test, validate and exploit the possible organisational, functional, procedural, technological and operational setup of a cybersecurity competence network with a central competence hub. Projects under this topic will help build and strengthen cybersecurity capacities across the EU as well as provide valuable input for the future set-up of the Cybersecurity Competence Network with a European Cybersecurity Research and Competence Centre as mentioned by the Joint Communication.

To achieve the above, support will go to consortia of competence centres in cybersecurity to engage together in:

- Common research, development and innovation in next generation industrial and civilian cybersecurity technologies (including dual-use), applications and services; focus should be on horizontal cybersecurity technologies as well as on cybersecurity in critical sectors (e.g. energy, transport, health, finance, eGovernment, telecom, space, manufacturing);
- Strengthening cybersecurity capacities across the EU and closing the cyber skills gap;
- Supporting certification authorities with testing and validation labs equipped with state of the art technologies and expertise.

Each proposal should bring together cybersecurity R&D&I centres in Europe (e.g. university labs/public or private non-profit research centres) to create synergies and scale up existing competences and demonstrated strengths to the European level. Proposals should take into consideration relevant active digital ecosystems and public-private cooperation models and focus on solving technological and industrial challenges. The centres within the proposal should aim to collectively develop and implement a Cybersecurity Roadmap covering the above and addressing multiple and complementary cybersecurity disciplines (e.g.

128 C(2016) 440 final

129 Joint Communication to the European Parliament and the Council: Resilience, Deterrence and Defence: Building strong cybersecurity for the EU, JOIN (2017) 450 final

cryptography, network security, application security, IoT/cloud security, data integrity and privacy, secure digital identities, security/crisis management, forensic technologies, security investigation, cyber psychology, bio-security). When developing the Roadmap the results of the work done by the cPPP on cybersecurity, notably its Strategic Research and Innovation Agenda, will serve as a starting point. Consideration should also be given to the relevant work of ENISA, Europol and other EU agencies and bodies.

The Roadmap should include targets to be achieved with deliverables by the end of the project (typically three to four years) that constitute clear milestones in its implementation, as well as priorities to be addressed in the future by the Cybersecurity Competence Network.

To implement this Roadmap, partners in the proposal(s) are expected to set up a functional network of centres of expertise with a coordinating "competence centre" (this role should be undertaken by one of the partners in the network, with the necessary capacity, resources and experience). Work includes the assessment of various organisational and legal solutions for the Cybersecurity Competence Network, taking into account various criteria, including the EU mechanisms and rules, national and regional funding structures, as well as those offered by industry. Based on the above work, a governance structure should be proposed (i.e. business model, operational and decision-making procedures/processes, technologies and people) and will be implemented, tested and validated in the demonstration cases (see below) involving all partners in the network to showcase (in a measurable manner) its performance and optimise the suggested governance structure.

Projects will demonstrate the effectiveness of their selected governance structure by providing collaborative solutions to enhance cybersecurity capacities of the network and develop cyber skills (e.g. by looking at models to align cybersecurity curricula at graduate/post graduate levels; align cybersecurity certification programmes; classify skills with work roles).

Projects should ensure outreach, to raise knowledge and awareness of cybersecurity issues among a wider circle of professionals, where possible in cooperation with EU and national efforts, and to spread the developed expertise.

Projects should also include industrial partners and their cybersecurity research collaborators to create synergies and: (a) collaboratively identify and analyse scalable (short/mid/long term[130]) cybersecurity industrial challenges in the selected sectors and (b) demonstrate their ability to collaborate in developing appropriate solutions to solve critical challenges through (not less than four) research and innovation demonstration cases.

These demonstration cases will constitute the core part of the work to be done within the project. They will be based on a specific research & development roadmap to tackle selected industrial challenges and will implement it covering a complete range of activities, from

130 *Short term*: referring to cybersecurity challenges in existing industrial products that can be addressed by the research and computational capabilities of the Network, *medium term*: referring to cybersecurity challenges in upcoming products that can be addressed by the research and computational capabilities of the Network and the Center and *long term*: high risk research for challenges that will shape new policies for long-term innovation capabilities requiring computational and research capacities beyond the existing ones by the Network.

research & innovation through testing, experimentation and validation to certification activities.

Projects under this topic are implemented as a programme through the use of complementary grants. The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will be applied. Proposals shall therefore foresee resources for clustering activities with other projects funded under this topic to identify synergies, best practices and kick-off the process of creating the network involving the sub-networks already created by awarded projects. This task will contribute to the actual set-up of the Cybersecurity Competence Network and a European Cybersecurity Research and Competence Centre at a later stage.

A proposal must involve distinct cybersecurity R&D&I excellence centres in Europe (e.g. university labs, public or private non-profit research centres, taking into consideration public-private cooperation models and the ecosystems around them), with complementary expertise, from at least 9 Member States or Associated Countries. With the aim of reinforcing technology and industrial capacity as widely as possible across Europe, proposals should include a substantial representation of the most relevant RD&I excellences centres in Europe, with a widespread European coverage and good geographical balance of activities as regards the scope of work. This will ensure the proposals meeting the policy goals of the initiative of supporting the establishment of the future Cybersecurity Competence Network with a European Cybersecurity Research and Competence Centre of the European Union.

The consortium in a proposal must involve at least 20 partners.

A proposal should also include industrial partners from various (not less than 3) sectors (e.g. telecom, finance, transport, eGovernment, health, space, defence, manufacturing) that will be involved in the demonstration cases.

The support and involvement of the relevant governmental bodies and authorities (e.g. for monitoring and assessing the projects' results during their life-cycles) will be considered as an asset.

The Commission considers that proposals requesting a contribution of up to EUR 16 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

For grants awarded under this topic the Commission may object to a transfer of ownership or the exclusive licensing of results to a third party established in a third country not associated to Horizon 2020. The respective option of Article 30.3 of the Model Grant Agreement will be applied.

Under this call topic, the beneficiaries nominated as project coordinators cannot, in this capacity, be awarded more than one grant from the European Union budget. In case an applicant organisation appears as coordinator in more than one proposal, only the last submitted proposal will be considered for evaluation. This approach should allow different governance models to be tested through this topic and provide a wide range of complementary outcomes, including lessons learnt, for the future set-up.

Expected Impact:

- Cybersecurity solutions, products or services for the identified critical challenges, increasing the cybersecurity of the Digital Single Market , in particular for sectors from which stakeholders are involved;
- A feasible, sustainable governance model for the Cybersecurity Competence Network developed and tested through successful pilot projects addressing selected industrial challenges;
- Clearly demonstrated strengthening of Member States' research and innovation competence and cybersecurity capacities, also within their national cybersecurity ecosystems, to meet the increasing cybersecurity challenges;
- Synergies between experts from various cybersecurity domains demonstrated;
- Bridges built between the network and industrial communities;
- Research and Development programme with a common Research and Innovation Roadmap reflecting all different cybersecurity sectors and covering a wide range of activities from research to testing;
- A cybersecurity skills framework model developed, which can be used as a reference by education providers to develop appropriate curricula; by employers, to help assess their cybersecurity workforce, and improve job descriptions; by citizens to reskill themselves;
- Establishment of foundations for pooling and streamlining the development and deployment of cybersecurity technology and strengthening industrial capabilities to secure EU's digital economy, society, democracy, space and infrastructures.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

SU-ICT-04-2019: Quantum Key Distribution testbed

Specific Challenge: Europe's economic activities and Europe's single market is dependent on well-functioning underlying digital infrastructures, services and data integrity, not the least for critical infrastructures like energy, transport, health, finance, etc. Current security of the digital infrastructures and services will soon be under threat of no longer providing long-term security. Confidentiality of data and communications, authentication, as well as the long-term integrity of stored data have to be guaranteed, even in the advent of quantum computers. Introducing Quantum Key Distribution (QKD) in the underlying infrastructure has the potential to maintain end-to-end security in the long-term.

Scope: Building an experimental platform to test and validate the concept of end-to-end security, providing quantum key distribution as a service. Proposals should develop an open,

robust, reliable and fully monitored metropolitan area testbed network (ring or mesh configuration). The aim is to integrate equipment, components, protocols and network technologies with QKD systems and current digital security and communication networks. Where necessary, R&D activities can be addressed. The testbed should be modular, to test different components, configurations and approaches from multiple suppliers and benchmark the different approaches against overall performance. The proposed solutions should demonstrate resistance against known hacking techniques, including quantum hacking techniques. The testbed should make use as much as possible of existing network infrastructure (fibres and/or satellites), provide a quantum key exchange rate compatible with concrete application requirements over metropolitan distances (i.e. of at least 40km). The proposed testbed should demonstrate different applications and use cases of QKD (including for authentication), optimizing end-to-end security rather than the security of individual elements.

Proposals should include an assessment of the applications and parts of the infrastructure for which the integration of QKD is economically justified, as well as an assessment of the minimal acceptable key rate for each application and its total cost of ownership.

Proposals should bring together relevant stakeholders such as telecommunication equipment manufacturers, users, network operators, QKD equipment providers, digital security professionals and scientists.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 15 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

For grants awarded under this topic the Commission may object to a transfer of ownership or the exclusive licensing of results to a third party established in a third country not associated to Horizon 2020. The respective option of Article 30.3 of the Model Grant Agreement will be applied.

Expected Impact:

- Demonstrating the feasibility of quantum communication networks.
- Validation of quantum network technologies, architectures, protocols, including broader cryptographic services based on QKD infrastructure.
- Interoperability of quantum and classical networks, as well as multi-vendor interoperability.
- Development of standards for QKD components, equipment and protocols.

Type of Action: Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Conditions for the Call - Cybersecurity

Opening date(s), deadline(s), indicative budget(s):[131]

Topics (Type of Action)	Budgets (EUR million)			Deadlines
	2018	2019	2020	
Opening: 01 Feb 2018				
SU-ICT-03-2018 (RIA)	50.00			29 May 2018
Opening: 15 Mar 2018				
SU-ICT-01-2018 (IA)	40.00			28 Aug 2018
Opening: 26 Jul 2018				
SU-ICT-04-2019 (IA)		15.00		14 Nov 2018
Opening: 25 Jul 2019				
SU-ICT-02-2020 (RIA)			47.00	19 Nov 2019
Overall indicative budget	90.00	15.00	47.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme. The following exceptions apply:

SU-ICT-03-2018	- At least 20 legal entities. They must be independent of each other and be established in at least nine different Member States or Associated countries. - Under this topic, the beneficiaries nominated as project

[131] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
The Director-General responsible may delay the deadline(s) by up to two months.
All deadlines are at 17.00.00 Brussels local time.
The budget amounts for the 2020 budget are subject to the availability of the appropriations provided for in the draft budget for 2020 after the adoption of the budget 2020 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

	coordinators cannot, in this capacity, be awarded more than one grant from the European Union budget. In case an applicant organisation appears as coordinator in more than one proposal, only this applicant's last submitted proposal will be considered for evaluation

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant guide published on the Funding & Tenders Portal.

Grant Conditions:

SU-ICT-01-2018, SU-ICT-02-2020, SU-ICT-03-2018, SU-ICT-04-2019	For grants awarded under this topic the Commission may object to a transfer of ownership or the exclusive licensing of results to a third party established in a third country not associated to Horizon 2020. The respective option of Article 30.3 of the Model Grant Agreement will be applied.
SU-ICT-03-2018	Complementary grant agreements will be implemented across projects originating under this topic through use of the respective options of Article 2, Article 31.6 and Article 41.4 2 of the Model Grant Agreement.

Consortium agreement:

SU-ICT-01-2018, SU-ICT-02-2020, SU-ICT-03-2018, SU-ICT-04-2019	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - EU-Japan Joint Call

H2020-EUJ-2018

Proposals are invited against the following topic(s):

EUJ-01-2018: Advanced technologies (Security/Cloud/IoT/BigData) for a hyper-connected society in the context of Smart City

Specific Challenge: Following the integration and federation of IoT with Big Data and Cloud, which has been explored in past coordinated calls, a remaining challenge to address is **enhanced security and privacy** and how the human user deals with the ever-increasing amount of sensors, smart objects and data. Both EU and Japan have excellent competences in the fields of cybersecurity systems and visualisation technologies. Especially, security aspects are of increasing importance in these years. **There is a need for simple, efficient and trustable systems based on advanced technologies combining Security, Cloud and IoT/Big Data technologies** that can provide **intelligent** detection and countermeasures for device malware attacks, automatic vulnerability discovery and patching, analytics and IoT/Big Data applications. All of these require **advanced cloud and edge computing technologies** and **interoperable IoT devices and platforms.**

These new requirements, including security aspects, will have an enormous impact on the underlying cloud/IoT platforms and associated services, especially for cross-border demonstrations of technologies and applications.

Furthermore, **interoperability** of IoT devices/platforms is of particular interest in the context of Smart Cities (the areas of energy, social infrastructure, traffic/transport, healthcare, and disaster/crime prevention) in order to promote collaboration between a variety of business operators and platforms connecting to various IoT devices, open source, standards, SDKs, common APIs, are the cornerstone of the EU-Japan collaboration.

Scope: The proposals should address one of the two following areas:

1) Advanced technologies combining Security, IoT, Cloud and Big data for a hyper-connected society

The focus is to research, develop and test advanced technologies combining Security, IoT, Cloud and Big data. The following technologies are expected for research and development: agility against emerging threats; automatic vulnerability discovery and patching; open-sourcing of security tools; IoT security; cloud security; data security; privacy protection; data anonymization; blockchain in the context of IoT/Cloud; critical information infrastructure protection, cross border application demonstrations; etc.

2) Interoperable technologies of IoT devices/platforms in the context of Smart Cities

The focus is to research, develop and test interoperable technologies of IoT devices/platforms in the context of Smart Cities. The following technologies are expected for research and development: edge/fog/cloud computing; low power; scalability; open-standards-based platforms; system and reference architectures; open application programming interfaces (API); data sharing among cross-market/cultural platforms; managing distributed data among different communities and regions; bridging different standardizations; technical verification; cross border application demonstrations; energy management; transportation systems; maintenance systems for life infrastructure; etc. A further objective is to contribute to standardization activities under the cooperation of EU-JP research institutes and IoT-related consortia (e.g. the Alliance for IoT Innovation (AIOTI) and IoT Acceleration Consortium), and promote a global expansion of research results in Smart Cities.

The Commission considers that proposals requesting a contribution from the EU up to EUR 1.5 million would allow this specific challenge to be addressed appropriately by one project of EUR 1.5 million in each of the suggested areas. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Credible demonstrations based on cross-border business and/or societal applications of robust interoperable technologies identifying policy/legal obstacles (i.e., free flow of data, data protection, data portability etc.).
- Concrete implementations of interoperable solutions that integrate IoT, Cloud and Big Data including security that are candidates for standardisation.
- Facilitation of the development of cloud-enabled, secure and trustworthy IoT/big data applications (i.e., integrating intelligent security systems and visualisation technologies and devices/interfaces).
- Promotion of the use of data related to Smart Cities and the creation of new increasingly efficient services in urban and regional administrative management.
- Joint contributions to standardization activities under the cooperation of EU-Japan research institutes and IoT-related consortia (e.g. AIOTI and IoT Acceleration Consortium).

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

EUJ-02-2018: 5G and beyond

Specific Challenge: The next phase of 5G activities running during the 2018-20 period covers both in EU and in Japan, technologies and systems demonstrations and trials. The challenge is hence to demonstrate technologies and system interoperability for 5G applications of interest

in the two regions in early version of the IMT-2020 standards, but also to go further to address long-term challenges beyond 5G.

The overall goal is to evaluate in real setup innovative end-to-end 5G systems built on the outcomes of previous phases of the 5G R&I. The optimisation of the frequency bands and their usage with different coverage requirements as well as the validation of geographic interoperability are key targets.

Scope: The proposals should address one of the two following areas:

1) Large-scale demonstrations and trials towards 5G applications: The objective is to research, develop and test technologies to enable applications developers and researchers to take advantage of the 5G integrated access/core network infrastructures and testbeds in Europe and Japan, in order to showcase the adaptability of the latest 5G systems, technologies and early version of the IMT-2020 standards.

The area of large-scale demonstrations and trials towards 5G applications, should showcase the adaptability of the 5G infrastructure to the 5G KPI's and the use of the integrated environment to contribute to global R&D and standardization efforts of 5G systems by having an open environment for the trials.

The focus should be on trials and demonstrations of 5G applications in the use cases of Enhanced Mobile Broadband (eMBB) and Broadband Access in Dense Areas. Typical applications scenarios could cover, but are not limited to, mobile 3D immersive experience, ultra high definition live video and HD video sharing in crowded environments. Typical test/demonstration environments will include high user density shopping malls, stadiums and open crowded streets.

To try out highly innovative solutions targeting new opportunities which will emerge with the worldwide deployment of 5G ecosystems, the participation of industry from both regions, and particularly SMEs, is key.

2) Joint research on enabling technologies for beyond 5G: 5G mobile technology is expected to handle a fully mobile and connected society. The demands for this are characterized by the tremendous growth in connectivity and data traffic density/volume as well as the required multi-layer densification to enable this. Beyond 5G should further support such trend.

Focus should be towards the enormous capacities foreseen to be needed in the backhaul and fronthaul networks to carry the traffic, as fibre-optic networks, may not be an option everywhere. A viable alternative in such cases is to use radio-based backhaul/fronthaul links in the millimeter or sub-millimeter wave bands to support super high rate applications, > 100 Gb/s, and targeting use new of very high frequency, notably spectrum > 275 GHz.

The goal is for an alternative transmission system occupying bandwidths as large as several tens of GHz to allow the realization of such high data rates with less complexity in the baseband.

Communication system and networks using both of advanced optical/photonic technologies and radio technologies should be expected for Beyond 5G.

The Commission considers that proposals requesting a contribution from the EU up to EUR 1.5 million would allow each area to be addressed appropriately. Nevertheless this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Large-scale joint demonstrators converging towards open 5G applications.
- Global interoperability demonstrations for 5G networks.
- Support of common standardisation roadmaps for 5G starting with 3GPP Release14, including coordinated and common standards in the SDN/NFV domain. Standardization impact through EU and Japanese research efforts are addressed through H2020 as well as 5GPF (5G Promotion Forum) and should also be relevant in the context of the 5G spectrum process for WRC-19
- Joint contributions to global 5G specifications for IMT-2020 in relevant organisations (e.g. 3GPP, ITU-R), especially in view of 5G phase 2 standardisation (beyond eMBB) and spectrum harmonization for IMT-2020.
- Open new prospects for wireless technologies in terms of applications and use of novel spectrum.
- Relevant results for wireless links in the millimeter or sub-millimeter wave bands in support of the identification of frequency bands above 275 GHz for use by administrations for the land-mobile and fixed services applications for WRC-19 agenda item 1.15.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Conditions for the Call - EU-Japan Joint Call

Opening date(s), deadline(s), indicative budget(s):[132]

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2018	

[132] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
The Director-General responsible may delay the deadline(s) by up to two months.
All deadlines are at 17.00.00 Brussels local time.

Opening: 31 Oct 2017		
EUJ-01-2018 (RIA)	3.00	31 Jan 2018
EUJ-02-2018 (RIA)	3.00	
Overall indicative budget	6.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme. The following exceptions apply:

EUJ-01-2018	Additional admissibility criterion: Participants in the EU collaborative projects are required to conclude a coordination agreement with the participants in the coordinated project of the scope 1) funded by NICT (National Institute of Information and Communications Technology) or the scope 2) funded by MIC (Ministry of Internal Affairs and Communications). A final draft of this agreement has to be provided with the proposal. Additional eligibility criteria: • Proposals submitted to this call which do not include coordination with a Japanese proposal submitted to MIC or NICT for evaluation will be considered ineligible. • The proposed project duration shall not exceed 36 months. • The Japanese authorities can consider non-eligible proposals with participation of partners from third countries (countries other than Japan, EU and Associated states). Consultation to MIC or NICT representatives is highly advisable before submitting proposals involving third country organisations. Proposals will only be selected on the condition that their corresponding coordinated Japanese project will be funded by

	MIC or NICT.
EUJ-02-2018	Participants in the EU collaborative projects are required to conclude a coordination agreement with the participants in the coordinated project of the scope 1) funded by MIC (Ministry of Internal Affairs and Communications) or the scope 2) funded by NICT (National Institute of Information and Communications Technology). A final draft of this agreement has to be provided with the proposal. Additional eligibility criteria: • Proposals submitted to this call which do not include coordination with a Japanese proposal submitted to MIC or NICT for evaluation will be considered ineligible. • The proposed project duration shall not exceed 36 months. • The Japanese authorities can consider non-eligible proposals with participation of partners from third countries (countries other than Japan, EU and Associated states). Consultation to MIC or NICT representatives is highly advisable before submitting proposals involving third country organisations. Proposals will only be selected on the condition that their corresponding coordinated Japanese project will be funded by MIC or NICT.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant guide published on the Funding & Tenders Portal.

Grant Conditions:

EUJ-01-2018	Grants awarded under this topic will be jointly funded with: NICT (National Institute of Information and Communications Technology). (Scope 1) MIC (Ministry of Internal Affairs and Communications) (Scope 2)

	The respective options of Article 2, Article 41.5 and Article 50.3.1 (i) (j) of the Model Grant Agreement will be applied.
EUJ-02-2018	Grants awarded under this topic will be jointly funded with: MIC (Ministry of Internal Affairs and Communications) (Scope 1) NICT (National Institute of Information and Communications Technology). (Scope 2) The respective options of Article 2, Article 41.5 and Article 50.3.1 (i) (j) of the Model Grant Agreement will be applied.

Consortium agreement:

EUJ-01-2018, EUJ-02-2018	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - EU-Korea Joint Call

H2020-EUK-2018

Proposals are invited against the following topic(s):

EUK-01-2018: Cloud, IoT and AI technologies

Specific Challenge: Over the last years Cloud computing technologies have evolved into the major driver that brought together IoT, Big Data and mobile computing into an integrated and ubiquitous computing platform. The capability offered by the cloud platforms to deliver on-demand computing power and the ability to process the vast amount of data coming from an abundance of devices/sensors will provide a huge impetus to AI technologies as never realized before. In order to provide AI services on Cloud computing platforms, the harmonious management of computing resources through multi-cloud federation environment as well as huge data management and analytics are necessary. In addition, there is a need for new mechanisms using intelligence to manage the deluge of data from various surroundings; standardizing open IoT data management platforms to enable launching new value-added AI services; data acquisition method using IoT technologies.

Combining Cloud, IoT and AI will bring tremendous technological advances with enormous benefits to business and societal applications.

Scope: The main focus of the joint research is to develop innovative solutions integrating AI with Cloud and IoT technologies to support future AI applications in an efficient way.

A number of R&D areas need to be considered so as to deliver these **advanced cloud platforms with IoT for AI** (i.e., innovative cloud computing models to deliver cross-border future AI applications; new data management models built on AI-based optimal resource allocation; new approaches for cloud resources orchestration for AI data processing; new approaches to handle a dynamic dataset in the federated clouds for AI functions; Cloud and IoT combined platforms managing intelligence from IoT objects and surroundings and supporting data-intensive applications; efficient navigation, device control and enhanced decision-making technologies using intelligence, etc.).

The technologies developed should be validated through concrete cross-border AI applications in business (cross-border enterprise settings) and/or societal contexts (e.g. autonomous vehicles in a complex urban area, smart living environments, personal health systems, etc.).

The Commission considers that proposals requesting a contribution from the EU of EUR 2.2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Concrete implementation of interoperable and reliable combined cloud/IoT solutions to support robust AI applications.
- Facilitate and enhance the adoption of combined cloud/IoT platforms and development, operation and delivery of AI services in future.
- Credible demonstrations based on cross-border business and/or societal AI applications on the cloud platform developed.
- Joint contributions to international standardization and/or forum activities.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

EUK-02-2018: 5G

Specific Challenge: The next phase of 5G covers, both in EU and in South Korea, technologies and systems demonstrations and trials. The challenge is hence to demonstrate innovative use of 5G technologies and system interoperability for a number of 5G applications of interest in the two regions in early version of the 5G standard. The possibilities of even broader regional test beds or demonstrators can be proposed, e.g. through extension to other countries or regions as this could further strengthen the co-operation towards a global 5G.

The overall goal is to evaluate in real setup innovative end-to-end 5G systems built on the outcomes of the previous phase of the 5G R&I in the earlier joint call with South Korea and focus on demonstrations of applications and use cases in joint pilots in line with the phase 3 targets of 5G-PPP and their validation in a system context and in the context of multiple use cases, with performances well beyond those of early 5G trials planned over the 2018-20 period.

The call will further advance common interests in standards (e.g. cell free networks and related RAN architecture) as well as advances concerning the core network, such as slicing and virtualisation which require more efforts in cloud like core environments and open source approaches.

Scope: The focus should be on large-scale demonstrations and trials towards 5G applications, this to have a strong focus on the harmonization for 5G standards and spectrum.

The proposals should address one of the two areas (a or b):

a) Focus on mmwave and super broadband services: The 5G vision on super broadband services mainly related to very high definition immersive video services (virtual reality) using mmWave frequency bands. This should be in the proposed specific context of the ground/aerial vehicles and also possibly include a focus towards autonomous network technologies toward safe and automated 5G networks.

This focus should include demonstration of 5G technologies concerning,

(1) Access networks, notably: i) Various duplexing technologies with (or without) interference cancellation; ii) Efficient radio transmission technology for the mmwave relay links; iii) Advanced beamforming (fast switching & adaptive hybrid.

(2) Core networks, notably: i) Implementation and Proof of Concepts of 5G core systems prototype software (e.g. AMF, SMF, UPF); ii) Implementation of end-to-end network slicing and orchestration and management of autonomous 5G networks; iii) Implementation of Multi-Access Edge Computing (MEC).

b) Focus on interoperability and integration of 5G vertical testbeds on heterogeneous environments: An open approach is to be taken to achieve a closer co-operation in spectrum harmonisation and co-operation in interoperability testing, e.g. in the C-band and/or Ka-band, to achieve coexistence and inter-working between same/different radio access technologies considering both terrestrial (i.e., cellular) and non- terrestrial links (i.e., satellite) incorporating QoS transparency between difference 5G mobile core networks.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 2 million would allow each area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: - Global interoperability demonstrations for 5G networks, contribution to the integration framework towards access and core.

- Joint contributions to global 5G standards specifications in relevant organisations (e.g. 3GPP, ITU-R), especially in view of 5G phase 2 standardisation (beyond eMBB) and IMT2020 spectrum harmonization.

- Succesful showcasing trials or testbeds with, ideally, joint demonstration across regions.

Type of Action: Research and Innovation action

The conditions related to this topic are provided at the end of this call and in the General Annexes.

Conditions for the Call - EU-Korea Joint Call

Opening date(s), deadline(s), indicative budget(s):[133]

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2018	

[133] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.
The Director-General responsible may delay the deadline(s) by up to two months.
All deadlines are at 17.00.00 Brussels local time.

Opening: 31 Oct 2017		
EUK-01-2018 (RIA)	2.20	31 Jan 2018
EUK-02-2018 (RIA)	4.00	
Overall indicative budget	6.20	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and
- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in General Annexes B and C of the work programme. The following exceptions apply:

All topics of this call	Additional admissibility criterion: Participants in the EU collaborative projects are required to conclude **a coordination agreement** with the participants in the coordinated project funded by MSIT (Ministry of Science and ICT/IITP (Institute for Information and Communications Technology Promotion). A final draft of this agreement has to be provided with the proposal. Additional eligibility criteria: • Proposals submitted to this call which do not include coordination with a South Korean proposal submitted to MSIT/IITP for evaluation will be considered ineligible. • The proposed project duration shall not exceed 36 months. • The Korean authorities can consider non-eligible proposals with participation of partners from third countries (countries other than South Korea, EU and Associated states). Consultation to MSIT/IITP representatives is highly advisable before submitting proposals involving third country organisations. • Proposals will only be selected on the condition that their corresponding coordinated South Korean project will be funded by MSIT/IITP.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in General Annex H of the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in General Annex H of the work programme.

The full evaluation procedure is described in the relevant guide published on the Funding & Tenders Portal.

Grant Conditions:

EUK-01-2018	Grants awarded under this topic will be jointly funded with: MSIT (Ministry of science and ICT)/IITP (Institute for Information and Communications Technology Promotion) The respective options of Article 2, Article 41.5 and Article 50.3.1 (i) (j) of the Model Grant Agreement will be applied.
EUK-02-2018	Grants awarded under this topic will be jointly funded with: MSIT (Ministry of science and ICT/IITP (Institute for Information and Communications Technology Promotion) The respective options of Article 2, Article 41.5 and Article 50.3.1 (i) (j) of the Model Grant Agreement will be applied.

Consortium agreement:

EUK-01-2018, EUK-02-2018	Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

SME instrument & Fast-Track-to-Innovation

The respective calls for the EIC-SME instrument (H2020-EIC-SMEInst-2018-2020) and EIC-Fast-Track-to-Innovation (H2020-EIC-FTI-2018-2020) are found under the Horizon 2020 Work Programme Part – ***Towards the next EU Framework Programme for Research and Innovation: European Innovation Council (EIC) Pilot*** (part 17 of this work programme).

Other actions[134]

1. External expertise

This action will support:

- The use of appointed independent experts for the monitoring of running projects.
- The use of individual independent experts to advise on, or support, the design and implementation of EU research policy. The activities carried out by the experts will be essential to the development and monitoring of the Union policy on Research, Technological development and demonstration. They will be paid a special allowance of EUR 450/day for each full working day spent assisting the Commission. This amount is considered to be proportionate to the specific tasks to be assigned to the experts, including the number of meetings to be attended and possible preparatory work.

Type of Action: Expert Contracts

Indicative timetable: All along the three years according to operational needs.

Indicative budget: EUR 6.50 million from the 2018 budget and EUR 6.50 million from the 2019 budget and EUR 6.50 million from the 2020 budget

2. Digital Assembly Events 2018, 2019 and 2020

DG CONNECT is organising the Digital Assembly Events 2018, 2019 and 2020. DG CONNECT plans to procure via Framework Contracts and call for tenders for indicatively 15 contracts before the end of 2020. The events are expected to take place in the 2rd calendar quarter of 2018, in the 2nd calendar quarter of 2019 and in the 2nd calendar quarter of 2020. The call for tenders are expected to be launched on the 1st and 2nd calendar quarter of 2018, 2019 and 2020.

Type of Action: Public Procurement - null

Indicative timetable: Q2 2018, Q2 2019 and Q2 2020

Indicative budget: EUR 1.00 million from the 2018 budget and EUR 1.00 million from the 2019 budget and EUR 1.00 million from the 2020 budget

3. ICT conferences, studies and other activities

In addition to calls for proposals, other actions are also expected to be undertaken on specific activities that the DG CONNECT will support. These include:

[134] The budget amounts for the 2020 budget are subject to the availability of the appropriations provided for in the draft budget for 2020 after the adoption of the budget 2020 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

- The organisation of two ICT conferences (2018 and 2020) and the organisation of an ICT proposers' day in 2019. DG CONNECT plans to conclude service contracts in 2018, 2019 and 2020, and also use existing Framework Contracts for this purpose. The events are expected to take place in the 4th calendar quarter of 2018, 4th Calendar quarter of 2020 and in the 3rd calendar quarter of 2019 respectively. Indicative budget in 2018: EUR 4.5 million. Indicative budget in 2019: EUR 1.5 million. Indicative budget in 2020: EUR 4.5 million. DG CONNECT plans to procure via framework contracts and calls for tender for a total of indicatively 40 contracts before the end of 2020 for the three events, depending on the operational needs. The calls for tenders are expected to be launched in the 1st calendar quarter of 2018, 2019 and 2020 respectively.

- Studies including socio-economics and impact analysis studies and studies to support the monitoring, evaluation and strategy definition for the ICT priority of LEIT in H2020. DG CONNECT plans to procure via framework contracts and calls for tender indicatively 60 study contracts before the end of 2020. The calls for tenders are expected to be launched in the 2nd and 3rd calendar quarter of 2018, 2019 and 2020. It should be noted that internal outsourcing of studies to other Commission departments based on Administrative Agreements can be used as an alternative to the public procurement. Indicative budget in 2018: EUR 4.0 million. Indicative budget in 2019: EUR 4.0 million. Indicative budget in 2020: EUR 7.75 million.

- Policy support activities, including benchmarking activities, evaluation and impact assessments, the development of ad hoc support software, possibly using existing Framework Contracts. DG CONNECT plans to procure via framework contracts and calls for tender indicatively 15 contracts before the end of 2020. The calls for tenders are expected to be launched in the 2nd and 3rd calendar quarter of 2018, 2019 and 2020. It should be noted that internal outsourcing of studies to other Commission departments based on Administrative Agreements can be used as an alternative to the public procurement. Indicative budget in 2018: EUR 3.0 million. Indicative budget in 2019: EUR 3.0 million. Indicative budget in 2020: EUR 3.0 million.

- Publications and support to other events (e.g. information, communication, dissemination etc.), either through the use of existing Framework Contracts, or the launch of indicatively 25 calls for tenders during 2018, 2019 and 2020. The calls for tenders are expected to be launched in the 2nd and 3rd calendar quarter of 2018, 2019 and 2020. Indicative budget in 2018: EUR 1 million. Indicative budget in 2019: EUR 2 million. Indicative budget in 2020: EUR 2 million.

Details will be provided in the texts of these calls for tender.

Type of Action: Public Procurement - As described in detail above

Indicative timetable: As described in detail above

Indicative budget: EUR 12.50 million from the 2018 budget and EUR 13.00 million from the 2019 budget and EUR 17.75 million from the 2020 budget

4. EUROSTAT[135]

EUROSTAT subvention for benchmarking ICT Take up by households and by enterprises.

Eurostat, on the basis of co-delegation, will coordinate the Households and Enterprises surveys that will be conducted by the national statistical institutes and other competent national authorities of the Member States and Associated Countries where appropriate.

Legal entities: To perform these surveys, grants will be awarded to the national statistical institutes [136] and other competent national authorities in accordance with Article 5 of Regulation (EC) No 223/2009 on European Statistics.

Funding rate: up to 90%.

Eligibility conditions for participation: At least one legal entity established in an EU Member State or Horizon 2020 Associated Country in accordance with Article 9(3)(d) of the Regulation (EU) No 1290/2013.

Award criteria: The following aspects of the applications will be assessed on the basis of the following main criteria:

1. Excellence: Relevance of applications in relation to the objectives and priorities of the Eurostat annual work programme;
2. Impact: Furthering the objectives and priorities of the Eurostat annual work programme;
3. Quality and efficiency of the implementation: Quality of the proposal including the efficiency of the proposed approach, the organisation and/or the methods proposed, etc.

Type of Action: Grants to identified beneficiaries in accordance with Article 5 of Regulation (EC) No 223/2009 on European Statistics

Indicative timetable: Q2 2018, Q2 2019 and Q2 2020

Indicative budget: EUR 2.00 million from the 2018 budget and EUR 2.00 million from the 2019 budget and EUR 2.00 million from the 2020 budget

5. Framework Partnership Agreement in European low-power microprocessor technologies (Phase 1)

Within the Framework Partnership Agreement in European low-power microprocessor technologies awarded in 2017, the selected consortium will be invited to submit a Research

135 This grant will be awarded without call for proposals in line with Article 190(1)(e) of the Rules of applications of Regulation (EU, Euratom) 966/2012, Regulation No 1268/2012 and Article 11(2) of the Rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)", Regulation (EU) No 1290/2013

136 In line with Regulation (EC) No 808/2004 of the European Parliament and of the Council of 21 April 2004 concerning Community statistics on the information society (OJ L 286, 31.10.2009, p. 31) and Regulation (EC) No 223/2009 of the European Parliament and of the Council of 11 March 2009 on European statistics (OJ L 87, 31.3.2009, p.164).

and Innovation Action proposal for the design and development of European low-power processors and related technologies for extreme-scale, high-performance big-data and emerging applications, in the automotive sector for example, in accordance with the research roadmap defined in the FPA. The designs should follow a modular approach that would allow a rapid scale-up or scale-down.

The grant will be subject to Article 30.3 of the grant agreement (Commission right to object to transfers or licensing).

In particular, the proposal is expected to cover both of the following topics

a) Low-power Processing System Units demonstrating the synergies between high performance computing at the exascale level and scalability to distributed collaborating systems in emerging computing applications, in the automotive sector for example, providing industry in Europe with a competitive edge in processor technology to be further exploited across a wide range of applications from engineering, science and bio-medical to automotive, manufacturing, finance and emerging big-data and smart objects fields.

Generate the functional and non-functional requirements for low-power Processing System Units (using representative HPC and big-data benchmarks, emerging applications specifications, in the automotive sector for example, and targeting maximum energy-efficiency and reliability); design the architecture of the Processing System Units; verify, tape-out, validate, test and bring up the Processing System Units; develop the required firmware and system software leveraging, as much as possible, on open source efforts and solutions. Sustainability and economic viability of the developed solutions are key aspects.

b) Low-power Processing Units for application acceleration

Generate the functional and non-functional requirements for low-power Processing Units (using relevant representative benchmarks/applications) and design the architecture of the Processing Units to accelerate specific applications such as connected and autonomous driving, cognitive computing, deep learning or other emerging applications. The applications must have high-volume potential. Processing Units may be realised as standalone components, distributed collaborating systems or IP-blocks. Where relevant, open-source hardware approaches may be employed. Work in this topic is required to interface with topic a) in order to achieve maximum interoperability (including IP-block interfacing) and roadmap synchronisation.

Wherever appropriate, the proposal, and in particular in addressing topic a), could seek synergies and co-financing from relevant national / regional research and innovation programmes, including structural funds addressing smart specialisation. Work combining different sources of financing should include a concrete financial plan detailing the use of these funding sources for the different parts of the activities.

The standard evaluation criteria, thresholds, weighting for award criteria and the maximum rate of co-financing for this type of action are provided in parts D and H of the General Annexes.

Expected impact:

- Demonstrating the synergies of the design for high performance computing at the exascale level and computing demanding emerging applications, in the automotive sector for example.
- Strengthening the competitiveness and leadership of European industry & science, in particular of the European technology supply in low-power microprocessor technologies for HPC, Big-Data and emerging applications based on on-site distributed collaborating systems such as connected and autonomous driving, cognitive computing, deep learning, etc.
- Availability of European processing units with drastically better performance/power ratios compared to current offerings for HPC, Big-Data and other emerging applications, such as connected and autonomous driving, cognitive computing, deep learning, etc.
- Covering important segments of the broader and/or emerging high-end computing markets.

Type of Action: Specific Grant Agreement

Indicative timetable: Q1 2018

Indicative budget: EUR 80.00 million from the 2018 budget

6. Fostering transnational cooperation between National Contact Points (NCP) in the area of ICT: follow-up project[137]

The action will facilitate transnational cooperation between Horizon 2020 NCPs in the area of ICT with a view to identifying and sharing good practices and raising the general standard of support to programme applicants, taking into account the diversity of actors that make up the constituency of the ICT sector. It will involve one consortium of NCPs focussing on transnational cooperation on issues specific to the ICT sector, within the context of Horizon 2020 calls for proposals.

All activities must be tailored according to the nature of this sector.

The proposal should show that the activities put forward will deliver tangible benefits to potential applicants. Activities should capitalise on relevant work of the previous NCP network project in this sector, and of the 'NCP Academy' (*www.ncpacademy.eu*). Various mechanisms may be included, such as benchmarking, joint workshops, enhanced cross-border brokerage events, and specific training linked to the ICT sector.

[137] This grant will be awarded without call for proposals in line with Article 190(1)(e) of the Rules of applications of Regulation (EU, Euratom) 966/2012, Regulation No 1268/2012 and Article 11(2) of the Rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)", Regulation (EU) No 1290/2013.

Where relevant, activities should make use of commonly available tools (e.g. for brokerage and partner search, benchmarking tools, guidebooks, promotional tools etc).

To help close the innovation divide, a substantial component of the proposed activities must be devoted to activities aimed at helping NCPs in those countries that have been participating at low levels in the programme up to now. These activities should help these NCPs rapidly acquire the know-how on NCP operations accumulated in other countries including, for example, training, mentoring, and twinning. They may also include awareness raising actions aimed at increasing visibility of well-qualified potential applicant organisations in the above mentioned countries.

The action is a continuation the project Idealist2018 (Grant Ageement Number 645216) and builds on its current participants and network. Therefore, the legal entities listed below are beneficiaries of the Project Idealist2018 or the host organisations of NCPs from EU Member States and Associated Countries who have been officially appointed by the relevant national authorities, and who have expressed a willingness to participate in this proposal. NCPs opting not to be a beneficiary are nevertheless invited and encouraged to participate in the project activities (e.g. workshops), and costs for such participation (e.g. travel costs paid by the consortium) may be included in the estimated budget and be eligible for funding by the Commission.

In line with Articles 2, 31.6 and 41.4 of the Model Grant agreement, the project arising from this grant will complement other NCP network projects. This means that the beneficiaries and those of the complementary grants must cooperate and provide access to their results. They must conclude a written collaboration agreement regarding the coordination of the complementary grants and the work of the action.

The duration of the action will be 2 years from 1 January 2019.

Expected impact:

- An improved, more consistent and professionalised NCP service across Europe, thereby helping simplify access to Horizon 2020 calls, and lowering the entry barriers for newcomers,
- An increase in the quality of proposals submitted, including those from countries where success rates are currently lower than average.

Legal entities:

Agjencia e Kerkimit, Teknologjise dhe Inovacionit, Rruga “Papa Gjon Pali i II”, Nr 3, Tiranë, Shqipëri, Albania

INFORMATION SOCIETY TECHNOLOGIES CENTER, P SEVAK 1 , 0014 , YEREVAN, Armenia

OESTERREICHISCHE FORSCHUNGSFOERDERUNGSGESELLSCHAFT MBH , Sensengasse 1, 1090 Vienna, Austria

Univerzitet "Džemal Bijedić" u Mostaru, University Campus, 88104 Mostar, Bosnia and Herzegovina

AGENCE BRUXELLOISE POUR L'ENTREPRISE, Chaussée de Charleroi 110, 1060 Brussels, Belgium

INSTITUTE OF INFORMATION AND COMMUNICATION TECHNOLOGIES, UL. ACAD G BONCHEV BL 2, Sofia 1113, Bulgaria

VEREIN EURESEARCH, Effingerstrasse 19 , 3008 , BERN, Switzerland

RESEARCH PROMOTION FOUNDATION, STROVOLOS AVENUE 123 , 2042 , NICOSIA, Cyprus

TECHNOLOGICKE CENTRUM AKADEMIE VED CESKE REPUBLIKY, Ve Struhach 1076/27 , 160 00 , PRAHA, Czech Republic

Centro para el Desarrollo Tecnológico Industrial, Calle Cid 4, 28001 Madrid, Spain

Business France, BOULEVARD SAINT JACQUES 77 , 75014 , PARIS 14, France

International Center for Advancement of Research, Technology and Innovation, Bakhtrioni Str. Block I , 0194 , Tbilisi, Georgia

ETHNIKO IDRYMA EREVNON, VAS KONSTANTINOU 48 , 11635 , ATHINA, Greece

AGENCY FOR MOBILITY AND EU PRPGRAMMES, FRANKOPANSKA 26 , 10000 , ZAGREB, Croatia

Nemzeti Kutatasi Fejlesztesi es Innovacios Hivatal, "Kethly Anna ter 1 1077 BUDAPEST Hungary"

Israel’s National Technological Innovation Authority , Hamered Street 29 , 61500 , TEL AVIV, Israel

Rannsóknamiðstöð Íslands, Borgartún 30, REYKJAVIK, Iceland

AGENZIA PER LA PROMOZIONE DELLA RICERCA EUROPEA, Via Cavour n.71, 00184 – Rome (Italy)

Luxinnovation GIE, 5 avenue des Hauts-Fourneaux L-4362 Esch-sur-Alzette, Luxembourg

VALSTS IZGLITIBAS ATTISTIBAS AGENTURA , Valnu street 1, Riga, LV-1050, Latvia

DAS Solutions S.R.L, 1/7 Studentilor str, Chisinau, MD-2045, Moldova

MASIT ICT CHAMBER OF COMMERCE, Blvd: Partizanski odredi br: 4, 1000 Skopje, Former Yugoslav Republic Of Macedonia

Norges Forskningsråd / The Research Council of Norway, Drammensveien 288 0283 Oslo / Postboks 564, 1327 Lysaker, Norway

INSTYTUT PODSTAWOWYCH PROBLEMOW TECHNIKI POLSKIEJ AKADEMII NAUK, Adolfa Pawinskiego 5B , 02-106 , WARSAW, Poland

Fundação para a Ciência e a Tecnologia, AVENIDA D CARLOS I 126 , 1249-074 , LISBOA, Portugal

INSTITUTUL NATIONAL DE CERCETARE-DEZVOLTARE IN INFORMATICA , MARESAL AVERESCU AVENUE 8-10 , 011455 , BUCURESTI, Romania

CENTRUM VEDECKO-TECHNICKYCH INFORMACII SR, LAMACSKA CESTA 8 A , 811 04 , BRATISLAVA, Slovakia

Ministry of Higher Education and Scientific Research, Bureau 710, 50, Avenue Mohamed V, 1002 Tunis, Tunisia

Non-governmental organization «Agency of European innovations», 11/3 Petra Pancha str., Lviv, 79020, Ukraine

EFPC (UK) LTD, OAKFIELD HOUSE, 378 BRANDON STREET, ML1 1XA, MOTHERWELL, Scotland, United Kingdom

SINGLEIMAGE LIMITED, BOXWORTH END 26 , CB4 5RA , SWAVESEY CAMBRIDGESHIRE, United Kingdom

Type of Action: Grant to identified beneficiary - Coordination and support actions

Indicative timetable: Q1 2019

Indicative budget: EUR 1.50 million from the 2019 budget

7. "Digital Opportunity" pilot scheme

Specific Challenge: Digital skills are needed to take full advantage of the opportunities emerging from LEIT ICT areas, as the presence of non-technical barriers such as the availability of appropriate skills can act as an obstacle to the effective uptake of technologies. This is the case for instance for Artificial Intelligence, Cybersecurity, HPC and quantum computing, Internet of Things (IoT), cloud computing, big data and data analytics, where Europe experiences a shortage of specialists. Currently, 40% of enterprises in need of ICT specialists (most of them SMEs) find it difficult to recruit them. Any strategy aiming at the diffusion of LEIT ICT technologies can't neglect the importance of having adequate human capital for their use. Education is not adapting at the necessary pace, and the acquisition of digital skills is increasingly taking place on the job. The private sector can therefore contribute effectively by facilitating on-the-job learning through internships.

Scope: To fully exploit the potential of LEIT ICT and to overcome the lack of appropriately skilled workforce in these technologies, the action supports internships for higher education students and recent graduates in companies in ICT producing and using sectors.

Expected Impact:

The activities supported under this Action are meant to increase the offer of deep-tech skills required to perform tasks and jobs in an economy which is being quickly and continuously digitally transformed. The action will be monitored through the following indicator:

- Number of higher education students and graduates performing an internship in digital skills. The target is 5,000 for the period 2018-2020

The action will be implemented by the Erasmus+ National Agencies for higher education. Grants will be financed in the form of lump sums. The use of these types of grants for cross-border internships have been authorised by Commission Decision C(2013)8550[138]. The action will comply with conditions laid in Regulation (EU) No 1290/2013[139]; in particular, applicants from countries associated to Horizon 2020 Framework Programme will be eligible to receive funding.

Type of Action: Indirect Management

Indicative timetable: Q4 2017 and Q4 2018

Indicative budget: EUR 5.00 million from the 2018 budget and EUR 5.00 million from the 2019 budget

8. Inducement prize: Tactile Displays for the Visually Impaired

The detailed information for this prize were included in the work programme 2016-2017 part 5.i *'Information and Communication Technologies'*, adopted with Commission Decision C(2017)2468 of 24 April 2017 available at the following link:

http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-leit-ict_en.pdf.

The Contest for this prize was published by the Commission on 23 May 2017 and information is available at the following link:

http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/tactileprize-01-2017.html

The indicative budget for the prize is EUR 3 million from the 2019 budget.

Type of Action: Prize

Indicative budget: EUR 3.00 million from the 2019 budget

[138] C(2013)8550 of 4 December 2013 authorising the use of lump sums, reimbursement on the basis of unit costs and flat-rate financing under the "Erasmus +" Programme.

[139] Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" and repealing Regulation (EC) No 1906/2006

9. Inducement prize: Online security – Seamless personal authentication

The detailed information for this prize were included in the work programme 2016-2017 part 5.i *'Information and Communication Technologies'*, adopted with Commission Decision C(2017)2468 of 24 April 2017 available at the following link:

http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-leit-ict_en.pdf.

The Contest for this prize was published by the Commission on 27 September 2017 and information is available at the following link:

http://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/onlinesecurityprize-01-2017.html

The indicative budget for the prize is EUR 4 million from the 2019 budget.

Type of Action: Prize

Indicative budget: EUR 4.00 million from the 2019 budget

10. Inducement prize: Zero Power Water Infrastructure Monitoring

The detailed information for this prize were included in the work programme 2016-2017 part 5.i *'Information and Communication Technologies'*, adopted with Commission Decision C(2017)2468 of 24 April 2017 available at the following link:

http://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-leit-ict_en.pdf.

The Contest for this prize was published by the Commission on 19 April 2017 and information is available at the following link:

https://ec.europa.eu/research/participants/portal/desktop/en/opportunities/h2020/topics/powerwaterprize-01-2017.html

The indicative budget for the prize is EUR 2 million from the 2019 budget.

Type of Action: Prize

Indicative budget: EUR 2.00 million from the 2019 budget

11. Eurochain: Developing a European Public Blockchain Infrastructure that builds on the European legal framework

In-line with the objectives of the Next Generation Internet [ICT-54-2020: Blockchain for the Next Generation Internet] the European Commission will carry out a pre-commercial procurement for the development and testing of a novel, use-cases based, distributed ledger or blockchain solution which builds on the EU legal framework, in particular the General Data

Protection Regulation, the eIDAS Regulation [140], the NIS Directive [141] and the AML Directive[142]. Such a public infrastructure should meet core requirements of scalability and throughput, interoperability with other systems, security, robustness, sustainability, energy efficiency and continuity of the service. The aim is to go significantly further than what is offered by existing solutions. This procurement builds on the work of the European Blockchain Partnership for an advanced European Blockchain Services Infrastructure and will be done in cooperation with the members of European Blockchain Partnership. This action should aim at setting a global standard for blockchain infrastructures for public and private services.

The PCP procedure will be carried out in compliance with the rules laid down in article 51(1)(2)(4) of the Horizon 2020 RfP.

Type of Action: Public Procurement - PCP

Indicative timetable: Q1 2020

Indicative budget: EUR 7.00 million from the 2020 budget

12. InnovFin Artificial Intelligence and Blockchain

It is key for Europe to identify and invest in the development of next generation of Artificial Intelligence and Blockchain technologies and their broad adoption and roll-out by SMEs and start-ups in innovative products, services or business models. In line with the Coordinated Plan on Artificial Intelligence, one important element is making available sufficient investment for start-ups and innovative SMEs in their early stage as well as growth phase. To this end, a thematic equity investment instrument for AI and blockchain is proposed. The instrument will mobilise additional contributions to increase the volume of investments available to venture capital fund managers and other investors across Europe, possibly complemented by coinvestments of national promotional banks in Member States.

It will focus on :

- financing a portfolio of innovative AI/blockchain companies;
- developing a dynamic EU-wide investors community focusing on AI and Blockchain;
- incentivising private sector investments and
- making Europe become more attractive for start-ups to stay and grow in.

140 Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market

141 Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union

142 Directive (EU) 2018/843 of the European Parliament and of the Council of 30 May 2018 amending Directive (EU) 2015/849 on the prevention of the use of the financial system for the purposes of money laundering or terrorist financing

Expected impact: An increase in the risk capital available to invest in startups, SMEs and small midcaps operating in the Artificial Intelligence and blockchain domain. The indicators include the number of agreements signed with financial intermediaries (i.e., risk capital funds) focused on such firms, the volume of investments made in target SMEs and small midcaps, and the number of target SMEs and small midcaps invested in.

Type of Action: Financial Instrument

Indicative timetable: Q1 2020

Indicative budget: EUR 25.00 million from the 2020 budget

13. Assessment of deployment and access-to-finance conditions in Artificial Intelligence and Blockchain[143]

The study will carry out an assessment of the state of play, prospects and main barriers to investments in Artificial Intelligence and Blockchain in Europe, and will provide actions and recommendations to address such barriers. This would include the analysis of key market trends and challenges of public and private investments, funding gaps and requirements for public intervention. The assessment will provide recommendations on appropriate financial engineering, pooling of resources, co-investment or other combination of financing actions and at EU level, which could be supported by EIB Group and other financial institutions/investors, in particular the National Promotional Institutions, in particular through the InvestEU programme.

The EIB advisory services have very specialised knowledge combining in-depth expertise on access to finance, EU financial instruments and digital innovations, including Artificial Intelligence and blockchain. Furthermore, the activity is a continuation of work focusing on assessing the existing investment gap for digital innovations in Europe.

Legal entities:

European Investment Bank, 98-100, Boulevard K. Adenauer, L-2950 Luxembourg, Grand Duchy of Luxembourg

Type of Action: Grant to identified beneficiary - Coordination and support actions

Indicative timetable: First Quarter 2020

Indicative budget: EUR 0.25 million from the 2020 budget

[143] This grant will be awarded without call for proposals in line with Article 195(e) of the Financial Regulation, Regulation (EU, Euratom) No 1046/2018 and Article 11(2) of the Rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)", Regulation (EU) No 1290/2013

Budget[144]

	Budget line(s)	2018 Budget (EUR million)	2019 Budget (EUR million)	2020 Budget (EUR million)
Calls				
H2020-ICT-2018-20		514.00	608.00	719.00
	from 09.040201	*514.00*	*608.00*	*719.00*
H2020-DT-2018-2020		115.00[145]	145.00[146]	160.50[147]
	from 09.040201	*115.00*	*145.00*	*160.50*
H2020-SU-ICT-2018-2020		90.00	15.00	47.00
	from 09.040201	*90.00*	*15.00*	*47.00*
H2020-EUJ-2018		6.00		
	from 09.040201	*6.00*		
H2020-EUK-2018		6.20		
	from 09.040201	*6.20*		
Contribution from this part to call H2020-SC1-FA-DTS-2018-2020 under Part			25.00	
	from		*25.00*	

144 The budget figures given in this table are rounded to two decimal places.
The budget amounts for the 2020 budget are subject to the availability of the appropriations provided for in the draft budget for 2020 after the adoption of the budget 2020 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

145 To which EUR 15.00 million from the 'Secure, clean and efficient energy' WP part will be added making a total of EUR 130.00 million for this call.

146 To which EUR 15.00 million from the 'Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy' WP part and EUR 15.00 million from the 'Secure, clean and efficient energy' WP part will be added making a total of EUR 175.00 million for this call.

147 To which EUR 15.00 million from the 'Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy' WP part and EUR 15.00 million from the 'Health, demographic change and wellbeing' WP part will be added making a total of EUR 190.50 million for this call.

8 of the work programme	*09.040201*			
Contribution from this part to call H2020-EIC-FTI-2018-2020 under Part 17 of the work programme		17.82	17.82	17.82
	from 09.040201	*17.82*	*17.82*	*17.82*
Contribution from this part to call H2020-NMBP-TR-IND-2018-2020 under Part 5.ii of the work programme			10.00	
	from 09.040201		*10.00*	
Other actions				
Expert Contracts		6.50	6.50	6.50
	from 09.040201	*6.50*	*6.50*	*6.50*
Public Procurement		13.50	14.00	25.75
	from 09.040201	*13.50*	*14.00*	*25.75*
Grants to identified beneficiaries in accordance with Article 5 of Regulation (EC) No 223/2009 on European Statistics		2.00	2.00	2.00
	from 09.040201	*2.00*	*2.00*	*2.00*
Specific Grant Agreement		80.00		
	from 09.040201	*80.00*		
Grant to Identified beneficiary			1.50	0.25
	from 09.040201		*1.50*	*0.25*
Indirect Management		5.00	5.00	
	from 09.040201	*5.00*	*5.00*	
Prize			9.00	
	from		*9.00*	

	09.040201			
Financial Instrument				25.00
	from 09.040201			*25.00*
Estimated total budget		856.02	858.82	1003.82