

HORIZON 2020

WORK PROGRAMME 2018 – 2020

Leadership in enabling and industrial technologies

Information and Communication Technologies

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Digitising European Industry

The Digitising European Industry¹ 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 Photonics, Robotics, Manufacturing technologies and Cyber-Physical Systems. Support to Micro-electronics 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 Digitization and Transformation of the EU industry, implemented in cooperation with other programme parts.

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

Specific Challenge:

Cyber-physical Systems of Systems (CPSoS) like electric grids, rail systems 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 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 physically-entangled systems, which are of utmost importance for sectors like transport, health, energy. Work is complementary to the Low Power Processor (LPP) initiative and the ECSEL programme. LPP addresses technology for HPC data center applications. ECSEL aims at lower TRLs and fundamental system engineering methods.

Computing software and systems design for future physically-entangled systems, supporting the creation of reliable, robust and energy-aware solutions for application areas

¹ <http://bit.ly/DigIndEU>

such as autonomous systems, augmented reality, sensor fusion and homomorphic encryption. 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 CPSoS supporting the complete lifecycle of Cyber-Physical Systems of Systems (CPSoS), from design to test, operation, evolution and decommissioning. Projects shall focus on solutions capable of adapting in real time to the behaviour of the SoS and of guaranteeing the overall reliability and security even when the components or subsystems are not fully reliable and secure or detrimental 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 easier take-up of digital technologies in real-world use cases and support know-how transfer. Activities should include constituency building, clustering of related projects, liaison with related programmes such as ECSEL and EUREKA, 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 state of the art technologies.
- 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 projects and dissemination of high-quality roadmap for future research and innovation activities in the relevant areas.

Type of Action: Research and Innovation Actions and one Coordination and Support Action.

Budget per Type of Action: 38 Million Euro for RIAs and 2 Million Euro for one CSA

ICT-02-[2018]: Large Area Electronics (LAE)

Specific challenge

Large Area Electronics (LAE) combines new and traditional materials with large-area processes to fabricate lightweight and multi-functional electronic products. The challenge is to tap open opportunities for LAE in existing and emerging markets by pushing technology barriers further and demonstrating innovative use in sectors that could benefit from LAE innovations.

Scope

To fully exploit the potential of LAE and overcome barriers of manufacturability, challenges need to be addressed, in materials, in processes for large-area fabrication, in integration technologies, and in demonstrating innovative products for professionals and consumers. This topic will support advances in technology and manufacturing readiness levels (TRL and MRL) of Large Area Electronics.

1. Enhancing manufacturability:

- Advances in combined printed electronics and existing technologies resulting in multi-functional components;
- Equipment and processes for large-scale fabrication (R2R, S2S...).

2. Integration technologies:

Development of new concepts for the integration of transducers, energy storage elements, logic, as well as new interconnection technologies.

3. Device demonstration:

Demonstrating LAE-enabled prototypes in specific applications of flexible and wearable electronics. Consideration to be given to the integration of electronic devices in connected wearable 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 should also be considered where relevant.

For item 1, it is expected that projects would demonstrate production capability in a laboratory environment (TRL 4).

For items 2 and 3, it is expected that technologies are validated in laboratory or other 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 joint call with NMBP² will support projects spanning from material improvement (electrical performance, processibility, stability and lifetime during device operation), to prototyping of advanced LAE-based electronic products - TRL 3 to TRL 5. This joint call will be implemented through Innovation Actions.

Expected impact

Proposals should address more than one 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 Electronics and Smart Wearables.
- The emergence of new products based on the combination of printed and large area processed electronics.
- Increased R&D cooperation along the MRL and TRL.
- Developing further LAE 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 LAE technologies.

Types of action

Research & Innovation Actions

Budget: 40M€

ICT-03-[2018]: Manufacturing Pilot Lines

Specific Challenge:

Manufacturing Pilot Lines are at the heart of Digital Innovation Hubs (DIHs). They aim to speed up technological development, to integrate highly productive laser processes into digital manufacturing solutions and to foster new business and business models. The challenge is to set up pilot lines that significantly improve uptake of photonics technology by end-user industry. 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 themes

Innovation Actions

- Manufacturing Pilot Lines:** The objective is to mature a technology platform and set up manufacturing pilot-lines which will be the basis for an innovation hub. It should offer generic solutions for a wide class of applications. It should cover all stages of manufacturing through to testing. It should provide a low entry barrier access to low

² Nanotechnologies, Advanced Materials, Advanced Manufacturing and Processing, and Biotechnology. Part of LEIT (Leadership in Enabling and Industrial Technologies) in Horizon 2020.

and medium production volumes and the process used should be suitable for scaling up to high volume production. The action should include a validation of the pilot line offer with involvement of external users in pre-commercial production runs. A credible strategy for future full-scale sustainable manufacturing in Europe must be presented. The action should make use of existing infrastructure and develop close links with on-going European and national initiatives in order to maximise impact.

The technologies to be addressed by the pilot lines are

- Indium Phosphide:
- Silicon Photonics:
- Free-form optics:
- Advanced optical medical device technologies for medical diagnostics

At least one proposal will be selected to cover each of these technologies under theme i. The Commission considers that proposals requesting a contribution from the EU between EUR 8 and 15 million 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 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.

Budget per type of Action:

Innovation Actions (60 million)

ICT-04-2018: Photonics based manufacturing and production of advanced photonics components

Specific Challenge:

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. For photonics based manufacturing the challenge is to develop the next generation of laser systems which deliver getting 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

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. Cybersecurity aspects may be addressed if appropriate.

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

Research and Innovation Actions

- iii. **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 up to max 10 picoseconds and with average beam power levels of at least 1 kW enabling fast materials processing with minimal heat impact on the work piece. Pulse energies and wavelengths must be appropriate for the intended application. The developed system should be demonstrated with a relevant industrial application.
- iv. **Tailored Laser Beams:** New methods and schemes of beam shaping providing the optimal distribution of photons at the right place and at the right time, producing a high resolution, temporal and spatial deposition of energy on the work piece. The developed system should be demonstrated with a relevant industrial application.

At least one proposal will be selected to cover each of these technologies under each theme.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 6 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 metrics, the baseline and the targets to measure impact.

- i: Significantly improved uptake of photonics technology by end-user industry, in particular SMEs, enabling a demonstrably more competitive European industry.

- ii: A strengthen European innovation ecosystem and improved cross fertilisation between photonics and other technology areas.
- iv: a massive deployment of Photonic Integrated Circuit (PIC)-based optical transceivers in datacenter (DC) environments thanks to the drastically reduced cost
- v: European mass manufacturing capacity for Datacom products and other products/components

Budget per type of Action:

Innovation Actions (20)

Research and Innovation Actions (30)

ICT-05-[2019]: Application driven photonics components and the innovation ecosystem

Specific Challenge:

The challenge is to develop application 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.

Scope:

The focus is on the following themes

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 devices for advanced imaging to support diagnostics driven therapy:** Actions should develop photonics devices for reliable (high sensitivity, specificity and accuracy), safe to operate, cost-effective and fast photonics enabled systems that are to provide quantified diagnostics during intervention and treatments of major diseases like cancer (excluding skin cancer), infectious, degenerative and cardiovascular diseases. In particular to support surgical procedures or to improve therapy by assessing and monitoring individual dispositions (eg methods to assess antibiotics resistance, or drug resistance in cancer chemotherapy). Physicians/clinicians/surgeons and a medical equipment manufacturer must be closely involved from requirement

specifications to the validation. Validation in clinical settings should be included, but clinical trials are excluded.

Innovation Actions

- iii. **Photonics devices for advanced imaging to support diagnostics driven therapy:** Actions should develop photonics devices for reliable (high sensitivity, specificity and accuracy), safe to operate, cost-effective and fast photonics enabled systems that are to provide quantified diagnostics during intervention and treatments of major diseases like cancer (excluding skin cancer), infectious, degenerative and cardiovascular diseases. In particular to support surgical procedures or to improve therapy by assessing and monitoring individual dispositions (eg methods to assess antibiotics resistance, or drug resistance in cancer chemotherapy). Physicians/clinicians/surgeons and a medical equipment manufacturer must be closely involved from requirement specifications to the validation. Validation in clinical settings should be included, but clinical trials are excluded.
- iv. **Sensor-Based Optimization of Production Processes:** Actions should address prototyping, demonstration and validation in real industry 4.0 settings of highly advanced smart broadband multimodal photonic sensing solutions operating in the extended infrared spectrum for the optimisation of the production process through the monitoring of process and product parameters (physical, chemical, imaging, geometrical and environmental). The focus is on process-integrated solutions that achieve higher measurement speed and accuracy at smaller size and lower system costs compared to existing state-of-the-art solutions.

Coordination and Support Actions

- v. **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 also address the life-long learning needs of professionals in primary, secondary and professional schools to universities, research centers and industry in order to provide the appropriate training and encourage innovation and entrepreneurship.

The Commission considers that proposals requesting a contribution from the EU between EUR 4 and 6 million (for themes i, ii and iii) and between EUR 1 and 1.5 million (for theme iv) 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 metrics, the baseline and the targets to measure impact.

- i: Significantly improved uptake of photonics technology by end-user industry, in particular SMEs, enabling a demonstrably more competitive European industry.
- ii: A strengthen European innovation ecosystem and improved cross fertilisation between photonics and other technology areas.

- iii: Strengthened European manufacturing industry and a safer work environment
- iv: Strengthened European manufacturing industry and a safer work environment
- v: a massive deployment of Photonic Integrated Circuit (PIC)-based optical transceivers in datacenter (DC) environments thanks to the drastically reduced cost

Budget per type of Action:

Innovation Actions (35)

Research and Innovation Actions (40)

Coordination and Support Actions (3)

ICT-06-[2020]: Disruptive photonics technologies

Specific Challenge:

The challenge is the development of advanced photonics technology which has the potential to revolutionise an existing application sector or to create completely new applications and new markets.

Scope:

The focus is on the following themes

Research and Innovation Actions

- 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. In addition the display components actions may also develop sensors and actuators for necessary support functionality such as sensing, connectivity, user interaction, scene recognition etc. Actions must include validation in application settings.
- ii. **New concepts for assembly and packaging of photonics components:** Proof-of-concept of new packaging, assembly or module integration technologies or new testing approaches offering breakthrough advances for the low-cost, scalable production of PIC-based photonic components or modules (PIC: Photonic Integrated Circuit). Also the other related key parameters affecting the application and market potential shall addressed as applicable (e.g. component / module size, complexity, functionality, performances, robustness, energy efficiency, thermal aspects; necessary production equipment; enabled applications; cost of component/module integration in systems; etc.). 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 for the direct 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 imaging systems and techniques which delivery greatly increased detection speed, resolution, sensitivity, specificity and penetration. Real time data handling and processing may also be addressed as appropriate.

At least one proposals 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. 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 metrics, the baseline and the targets to measure impact.

- i: Significantly improved uptake of photonics technology by end-user industry, in particular SMEs, enabling a demonstrably more competitive European industry.
- ii: Advances in production costs by an order of magnitude.
- iii: Strengthened European manufacturing industry and a safer work environment
- iv: a massive deployment of Photonic Integrated Circuit (PIC)-based optical transceivers in datacenter (DC) environments thanks to the drastically reduced cost
- iv: European mass manufacturing capacity for Datacom products and other products/components

Budget per type of Action:

Research and Innovation Actions (42)

ICT-07-[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 digitised laser-based manufacturing. Digital Innovation Hubs (DIHs) will help speed up technological development, integrate highly productive laser processes into digital manufacturing solutions, transfer innovative laser processes and equipment into a wider community of manufacturing, 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 themes

Innovation Actions

- i. **Open access to Photonics Innovation Hubs:** One-stop-shop access, supported through a network of competence centers, to services and capabilities such as expertise, training, prototyping, design, engineering, business support 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 track record in supporting industry, in particular SMEs. Actions should also address skills development as well as support to the development of new innovation hubs.

Expected Impact:

Proposals should describe how the proposed work will 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.

Budget per type of Action:

Innovation Actions (20 million)

ICT-08-[2020]: Advancing photonics technologies and application driven photonics components and the innovation ecosystem

Specific Challenge:

The challenge for the advancement of photonics technologies is core photonics technology which can be applied in many different application areas. The challenge for application 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.

Scope:

The focus is on the following themes

Research and Innovation Actions

- i. **Flexible Farm-to-Fork Sensing:** Development of innovative smart photonic sensor solutions in the VIS-MIR spectral range for monitoring food quality with respect to microbiological and chemical contamination along the farm-to-fork food production chain. The targeted solutions 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 plants, wholesale and retail. Actions should focus on the following areas: (1) food production by small/medium-sized farms engaging in “precision farming”; (2) novel types of food production processes (3) on-site food processing and vending (e.g. farmers markets). The developed

solution should be demonstrated in real settings involving relevant stakeholders along the food supply chain, from farmers to end consumers.

- ii. **New Photonics Integrated Circuit Technology:** Major advances in photonic integrated circuit technology, delivering building blocks with significantly enhanced or new functions.

The building blocks 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.

Innovation Actions

- v. **Hyperspectral VIS-NMIR Sensing and Deep Learning:** Prototyping, demonstration and validation in real settings of an innovative, cost-effective, portable, smart hyperspectral sensing system operating in the visible to mid-infrared (VIS-MIR) 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.

Coordination and Support Actions

- vi. **Supporting the industrial strategy for photonics in Europe:** Support for the development and implementation of a comprehensive industrial strategy for photonics in Europe. The action should include the development of strategic technology roadmaps, 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 of financial models and financial engineering to facilitate access to different sources of financing.

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 4 and 8 million (for themes i, ii and iv) and between EUR 8 and 14 million (for theme iii), between EUR 8 and 20 million (for theme v) 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 metrics, the baseline and the targets to measure impact.

- i: Significantly improved uptake of photonics technology by end-user industry, in particular SMEs, enabling a demonstrably more competitive European industry.
- ii: A strengthened European innovation ecosystem and improved cross fertilisation between photonics and other technology areas.
- iii: Strengthened European manufacturing industry and a safer work environment
- iv: a massive deployment of Photonic Integrated Circuit (PIC)-based optical transceivers in datacenter (DC) environments thanks to the drastically reduced cost
- iv: European mass manufacturing capacity for Datacom products and other products/components

Budget per type of Action:

Innovation Actions (30)

Research and Innovation Actions (30)

Coordination and Support Actions (4)

ICT-09-[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 of industrial relevance. 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. Quantum and 2D layer based electronics might be considered under the respective Quantum and Graphene FET-Flagships. Only proposals with clear industrial involvement and on innovative solid-state approaches will be considered within this call.

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, 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).

In line with the strategy for EU international cooperation in H2020, cooperation is encouraged 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 the key parameters of the intended approach (power, size, frequency, and cost) with indication of the quantitative targets to be achieved (figures of merit);
- Specify the road to industrialisation and clearly establish links to applications likely to benefit from the development.
- Ensure that new technologies with high potential for computing emerge in time to be further taken up under ECSEL to contribute to the mid-term viability of the European Nanoelectronics industry.
- At technological level, sustain the integration requirements by focussing on challenging 3D integration issues as well as for electronics at cryogenic temperature.
- Tackle advanced design challenges to provide the necessary tool validation to ensure the European industry will have the capability to design advanced circuits for its needs.

Types of action

Research & Innovation Actions

Budget: 30M€

ICT-10-[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 wireless transmission (to network or local infrastructures).

Scope

Focus is on:

a) Technological breakthroughs for future ESS leading to further miniaturisation, new functionalities, improved power consumption, autonomy 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 2D and 1D nanomaterials for ultra-high sensitivity and low power, and MEMS/NEMS-based sensors,
- Demonstrating ESS that brings intelligence to the IoT edge with integration of sensor systems, processors, computing and networking elements,
- 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 MNBS (Micro-Nano-Bio Systems) through cost-effective miniaturisation, manufacturing and demonstration, leading to unprecedented 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 and operation in remote and low resource settings should be considered. User needs, 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).

c) Support Action on Electronics

- Reinforced collaboration & cross-fertilisation between projects and experts groups supported under the Electronics topics, namely (i) Nanoelectronics, (ii) Electronics Smart Systems and (iii) Large Area Electronics,
- Increased outreach of these actions across Europe, their industrial perspective and technology (and manufacturing) readiness levels,
- 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.

a, b) Expected impact

Proposals should address more than one 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...)
- Improving ESS manufacturing capabilities in Europe,
- Increasing ESS Market penetration in emerging digital economy sectors,
- Creating new opportunities for digitisation in traditional sectors and improving user acceptance
- Increased industrial investments and open innovation marketplace for ESS and bio-ESS technologies.

Types of action

a, b: Research & Innovation Actions

c: Coordination and Support Action

Budget: 40M€

ICT-11-[2019]: Security and resilience for collaborative manufacturing environments

Specific Challenge:

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 a free flow of data is a primary requirement for digitisation of industry, it poses significant challenges in terms of security and data ownership, 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 outside of the factory.

Scope:

Tools for digital collaboration between manufacturing environments guaranteeing an adequate level of data security. Proposals will be focused on tools practically usable in real manufacturing facilities, taking into account the operational requirements needed for a factory usage in real-world conditions. Issues of threat detection and implementation of countermeasures should be addressed, as well as evolution and real-time response when needed. Semi-autonomous or fully autonomous solutions, requiring little or no local supervision are encouraged.

Proposals will target medium-high TRL up to 7, and will include at least one use case which will demonstrate a measurable and significant potential improvement over state of the art tools and methods. 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:

- Availability and take-up from industry of practically usable solutions which guarantee significantly increased cyber-security levels in daily operations of manufacturing facilities.

Type of Action: Research and Innovation Actions

Budget per Type of Action: Budget of € 10 million is dedicated to this topic.

ICT-12-[2019]: Artificial Intelligence, Machine Learning and Data Analytics in Collaborative Manufacturing

Specific Challenge:

The demand for personalized products and services as well as right-away delivery is increasing. For manufacturing industry to remain competitive, the collaboration between relevant stakeholders (product design, process planning, manufacturing, service and industrial platform providers, suppliers) has to be optimised. As a result, the complexity of such an optimisation exceeds human's capability to effectively manage required flexible, future-proof and competitive production processes. Artificial Intelligence, machine learning combined with advanced data analytics and simulation tools have a huge potential for improving the manufacturing process both on the shop floor and in collaborative manufacturing.

Scope:

Advancing and applying Artificial Intelligence technologies on the shop floor: State-of-the-art AI technologies have to be integrated into advanced manufacturing technologies and systems in order to exploit their potential swiftly. Novel AI technologies have to be developed and implemented which are capable of massive information processing and reacting in real-time to enable new levels of autonomy, navigation and cognitive perception in the production sector. Projects shall focus on adoption of state-of-the-art AI technologies to optimize information flow, knowledge extraction and decision making within collaborative, distributed manufacturing scenarios; enhancing digitized manufacturing environments and smart factories to allow easy integration of advanced AI techniques; optimizing collaborative manufacturing processes with the help of deep learning, big data analytics and simulation approaches exploiting available data from machines and sensors; developing solutions for dynamic planning and orchestration of production processes according to the current and potential future context (incoming orders, accessible data, availability of production plants and modules, dealing with unforeseen events, etc.) to deliver functionalities not available in current generation IRP systems.

Improving assembly, inspection and maintenance based on AI: More flexibility is required from the manufacturing procedures as well as the production equipment. Given this,

the probability of failures in the production process (e.g. assembly failures due to complex objects, large variety of different objects or enhanced requirements for the assembly worker) increases. Projects shall focus on developing cognitive and autonomous technical systems for assembly, inspection and maintenance; adaptive behavior of production machines such as technical assistance, inspection and collaboration to react to flexible requirements of the worker; self-regulatory and self-configuring measures for new or for slightly changed process events; machine learning techniques for adaptive inspection; human-machine interaction techniques addressing a wide range of human senses (e.g. visual, haptic, sound); providing machine learning techniques and systems to aggregate and analyse data from multiple sources in order to perform e.g. comprehensive condition monitoring and predictive maintenance.

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. Developed technologies and solutions should be demonstrated in at least two use cases.

Expected Impact:

- Establishment of technological and methodological foundations to set up AI-based collaborative production environments and migrate existing production facilities.
- Easy access to AI-based services with widespread, easy-to-deploy applications of AI technologies especially within manufacturing SMEs and mid caps.
- Improving service levels for customers, e.g. via Predictive Maintenance
- Develop business models for professional IT solutions for the factory
- Facilitate anticipatory logistics realized by Big-Data-analytics
- Enable automatic creation of assistance functionalities based on digital model information

Type of Action: Research and Innovation Actions, TRL 3-5

Budget per Type of Action: Budget of € 40 million is dedicated to this topic.

ICT-13-[2019]: Digital advances for local/urban manufacturing

Specific Challenge:

Local, often urban, manufacturing is characterised by small, universal factories, close to customers (and highly qualified workers), where various types of customised products are produced in small series for the cost price of mass-produced products. Its ambition is to change the economy-of-scale target as in today's mass production sites, into economies achieved by networking.

The challenge is to better understand customer needs, to significantly reduce quotation-delivery lead time, to reduce transaction costs for small series, to better link customer needs, digital design, simulation, and manufacturing, and to smoothly collaborate with different actors. The evolving industrial internet, CPS, IoT, big data technologies and emerging enablers such as blockchain enable or promise easier connected digital value chains. It also requires flexible production equipment, such as robots, CNC systems, 3D printers, and fast change-over times.

Scope:

Proposals are expected to develop digitally-enabled solutions that support the localised/urban manufacturing vision. Possible technology development includes the adoption of artificial intelligence and smart data approaches for local/urban production to control and optimise distributed manufacturing and logistic processes; Internet of Things solutions and big data analysis to reach zero-defect manufacturing processes and zero-surprises predictive maintenance; distributed ledger technologies to reduce transaction costs. Developed technologies should be demonstrated in at least two complementary use cases. Proposals are expected to contribute to the development of standards for reconfigurable, modular and scalable local/urban production facilities.

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:

- Significantly improve small-series, customised production costs in local/urban environments as compared to traditional economies-of-scale production sites.
- Improved access to flexible production capabilities in local/urban environments, esp. for SMEs.

Type of Action: Research and Innovation Actions

Budget per Type of Action: € 20 million EURO

Robotics

In order to maintain and strengthen Europe's excellence and competitiveness in robotics, four **Focus Application Areas (FAAs)**, **Healthcare, Inspection and Maintenance of Infrastructure, Agri-food, Industrial SME use of robotics in production** and four **Core Technologies (CTs)**, **AI and cognition, Cognitive mechatronics, Socially cooperative human robot interaction** and **Model based design and configuration tools** have been selected with the objective to overcome market barriers and significantly accelerate development and deployment in those areas.

Strong coherence and integration between the FAA actions is critical to stimulate co-innovation within an extended stakeholder network and will be supported by the creation of **Digital Innovation Hubs (DIH)**, both in the FAAs and through an overarching robotics DIH.

In each of the FAAs there is a need to develop both system and application platforms. DIH are concerned with the development of system platforms and pilots with the development of application platforms. In both cases platforms should be based on open access and create common infrastructure, data and knowledge exchange so as to stimulate technology-application alignment and therefore the supply chain. Platforms should be built around open, industry led standards, including de facto standards. Stakeholders across each FAA are expected to engage in collaborative innovation to stimulate deployment and develop connections to Big Data and IoT.

Pilots can be built alongside or in conjunction with Digital Innovation. Pilots must be built around open platforms and industry led standards. They are expected to showcase advanced prototype applications built around platforms operating in real or near real operating environments and are expected to demonstrate high levels of socio-economic impact relevant to the FAA. Pilots are expected to bring together a range of stakeholders including third party application developers, service providers and users and thereby contribute to the FAA ecosystem.

Pilots are expected to address both technical and non-technical issues such as socio-economic impact, novel business models, legal and regulatory issues, cyber-security (including security by design and data integrity) and connections to Big Data and IoT.

ICT-14-[2018]: Robotics - Establishing Digital Hubs, System Platforms and Focus Application Areas

Specific Challenge:

The challenge is to establish Digital Innovation Hubs that can help companies become more competitive by improving their business/production processes as well as products (and services) by means of digital technology.

Scope:

Proposals should address one of the following sub-topics:

- a) The provision of a central Robotics DIH able to provide technical coherence across the FAAs and develop common system platform demonstrators, deliver demand based services and coordinate the provision and development of services in the DIH established in each FAA including access to Core Technology support.

Proposals should address a mechanism that ensures the development of and dissemination of best practice in the development of open platforms, pilots and demonstrators and champion the development of open industry led system platform standards including interface and module standards and demonstrators.

Proposals should address the establishment and operation of interconnections with and between the “working groups” created within the actions arising from this work programme and with the FAA DIH.

- b) Proposals are expected to establish Digital Innovation Hubs in robotics that provide services to the FAA. Proposals are expected to address the delivery of services through the hub; the provision of access to best practice in robotics relevant to the FAA (including existing academic and research projects results); connect with and share expertise with the central Robotics DIH; to act as a coordination point for the development of common system platforms and engage in the development of industry led standards and to develop and disseminate standards demonstrators; to facilitate access to pilots and to collaborate with the “working groups” set up within each action. DIH should support the development of FAA use case demonstrators at TRL 5 and above based on open system platforms that encapsulate core robotics technologies.

Proposals should develop and utilise metrics and benchmarks to act as Key Performance Indicators of impact and success.

Proposals are expected to create a “working group” that connects with the Robotics DIH and the FAA DIHs and actions arising from the core technology theme in order to communicate best practice, coordinate access to platforms and demonstrators and facilitate the cross development of platforms.

Proposals in a) and b) should involve financial support to third parties to enable third party contribution, particularly from SMEs, to the development of demonstrators and platforms. In line with the conditions set out in Part K of the General Annexes, a minimum 60% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties. Third party support is expected to fund technology transfer experiments typically in the order of EUR xxx.xxx – xxx.xxx K€ per party in a given experiment. The Commission considers that proposals requesting a contribution from the EU of between EUR 10 and 20 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

At least one action will be supported in each FAA and one action as the overarching Robotics central DIH.

Expected Impact:

- Increased deployment of robotics in each FAA.
- Formation of supply chains around platforms and modules that straddle FAA
- Introduction of Cross industry based standards for modules and systems
- Improved technology transfer in each FAA
- Greater awareness of autonomy and its benefits in each FAA
- Greater coherence of stakeholder communities around each FAA.
- Generation of new businesses based around platform supply
- Demonstration of platforms within each FAA at TRL 5 or greater.

- Increased competitiveness and efficiency within each FAA
- The development supply chains.
- Leveraging effect on other sources of funding, in particular regional and national funding

Type of Action:

Innovation Action

Budget per Type of Action: (96)

ICT-15-[2019]: Robotics Establishing Focus Application Area Pilots

Specific Challenge:

The challenge is to, through large scale pilots, to demonstrate how robotics can impact at scale either within existing business models or disruptively. Such pilots reduce technical and commercial risk by exploring technology in context with existing practices and 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.

Scope:

1. Innovation Actions in Robotics

Proposals are expected to establish large scale pilots able to demonstrate the use of robotics at scale in actual or highly realistic operating environments in the following FAA:

- The inspection and maintenance of infrastructure
- In the SME industrial sector.

In developing the pilot, proposals are expected to; consider utilising existing infrastructure and links to other European, national or private funding sources to leverage infrastructure delivery; identify the long term sustainability of the pilot; develop scalable technical solutions capable of meeting performance targets relevant to the FAA; to develop metrics and performance measures that act as KPIs for the pilot; to engage relevant industry stakeholders, including SMEs, in the provision and operation of the pilot.

Proposals are expected to create a “working group” that connects with the Robotics DIH and the FAA DIH and actions arising from the core technology theme in order to communicate best practice and coordinate access to platforms and demonstrators.

Proposals may involve financial support to third parties to enable third party contribution, particularly from SMEs, to the development of demonstrators and platforms. In line with the conditions set out in Part K of the General Annexes, a minimum 60% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties. Third party support is expected to fund technology transfer experiments typically in the order of EUR xxx.xxx – xxx.xxx K€ per party in a given experiment. The Commission considers that proposals requesting a contribution from the EU of between EUR 10 and 20 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

At least one action will be supported in each FAA.

2. Coordination and Support Action in Robotics

Proposals should address the delivery of challenge led robotics competitions focusing on the FAA that have the potential to stimulate public engagement. Proposals should engage with the Digital Innovation Hubs in Robotics. Proposals are expected to address all aspects of running competitions as public events, to address media and public engagement with the competitions. Proposals should seek to engage external partners in sponsoring and mounting the competitions.

Expected Impact:

IA:

- The demonstration of the potential for robotics to impact at scale in the chosen FAA.
- The reduction of technical and commercial risk in the deployment of services based on robotic actors within the FAA.
- Greater understanding within existing FAA organisations of the potential for deploying robotics.
- Demonstration of standards and platforms operating over extended time periods in near realistic environments.

CSA:

- Greater public exposure to actual robotics capability.
- Greater engagement with competitions from FAA commercial organisations.

Type of Action:

Innovation Action / Coordination and Support Action

Budget per Type of Action:

Innovation Action (60)

Coordination and Support Action (2)

ICT-16-[2020]: Robotics - Establishing Focus Application Area Pilots

Specific Challenge:

The challenge is to, through large scale pilots, to demonstrate how robotics can impact at scale either within existing business models or disruptively. Such pilots reduce technical and commercial risk by exploring technology in context with existing practices and 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.

Scope:

1. Innovation Actions in Robotics

Proposals are expected to establish large scale pilots able to demonstrate the use of robotics at scale in actual or highly realistic operating environments in the following FAA:

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

In developing the pilot, proposals are expected to; consider utilising existing infrastructure and links to other European, national or private funding sources to leverage infrastructure delivery;

identify the long term sustainability of the pilot; develop scalable technical solutions capable of meeting performance targets relevant to the FAA; to develop metrics and performance measures that act as KPIs for the pilot; to engage relevant industry stakeholders, including SMEs, in the provision and operation of the pilot.

Proposals are expected to create a working group that connects with the Robotics DIH and the FAA DIH and actions arising from the core technology theme in order to communicate best practice and coordinate access to platforms and demonstrators.

Proposals may involve financial support to third parties to enable third party contribution, particularly from SMEs, to the development of demonstrators and platforms. In line with the conditions set out in Part K of the General Annexes, a minimum 60% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties. Third party support is expected to fund technology transfer experiments typically in the order of EUR xxx.xxx – xxx.xxx K€ per party in a given experiment. The Commission considers that proposals requesting a contribution from the EU of between EUR 10 and 20 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

2. Coordination and Support Action in Robotics

Proposals should address issues that concern 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 issues with robotics and AI technology that leads to strategic development and the dissemination of best practice to robotics stakeholders.

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.

Expected Impact:

IA:

- Improved competitiveness in FAA
- Greater levels of robotics use within FAA
- Higher levels of investment for robotics in FAA.
- The reduction of technical and commercial risk in the deployment of services based on robotic actors within the FAA.

CSA:

- 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

Budget per Type of Action:

Innovation Action (30)

Coordination and Support Action (3)

ICT-17-[2018-2019-2020] Robotics PPP: Developing robotics core technology

Specific Challenge:

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

AI and Cognition: AI provides tools to make systems cognitive. Cognition equips robots with the ability to interact, with people and environments, learn and categorise, make decisions and 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: The greatest step in robotic application development will come when robots are able to cooperatively interact with people. Social interaction is critical in many work environments from providing collaborative support, for example passing tools to a worker or holding a ladder 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 any application area where tasks need to be defined by the user requires easy to use configuration tools. The accessibility of robotics technology is a key barrier to at scale deployment. Embedding and sharing of knowledge between tools is essential as well as 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 technology areas: AI & Cognition in Robotics; Cognitive Mechatronics; Socially cooperative human robot interaction; Model based design and configuration tools. Proposals should address the development of core technology modules and tool kits in robotics for use in deployable system platforms that meet the requirements of applications in the focus application areas.

Proposals are expected to create a working group that connects with the DIH actions arising from ICT-14-2018.

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 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 FAA that can be demonstrated at TRL 3 and above.
- The lowering of technical barriers within FAA applications.
-

Type of Action: Research and Innovation Action

Budget per Type of Action: 90

Proposals are requested to specify their centre of gravity in terms of core technology. At least 30M€ will be dedicated to proposals focusing on the core technology" AI and Cognition", and at least 2 proposals with a minimum total amount of 15M€ (tbc) in each topic will be funded.

European Data Infrastructure: HPC, Big Data and Cloud technologies

The activities under this heading aim at enabling the creation of a world-class HPC/BD ecosystem based on European leadership in HPC, Cloud and Big Data technologies. A synergetic approach is promoted, which is complementary to relevant activities covered in the e-Infrastructures and FET work programmes 2018-2020, and implemented around the following pillars:

- Developing competitive large-scale test-beds and applications that integrate relevant technologies (Big Data, HPC, Cloud, IoT) and build on and enhance existing HPC/BD infrastructures;
- Building a world-class future HPC infrastructure through the co-design of extreme-scale low-power HPC/BD systems;
- Research and innovation actions in technology and capacities development in targeted areas of enabling Big Data technologies and in next generation Cloud technologies to support HPC/BD demands.
- Technology transfer, innovation support, and entrepreneurship measures to facilitate the adoption of new HPC/BD/cloud technologies by industry, society and SMEs in particular;
- Policy support, networking, collaboration, framework conditions to progressively remove the obstacles to digitisation and free flow of data.

ICT-18-[2018-20]: Big Data and HPC PPPs: 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 (healthcare, manufacturing, energy, finance & insurance, agri-food and security).

Scope:

a) **Innovation Actions** targeting the development of large-scale HPC-enabled pilot test-beds supporting big data applications and services by combining existing relevant technologies (HPC / BD / cloud). The test-beds should handle massive amounts of diverse types of big data coming from a multitude of players and sources for enabling value creation. The data assets available to the test-beds must 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.

b) **Innovation Actions** targeting the development of large-scale IoT/Cloud-enabled pilot test-beds for big data applications by combining relevant technologies (Big Data, IoT, cloud and computing). The aim is to develop 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) for enabling value creation from such data assets. The pilot test-beds shall also address the relevant networking connectivity and large-scale data collection and management issues. The data assets available to the test-beds must 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.

For both subtopics a) and b) above:

The proposals shall demonstrate additional industrial/stakeholder investment of at least three times the EU support, in activities and resources related to the large-scale test-bed activities.

The Commission considers that proposals requesting a contribution from the EU between EUR 25 and 30 million for subtopic a), and EUR 20 and 25 million EUR for subtopic b) would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Proposals should seek synergies and co-financing from relevant national / regional research and innovation programmes, including structural funds addressing smart specialisation. 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:

a) and b)

- Demonstrated increase of productivity in the main target sector of the Large Scale Pilot Action by at least 20%;
- Increase of market share of Big Data technology providers of at least 25% 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 and fostering the democratisation of advanced HPC, big data and cloud infrastructures stimulating the emergence of the data economy in Europe.
- Leveraging additional target sector investments, equal to at least four times the EU support.

Type of Action:

a) Innovation Actions (IA)

b) Innovation Actions (IA)

Budget per type of action:

a) EUR 55 million (2018)

b) EUR 50 million (2019)

ICT-19-[2018-20]: Big Data PPP: Methods and tools for extreme-scale analytics, and innovation hubs

Specific Challenge

1. Enable value creation through advances in the basic technologies and engineering paradigms for rapidly processing ever increasing volumes of data over distributed computing and data infrastructures.
2. Launch a second-generation innovation hub to promote new business opportunities notably for SMEs and ensure that the best ideas progress to markets.
3. Coordinate the various initiatives bringing together relevant stakeholders for creating European leadership in HPC/BD/Cloud technologies.

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** 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 federated and unified systems, and the co-design of big data/distributed systems; privacy-aware extreme-scale analytics for deep analysis and 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 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) **Innovation Actions** are invited to address one of the following two topics:

- Federate the data integration and data experimentation actions resulting from ICT-14-2016-2017 and from other relevant innovation hubs (including national and regional hubs) by creating a single Innovation Space, promoting data sharing across sectors and borders and supporting innovation and new business creation, especially by/for SMEs, web entrepreneurs and start-ups.
- Select, launch and incubate mini projects in view of bringing to the market new solutions and services based on secure and trusted data value chains, including those based on actions resulting from ICT-14-2016-2017 and ICT-18-2016. Innovation

Actions shall make available to the mini projects the appropriate computing infrastructure and resources.

For both topics, Innovation Actions are expected to provide financial support to third parties (cascading grants) in line with Part K of the General Annexes to this work programme. At least 60% of the budget of the IA shall be allocated to third parties by means of mini grants of up to EUR 200.000.

One Innovation Action will be selected under the first indent above. Several Innovation Actions can be selected under the second indent above. Innovation Actions are expected to collaborate closely with the CSA under ICT-18 c). Special attention should be paid on fostering and facilitating the "fitness to the market" of the new solutions and business concepts.

The Commission considers that proposals requesting a contribution from the EU of EUR 3-5 million (first indent) or EUR 10-15 million (second indent) would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

c) **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.

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:

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

b)

- 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;
- Sustaining the operations of the federated incubators after the end of the EU-funded actions.

c)

- 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:

- a) Research and Innovation Actions (RIA)
- b) Innovation Actions (IA)
- c) Coordination and Support Action (CSA)

Budget per Type of Action:

- a) EUR 70 million (2019)
- b) EUR 33 million (2018)
- c) EUR 2 million (2018)

ICT-20-[2018-20]: Big Data PPP: Supporting the emergence of data markets and the data economy

Specific Challenge:

- a) The lack of platforms for secure sharing of personal data and proprietary 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 platforms³ and for industrial data platforms.^{4,5,6}
- b) 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

³ See a Commission paper on "[Personal information management services – Current state of service offers and challenges](#)" analysing feedback from public consultation

⁴ See "[Industrial Data Platforms – Key Enablers of Industry Digitization](#)", IDC study report 28/7/2016

⁵ 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.

⁶ See European Commission Staff working document accompanying the communication "Building the European Data Economy", to be published in January 2017.

build on existing computing platforms. Proposals shall address one of the following two 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 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 data assets with automated and robust controls on compliance (including automated contracting) of legal rights and fair remuneration of data owners.

At least two actions shall be funded for each of the two indents above. 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) **CSA** proposals are invited to cover one of the following:

- Promote and bring users and clients to the industrial and personal data platforms, monitor the impact, ensure SME inclusion, entrepreneurial support and trust-building. The CSA action is expected to create mechanisms for partner-finding, addressing the skills gap, and leveraging venture capital, and to launch promotional campaigns and training. The CSA action shall liaise with and complement related initiatives⁷, and shall support and work in collaboration with the platforms under ICT 18 a) and the innovation hubs under ICT-19 b).
- In line with the Communication on ICT Standardisation Priorities for the Digital Single Market⁸, promote standardization, interoperability and policy support in the field of data and federated/networked computing systems. The CSA action shall analyse and address the legal, institutional and interoperability challenges that currently hamper the free flow of data across borders and sectors and restrict the cross-border federation of computing infrastructures.

One CSA will be funded for each indent above. The Commission considers that proposals requesting a contribution from the EU of 2 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

⁷ Such as the European Data Science Academy (EDSA), the network of European Centres of Excellence in Big Data, the BDVe project.

⁸ <https://ec.europa.eu/digital-single-market/en/news/communication-ict-standardisation-priorities-digital-single-market>

Expected Impact:

a)

- Personal data protection is improved, and compliance with the General Data Protection Regulation (and other relevant legislation) is made easier for economic operators
- Citizens' empowerment is improved as privacy-aware transparency and control features are increasingly streamlined across 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

b)

- 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:

a) Innovation Actions (IA)

b) Coordination and Support Actions (CSA)

Budget per Type of Action:

a) EUR 46 million (2018)

b) EUR 4 million (2018)

ICT-21-[2018]: HPC PPP: European low-power microprocessor technologies (Phase 1)

Specific challenge

Design and development of European low-power processors and related technologies for extreme-scale, high-performance big-data and emerging applications. The designs should follow a modular approach that would allow a rapid scale-up or scale-down.

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) Low-power Processing Units for exascale-class supercomputers

Proposals are expected to generate the functional and non-functional requirements for low-power Processing Units (using representative HPC and big-data benchmarks/applications and targeting maximum energy-efficiency and reliability); design the architecture of the Processing Units; verify, tape-out, validate, test and bring up the Processing Units; develop the required firmware and system software leveraging, as much as possible, on open source efforts and solutions; develop the boards and blades; demonstrate the Processing Units in complete rack(s) with the porting of a representative set of real-life HPC and big-data application kernels. Sustainability and economic viability of the developed solutions are key aspects.

b) Low-power Processing Units for application acceleration

Proposals are expected to 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 for specific applications. The applications must have high-volume potential. Processing Units may be realised as standalone components or IP-blocks. Where relevant, open-source hardware approaches may be employed.

Proposals can address only one of the above topics and they should clearly state which topic they address. Projects of topic b) will be required to interface with the project of topic a) in order to achieve maximum interoperability (including IP-block interfacing) and roadmap synchronisation.

The Commission considers that for topic a) proposals requesting a contribution from the EU of between EUR 30 to 40 million would allow this area to be addressed appropriately. At least one project will be funded under topic a). The Commission considers that for topic b) proposals requesting a contribution from the EU of between EUR 5 to 15 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Wherever appropriate, actions, and in particular those addressing topic a), should seek synergies and co-financing from relevant national / regional research and innovation programmes, including structural funds addressing smart specialisation. Actions 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.

Expected impact:

- 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 other emerging applications.
- Availability of European processing units with drastically better performance/power ratios compared to current offerings for HPC, Big-Data and other emerging applications.
- Covering important segments of the broader and/or emerging HPC and Big-Data markets.

Type of Action:

Research and Innovation Action

Budget: EUR 80 million

ICT-22-[2018]: HPC and Big Data PPPs: Co-designing Extreme Scale Demonstrators (EsD)

Specific challenge:

Co-design and operations of extreme scale systems in close cooperation with the scientific disciplines and all stakeholders concerned. These will include technology suppliers, system integrators, supercomputing infrastructure providers and user communities, as well as ambitious HPC and extreme-data application owners or providers.

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: Proposals are expected to address the research, co-design, integration, validation and experimentation of extreme scale computing systems driven by a set of ambitious extreme data and HPC applications. EsDs must have the potential of being commercialised, operating in mode close to service delivery to users, and must integrate to a large extent technologies developed in projects funded by FP7, Horizon 2020 or other R&D actions in Europe. In particular, proposals will demonstrate how the building blocks developed in the FETHPC actions supported in Horizon 2020 are integrated and leveraged in the EsDs (e.g. architectural work, software and parallel programming environments, etc.). EsDs are expected to demonstrate scalability up to exascale-class levels with specific design points and performance/power targets (e.g., design point target of 500 Petaflops to 1 Exaflop).

Each proposal should follow a 2-phase approach: Phase A consisting of development, integration and testing of a HW/SW system with a sufficient size to enable evaluation and validation of the design and that is fully usable by the end of this phase; and Phase B dedicated to deployment, use for relevant applications and validation in operational environments for real users. It is critical that the EsDs achieve well specified performance/power targets in both phases using a representative set of ambitious applications. These applications will address Big Data and extreme scale computing challenges combining fast response times, and advanced Big Data analytics and High-Performance Computing techniques.

The Commission considers that proposals requesting a contribution from the EU of between EUR 20 and 40 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Wherever appropriate, actions should seek synergies and co-financing from relevant national / regional research and innovation programmes.

Expected impact:

- Strengthening the competitiveness and leadership of European industry & science, in particular of the European technology supply
- Proof-of-principle for pre-exascale machines addressing strategic HPC and Big-Data applications
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda
- Maximising the impact and leveraging the results of European R&D projects (in particular FETHPC actions) into operational extreme scale demonstrators

Type of Action:

Research and Innovation Action

Budget: EUR 80 million

ICT-23-[2020]: HPC PPP: European low-power microprocessor technologies (Phase 2)

Specific challenge

Design and development of European low-power processors for extreme-scale high-performance, big-data and emerging applications. The designs should follow a modular approach and allow for rapid scale-up or scale-down.

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: Building on results of phase 1, phase 2 proposals are expected to design and develop the 2nd generation of innovative low-power Processing Units (using representative HPC and big-data benchmarks/applications and targeting maximum energy-efficiency and reliability); update the architecture of the Processing Units; verify, tape-out, validate, test and bring up the Processing Units; update the required firmware and system software leveraging, as much as possible, on open source efforts and solutions; develop the boards and blades; demonstrate the 2nd generation Processing Units in complete rack(s) with the porting of a representative set of real-life HPC and big-data application kernels. Sustainability and economic viability of the developed solutions are key aspects.

The Commission considers that proposals requesting a contribution from the EU of between EUR 30 and 40 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Wherever appropriate, actions should seek synergies and co-financing from relevant national / regional research and innovation programmes, including structural funds addressing smart specialisation. Actions 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.

Expected impact:

- 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 other emerging applications.
- Availability of European processing units with drastically better performance/power ratios compared to current offerings for HPC and Big-Data and other emerging applications.
- Covering important segments of the broader and/or emerging HPC and Big-Data markets.

Type of Action:

Research and Innovation Action

Budget: EUR 40 million

ICT-24-[2018]: Cloud Computing

Specific Challenge:

Support the cloud industry in Europe to develop competitive cloud solutions based on advanced cloud platforms and services, focusing on HPC, and cloud-based software and data applications. Such solutions should also address stringent security, data protection, performance, resilience and energy-efficiency requirements to respond to the 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 challenges:

- i) Comprehensive and context-aware cloud service management, including for IoT and Big Data, 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 of such services should particularly look at SMEs and public sector users.
- ii) New languages 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.
- iii) 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 to make intelligent decisions when to move computation from the edge to the cloud.

- iv) Innovative Software development methods and tools for cloud services to cope with the scale and complexity of future cloud applications and services while addressing security, privacy, reliability, resilience, and energy-efficiency.

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 at least the following two challenges:

- 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 strengthen the cloud industry in the EU;
- 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)

- To support a sustainable European forum of stakeholders representing the Cloud Computing research and industry.

Type of Action:

- a) Research and Innovation action (RIA)
- b) Coordination and Support action (CSA)

Budget per Type of Action:

- a) EUR 48.5 million
- b) EUR 1.5 million

ICT-25-[2019]: Advanced testbeds for innovative cloud technologies

Specific Challenge:

Strengthen the cloud industry in Europe (supply and demand side) by developing and testing innovative cloud technology solutions with high standards of quality, reliability and confidentiality, while ensuring data protection and security. Advancing cloud technologies and piloting them on available open cloud infrastructures will contribute to the functioning and implementation of the European Open Science Cloud (EOSC), as well as to the adaptation and enhancement of technologies that may facilitate the integration between the EDI (European Data Infrastructure) and the EOSC initiatives.

Scope:

Develop testbeds that contribute to the development of the EOSC by supporting testing, validation and experimentation of scalable and integrated cloud computing services for wide use by the science community. The enabling cloud layer of these testbeds should offer "policy-driven" access to the data processing infrastructure; provide technological support and address contracts, service level agreements (SLAs), payment schemes, certification, etc.

Targeted test-beds should include test scenarios, protocols and reporting, and may address integrated innovative cloud solutions for IaaS, PaaS, and SaaS services and their scalability and applicability across the EOSC, keeping in mind possibilities for widened use towards the digitalisation of industry and the public sector.

To address this area comprehensively and decisively, proposals requesting a contribution between EUR 8 and 12 million are considered appropriate. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Test new cloud solutions using available open cloud infrastructure relevant for a wide spectrum of European science, research and innovation organisations, public and private, including industry;
- Contribute to the establishment and wide adoption of EOSC and to bringing the EOSC to a near-operational level (TRL 6 or 7);
- Provide a competitive environment for commercial providers to offer their services, potentially to the EOSC including relevant certification schemes;
- Contribute to the development of an ecosystem that will strengthen the cloud industry in the EU.

Type of Action:

Innovation action (IA)

Budget per Type of Action:

EUR 30 million

5G PPP

During 5G PPP phases 1 and 2, multiple technologies and architectures have been researched to meet the 5G Goals. Phase 3 targets 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, and supporting innovative "vertical" use cases as per the EU "5G vision". It 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 at leveraging international cooperation towards industrial consensus on 5G key aspects such as interoperability, architecture, standards, spectrum.

ICT-26-[2018]: 5G PPP – 5G End to End Demonstrator

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

Scope: The target 5G end to end network facility includes the key fixed/multi radio access, 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 KPI's 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. Provision of such facility may be based on the interworking of several experimental platforms existing in Europe. It requires availability of an openness framework enabling "vertical" projects to access it⁹.

Expected Impact:

- Demonstrated feasibility of 5G PPP KPI's beyond 4G evolution (NB-IoT, 4G LTE-A-PRO), including at least KPI's for capacity, speed, latency, 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 usage and sharing applicable to 5G spectrum licensing;
- Validation of end to end 5G architecture including end to end slicing capabilities

⁹ Openness of the facility may make it eligible as an "innovation hub".

- 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: RIA

Budget per Type of Action: 60 M€. See budget table end of 5G PPP section

ICT-27-[2018]: 5G PPP – 5G for connected and automated driving

Specific Challenge: The challenge is to qualify 5G as a core infrastructure to address 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 2025¹⁰.

Scope: It covers the viable applicability of 5G connectivity to "Connected and Automated Driving" (CAD) V2X use cases, taking a broad service approach, including and reaching beyond safety/efficiency –C-ITS- use cases. 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 cars in the context 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 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 CAD context is realised through cross border trials covering significant portions roads and including the core technological innovation expected from 5G, such as (but not limited to) New Radio, new frequency bands, C-RAN, Mobile Edge Computing, network virtualisation, new network architecture. 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 options is in scope in relation to who has to invest and to who will benefit commercially.

Expected Impact:

- Validation of 5G technologies and architecture in an "extended CAD" context, including validation of innovative business models and applicable standards;
- Validated cost/benefit analysis of cross border 5G deployment for extended CAD scenarios;

¹⁰ Communication of the Commission "A 5G Action plan for Europe", COM(2016)XXX

- 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 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: IA

[Budget per Type of Action: 50 M€. See budget table end of 5G PPP section]

ICT-28-[2019]: 5G PPP – 5G validation Trials across multiple vertical industries

Specific Challenge: The challenge is to get the European 5G Vision of "5G empowering vertical industries"¹¹ 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: within the set of requirements specific from one application domain; ii) across all sets of heterogeneous requirements stemming from concurrent usages of network resources by different vertical domains.

Scope: a) **Trials** of various scales, depending on the target technology validation, in view of demonstrating that performance conforming to 5G PPP KPI 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 validation trials are also targeted in the context of concurrent usage of resource by multiple verticals, taking into account the 3 classes of ITU requirements (eMBB, mMTC, URLL use cases). In practice, the 5G infrastructure (RAN, back/fronthaul, Core) will be shared among multiple verticals with a variety of applications, each asking for independent service guarantees and very different service requirements. In that context, 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 though other may be considered. High density location application should be covered.

¹¹ 5G PPP White Paper "5G empowering vertical industries, ref XXXX

Trials are preferably implemented over the 5G end to end platforms developed under **ICT-26-2018**, and may contribute to 5G demonstration in the context of large showcasing events.

Type of Action: IA

Budget per Type of Action: 90 M€. See budget table end of 5G PPP section.

b. Coordination and Support Actions

5G PPP projects 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 calls for activities to ensure 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:

- management of 5G PPP project cooperation for horizontal issues of common interests (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 SDO's 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 4 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Type of Action: CSA

Budget per Type of Action: 4M€. See budget table end of 5G PPP section.

Expected Impact:

a)Trials

- Validation of core 5G technologies and architectures in the context of specific vertical use cases;
- Validation of core technologies and architecture for differentiated performance requirements originating from eMBB, mMTC, URLL use cases, notably for end to end slicing and virtualisation

- Identification of viable business models for innovative digital use cases, 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 with services linked to specific vertical sectors
- Europe 5G know how showcasing

b) Coordination and Support Actions

- Organisation of the 5G PPP as a programme with clear links to the 5G-I-A
- 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

ICT-29-[2019]: 5G PPP – 5G Long Term Evolution

Specific Challenge: Whilst 5G early introduction targets "local" network improvements (e.g. at radio access level) longer term vision targets the realisation of pervasive mobile virtual services, through a network managing compute, storage and transport connectivity functions in an integrated way. The challenge is to transform the network into a 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, doors, mirrors, 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: Extension of virtualisation technologies and architectures 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) resource self-configuration and management according to service, traffic 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;

- Security¹²: 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

¹² This should be covered as part of an integrated Network management system

systems, vulnerabilities and compromises. It covers Trusted Execution Environments (TEEs) 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.

- Radio network technologies, architectures and advanced signal processing enabling i) differentiated service requirements, including broadcast/multicast and strategies for spectrum sharing and usage optimisation; 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 untested spectrum at Terahertz frequencies.

- Optical network technologies and architectures allowing i) optimised integration of optical resources with wireless access resources with fast varying usage conditions; ii) seamless integration of optical resources with data centre resources; iii) support of very high rate aggregation for very high cell density deployments; iv) efficient support of distributed access like C-RAN; v) 10-fold capacity increase in core and metro networks.

Expected Impact:

- Evolution of networks towards OTT like platforms integrating connectivity storage and computing resources opening for new service models to telecom/ISP providers;
- Network scalability towards high number of resource constrained devices, multiplicity of service requirements, and new connectivity paradigms (user controlled)
- Characterisation and availability of secure and trusted environments for software based virtualised networks, enabling trusted multi-tenancy;
- Improvements of radio spectrum usage, novel strategies for coverage/service extension, support of novel use cases, usability of today unexplored spectrum;
- dynamic scalability of network capabilities through availability of managed and enhanced optical resources.
- Network energy consumption reduction, a factor of at least 10 is targeted.

Type of Action: RIA

Budget per Type of Action: € 86 million. See budget table end of 5G PPP section.

ICT–30-[2020]: 5G PPP – Network innovations with 5G 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. However, there is a lack of open platforms that provide access to networks resources to support virtualisation. The challenge is hence the provision of an open platform, which can be used to develop NetApps supporting requirements and developments from vertical sectors. It includes

migration to provide operators, service providers and users with NetApps into an operational setting.

Scope: Experimentation facilities able to provide enhanced experimentation infrastructures on top of which, third party experimenters e.g. SMEs or any service provider will have the opportunity to test their applications in an integrated, open, cooperative and fully featured network platform running across multiple domains, and tailored to specific vertical use case.

The work leverages the sharing of infrastructures and virtualised network functions for network application development and testing. The objective is to focus on innovation for operations and 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 on open experimental network platforms, and to create 5G open source repositories for further leverage and towards standards development. The target is implementation, testing and validation of multi-tenancy applications and network solutions in an open platform, fine-tuned to the characteristics and requirements of a specific network slice.

Most promising results are expected to be transferred to an incubator or start up.

The work contributes to the Hub strategy of the Digitising of European Industry initiative.

Expected Impact:

- Availability of open experimentation facilities for developers with opportunity to test and validate the developed solutions in a 5G environment under different implemented functions and vertical-specific configurations;
- Efficient testing and validation of innovative network applications in Open environments;
- NetApps Interoperability beyond vendor specific implementation across multiple domains and availability of related standards;
- Open-source repository of network applications that can be further leveraged by other developers;
- Creation of third party markets for start-ups and SMEs. At least 50% of SME's are targeted for this action. At least 10% of budget reserved for open calls
- Service creation time in minutes.

Type of Action: IA

Budget per Type of Action: € 56 million See budget table end of 5G PPP section.

ICT-31-[2020]: 5G PPP – 5G core technologies innovation¹³

Specific Challenge: 5G offers prospects for a range of new technologies and hardware devices to hit 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 foster emergence of new markets and new market actors in Europe.

Scope: The key 5G technological blocks under consideration are primarily hardware based and include, but are not limited to, array antenna, array processors, baseband processor platforms, low-cost access points, millimetre wave devices and subsystems, new generation of 5G terminals, with a view to providing opportunities to innovative high tech SME's access 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 goes beyond individual components and also address integration of technologies. It targets a TRL level of 6-7. The actions added value is in the validation of the target component as part of its insertion into an overall architecture representative of a (sub)set of 5G network functions. The successful projects should target transfer of results towards an incubator or demonstrate a clear path towards downstream industrialisation and commercial exploitation.

Expected Impact:

- support to the emergence of a European offer for new 5G core technologies;
- 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
- SME strong presence through participation of at least 50% of the actions (budget wise)

Type of Action: IA

Budget per Type of Action: *EUR 55 million. See budget table end of 5G PPP section.*

Budget breakdown per Type of Actions: For the 5G PPP actions, the Commission considers that proposals requesting a contribution as per below table would allow the various areas to be addressed appropriately, though this does not preclude submission and selection of proposals requesting other amounts.

ICT-26-2018	ICT-27-2018	ICT-28-2019	ICT-29-2019	ICT-30-2020	ICT-31-2020
€ 15 to 20 million	€ 12,5 to 25 million (TBC)	€ 10 to 15 million CSA: up to €	€ 4 to 6 million	€ 5 to 8 million	€ 3 to 6 million

¹³ To be refined when WP 2020 detailed spec is reopened.

		4 million			
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International Cooperation Activities – Joint /Targeted opening calls under 5G PPP

The proposed International cooperation activities are mainly supporting the Joint Declarations for 5G cooperation signed with a number of important "5G Third countries". The complete texts for these activities are not yet available, as these require further negotiations/discussion with the third countries. Rationale and target budgets are as follows:

EU-Japan (2018 call)

Japan being an "eMBB" priority nation and supporting 28 GHz band, it is proposed to focus joint 5G R&D on application aspects of 5G, providing opportunities to EU actors to also benefit from Japanese test facilities, whilst testing interoperability of EU vs Japanese frequency bands.

In addition, it is proposed to support complementary joint research on enabling technologies for beyond 5G, especially those radio technologies contemplated to open new allocations at ITU level (beyond 200 GHz).

Types of Actions: RIA, Joint call

Budgets: 1,5 M€ for 5G application demos and 1,5 M€ for Beyond 5G radio technologies.

Total : 3M€

Policy Deliverable: Interoperability, standards, spectrum

EU-Korea (2018 call)

Korea is similarly to Japan an eMBB country, though with audiovisual application focus. Korea is ready to provide some of their testbed facilities to support joint interoperability testing across regional testbeds. This can be done in the context of eMBB applications.

Type of actions: RIA, Joint call

Proposed budget: 4M€, TBC

Policy deliverable: Interoperability, standards, spectrum

EU-China (2018 call)

China is a "DEI" nation for 5G and has a similar vision to that of Europe. We have been solicited for joint work in the context of 5G phase 2 standards, using pilots to validate 5G use for verticals. This can be done in a multi regional/multi domain context, with operators like China Mobile. The proposed activity also potentially opens further the Chinese IMT 2020 environment to EU actors. It piggybacks on the development of an EU 5G test facility further connected to a Chinese facility.

Type of action: RIA, Targeted opening

Proposed Budget: 6M€, TBC

Policy deliverable: Joint approach towards 5G phase 2 standards (verticals) and showcasing events (5G twin cities)

EU Taiwan (2019 call)

Taiwan has made offers to European actors to use their test facilities, which are unique in some cases (e.g. high speed train). Proposal is to run joint trials for interoperability tests for specific applications.

Type of action, RIA, Targeted opening

Proposed Budget: 4M€, TBC

Policy Deliverable: Interoperability, standards validation

EU-Brazil (2020 call)

Brazil main interest so far is in IoT applications for 5G. It covers usage of technologies primarily for societal applications. Proposed (TBC) focus is on applicability of 5G for large scale IoT applications, with focus on specific societal applications.

Type of action: RIA, Joint call (or targeted opening)

Proposed budget: 1M€

Policy Deliverable: Societal applicability of 5G.

Next Generation Internet

The upcoming *digital era* and *hyper-connected society* must be based on principles that are in line with European values of openness, cooperation, inclusiveness, transparency and protection of data and privacy. The Next Generation Internet should ensure that the immense potential of artificial intelligence, the connection with the physical world, immersive environments, machine learning, massive networks of people and machines are used to empower people to steer their lives and contribute to sustainable societies. It should be an Internet that is dependable and trustable, creating new usage and new business opportunities making Europe a trusted hub globally. It is at the heart of the industry 4.0 revolution and the digitization of industry in general and is essential for the competitiveness of European industry.

To help shape it, we must involve all stakeholders, from the public and private sectors to academia and civil society. The Next Generation Internet will benefit from advances in the following areas:

- Future **Interactive Technologies** will allow internet users to access, process and deliver information in more natural, efficient and less intrusive ways, providing enhanced and personalized experiences;
- Advances in **Artificial Intelligence** are critical to turn information into knowledge and to embed autonomy and intelligence into networks, robots and other connected devices;
- **Internet of Things** technologies and applications are changing the way users, services and applications interact with the real world environment in a trusted way.
- **Media technologies** are transforming the way we produce, consume and interact with content and objects on the internet, within and across users' groups, and lead to new forms of media content creation, aggregation and delivery.
- The Next Generation Internet will be **multilingual** and **inclusive**. Advances in **language technologies** will help eliminate language barriers. Smart, open, **inclusive** and **personalised learning** solutions will be tailored to each individual's needs, competences and abilities. Similarly, **accessible ICT** will allow people with disabilities to participate in a more inclusive digital society.

In addition, the **Open Internet Initiative**, based on an agile and flexible programme approach, will focus on research teams, hi-tech start-ups, SMEs and social innovators, and will rapidly explore promising avenues for the Internet of 2025.

The topics addressed here are a coherent and integrated package. Coordination and support actions will be called upon to cut across topics and benefit from synergies.

ICT-32-[2018]: Next Generation Internet - An Open Internet Initiative

Specific Challenge: This initiative aims at developing a more human-centric Internet supporting European values of openness, cooperation across borders, decentralisation, inclusiveness, transparency and protection of privacy. Giving the control back to the users and promoting essential European values will help restore trust in the Internet. It should provide more transparent services, more intelligence, greater involvement and participation. It should be more open, neutral and secure, more interoperable, decentralised, and more conducive to social innovation.

Scope: Technological opportunities arising from cross-links and advances in various research fields ranging from new network architectures and software-defined infrastructures to open service platforms, from application domains to aspects of social innovation. Beyond research, work also includes validation and testing of market traction with minimum viable products and services, and involves users and market actors at an early stage. Eventually this should influence Internet Governance to make the Internet more open, safe, inclusive and secure.

Carrying out this research work requires the involvement of today's best Internet innovators. There are four components; the 'Research Module', the 'Technology Strategy & Policy Module', the 'Technology Harvest & Transfer Module' and the 'Outreach Office'. These modules shall operate as one programme in a most effective and efficient manner. Proposals should address only one of the four components.

a) Research and Innovation Actions

Component 1: Each 'Research Module' 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.

For grants awarded under this topic and type of action beneficiaries may provide support to third parties as described in part K of 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.

Through an agile and flexible process, funding will focus on individual research groups / organisations, so that multiple groups are funded in parallel contributing to the same research area, using short research cycles targeting the most promising ideas. The 'Research Module' will provide the programme logic, coaching and mentoring. The focus will be on advanced research that can be brought quickly to the market; apps and services that innovate without a research component are not covered by this model.

The proposers of such 'Research Modules' have to demonstrate explicitly in their proposal a clear intervention logic, their capacity to attract top Internet talents, to define a solid action-programme and to offer a credible path to adoption. A combination or co-funding with other

innovation actions, supported by regional, national or European policies and funds, is highly desirable.

Normally 80% of the EU funding should be allocated to financial support for these third parties, typically of the size of EUR 100 000 to 200 000¹⁴ and a duration of about 9 to 12 months. Each research module is expected to run several cycles of projects, which will require a duration of 24 to 36 months. Best performing and most promising projects shall be entitled to participate in several funding cycles, thus receiving higher amounts and longer support. The proposers should encourage, when relevant, open software, firmware and hardware design, access to data, open standardisation activity, access to testing and operational infrastructure as well as 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.

For the call closing in 2018 research modules in the following three technological domains will be called for. Proposals should address one of these domains.

- a) Privacy and trust enhancing technologies: develop robust technologies to help users increase trust, usability and to achieve greater control when sharing their personal data, attributes and information. The Commission considers that this topic is best addressed by academic oriented research groups, however this may not exclude other researchers to apply.
- b) Decentralized data governance: explore new light-weight in-device data management and awareness systems, paying attention to ethical, legal and privacy issues, as well as to the concepts of autonomy, values and regulations. The Commission considers that this topic is best addressed by academic research groups, however this may not exclude others such as highly relevant start-ups, hackers or social innovators to apply.
- c) Discovery and identification technologies: to access heterogeneous data sources, services, objects and sensors, devices, multi-media content, etc. Target community: The Commission considers that this topic is best addressed by hi-tech startups, however this may not exclude other organisations to apply.

For the call closing in 2019, the technological domains will be published by the European Commission in the update to the WP 2019 that will be done before the call is published.

A maximum of 3 'Research Modules' will be selected in the call closing in 2018, each one addressing a single different technology domain listed above. Another maximum 3 'Research Modules' will be selected in the call closing 2019.

¹⁴ 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, and if this case proposals should explain why this is necessary to achieve the objectives of the action.

b) Coordination and Support Action

Component 2: The 'Technology Strategy & Policy Module' will engage leading edge Internet stakeholders in driving this programme forward through a continuous public consultation and open stakeholder engagement. This could include small prizes (with an overall budget limit of Euro 300.000) and crowd sourcing. It should map and cooperate with national/regional initiatives, associated countries and global activities where relevant. It should closely engage with the other components.

For grants awarded under this topic and type of action beneficiaries may provide support to third parties as describe in part K of 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 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 amounts. A maximum of one action will be selected.

Expected Impact:

- A complementary European research landscape for the Next Generation Internet.
- Contributing to a human-centric Internet for a European policy strategy actively shaping the opinion the policy makers, stakeholders and the public, including Internet Governance communities.
- Key performance indicators include the satisfaction of research and policy committees and Member States and associated countries, size and level of engagement ecosystem stakeholders, communication and the international standing of forum members.

Component 3: The 'Technology Harvest & Transfer Module' will exploit value at the level of research topics and at the programme level through continuous, qualitative and quantitative socio-economic monitoring and impact assessment. It will ensure the best use of the outcome and IPR created with specific exploitation strategies, including follow-up investment opportunities, IPR/knowledge transfers, tech-transfer services to digital innovation hubs, coaching services and linkage to national IPR exploitation programme.

The 'Technology Harvest & Transfer Action' shall start no earlier than 6 months after the start of the first 'Research Modules' in 2018. A duration of 3 years best supports the full cycle of the research modules launched in 2018 and 2019. The Commission considers that proposals 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 amounts. A maximum of one action will be selected.

Expected Impact:

- Best use of the outcomes ensured by specific follow-up.
- Best programme performance driven through assessment and feedback.

- Key performance indicators include the number of successful exploitation actions, quantified and qualified socio-economic impact, growth and diversity of the ecosystem, visibility and the size of the risk capital fund.

Component 4: The 'Outreach Office' will deliver an extensive online and social media presence and will establish a positive brand image among young researchers, innovators, policy makers and people at large.. It will engage leading Internet researchers and innovators in a growing and lasting ecosystem across Europe.

The Commission considers that proposals 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 amounts. A maximum of one action will be selected.

Expected Impact:

- Key performance indicators include the degree of coherent programme communication, branding and marketing, satisfaction of the projects in the 'Research Module', number of communication actions and number of people reached and the global visibility in the press.

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.

Budget: The overall budget for this NGI Open Internet initiative for the work programme period 2018-2020 is Euro 50 million.

ICT-32-RIA Component 1: 43 MEuro

ICT-32-CSA Component 2: 3 MEuro

 Component 3: 2 MEuro

 Component 4: 2 MEuro

Call Timing:

Call closing 2018: 28,5 MEuro, components 1 - 4

Call closing 2019: 21,5 MEuro, component 1

ICT-33-[201x]: 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 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; 3/ improve competitiveness through research into future high-quality multi-sensorial interactive hardware and multi-user interaction systems.

a) Interactive Community Building (CSA)

To better coordinate European stakeholders the focus should be on:

- elaborating a common research agenda and a technology transfer strategy;
- developing collaborative and exchange platforms and providing broad access to them;
- promoting the existence of such facilities and providing technical support.

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.

This action is expected to include financial support to third parties as described in part K of General Annexes of the Work Programme, actions to fund research and development teams who will integrate their tools into the collaborative and exchange platforms or develop dedicated operating systems as well as to establish links with existing platform efforts.

(Year 1 – Total 3 Mio - 1 action - 3 year duration - 60% of which is financial support to third parties of 50-100k grants of 12-18 months)

b) Deployment of Interactive Technology (IA)

To maintain competitiveness and allow the European industry to embrace these new technologies, the focus should be either on:

- developing authoring systems that enable rapid and easy interactive content creation and deployment also for non-expert users on various platforms;
- or developing interactive applications targeting specific sector(s) such as the automotive, healthcare or cultural and creative industries.

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 leverage and contribute to the exchange platforms developed in a)

(Year 1– Total 17 Mio – 1 Mio each action of 18 months).

c) Multi-user interaction (RIA)

To better exploit opportunities offered multi-user interactions, focus should be on technologies augmenting human interaction in groups within both professional and private contexts.

(Year 1– Total 10 Mio – 1 Mio each action of 2-3 years).

d) High-quality interactive hardware (RIA)

Future interactive hardware should aim at offering higher quality experiences, for instance through systems which are mobile, support additional senses, have higher accuracy or incorporate bio or environmental sensors.

(Year 3– Total 10 Mio – 2 Mio each action of 2-3 years).

Expected Impact:

a) Establish a sustainable competitive ecosystem of European technology providers.

b) Facilitate technology transfer to start-ups, SMEs and industries.

c&d) Strengthening European research and industrial capacities to develop future interactive devices.

Type of Action: Research and Innovation Actions, Innovation Actions, Coordination and Support Action

Budget: The overall budget for the objective Interactive Technologies for the work programme period 2018-2020 is Euro 40 million.

ICT-33-CSA 3 MEuro.

ICT-33-IA 17 MEuro. (7 M€ in 2019- 10M€ in 2020)

ICT-33-RIA 20 MEuro. (10 M€ in 2018- 10M€ in 2020)

Call Timing:

Focus	2018	2019	2020
a) Interactive Community building	(CSA) 3Mio €		
b) Deployment of Interactive Technology	(IA) 7 Mio €		(IA) 10 Mio €
c) Multi-user interaction	(RIA) 10 Mio €		
d) High-quality interactive hardware		(RIA) 10 Mio €	
Total	20 Mio €	10 Mio €	10 Mio €

ICT-34-[201x]: Artificial Intelligence

Specific Challenge:

AI is essential to create a truly disruptive change to the internet as it is critical to exploit both the information available both locally and remotely through connectivity. AI is enabled by NGI bringing knowledge to users. AI is also an enabler for NGI, embedding intelligence in the network. Yet, AI is not limited to NGI only and is re-emerging as one of the most promising areas in ICT with the potential to impact all economic sectors. The challenge is to fully exploit the AI potential in Europe, building on S&T strength, boosting European industry competitiveness with AI technologies and addressing societal challenges.

Scope:

The objective is to develop a European AI-on-demand platform:

- serving as a central point to gather and provide access to all scientific and technologic knowhow and AI tools;
- providing a one-stop shop offering solutions and support to all potential users of AI in order to integrate such technology into applications and solutions;
- facilitating the interaction with existing data portals with data being the fuel for AI algorithms.

This platform is an AI knowledge hub, developing an infrastructure integrating the knowledge and capacity in AI and advancing core AI capabilities (objective a) and offering solutions to users of AI (objective b), exploiting at best this infrastructure. The focus in (a) is on developing the platform with RIAs, while objective b) focuses on using the platform with IAs.

a) Research and Innovation Actions: Develop and Integrate the AI knowledge and capacity

- Mobilise the European AI community to provide access to their knowledge, algorithms and results. This would include financial support to third parties actions to fund R&D teams to integrate their AI tools into the common platform and to establish links with existing platforms.
- Advance core AI systems capabilities, filling gaps in current research landscape (including financial support to third parties to fund smaller size research projects)
- Develop the underlying infrastructure and support services to gather knowledge and provide tools to easily integrate such results in application.
- Develop synergies between the various providers and users and define a common strategic research agenda for AI, taking into account both the technological and ELSE aspects.

The action will involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. Maximum 40% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties. Third party support is expected to fund¹⁵:

¹⁵ 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, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

- i) R&D teams to integrate their AI tools in the common platform [typically in the order of EUR 20.000 – 50.000 K€ per party in a given project]
- ii) Research projects advancing AI system capabilities [typically in the order of EUR 100.000 – 300.000 K€ per party in a given project]

The Commission considers that proposals requesting a contribution from the EU of between EUR 10 and 15 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: One-stop shop AI: boosting the use of the AI on-demand platform

Offering solutions and support to all users of AI to integrate such technology into applications and solutions, providing easy access to industry and research, and leveraging AI as an enabling technology. This would build on the common AI platform developed in a) and would foster deployment via financial support to third parties to run technology transfer experiments.

The action will involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. Minimum 60% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties. Third party support is expected to fund technology transfer experiments [typically in the order of EUR 50.000 – 150.000 K€ per party in a given experiment¹⁶]. The Commission considers that proposals requesting a contribution from the EU of between EUR 10 and 15 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

c) Research and Innovation Actions & Innovation Actions: Consolidation of the European AI-on-demand platform

This activity aims at consolidating the hub developed in a) and b), both in terms of technology offer and use. This includes mechanisms to reinforce some research and foster deployment, and make the platform self-sustainable.

The tool will also include financial support to third parties for research projects and for deployment projects in line with the conditions set out in Part K of the General Annexes. Minimum 70% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties. Third party support¹⁷ is expected to fund:

- i) Deployment projects [typically in the order of EUR 50.000 – 150.000 K€ per party in a given project]
- ii) Research projects advancing AI system capabilities or adding new AI tools to the

¹⁶ 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, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

¹⁷ 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, and if this is the case proposals should explain why this is necessary to achieve the objectives of the action.

platform [typically in the order of EUR 20.000 – 300.000 K€ per party in a given project project].

The Commission considers that proposals requesting a contribution from the EU of between EUR 5 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:

- a) Strengthen European position worldwide, mobilising the entire European AI community to contribute to the platform development
- b) Boost technology transfer of AI, especially towards SMEs and non-IT sector
- c) Consolidate the EU platform and make it sustainable

Type of Action: Research and Innovation Actions, Innovation Actions

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

Budget: The overall budget for the objective Artificial Intelligence for the work programme period 2018-2020 is Euro 50 million.

ICT-34-RIA 25 MEuro (15 M€ in 2018- 10M€ in 2020)

ICT-34-IA 25 MEuro (15 M€ in 2019- 10M€ in 2020)

Call Timing:

Objective	2018	2019	2020
a) Develop and Integrate the AI knowledge and capacity	(RIA) 15 Mio €		
b) One-stop shop AI		(IA) 15 Mio €	
c) Consolidation of the European AI-on-demand platform			(RIA) 10 Mio € (IA) 10 Mio €
Total	15 Mio €	15 Mio €	20 Mio €

ICT-35-[2019]: Internet of Things

Specific Challenge:

Internet of Things (IoT) technologies and applications will bring 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 and to build and sustain a competitive ecosystem of European technology providers in IoT.

Scope:

The scope is to develop novel IoT concepts that will make provision for predicting future events, trigger actions and moving decisions to the point of interest in order to better serve the end-user. This would be achieved bringing enhanced sensing/actuating, reasoning capabilities and computational power to the edges, but also new capabilities on the backend, such as artificial intelligence and deep semantic interoperability.¹⁸

a) Research and Innovation Actions

- **Next generation of IoT devices** drawing from applicable results in micro-nano-bio technologies, including radical new technology like Brain-Computer Interfaces and miniaturised robots 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 networks capabilities such as integration with parallel and opportunistic computing capabilities, neuromorphic and contextual computing.
- Next generation **IoT architectures** with a focus **self-aware** and **semi-autonomous IoT systems building** making scalable use of artificial intelligence both centrally and at the network edge.
- **Semantic interoperability** to cope with the increased complexity of connecting vast number of heterogeneous devices with increasing demands for **contractual arrangements** (e.g. blockchains) for secure interaction.

The scope includes reference implementations including proof-of-concept, demonstrations and validation driven by novel use scenarios, also leveraging novel architecture concepts and Internet technologies developed elsewhere in the NGI programme.

Proposals should address one or more of the above topics and be supported by a number of use cases and demonstration. 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

- Measures for development of ecosystems, stakeholders networking, contribution to pre-normative activities and to standardisation, development of business models, innovation activities and skills building.

¹⁸ Ex.: A pedestrian crossing a street will connect to traffic signs that interact with approaching cars to guide the person over the street.

- One Co-ordination and Support Action to stimulate the collaboration between selected projects, liaise with other areas of the NGI programme and to disseminate results.

Proposals should address one of the above topics. The Commission considers that proposals requesting a contribution from the EU of **EUR 1 million**

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 platform technologies and contribution to scientific progress enabling novel, future semi-autonomous IoT applications.
- Propose novel and disruptive business models

Type of Action: Research and Innovation Actions, Coordination and Support Action

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

Budget: The overall budget for the objective Internet of Things for the work programme period 2018-2020 is Euro 50 million.

ICT-35-RIA 48 MEuro

ICT-35-CSA 2 MEuro

Call Timing: 2019.

ICT-36-[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 innovation integrating new technologies and user experiences.

Scope: Analysing and building the foundation of next generation Social Media platforms towards a "Global Social Sphere", based on peer-to-peer, community and free source principles, enhancing the role of prosumers and businesses, master technological barriers and introducing quality journalism. These activities should help to overcome the current accumulation of power by central intermediaries often located outside Europe. Proposals are invited for one of the following actions:

a) Veracity and digital companions for social media. Development of innovative intermediary-free solutions addressing questions of security, privacy, trust and pluralism for Social Media. The solutions to be developed shall contribute to the understanding of information cascades, openness of algorithms and users' access to their personal data (such as

profiles, images, videos, biometrical and local data), information veracity e.g. through use of advanced approaches such as the Blockchain protocol, and mechanisms for "bubble-busting". Linked to this and in order to allow mastering better the complexity for users of Social Media, a Digital Companion interaction component shall also be realised.

b) Support of new Social Media initiatives, and transition to peer-to-peer federated social networks based on decentralised architectures, jointly setup by a consortium of cross-sectorial and trans-national partners and exploiting the synergies to be derived from data aggregation and data analytics. This includes work on open API, interface design, content production, consumer/prosumer business models for identification and monetising user generated content, accessible profile management, gaming and art aspects. Proposals should also consider aspects of a "Social Networks of Objects", integrating latest European advancements on smart objects, big data, autonomous systems and augmented/virtual reality. Reference initiatives including demonstrations and validation driven by novel use scenarios, should also leverage on concepts and technologies, developed elsewhere in the NGI programme.

c) Support of Social Media ecosystem community building between Social Media actors of all ages such as developers, designers, users, artists, socially engaged people, researchers, and at European and Member State level, also linking to important international initiatives. This should include an analysis of a future hyper-connected social media society, considering societal, educational and legal aspects, also linked to the EU regulatory framework for audio-visual services, copyright and e-commerce.

For a) and b) the action should involve financial support to third parties in line with the conditions set out in Part K of the General Annexes for supporting growth of the community and evolutionary development. The consortium will define the selection process of additional users and suppliers for which financial support will be granted. A maximum of 35% and a minimum of 25% of the EU funding requested by the proposal shall be allocated to this purpose. Involved parties in this topic shall also contain non-ICT competencies, and contribute to the European Media policies.

Budget: a) IA 8 MEUR, b) RIA 8 MEUR, c) CSA 1,5 MEUR

The Commission considers that proposals requesting a contribution from the EU of maximum 4 MEUR per a) and b) would allow this specific challenge to be addressed appropriately.

Expected impact:

- Overcome current issues on trust and governance for Social Media
- Seeding new approaches for Social Media platforms and hyper-connected societies
- Support of societal change

Call Timing: 2018

ICT-37-[2019]: Next Generation Media

Specific Challenge:

Immersive, accessible, personalized user experiences will drive the Next Generation Internet. This will be the main field where all media sectors will compete to satisfy user expectations. The challenge for the European media industry is to develop a cross-sectorial sustainable ecosystem capable of rapidly embracing new technologies in the processes of creation, management, and distribution of content.

Scope: Innovative solutions to 1/ facilitate the integration of emerging technologies such as 5G, Cloud, the Internet of Things, Virtual Reality/Augmented Reality, smart objects, smart contracts, wearables/conformable devices, data analytics etc. in the media processes; 2/ share resources and promote content to help the European media ecosystem become more agile and 3/ support synergies among different media sectors, and when possible non-media sectors, to develop new business opportunities in the Digital Single Market. Actions are encouraged to contribute to the European Media policies. This topic is articulated in 2 components.

COMPONENT 1: BUSINESS INNOVATION ECOSYSTEMS

- Sandbox for technology-driven innovation in media to foster the development of business innovation ecosystems through at least two incubators hosted in real operational environments. Incubators have to be interlinked and foster technology-driven innovation for open and interoperable media with a particular focus on SMEs and start-ups. Incubators exploiting synergies between media and non-media sectors are also welcomed. Each incubator will finance and host national and non-national projects (also called third-parties) selected by open and competitive calls providing access to media and other relevant infrastructures and services as well as internal support.

Projects should carry out within the lifespan of the action 2 open calls (one defined in the proposal and the second to be defined in accordance with the Commission during the project) for third-party projects according to the text of this call and evaluation standards similar to those of the Commission. Typically each project will last from 5 to 12 months with a size from EUR 50.000 to 350.000. Moreover, projects should provide specific, mentoring and coaching to all third-parties, connect high-performers to the venture capital market, and work closely with actions of the component 2.

At least 70% of the EU funding should be allocated to financial support for these third parties' projects. Financial support to third parties should be in line with the conditions set out in Part K of the General Annexes. Key performance indicators used to evaluate proposals (e.g. size of the venture capital market reachable, level of industry engagement) should be clearly specified.

COMPONENT 2: NEW USER DRIVEN AND ENRICHED EXPERIENCES IN FUTURE MEDIA

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

- Exploiting solutions for platforms enabling all-Internet Protocol content value chain;
- New business opportunities based on cross-media and cross-sectorial data analytics;

- 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 reduce the number of intermediaries and improve online content distribution.

Whenever appropriate, proposals are encouraged to look for synergies with media development programs for Content and Creative Industries to exploit project results.

All the actions in component 2 will cooperate and work closely with component 1.

Expected Impact:

Foster a user-driven and user-centric media value chain, involving the user since the early phases of the proposal.

- To develop and validate in real operational environments new media services.
- Open and interoperable solutions that can clear barriers for the success of the Digital Single Market from the content and media perspective.
- Improve the technological transfer from European technological SMEs to the media value chain.

Type of actions: Innovation Action

Budget: 17.5 MEUR.

A minimum of 1 action will be selected per theme described in each bullet point. Proposals should clearly state which theme they address.

The Commission considers that proposals requesting a contribution of EUR 4.5 million and 3 years duration in component 1; EUR 2 million and 2 years in component 2 would allow the themes described to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts and durations.

Call Timing: 2019

ICT-38-[2018]: A multilingual, inclusive Next Generation Internet

Specific Challenge:

The Next Generation Internet must be **multilingual, inclusive and accessible** to every citizen, across all walks of life. The challenge is to remove key barriers to the Digital Single Market by making content and services available in all the EU languages, in forms that are accessible, perceivable and understandable by everybody, especially people with disabilities and by further developing digital skills.

Scope:

Actions on **multilingual technologies** will address both mission-oriented challenges and the transfer of excellent research results to the European language technology industry and its users, in a variety of sectors. Actions on smarter, open, trusted and **personalised learning** solutions will optimise skills acquisition and allow learners to engage and interact with content and with peers. **Accessibility** actions will identify potential scenarios, innovation factors and exploit research results in the field of accessible ICT.

All three actions will address opportunities arising from cross-links and synergies between relevant communities. They will address technological and legal challenges and support coordination and networking, exploiting excellences and synergies with activities carried out in the Member States.

Block 1: multilingual technologies

a) Research and Innovation Action: A European Language grid

The action will develop and pilot - in clearly identified use scenarios - the architecture and components for a public, open and interoperable grid connecting resources and tools, sharing and combining resources and supporting language services across Europe. It shall open up access to servers and clouds and provide easy access to basic natural language processing tools and services for European languages. The action shall cater for 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 action shall also endeavour to establish competence centres / nodes in each Member States. It shall build on the previous EC-funded actions within the FP7 and H2020, address interoperability and copyrights issues.

The Commission considers that proposals requesting a contribution from the EU of about 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:

- Better access to and practical usage of language resources and tools with guaranteed quality by the European research and language technology industry
- Increase the quality and coverage of multilingual solutions used by industrial players in sectors relevant to the emergence of the Digital Single Market

b) Research and Innovation Action: Facilitating breakthroughs and accelerating the transfer of best language technology research results in various sectors

The actions should address - together with industrial users - mission-oriented challenges of social or economic relevance for overcoming language barriers in Europe. The actions should encourage technology transfer and support the take-up of language technologies in specific sectors of high commercial and/or societal impact.

Each proposal should address a single specific sector/problem area. It should include targeted research actions ("research" small scale projects) and competitive calls for fast and light

"integration" small scale projects for innovative integration of language technologies in specific operating processes/operations.

The results of all small scale projects should be made available through the European Language grid called for under appropriate licensing conditions. The action shall provide facilities for collaboration, technical and linguistic guidance, access to open-source tools and open language resources, access to venture capital, and promotion and dissemination events.

Use of cascading grants: The action will issue grants (between 100.000 and 500.000 EUR) for projects of a short duration (6 to 12 months) to third parties implementing the mini projects. Each action is required to allocate at least 70% of its grant to fund the small scale projects. Financial support to third parties should in line with the conditions set out in Part K of the General Annexes.

The Commission considers that proposals requesting a contribution from the EU of about 5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. The Commission expects to support at least 4 proposals covering different single specific sector/problem area.

Expected Impact:

- Increased transfer of best research results to industry
- Higher take-up rate of multilingual solutions in sectors relevant to the emergence of the Digital Single Market
- Cost savings for private and public sector users of language technology solutions

c) Coordination and Support Action

Coordinate of the work of the European Language grid and all actions supported under this topic. It shall identify and address barriers for deploying cross-lingual services and to establish multilingual language infrastructure at European scale. The action will address the legal and institutional obstacles, facilitate coordination between various European, national and regional activities through a structured dialogue and address framework conditions such as skills gap, the promotion of traineeships and exchanges and the establishment of best practices.

The Commission considers that proposals requesting a contribution from the EU of about 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:

- Easier access to and increased use of language resources and tools for European languages by language industry
- Better technology and language engineering skills among European graduates
- Increased use of language technologies in Europe in various sectors

Block 2: Inclusive and Personalised Learning

a) Research and Innovation Action: Digital Learning Incubator

Setting up an Incubator bringing together all relevant stakeholders to form strategic alliances that through research, innovation and deployment can jointly achieve breakthroughs in the area of personalised and inclusive learning online.

The focus is on the high level challenges for personalised and inclusive learning implemented through fast-track experimentations in form of small-scale projects, providing access to knowledge, research prototypes, learning resources and data to parties interested to conduct the experimentations.

The action is expected to launch calls for small scale projects to work on a topic/challenge set out in a roadmap. It shall foresee suitable arrangements for enabling an environment for conducting the competitive evaluation.

Use of cascading grants: The incubator will issue grants (between 100.000 and 200.000 EUR) and a short duration (up to 12 months) to third parties implementing the small-scale projects in several cycles. The incubator is required to allocate at least 70% of its grant to fund the small scale projects. Financial support to third parties should in line with the conditions set out in Part K of the General Annexes

The Commission considers that proposals requesting a contribution from the EU of around 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:

- Uptake of technology allowing for personalised and inclusive learning for all.
- Increase of 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.

b) Innovation Action – trusted digital learning identities

Develop and pilot solutions based on open components for blockchain-based certificates that enable the recognition of learning achievements, accomplished in formal and informal learning contexts. The action should take into account existing open infrastructures and components and include work on digital identities, portability and scalabilities. It should address legal, organisational and technological challenges underpinning the scalability and operability of the solution.

The Commission considers that proposals requesting a contribution from the EU of around 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:

- Emergence of new business model for blockchain-based certificates
- Enhanced portability and scalability of proposed solutions

In both a) and b), potential proposers should make best use of the work, research results and outcomes of projects included those funded by the European Commission (e.g. FP7, H2020, etc.).

Block 3: Accessibility

a) Innovation Action: Accessible ICT

Identify key research and innovation results, and based on them, highlight gaps and priorities for future accessible information and communication technologies. The focus is on the needs of and challenges faced by people with disabilities in their everyday life to access and use ICTs and the Internet. The scope of the components is open to address any disability by any solution.

Based on the identified priorities, the IA is expected to launch calls for small-scale take-up projects, evaluate the submissions and issue cascading grants for the most promising ideas.

Use of cascading grants: The incubator will issue grants (between 100.000 and 200.000 EUR) with an estimated duration of 6 - 12 months to third parties implementing the mini projects. The action is required to allocate at least 70% of its grant to fund the mini projects. Financial support to third parties should in line with the conditions set out in Part K of the General Annexes

Expected Impact:

- Wider take up of research results for more accessible ICT, including the Internet, for people with disabilities.
- Better interaction between people with or without disabilities with the use of fit for purpose, easy-to-use, user-centred technologies

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

Type of Actions: 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.

Call Timing:

Block	Objective	2018	2019	2020
Multilingual Technologies	a) A European Language grid (RIA)	4 MEUR		
	b) Facilitating breakthroughs and accelerating the transfer of best language technology research results in various sectors (RIA)	20 MEUR		
	c) CSA	3 MEUR		
Inclusive and Personalised Learning	a) Digital Learning Incubator (RIA)		5 MEUR	

	b) Trusted Digital Learning Certificates		3 MEUR	
Accessibility	a) Accessible ICT			5 MEUR
	Total	27MEUR	8 MEUR	5 MEUR

Cross-cutting activities

ICT-39-[2018]: S+T+ARTS = STARTS – The Arts stimulating new forms of innovation

Specific Challenge: The European Union strongly promotes innovation to compete globally and to make our society more sustainable and inclusive. Artists can stimulate innovation through their transversal competencies and unconventional thinking. The challenge of the S+T+ARTS=STARTS topic is to fully engage artists in H2020 to help better address industrial and societal challenges raised by key priorities in LEIT.

Scope: Lighthouse pilots will address concrete industrial/societal problems and develop art-inspired solutions to these problems. They will engage technology and the arts jointly in development, exploration and novel uses of technologies that respond better to human needs. The topic will help creating a STARTS ecosystem stimulating innovation in H2020.

a) STARTS light house pilots (RIA instrument) shall engage industry, technology, end-users, and artists in a broad exploration of technologies and their uses with the aim of creating new products and services as well as new processes for innovation. The value-added of artistic practices to overcome concrete challenges has to be clearly put forward.

It is expected to fund one lighthouse pilot in each of the two topics below:

(i) Light house pilot in 'art-inspired smart environments' (linked to ICT-x-20xx) will address media for creation of smart environments for homes, mobility or urban spaces. It will drive the art-driven design and development of digitally enhanced media and products for such smart environments.

(ii) Light house pilot in 'art-inspired urban manufacturing' (linked to ICT-x-20xx) will address the future of small scale production and production value chains. It will advance art-driven design and prototyping of next generations of digitally-enabled small-scale production.

b) Support Action (CSA instrument) to create a STARTS ecosystem by coordinating art-relevant aspects of the two lighthouse pilots and other H2020 projects that include prominently artists in their innovation processes. Such projects are encouraged in a number of topics such

as Internet of Things, wearables, transport, health, and creative industries.

Tasks include analysing best practices for including artists in H2020 projects, organising conferences, workshops and online spaces where these projects as well as interested artists and technologists can meet, present artistic results from such collaborations in highly visible exhibitions and assist future H2020 proposers willing to include artists in their teams.

To address the scope appropriately, proposals may request contributions from the EU of a maximum of EUR 4 million for each of the two light house pilots and EUR 1 million for the support action. At least 30% of the EU funding requested shall be allocated to representatives of the Arts. To this end, projects may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. All proposals should target duration of 3 years.

Expected Impact:

- The value-added to industry in having artists contribute to the development of radically new products, services and processes in the chosen domain (RIA)
- Signalling effect for future uptake of art-driven solutions to concrete industrial and societal challenges (RIA, CSA) and art-driven user-centred products and services.
- Efficient working models how art-technology collaboration can contribute to innovative processes in research and industry (RIA, CSA)
- Capacity to create and sustain a burgeoning STARTS ecosystem involving all stakeholders including industry, technology, end-users and artists (CSA)

Budget: a) IA: 8 MEUR, b) CSA: 1MEUR

Call Timing: 2018

ICT-40-[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 supports innovators in going to market. Actions under this heading reinforce the Startup Europe¹⁹ and Innovation Radar²⁰ initiatives and links to the activities of the European Innovation Council in a complementary way by focusing on ICT innovators that are not supported by the EIC.

Scope:

¹⁹ <http://ec.europa.eu/digital-agenda/about-startup-europe>

²⁰ <https://ec.europa.eu/digital-agenda/en/innovation-radar>

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 ecosystem²¹.

a. Innovation actions

Connecting local tech ecosystems and supporting cross-border activities: among the 4-5 hubs connected by each project, at least half of them will be located in less developed ecosystems. The project should develop a single online entry point to each one of the ecosystems and connect them to the **Startup Europe one-stop-shop**. Cross-border activities will include: connecting tech entrepreneurs with e.g. potential investors, business partners, accessing skills and services helping startups soft land in new international markets. Particular focus will be placed on stimulating partnerships between scaleups and corporates with a view to procurement, mergers or acquisitions. Similar attention will be placed to support SMEs, startups and scaleups, wherever situated in Europe, to access public procurement opportunities across borders.

b. Coordination and support actions

- Provide targeted and tailored support to SMEs, startups, scaleups, spinoffs and market-oriented researchers planning to launch a spin-off, who are supported by EU funded ICT projects²² 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 3rd party data sources is welcomed).
- Support 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

- Connecting tech startup hubs and their companies (startups and scaleups) to the larger European business ecosystem seeking maximum synergies;

²¹ 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.

²² From Framework Programme 7, Competitiveness and Innovation Program and Horizon 2020 programme.

- 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 digital sectors through increasing the number of cross-border investments; Demonstrate sustainability of proposed actions beyond the life of the project.
- Where appropriate, seeking synergies with ESIF funds or ESIF supported actions in order to improve the synergies between H2020 and ESIF.

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: IA and CSA

Indicative Budget: EUR 10 Mio for IA, EUR 1.5 Mio for CSA.

The Commission considers that proposals requesting a contribution from the EU of around 1,5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. The intention is to select minimum one proposal for each of the themes described.

ICT-41-[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 action targets 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.

Scope: PCP Actions

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 Procurement²³. This topic is open to proposals for PCP actions in all areas of public sector interest requiring innovative ICT based solutions. The work will complement PCP Actions under other challenges in ICT LEIT. 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.

²³ <https://ec.europa.eu/digital-single-market/en/pre-commercial-procurement>

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.

Expected Impact:

- Reduced fragmentation of demand for innovative solutions by enabling public procurers to collectively implement PCPs in areas, which due to their nature are better addressed jointly, or which they would not have been able to tackle independently;
- 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

Indicative Budget: EUR 6 million from the 2018 budget, EUR 6 million from the 2019 budget (same topic calling once per year in 2018 and 2019)

ICT-42-[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 and its hubs play in Fintech so that EU startups can better scale-up across Europe and at global level.

Scope:

- Bring together a group of regulatory bodies and other relevant organisations to investigate new approaches for piloting innovative Fintech solutions and facilitating their operations and scale-up across borders in Europe.
- Build capacity and expertise to offer specific advice to Fintech startups to support their growth 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 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 DLT/blockchain based or algorithmic regulation based initiatives.

Expected Impact:

- Support Europe's leading position with practical approaches for Fintech experimentation frameworks; support collaboration between regulators and experts when appraising new Fintech solutions and cross border implementation, to provide clear guidance to (Fintech) firms that want to grow and scale-up across Europe.
- Develop common understanding, interpretation and expertise regarding 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: CSA

Indicative Budget: EUR 2.5 million from the 2018 budget.

ICT-43-[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 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 that will lead to a selection of an additional pool of specialists that may be needed to fulfil the scope of the proposal. 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 facilities for funding experts within the topic ICT-40-2017.

The Commission considers that proposals should cover a period of at least three years.

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 of Europe into international ICT standardisation, ensuring promotion of European requirements and interests;
- Set-up of a facility to support participation of European experts in international ICT SDOs and technical bodies.
- Increase the participation of European experts in international ICT Standardisation activities to support European interests.
- 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: CSA

Indicative Budget: EUR 4 million from the 2020 budget.

International Cooperation Activities

International Cooperation Activities – Outside 5G PPP
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US

Both EC and NSF address the challenge of advanced wireless research beyond 5G focusing on game changing technologies for wireless communications, including 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. They capitalize on existing testbeds and projects to reach further frontiers like Tbit/s wireless communications.

The agreed aim is to establish a set of actions including cooperation between projects, exchange information, nurture academic exchanges of researchers and scientific workshops, realize common transatlantic experiments and link platforms and testbeds, foster common options for standards ahead of worldwide competition for beyond 5G connectivity systems and services.

An EU US Working Group with about 20 Wireless platforms/ testbeds participants will provide a draft of topics for actions this week.

Budget: 2M€

Type of Action: CSA

Cloud & Software

EU Cooperation and International Dialogues in Cloud & Software Research and Innovation

Type of Action: 2 CSAs

Target Countries: Japan, South Korea (1 CSA each)

Budget: 3 Mio (1.5 Mio each).

Focus:

- Encourage and facilitate structured cooperation and exchanges of views between the relevant EU and Japanese [*resp. South Korean*] stakeholders on matters relating to cloud and software R&I trends and challenges; identify and map the relevant legislation and policies in place stimulating innovation in and deployment of cloud solutions.
- Support the EU-Japan [*resp. EU-South Korea*] ICT dialogue in the area of cloud & software;
- Identify opportunities for future cooperation between the European research and innovation ecosystems (including standardisation) and policy makers and the corresponding institutional and private Japanese [*resp. South Korean*] entities.

Next Generation Internet

US

The focus of the international cooperation activities on NGI will be the US given their clear leadership role in this area. It builds upon today's fruitful co-operation in the area of experimentation and the well-established links with NSF, including regular video conferences to define the terms and scope of the collaboration. The aim is to have a continuous dialogue and collaboration among the key actors in the US and European programmes.

We are currently identifying potential research areas for collaboration, such as immersive environments, distributed architectures, personal data spaces, or software defined technologies. This will be followed by expert meetings (from both sides) to select the set of research areas of common interest for the cooperation.

Based on initial discussions with NSF, we are considering several instruments to implement the collaboration:

- Coordination and support actions: allow to organise workshops and other support activities to facilitate the coordination of the initiatives in the EU and US, and to promote collaboration between the research groups. **CSA of 0.8 m €**
- Coordination and support actions: building up over time a joint online and off-line think-tank on the Next Generation Internet as open ecosystem engagement tool and repository for initiatives, positions and key actors. **CSA of 0.8 m €**
- Fellowship programme: 3-6 months placements for young promising Internet leaders from academia and hi-tech startups into each other Internet ecosystem. **CSA of 2 m €**

For all the activities mentioned above, the basic principle for the collaboration will be that the EU and the US launch synchronised initiatives, with the same focus and similar size, but the EU part and the US part of the initiative remain completely independent in financial, administrative and contractual terms.

Total budget: 3.6 m Euro

International cooperation in IoT

In the era of worldwide IoT deployment, the overall rationale for IoT international cooperation as part of the DSM is to prepare the ground for market access, the creation of

interoperable products and services, and standardisation. Promising areas are novel interfaces coupled with Artificial intelligence, and the integration of interface technologies with underlying flexible and self-organising platforms. Favourable use cases are strategic areas such as Smart Agriculture, Smart Cities, Smart Industries but also those for sustainability like Reverse logistics and Water management.

Depending on the country, there is a stronger interest for application/service driven or technology driven cooperation. A continued IoT international collaboration will also extend the recently launched IoT European Platform Initiative (EPI) and IoT Large-scale Pilots (IoT LSP) to build a vibrant and sustainable IoT-ecosystem in Europe, and link AIOTI – the European Alliance for Internet of Things Innovation with similar initiatives abroad, e.g. with the IoT Acceleration Consortium in Japan or with Câmara M2M in Brazil.

Japan

Following the Integration and federation of IoT with Big Data and Cloud, which has been explored in the past calls, a remaining challenge is to evaluate the ongoing collaboration before proceeding to the identification of future topics of cooperation. A common interest in developing the security elements of our collaboration could offer an opportunity to link research with our policy objectives on the Human centred IoT.

A Coordination and Support action would identify and enable the twinning of projects on the two sides and define future topics for collaboration.

Proposed budget (CSA), 1 MEUR (together with other Units)

Korea

In order to create harmonised IoT architectures and reference implementations, integrating future generations of devices for cross application silo implementation of IoT, Korea is putting a lot of effort in IoT platform development. Europe supports the development of sophisticated platform architectures for smart objects, embedded intelligence, and smart networks. However, future IoT platforms need to be capable of dealing with sophisticated interfaces (augmented and virtual reality) and fully exploit the roll out of emerging low-power wide area (LPWA) networks. The benefits of this collaboration would be to discuss roaming between long-range wireless networks as well as to commonly enrich strong platform developments in both regions with next generation IoT interfaces. A Coordination and Support action would identify and enable the twinning of projects on the two sides and define future topics for collaboration.

Proposed budget (CSA), 1 MEUR (together with other Units)

Brazil

The specific interest in IoT cooperation with Brazil lays in the rich potential of uses cases of common interest, particularly regarding sustainable development and efficient use of resources. At the same time Europe's interest is in the extended use and application of European IoT architectures, platforms and standards in other regions. Given the envisaged collaboration between the two industrial associations (Câmara M2M in Brazil and AIOTI in Europe) a Memorandum of Understanding will be signed in February 2017. Expected benefits are sharing of knowledge and experience and input for standardisation.

In the remainder of H2020, the envisaged collaboration could be limited to **collaboration between respective industrial associations** and a **Coordination and Support Action** to identify potential subjects and projects for twinning.

Proposed budget (CSA), 1 MEUR (together with other Units)

USA

Building on the close and long-standing collaboration between Future Internet Research and Experimentation (FIRE) and GENI, the similar initiative of the National Science Foundation (NSF) in the US, a closer collaboration can now be established with twinning of projects. This would allow the exchange of results from a large-scale pilot perspective, given the huge interest of the US e.g. in Smart Cities applications over a city-scale testbed and in particular with the upcoming IoT pilot on cities as reference zones.

Twinning of projects would allow a common work programme with the same opening and closing dates, but separate evaluations in order to select winning twinned projects. This activity can be included first in a CSA for establishing subjects for collaboration and strategies for exploitation of results.

Proposed budget (CSA), 1 MEUR

Unit	Topic	Country	Call Instrument	Funding MEuro	Project type
E4 together with other Units	Collaboration could be on multiple topics, not just IoT	Japan	Twinning	1	CSA
		Korea	Twinning	1	CSA
		Brazil	Twinning	1	CSA
		USA	Twinning	1	CSA

Support to hubs

The Digitising European Industry Strategy²⁴ aims to ensure that any business in Europe should have access to a Digital Innovation Hub at ‘a working distance’. A Digital Innovation Hub (DIH) 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 of digitising and transforming Industry, 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. Organisations participating in the call should demonstrate that they are deeply rooted in a digital innovation hub that offers digital transformation services to companies in its proximity.
2. Every project should support a critical mass of dedicated innovation experiments bringing together technology suppliers and users. The action may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes.
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 needs and dissemination. The use of established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network is encouraged.
4. Selected projects are expected to collaborate on building a network of Digital Innovation Hubs, covering most regions in Europe.

In this work programme, the following eight areas are calling for Digital Innovation Hubs:

- DT-01-2020: I4MS (phase 4) – uptake of digital game changers and digital manufacturing platforms (detailed below)
- DT-02-2019: Smart Anything Everywhere (detailed below)
- ICT-07-2018-2020: Photonics Innovation Hubs (detailed under the DEI section)
- ICT-14: Robotics – Establishing Digital Hubs, System Platforms and Focus Application Area (FAAs) (detailed under the DEI section)

²⁴ <https://ec.europa.eu/digital-single-market/en/digitising-european-industry>

- ICT-30-2020: 5G PPP – Network innovations with 5G third party services (detailed under the 5GPPP section)
- ICT-19-2018-20: Big Data PPP: Methods and tools for extreme-scale analytics, and innovation hubs (detailed under the European Data Infrastructure section)
- Call from DG AGRI on ICT Innovation for agriculture – Digital Innovation Hubs for Agriculture (detailed under Societal Challenge 2 programme part)
- Call from DG RTD on Upscaling and technology hubs: Open nanotechnology and advanced materials hubs (detailed under the LEIT NMBP programme part)

Coordination and Support Activities Digital Innovation Hub network

The action will link up sectoral 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. The action will contribute to a catalogue of Digital Innovation Hubs which is currently under development and will be available on the S3 platform for industrial modernisation. For this support action, close cooperation with other CSAs funded under the Digitising European Industry focus area is required.

Type of Action: Coordination and Support Action

Budget per Type of Action: 1 M€ for one CSA

DT-01-[2020]: I4MS (phase 4) – uptake of digital game changers and digital manufacturing platforms

Specific Challenge:

Provide support to SMEs and mid-caps in the manufacturing sector to help them adapt their production processes, products and business models to the needs of society for personalised products and to facilitate cost effective small-scale production contributing to a circular economy.

Scope:

a. Innovation Actions

As Phase 4 of I4MS²⁵, this 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 in order to develop new products, production processes or business models.

1. **IoT and cyber-physical systems contributing to the circular economy:** Adoption and piloting of CPS/IoT in production environments, with special focus on reduction of waste, energy and resource consumption and efficient logistic processes.

²⁵ www.i4ms.eu

2. **Human-robot cooperation:** Adoption of robots safely cooperating with humans to support their work, improving both the efficiency and the working conditions. The focus would be on minimising the entry barriers and demonstrating the clear added value of such technologies in making the SMEs and mid-caps more competitive.
3. **Analytics, simulation and artificial intelligence:** Adoption and piloting of data analytics, simulation, and artificial intelligence services that bring significant advantages to production processes, in particular the interaction between design of products - understanding customer preferences – understanding the way products are used by the customer.
4. **Additive Manufacturing and 3D printing:** Adoption and piloting of highly productive laser processes in digital manufacturing solutions. This subtopic will be called for in 2018.
5. **Uptake of emerging platforms by SMEs and mid-caps:** The goal is to support ecosystem building for promising platforms developed in earlier R&I projects developed under the topic FoF 04 "Interoperable Digital Manufacturing Platforms" and predecessor topics.

The Commission considers that proposals requesting a contribution from the EU of up to 8 million would allow each area 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 of technologies.

b. Coordination and Support Activities

The action will support the network 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. This shall include maintaining a single innovation portal, sharing of best practices, dissemination, brokering between users and suppliers, leveraging investment and training. For these support actions, close cooperation with the European Factories of the Future Association (EFFRA[4]), and other CSAs funded under the Digitising European Industry focus area is required.

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.
- 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 Actions and one_Coordination and Support Action

Budget per Type of Action: Budget of € 64 million for IAs and 1 M€ for one CSA is dedicated to this topic.

DT-02-[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 underexploited²⁶.

Scope:

a. Innovation Actions

As Phase 3 of Smart Anything Everywhere, this 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. Innovation actions are expected to focus on one or more of the following four areas of technologies.

- 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. This area should also support eco-system building for promising platforms developed in earlier R&I products.
- 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 and to support eco-system building for promising platforms developed in earlier low power computing projects.
- Area 3: Nanoelectronics and Electronics Smart Systems: 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.
- Area 4: Large area electronics: The goal is to help businesses in further maturing, innovating and validating their products with thin, organic and large area electronics technologies, including wearables. Focus is on i) access to design, technology and prototyping which are mature and ready to use, and ii) application experiments driven by concrete user requirements and business cases.

²⁶ For an overview of already existing projects in this initiative see www.smartanythingeverywhere.eu/

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 of technologies.

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 required.

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.
- 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 Actions and one Coordination and Support Action

Budget per Type of Action: € 49 Million for IAs and 1 M€ for CSAs

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. Platforms are often understood as “multi-sided market gateways creating value by enabling interactions between several groups of economic actors”²⁷. A broader interpretation would be “agreements on functions and interfaces between industry players that create markets and market opportunities leading to ecosystems and standards”. This encompasses platforms (in the narrow sense) together with reference architectures, interaction protocols, and interoperability frameworks.

Proposals are expected to make a significant step forward in platform development, interoperability between existing platforms, integration of relevant digital technologies such as IoT, AI, photonics, robotics, cloud and Big Data, and validation via pilots and

²⁷ COM(2016) 180 final, 19 April 2016

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

Various platform development activities exist at EU or national level. 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 applicable²⁸.

Proposals need to address all of the three overlapping phases/activities, namely platform development, large-scale piloting, and ecosystem building.

In platform development, proposals need to develop next-generation digital platforms, which build on the state-of-the-art, reuse what is available and usable, and integrate different technologies. 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. The interfaces of the platform need to be described via open specifications. A major aim is to offer platform functionalities that can be generically reused in multiple usage contexts to support various types of applications and services. For the software prototypes developed in the projects, 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. APIs and SDKs should be made available to third party developers for the development of complementary applications.

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 making use of the digital platforms. 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 provide interoperable solutions that provide an experience that customers or business require, to test them in complex regulatory environments, and to provide guidance for secure and safe implementation.

In ecosystem building, the take-up of digital platforms is fostered by increasing the ecosystem of players involved and by standardisation activities. For instance, small and innovative ICT players such as SMEs 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. Proposals need to cater for contributions to suitable standardisation bodies, leading to new or better standards as outlined in the Communication on Priorities of ICT Standardisation for the Digital Single Market.

In large-scale piloting and ecosystem building, projects may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. Consortia need to

²⁸ Relevant ongoing initiatives 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.

define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 20 000 – 100 000 per party). Maximum 50% of the EU funding can be allocated to this purpose.

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, both in the public and private spheres, industry, businesses and public services. Key performance indicators should be identified to measure progress on citizen benefits, economic growth, jobs creation, environment protection, productivity gains, etc.

In particular:

- Reaching a high leveraging effect on other sources of funding, in particular regional and national funding
- Pooling of resources via the federation of other, bottom-up initiatives, supported by regional, national and European policies and funds,
- Increased opportunities for entrepreneurs by promoting new market openings allowing also smaller and newer players to capture value.
- Significant and measureable contribution to standards or pre-normative activities in the domains of the projects.
- Validation of technological choices, sustainability and replicability, of architecture models, standards, and interoperability, as well as of non-functional characteristics such as security and privacy.
- Exploration and validation via large-scale piloting of new industry and business processes and innovative business models.
- Sustainable ecosystems and contributions to digital transformation.

For all pilots, proposals should describe how the proposed work will contribute to one or more of the following impact criteria, as appropriate, and provide metrics, the baseline and targets to measure impact.

Proposals are called for under the following topics:

LEIT-ICT

- ICT-18-2018-20: Big Data and HPC PPPs: HPC and Big Data enabled Large-scale Testbeds and Applications
- ICT-27-2018: 5G PPP – 5G for connected and automated driving
- DT-03-2018: Digital Manufacturing Platforms for Connected Smart Factories

LEIT-ICT + SC1

- DT-07-2018: Smart living at home
- DT-08-2020: The smart hospital of the future

LEIT-ICT + SC2

- DT-04-2019: Digital platforms for Agriculture

- DT-05-2020: Digital service platforms for rural economies
- **TBD**: Next-generation food data platforms for transparency [RTD-F]

LEIT-ICT + SC3

- DT-06-2018/19: Smart and energy-efficient homes

LEIT-ICT + SC4

- **TBD**: Automated Road Transport

LEIT-ICT + SC6

- Transformative impact of disruptive technologies in public sector administration
- Pilot on using the European cloud infrastructure for public administrations
- New form of delivering public goods

LEIT-NMBP

- **TBD**: Digitising the process industry
- **TBD**: Smart construction and buildings
- **TBD**: Plug & Produce Components for Digital Factories

DT-03-[2018]: Digital Manufacturing Platforms for Connected Smart Factories

DT-04-[2019]: Digital platforms for Agriculture

DT-05-[2020]: Digital service platforms for rural economies

DT-06-[2018-19]: Smart and energy-efficient homes

Digital transformation of health and care

DT-07-[2018]: Smart living at home

DT-08-[2020]: The smart hospital of the future

DT-09-[2019]: Supporting cross-cutting pilots

Specific Challenge:

Coordination and Support activities are needed to support the operation of the pilot projects under the topics in this Focus Area. These activities are expected to identify synergies among

the projects, to promote cross-fertilisation, and to exchange best-practices and lessons learned. Furthermore, they need to promote the results obtained, addressing and enlarging the ecosystems around the projects, and supporting the transfer of skills and know-how to industry.

Type of Action: Coordinated and Support Actions. The Commission considers that proposals requesting a contribution from the EU up to EUR 1-1.5 million would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Budget: 3 Mill. € for 2 or 3 CSAs

**Boosting the effectiveness of the Security Union: Cybersecurity PPP Call
(H2020-SU-2018-20)**

Cybersecurity

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. Digital security and privacy should be addressed with cross-cutting approaches. Challenges include assuring security and privacy in the design and management of networks, achieving a high degree of trust in EU digital networks, products and services and developing the ecosystem of skilled professionals, educators and EU-wide harmonized regulation, policies and standards. Specific research topics should be complemented by multidisciplinary research on longer term challenges, addressing non-technical aspects of cybersecurity and digital privacy such as economics and law as well as political science and international relations.

SU-ICT-01-[2018]: Cybersecurity PPP: Assurance of resilience in evolving ICT systems.

Specific Challenge:

Software and hardware systems must be designed having privacy and data protection features in mind from the beginning, providing adequate security and privacy in challenging environments as well as guaranteed means to measure them. The challenge is to develop mechanisms that certify the origin and/or the performance of these products and that enhance consumer control, and tools aiming to ensure the trust in the security/privacy levels of the components along the supply chain. The dynamic character of the environment, including human aspects or rise of new vulnerabilities are additional challenges.

Scope:

Proposals should address at least one of the following three strands:

1) Cybersecurity certification and standardisation

- Develop mechanisms that ease the process of certification at the level of services. These mechanisms may include the creation of a European Data Privacy Label to give companies with privacy-respecting practices a competitive advantage over other companies that make profit from personally sensitive data.

- Address the evolution of the level of certification with respect to the dynamicity of the deployed environment, also taking the human factor of this environment into account.

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.

2) Trusted supply chain for ICT systems

- Methods for developing resilient systems out of potentially insecure components
- Certification and security assurance methodologies such as:
 - Composition: defining security claims for composed systems and certifying the security contributions of components
 - Certification methods allowing harmonisation and mutual recognition based on evidence and not on trust
- Open source security: Identifying and assessing vulnerabilities, understanding the source code (e.g: slicing, impact analysis, dependency analyses)
- Black-box security validation: model generation, automated testing, fuzzing, coverage.
- Binary code security analysis: malware de-obfuscation, verification, relation to source code assessments.
- Interplay between functional safety and security. Tackle degraded modes due to safety or security issues.

3) Security and privacy engineering

- Methods and tools for developing privacy enhancing and secure software and hardware, such as the following ones:
 - Security and privacy requirements engineering, including attack and threat modelling, and risk analysis
 - Automated model-level security validation and testing (static and dynamic and their combination), exploiting the knowledge of architecture, code, and development environments (white box) and coverage.
 - Secure development lifecycles adopting current paradigms, e.g. agile development and DevOps.
 - Automated code-level security verification: test, runtime verification, static analyses, and their combinations, focusing on scalable taint analysis, information-flow analysis, control-flow integrity, security policy, and protocol enforcement, and considering the relation to secure development lifecycles.

- System-wide consistency: connection between models, objectives, policies, and functional implementations.
- Automated vulnerability discovery, analysis and prediction, based on large data sets (machine learning)
- Metrics for secure and privacy-friendly development
- Secure programming languages, hardware design languages, development frameworks, secure compilation and execution
- Security and privacy architectures
 - Architectural principles providing isolation of security functions in implementations with reduced complexity
 - Isolation of sensitive information processing in hardware enforced devices. Reference architectures and their implementation guidelines, targeting cloud, IoT etc.
- Secure deployment
 - Reinforcement of complex systems
 - Container / Virtual Machine security
 - Preventive security measures eliminating vulnerabilities, including runtime countermeasures

The expected TRL level at the end of the project is 5-7.

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Type of Action: RIA

Budget per Type of Action: 47M (2018)

Expected Impact:

- Improved market opportunities for the EU vendors of security components, because the market on cybersecurity/digital privacy will be more open to competition across Member States.
- The use of more harmonized certification schemes will increase the business cases for cybersecurity services as they will become more reliable. It will also create appropriate conditions for more commercial IT applications and services to integrate the use of EU labelling in the cybersecurity and digital privacy fields.

- Validation platforms will provide assessments with less effort compared with nowadays, because they will be more able to handle the specificities of various jurisdictional or national systems
- Increased trust along the supply chain of ICT products and services.
- The improvements in the levels of security/privacy of ICT products/services will be demonstrable, because these levels will be measurable.
- Increased trust both by developers using/integrating the ICT components and by the end-users of IT systems.
- Better compliance with relevant regulations and standards.

SU-ICT-02-[2019]: Cybersecurity PPP: Dynamic countering of cyber-attacks.

Specific Challenge:

The prevention of and protection against attacks in modern ICT components, infrastructure, and systems remains a complex task. The complexity of heterogeneous collections of hardware and software components finds its roots in the diversity of individual development contexts and levels of maturity, the growing means of networked interactions, and finally the varied lifecycle schedules that generate highly dynamic behaviours. The challenge is to design, implement, and verify high-assurance components, systems, and infrastructures.

Scope:

Proposals should address at least one of the following two strands

1) Assurance and protection against cyber attacks

Applicants should propose integrated, holistic approaches including the minimisation of 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 social and human aspects in the engineering process until developed systems and processes address the planned security/privacy/trust properties.

Proposals may cover secure execution environments not only including the execution platforms themselves plus the operating systems, but also the mechanisms (e.g. security supporting services, control and intrusion prevention systems) that ensure an adequate level of security in the execution of all processes. As multiple systems and paradigms will interact with each other in a distributed and dynamic environment, it is crucial to achieve a full secure integration of all of them, taking into account the

integration/migration of legacy systems, whose components and protocols are not usually up to the security and privacy risks.

Proposals may also take into account means of assisting the users in handling security-related tasks, providing users with usable information on the trustworthiness of systems and environments and including citizen science approaches to improve the quality of human sensors network for security.

2) Cyber-attack management: response and recovery

Response and recovery are typical ingredients of managed security services. These capabilities are required for any entity targeted by cyber-attacks.

The Response and Recovery related items to be addressed by proposals are:

- Combining automation with human expertise, in ways adapted to specific customer environments and requirements. Capabilities to support human operators, such as Incident Response (IR) professionals, in controlling Response and Recovery actions, including information visualization.
- Risk- and cost- based models for Response and Recovery decisions to evaluate, prioritize, and select security countermeasures and remediation actions for complex cyber-attacks; metrics of the Return On Response Investment (RORI) type.
- Integration and cooperation between modules implementing Protect, Detect and Response & Recovery functions.
- Utilization of and contribution to appropriate Threat Intelligence sources. Relevant information sharing within industry cooperation groups and Computer Security Incident Response Teams (CSIRTs).
- Response and Recovery aspects specific to environments and emerging technologies such as Industrial Control Systems, IoT, Transportation (including connected vehicles), virtualised and service-oriented systems and networks, cloud and hybrid ICT infrastructures, cloud hosted applications.
- Log management principles, tools, and practices. Utilization of logged information for Recovery activities and retrospective analysis, including forensics.
- Forensics and attack attribution for better protection against similar attacks in the future and for supporting possible investigations by Law Enforcement Agencies.
- Remote forensics capabilities for shortening incident response and recovery actions planning time.
- Measuring the platform and related Response and Recovery processes against red-team assessments.
- Guidance for the users and security personnel: security incident reporting, security incident taxonomy, symptom checklist, IR service activation checklist, etc.

TRL level: 7

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

Type of Action: IA

Budget per Type of Action: 40M (2019)

Expected Impact:

- Enhanced protection against emerging novel advanced threats.
- Better Response and Recovery technologies and services will help organizations significantly reduce the impact of breaches with various levels of success in penetrating the defences.
- Proven and standardized techniques and practices of security log management, incident reporting, cost-based Response and Recovery decision-making, and incident information sharing. These will also enable more effective and timely co-operation in resolving incidents and higher preparedness of the users to dealing with incidents and their consequences.
- 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.

SU-ICT-03-[2020]: Cybersecurity PPP: Advanced technologies for cybersecurity and digital privacy.

Challenge:

Since the advent of the Internet ever-more data resides inside centralized hubs. This increases the dependence on trusted third parties to coordinate transactions which in turn increases the vulnerability to cyber-attacks. Quantum computing has the potential to challenge current approaches to cryptography and to bring new threats. A major challenge is therefore to develop new and efficient public-key cryptographic schemes and protocols that resist attacks on or from forthcoming quantum computers. It is also to develop tuneable authenticated encryption schemes that offer a broad trade-off between security on the one hand and energy/power/latency on the other hand and to develop open and efficient white-box crypto solutions.

Scope:

a) Enhanced cryptography for our time as well as for the future and

- Research into short-term alternatives for the migration to post-quantum cryptography, such as increased key lengths or other "drop-in" solutions
- Developing new quantum-safe crypto methods and algorithms for both asymmetric and symmetric cryptography.
- Research on the usability and efficiency of current and novel suggestions for methods for post-quantum cryptography including their integration in security protocols; as they offer present performance challenges, it is anticipated that the protocols need to be adapted to make optimal use of them.
- Transition from present-day crypto systems to quantum-resistant cryptography (or post-quantum cryptography)
- Developing evaluation criteria for quantum-resistant public key cryptographic standards and implementations.

b) Trusted networks and protocols for Digital Security

- Research on distributed trust networks allowing offering security by design and reducing significantly the level of vulnerability of ICT systems.

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.

TRL 4-5

Type of Action: RIA

Budget per Type of Action: 28M (2020)

c) Distributed trust management and digital identity

- Authentication of artefacts (code, (sensor) data, ...),
- Flexible authentication and authorisation, dynamic integration of different schemes, compatibility assessment
- Interoperability and scalability of authentication
- Distributed trust management solutions, e.g., ledgers, Block Chain, formalised characteristics of such solutions that allow the assessment of their feasibility in a specific context (Security assumptions)

- Distributed root of trust, dynamic root of trust
- Machine-to-machine and machine-human authentication mechanisms for IoT components
- Partial identities (or identity diversification) in order to build technologies that allow users to split their identities for different aspects of life.

d) Machine learning & analytics for cybersecurity

Deep learning is a technique that recently has shown to be able to improve many different software challenges (e.g. image recognition). It seems also promising to be used to recognize cyber-attacks. Deep learning applications may be trained to learn without human intervention whether a file is malicious or legitimate and so screen out malware, spam and other infections before they have a chance to harm.

TRL 6-7

The Commission considers that proposals requesting a contribution from the EU of between EUR 4 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Type of Action: IA

Budget per Type of Action: 24M (2020)

Expected Impact:

- Deep learning applications that can provide a breakthrough in the fight against cyber-attacks.
- An EU industry better prepared for the eventual appearance of quantum computers
- More lasting protection for confidential and classified information
- Minimal time window of potentially unsafe cryptography
- Standardisation towards quantum-resistant cryptography with forward secrecy
- Government agencies of EU Member States will have more means to protect sensitive/classified information, in order to preserving national security.
- Privacy-respecting identity management schemes
- Further steps towards interoperable and scalable identity management schemes
- Larger adoption of distributed trust management frameworks
- Authentication operates in a distributed fashion without single points of failure on critical paths and considering small scale devices as used in the Internet of Things.
- Increased trust in the digital economy, including developers of components and end-users of ICT systems.

- Requirements for trusted security credential provisioning (e.g. trusted secure elements)
- More efficient on-line products, services and business.
- Trusted networks and network protocols that can provide a breakthrough in the fight against cyber-attacks and make the live of European citizens, organisations and governments more cybersecure

Other actions

Awaiting from DG BUDG final confirmation for the possibility of using blending instruments and transfer this money to DG EAC for a pilot "Erasmus Digital" to be implemented through Erasmus +.

"Erasmus Digital" is a pilot program supporting internships in the digital domain, aiming at reducing skills mismatches due to the fast changing technological environment. It will support the digital skills development of students from all faculties as well as of teachers. Digital skills are needed to take full advantage of opportunities emerging in LEIT ICT areas (e.g. data analytics, content, computing).

The proposed budget for this pilot is EUR 10 Million, to be distributed over 2018-2020 as follows:

- 2018: EUR 2 Million
- 2019: EUR 4 Million
- 2020: EUR 4 Million