EN

Annex 6

Horizon 2020

Work Programme 2016 - 2017

5.i. Information and Communication Technologies

Important notice on the second Horizon 2020 Work Programme **This Work Programme covers 2016 and 2017. The parts of the Work Programme that relate to 2017 are provided at this stage on an indicative basis. Such Work Programme parts will be decided during 2016.**

(European Commission Decision C (2015)XXXX of JJ Month 2015)

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Introduction

Digital technologies underpin innovation and competitiveness across a broad range of market sectors. The topics addressed in this Work Programme part cover the ICT technology in a comprehensive way, from key enabling technologies to networking technologies, robotics, content and information management technologies. Pursuing the change initiated under Work Programme 2014-2015, activities will continue to promote more innovation-orientation to ensure that the EU industry remains strong in the core technologies that are at the roots of future value chains.

Firstly, this WP will support core ICT industries through roadmap-based Public Private Partnerships (PPPs). The work will contribute to maintaining and developing the technology leading edge in key areas such as electronics, photonics, embedded systems, computing, robotics, big data or network technologies and systems, in which the EU has and should keep major strengths. The ECSEL Joint Undertaking on electronic components and systems and the contractual PPPs will continue to be cornerstones for this strategy.

Secondly, the innovation capacity will be further supported through a strengthening of the 'Open and Disruptive Innovation' topic directed towards SMEs and through the new open call on 'Fast Track to Innovation' (FTI). All available demand-side instruments and accompanying measures will continue to be exploited in order to reinforce the involvement of end users, support digital entrepreneurship, strengthen support to start-ups and SMEs and as a result more effectively embed innovation in LEIT-ICT.

Proposers are encouraged to use FIWARE for some or all of their platform developments, when relevant. Projects aiming to develop specific platforms, are encouraged to make them interoperable with FIWARE. FIWARE enablers are available at www.fiware.org under open source licence for business use. Free online training, a sand-box environment and technical support are available, equally, proposers may contribute to the evolution of FIWARE. Proposers may propose different platform technologies.

Application of Language Technologies is supported under topics ICT-14, 15, 16 (Big data PPP). Proposers addressing other topics are encouraged to make use of Language Technologies (e.g. machine translation, speech recognition, dialogue management, text analysis, text generation), if the proposal involves analysis or interpretation of information expressed in human language, or if the proposal addresses human-to-human or human-to-machine interaction or communication.

Particular attention will be given to the engagement of a broad set of relevant stakeholders. Wherever relevant, key principles to encourage a responsible approach to research and innovation are included in this WP part. The WP also includes support to the establishment of a structured dialogue between creative people and technology developers and to the integration of artists into research and innovation projects. Security also remains a key

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

Finally, the international dimension of ICT activities is reinforced through joint calls with Brazil, Japan and South Korea on a set of specific topics, a targeted call to help build partnerships with sub-saharan Africa and ASEAN countries, as well as additional support actions towards improved cooperation with China and Mexico.

Call - Information and Communication Technologies Call

H2020-ICT-2016-2017

A novelty in Horizon 2020 is the Pilot on Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects. Projects funded under the ICT call of the Work Programme 2016-17 will by default participate in the Pilot on Open Research Data in Horizon 2020.

Projects have the possibility to opt out of the Pilot. Participation in the Pilot is not taken into account during the evaluation procedure. In other words, proposals will not be evaluated favourably because they are part of the Pilot and will not be penalised for opting out of the Pilot.

A further new element in Horizon 2020 is the use of Data Management Plans (DMPs) detailing what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. The use of a DMP is required for projects participating in the Open Research Data Pilot. Other projects are invited to submit a DMP if relevant for their planned research. Only funded projects are required to submit a DMP.

Further guidance on the Pilot on [Open Research Data](#) and [Data Management](#) is available on the Participant Portal.

A NEW GENERATION OF COMPONENTS AND SYSTEMS

Electronics, microsystems and embedded systems underpin innovation and value creation across the economy and society. The objective is to reinforce Europe's stronghold positions in these areas and to capture opportunities arising in new growth markets driven by advances in relevant technologies. This area addresses the broad range of system level integration from miniaturised smart components and large area organic electronics to cyber-physical systems and systems of systems. It covers technology-driven R&D which is mostly cross-cutting or application-independent.

The area consists of four topics. The Smart Cyber-Physical Systems (CPS) topic is to reinforce an area of clear European strength, with a EUR 410 billion market, 4 million jobs worldwide of which one quarter in Europe. Research will focus on model-centric engineering methods. Thin, Organic and Large Area Electronics (TOLAE) is well suited for applications of micro/nanotechnologies that need large areas and/or flexibility. Research will focus on bringing innovative TOLAE-based solutions to the market. The Smart System Integration (SSI) topic focuses on integration and mastering of complexity of electronics and materials into miniaturised systems for a broad spectrum of use. The "Smart Anything Everywhere" initiative will stimulate the take up of these technologies by SMEs and mid-caps in order to increase Europe's innovation capacity and to develop more products with "digital inside".

Work is complementing the activities addressed by the Electronic Components and Systems Joint Undertaking (ECSEL, www.ecsel-ju.eu), notably focussed on higher TRL large scale federating projects and integrated demonstrations and pilots. In that context topics under this area contribute also to the implementation of parts of the Strategic Research Agendas of Artemis-IA (www.artemis-ia.eu) and EPoSS (www.smart-systems-integration.org). With its emphasis on real-time and safety-critical capabilities, work on CPS system level is complementing the focus area "Internet of Things" under Work Programme part 17, 'Cross-cutting activities (Focus Area)'.

Proposals are invited against the following topic(s):

ICT-01-2016: Smart Cyber-Physical Systems

<u>Specific Challenge</u>: The importance of the areas of the often time- and safety-critical embedded and cyber-physical systems (CPS) will continue to grow with the increasing pervasiveness of ICT and the development of the Internet of Things. The challenge is to design, programme and implement highly distributed and connected digital technologies that are embedded in a multitude of increasingly autonomous physical systems with various dynamics and satisfying multiple critical constraints including safety, security, power efficiency, high performance, size and cost. Such combination of several cyber-physical systems in "system of systems" gives rise to unpredictable behaviour and emergent properties. A significant improvement in design and programming of CPS is therefore needed including a "science of system integration".

<u>Scope</u>: **a. Research and Innovation Actions - Science of system integration:** Research and Innovation projects should address new model-centric and predictive engineering methods and tools for cyber-physical systems and systems of systems with a high degree of autonomy ensuring adaptability, scalability, complexity management, security and safety, and providing trust to humans in the loop. Work should be driven by industrial needs and validated in at least two use cases complementing each other in different application domains and sectors. Results should be integrated into broader development environments and middleware. The centre of gravity of the work should be on TRLs 1-4, with demonstrations up to level 5.

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

b. Coordination and Support Actions for structuring of constituencies, strategically updating and validating CPS roadmaps, cooperating with other European programmes such as ECSEL and ITEA on the foundations of CPS engineering, promoting platform building and pre-normative activities (such as a repository of CPS technology blocks) and consensus-building on societal and legal issues related to the deployment of CPS.

Proposals are expected to bring together leading CPS experts from academia and industry to collaborate on future CPS architectures and platforms.

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

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

- Extension of, and/or performance improvement in the supply of CPS methods and tools targeting specific industrial markets;

- Demonstrable advances in CPS engineering to reduce significantly development time and cost of ownership;

- Contribution to interoperability activities (e.g. repositories of models, interface specifications or reference architectures/platforms/patterns).

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

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

ICT-02-2016: Thin, Organic and Large Area Electronics

Specific Challenge: Thin, Organic and Large Area Electronics (TOLAE) is an emerging technology with high growth potential, well suited for applications that need large area and/or flexibility or stretchability. To be able to fully benefit from the opportunities brought by this technology and widen the scope of its applications, improvements are sought on features such as reliability, manufacturability and performance. The main challenge is to develop and also demonstrate prototypes of innovative TOLAE-enabled solutions with the above characteristics. This can be addressed in two complementing ways, hybrid integration bringing new opportunities for traditional electronics on flexible substrates and improving readiness of TOLAE technologies for use in dedicated applications.

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

Advancing the readiness of TOLAE technologies and/or hybrid integration for use in applications.

Actions will address the development of advanced materials, technologies and scalable manufacturing processes (ranging from vacuum deposition to printing under ambient conditions) and/or the hybrid integration of micro/nano-electronics (including thin silicon) and photonics components. Focus is on conformable, flexible or stretchable substrates (such as paper, plastic, metal foil, glass or textile). The goal is to have reliable TOLAE-enabled devices with more functionality, better performance and longer lifetime that are ready for use in applications with high growth or high volume potential.

Actions may include related work on design and modelling tools in particular addressing variability issues in printing, interfacing of hybrid integration and reliability. Work could also address specific needs for textile electronics.

Actions should demonstrate strong industrial and user commitment, be driven by user requirements and include validation of the results for the chosen applications. They should include standardisation and address the value chain, as appropriate.

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.

b. Innovation Actions

Proposals should cover one or both of the following themes:

- **Set-up and validation of pilot line for Hybrid Systems**

The objective of the pilot line is to provide design and development services in particular for SMEs. Focus is on manufacturing of Hybrid Systems where conventional micro-/nano-electronics and photonic components are integrated on flexible substrates. The action should be driven by stakeholders able to set-up and run the pilot line. Proposals should describe the business cases and exploitation strategy for the industrialisation of the pilot line and the pilot line should be open access by offering services to external users under fair conditions. There should be a strong commitment to manufacturing in Europe. The pilot line could make use of existing (research or industrial) pilot lines.

- **Demonstration of TOLAE-enabled product prototypes**

The objective is to develop and demonstrate innovative product prototypes enabled by TOLAE technologies in automotive, healthcare, smart packaging and buildings[1]. Proposals may include small scale pilot manufacturing.

The action should build a dedicated innovation value chain (preferably covering the full value chain).

The action should target medium- to high-volume markets, be driven by concrete business cases and address user needs. They should include exploitation strategies for the targeted products with strong commitment to industrialise and manufacture them in Europe.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 8 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. In case of proposals covering one theme, one proposal for each theme is expected to be selected.

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[1] Demonstration of wearable solutions for healthcare and well-being are addressed under topic IoT-01 Large Scale Pilots.

<u>Expected Impact</u>: 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.

a. Research and Innovation Actions

- Increased readiness of TOLAE technologies, in particular on functionality, performance, manufacturability and reliability, and wider exploitation of TOLAE in concrete applications with high-growth or high volume potential;

- Improved business opportunities and value creation in Europe by strengthening cooperation along the value chain.

b. Innovation Actions

- Fabrication of reliable hybrid systems with short time-to-market and higher investment in advanced manufacturing capabilities;

- Market introduction of innovative and competitive TOLAE-enabled products targeting medium- to high-volume applications in automotive, healthcare, smart packaging and buildings;

- Industrial leadership in TOLAE technology, improved business opportunities in Europe and strengthening Europe's position in growing market segments.

<u>Type of Action</u>: Research and Innovation action, Innovation action

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

ICT-03-2016: SSI - Smart System Integration

<u>Specific Challenge</u>: The challenge is to be able to develop and manufacture smart objects and systems that closely integrate sensors, actuators, innovative MEMS, processing power, embedded memory and communication capabilities, all optimising the use of supply power. This will require technology breakthroughs notably in integration, miniaturisation with additional functionalities and mastering complexity. This will result in highly reliable, resilient and resource efficient digital and heterogeneous smart objects and systems that could easily be made interoperable within systems of systems. As dependency on these smart objects and systems increases, reliability and security will become critical differentiating factors as well as low power consumption, energy harvesting and the capability to operate under various and harsh conditions.

<u>Scope</u>: **a. Research and Innovation Actions**

The aim is to make technological breakthroughs and their validation in laboratory environments of the next generations of miniaturised smart integrated systems, including

micro-nano-bio systems (MNBS). Proposals are expected to address the integration of new or most advanced technologies such as micro and nano-electronic, micro-and nano-electro-mechanical, micro-fluidic, magnetic, photonics, bio-chemical and microwave and related materials in miniaturised and highly reliable multi-functional smart integrated systems.

Proposals will address industrial-relevant technological developments, modelling and validation that will enable solutions in particular for health and well-being, automotive, food, telecommunication, safety and security, environmental monitoring, manufacturing or energy. Ethical issues will be paid due attention when considering the enabled solutions. The target is TRL 2 to 4, tackling hard technology challenges with results ready for full scale deployment in the next 5 years.

The work will complement the ECSEL JU support that focuses on higher TRLs.

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.

b. Coordination and Support Actions

The objective is to complement R&I activities by structuring industrial cooperation and facilitating end-user adoption for the next generations of miniaturised smart objects and systems. Proposals should include one or more of the following actions:

- Understand the emerging needs of end users and changing requirements for customer acceptance, including public procurers needs for MNBS solutions. The variety of users' needs and customers, induced by age, gender and other factors, will be taken into account.

- Support the industrial smart systems integration stakeholder community by translating industry needs into Strategic Research and Innovation Agendas, and defining measures for standardisation, regulation, policy initiatives, harmonisation and skills development

- Communicate and demonstrate the benefits and potential of miniaturised smart systems integration to users, public procurers, investors, regulators…

- Strengthen the networking and cooperation between the industrial smart systems integration stakeholder community in Europe and support to international collaboration

- Foster cooperation and clustering between projects and monitor technology advances and developments in the field

The Commission considers that proposals requesting a contribution from the EU of between EUR 0.5 and 1 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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

a. Research and Innovation Actions

- Availability of new generations of miniaturised smart systems with significant improvements in performance (including in terms of size, cost and affordability, reliability and robustness, low power consumption and energy autonomy and user acceptability);

- Reinforced industrial technology leadership in next generation smart systems with high market potential;

- Business growth and increase competitiveness by strengthening cooperation along the value chain;

- Increased industrial investment in smart system integration technologies;

- Strengthening Europe's position in the manufacturing of miniaturised smart systems;

- Provide innovative solutions for addressing societal needs and expectations in particular for the health and well-being, safety and security and environment.

b. Coordination and Support Actions

- Strengthened cooperation between the multi-disciplinarily miniaturised smart systems research and innovation stakeholders;

- Better connected smart systems technology developers and users community in selected sectors;

- Strengthened smart systems integration ecosystems and better addressing public procurers needs.

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

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

ICT-04-2017: Smart Anything Everywhere Initiative

Specific Challenge: "Smart anything everywhere" stands for the next wave of products that integrate digital technology inside. A major challenge is to accelerate the design, development and uptake of advanced digital technologies by European industry, especially among them many SMEs and mid-caps in products that include innovative electronic components, software and systems[2].

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

Scope: **a. Innovation Actions** should address all of the following three aspects.

i. Establishing across Europe networks of multidisciplinary competence centres offering one-stop shops/marketplaces for companies that want to experiment with digital technologies inside their products. Centres should act as "innovation hubs" offering facilities (access to technology platforms) and services for developing innovative products, such as design, manufacturing, rapid prototyping and life-cycle management. They should also act as brokers between suppliers and users of technology products and solutions. Competence centres are encouraged to link to existing and emerging regional (smart specialisation) or national innovation hubs. If Horizon 2020 funding is complemented by ESIF or other regional or national funds, Horizon 2020 funding should be used for carrying out highly innovative experiments that will multiply the impact of local initiatives to a European scale, and will build partnerships between businesses in Europe.

ii. Carrying out a critical mass of cross-border experiments bringing together different key actors along the full value chain to customise the technologies according to the requirements of the users. Driven by the requirements of first-time users, **Application Experiments** bring together the actors of the value chain and the experts necessary to enable new users to develop novel products or services and assist them in customising and applying these in their respective environments. Alternatively competence centers could provide access to design and prototyping and small value production or a combination of the above. Experiment descriptions in proposals should include an outline of the initial exploitation plan and business scenario. To remain flexible on which experiments will be carried out and to stay flexible in fast moving markets, the action may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. The proposal will define the selection process of additional users and suppliers running the experiments for which financial support will be granted (typically in the order of EUR 20 000 – 100 000[3] per party). Maximum 50% of the EU funding can be allocated to financial support to third parties.

iii. Activities to achieve long-term sustainability of one-stop shop / market place services by the competence centres and the eco-system. This includes the development of a business plan for the competence centres and the marketplace, of which an outline business scenario should be described in the proposal. In addition, investors should be attracted to support business development of SMEs and mid-cap actors in successful experiments. Such activities would include also dissemination and support to exploitation. Among others, communication and dissemination activities shall make use of established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network.

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[3] 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.

Innovation actions are expected to focus on one or more of the following four areas of technologies. Selected projects are expected to collaborate on building the European "Smart Anything Everywhere" ecosystem:

- 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 with innovative embedded ICT components and systems and to 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: Advanced micro-electronics components and Smart System Integration: The goal is to support electronic components, sensors, smart objects and systems (i) access[4] to advanced design and manufacturing for academia, research institutes and SMEs, and (ii) rapid prototyping targeting SMEs.

- Area 4: Organic and large area electronics: The goal is to help businesses in further maturing, innovating and validating their products with organic and large area electronics technologies. 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.

The Commission considers that proposals requesting a contribution from the EU of up to 7 million would allow areas (1), (2) and (3) to be addressed appropriately. The Commission considers that proposals requesting a contribution from the EU of up to 3.5 million would allow area (4) to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. It is expected that a minimum of one innovation action is supported for each area of technologies.

b. Coordination and Support actions

The aim is to reinforce the collaboration between the actions supported under this initiative, to increase the outreach of these actions and their impact and to achieve a wider coverage of stakeholders in technological, application, innovation, and geographic terms. Tasks and services should include maintaining a single innovation portal for newcomers; sharing of best practices and experiences; dissemination; identifying new innovative ICT technologies that can benefit from this scheme, brokering between users and suppliers; leveraging further investment by creating linkages with regional/national initiatives and by stimulating organic growth.

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[4] Including EuroPractice-type actions

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

Expected Impact: Proposals should address all of the following impact criteria, providing metrics to measure success when appropriate.

- Innovation in products, processes and business models leading to quantifiable increases in market shares and/or productivity of European companies and/or industrial capacities in Europe, notably for SMEs and mid-caps operating in non tech sectors.

- Business growth and increase competitiveness of **digital technology suppliers**, in particular SMEs, able to supply components and systems that may be integrated in various products.

- Creation of a self-sustainable ecosystem of innovation hubs including ICT suppliers and users supported by services available through a one stop shop, covering a large number of regions and their smart specialisation.

Type of Action: Innovation action, Coordination and support action

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

ADVANCED COMPUTING AND CLOUD COMPUTING

Industry in Europe has recognised strengths in customised and low power computing and notably those focusing on dedicated and special purpose tasks such as control of the physical world. With the advent of the Internet of Things and smart connected objects, customised and low power computing becomes mainstream technology with high growth potential. This is also reinforced when combined with the shift to Cloud Computing providing anywhere access to processing, storage and applications for front or back office operations. Actions in this area will therefore address further progress in the design, programming and implementation of advanced low power and customised computing as well as Cloud Computing infrastructures and services, enabling the delivery of a wide range of IT solutions as a Service on a secure, flexible, on-demand and pay-per-use basis.

Some challenges are common across these sectors, primarily in the areas of software quality and software evolution, in particular efficient parallel programming, complexity management, change management and energy efficiency.

However, other requirements result in a need for specialised research for the two sectors; e.g. hard real time constraints are typical for customised and low energy computing, while extreme scalability and elasticity are a challenge in Cloud Computing.

This research is complemented by High Performance Computing, which is addressed in the "Excellence" part of Horizon 2020 and is focused on supporting leading edge scientific and technological developments, and by ICT-01-2016 - Smart Cyber-Physical Systems, which is focused on the integration challenges of complex cyber-physical systems and "system-of-systems".

Proposals are invited against the following topic(s):

ICT-05-2017: Customised and low energy computing

Specific Challenge: Information and Communication Technologies are becoming a core component of products in all market sectors. The trend towards "Smart Anything Everywhere" must be supported by innovations allowing a very significant reduction of the cost and complexity of software development for modern architectures, and of the energy footprint of computation and communication.

Software development is the key challenge, because current programming tools do not fully support emerging system architectures. Massively parallel and heterogeneous systems are difficult to program and to optimise dynamically for the multiple conflicting criteria imposed by the application domain like performance, energy efficiency, dependability, real-time response, resiliency, fault tolerance and certifiability.

The reference markets are cyber-physical systems, industrial and professional applications, Internet of Things, connected smart objects and all the application areas where very low energy consumption is essential and where non-functional requirements like guaranteed performance, high reliability levels or hardware-enforced security may be critical.

Scope:

a. Research and Innovation Actions

Programming environments and toolboxes for low energy and highly parallel computing: Proposals will provide programming environments and tools optimised for specific application domains of significant economic value, covering the complete software stack from runtime systems to application programming. The solutions proposed will support modern system architectures possibly including those based on heterogeneous processors while allowing for optimization of energy, performance, reliability, time predictability and system cost. All the activities needed in software development should be addressed when relevant; e.g.: remote collaboration, debugging and bug tracking, runtime software analysis. Model-based approaches and reuse and extension of existing platforms, libraries, frameworks and tools are encouraged, resulting ideally in complete solutions which are practically usable for application development for real-world use cases.

Security by design features allowing applications to be resilient to cyber-attacks are encouraged to be part of the proposed technology, as well as features for energy-aware

solutions and for tolerating hardware and software errors while guaranteeing the required service level.

Solutions will be demonstrated in real-life applications through at least two different use cases complementing each other, and will provide significant and measurable improvements over state-of-the-art methods and technologies in productivity, software quality and energy consumption.

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

b. Coordination and Support Activities for structuring and connecting the European academic and industrial research and innovation communities. Activities will include (e.g.) cross-sectorial industrial platform-building, constituency building and consultations, clustering of related projects, and road-mapping for future research and innovation agendas.

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

- Reinforce and broaden Europe's strong position in low-energy computing by reducing the effort needed to include digital technology inside any type of product or service, including outside the traditional "high-tech" sectors.

- Availability of software development environments and tools allowing easy development of applications for parallel and heterogeneous architectures. Tools should be usable in realistic use cases, and should significantly increase the productivity in efficiently programming and maintaining advanced computing systems as compared to the state of the art at the time of proposal writing.

- Higher share of European SMEs and mid-caps in the reference markets, both on the supply and the demand side.

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

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

ICT-06-2016: Cloud Computing

Specific Challenge: Recent trends in cloud computing go towards the development of new paradigms (heterogeneous, federated, distributed clouds) as opposed to the current centralised model, with tight interactions between the computing and networking infrastructures. The challenge is to address, from the research and experimentation perspectives, the necessary evolution in cloud architectures, cloud networking, deployment practices and run-time management as well as the associated security and privacy needs. The ambition is to increase the uptake of cloud technology by providing the robustness, trustworthiness, and performance

required for applications currently considered too critical to be deployed on existing clouds. From the innovation side, the challenge is in fostering the provision and adoption of competitive, innovative, secure and reliable cloud computing services by SMEs and public sector organisations across Europe. Mastering these trends in cloud computing will contribute towards a connected Digital Single Market[5].

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

New paradigms: proposals may cover one or more of the themes identified below, but not necessarily all of them.

- Deployment and management of densely interconnected and decentralised cloud infrastructures, including the extension of the fog computing paradigm to the extreme edge of the network;

- Cloud networking in the context of software-defined data centres as well as re-allocation of resources and services (independently of their location) across distributed computing and geographically separated data storage infrastructures;

- Techniques to deal with trust, security and privacy in decentralised cloud infrastructures and across multiple cloud providers, including aspects of data integrity, data localisation and data confidentiality;

- Evolution of cloud architectures to improve the management of physical resources and the efficiency of cloud systems, including the concomitant evolution of databases and cloud computing architectures, to address new challenges on scale, resilience and security posed by data-intensive applications deployed over highly distributed and federated environments.

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

b. Innovation Actions

Proposals should cover one of the themes identified below:

- **Experimentation** of cloud-based services and their deployment configurations in large-scale decentralised and federated environments, in particular exploring and contributing towards interoperability and standardisation. Experiments are intended to support the automated deployment of complex applications across multiple clouds and data centres, to investigate the performance of cloud infrastructures and to characterise Quality of Service and Quality of Experience under a wide range of load and fault conditions. The

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5   http://ec.europa.eu/priorities/digital-single-market/docs/dsm-communication_en.pdf

approach should explore aspects of interoperability, scalability, performance, robustness, security and efficiency of the mechanisms, like those put forward by FIRE[6].

- **Cloud Computing for SMEs and Public Sector Innovation:** the focus is on fostering innovation through an increased provision and adoption of cloud computing services by two strategic target communities: SMEs and public sector organisations. The focus is on piloting and demonstration in near-operational settings that could lead to the introduction and uptake of new, flexible and resource-effective cloud solutions for SMEs and/or the public sector. The proposed work is intended to leverage these innovative solutions to overcome current challenges such as data portability and interoperability, data protection and access control, standardisation, etc.

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: Increase Europe's technological capacity and competitiveness through the development of advanced cloud solutions. Proposals should provide appropriate metrics for the claimed impacts.

- Increased and predictable performance of cloud offerings, facilitating deployment of critical applications and services.

- Increased trust in clouds through stronger security and data protection practices, including open and auditable solutions for data security. Increased control by users of their data and trust relations.

- Experimentation across a variety of settings that enhance Quality of Experience and contribute to standardisation and interoperability. Integration with other international initiatives for large-scale global experimentation.

- Increased readiness for adoption of trustworthy cloud-based solutions for SMEs and public sector organisations, spanning from generic enabling services to specific applications.

- Demonstration, through appropriate use cases, of the potential to improve the competitive position of the European cloud sector and to facilitate the emergence of innovative business.

Type of Action: Research and Innovation action, Innovation action

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

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[6] FIRE means Future Internet Research & Experimentation (http://cordis.europa.eu/fp7/ict/fire/)

FUTURE INTERNET

Internet has become an engine for innovation, economic growth, job creation and social progress. It is accelerating innovation, reshaping established industries, facilitating new ways of doing business, and transforming social behaviours. At the same time, this increasing diversification of usage patterns and of applications, is posing stronger requirements on the underlying networking and computing infrastructures. User privacy and data protection also emerge as technology drivers. The aim is to provide an integrated response to the technology challenges and to the innovation needs, in order to position Europe at the forefront of the Internet developments. The use and development of open source software will be encouraged where appropriate to further promote openness, facilitate the sharing of project results and accelerate innovation in Europe through the introduction of novel products and services.

The Future Internet challenge focuses on four interrelated areas that complement each other:

- **Networks**, where the 5G PPP industry roadmap is complemented by longer term research;

- **Software Technologies**, responding to the need of more flexible, reliable, secure and efficient software for complex and highly connected systems;

- **Experimentation** in large-scale or real-life environments, infrastructures for validating Future Internet technologies, products and services and their application to related areas;

- **Innovation**, supporting the emergence and nurturing of innovation ecosystems, supporting Web entrepreneurship, bottom-up innovation and social collaboration.

Proposals are invited against the following topic(s):

ICT-07-2017: 5G PPP Research and Validation of critical technologies and systems

Specific Challenge: This challenge frames the 5G PPP initiative, whose phase 2 will be implemented under this LEIT-ICT Work Programme. The challenge is to eliminate the current and anticipated limitations of network infrastructures, by making them capable of supporting a much wider array of requirement than is the case today and with capability of flexibly adapting to different "vertical" application requirements. The vision is that in ten years from now, telecom and IT will be integrated in a common very high capacity and flexible 5G ubiquitous infrastructure, with seamless integration of heterogeneous wired and wireless capabilities. 5G Networks have to cover a wide range of services from different use case and application areas/verticals, for increasingly capable user terminals, and for an extremely diverse set of connected machines and things; to cope with an increasingly cloud-based service access (>90% of the internet traffic will go through data centres); to support a shift from the "Client-Server" model to "Anything" as a Service (XaaS), without needs of owning hardware, software or the cognitive objects themselves. Network elements will become "computing equivalent" elements that gather programmable resources, interfaces and

functions based on virtualisation technologies, to implement control functionalities ad-how as a function of the use case.

This challenge includes optimisation of cost functions (capex/opex) and of scarce resources (e.g. energy, spectrum), as well as migration towards new network architectures.

A particular issue is to leverage work and results of phase 1 (WP 2014-15)[7] and to accelerate on proof of concepts and demonstrators. Where technological maturity permits, validation of research results, of the most demanding KPI's and of the most promising 5G technology options will be supported by experimental testing conducted in the context of use case in active cooperation with the various potential "vertical" sectors driving the innovative requirements. This validation activity is also expected to be boldly leveraged in the context of the important standardisation (3G PP) and spectrum (WRC 19) milestones that will appear over this WP implementation period.

Scope: **a. Research and Innovation Actions** covers three strands that complement each other. Proposal may address parts of a strand or parts that cut across several strands.

Strand 1 covers wireless access and radio network architecture/technologies:

- Novel air interface technologies i) supporting efficiently a heterogeneous set of requirements from low rate sensors including mission critical M2M communications to very high rate HD/3D TV and immersive services; ii) supporting local and wide area systems, heterogeneous multi-layer deployments, assuring uniform performance coverage, capacity, e.g. through advanced Multi Antenna Transceiver Techniques, including 3D and massive MIMO beam-forming; iii) enabling usage of frequency bands above 6GHz, for ultra-high speed access, backhaul and fronthaul, based on fully characterised channel models.

- Hardware architectures technologies and building blocks for 5G low cost low-within relevant spectrum range;

- (Radio) Network functional architectures and interfaces leading to a stable vision / reference architecture for 5G in support of the standardisation work expected to culminate under the 2017-2020 period. It provides a platform for technical coordination with other 5G initiatives. This architecture efficiently supports different deployment topologies ranging from fully distributed to fully centralised, with reduced management complexity and minimised signalling overhead. It also covers technologies like WiFi. It supports the "5G services and verticals" framework embracing the machine-type of communication services, the Internet of Things. It covers solutions that unify connection, security, mobility, multicast/broadcast and routing/forwarding management capable of instantiating any type of virtual network architecture;

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[7] This is not limited to results worked out under the H2020 context, but may include results from other R&I initiatives, e.g. in Member States

- Co-operative operation of heterogeneous access networks integrating virtual radio functions into service delivery networks, including broadcast/multicast technologies (terrestrial and satellite based) and supporting Software Defined Networking (SDN) and virtualisation techniques of RAN functions, providing the environment for multi-base station attachment;

- Support of numerous devices with different capabilities, with unified connectivity management capabilities, in terms of security, mobility and routing. It includes cloud and edge computing for low latency requirements and carrier grade communications for Machine Type Communications (MTC) with resource-constrained sensor and actuator nodes with multi-year battery life operation;

- Coordination and optimization of user access to heterogeneous radio accesses including ultra-dense networks, supported by intelligent radio resource management framework. This covers the joint management of the resources in the wireless access and the backhaul/fronthaul as well as their integration with optical or legacy copper networks;

- Multi-tenancy for Radio Access Network (RAN) sharing, covering ultra-dense network deployments with the ability to allocate traffic to shared MNOs infrastructure while satisfying their SLAs. Load and deployment are key aspects. Impacts in other segments of the network (e.g., backhaul), is taken into account for joint management;

- Integration of Satellite Networks to support ubiquitous coverage, resilience, specific markets, and where appropriate further complement terrestrial technologies (e.g. in traffic off loading, backhaul, or content delivery).

Strand 2: High capacity elastic - optical networks

The objective is to support very high traffic and capacity increase originating from an (5G) heterogeneous access networks with matching capabilities from the core and metro environments, at ever increasing speeds and in more flexible and adaptive form. It covers new spectrally efficient, adaptive transmission, networking, control and management approaches to increase network capacity by a factor of >100 while at the same time providing high service granularity, guarantees for end-to-end optimization and QoS - reducing power consumption, footprint and cost per bit and maintaining reach. The integration of such new optical transport and transmission designs with novel network control and management paradigms (e.g., SDN) are expected to enable programmability.

Disruptive approaches for a massive capacity scaling may impact network infrastructure, and system architectures which need to be assessed for integration and migration aspects.

Strand 3 covers the "Software Network", including work on:

- Software network architecture to support an access agnostic converged core network and control framework enabling next generation services (including services for vertical sectors) and integrating next generation access and devices. The architecture leverages

the SDN/NFV paradigm and is able to integrate/manage next generation transport and optical technologies, both for backhaul and fronthaul, to flexibly meet increasing system capacity requirements;

- A unified management of connectivity, with end to end security mobility and routing (including multicast/broadcast) beyond current concepts (e.g. tunnelling) for flexible introduction of new services. This aims at a unified physical infrastructure and includes corresponding abstractions – (virtual) resources, functions, hardware etc. – for control and orchestration. Solutions to provision SDN networks across administrative boundaries (e.g. multiple operators, customer networks, datacentres) and interoperability issues between multiple SDN control domains are in scope;

- Solutions (e.g API's and corresponding abstractions) that allow re-location or anycast search of services and their components, as a function of the context. This includes problems involved in portability of virtual network functions and naming of deployed functions and services. It supports co-existence of multiple network domains and easy migration;

- Scalability and efficiency related to increasing deployment of software-based network equipment and functions as well as corresponding more diverse services and usages. These include ease of deployment of multitenant networks, cost and energy efficiency, "five 9" reliability, flexibility and perceived "zero latency" where relevant;

- Realisation of the "plug and play vision" for computing, storage and network resources through appropriate abstraction, interfaces, and layering. It covers the full network infrastructure from core network to heterogeneous access, also with integration of the 5G architecture with legacy infrastructure. The target is for a Network Operating System (NOS) with hardware and user interfaces to manage and orchestrate unified access to computing, storage, memory and networking resources. The approach towards a NOS may also be considered in the context of experimental facilities, in view of integrating multiple heterogeneous European experimental facilities. The goal is to allow proper testing and comparison of the different 5G technological components. OSS solutions are preferred;

- Management and security for virtualised networks and services to support service deployment decisions related with location and lifecycle management of network functions, and flexible configuration of network nodes. Network analytics tools, knowledge reasoning and cognition, may be extended towards network operations to cope with complex, heterogeneous, and dynamic networks featuring large numbers of nodes, and to correlate all monitoring sources in order to create a real-time supervision of Quality of Service and Quality of Experience. Management of security (privacy where appropriate) across multiple virtualised domains is a key aspect to be cobered by this call.

For the 3 strands above, projects will be implemented as a programme and be expected to actively contribute key horizontal results to the integration process led by the programme level CSA. Therefore all grants awarded under this topic will be complementary to each other and to the grant agreement(s) under the topic ICT-08-2017 a). The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will be applied [8]. International cooperation with clear EU industrial benefits may be considered, preferably with nations having launched strategic 5G initiatives (e.g. China, Japan, South Korea, Taiwan, USA).

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, in particular for proposals targeting significant experiment/demonstrations activities in relation to well identified use cases justifying higher amounts.

b. Coordination and Support Actions

5G PPP projects will be implemented as a programme through the use of complementary grants and the respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement [9] will be applied. This calls for activities to ensure a sound programmatic view of the implemented 5G Research and Innovation Actions (RIA) and Innovation Actions (IA) results. The proposed support actions shall liaise with the 5G RIA and IA actions to exploit synergies in the implementation of the activities that include:

- Programme level integration through management and orchestration 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 the emergence of a 5G PPP "5G vision", to key international co-operation activities. A clear proactive strategy is expected to channel relevant 5G PPP project outcomes towards key SDO's like 3G PP (standardisation work expected to start in 2016) and to valorise relevant spectrum work in the context of future WRC's;

- 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;

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[8] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf
[9] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf

- Maintenance of the "5G web site".

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

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

- Overarching impact: 40% of the world communication infrastructure market for EU headquartered companies;

- Demonstrated progress towards core 5G PPP KPI's: 1000x capacity, 1ms latency, 90% energy savings, 10x battery lifetime, service creation in minutes, better/increased/ubiquitous coverage, 10 times to 100 times higher typical user data rate, 10 times lower energy consumption for low power Machine type communication, Lowered EMF levels compared to LTE solutions;

- Novel business models through innovative sharing of network resources across multiple actors;

- Finer grained management of optical metro and core capacity and capacity increase by a factor of 100 (only for Strand 2);

- Optimised optical backhaul architectures and technologies (only for Strand 2);

- Ubiquitous 5G access including in low density areas (only for Strand 1 and 2);

- Definition of 5G network architecture and of core technological components (only for Strand 1 and 3);

- Proactive contribution to the 3G PP standardisation activity on 5G, and to other standardisation activities, e.g. ONF, ETSI-NFV, IEEE; proactive contribution to the WRC 19 preparation for 5G spectrum.

- Proof-of-concept and demonstrators beyond phase one and validating core functionalities and KPI's in the context of specific use cases with verticals closely associated to the demonstrations and validation. Indicative sectors include: automotive, connected cars; eHealth; video/TV broadcast; Energy management; very high density locations and events (only for Strand 1 and 3);

- Novel connectivity paradigms, beyond the Client server model and enabling massive edge network deployments (only for Strand 1 and 3);

- Network function implementation through generic IT servers (target) rather than on non-programmable specific firmware (today) (only for Strand 3);

- OS like capabilities to orchestrate network resources (only for Strand 3);

- Trustworthy interoperability across multiple virtualised operational domains, networks and data centres;

- Solutions for the management of multi domain virtualised networks with coverage of security architectures based on industry characterised threat models.

b. Coordination and Support Actions

- 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 through roadmapping.

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

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

ICT-08-2017: 5G PPP Convergent Technologies

Specific Challenge: Network and service providers are faced with increasing challenges to manage convergence technologies. On the one hand, technological versatility increases service provision capabilities, with ever raising possibilities to dimension service offer to context and user specific SLA's. On the other hand, convergence technologies are getting increasingly complex, with ever larger integration of multiple technological heterogeneous hardware and software components, and more difficult properties to characterise at scale. The challenge thus tackles scalability and usability of mixed network technological approaches that can benefit from previous research, towards validation of deployment at scale.

Scope: **a. Innovation actions**

Strand 1: Ubiquitous 5G access leveraging optical technologies

5G access networks have to dramatically grow in user capacity, quality of service, responsiveness, energy efficiency and number of connected devices while keeping a sustainable cost.

The objective is to develop and assess new optical access network solutions based on integrated optical device prototypes. Novel integrated devices and subsystems may cover new optical transmission, switching and information processing techniques to support key access functionalities such as beam forming, high accuracy cm/mmWave generation and massive MIMO deployments. They may also be based on new network concepts and control architectures. Co-operative radio-optical approaches are seen as very promising, also to cover

intelligent interference cancellation. Techniques to map 5G channels to optical transport and a co-design of the optical and wireless interfaces and protocols are also targeted, to increase capacity and reduce latency, especially in highly dense 5G scenarios. The work draws on existing scientific and research results in the field and includes scalable demonstrators validated through typical usage scenario.

Strand 2: Flexible network applications

The work leverages the current intense research activities in relation to Virtualised Network Functions (VNF) and targets development of a multiplicity of VNF's useful to operators, service providers and users. Service providers or third party providers should be able to assemble these virtualised 5G functions as "network apps" from an NFV hosting infrastructure, to deploy them in the relevant network nodes, to orchestrate and customise resources to provision user services. The target is for a cloud like 5G infrastructures, supporting network services, resource and service orchestration. This environment also provides an open source development framework for control functionalities and application developments. It also provides the link between the network –terminal functions and the app/content providers towards standards developments. The platform will be opened to third party developers to demonstrate network "apps".

For the strands above, projects will be implemented as a programme and will be expected to actively contribute key horizontal results to the integration process led by the programme level CSA. Therefore all grants awarded under part a) of this topic will be complementary to each other and to the grant agreement(s) under the topic ICT-07-2017. The respective options of Article 2, Article 31.6 and Article 41.4 of the Model Grant Agreement will be applied [10]. International cooperation with clear EU industrial benefits may be considered, preferably with nations having launched strategic 5G initiatives (e.g. China, Japan, South Korea, Taiwan, USA).

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. Minimum one proposal per strand will be selected.

b. Research and Innovation Actions – Cooperation in access convergence

This activity takes advantage of the supporting 5G research and demonstration facilities offered by Taiwan towards collaborative 5G research with the EU, and aims at developing and demonstrating an integrated convergent access across different air interface technologies and the fronthaul/backhaul/core network. Test beds making use of facilities offered by Taiwanese partners are targeted. It demonstrates the capabilities of new spectrum access schemes, including for co-working with the network. A system demonstrator showing applications potential is thus favoured, e.g. for high speed moving vehicles.

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[10] http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/amga/h2020-amga_en.pdf

The Commission considers that proposals requesting a contribution from the EU of EUR 2.5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: **a. Innovation Actions**

- Validated access network architecture with integrated optical technologies for the realisation of critical access and transport control function (only for Strand 1);

- Demonstration of technological applicability to dense access scenarios supporting the 1000 capacity increase objective (only for Strand 1);

- Demonstrated scalability, close to operational context, of the proposed technological approach (only for Strand 1);

- Contribution to standards, notably 5G and optical access (only for Strand 1);

- Optical access interface with 10 times lower energy consumption (only for Strand 1);

- Open environments for creation of network apps (only for Strand 2);

- Open repository of network apps that may be validated and leveraged by third party developers (only for Strand 2);

- Validation at scale of the VNF aggregation capability of the proposed environment (only for Strand 2).

b. Research and Innovation Actions – Cooperation in access convergence

- Contribution to the ITU-R objectives for the next generation mobile network including requirements on data rates, mobility, connection density, latency, energy efficiency, spectrum efficiency, and traffic volume density

- Contribution to the 1000 fold mobile traffic increase per area, in the context of the target application

- Contribution to the 1ms latency objective in the context of the target application

- Results exploitation in the context of standardization and spectrum requirements

Type of Action: Research and Innovation action, Innovation action

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

ICT-09-2017: Networking research beyond 5G

Specific Challenge: While 5G networks has an established roadmap towards technology validation, specifications and tests by industry, outstanding new scientific opportunities are

blooming in the field of networking research, with the objective of bringing little explored technologies and system concepts closer to exploitation. The challenge is to support European scientific excellence notably in the DSP domain, and to bring the most promising long term research coming from the labs closer to fruition. This includes perspectives for the full exploitation of the spectrum potential, notably above 90Ghz, with new waves of technologies and knowledge, bringing wireless systems to the speed of optical technologies, and for new applications. It includes interaction with photonic systems as well as new cooperation networking and protocols, notably in the mobility context.

Development and exploitation of academic research through transfer and innovation towards industry with a particular focus on SMEs is an integral part of the challenge.

Scope: **Research and Innovation Actions**

Proposals may cover one or more of the themes identified below.

- **Scientific and technology advances** for novel use of the spectrum potential, de-risking technological building blocks at frequencies above 90 Ghz up to Thz communications backed by innovative usage scenarios, address visible light communications and develop radically new approaches for spectrum efficiency.

- **Advanced signal processing**, antenna processing, information theory and coding to optimize and reach Tbit/s in wireless communications.

- **Demand-attentive and cooperation networking** alternative to 5G architectures, including HetNets, opportunistic networks novel architectures and protocols for routing, latency and caching in complex networks notably for mobility.

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

Expected Impact:

- Validation of disruptive communication concepts, technologies and architectures;

- Proof of applicability of challenging spectrum regions towards innovative and cost efficient applications;

- Advances in signal processing and information theory and scientific publication in world class journals;

- Industry competitiveness with exploitation of academic research through transfer and innovation towards industry, in particular SMEs or start ups.

Type of Action: Research and Innovation action

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

ICT-10-2016: Software Technologies

Specific Challenge: Software is an enabling technology underlying all ICT developments. Recent advances in the areas of Cloud, Internet of Things, and Big Data increase the need for programming and modelling methods, platforms and software reuse that facilitate the development of more interconnected, flexible, reliable, secure and efficient software. The convergence and interrelationship of all these technologies require a holistic approach in the software development that goes beyond software production within specific application domains.

Scope: **Research and Innovation Actions**

Proposals may cover one or both of the themes identified below.

a. **Advanced software development approaches and methodologies:** Novel development approaches which would drastically increase development productivity and various dimensions of software quality such as security, reliability, performance, scalability and adaptability. Aspects that can be covered include: novel requirement engineering approaches; tools and mechanisms for managing software quality, including big data analytics on user feedback and run-time software performance monitoring; tools for automated deployment and dynamic configuration; tools and techniques for automating software interoperability and compliance testing. Algorithms and techniques for extracting knowledge (e.g., specifications, designs or models) from the huge amount of existing open source code; tools using that knowledge in the development of new software.

b. **Seamless software architectures:** Innovative architectures, frameworks and platforms addressing the need for evolvable, secure, context-aware and self-adaptive software in highly connected and interoperable systems. Support for the development and testing of software for distributed systems in heterogeneous environments, addressing issues such as data consistency, reliability, scalability and the efficient use of underlying resources.

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.

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

- Reduction of the time to market of the new generations of software enabled products and services;

- A significant and substantiated productivity increase in all aspects of software life-cycle especially for distributed systems;

- Ability to meet software quality levels required by a fast growing number of software-enabled products and services;

- Increased reuse of code, design or functional requirements in the development of new software.

Type of Action: Research and Innovation action

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

ICT-11-2017: Collective Awareness Platforms for Sustainability and Social Innovation

Specific Challenge: Today Europe fails to capitalise fully on participatory innovation; more models and blueprints are needed to lead to new ways to produce collective intelligence in key sustainability areas, leveraging on open data, knowledge networks, open hardware and Internet of things. The challenge is to demonstrate that innovative combinations of existing or emerging network technologies enable new Digital Social Innovation which can better cope with emerging sustainability challenges, achieving mass adoption and measurable global impact.

Scope: **a. Innovation Actions:** pilots of Collective Awareness Platforms (CAPs) demonstrating new forms of bottom-up innovation and social collaboration exploiting digital hyper-connectivity and collaborative tools based on open data, open knowledge, open source software and open hardware, harnessing crowdsourcing or crowdfunding models. Within this vision, target areas for pilots include:

- New participatory innovation models for economy and society, such as the collaborative or circular economy, collaborative public services and collaborative making;

- Solutions for sustainable lifestyles such as collaborative consumption and production, smart reuse and low carbon approaches;

- Emerging ethics of digital innovation, such as social entrepreneurship, direct democracy, privacy preservation and digital rights.

Proposals are expected to leverage on fresh grassroots ideas and civil society participation in the broad digital social innovation domain, and should:

- Include in consortia an existing and motivated community of citizens, to drive platform development;

- Base the platforms on an appropriate combination of existing or emerging network technologies (e.g. distributed social networks, wikis, sensors, blockchains);

- Demonstrate a durable multidisciplinary collaboration by including in the consortia at least two entities whose main focus of interest is beyond the ICT domain.

Proposers are encouraged to integrate different platforms, addressing several sustainability challenges at a time, in order to achieve critical mass and measurable global impact.

Preference will be given to proposals engaging civil society at large, for instance through NGOs, local communities, social enterprises, non-profit organisations, students and hackers.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one proposal per target area will be selected.

b. Coordination and support Actions, to coordinate and support the CAPs initiative and the underlying broader digital social innovation constituency, by identifying links and synergies among different projects, and ensuring visibility and contacts at European and international level.

The Commission considers that proposals requesting a contribution from the EU of between EUR 0.2 and 0.8 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: Proposals should address as many as possible of the following criteria, possibly defining appropriate metrics to measure impact

- Demonstrate increased effectiveness, compared to existing solutions to societal and sustainability challenges, of new bottom-up, open and distributed approaches exploiting network effects and based on open data and open hardware;

- Capability to reach a critical mass of European citizens and to transpose the proposed approaches to other application areas related to sustainability;

- Achieve effective involvement of citizens and relevant new actors in decision making, collective governance, new democracy models, self-regulation, citizen science and citizens' observatories, new business and economic models.

- Achieve measurable improvement in cooperation among citizens, (including elderly), researchers, public authorities, private companies and civil society organisation in the development of new sustainable and collaborative consumption patterns, new lifestyles, and innovative product and service creation and information delivery.

- Demonstrate the applicability of concrete and measurable indicators to assess the social impact and the "social return of investment" of the proposed solutions.

Type of Action: Innovation action, Coordination and support action

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

ICT-12-2016: Net Innovation Initiative

Specific Challenge: Today the net is a place unlocking rapid innovation. This potential is too often left un-exploited, i.e. Europe does not do enough to turn RTD & I outcomes into business success. In particular open platforms offer opportunities for the development of new services and applications. FIWARE, for example, is an open platform that demonstrates the capacity to become a preferred service platform, but its potential is currently underused.

Current centralised platforms for big and social data management consolidate the dominance of existing incumbent actors, stifling innovation and allowing less and less control over the data by citizens. Distributed architectures and decentralised platforms have a huge potential to enable the creation of viable alternatives to current dominant models.

More generally, key players and ecosystems, startups and SMEs often do not have sufficiently innovative technology in their hands to innovate on the net. Outcomes of Future Internet RTD & I need to be transferred faster into real life.

Scope:

a. Innovations Actions

Multi-vendor **Open Service Platforms** will allow increased competition and avoid vendor lock-in. They should have royalty-free open specifications, open source reference implementations, and be offered by multiple vendors. The Seventh Framework Programme for Research and Technology Development (FP7) has developed the FIWARE platform which has demonstrated its potential of becoming a service platform of choice, as well as other research results with a lot of potential for usage by SMEs and startups. For such potential to be realised, the following three innovation activities are needed. In addition, a fourth activity develops applications and services on top of any Future Internet research results.

  i. Among lead sectors, smart cities have emerged as a viable vector for FIWARE **adoption**. The activities will focus on the take-up of FIWARE in cities and the evolution of the FIWARE platform with new context-aware services addressing the needs of cities.

 ii. The **ecosystem creation** consists of building and supporting an open community of FIWARE innovators and users. A professional online and open engagement strategy may include hackathons and challenges, building community programmes for startups and SMEs and link to related national and regional programmes. Activities will incentivise entrepreneurs and users to explore FIWARE, by building on previous community achievements and contributing to an evolving ecosystem.

iii. FIWARE **sustainability and evolution** will be supported by the further evolution of the service platform by an open community. Activities include supporting the execution of a roadmap with a full set of supported enablers, with a reference implementation in open source, maintained and made available to third parties for use, with high quality and

clear terms and conditions. Furthermore, a public sandbox environment for experimentation of all supported enablers by any third party interested is made available. Activities contribute to building an open source community to manage the integrity and evolution of the FIWARE technology, and to ensure a real multi-vendor approach.

iv. Future Internet research results will be transferred into innovation via acceleration activities. They will support SMEs and startups taking research results of completed or ongoing projects in the domain of Future Internet and develop applications and services on top of these research results in order to achieve concrete business and market take-up. The action will involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the process of selecting SMEs and startups for which financial support will be granted (typically in the order of EUR 25 000-75 000[11]). At least 60% of the EU funding should be allocated to financial support for these third parties. However, the selected SME and startups ideally bring additional resources, i.e. additional private and/or public funds. Any IPR generated by the SMEs and startups shall rest with them[12].

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 6 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one proposal per innovation activity will be selected.

b. Research and Innovation Actions

Distributed architectures for decentralized data governance aims at demonstrating a distributed open hardware and software platform (for communications, cloud computing or Internet of Things) capable of supporting decentralised data and identity management and bottom-up participatory innovation.

The goal is to provide SMEs, social enterprises, industries, researchers, communities and individuals with a new development platform, which is intrinsically protective of the digital sovereignty of European citizens. The key characteristic of such a platform is to be fully distributed (e.g. using decentralised algorithms based on blockchains), in order to be more resilient, intrinsically resistant to malware and hacking, preventing any possible centralisation of data storage or data management, and able to provide federated identity management.

Proposals are expected to design, develop and demonstrate an architecture for such a platform, with the involvement of relevant technological actors (P2P and open source developers, open hardware manufacturers, experts in security, encryption, anonymity, blockchains and linked data) as well as of civil society organisations (citizens' organisations,

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[11] 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.

[12] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

digital rights advocacies, artists, social scientists) and interested developers of the overlying social applications and systems (creative industries, SMEs, social entrepreneurs, software developers).

A strong focus is expected on the creation of robust open standards for such distributed and decentralised architectures, in coordination with industry and academia.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

c. Coordination and Support Actions.

Support for collaboration and networking in the domain of Future Internet including the organisation of the Net Futures conference.

The Commission considers that proposals requesting a contribution from the EU of EUR 0.2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

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

a. Innovation Actions: Open Service Platform

- The outcomes of the Future Internet PPP are handed over to an open, multi-stakeholder community to ensure the evolution of FIWARE and its take-up among industry, small business and notably establishing FIWARE as the open service platform of choice for cities. This will allow them to develop and integrate smart cities applications more easily and faster, but also to achieve economies of scale through easy sharing of applications between cities;

- Increased take-up of Future Internet technologies by SMEs and web entrepreneurs;

- Significant increase of the effectiveness of business processes and applications of high economic and/or societal value.

b. Research and Innovation Actions: Distributed architectures

- To demonstrate how a distributed architecture can enable new data services and disruptive (e.g. commons-based) economic models, and become a viable decentralised alternative to the current dominant data management platforms which are gathering big data at global scale in a centralised manner;

- To demonstrate that citizens' generated data can be made available as part of a common distributed and decentralised architecture, open to all, so to allow new entrants to aggregate data on demand, bringing unanticipated features and innovative services;

- To develop an architecture and open standards allowing European citizens to retain full control over their digital identities, and to move their personal profiles between different platforms, for distributed or centralised (data portability);

- To create a level playing field for the development of new collaborative applications and services based on emerging participatory innovation models that are intrinsically respectful of privacy and ethics.

c. Coordination and Support Actions

- Increased multi-disciplinary collaboration among Future Internet communities.

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

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

ICT-13-2016: Future Internet Experimentation - Building a European experimental Infrastructure

Specific Challenge: The validation of research results in large-scale, real life experimental infrastructures is essential for the design and deployment of products, applications and services on the Future Internet. Europe needs a Federated Experimental Infrastructure for Future Internet Research & Experimentation (FIRE+) available to experiments of any size, complexity, or networking technology. Experimenters need to run experiments under controlled and replicable conditions, according to specific requirements by accessing real or virtual equipment, services, systems and tools on demand, seamlessly and regardless of their geographical location.

A dynamic and promising segment of experimenters, in particular small and medium-size developers and innovators cannot afford testbeds or even testing equipment of their own and need to be provided easy and affordable access to said capacities. Real-world prototyping and experimenting environments are needed in certain cases for innovation creation. In addition, Future Internet Research and Experimentation in Europe could benefit from similar initiatives around the world.

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

Proposals should cover one of the following bullet points:

- Proposals for at least one very large collaborative project that would i) build upon the federation efforts already undertaken, including the development of relevant federation tools and concepts like Experimentation-as-a-Service (EaaS); ii) develop a sustainability and evaluation framework for selecting testbeds for federation iii) continue federating the experimental testbeds under FIRE+, including testbeds (national, regional or local) selected using the above sustainability and evaluation framework, for the benefit of

experimenters; iv) broker between facilities and experimenters, including in particular SMEs allowing experimenters to access the facilities for experimentation; v) pursue the efforts of federation in a global context, in particular with US, Japan, Brazil and South Korea, with the aim of exchanging best practices, tools and methodologies.

- Proposals for at least one large collaborative project in each of the following three areas, for the creation, reconfiguration and/or extension of experimental infrastructures: i) large-scale experimentation on management and control of cognitive radio, including in terms of compliance, as well as dynamic spectrum sharing in licensed and unlicensed bands, addressing also new spectrum bands; ii) large-scale experimentation for service delivery networks, based on heterogeneous and cooperative networks integrated through SDN/NFV techniques and compatible with demanding high mobility environments, e.g. connected vehicles ; iii) large-scale experimentation on Future Multimedia Internet (FMI) services fully integrated with broadcasting, with a focus on high mobility scenarios and its impact on communication and storage infrastructures.

The Technology Readiness Level (TRL) of proposed actions must be between 3 (experimental proof of concept) and 7 (system prototype demonstration in operational environment). Actions should contribute to pre-standardisation and standardisation on their respective technologies in collaboration with bodies and fora, such as ETSI, W3C and IETF.

Actions will involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of third parties for which financial support will be granted (typically in the order of EUR 50 000 – 150 000[13] per party). At least 50% of the EU funding should be allocated to experimentation-related financial support to third parties, while an additional 20% could be allocated to the brokering between facilities and experimenters. Lower percentages can be accepted, if justified, especially in the case of creation of new experimental facilities.[14]

The Commission considers that proposals requesting a contribution from the EU of up to EUR 10 million for the first bullet point and up to EUR 5 million for the second bullet point would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b. Coordination and Support Actions:

Proposals should cover one or both of the following bullet points:

- Identification, evaluation and roadmap of the future needs for Future Internet large-scale experimentation; analysis and development of collaboration models, capabilities and resources; vision and strategy for FIRE+;

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[13] 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.

[14] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

- Communication, community building, impact and effectiveness stimulation and dissemination of FIRE+ results; performance monitoring and performance indicators.

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

Expected Impact: Proposals should address the following and provide appropriate metrics for measuring success:

- Experimental capability at European level that covers a variety of networking technology areas and allows tens of experiments to be run on top of them each year;

- Potential to experiment without the constraints of the physical location or access to a specific experimental facility;

- Reduction of the time to experiment by allowing a larger set of experiments to take place on reliable and benchmarked infrastructure that can evolve and be re-configured;

- Response to the needs of individual, small and medium experimenters without access to experimental facilities or environments;

- Support of trials driven by vertical application areas with a good mix of supply and demand stakeholders;

- Contribution to the sustainability model of experimental facilities;

- Contribution to standardisation and interoperability of experimental facilities;

- Concrete cooperation and cross-fertilisation between European and international initiatives in experimentally-driven research as a first step towards a wider collaboration with US, Japan, Brazil and South Korea.

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.

CONTENT

Europe needs to strengthen its position as provider of products and services based on individual and business creativity, to improve access, creation, management and use of data, to make information and knowledge accessible for all.

This requires advances in key industrial ecosystems: along the *data value chain* and specifically for big data, along the *content value chain* for creative, social media and

convergence industries and finally for the *knowledge value chain*, addressing at the same time accessibility issues.

The main objective for the ***data value chain*** is to roll out an industrial strategy to develop Europe's data driven economy as outlined in the Communication adopted on July 2nd 2014, drawing on the prospects offered by Big Data technologies.

The aim of the actions in the ***content value chain,*** which covers technologies for digital content creation and management, as well as the issue of accessibility to digital content, is to address the growing demand for high-quality content and new user experiences.

In an increasingly globalised and digital economy, where Europe needs a well-skilled workforce that can compete in terms of productivity, quality and innovation the actions of the ***knowledge value chain*** should allow developing advanced knowledge and learning technologies.

Proposals are invited against the following topic(s):

ICT-14-2016-2017: Big Data PPP: cross-sectorial and cross-lingual data integration and experimentation

Specific Challenge: Europe lacks a systematic transfer of knowledge and technology across different sectors and there is an underdeveloped data sharing and linking culture. Traditionally, data has been collected and used for a certain purpose within sectorial "silos", while using data across sectors for offering new services opens new opportunities for solving business and societal challenges. The lack of agreed standards and formats, and the low rates of publishing data assets in machine discoverable formats further hold back data integration. The fact that textual data appears in many languages creates an additional challenge for sharing and linking such data. Finally, there is a lack in Europe of secure environments where researchers and SMEs can test innovative services and product ideas based on open data and business data.

The challenge is to break these barriers and to foster exchange, linking and re-use, as well as to integrate data assets from multiple sectors and across languages and formats. A more specific challenge is to create a stimulating, encouraging and safe environment for experiments where not only data assets but also knowledge and technologies can be shared.

Scope: Proposals should cover one of the following bullets:

a. Data integration activities will address data challenges in cross-domain setups, where similar contributions of data assets will be required by groups of EU industries that are arranged along data value chains (i.e. such that the value extracted by a company in a given industrial sector is greatly increased by the availability and reuse of data produced by other companies in different industrial sectors). The actions will cover the range from informal collaboration to formal specification of standards and will include (but not be limited to) the operation of shared systems of entity identifiers (so that data about the

same entity could be easily assembled from different sources), the definition of agreed data models (so that two companies carrying out the same basic activity would produce data organised in the same way, to the benefit of developers of data analytics tools), support for multilingual data management, data brokerage schemes and the definition of agreed processes to ensure data quality and the protection of commercial confidentiality and personal data. The actions are encouraged to make use of existing data infrastructures and platforms.

b. Data experimentation incubators should address big data experimentation in a cross-sectorial, cross lingual and/or cross-border setup. This setup should include access to data in different domains and languages, appropriate computational infrastructure, and open software tools. The incubator should make these available to the experimenters, who are expected to be mainly SMEs, web entrepreneurs and start-ups. Experimentation is to be conducted on horizontal/vertical contributed data pools provided by the incubator. At least half of the experiments should address challenges of industrial importance jointly defined by the data providers, where quantitative performance targets are defined beforehand and results measured against them. Effective cross-sector and cross-border exchange and re-use of data are key elements in the experiments ecosystem supported by the incubators. Therefore, the incubators are expected to address the technical, linguistic, legal, organisational, and IPR issues, and provide a supported environment for running the experiments. To remain flexible on which experiments are carried out and to allow for a fast turn-over of data experimentation activities, the action may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. The proposal will define the selection process of the experimenters running the data activities for which financial support will be granted (typically in the order of EUR 50 000 – 100 000[15] per party). At least 70% of the EU funding shall be allocated to this purpose. Experiments are expected to run for a maximum of 6 months, while the incubator should run for a minimum of three years. The proposals are expected to explain how the incubator would become self-sustaining by the end of the funded duration of action.[16]

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 3 million (for the data integration activities under a) or about EUR 7 million (for the incubators under b) would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: a. Data integration activities

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[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.

[16] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

- Data integration activities will simplify data analytics carried out over datasets independently produced by different companies and shorten time to market for new products and services;

- Substantial increase in the number and size of data sets processed and integrated by the data integration activities;

- Substantial increase in the number of competitive services provided for integrating data across sectors;

- Increase in revenue by 20% (by 2020) generated by European data companies through selling integrated data and data integration services offered.

b. Data experimentation incubators

- At least 100 SMEs and web entrepreneurs, including start-ups, participate in data experimentation incubators;

- 30% annual increase in the number of Big Data Value use cases supported by the data experimentation incubators;

- Substantial increase in the total amount of data made available in the data experimentation incubators including closed data;

- Emergence of innovative incubator concepts and business models that allow the incubator to continue operations past the end of the funded duration.

Type of Action: Innovation action

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

ICT-15-2016-2017: Big Data PPP: Large Scale Pilot actions in sectors best benefitting from data-driven innovation

Specific Challenge: European research and development in data technologies produces promising results, but these are not yet deployed at large scale in a systematic manner. The challenge is to stimulate effective piloting and targeted demonstrations in large-scale sectorial actions ("Large Scale Pilot actions"), in data-intensive sectors, involving key European industry actors. The Large Scale Pilot actions are meant to serve as best practice examples to be transferred to other sectors and also as sources of generic solutions to all data intensive sectors.

Scope: Large Scale Pilot actions should address domains of strategic importance for EU industry and carry out large scale sectorial demonstrations which can be replicated and transferred across the EU and in other contexts.

Possible industrial sectors for Large Scale Pilot actions include (but are not limited to) health, energy, environment, earth observation, geospatial, transport, manufacturing, finance and media. Although Large Scale Pilot actions are required to have a strong focus in a given industrial domain, they may involve cross-domain activities where these provide clear added value. Large Scale Pilot actions will propose replicable solutions by using existing technologies or very near-to-market technologies that could be integrated in an innovative way and show evidence of data value (see the section "Expected Impact"). Their objective is to demonstrate how industrial sectors will be transformed by putting data harvesting and analytics at their core.

Large Scale Pilot actions are expected to exhibit substantial visibility, mobilisation, and commercial and technological impact. Proposals should demonstrate that they have access to appropriately large, complex and realistic data sets.

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

Expected Impact:

- Demonstrated increase of productivity in 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;

- Doubling the use of Big Data technology in the main target sector of the Large Scale Pilot Action;

- Leveraging additional target sector investments, equal to at least the EC investment;

- At least 100 organizations participating actively in Big Data demonstrations (not necessarily as partners of the projects).

Type of Action: Innovation action

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

ICT-16-2017: Big data PPP: research addressing main technology challenges of the data economy

Specific Challenge: Significant opportunities for value generation from (Big) Data assets are lost because the available software and IT architecture solutions are not adapted to the processing, analysis and visualisation of data in a situation where the volume, velocity and variety of the data are increasing rapidly. The challenge is to fundamentally improve the

technology, methods, standards and processes, building on a solid scientific basis, and responding to real needs.

Scope: Research and innovation actions are expected to address cross-sector and cross-border problems or opportunities of clear industrial significance.

These will include (but are not limited to):

- Software stacks designed to help programmers and big data practitioners take advantage of novel architectures in order to optimise Big Data processing tasks;

- Distributed data and process mining, predictive analytics and visualization at the service of industrial decision support processes;

- Real-time complex event processing over extremely large numbers of high volume streams of possibly noisy, possibly incomplete data.

All human factors claims (e.g. usability, maintainability) concerning software to be developed will need to be rigorously tested by methodologically sound experiments with clear plans to recruit adequate numbers of experimental subjects of the required type (e.g. professional experts as opposed to researchers or software developers). Proposals must demonstrate that they have access to appropriately large, complex and realistic data sets. Proposals are expected to make best possible use of large volumes of diverse corporate data as well as, where appropriate, open data from the European Union Open Data portal and/or other European open data sources, including data coming from EU initiatives like Copernicus and Galileo. Proposals should make appropriate use of and/or contribute to data exchange and interoperability standards.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 5 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:

- Powerful (Big) Data processing tools and methods that demonstrate their applicability in real-world settings, including the data experimentation/integration (ICT-14) and Large Scale Pilot (ICT-15) projects;

- Demonstrated, significant increase of speed of data throughput and access, , as measured against relevant, industry-validated benchmarks;

- Substantial increase in the definition and uptake of standards fostering data sharing, exchange and interoperability.

Type of Action: Research and Innovation action

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

ICT-17-2016-2017: Big data PPP: Support, industrial skills, benchmarking and evaluation

Specific Challenge: The newly created Big Data Value contractual public-private partnership (cPPP) needs strong operational support for community outreach, coordination and consolidation, as well as widely recognised benchmarks and performance evaluation schemes to avoid fragmentation or overlaps, and to allow measuring progress in (Big) Data challenges by solid methodology, especially in emerging areas where the significance of Big Data is rapidly increasing. Also, there is an urgent need to improve the education, professional training and career dynamics (including addressing the existing gender gaps in ICT) so that the profiles of data professionals better respond to the rapidly evolving needs of data intensive industry sectors.

Scope: a. One **Coordination and Support Action (CSA)** will perform all of the following tasks:

- support the community building, the administration and governance of the cPPP, in close collaboration with the cPPP governance bodies; facilitate discussion on relevant topics such as the framework conditions of the data economy; organise events and contribute to synergies and coordination between the actors and stakeholders of the cPPP and beyond;

- liaise with and build on related actions[17] and support the establishment of national centres of excellence in all Member states, and exchange knowledge on the universities' data scientist programmes across all Member States; to align curricula and training programmes to industry needs; to stimulate and promote (among the organisations participating in the Big Data PPP actions) exchanges of students, confirmed data professionals and domain experts that would acquire data skills and let them work on a specific Big Data challenge/project in a company or a research centre/university in another Member State.

The Commission considers that proposals requesting a contribution from the EU of about 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. No more than one proposal will be funded.

b. Research and Innovation Actions

The benchmarking action will identify specific data management and analytics technologies of European significance, define benchmarks and organise evaluations that allow following their certifiable progress on performance parameters (including energy efficiency) of

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[17] Such as the European Data Science Academy (http://edsa-project.eu/), EIT ICT Labs KIC and Marie Sklodowska-Curie Actions (MSCA)

industrial significance. The benchmarking and evaluation schemes will liaise closely with data experimentation/integration (ICT-14) and Large Scale Pilot (ICT-15) projects to reach out to key industrial communities, to ensure that benchmarking responds to their real needs and problems, and to provide a basis for measuring the success of the PPP. The "European significance" of industry/technology sectors should be determined and documented by objective criteria such as turnover, world-wide market share and growth rates of the European companies who provide or use such technologies. When real datasets cannot be made available for benchmarking, synthetic datasets will be acceptable, provided that they are produced by models that certifiably produce data distributions approximating real datasets in all respects that are industrially relevant. The action shall address areas of activity that do not yet have a benchmarking/evaluation scheme.

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

Expected Impact: a. Coordination and Support action

- At least 10 major sectors and major domains supported by Big Data technologies and applications developed in the PPP;

- 50% annual increase in the number of organisations that participate actively in the PPP;

- Significant involvement of SMEs and web entrepreneurs to the PPP;

- Constant increase in the number of data professionals in different sectors, domains and various operational functions within businesses;

- Networking of national centres of excellence and the industry, contributing to industrially valid training programs.

b. Research and Innovation actions

- Availability of solid, relevant, consistent and comparable metrics for measuring progress in Big Data processing and analytics performance;

- Availability of metrics for measuring the quality, diversity and value of data assets;

- Sustainable and globally supported and recognized Big Data benchmarks of industrial significance.

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

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

ICT-18-2016: Big data PPP: privacy-preserving big data technologies

Specific Challenge: In view of privacy considerations, businesses are often unsure about how to deal with the data collected through their operations. This data is of particularly high value to companies for offering personalised services or developing new business models. Data subjects (citizens, consumers) often feel that they have no control over the use of their personal data. This is aggravated by uncontrolled exploitation, aggregation and linking of personal data by large corporations and advertisers. The resulting lack of confidence undermines efficient and legitimate data sharing and value creation for agreed purposes. The challenge is to develop technologies that are inherently privacy-preserving and offer the basis for empowering the data subjects to understand and be informed of (and, where appropriate, control) the use of their personal data, and the entrepreneurs to develop and run their data driven business.

Scope:

a. **Research and Innovation actions** will advance the state of the art in the definition of methods that will support protection of personal data for harvesting, sharing and querying data assets. The personal data protection methods shall be implemented in secure and robust software modules and be exposed to publicly administered penetration/hacking challenges, open to participants the world over. Cross-disciplinary consortia are required to conduct legally and methodologically sound field work and coordinate with the CSA to determine i) if the various formal notions of personal data protection implemented are consistent with EU legislation and with the ethical intuitions of the EU citizens such methods are designed to protect; ii) to what extent privacy protection measures can be personalised in a way that remains intelligible to the data subject while remaining consistent with EU legislation. The diversity (e.g. in terms of age, sex, gender, socio-economic class) of data subjects should be taken into account, as appropriate. The data experimentation and integration projects (ICT-14) are likely to provide real-world challenges and data to validate the privacy-preserving technologies. 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.

b. **Coordination and Support Actions** will complement the research by exploring the societal and ethical implications and provide a broad basis and wider context to validate privacy-preserving technologies. The CSA is expected to liaise with a broad and multidisciplinary community of stakeholders (including public administrations, research community, companies, civil society, citizens) to advise the research and innovation in privacy-preserving (Big) Data technologies, promoting an integrated societally and ethically valid approach. Another task is to observe, map and report on ethical and Responsible Research and Innovation (RRI) issues in the field of Big Data, including technology, research, markets and education. The action is expected to organise

networking, awareness-raising and consultation among its communities, connect with the technical RIAs to inform their thinking and issue reports, analyses and recommendations. The Commission considers that proposals requesting a contribution from the EU of about EUR 1 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. No more than one proposal will be funded.

Expected Impact: **a. Research and Innovation actions**

- Substantial improvement of technologies for data access, processing and analysis to better protect consumer and personal data and respect security in line with existing and future EU rules on the protection of personal data, and as measured in terms of improved confidence and satisfaction of data subjects by the end of 2020;

- Substantial improvements towards creating a secure environment for data access, process and analysis, demonstrated in the use situations that arise in the data experimentation/integration projects (ICT-14).

b. Coordination and Support action

- Appropriate consideration and attention towards an ethically sound approach to big data processing, and effective involvement of the relevant actors and stakeholders;

- Improving the dialogue between data subjects and Big Data communities (industry, research, policy makers, regulators), thereby improving the confidence of citizens towards Big Data technologies and data markets.

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

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

ICT-19-2017: Media and content convergence

Specific Challenge: The media and content sector is driven more and more by the use of technology and new business models, new ways of interaction, consumption and expression are appearing in the rise of the digital era. Europe's media sector is strong in creating content. It is embracing new technologies and investing in innovation to benefit from the digital market. However, the sector has to become even more tech savvy as competition is growing from global players that are particularly strong at technological innovation. The challenge is to make the best use of technology for reaching out to new audiences, adapting to the digital era and thriving in the connected Digital Single Market.

<u>Scope</u>: Demonstration and validation of new technologies, services and solutions through large scale demonstrations[18], pilots or close-to-market prototypes exploiting the convergence, interoperability and integration between broadcasting, broadband Internet-based services, audiovisual and social media.

a. Innovation Actions – Media and Content Convergence: opportunities for new personal and immersive experiences.

Convergence among different communication and delivery platforms offers unprecedented opportunities. They should be exploited in order to develop immersive environments able to enhance users' experience in content consumption. Moreover, such opportunities open to great improvements on content accessibility for people with different types of impairments (due to e.g. aging or disabilities). Convergence enables to collect users' behaviour through several feedback channels facilitating hyper-personalised services, forms of participatory content and advanced content management.

Proposals should address one but ideally more challenges to exploit media and content convergence opportunities. A non-exhaustive list of challenges that proposals might want to look at are:

i. Exploiting synergies between the participation of individuals connected through social media and the convergence environment. New services will build around content aggregation, annotation, mash-ability, verification, analysis, search, media sharing and recommendation.

ii. Developing immersive and pervasive solutions for increased personalised user experience in content consumption in order to meet new user expectations (e.g. hyper-personalized, real-time storytelling, QoE, free viewpoint, augmented reality).

iii. Facilitating the convergence process to enable the interaction with content on any device, anywhere, anytime in a multiplatform scenario. For instance, through the development of advanced personalised audio-visual services, for a successful European media and content industry, sustaining a participatory, pluralistic and diverse European media landscape.

iv. Development and advancement of accessibility solutions specifically for converging media and content. This may include technologies for subtitles, sign language, descriptive language, automated graphical presentation of avatar character, automated translation and adaption, personalised setup in an accessibility scenario.

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.

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[18] When testing accessibility solution, ,attention should be paid to the diversity of the disabled population, in particular to social characteristics, such as age, gender, and socio-economic status.

b. Coordination and Support Actions on Convergence and Social Media

Proposals in this action will address at least these two challenges:

- Facilitate research and policy exchange in Convergence and Social Media by: increasing awareness of the latest technological developments among policy stakeholders, making researchers aware of the current and future policy and regulatory framework and monitoring the state of the art of the European Media and Content sector in a digital single market.

- Support R&D programmes/activities, dissemination of results and organisation of scientific and/or policy events in Convergence and Social Media. Analysis and development of research agendas and roadmaps, pre-standardisation initiatives and stakeholders coordination in Convergence and Social Media.

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

Expected Impact: **a. Innovation Actions**

Proposals should address one or more of the following impact criteria, providing, when appropriate, metrics and benchmarks to measure success:

- To develop new services as a consequence of the convergence of broadband, broadcast and social media;

- To move closer to a fully personalised and interactive user experience;

- To increase the use of ICT technologies in the Media industry;

- Solutions that can clear barriers for the success of the Digital Single Market from the content and media perspective.

b. Coordination and Support Actions

- To support a sustainable European fora of stakeholders representing the evolving Media environment.

Type of Action: Innovation action, Coordination and support action

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

ICT-20-2017: Tools for smart digital content in the creative industries

Specific Challenge: High quality content is the main source of revenue for the Creative Industries and also instrumental for their competitiveness in a large, international market. The

challenge is to maximise the potential for re-use and re-purposing of all types of digital content, for instance, by directly conceiving and creating content usable in different contexts and technical environments; improving its granularity; increasing its ability to dynamically adapt to the users; generating more realistic digital models; embedding semantic knowledge; and other approaches to make content "smarter" thanks to new and emerging technologies.

Scope: **Research and Innovation Actions**

Actions under this topic will explore novel ways of digital content production and management in the creative industries such as advertising, architecture, performing and visual arts, craft, design, fashion, films, music, press, publishing, radio, TV and video games. Proposals should clearly specify which sector(s) of the Creative Industries are being addressed and demonstrate a significant progress beyond the current state of the art in digital content production and management. They should focus on technologies for the production of new content or for the enhancement and (re-)use of already existing digital content of any type, but the production or acquisition of the content itself is not to be financed through these actions.

Consortia should include representatives from the targeted Creative Industries with a leading role in the design of solutions and their validation in real-life environments. Combining research and innovation activities, the actions are expected to achieve results between technologies validated in lab conditions and technologies demonstrated in industrially relevant environments. Proposers should pay attention to cost effectiveness and efficiency increase through the use of ICT in the creative industries and provide corresponding progress indicators and measurable objectives.

The Commission considers that proposals requesting a contribution from the EU of between EUR 2 and 4 million for a period between 24 and 36 months would allow this specific challenge to be addressed appropriately. This does not preclude the submission and selection of proposals with a different budget or duration.

Expected Impact: It is expected that the set of funded actions will:

- Increase the potential for purposing and re-use of digital content in order to diversify the market and improve the return on investment for producers;

- Provide significantly improved technologies for digital content production and management in the creative industries;

- Reduce the costs for the production of enhanced digital content for the creative industries, with the support of leading edge ICT.

Proposals should provide concrete individual impact statements guided by the expectations above, including clear qualitative and quantitative objectives and success indicators.

Type of Action: Research and Innovation action

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

ICT-21-2016: Support technology transfer to the creative industries

Specific Challenge: SMEs represent 85% of all actors in the creative industry sector. They co-exist with global players and often face difficulties in adopting state of the art ICT technologies and accessing finance. Moreover, they operate on fragmented and localised target markets and have to bear high market costs which affect their international competitiveness. In this context, ICT tools and technological innovation are fundamental for the creative industries and their competitiveness. They widen creative possibilities and improve efficiency in all sectors.

The goal is to increase the competitiveness of the European creative industries by stimulating ICT innovation in SMEs, by effectively building up and expanding a vibrant EU technological ecosystem for the creative industries' needs and by fostering exchanges between the creative industries SMEs and providers of innovative ICT solutions.

Scope: **Innovation Actions**

Actions should support creative industries SMEs in leveraging emerging ICT technologies for the development of innovative products, tools, applications and services with high commercial potential. Proposals should ensure that creative industries SMEs are participants in the consortium and take on a driving role in the action, i.e. leading the innovation activities and liaising with end-users, ensuring that the work responds to a clear market demand. The draft business plan provided should demonstrate that the solutions are cost-effective, market-ready and targeted at existing markets with a potential for cross-border extension.

Proposals should make clear if the action would lead to impacts at European or international level and explain how the achievement of those impacts would be measured.

The Commission considers that proposals requesting a contribution from the EU between EUR 0.5 and 1 million for a period between 12 and 18 months would allow this specific challenge to be addressed appropriately. This does not preclude the submission and selection of proposals with a different budget or duration.

Expected Impact:

- For the project portfolio resulting from the Call: tens of innovative solutions with high market potential ready to be deployed by European creative industries SMEs.

- Stronger collaboration between ICT innovative technologies providers and creative industries SMEs to improve the competitive position of the European creative industries.

Type of Action: Innovation action

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

ICT-22-2016: Technologies for Learning and Skills

Specific Challenge: Learning today takes place in a context of new interactions between formal and informal learning, the changing role of teachers, the impact of social media, and the students' active participation in the design of learning activities. While there is strong demand for (user-driven) innovation in digital learning, the current environment limits development to silo products, creates barriers to technological and market innovation and cross border adoption of new learning technologies. The challenge is to create an innovation ecosystem that will facilitate open, more effective and efficient co-design, co-creation, and use of digital content, tools and services for personalised learning and teaching. It requires co-creation and co-evolution of knowledge and partnerships between business actors and research players, communities of users, educational and training organisations to develop the appropriate components and services and leading edge learning technologies, which in turn will empower teachers and learners and facilitate (social) innovation in education and training.

Scope: **a. Innovation Action**

Develop and test open, interoperable components for a flexible, scalable and cost-effective cloud-based digital learning infrastructure to deliver user-driven innovation in technological solutions and educational services for primary and secondary education, for personalised, collaborative or experimental learning and skills validation. The infrastructure shall enable stakeholders to create, manage and deliver more efficient processes, content, services, applications and contextual data across a wide variety of education and training systems. It should enable stakeholders to discover, mix and re-use different components and to create new learning solutions. It should be scalable to meet rapidly changing and expanding needs and software requirements while maintaining high levels of security and privacy for teachers and students

The proposed solutions should cover one or several of the following areas:

- easy creation, mix and re-use of content, services, applications and contextual data for interactive learning processes (e.g. authoring and modelling tools; syndication tools; networked objects; electronic publishing platforms; social and collaborative networks);

- environments for new learning experiences and experimentation (e.g. 3D simulation and modelling technologies, visualisation technologies, augmented and virtual reality, location intelligence, intelligent tutors and other adaptive and multimodal technologies);

- educational support services (e.g. learning analytics for creating, collecting, storing, sharing learner/educational data in a systematic, secure way).

Proposed solutions should have a clearly defined learning context, integrate dynamic real-time assessment of learner's progress and be tested through very large pilots in typical learning circumstances in several European countries to identify strategies for scaling and achieve bigger impacts.

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.

b. Research and Innovation Action

Technologies for deeper learning of Science, Technology, Engineering, Mathematics, combined with Arts (STEAM), improving the innovation and creative capacities of learners and supporting the new role of teacher as a coach of the learner. Activities may cover both foundational research (tapping into a mix of disciplines, including SSH disciplines) and/or component and system level design with pilot testing to support (user-driven) real-life intervention strategies with new enabling technologies (e.g. new interfaces, affective computing, mixed reality learning environments, 3D technologies, wearable technology).

The Commission considers that proposals requesting a contribution from the EU of about 2.5 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. The maximum duration is expected to be 2 years.

Expected Impact: Projects should address the following impact criteria and provide appropriate metrics:

a. Innovation Action

- Availability of new, open cloud-based components, tools and services for use in digital learning scenarios;

- Increased cross-border availability and wider adoption of education technology products/services generating new business opportunities for, European providers;

- More efficient and effective learning, through mainstreaming new ways of learning with digital technologies and more efficient ways of assessing learning outcomes;

- Scalable solutions, capable of reaching very large numbers of schools and students, and deliver social innovation in education.

b. Research and Innovation Action

- Break-through technologies for learning, through novel research-industry collaborations in emerging areas;

- Improved ability to innovate in key economic growth areas by fostering intertwined development of creative and scientific/technological skills.

Type of Action: Research and Innovation action, Innovation action

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

ICT-23-2017: Interfaces for accessibility

Specific Challenge: Research on user-driven multimodal interface design has advanced the usability and accessibility of many software and devices to the benefits of all people, especially for those with different functional abilities. However, despite progress, there are still many who are disadvantaged due to lack of accessible and usable systems. Among those are persons with neurological conditions and disorders as well as cognitive disabilities.

More effective solutions, designed with people with disabilities and their carers, are needed to mediate communication experiences or for more natural interactions, including with their environment. Technologies aiming at enhancing cognitive accessibility hold the potential to improve attention, executive functions, knowledge acquisition, communication, perception and reasoning. Furthermore, improving the capacity to decode and use brain signals will help to accelerate the development of solutions for people with communication disorders.

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

Proposals should cover one of the following themes:

- Support the development of intelligent, affordable and personalised interfaces and affective computing for people with cognitive disabilities to enable them to undertake everyday tasks and in particular to improve communication and facilitate the uptake and use of digital services. Solutions should recognise user's abilities and be able to detect behaviours and recognise patterns, emotions and intentions in real life environments. A mix of expertise is necessary including from relevant social sciences and humanities disciplines (e.g. cognitive sciences, psychology, disability studies) and due attention will be paid to the diversity of users and users' needs (e.g. age, gender, socio-economic status).

- Develop and test solutions, models and algorithms to improve (and act upon) information extraction from brain and neural signals, including through advances on state of the art electrodes and implantable devices.

The Commission considers that proposals requesting a contribution from the EU of about EUR 2 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

Building on ongoing efforts, develop and demonstrate decision support tools for the assessment of compliance to web sites accessibility standards and guidelines. Research should focus primarily on quality and accuracy of automatic support to assessments, detecting

accessibility hurdles and assisting developers in repairing accessibility barriers. Solutions shall enable fast processing of dynamic content and large volumes of web pages/content and data, and more effective hybrid combination of automatic /expert reviews.

The Commission considers that proposals requesting a contribution from the EU of about EUR 2 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. No more than one proposal will be funded.

Expected Impact: Projects should address the following impact criteria and provide appropriate metrics

For a)

- Improved communication and interaction capability of people with disabilities and facilitate social innovation;

- More affordable technologies and products that support interactions for people with disabilities;

- New generation of services that are highly adaptable and personalisable to individual contexts;

- New approaches to brain computer interfaces.

For b)

- Easier and more cost effective assessment of web accessibility requirements, at scale.

Type of Action: Research and Innovation action, Innovation action

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

ICT-24-2016: Gaming and gamification

Specific Challenge: The software games business is growing fast. Its technological and methodological underpinnings have been laid down in years of research and development. At a significantly lower scale, they are now finding their way into non-entertainment contexts, helping deliver substantial benefits, particularly in education, training, research and health. Recent European research projects have identified comprehensive roadmaps and are creating resources and state-of-the-art knowledge for European players to develop applied games more easily, faster and more cost-effectively. The challenge is to mainstream the application of gaming technologies, design and aesthetics to non-leisure contexts, for social and economic benefits. Supporting the expansion of applied gaming and gamification will not only create new solutions and methodologies to address societal issues, but it will also help SMEs to seize new business opportunities.

Scope: Technology transfer through small scale experiments on developing and validating open gaming technologies and mechanics including from sectors other than the gaming industry into non-leisure situations and scenarios for training and motivational purposes. Actions shall integrate contributions from game developers, researchers from social science disciplines and the humanities, publishers, educational intermediaries and end-users. Activities shall include work on gaming technologies (augmented and mixed reality, 3D audio and video, virtual worlds, interactive storytelling, narratives, modelling and data, etc.), learning and behavioural triggers (pedagogical effectiveness, engagement, creativity, collaborative behaviours, proactive) and social science aspects (potential risks and challenges, privacy, gender and ethical issues etc.).

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

Expected Impact: Increased take up of gaming technologies in non-leisure contexts – and specifically in education and for social inclusion, measured by the number of new businesses and applications generated by the action.

Type of Action: Innovation action

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

ROBOTICS AND AUTONOMOUS SYSTEMS

The importance of robotics and autonomous systems (RAS) lies in its strong economic contribution as an industrial and commercial activity in its own right and in its broad and disruptive socio-economic impact across diverse market sectors world-wide. Advanced robotics and autonomous (or near-autonomous) vehicles will have a potential annual economic impact by 2025 on a par with e.g. mobile Internet, advanced materials or energy markets[19].

Already now, industrial robotics has become a cornerstone in several of Europe's high value manufacturing industries, such as automotive, keeping these industries in Europe. This trend must be maintained, strengthened and enlarged to all main industries in Europe. Robotics technology also has an impact on a broad range of end user markets and applications. The robotics professional and consumer service sectors are expected to achieve double-digit growth during the next decade and SMEs will play a key role e.g. in opening new markets. In addition to manufacturing, important future application domains for robots, with high impact on everyday life, will include healthcare, agriculture, civil, commercial or consumer sectors, logistics and transport.

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[19]   "Disruptive technologies: Advances that will transform life, business, and the global economy", McKinsey Global Institute May 2013.

The EU's strategic vision aims at strengthening Europe's global position in the robotics market to one third of industrial robotics, two-thirds of professional services and one-fifth of the domestic services market by 2020. Overall, an expected robotics-related increase of the EU GDP by EUR 80 billion is targeted.

This Work Programme directly supports this strategic vision. The main approach is to generate new RAS technical capabilities and system abilities and to move research results out of the laboratory and into the marketplace, engaging with SMEs and end users[20]. The technical capabilities targeted by this Workprogramme are: systems development; interaction; mechatronics and perception / navigation / cognition. The targeted system abilities are: configurability; adaptability; interaction capability; dependability; motion capability; manipulation and grasping; perception; decisional autonomy and cognitive ability.

This approach is founded on interleaved mix of technology-driven R&D&I to keep Europe at the cutting edge of research and market-driven R&D&I to accelerate take-up and deployment, including by SMEs. These actions will be supported by a critical mass of flanking measures to improve the market and regulatory climate at EU level through e.g. addressing non-technical market barriers (entrepreneurship, ethical / legal / socio-economic issues in a pro-active and forward-looking perspective, skills and training) and through the impetus of a high-profile robotics competition. This approach is built on the priorities of the SPARC Robotics PPP Strategic Research Agenda and Multi-Annual Roadmap (MAR)[21]. All proposals are expected to demonstrate their contribution to this roadmap.

Proposals are invited against the following topic(s):

ICT-25-2016-2017: Advanced robot capabilities research and take-up

Specific Challenge: RAS technology has evolved significantly in the past decade, moving robots out of constrained environments and into the workplace or home. Technologies ranging from mechatronics to sensing, manipulation and mobility have all contributed to this evolution. However the easy deployment of smart robots in everyday life is still beyond the technical capability of most current laboratory prototypes.

The specific challenge here is to develop robots that respond more flexibly, robustly and efficiently to the everyday needs of workers and citizens in professional or domestic environments, and which will also maintain Europe at the forefront of global research and development. The actions will address the whole research value chain, whether generic technology, developing RAS building blocks in the form of key technical capabilities, or market-led prototypes directly involving end users. End users will help drive Innovation

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[20] "End users" here are distinct from "users" in that they are typically organisations that own applications or specific functional tasks, whereas users are those who benefit directly from the actions of or interact with a robot system during its operation

[21] SPARC Robotics PPP Strategic research Agenda for robotics in Europe 2014-2020 and Multi-Annual Roadmap http://www.eu-robotics.net/cms/upload/PPP/SRA2020_SPARC.pdf.

Actions as active partners, setting the operating parameters for a given application as well as testing and validating the prototype solutions.

Scope: **Research and Innovation Actions** addressing generic advances and technical capabilities:

a. Open, generic forward-looking research into novel technical advances in robotics – open to all robotics-related research topics and disciplines. Proposals are expected to address technical topics which cut across application domains and which can be developed further with a view to achieving high future impact on markets or societal sectors in Europe.

b. Technology research and development to achieve step changes in the capabilities of the following high priority RAS technologies: systems development, human-robot interaction, mechatronics, perception, navigation and cognition. Step changes are sought through either a multiplicative improvement in technical capability, for example achieving a difference in order of magnitude in the number of everyday objects a robot can recognise or handle, or a categorical advance, for example moving from rigid to intuitive human-robot interfaces.

The Commission considers that the open research and the technical capabilities proposals are expected to require EUR 2 to 4 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. It is expected that a minimum of one action will be supported for each bullet (a or b above). Proposals are expected to identify which bullet is their main centre of gravity.

Innovation Actions driven by end users:

c. Improving the deployment prospects of RAS through end user-driven application developments in domains and application areas with significant market potential. Proposals are expected to address system development beyond TRL 5.[22]

The outputs will not be purely technological; actions will generate economic and operational data that will provide a valuable basis for setting operating parameters and for reducing commercial risks for future investors.

d. Filling technology or regulatory gaps through end user-driven innovation actions, where the gap represents a challenging market entry barrier. Proposals are expected to address a gap in either technical capability or system ability. The targeted gap and the required steps to tackle the gap must be clearly identified in the proposal.

The Commission considers that End-user proposals are expected to require 2 to 4 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. It is expected that a minimum of one action will be supported for each bullet (c or d above). Proposals are expected to identify which bullet is their main centre of gravity.

Expected Impact: The expected impacts for the **Research and Innovation Actions** are:

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[22] Technology readiness level 5: technology validated in a relevant environment

- Promote excellent science and technology knowledge in Europe, demonstrated by a high standard of research outputs (including publications, open source software or, as appropriate, patents);

- Develop a new generation of robotic and autonomous systems with clear and measurable progress over the state of the art in terms of step changes in technical capabilities, as evidenced by improvements in performance (including in terms of affordability, reliability and robustness, energy autonomy and user acceptability);

- Greater industrial relevance of research actions and output as demonstrated by deeper involvement of industry and stronger take-up of research results;

- Fostering new links between academia and industry, accelerating and broadening technology transfer;

- Contributing by 2020 to the strategic vision of a more competitive positioning of European robotics providers in the marketplace, in terms of their penetration in new or emerging robotics sectors.

The expected impacts for the **Innovation Actions** on end-user research are:

- Increasing the market-readiness of robotics applications including in terms of technological validation outside the laboratory and of sound operational and cost-benefit models;

- Lowering of market entry barriers of a business or regulatory nature and increasing industrial and commercial investment in Europe at a rate comparable with other global regions;[23]

- Contributing to the faster growth of competitive small and mid-scale robotics companies in Europe.

Type of Action: Research and Innovation action, Innovation action

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

ICT-26-2016: System abilities, development and pilot installations

Specific Challenge: RAS operate through the integration of a wide range of different technologies, as noted above. In addition to the contribution of each of these technologies, it is also important to characterise the overall performance of an RAS in terms of its ability to perform system functions which traverse specific technological capabilities. The specific challenge here is to increase the system ability levels in terms of configurability, adaptability,

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23 According to the PwC/NVCA MoneyTree Report, capital investments by US venture capital firms rose to about $172 million in 2013, nearly tripling 2011 levels

motion, manipulation, decisional autonomy, dependability, interaction, perception and cognitive ability. Such system abilities provide a basis for setting performance metrics and for specifying desired levels of system performance. Reaching higher ability levels than currently available allows to advance the state of the art and to set future targets for robotic systems.

Multiple-actor systems are composed of many actors who are able to operate independently but together can perform system functions. These actors may be autonomous entities, people, or static systems, including embedded sensor networks and cloud services, working together in the operational environment. The challenge is to develop complete, robust systems through the interaction of these many actors to carry out the system function.

Integrated sets of common tool chains and real-world test installations are increasingly needed to support the development of complex robotics systems. The challenge resides in the need for open development and dissemination of common development tools and the provision of wide access to realistic testing environments for the end user community, especially SMEs. Robot testing and innovation facilities are starting to emerge in Europe but are underdeveloped in terms of their infrastructure and the facilities they offer.

Scope:

a. Research and Innovation Actions on system abilities

Research & Innovation Actions will focus on advancing the state of the art in the level of smart robotics system abilities. The focus is on the technical challenges; research actions will address cross cutting technology issues that will make a significant contribution to the needs of applications and domains with the highest impact on markets. Proposals are expected to address at least one or a combination of the following prioritised abilities: robot dependability, social interaction ability and cognitive ability.

The Commission considers that System ability 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. It is expected that a minimum of one proposal will be supported within actions on system abilities.

b. Research and Innovation Actions on multiple-actor systems:

This action focuses on developing advanced multiple-actor systems utilising actors which can operate individually, as members of a team and within a network of other assets in semi-structured, unstructured, dynamic or harsh environments. The system operates through the interaction of diverse independent actors and needs to be robust against errors or the inaction of any specific actor. Proposed multiple-actor systems are expected to demonstrate autonomy over an extended time scale and clearly identify service level gains (compared with current systems) in the application area chosen by the proposal. Systems must be built around identified end user needs and performance should be measured using relevant end user metrics.

The Commission considers that Multiple-actor proposals requesting a contribution from the EU of between EUR 2 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. It is expected that a minimum of one proposal will be supported within actions on multiple-actor systems.

c. **Innovation Actions** on systems development technology:

The action will address the open development and dissemination of integrated sets of tool chains and building-block applications which support the construction of complex robotics systems. This will result in a European-level ecosystem of development tools using commonly agreed ways of describing robot systems and system building blocks and their interaction. The ecosystem should be flexible and able to accommodate a diverse range of end application requirements in a broad range of different domains. Proposals must aim at developing such an ecosystem, provide mechanisms for its dissemination and stimulate community engagement in its development and subsequent deployment.

Key to the success of this action will be support for modularity, composability[24], re-usability, ease of use and the adoption of existing and emerging standards within both the system and its components. The action is also expected to build on existing systems and structures.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 50.000 – 250.000[25] per party). Minimum 50% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.[26]

The Commission considers that System development tools 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. It is expected that a minimum of one proposal will be supported within actions on systems development technology.

d. Innovation Actions on pilot installations for robot testing:

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[24] Composability is defined as the ability to combine and recombine building blocks to fulfill different functions. Building blocks may be at different levels of granularity ranging from components to systems of systems. Composability applies to all aspects of the design and development of systems.

[25] 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.

[26] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

The action will develop and deploy access mechanisms and supporting infrastructure for single-site[27] pilot installations outside the laboratory for robot testing, based on the needs of end users. Proposals will build on an installation supported through existing EU, regional, national or commercial funding to develop a European accessible facility prioritised against emerging market domains and application areas. In order to ensure real-world conditions, these pilot installations will be based on existing infrastructures such as farms, hospitals / care homes, mines, nuclear sites, undersea sites, collapsed buildings etc. The proposed access mechanisms and infrastructure should provide a low access threshold for SMEs, public bodies and research organisations.

Proposals are expected to provide a support infrastructure including as a minimum: instrumentation of the site; simulation support to allow off-site testing; access to the end user and local site experts, and metrics relating to the functional goals of the end user. The proposal should also address safety certification processes, the development of appropriate performance evaluation measures and application-specific benchmarks. The proposal should identify application-relevant standards and, where relevant, the types of human interaction expected, including the level of social interaction.

Where appropriate, proposals should consider providing sharable standard platforms (hardware and software) to allow organisations offering individual modules or technologies to access the site, rather than limiting access to groups able to deliver whole systems.

Proposals should clearly show how they will assess and, where appropriate, disseminate the results and market impact from trials carried out on the installation. Proposals are encouraged to highlight how deployed system dependability can be enhanced through interaction with the installation.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers running the experiments to access the installation for which financial support will be granted (typically in the order of EUR 50.000 – 150.000[28] per party). 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 cover the development of end user solutions for use at the pilot installation as well as the development of related service-side support that would enable the deployment of the end user application.[29]

The Commission considers that Pilot installation proposals requesting a contribution from the EU of between EUR 7 and 10 million would allow this area to be addressed appropriately.

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[27] "Single Site" refers to the need for the site to be fully self-contained and aligned to a specific existing asset. Proposals may cover multiple assets at different geographic locations but each must be a single site asset.

[28] 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.

[29] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. It is expected that a minimum of one proposal will be supported within actions on pilot installations for robot testing.

Expected Impact: The expected impacts for the RIA in system abilities are:

- Verifiable increase in the level of system abilities of value in the targeted application domains, in particular improving the innovativeness, robustness and longevity of operations of robots deployed in challenging environments

The expected impacts for the RIA on multiple-actor systems are:

- Contribution to the development of innovative multiple-actor systems which achieve measurable service level gains in new application areas

- Measurable improvements in the provision of autonomy over an extended time scale from the current state of the art in the chosen application

- Advances in the development and understanding of new metrics characterising the operation of multiple-actor systems.

The expected impacts of system development tools actions are:

- Enhanced productivity of RAS through high quality tools

- Wide acceptance of new, efficient and flexible system development tools across the development community and in the marketplace.

The expected impacts of pilot installation actions are:

- Improved understanding of current technology capability limits in real world situations, to promote higher take-up of new robotics systems and to achieve faster time-to-market for new applications.

- Characterisations of the performance of robotics systems in the given installation.

Type of Action: Research and Innovation action, Innovation action

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

ICT-27-2017: System abilities, SME & benchmarking actions, safety certification

Specific Challenge: Technology capabilities alone are not sufficient to enable future markets development. Robotic technology and systems must be designed, integrated and deployed along functional lines and match much more closely to SME and to general market needs.

Research into promising system abilities such as configurability, adaptability, motion, manipulation, decisional autonomy, dependability, interaction, perception and cognitive ability will play a key role here, as mentioned above.

A key challenge is to revitalise Europe's robot-making capacity.Whilst SMEs are generally regarded as the backbone of EU industry, they are under-contributing to the robotics industry. There is a requirement to stimulate SMEs in the robotics sector to develop novel and innovative technology that has the potential to open new markets.

Underlying these requirements, is a market-driven need for benchmarks as clear markers of progress for any developer, whether SME or large industry. Benchmarking processes that provide consistency and value to the process of technology validation are lacking currently. Developing benchmarks that can be applied across multiple domains or areas of application allowing technical comparison is a priority.

A further underlying need for the robotics community at large is to ensure the safety and security of their developments. Viable safety certification standards and processes (including testing protocols) are critical to the widespread deployment of robotic systems, but are not yet generally available. Such certification processes should cut across different domains and areas of application and need to be developed on a pan-European basis, but with global impact.

Also the take up of robotics systems by public authorities is a challenge, as there are few if any generalised schemes for public procurement. Smart cities will provide a range of different applications where robotics technology may be able to provide opportunities for enhancing the utilisation of existing general infrastructure, ensuring higher levels of service delivery and addressing demographic change.

Scope: **a. Research and Innovation Actions on system abilities.**

RIAs will focus on advancing the state of the art in the level of smart robotics system abilities. The focus is on the technical challenges; research actions will address cross cutting technology issues that will make a significant contribution to the needs of applications and domains with the highest impact on markets. Proposals are expected to address at least one or a combination of the following prioritised abilities: perception ability which is immune to natural variation (e.g. changing weather conditions); decisional autonomy; increasing dependability levels to the level of graceful degradation; systems that are able to self-verify correct behaviour in safety critical tasks.

The Commission considers that System ability 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. It is expected that a minimum of one proposal will be supported for this action.

b. Research and Innovation Actions for SME-based research and for benchmarks:

Proposals should cover one of the following bullet points:

- This activity will stimulate SMEs in the robotics sector to develop novel and challenging technology and systems applicable to new markets. Proposals should provide SMEs with access to technical and non-technical support services and technology that are relevant to the new market being addressed. Such services should provide SMEs, who are not necessarily in the original consortium, with facilities to carry out their research more efficiently and may include access to specialised development facilities or technology. Proposals should also identify how they will enable SMEs to access stakeholders in new markets. Proposals addressing extended clinical validation for healthcare are specifically excluded.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 50.000 – 200.000[30] per party). Minimum 50% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.[31]

- Development and implementation of robotics application-relevant benchmarks and metrics to assess progress in technologies and systems. These actions should provide qualitative and quantitative information to support the assessment and development of systems addressing step changes and ability levels; they should also help define benchmarks and metrics which are useful to an end user.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 50.000 – 100.000[32] per party). Minimum 60% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.

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. It is expected that a minimum of one action will be supported for each of these two bullets (SME-based research and benchmarking).

c. Innovation Actions on shared facilities for safety certification:

Development of testing protocols for shared space cooperative and collaborative systems leading to viable safety certification standards. Proposals must cover a range of domains and

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[30] 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.

[31] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

[32] 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.

applications where safety certification is a market barrier. Potential examples include healthcare and elderly or handicapped care applications, infrastructure maintenance, transport and logistics. The development of common approaches and tools is strongly encouraged.

Proposals are expected to not only devise protocols but to carry out realistic trials to validate them. Proposals are also expected to show how the protocols they devise can match the requirements of relevant standards and regulations or inform the creation of new standards and regulations.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 50.000 – 100.000[33] per party). Minimum 50% of the EU funding requested by the proposal should be allocated to the purpose of financial support to third parties.[34]

The Commission considers that Safety certification related proposals requesting a contribution from the EU of between EUR 6 and 11 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

d. Pre-commercial Procurement Actions:

Demand-driven PCP actions will be pursued in the area of smart cities. Actions will aim at but not be limited to one or several of the following topics: waste management, transport (with focus on smart mobility), the provision of city-wide utilities and services, the provision of healthcare, social care and education (including social innovation). Actions will be expected to show how the PCP instrument and procurers will be mobilised to develop new robotics related solutions in a smart cities context.

The Commission considers that PCP proposals requesting a contribution from the EU of between EUR 5 and 7 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The expected impacts for the RIA in system abilities are:

- Verifiable increase in the level of system abilities of value in the targeted application domains, in particular improving the innovativeness, robustness and longevity of operations of robots deployed in challenging environments

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[33] 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.

[34] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

- Significant improvements in the technologies or their combination, underlying the chosen system abilities.

The expected impacts for the RIA on SMEs & benchmarks are:

- Contribute to overall growth of SMEs targeting new robotics markets

- SMEs conducting and utilising research to access new markets

- More efficient development of the robotics sector and wide acceptance in both academia and industry of new benchmarking tools

- Improved systems characterisation and improved means of robotics system performance evaluation.

The expected impacts for the Innovation Actions on safety certification are:

- Broad acceptance of testing protocols and validation processes for a wide range of shared space applications

- New validation processes on which deployment regulations and standards can be based.

The expected impacts for the PCP are:

- Proof-of-concept and validation of robotics technology in the smart city context, to encourage procurement by smart city stakeholders of robotics technology for the benefit of citizens in everyday civic applications.

- New market opportunities for robotics technology suppliers to the smart city sector.

- Inroads into the defragmentation of the market and potential elaboration of standards for public procurement in this domain.

Type of Action: Pre-Commercial Procurement , Research and Innovation action, Innovation action

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

ICT-28-2017: Robotics Competition, coordination and support

Specific Challenge: The global robotics market will change shape significantly in the next few years. As the deployment of robotics technology increases, it is necessary to ensure that robotics actions are flanked by specific measures to optimise market take-up of European research whilst the window is still open.

There are several challenges including the lack of sustained exchanges about robotics between members of the widespread European stakeholders' community and of coordinated European effort towards global standardisation and regulation. There is also a lack of systematic

foresight of developing trends and issues to inform strategy-makers and the robotics community e.g. as relating to a pro-active approach of ethical, legal and socio-economic (ELSE) issues. Understanding and responding to developments in these areas will require engagement with non-robotics experts able to analyse impact within their area of expertise. Robotics-specific strategy can then be developed from this analysis and used to shape the processes of design, development and deployment of market services and applications.

It is also important to disseminate information not only to the robotics community but also externally to those users and organisations impacted by robotics technology. Furthermore it is important to identify and assess socio-economic weaknesses and threats in the European robotics landscape. These will change over time and long term monitoring actions will be critical to the development of a responsive strategy.

Potential issues range from the development of supportive and effective regulatory environments to assessing the public perception of robotics and its socio-economic impact, as well as the underlying imaginaries (e.g. pre-conceptions helping to envisage the future) of robotics developers. Broader technology impact issues such as data privacy, legal rights, liability, responsible innovation and ethical issues concerning vulnerable sections of society will also need to be addressed.

An intense user-engagement in the developments of robots designed to perform social tasks, and a wide public debate around the issues and concerns that these developments may raise are key conditions to ensure a societal and socio-economic uptake of robotic technology in an informed way and to enhance market and community development.

Competitions on smart robotics can also play an important role in increasing the levels of public understanding, as well as helping to accelerate progress in a stimulating way.

Scope: **Coordination and Support Actions** focusing on one or more of the following topic areas and taking into account ongoing actions:

a. Non-technical barriers to robotics take-up:

- Promotion of entrepreneurship skills specific to robotics and the provision of non-technical early stage support for SMEs and spinouts. Analysis of funding mechanisms, including follow-on funding support for take-up of research results and the effectiveness of public funding;

- Addressing non-technical market barriers in a pro-active way such as ethical, legal and socio-economic issues affecting take-up, including the impact of robotics on the labour market, ethical concerns about safety, informed consent, clear legal responsibility and insurance structures. The engagement and coordination with non-robotics experts, for example in law, social sciences and economics, will be sought;

- The effective promotion of responsible research and innovation (RRI) in robotics and the assessment of societal readiness for robotics products;

- Given the fast-moving evolution of RAS research and innovation, develop dynamic strategies to anticipate new skills requirements, reduce skills shortage and provide responses to economic change through training, skills development, and education from pre-school to university level.

b. Standards and Regulation:

- Coordination of standards harmonisation and regulation across Europe in all domains to enable the development of supply chains and certification processes;

- Dialogue with regulatory bodies and policy makers to support the market entry of robotics and raise awareness of the impact of robotics.

c. Community support and outreach:

- New mechanisms to improve information exchange across the diverse sections of the European robotics community (including networking between EC projects), to provide open access resources, for example brokerage for design information, communicating the outcomes of EC-funded research projects and to improve the public level of understanding and societal uptake of robotics through two-way public engagement activities.

d. Competitions:

- Organisation of robotic competitions to speed up the advance towards smarter robots, demonstrating progress in the field and raising the awareness of the general public towards intelligent robots.

The Commission considers that Coordination and Support Actions proposals covering all or an appropriate mix of topic areas (a), (b) or (c) above are expected to require up to EUR 3 million; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one proposal will be selected. Competition proposals addressing topic area (d) are expected to require up to EUR 2 million each; nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one proposal will be selected.

Expected Impact:

- Strengthen collaboration between diverse robotics communities;

- Gain a higher level of European involvement in global robotics regulatory policy and standard-making;

- Lower non-technical market barriers to robotics market readiness and take-up; increase the uptake by entrepreneurs and end users through e.g. skills acquisition and training;

- Clearer understanding by the community and non-technical experts of the impact of robotics technology through two-way engagement, which helps to better inform related strategy and policy decision-making;

- Significant and measurable evolution in the public awareness and understanding of robots, especially amongst broad demographic groups, as shown by surveys, greater media coverage and increased take up of robotic products in domestic applications;

- Increase public and private investment interest in robotics technology for all stages of company formation and growth, from start-up to mature company, as measured by levels of grant and investment activity by national, regional or private-sector bodies.

Type of Action: Coordination and support action

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

ICT KEY ENABLING TECHNOLOGIES

Topics in this area address research and innovation in the two ICT Key Enabling Technologies (KETs), photonics and micro- and nanoelectronics. The objective is to translate Europe's S&T excellence in these two ICT KETs into strengthened competitiveness and market leadership and increased economic impact. In addition the objective is to develop innovative solutions to societal challenges and deliver clear benefits to the European citizen.

The challenge is structured as follows:

The photonics topics cover research and innovation activities under the photonics public private partnership (PPP). These will mainly be implemented through this Work Programme under this challenge, however some topics related to laser-based manufacturing are covered in the Work Programme of the Factories of the Future (FoF) PPP:

- Implementation through this Work Programme: the activities will address the whole research and innovation value chain in photonics technology – from materials through equipment and devices, to manufacturing and to products and services, and from advanced RTD to pilot lines. In addition coordination and support actions cover activities such as structuring, coordination, networking, outreach, awareness creation.

- Implementation in the FoF Work Programme: the activities will address research and innovation in laser-based manufacturing processes and the focus is on the use and integration of photonic devices (lasers but also other devices) for manufacturing industrial products.

The micro- and nanoelectronics part will be implemented by the Joint Technology Initiative (JTI) on 'Electronic Components and Systems' and through this Work Programme.

- Implementation through the JTI on 'Electronic Components and Systems': The JTI will facilitate multi-disciplinary industry-driven research and innovation along the full innovation and value chain, covering Technology Readiness Levels (TRLs) 3 to 8. Focus is on large federating projects including manufacturing pilot lines, technology platforms and application experiments. These are areas in which resources must be pulled from Member States and regions. An Annual Work Plan will be developed within the JTI. It will be based on the multi-annual Strategic Research and Innovation Agenda elaborated by industry.

- Implementation through this Work Programme: Generic Technology Development for the continued shrinking of horizontal and vertical physical feature sizes in nanoelectronics focused on exploratory research that will bring differentiating factors for the industry.

Proposals are invited against the following topic(s):

ICT-29-2016: Photonics KET 2016

Specific Challenge: Europe's photonics industry is facing fierce global market competition and has to cope with a very high speed of technological developments in the field. Further major S&T progress and research and innovation investments are required for sustaining Europe's industrial competitiveness and leadership in photonic market sectors where Europe is strong (e.g. in laser-based manufacturing, medical photonics, sensing, lighting) and to exploit new emerging market opportunities.

Moreover, Europe is experiencing the existence of many fragmented and rather uncoordinated developments between many different national and regional players. Europe suffers also from a slow innovation process for turning many good R&D results into innovative products ('Valley of Death'). This requires a joined-up approach, covering missing links in the value chain, such as assembly and packaging of photonics components. Finally, Europe needs to better exploit the large enabling potential of photonics in many industrial sectors and in solutions addressing major societal challenges such as health and well-being, energy efficiency or safety. Europe also needs to better exploit the innovation leverage potential of the innovation clusters and national platforms. The new trend in society of makerlabs and the efforts to create more interest in STEM (Science, Technology, Engineering and Mathematics) need to be exploited to generate an increased awareness of and improved skills in photonics.

In order to capitalise on the opportunities coming from advances in Photonics for laser-based production, a topic addressing these is proposed in collaboration[35] with Factories of the Future topic FOF-13-2016 - Photonics Laser-based production.

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

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[35] The Photonics PPP contributes 10M€ funding to this topic in the FoF Work Programme.

Application driven core photonic technology developments for a new generation of photonic devices (including components, modules and sub-systems): Actions should demonstrate strong industrial commitment, be driven by user needs and concrete business cases supported by strong exploitation strategies, and cover the value/supply chain as appropriate. Actions should address manufacturability and validation of results for the target applications and should include standardisation activities as appropriate. Actions may also include the related materials. Focus is on one of the following themes:

i. **Biophotonics: advancing imaging for in-depth disease diagnosis:** The objective is to develop innovative, compact, easy to operate non- or minimally invasive functional imaging systems that are multi-band and multimodal (including photonics in combination with non-photonic techniques) to support the in vivo diagnosis of age and life-style related diseases like cancer, cardiovascular, osteoarticular, eye diseases and various neuro-pathologies, after a positive screening. The imaging system must be either label-free or based on already/rapidly safety-approved labels, and should either address unmet medical needs or support a diagnostic approach which is significantly superior to existing approaches. Physicians/clinicians must be closely involved from requirement specifications to the validation. Validation in clinical settings should be included, but clinical trials are excluded.

ii. **Breakthrough in miniaturization of SSL light engines and systems***:* Research into breakthrough miniaturization of SSL (LED and OLED) light engines and systems allowing for new types or revolutionary designs of luminaires and lamps with new form factors and expanding application fields, such as in automotive, signalling, wearables, and through the integration into building materials in the construction sector. Research on the integration of driver electronics and system and functionality aspects may be included.

iii. **Pervasive high-specificity and high-sensitivity sensing for a safer environment***:* Breakthrough advances in cost-effective, compact, high-performance (both in specificity and sensitivity) photonic devices (including sources) for pervasive (i.e. large area coverage) near- and mid-infrared sensing applications (spectral range of 2 to 12 μm) for a safer environment, such as monitoring of water or air quality at large scale. Specificity and sensitivity levels should at least respect regulatory requirements. Actions should include validation of the device and proof of its suitability for the targeted application. Research on application related computation, communication and sensor system/network level aspects should be excluded, while development necessary for validation can be included. Hybrid solutions where the core photonic technology is complemented with other technologies are allowed.

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. Minimum one action per theme is expected.

b. Innovation Actions

Focus is on one of the following themes:

i. **Application driven core photonic devices integrated in systems:** Focus is on **microdisplay-based immersive, augmented and virtual reality visualisation systems.** Actions should address validation and demonstration of new micro-display based visualization systems for key applications in e.g. healthcare, maintenance & training, entertainment, tourism or sports. This may include wearable systems, as well as larger projection systems. Actions should also include standardisation activities. They should demonstrate strong industrial commitment, be driven by user needs and concrete business cases supported by strong exploitation strategies, and cover the whole value/supply chain and the end-user.

ii. **Pilot line for Assembly and Packaging**[36] : The objective is to set-up a pilot line for the assembly and packaging of integrated photonic components. The pilot line should offer generic solutions for a wide class of PICs (Photonic Integrated Circuits) as well as for the more demanding requirements of some selected PIC-based product groups of strategic interest to European industry. It should cover all stages of manufacturing through to testing. From technical as well as from user perspective, it should provide a low entry barrier access to low and medium production volumes, although the available processes should be suited also for scaling to high volume production. The action may include also process and equipment optimisation and qualification, and should include a validation of the pilot line offer with involvement of external users through pre-commercial pilot runs. A credible strategy to future full-scale manufacturing in Europe is expected. The action should deliver the additional knowledge and experience needed for this, be driven by the key stakeholders able to set-up and run such pilot lines, and cover the value chain as appropriate.

The Commission considers that proposals requesting a contribution from the EU between EUR 2 and 4 million (for theme b.i), and between EUR 6 and 14 million (for theme b.ii) would allow these themes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one action per theme is expected.

c. Coordination and support actions

i. **Coordination of regional photonics strategies:** The objective is to stimulate collaboration of photonics clusters to extend the range of Go-To-Market services for SMEs (including access to finance) through exchanging and adopting best practises, to network the SMEs with potential collaborators, business partners and customers, and to

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[36] Wherever appropriate, actions could seek synergies and co-financing from relevant national/regional research and innovation programmes, or from 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.

coordinate regional, national and European strategies and financial resources to the benefit of the local ecosystem and the regional smart specialisation strategies. Actions should build on on-going support actions in this field.

ii. **Photonics enhanced MakerLabs**[37] **:** The objective is to raise awareness, support hands-on learning and enhance skills of students, technicians and young professionals interested in photonics by extending existing facilities in order to provide access to photonic components, photonics-based equipment and related support services.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 1.5 million would allow these themes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one action per theme is expected.

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

a. Research and Innovation Actions

i. Biophotonics: advancing imaging for in-depth disease diagnosis

- Substantially improved in-depth diagnosis and more effective treatment of age and life-style related diseases;

- Secured and reinforced industrial leadership in the biophotonics related market for Analysis and Diagnostic Imaging Systems.

ii.. Breakthrough in miniaturization of SSL light engines and systems

- Improved cost/performance ratio and higher energy efficiency of miniaturized SSL light engines and systems;

- Innovative lighting, expanding application fields and markets for lighting solutions and maintained European industrial leadership in the global lighting market.

iii. Pervasive high-specificity and high-sensitivity sensing for a safer environment

- Better and pervasive environmental sensing and a safer environment;

- Secured and reinforced industrial leadership in sensing applications for the environment.

b. Innovation Actions

i. Microdisplay-based immersive, augmented and virtual reality visualisation systems

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[37] Wherever appropriate, actions could seek synergies and co-financing from relevant national/regional research and innovation programmes, or from 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.

- Major benefits for the users and end-markets from immersive, augmented and virtual reality visualisation systems;

- Increased market presence in augmented and virtual reality visualisation systems.

ii. Pilot line for Assembly and Packaging

- Industrial assembly and packaging of integrated photonic components in Europe and providing cost effective assembly and packaging solutions for SMEs;

- Strengthening Europe's position in the manufacture of integrated photonic components and covering the full value chain in Europe.

c. Coordination and support actions

i. Coordination of regional photonics strategies

- Improved coordination of strategies and resources within Europe and effective reinforcement of the European photonics sector.

ii. Photonics enabled MakerLabs

- A larger and better skilled photonics workforce and improved innovation capacity in photonics.

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

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

ICT-30-2017: Photonics KET 2017

Specific Challenge: Investments in R&D&I are essential for reinforcing Europe's industrial competitiveness and leadership in photonic market sectors where Europe is strong (e.g. in communications, medical photonics, sensing) and to seize new opportunities. Europe also needs to strengthen its manufacturing base in photonics to safeguard the further potential for innovation and value creation and for job creation. We must better exploit the large enabling potential of photonics in many industrial sectors and in solutions addressing major societal challenges such as health and well-being, energy efficiency or safety. Finally, Europe needs to better exploit the innovation capacity of the photonics SMEs and the innovation leverage potential of the innovation clusters and national platforms.

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

All R&I actions should demonstrate strong industrial commitment, be driven by user needs and concrete exploitation strategies, and they should cover the value/supply chain as

appropriate. They should address manufacturability and include standardisation activities as appropriate. Focus is on one of the following themes:

i. **Application driven core photonic technology developments** for a new generation of photonic devices (including components, modules and sub-systems) **for agile Petabit/s Optical Core and Metro Networks.** The objective is to develop new photonic technologies for metro and core networks allowing capacities of Pb/s per node, and Tb/s per channel and 100 Tb/s per link over increased transport distances, while supporting network programmability features and fitting network operator requirements and roadmaps. Actions should include all new device developments for the envisaged network architecture. The action should also lead to network solutions with an energy consumption and equipment footprint reduction by more than 10 and a significant reduction in network cost. Actions may include system, network, control and security level aspects to the extent necessary for the action.

ii. **Photonic integrated circuit (PIC) technology:** The objective is to achieve major advances in chip integration technology, enabling a cost effective volume manufacturing of PICs with significantly enhanced performances (e.g. integration complexity, footprint, energy efficiency, speed, …) or new functions. Potential for such technology advances exists e.g. in selective area growth for multi-function integration, wider band-gap engineering, heterogeneous integration, wafer-scale electronic-photonic integration, the use of new materials, and in new approaches to small and efficient laser sources. Actions may address also the related design methodology and tools and the optimisation of materials, and should include a validation of results with fabricated PIC prototypes.

iii. **Disruptive approaches to optical manufacturing by 2 and 3 D opto-structuring:** The objective is to develop new optical manufacturing approaches for photonic components with unprecedented resolution (down to the submicron and nano-scale) or for functionalization of the surface of the materials to tailor and optimise their characteristics for a specific application. Actions may also address the related material. Novelty may be related for example to the laser source, to the optical system for light manipulation, to light-matter interaction or to the exploitation of quantum effects. Actions should include the validation of the manufacturing approach through a functional prototype of an application relevant device that goes clearly beyond the state of the art.

The Commission considers that proposals requesting a contribution from the EU of between EUR 6 and 8 million (for theme a.i), between EUR 3 and 4 million (for theme a.ii and a.iii) would allow these themes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one action per theme is expected.

b. Innovation Actions

Focus is on one of the following themes:

i. Innovation Incubator for SMEs[38]

The objective is to reinforce the competitiveness of photonics and end-user industries, in particular SMEs, by providing them one-stop-shop access, supported through competence centres, to services and capabilities such as expertise, training, prototyping, design, engineering or pilot manufacturing services for first users and early adopters enabling the wider adoption and deployment of photonic technologies in innovative products. The service to be provided to the SME should be driven by its business needs and the implementation must be flexible and fast to better cope with the speed of innovation in ICT and the SME requirements.

Large projects are expected to achieve critical mass and to better exploit EU-added value. The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the selection process of additional users and suppliers for which financial support will be granted (typically in the order of EUR 30.000 – 100.000[39] per party). A maximum of 50% of the EU funding requested by the proposal should be allocated to this purpose.[40]

ii. Application driven core photonic devices integrated in systems: Actions should address validation and demonstration of photonic based systems for the target applications. Actions should also include standardisation activities. They should demonstrate strong industrial commitment, be driven by user needs and concrete business cases supported by strong exploitation strategies, and cover the whole value/supply chain and the end-user. Focus is on one of the following themes:

1. **Biophotonics: imaging systems for in-depth disease diagnosis:** The objective is the demonstration and validation in real-settings of innovative, easy to operate, compact, and non- or minimally invasive imaging systems to support diagnosis of age and life-style related diseases. The imaging system should either be label-free or be based on already/rapidly safety-approved labels. The feasibility and validity of the diagnostics approach should already have been demonstrated and it should potentially have a significant advantage with respect to current diagnostic approaches. The action should further develop, improve and assess the imaging system under a sufficient range of realistic conditions and disease profiles. The evaluation of its usability and applicability and its validation in clinical settings should be included.Actions should be driven by medical equipment manufacturers that are capable of and committed to the

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[38] Wherever appropriate, actions could seek synergies and co-financing from relevant national/regional research and innovation programmes, or from 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.

[39] 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.

[40] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

commercialisation of the solutions and include teams of physicians/clinicians to take part in the development and the functional and quantitative validation. Clinical trials are not covered by these actions and will normally take place after these actions.

2. **Sensing for process and product monitoring and analysis:** The prototyping and testing of new process analytical instrumentation for on-line/in-line control, targeting the food and pharmaceutical industry, based on compact and miniaturized photonics sensors that include novel key photonics components and modules. This new instrumentation should show significant improvements beyond the state of the art in sensitivity, specificity, long term stability (including calibration stability), high measurement rate, and reliability. Instruments should have self-testing/-monitoring functionalities and on-site calibration capabilities. The significant advantages compared to conventional sensors in terms of performance or cost, as appropriate, have to be demonstrated in a specific industrial application for monitoring product quality in real settings.

The Commission considers that proposals requesting a contribution from the EU of between EUR 8 and 10 million (for theme b.i) and between 6 and 8 million (for theme b.ii) would allow these themes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Minimum one action per theme is expected.

c. Coordination and Support actions

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

The Commission considers that proposals requesting a contribution from the EU of up to EUR 3 million would allow this theme to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. No more than one proposal will be funded.

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

a. Research and Innovation Actions

i. Agile Petabit/s Optical Core and Metro Networks

- next generation agile, high-capacity and energy efficient core and metro networks to support the highly connected and communicating society;

- Secured industrial leadership in optical communications systems for core and metro networks and reinforcing the full value chain in Europe.

ii. Photonic integrated circuit (PIC) technology

- Industrial volume manufacturing in Europe of PICs with significant competitive advantages in cost/performance and with reduced development costs;

- New or significantly enhanced integration technology platforms for a more competitive European photonic industry.

iii. Disruptive approaches to optical manufacturing by 2 and 3 D opto-structuring

- Technology leadership in optical manufacturing of 2 and 3 D opto-structuring;

- Emergence of innovative optical components or material for specific applications.

b. Innovation Actions

i. An Innovation Incubator for SMEs

- Broader and faster take-up of photonics in innovative products, in particular by SMEs.

ii.1. Biophotonics: imaging systems for in-depth disease diagnosis

- Substantially improved and wider deployed in-depth diagnosis, and more effective treatment of age and life-style related diseases;

- increased market presence in the Diagnostic and Analysis Imaging Systems and increased European competitiveness of the medical equipment industry.

ii.2. Sensing for process and product monitoring and analysis

- Increased process monitoring efficiency in the food and pharmaceutical industries and reduction of waste along the logistic food and drugs chain;

- Increased competitiveness of the European process and product monitoring equipment industry.

c. Coordination and Support actions

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

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

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

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

ICT-31-2017: Micro- and nanoelectronics technologies

Specific Challenge: While the state-of-the-art micro/nano-electronics technologies and their manufacturing are being further advanced towards market-readiness in the context of the ECSEL Joint Undertaking, it is essential to prepare for the future of the electronics industry the next wave of industry-relevant technologies to extend the limits (technological and/or economic) mainstream technologies will be facing in the medium term[41]. This is essential to maintain and increase Europe's longer-term capacity in the design and manufacturing of these technologies and to strengthen the competitiveness and market leadership of the many industries innovating through these technologies.

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

The work must be in the scope of one of the following topics:

- the development of new approaches to scale functional performance of information processing and storage substantially beyond the state-of-the-art technologies with a focus on ultra-low power and high performance. Work may address materials, processes, device and component architectures, system micro-architectures (processor and memory), security, design, modelling, simulation and nano-characterization, and must consider integration, systemability and manufacturability. Technologies exploiting the quantum effects in solid-state devices are also relevant. Advanced explorative technology development at TRL 2-3 is called for.

- 3D sequential integration (at transistor scale) possibly mixed with 3D parallel integration (at circuit level) for system solutions to increase functionalities and capabilities. Work could address interconnects (intra-layer and vertical structures), design challenges (3D design kits and tools, power models and optimization), prototyping and test methods. Proposals at TRL 2-3 are called for.

International cooperation with clear EU industrial benefits may be considered preferably with nations 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 specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b. Innovation action[42]

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[41] Graphene is covered by the eponym FET Flagship initiative

[42] Access actions (including EuroPractice-type actions) are addressed under ICT-4

In **Equipment Assessment Experiments**, suppliers of innovative high-tech equipment install, assess and validate their prototypes or products that have left the R&D phase in environments that are very close to real-life conditions in cooperation with end-user. Proposals at TRL 6-7 are called for.

The Commission considers that proposals requesting a contribution from the EU between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

c. Coordination and Support actions

In view of promoting the attractiveness of careers in micro/nanoelectronics towards young people, a dedicated pan-European challenge event should be proposed to showcase the possibilities offered by state-of-the-art hardware technologies (similar to the European code week for software apps). The sustainability of this event should also be addressed.

The Commission considers that proposals requesting a contribution from the EU of about EUR 0.5 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: Proposals should address the following impact criteria and provide metrics to measure and monitor success

a. Research and Innovation actions

The actions will aim at contributing to the future growth in Europe of the micro-/nanoelectronics and related industries.

- The proposals must describe how the proposed developments of new/enabling technologies will contribute to the target of doubling the economic value of semiconductor component production in Europe within the next 10 years as set by the Electronics Leaders Group in their strategic roadmap[43] and implementation plan[44].

- The proposals must outline a realistic roadmap for further progressing on the TRL range beyond the project timeframe and a concrete business perspective describing expected markets for the industrial partners and impact for European industry and society at large.

b. Innovation actions

- Proposals should clearly demonstrate the route from assessment to first use of the equipment. The user requirements of the equipment to be assessed should represent

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[43] https://ec.europa.eu/digital-agenda/en/electronics-roadmap-europe

[44] https://ec.europa.eu/digital-agenda/en/news/european-industrial-strategic-roadmap-micro-and-nano-electronic-components-and-systems-0

significant improvements to existing equipment in terms of capability, precision, efficiency or other characteristics opening new avenues of deployment.

c. Coordination and Support actions

- The actions will raise the awareness of young people for the potential offered by a technological career thereby attracting more students to the field.

- The proposed event should have ambitious targets in the number of participations (reach-out to thousands of students) and the scope of the activities (designs and prototypes) to be showcased.

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

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

INNOVATION AND ENTREPRENEURSHIP SUPPORT

Turning research results into innovative products and services often remains difficult in Europe and more needs to be done to foster a culture of entrepreneurship. The topics of this section address these problems by reinforcing the involvement of end users, supporting digital entrepreneurship, strengthening support to start-ups and SMEs, facilitating the meeting between financial investors and start-ups, increasing the skills for future entrepreneurs. Topics are furthermore leveraging the power of the public purse by bringing procurers together to use innovation in order to create better services for citizens and first customer opportunities for digitally-driven tech companies in Europe.

Proposals are invited against the following topic(s):

ICT-32-2017: Startup Europe for Growth and Innovation Radar

Specific Challenge: In Europe too many promising high tech start-ups or innovative SMEs do not manage to grow and scale up at pan-European or international level. The tendency is that they either remain within a restricted national market or, if they manage to emerge, are often bought while they are still too small, thus failing to become full actors on the international scene and to create a sound ecosystem around their success. Beyond this, turning research results with high innovation potential into viable products and services, bringing them to the market at European or even global level remains a big challenge.

Scope: Leveraging the Startup Europe[45] and Innovation Radar[46] initiatives, actions within this topic should on the one hand help established startups and prospective tech entrepreneurs to

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[45] http://ec.europa.eu/digital-agenda/about-startup-europe
[46] https://ec.europa.eu/digital-agenda/en/innovation-radar

achieve market success and, on the other, raise broader awareness of high potential innovators in Europe with specific targeted actions for maturing innovation excellence in EU-funded ICT projects. Actions should support the expansion of startups on a pan-European and international level. They should stimulate further tech entrepreneurship and the creation of new high growth businesses and jobs, seeking maximum synergies through European innovation ecosystems. Innovators targeted by the Innovation Radar include startups, SMEs, spinoffs and research teams. Innovators identified, promoted and supported by the Innovation Radar are expected to enriching and benefiting from, the Startup Europe ecosystem.

a. Innovation actions

Proposers should cover one or both of the following themes:

- Reinforcing ICT ecosystems for high growth tech startups by interconnecting and creating new synergies between 3-4 different Startup hubs across Europe per project. Activities should focus on scaling-up of companies by connecting, across different entrepreneurial ecosystems, key relevant stakeholders such as tech entrepreneurs, mentors, corporates, customers, artists, designers, media, investors and local authorities. Cross-border actions can include, strategic partnerships among the players from local startups hubs across Europe; actions to help startups to find skilled employees throughout the connected hubs; access to the right combination of finance; helping startups to have access to procurement opportunities; and provide information to allow startups to grow across borders.

- Facilitating financing and improving the liquidity for European investments in fast growing ICT startups and scaleups, increasing their chances for a successful exit. Activities should support networking for corporates, help EU and international investors to gather and improve knowledge of opportunities for investing in digital sectors as well as stimulating financing through European stock markets, preparing companies for investment, enlarging the pool of investors and analysts with deeper understanding of market trends and business models in digital sectors.

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

Minimum one proposal will be selected for each of the themes described.

b. Coordination and Support actions

These actions shall primarily be targeted towards technologies developed in EU funded ICT projects (from Framework Programme 7, Competitiveness and Innovation Programme and Horizon 2020).

- In the framework of DG Connect's "Innovation Radar" initiative, offering tailored support to innovators in order to turn their research results into marketable products and,

preparing such innovators for success in the market place. Support services will help EU-funded innovators with promising innovations and prepare for market introduction or technology transfer. Actions to champion and provide recognition to best-in-class ICT innovators and innovations from ICT specific programmes e.g. through organisation of recognition prizes, quality labelling, facilitating participation in relevant and impactful events, meeting corporate or institutional investors, procurers, potential customers or partners.

- Establishing a European wide network of nodes supporting primarily the needs of EU framework programme innovators in delivering pre-seed workshops for market-oriented researchers; practitioner-led, customer and user-centred, hands-on courses based on proven, state of the art methodologies for the development of business models for growth (e.g. customer discovery, lean startup, business model canvas, minimum viable product). Such courses are to be tailored to researchers, innovators and ICT based high-tech startups and should include interaction with prospective customers and users and where relevant taking into account market and regulatory conditions.

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

Minimum one proposal will be selected for each of the themes described.

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 start-up hubs and their companies (startups, scaleups) to the larger European business ecosystem seeking maximum synergies in terms of number of concrete collaborations between relevant players within existing ecosystems and networks;

- Increased access to customers, new products or services on the market, increase in turnover, better access to qualified employees, access to the right combination of finance and prospects for scaling up across borders and new job opportunities;

- Stimulate European investments in digital sectors through creating increased mutual understanding between investor communities and in particular tech startups and scaleups;

- Demonstrate sustainability of proposed actions beyond the life of the project;

- Where appropriate, seeking synergies with ESIF funds or ESIF supported actions to improve the synergies between H2020 and ESIF.

b. Coordination and Support actions

- Increase the number of digital technology based spin-offs and startups or successfully transferred technology from EU funded projects;

- Enable a significant number of companies based on ICT technologies to reach investment maturity and market introduction readiness;

- Enable innovators from EU funded projects to be part of the relevant EU networks created by Startup Europe;

- Where appropriate, seeking synergies with ESIF funds or ESIF supported actions in order to improve the synergies between H2020 and ESIF.

Type of Action: Innovation action, Coordination and support action

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

ICT-33-2017: Innovation procurement networks

Specific Challenge: ECB and FP7 impact studies point out that the biggest challenge faced by innovative companies in Europe is not to find funding for R&I but to find a first customer. The challenge is to facilitate access of innovative companies to the market by removing barriers to Pre-Commercial Procurement (PCP) and Public Procurement of Innovative solutions (PPI) in Europe. Cross-border cooperation among procurers and defragmentation of public demand are key in this respect as potential market size is the most important decision factor for firms to participate or not in a public procurement. Speeding up of implementation cycles and further networking of national innovation procurement competence centres are also needed.

Scope: **Coordination and Support actions**

Proposals should focus on one of the two themes below:

a. The objective is to support the creation of European wide networks of procurers (European Public Procurers networks) that define together an innovation procurement roadmap, identifying shared procurement needs in the near term (relevant for PPI) as well as mid-to-long term (relevant for PCP) in areas of common European interest.

European Public Procurers (EPP) networks are expected to engage into an open dialogue with all potential stakeholders, including other procurers and end-users. EPP networks are encouraged to publish their perceived procurement needs online, in a way that enables the research and innovation community to comment and submit ideas to make suggestions for future PCPs or PPIs.. EPP networks should also undertake activities that investigate the feasibility and facilitate the concrete preparation of a cross-border PCP or PPI for at least one shared common procurement need.

EPP networks should contain a critical mass of public procurers responsible for the acquisition and/or regulatory strategy for innovative solutions in areas of public interest that are large potential customers for ICT LEIT technologies. EPP networks should also undertake dissemination activities to share results and raise awareness about PCP and PPI across Europe.

b. The objective is to support the creation of one EU wide network of national competence centers on innovation procurement (PCP and PPI). Activities undertaken by the network are expected to include the creation of new national innovation competence centers and the enlarging of the scope of existing competence centers. They should also include experience sharing on PCP/PPI implementation across Europe, promoting Horizon 2020 funding and synergies with ESIF funding for PCP and PPI to ICT procurers in cooperation with NCPs, assisting ICT procurers in starting up such procurements nationally and collaborating cross-border to facilitate also transnational joint procurement.

In cooperation with policy makers, the network should also develop and coordinate policy actions to mainstream PCP and PPI across Europe such as setting targets and developing financial incentive schemes for procurers to undertake PCP and PPI.

The network is expected to maximize synergies with national and ESIF funding and focus the budget requested from Horizon 2020 on activities/partners that cannot be funded from ESIF or for which national funding is not available.

The expected duration for the action is 4 years. The minimum participation is 5 existing national innovation procurement competence centers plus 5 public bodies that have the mandate to setup 5 new innovation procurement competence centers (in total from 10 different Member States or associated countries), aiming for EU wide participation of innovation procurement centers in the network by the end of the project.

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 2 million would allow these themes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

a. More forward-looking, concerted approach to develop common answers to challenges faced by the public sector in a number of countries. Increased opportunities for the supply side to present the potential of innovative solutions the demand side in order to address concrete public sector challenges. Reduced fragmentation of public sector demand through definition of common specifications and preparation of cross-border procurements.

b. Increased awareness on PCP and PPI among policy makers and procurers. Enhanced capacity of the public sector to carry out PCPs and PPIs. Increased amount of PCPs and PPIs taking place at national and EU level (Horizon 2020 and ESIF funded). Creation of 5 new innovation competence centers and enlarged scope of the support to public

procurers provided by 5 existing competence centers, in a way that maximizes synergies with national and ESIF funding.

Type of Action: Coordination and support action

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

ICT-34-2016: Pre-Commercial Procurement open

Specific Challenge: This specific challenge addresses the lack of public demand-driven innovation in Europe needed to close the gap between supply and demand for innovative ICT solutions. It targets consortia of procurers with similar procurement needs of common European interest, to drive innovation from the demand side and reduce fragmentation of public sector demand in Europe. The aim of engaging in such forward looking R&D procurement strategies is to modernize the provision of public services faster whilst creating opportunities for industry and researchers in Europe to take international leadership 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 Procurement. This topic is open to proposals for pre-commercial procurement actions in all areas of public sector interest requiring innovative ICT based solutions. The work will complement PCP Actions foreseen 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.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 4 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

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

RESPONSIBILITY AND CREATIVITY

For innovation to happen and to be of value for society, the critical skills needed – in addition to scientific and technological knowledge – are skills such as creativity, and the capacity to involve all of society in the process of innovation.

This section includes cross-cutting activities aiming at supporting the nexus between technology, social sciences, humanities and arts. The proposed topics address the need to engage:

- with social scientists and humanists on the development of responsible research and innovation agendas that meet citizens' civil society's concerns and expectations,

- and with artists, in order to better include them in innovation processes to foster creativity and help enhance user acceptance.

They are complemented by other activities embedded in the topics of the technological areas of the previous sections, including notably a series of coordination and support actions addressing specific issues related to Big Data, IoT and Security, as well as a large RRI-SSI hub to be supported through the Societal Challenge 6 part of the work programme.

Proposals are invited against the following topic(s):

ICT-35-2016: Enabling responsible ICT-related research and innovation

Specific Challenge: The development and deployment of digital technologies and services induces pervasive and radical changes in our lives and in the societal system. The explosion of the number of devices, their increased "intelligence", autonomous behavior and connectivity are changing significantly the life conditions of Europeans. Beyond the benefits brought about by technological innovations, there are also challenges, and sometimes threats, that need to be addressed to ensure that technological innovations go hand in hand with societal needs and expectations. Including SSH (social sciences and humanities) expertise provides a constructive and critical accompaniment of the scientific and technological developments for the projects funded under LEIT-ICT, and enables responsible research and innovation in the digital age.

SSH engagement in ICT research can both address proactively the impacts of the take-up of novel technologies, and contribute to innovation by proposing alternative approaches. For example, considering that there is a trade-off between privacy and security refers to conceptions that can be challenged. Reconsidering underlying assumptions or taking a new and broader view to ICT related research and innovation can lead to other options that inspire different and more responsible technological R&I, with new benefits for the society.

Scope:

a. Research and Innovation Actions should take a fresh look on the relationship between information and communication technologies, on the one hand, and social phenomena, on the other hand. They should contribute to ongoing ICT-driven research and innovation by providing best practice in collaborative research between SSH and ICT communities. The projects are expected to have direct relevance to ongoing ICT-related research and innovation, in particular in the area of robotics, cyber-physical systems, internet of things, big data and cybersecurity.

From this wide range of issues, proposals are expected to focus on one or both of the following clusters:

- How can we avoid the traps of ICTs ending up in isolating humans behind their screen, or harnessing them in a passive role? In the forthcoming hyperconnected era, it is essential to acknowledge the dual human aspirations for relationships and for freedom, and the dynamic nature of the relationships between humans and artefacts.

- What are the conditions for ICT-enabled innovations to generate interesting and rewarding jobs, and reduce the risk of excluding sections of society from the labour market? What economic models can ensure a fair sharing of the created added value?

The Commission considers that proposals requesting a contribution from the EU of between EUR 1 and 2 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b. Smaller short-term **Research and Innovation Actions** are expected to engage SSH expertise and, potentially other actors, to reflect and challenge the way ICT-related research and innovation is currently approached in a specific area and/or reflected in the call text. This approach opens new ways for interactions between SSH and ICT. SSH expertise is called for to unveil and challenge the implicit assumptions underlying broader technological research agendas, with a view to propose constructive alternative framings which enhance considerations for responsible ICT research and innovation. These so called "*sister projects*" should clearly describe how they intend to bring an innovative research perspective for one or more LEIT ICT topic areas. These projects are expected to have a light project structure, accommodating for its exploratory experimental nature and its relevance beyond disciplinary boundaries.

The Commission considers that proposals requesting a contribution from the EU of between EUR 300.000 and 500.000 and running for 12 months would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts and/or proposing other durations.

Minimum one proposal will be selected for each of the areas (a, b) described above.

Note that there are related topics with emphasis on SSH and responsible ICT research and innovation in other parts of ICT LEIT WP.

Expected Impact:

- Alternative approaches and new perspectives for future societal relevant ICT research and innovation activities.

- Increased research collaboration and common agenda between ICT and RRI-SSH communities.

- Improved take-up of responsible ICT research and innovation that takes into account human and societal concerns and expectations under new technological conditions

- Increased relevance and usability of SSH knowledge for ICT R&I processes in order to align ICT R&I with human needs and societal expectations.

- Increased societal relevance of future research agendas in ICT-related areas.

Type of Action: Research and Innovation action

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

ICT-36-2016: Boost synergies between artists, creative people and technologists

Specific Challenge: Innovation, today, is as much about novel solutions that technology and design can provide as it is about understanding needs of society and ensuring wide participation in the process of innovation. In this context, the Arts are gaining prominence as a catalyst of an efficient conversion of S&T knowledge into innovative products, services, and processes.

The challenge is to accelerate and widen the exchange of skills of artists and creative people with entrepreneurs and technologists, thus creating a common language and understanding. This topic supports the STARTS (S&T&ARTS) initiative, fostering innovation at the nexus of 'Science, Technology and the Arts'.

Scope: The activities are structured in two lines: establishing a structured dialogue between creative people and technology developers and encouraging artists' integration into research and innovation projects, providing visibility of good practices and rewarding them.

a. Innovation Action establishing a structured dialogue between creative people and technologists:

First, it will identify the relevant regional, national and international agencies active in education, research and economic support of the Creative Industries and:

- establish a Europe wide sustainable structured dialogue, ensuring the synchronisation of the efforts; as well as

- promote the replication of successful initiatives across other industries and European countries.

Second, it will directly support creative people and technologists to work together and produce unconventional and compelling new products. Taking advantage of existing structures such as fab labs, creative and innovation hubs, the action should at least combine the following activities:

- Launch a yearly Europe wide competition for the best creative product ideas and ensure the financial support of their realisation. The action should cover the promotion of the competition, the selection process and support for the development of the selected ideas into fully functional prototypes. The competitors should be teams of creative individuals and technologists providing novel ideas to be evaluated according to their originality, feasibility and economic or social value potential.

- Promote the newly selected ideas as well as the prototypes resulting from the selection of the previous year, through highly visible actions addressing both the general public and potential investors across Europe[47].

- Develop a sustainability strategy to ensure the persistence of the experiences gained and the coordination mechanisms set up during the action beyond the funding period.

The action may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. The consortium will define the process for selecting the prototype developments to which financial support will be granted (typically below the range of EUR 50.000 per experiment). At least 80% of the funding should be dedicated to the prototype developments.

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

b. Coordination and Support Actions

Proposals will cover one of the two areas defined below:

1. Integration of artists in research and innovation projects is encouraged across all ICT objectives in WP2016/2017. To facilitate this integration and help build silo-breaking

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[47] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

partnerships between industries, entrepreneurs, and researchers in ICT with the Arts, a Coordination and Support Action will provide a brokerage service that will:

- Fund short-term residencies/fellowships in running H2020 projects or in institutions and sponsor 'matchmaking events' (workshops, hackatons, etc.) that will allow artists and ICT experts to develop common work practices and address concrete problems.

- Set up an online platform to match partners from the ICT and the Arts, identify concrete R&D&I problems that artistic practices could help address.

- Organise an annual high visible STARTS event with international outreach bringing together H2020 projects, industrial players and artists and showcasing successful interactions between industry, technology and the Arts.

2. Implementation of a 'STARTS prize' that will showcase vision and innovation in technology rooted in links with the Arts by giving visibility to the most forward- looking collaborations and the impact on innovation that they have achieved. rewarding outstanding contributions to innovation resulting from collaborations of technology with the Arts. The support action will ensure publicising the prize, handling of submission in a scalable manner, the evaluation procedure for the prize in liaison with the EC services, the award ceremony together with an exhibition and a (travelling) exhibition of shortlisted works.

It is foreseen to hand out two annual prizes (20.000Euros each) covering different aspects of STARTS, one honouring artistic exploration where appropriation by the Arts has altered (the use, deployment, or perception of) technology and one that honours works linking ICT and the Arts (technological or artistic) that open new pathways for innovation and/or society.

To achieve visibility and impact the STARTS prize must be a long-term commitment, must reach out to both technology/industry and to the art world. It might therefore be best linked to an existing high profile prize allowing leveraging existing resources and credentials. This action allows for the provision of financial support to third parties in the form of prize in line with the conditions set out in Part K of the General Annexes.

The Commission considers that proposals requesting a contribution from the EU of about EUR 4 million for area 1 and of about EU 1 million for area 2 would allow each area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Proposals should target a duration of four years.

Expected Impact:

- Provide the European landscape with sustainable structured dialogues between creative people and technologists.

- Increase the transfer of knowledge between the ICT and the Creative Industries.

- Contribute to a change of culture, appreciating the societal and economic added value of creativity, promoting more innovation-oriented mind-set rooted in silo-breaking collaborations between technology and the Arts.

Type of Action: Innovation action, Coordination and support action

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

INTERNATIONAL COOPERATION ACTIVITIES

The international dimension of Horizon 2020 supports the EU's research and innovation excellence and industrial competitiveness. Several objectives are pursued in the ICT area. The aim is to encourage some of the world's "best minds" to work with Europe's researchers and in European-funded projects and to enable the EU industry to benefit from ICT market developments internationally, especially in the most prominent emerging economies. The international dimension will also promote the global reach and adoption of technological developments, market innovations and standards coming from the EU, particularly in growing markets. Longer term partnerships need to be fostered with countries of strategic importance for the EU. Finally, research and innovation also have a significant contribution to make in achieving the commitments the Union has made internationally with regard to developing countries.

Proposals are invited against the following topic(s):

ICT-37-2016: CHINA: Collaboration on Future Internet

Specific Challenge: The challenge is to create the conditions for optimised cooperation opportunities between the European and the Chinese research and innovation ecosystems including standardisation, in particular for key strategic domains where global approaches, interoperability and standards are sought like IoT and 5G. It includes the identification of practical opportunities for future cooperation on a reciprocal basis.

Scope: The scope of the work is of analytical nature, and requires a good understanding of both the Chinese and European models for research support, standardisation support, and lead market introduction. The work targets the analysis of the Chinese research/standardisation/innovation ecosystems, of their main partners and conditions of contributions and participation for foreign companies, including the legal environment. It includes a comparative analysis with the European research systems, and further identifies key CN national projects, that could form the basis of joint EU-CN collaborations. These activities are complemented with roadmapping activities for EU-CN cooperation in the specific domains of 5G and IoT.

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

Expected Impact:

- Identification of opportunities of EU-CN technological cooperation in strategic sectors and associated road-mapping, including support for technical and policy cooperation between EU-CN IoT or 5G Large Scale Pilots of common interest.

- Comparative analysis of EU-CN Research and innovation ecosystems and conditions of win-win participation.

Type of Action: Coordination and support action

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

ICT-38-2016: MEXICO: Collaboration on ICT

Specific Challenge: Mexico has demonstrated its commitment to use FIWARE as the open service platform of reference. Two FIWARE nodes have been established in Mexico, applications and services are being developed and some new FIWARE platform components are added from Mexican research teams. Furthermore Mexico has confirmed in the Joint Scientific Committee the interest to strengthen the collaboration in the ICT domain. Therefore, the present Challenge is to enhance collaboration in FIWARE and opening horizons for future cooperation in the ICT domain.

Scope: **a. Research and Innovation Actions**: Development, implementation and replication of FIWARE-based services in the EU and Mexico, to facilitate the transfer of applications between the EU and Mexico, to develop the global uptake of applications in validated scenarios (e.g. energy, transport, smart cities), and to ensure multilingual training and support.

Development of new FIWARE components and evolution of existing ones from sectorial implementations in the EU or Mexico.

The Commission considers that proposals requesting a contribution from the EU of EUR 0.5 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b. Coordination and Support Actions:

Proposals should cover one of the following bullet points:

- Networking and other actions for sustainability, standardisation and industrial commitment to FIWARE in Mexico;

- Identify and explore topics for future collaboration in the domain of ICT, e. g. by road-mapping and events in order to ensure that any further cooperation is based on solid basis and a clear mutual value added.

The Commission considers that proposals requesting a contribution from the EU of EUR 0.25 million would allow this specific challenge to be addressed appropriately by two distinct projects. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Enhanced collaboration in FIWARE between EU and Mexico, with increased alignment between EU and Mexican actors, and joint forces in strategic actions on FIWARE;

- Increased synergies and reduced efforts thanks to exchanges and joint EU-Mexico actions on FIWARE;

- Identification of the most viable, future research topics and ways of cooperation between EU and Mexican actors in ICT research and innovation.

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

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

ICT-39-2016-2017: International partnership building in low and middle income countries

Specific Challenge: To reinforce cooperation and strategic partnership with selected countries and regions in areas of mutual interest.

Targeted countries: Low and middle income countries[48] *in sub-Saharan Africa and ASEAN countries*

Scope: **a. Innovations Actions**

Actions will address the requirements of end-user communities in developing countries. This may include technological improvements and adaptations as well as innovative service creation based on existing technologies.

Proposals could include specific technological targets such as co-design, adaptation, demonstration and validation (e.g. pilots) of ICT related research and innovation in relevant thematic areas addressed by Horizon 2020 including Content Technologies and Societal Challenges. Proposals are expected to address take up and scalability of the proposed solutions.

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[48]   See World Bank country classification.

Activities under this topic should be led by a clearly defined user need/market opportunity for the technology being adapted; they should in particular include requirements of developing countries (at national and local level), and where possible, have the potential for wider impact by involving a number of countries from the same region. Proposals should feature an explicit element exploring technology adoption, through understanding and evaluating behavioural responses to the introduction of new technologies in different regional settings. Societal and gender issues will be taken into account. Proposals should be submitted by a partnership complementing each other with a particular focus on the participation of relevant developing country innovation stakeholders and end-user community representatives (e.g. relevant public, private, education and research, and societal sector organisations, Innovation Hubs or Living Labs).

The Commission considers that proposals requesting a contribution from the EU between EUR 1 and 2 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

b. Coordination and Support Actions for Africa

One CSA to foster research coordination and support collaborative activities between Europe and Africa, through the organisation of events – if possible synchronised with relevant either policy or research meetings - and monitoring ICT-related activities in targeted countries in Africa providing input on common R&D priorities and future cooperation opportunities; strengthening cooperative research links; supporting greater awareness of research cooperation opportunities and dissemination of results from ICT39-2015 and other relevant developments. Actions should build upon the achievements of similar past or ongoing Support Actions for Africa.

The Commission considers that proposals requesting a contribution from the EU of around EUR 0.8 million would allow this area to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. No more than one proposal will be funded.

Expected Impact:

- Development of relevant technology responding to specific needs and conditions of the target country;

- Sustainable uptake of results within the targeted countries, beyond the project completion date;

- Reinforced international dimension of the ICT and Innovation aspects of Horizon 2020 and a higher level of international cooperation with low and middle income countries in ICT R&D and Innovation, focusing on areas that are beneficial to the target countries/region;

- Reinforcement of strategic partnerships with selected countries and regions in areas of mutual interest and added value in jointly addressing important issues.

Type of Action: Innovation action, Coordination and support action

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

Conditions for the Call - Information and Communication Technologies Call

Opening date(s), deadline(s), indicative budget(s):[49]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 20 Oct 2015			
ICT-37-2016 (CSA)	1.00		19 Jan 2016
ICT-38-2016 (CSA)	0.50		
ICT-38-2016 (RIA)	0.50		
ICT-39-2016-2017 (CSA)	0.80		
ICT-01-2016 (RIA)	19.00		12 Apr 2016
ICT-01-2016 (CSA)	1.00		
ICT-02-2016 (RIA)	12.00		
ICT-02-2016 (IA)	8.00		
ICT-03-2016 (RIA)	17.00		
ICT-03-2016 (CSA)	1.50		
ICT-06-2016 (RIA)	35.00		

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[49] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

ICT-06-2016 (IA)	10.00		
ICT-10-2016 (RIA)	31.00		
ICT-12-2016 (IA)	15.00		
ICT-12-2016 (RIA)	5.00		
ICT-12-2016 (CSA)	0.20		
ICT-13-2016 (CSA)	1.00		
ICT-13-2016 (RIA)	25.00		
ICT-14-2016-2017 (IA)	27.00		
ICT-15-2016-2017 (IA)	25.00		
ICT-17-2016-2017 (CSA)	5.00		
ICT-18-2016 (RIA)	8.00		
ICT-18-2016 (CSA)	1.00		
ICT-21-2016 (IA)	14.00		
ICT-22-2016 (IA)	20.00		
ICT-22-2016 (RIA)	11.00		
ICT-24-2016 (IA)	12.00		
ICT-25-2016-2017 (RIA)	15.00		
ICT-25-2016-2017 (IA)	15.00		
ICT-26-2016 (RIA)	24.00		
ICT-26-2016 (IA)	18.00		

ICT-29-2016 (RIA)	40.00		
ICT-29-2016 (IA)	23.00		
ICT-29-2016 (CSA)	3.00		
ICT-34-2016 (PCP)	4.00		
ICT-35-2016 (RIA)	7.00		
ICT-36-2016 (IA)	3.00		
ICT-36-2016 (CSA)	5.00		
Opening: 20 Apr 2016			
ICT-04-2017 (IA)		24.50	08 Nov 2016
ICT-04-2017 (CSA)		1.00	
ICT-07-2017 (RIA)		100.00	
ICT-07-2017 (CSA)		3.00	
ICT-08-2017 (IA)		40.00	
ICT-08-2017 (RIA)		5.00	
ICT-09-2017 (RIA)		18.00	
ICT-19-2017 (IA)		38.00	
ICT-19-2017 (CSA)		1.00	
Opening: 14 Dec 2016			
ICT-05-2017 (RIA)		24.00	25 Apr 2017
ICT-05-2017 (CSA)		2.00	

ICT-11-2017 (IA)		9.00
ICT-11-2017 (CSA)		1.00
ICT-14-2016-2017 (IA)		27.00
ICT-15-2016-2017 (IA)		25.00
ICT-16-2017 (RIA)		31.00
ICT-17-2016-2017 (RIA)		2.00
ICT-20-2017 (RIA)		17.00
ICT-23-2017 (RIA)		10.00
ICT-23-2017 (IA)		2.00
ICT-25-2016-2017 (RIA)		15.00
ICT-25-2016-2017 (IA)		19.00
ICT-27-2017 (RIA)		28.00
ICT-27-2017 (IA)		11.00
ICT-27-2017 (PCP)		7.00
ICT-28-2017 (CSA)		5.00
ICT-30-2017 (RIA)		41.00
ICT-30-2017 (IA)		43.00
ICT-30-2017 (CSA)		3.00
ICT-31-2017 (RIA)		19.00
ICT-31-2017 (IA)		3.00

ICT-31-2017 (CSA)		1.00	
ICT-32-2017 (IA)		10.00	
ICT-32-2017 (CSA)		2.00	
ICT-33-2017 (CSA)		4.00	
ICT-39-2016-2017 (IA)		13.00	
Overall indicative budget	463.50	604.50	

<u>Indicative timetable for evaluation and grant agreement signature</u>:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

<u>Exceptional funding rates</u>:

ICT-27-2017, ICT-34-2016	The funding rate for Pre-Commercial Procurement (PCP) actions is limited to 90% of the total eligible costs (PCP is procurement of R&D services) to leverage co-financing from the procurers.

<u>Eligibility and admissibility conditions</u>: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

ICT-33-2017	For ICT-33-2017 point b) only: The minimum participation is 5 existing national innovation procurement competence centers plus 5 public bodies that have the mandate to setup 5 new innovation procurement competence centers (in total from 10 different Member States or associated countries).
ICT-08-2017	For ICT-08-2017 point b) only: Additional eligibility criteria: - Due to the specific scope of this sub-topic, in addition to the minimum number of participants set out in the General Annexes, proposals shall include at least one participant from Taïwan.

	• Proposals will only be selected on the condition that the Taïwanese partners are funded by the Ministry of Economic Affairs (MoEA).

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme with the following exceptions:

ICT-08-2017	For ICT-08-2017 point b) only:
	Criterion 3 "Quality and efficiency of the implementation": additional evaluation sub-criterion: Balanced effort between participants from the EU and associated countries and participants from Taïwan, with a work plan properly involving coordinated research and innovation activities between Europe and Taïwan.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

SME INSTRUMENT - ODI

Full details on the continuously open SME instrument call (H2020-SMEInst-2016-2017) are provided under the Horizon 2020 Work Programme Part – Innovation in SMEs (Part 7 of this Work Programme). This Work Programme part contributes the following challenge of the SME instrument call:

SMEinst-01-2016-2017 - Open Disruptive Innovation Scheme

Specific Challenge:

The challenge is to provide support to a large set of high risk innovative Startups and SMEs in the ICT sector. Focus will be on companies proposing disruptive ICT concepts, products and services applying new sets of rules, values and models which ultimately create new markets (e.g. by tackling non consumption) or disrupt existing markets.

The objective of the ODI is threefold:

1. Nurture promising innovative and disruptive ideas;

2. Support prototyping and scalability of disruptive solutions through validation and demonstration in real world conditions;

3. Promote wider deployment and/or market uptake.

Proposed projects should have a potential for disruptive innovation and fast market up-take. The action is particularly well suited for start-up and young innovative SMEs that are looking for swift support to their innovative ideas.

FAST TRACK TO INNOVATION - PILOT

Full details on this pilot are provided in the separate call for proposals under the Horizon 2020 Work Programme Part - Fast Track to Innovation Pilot (Part 18 of this Work Programme).

Call - EU-Japan Joint Call

H2020-EUJ-2016

Proposals are invited against the following topic(s):

EUJ-01-2016: 5G – Next Generation Communication Networks

<u>Specific Challenge</u>: Bold 5G initiatives in both EU and Japan open industrial collaboration prospects to further progress with the objective of developing common positions, standards and interoperable systems for critical networks and computing platforms. Proposals with balanced participation of EU and Japanese partners should make a substantial contribution to the identified themes indicating the benefits of a joint effort.

Progress on standards related technologies and system approaches are needed to realise 5G radio access and include ultra-lean signalling design, new spectrum and access methods, massive MIMO, a new air interface, and SON. It also requires to futher valorise the themes made in the first two EU-Japan coordinated calls with co-funding scheme between EC and MIC/NICT, to achieve high speed/high capacity dense local networks and user environments. Unified network management applying SDN/NFV techniques is directly applicable in the context of this challenge

<u>Scope</u>: **Research and Innovation Actions**

Two aspects that are complementing each other are in scope:

- 5G technologies and systems to realize high-performance heterogeneous networks which have dynamic resource allocation capabilities, superior spectral efficiency performances and functions of supporting a very wide range of application requirements. The work focuses on interoperability across heterogeneous networking implementation, on the basis of agreement on the overall testing and evaluation methodologies and the identification of related evaluation criteria and parameters and usage scenarios. This work is expected to visibly contribute to the overall evaluation methodology of 5G technologies carried out by 3GPP. It includes both below and above 6GHz relevant frequency bands in the context of global interoperability scenarios.

- 5G network to control heavy dynamicity, which change traffic volume and characteristic as well as traffic growth, with agile and flexible control or management scheme such as SDN/NFV. The Software-Defined Networking (SDN) technologies with networks controlled by software, automatically is targeted for advancing networks, as well as the Network Functions Virtualisation (NFV) to virtualize entire classes of network node functions into building blocks that may be connected, or chained, together to create telecommunication services. They draw out the performance of 5G and are essential to manage the networks in the near future. The work focuses on the earliest networks by

SDN and NFV in the world, on the overall testing and evaluation SDN network management and the result of related evaluation will contribute to to relevant standardisation (i.e. ONF, ITU, 3GPP). This work is expected to visibly contribute to the overall evaluation methodology of 5G technologies carried out by 3G PP.

Sharing the results in common testbeds and applications may be targeted, and the 2020 Tokyo Olympics may be considered as a deployment scenario of 5G networks or technologies.

A strong focus should be given towards a common standardization roadmap for 5G which may start with 3GPP R14, including coordinated and common standards in the SDN/NFV domain. Standardization impact through EU and Japanese research efforts are addressed through H2020 as well as 5GPF (5G Promotion Forum) and should also be relevant in the context of the WRC'19 5G spectrum process.

The Commission considers that proposals requesting a contribution from the EU up to EUR 1.5 million would allow this specific challenge to be addressed appropriately by two distinct projects. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. No more than one proposal per bullet point will be funded.

Expected Impact:

- Optimised exploitation of access resources through interoperability across a range of technologies for multiple applications in both dense and rural environments.

- Development and demonstration of key enabling technologies for the future generations of integrated/heterogeneous access network systems.

- Joint identification of standardization requirements and contribution to standardization bodies and fora, supporting global views on open standards and interoperability, with particular focus on 3G PP and WRC 2018/19 developments. It includes a significant contribution to the testing and evaluation methodologies of 5G access technologies under 3G PP.

- New basic technologies for network management. Implementation acceleration through agile relocation and flexible reconnection of virtual network functions (VFN) with real-time monitoring as proof of concepts.

Type of Action: Research and Innovation action

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

EUJ-02-2016: IoT/Cloud/Big Data platforms in social application contexts

Specific Challenge: Over the last years, the Internet of Things has moved from being a futuristic vision to an increasing market reality. The Integration and federation of IoT with Big Data and Cloud (including edge cloud), having all three diverging principles, remains a

key challenge. The exploitation of big data, being obtained from remote sensing / actuation and the Web and social media crawling in specific contexts and being processed by smart objects and in sophisticated clouds, enables the creation of distributed intelligence as key application/service drivers toward attractive IoT services. Cloud-based applications driven by decentralised information processing capabilities need to use dedicated cloud architectures, standardised APIs, open software components, and to pay special attention to data integrity, localisation, and confidentiality. Holistic approaches are required to address privacy & security issues across value chains including privacy by design aspects, SLAs, software algorithms and new data management models.

Scope: **Research and Innovation Actions**

The scope is to realise IoT/Cloud/Big Data platforms in social application contexts. Specific requirements include multiple sensors and devices linked with big data analytics and cloud data management, edge-heavy computing, machine learning and complex event discovery, and a programmable IoT logic and IoT Data Warehouse. The research will address technological issues in big data application scenarios such as: elasticity and scalability of cloud data management; transregional federated clouds; distributed storage; distributed and/or edge computing; wireless sensor networks; cross-sectoral and spatio-temporal data analysis; etc. Applications related in particular to smart cities supporting urban needs and green manufacturing should serve as test-bed and verification areas.

The Commission considers that proposals requesting a contribution from the EU of EUR 1.35 million would allow this specific challenge to be addressed appropriately by two distinct projects. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact:

- Credible demonstration based on cross-border business and/or societal applications of robust interoperable technologies combining IoT with Cloud technologies and Big Data approaches.

- Concrete implementations of interoperable solutions that integrate Big Data, IoT and Cloud that are candidates for standardisation.

Type of Action: Research and Innovation action

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

EUJ-03-2016: Experimental testbeds on Information-Centric Networking

Specific Challenge: Recent Internet multimedia applications are characterized by an increasing trend in the number of users creating, storing, sharing and consuming a larger number of bigger content. With the introduction of new types of content (higher quality,

richer content, networked media …), Future Internet applications and services will be more and more demanding on the underlying infrastructures.

To accommodate Future Internet applications/services, national projects in United States such as Named Data Networking (NDN) and eXpressive Internet Architecture (XIA) have been focusing on content-centric or content-oriented networking by academia. Japan and Europe have also for the last years conducted very close and complementing research and developments on information-centric networking and efficient media distribution technologies driven by industry and academia consortium. Yet, there are still unsolved issues, especially when facing current and future worldwide end-to-end use cases.

Global experimentation, with close to reality setup and constraints, is required to be able to identify and reproduce known or unknown limitations and problems; and to test and validate new solutions (protocols, architectures, …) from the network layer up to the application layer.

Scope: **Research and Innovation Actions**

The overall objective is to develop frameworks, architectures, protocols or tools for efficient media and content distribution on content-centric networking and enable the experimentation by building a large scale global Information-Centric Networking (ICN) testbed. The proposals must cover joint work on connecting and federating key existing ICN and related testbeds in Europe and Japan, or other regions, building upon previous research results, tools and framework (e.g. CUTEi, Fed4Fire, Contrace, Testman, Felix, Green-ICN …). The proposals must be based on strong cooperation between academia and industry, in order to clearly demonstrate mutual interests for future Internet services. When appropriate, enhancement of recent developments of existing ICN architectures (e.g. outcomes of the NDN or XIA projects) can be considered. A dedicated attention should be put on the experimenters experience and interaction. The proposals should also contribute to the definition of open standards and common APIs (Application Programming Interface) to ensure world-scale interoperability in the domain.

The Commission considers that proposals for project duration of 3 years and requesting a contribution from the EU of EUR 1.3 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts or duration.

Expected Impact:

- Enabling global scale experimentation, with very large testing capacities (content type/amount/number of sources/consumers …) for the distribution and management of networked media, rich and large contents requesting high to very high data rate communication among a large number of consumers.

- Identification and validation of interoperable technologies for ICN.

- Validation of new framework, architectures or protocols for ICN.

- Influence and contribute to testbeds federation at the global level.

<u>Type of Action</u>: Research and Innovation action

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

Conditions for the Call - EU-Japan Joint Call

Opening date(s), deadline(s), indicative budget(s):[50]

Topics (Type of Action)	Budgets (EUR million) 2016	Deadlines
Opening: 20 Oct 2015		
EUJ-01-2016 (RIA)	3.00	19 Jan 2016
EUJ-02-2016 (RIA)	2.70	
EUJ-03-2016 (RIA)	1.30	
Overall indicative budget	7.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

EUJ-01-2016, EUJ-02-2016, EUJ-03-2016	Additional admissibility criterion: • Participants in the EU collaborative projects are required to conclude a coordination agreement with the participants in the coordinated project funded by MIC (Ministry of Internal Affairs

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[50] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

	and Communications) or NICT (National Institute of Information and Communications Technology). A final draft of this agreement has to be provided with the proposal. Additional eligibility criteria: • Proposals submitted to this call which do not include coordination with a Japanese proposal submitted to MIC or NICT for evaluation will be considered ineligible. • The proposed project duration shall not exceed 36 months. • The Japanese authorities can consider non-eligible proposals with participation of partners from third countries (countries other than Japan, EU and Associated states). Consultation to MIC or NICT representatives is highly advisable before submitting proposals involving third country organisations. • Proposals will only be selected on the condition that their corresponding coordinated Japanese project will be funded by MIC or NICT.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme with the following exceptions:

EUJ-01-2016, EUJ-02-2016, EUJ-03-2016	Criterion 3 "Quality and efficiency of the implementation": additional evaluation sub-criterion: Balanced effort between the two coordinated projects and a research plan properly involving coordinated research activities between Europe and Japan, that ensure a more genuine EU-Japan cooperation and represent an added value to the activities. Criterion 2 "Impact": additional evaluation sub-criterion: Standards are an important element in the field of international cooperation. Beyond access to additional research capability, international cooperation in the context of industrial research should have global consensus and standards as a main target. Contribution to the elaboration of new standards or adoption of standards through implementation of research results.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - EU-Brazil Joint Call

H2020-EUB-2017

Proposals are invited against the following topic(s):

EUB-01-2017: Cloud Computing

Specific Challenge: Cloud computing is now an established global paradigm for the delivery of IT services in all sectors of the digital economy. However, further enhancements are still required in critical aspects of cloud computing, including enhanced security and privacy; trustworthy clouds; resource pooling; data management and traceability; virtualization; and hybrid systems. Support towards intercontinental experimentation on cloud infrastructures and services are necessary as well, especially in the context of EU-Brazil cooperation.

Scope: **Research and Innovation Actions**

The focus of the joint research will be the development of innovative technologies for next generation cloud infrastructures and services able to cope with the challenges from different application domains in business and societal contexts. The technologies to be developed should aim at future standardization as well as take into account interoperability and data portability.

The Commission considers that proposals requesting a contribution from the EU between EUR 1.0 and 1.5 million would allow this specific challenge to be addressed appropriately by two distinct projects. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact: The joint EU-Brazil research is intended to develop innovative cloud computing technologies leading to next generation solutions. The research collaboration will also facilitate and enhance policy coordination between the EU and Brazil in relevant areas. In particular, projects are expected to:

- Facilitate the development of cloud-enabled, secure and trustworthy applications based on robust standardized technologies.

- Develop technologies to manage hybrid resources in the cloud, as well as solutions for cloud-centered data management.

- Submit joint contributions towards international standardization activities.

Type of Action: Research and Innovation action

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

EUB-02-2017: IoT Pilots

<u>Specific Challenge</u>: In order to make use of the rich potential of the Internet of Things (IoT) in real-world scenarios, technologies and tools developed so far need to be demonstrated in controlled environments with the ultimate goal of validation. Given the specific nature of this Call, widely replicable pilots are targeted in view of solving specific societal challenges, in the context of EU-Brazil cooperation.

Given the considerable amount of work carried out on M2M/IoT and Cyber Physical Systems architectures (e.g. IoT-A), platforms (e.g. FIWARE, CRYSTAL, SOFIA) and standards (e.g. oneM2M) over the last few years, pilots are encouraged to exploit this previous work where applicable. The goal is to further demonstrate the generic applicability of these architectures, platforms and standards and to identify where standards are missing or should evolve, as well as relevant pre-normative activities.

Pilots aim at validating IoT approaches to specific socio-economic challenges in real-life settings. Pilots' objectives include user acceptability, technology assessment and optimisation, business model validation, approaches to sustainability and replicability. They should be implemented through close cooperation between users and suppliers with the active involvement of relevant stakeholders on the demand side.

<u>Scope</u>: **Research and Innovation Actions**

IoT finds applicability in a broad range of industry, business and public services scenarios. Specific focus will be on implementing pilots incorporating the whole value-chain, and involving all relevant stakeholders, in particular end-users. Where relevant, institutional involvement may be appropriate.

The joint call would support <u>three</u> pilots each addressing a distinct area among the following areas of interest for EU-Brazil collaboration:

- **Environmental monitoring**

Environmental and carbon footprint –as well as energy and water consumption- can be drastically reduced by an optimised management both along and across value-chains.Sensors can be used to measure and monitor a series of distinct environmental variables. The data collected across different areas can in turn be used for data analytics and decision-making. A pilot combining a system approach to integrate a large number of sensors across a large set of variables will test the acceptability and scalability of the selected IoT platform and test how to optimise results and reduce costs, as well as validating standards and interoperability.

- **Utilities: smart water management**

Smart water management can reduce leakages, optimise watering and irrigation and improve water consumption both in cities and for agricultural purposes.A pilot focusing on integrated solutions enabling real-time interconnection of heterogeneous sensors and actuators, geo-localisation and data fusion including data from meteorological forecast will test the

acceptability and scalability of the selected IoT platform. High reliability and low maintenance costs are key parameters as well as the possibility to replicate the pilot in other locations.

- **Utilities: energy management at home and in buildings**[51]

A group of IoT use cases in the area of the residential smart grid that involve the use of a home energy management system (HEMS) that would exploit automation and self-learning capabilities to monitor and steer local energy consumption (electricity and carbon fuels) and generation. This includes the better steering of HVAC units according to thermostats, weather forecasts, dynamic electricity pricing, and availability of (locally) generated renewable energy.

- **Smart assisted living and wellbeing**

A group of IoT use cases which use intelligent devices (e.g. wearables, sensors, smartphones, and intelligent home appliances) to autonomously generate reports on an individual's physical activity, overall vital signs and well-being. It allows the use and sharing of generated data for personal use or report to specific services (e.g. doctors, nurses, dieticians and sport coaches) through connected devices. It also enables "smart assisted living": the remote follow-up of vulnerable people (children, elderly, hospital patients, etc.) and the automated notification of emergency services, family, etc. when necessary.

- **Smart manufacturing: customisation**

A group of IoT use cases that enable the production of customised outputs. Such production systems combine the low unit costs of mass production processes with the flexibility of individual customisation. This includes:

- Continuous Additive Manufacturing;

- Flexible automation for robot manufacturing;

- Robot systems for additive manufacturing;

- Production of one-of-a-kind customer designs; and dynamic production systems and shop floors - mobile robot for efficient and flexible use in cleanrooms.

The Commission considers that proposals requesting a contribution from the EU up to EUR 1.5 million would allow this specific challenge to be addressed appropriately by three distinct projects. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. Three projects in three different areas are expected.

Expected Impact: Pilots should empower citizens, both in the public and private spheres, and businesses, as well as improve the associated public services where appropriate. Pilots are not

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[51] Proposers interested in this area are also encouraged to read Topics EE7 and EE12 dealing with energy efficiency and LCE 1, LCE 2 and LCE 5 dealing with the distribution grid and storage under the Energy Work Programme.

only expected to validate technologies and architectures for a specific set of use cases requirements, but also the related business models to guarantee the sustainability of the approach. Security and privacy aspects relating to access to and processing of collected information need to be properly taken into consideration.

Improved sharing of information, approaches and solutions, as well as expertise through:

- pilots on both sides and across the Atlantic, involving end-users.

- establishing common benchmarks;

- contributing to standardisation and to open-source and open-data repositories

- linking with ongoing work in the IoT Focus Area.

Type of Action: Research and Innovation action

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

Conditions for the Call - EU-Brazil Joint Call

Opening date(s), deadline(s), indicative budget(s):[52]

Topics (Type of Action)	Budgets (EUR million)	Deadlines
	2017	
Opening: 20 Sep 2016		
EUB-01-2017 (RIA)	2.50	14 Mar 2017
EUB-02-2017 (RIA)	4.50	
Overall indicative budget	7.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

EUB-01-2017, EUB-02-2017	Additional admissibility criterion: • Participants in the EU collaborative projects are required to conclude a coordination agreement with the participants in the coordinated project funded by the RNP (Rede Nacional de Ensino e Pesquisa - Brazilian National Research and Education Network).

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[52] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

	A draft of this agreement has to be provided with the proposal. Additional eligibility criteria: - Proposals submitted to this call which do not include coordination with a Brazilian proposal submitted to RNP for evaluation will be considered ineligible. - The proposed project duration shall not exceed 36 months. - Proposals will only be selected on the condition that their corresponding coordinated Brazilian project will be funded by the RNP.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme with the following exceptions:

EUB-01-2017, EUB-02-2017	Criterion 3 "Quality and efficiency of the implementation": additional evaluation sub-criterion: Balanced effort between the two coordinated projects and a research plan properly involving coordinated research activities between Europe and Brazil, that ensure a more genuine EU-Brazil cooperation and represent an added value to the activities. Criterion 2 "Impact": additional evaluation sub-criterion: Standards are an important element in the field of international cooperation. Beyond access to additional research capability, international cooperation in the context of industrial research should have global consensus and standards as a main target. Contribution to the elaboration of new standards or adoption of standards through implementation of research results.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - EU-South Korea Joint Call

H2020-EUK-2016

Proposals are invited against the following topic(s):

EUK-01-2016: 5G – Next Generation Communication Networks

Specific Challenge: Recently, 5G has been subject of intensive research and development actions in many regions in the world. The republic of Korea has launched an ambitious set of projects (e.g. Gigaproject) towards early deployment by 2020. Beyond regional developments, a certain level of technological convergence at an early stage during the research phases is considered beneficial to ensure future consensus on global standards, timeline or spectrum usage. Similarly, global convergences at use case and applicability levels of future 5G networks are considered useful.

A key challenge will be to avoid and overcome the fragmentation of multiple initiatives to address technologies with similar characteristics, use case potential thus fostering global interoperability and wide spread adoption.

Scope: **Research and Innovation Actions**

It covers technology demonstration that address and demonstrates feasibility of an integrated architectural approach towards heterogeneous accesses (with emphasis on mmWave access including RF/Antenna, Relay, Base stations and Terminals), high capacity/resilient backhaul, an evolved packet core implemented through NFV/SDN based core functions, high precision/integrity positioning techniques for advanced location based services/timing and satellite communication and navigation technologies where appropriate.

The setup of the demonstration should allow to show the principle support of specific requirements of vertical sectors, though not at the stage of a large scale implementation. Most challenging 5G characteristics should be targeted for the technology demonstration, for instance latency in the ms range, capability to serve very dense user environments without loss of performance (such as throughput or energy consumption), capability to provide various network functions (e.g., mobile core, heterogeneous fixed and mobile access convergence, satellite, virtualization, orchestration), capability to support high precision/integrity ubiquitous location based services and timing, capability to support various types of IoT, and interoperability between them. Furthermore, the capability should be demonstrated to efficiently provide ubiquitous 5G services.

The main output of the work is a proof of concept for an interoperability/architecture framework which demonstrates a possible way forward for the needed definition of the interoperability specifications, that future 5G products have to achieve, and towards related standardisation activities for existing and new interfaces.

Prototype installations and proof of concept are expected to be implemented and demonstrated in the context of the 2018 Olympic Games of Pyungchang.

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.

Expected Impact:

- Contribution to the definition of a 5G interoperability architectural framework

- Contribution to the identification of key interfaces to standardise

- Contribution to the integration framework towards access and core

- Support to related standardisation activities (e.g. 3G PP)

Type of Action: Research and Innovation action

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

EUK-02-2016: IoT joint research

Specific Challenge: Over the last year, IoT has moved from being a futuristic vision to an increasing market reality. The Internet of Things is also considered to be a game changer in terms of the digital representation of the real-world (more precise and correlated data from real events and occurrences) and new ways of collaboration and exchange. An important action is now to stimulate the creation of IoT ecosystems, integrating the future generations of applications, devices, embedded systems and network technologies and other evolving ICT advances, based on open platforms and standardised identifiers, protocols and architectures.

The biggest challenge will be to overcome the fragmentation of vertically-oriented closed systems, architectures and application areas and move towards open systems and platforms that support federation of multiple applications at global scale.

Scope: **Research and Innovation Actions**

The scope is to create harmonised IoT architectures and reference implementations, integrating future generations of devices, embedded systems and network technologies and other evolving ICT advances. These environments support citizen and businesses for a multiplicity of novel applications. They address the issue of security and privacy mechanisms for devices, architectures, service and network platforms, including characteristics such as openness, dynamic expandability, interoperability, dependability, cognitive capabilities and distributed decision making, cost and energy-efficiency, ergonomic and user-friendliness. In the context of EU-Korea cooperation, the focus is on federation and interoperability of IoT platforms. It covers the integration of existing approaches and development of common IoT

Reference Architectures towards joint IoT infrastructure reference implementation models and IoT standardisation, taking into account smart and semi-autonomous objects and issues of semantic interoperability.

Prototype installations shall be linked to pilots in the area of smart city, health care or smart service with smart factory and smart logistics. Proposed solutions should be experimented and tested through a federation of existing IoT testbeds.

The Commission considers that proposals requesting a contribution from the EU of EUR 1.5 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:

- Credible cross-regional demonstrations of support societal and business applications through interoperable frameworks ensuring application and service portability;

- Interoperability across different IoT architectures models and IoT infrastructures towards complex IoT application scenarios;

- Joint contributions to International Standardization and/or Forum activities, and community building.

Type of Action: Research and Innovation action

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

EUK-03-2016: Federated Cloud resource brokerage for mobile cloud services

Specific Challenge: Cloud federation enables cloud providers to expand their business globally and easily adjust to unexpected increases in demand through dynamic resource brokerage. The dynamicity of mobile users and applications coupled with the advent of different devices and sensors make it difficult for the cloud provider to predict in advance the need for the cloud resources required to fulfil the application's requirements. Mobile cloud services require the support of very scalable cloud platforms in order to provide optimal services to mobile users especially for services and data hosted and executed across borders.

Advancements are needed in the area of Cloud Resource Brokerage that will provide effective utilization and optimization of heterogeneous resources (such as storage and communications) for mobile applications and services in federated cloud environments.

Scope: **Research and Innovation Actions**

The focus of the joint research will be the development of an innovative cloud resource brokerage platform where advanced Cloud technologies are supporting the unpredictable mobile application needs to address the challenges (i.e., heterogeneity, ultra- scalable resource

provisioning & availability, computing offloading, code portability, data integrity, context-awareness, quality of service, etc.) stemming from different application domains in business and societal contexts. The technologies developed should take into account interoperability, and portability issues and aim towards future standardization. The technologies developed should be validated through relevant mobile applications requiring a federated Cloud environment, in which services and data can be hosted and executed efficiently across borders.

The Commission considers that proposals requesting a contribution from the EU of EUR 1.5 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:

- Credible demonstrations based on cross-border business and/or societal applications of robust interoperable technologies for mobile applications on cloud platforms.

- Concrete implementations of interoperable solutions for Cloud resource brokerage technologies that are candidates for standardisation.

- Joint contributions to International Standardization and/or Forum activities.

Type of Action: Research and Innovation action

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

Conditions for the Call - EU-South Korea Joint Call

Opening date(s), deadline(s), indicative budget(s):[53]

Topics (Type of Action)	Budgets (EUR million) 2016	Deadlines
Opening: 20 Oct 2015		
EUK-01-2016 (RIA)	3.00	19 Jan 2016
EUK-02-2016 (RIA)	1.50	
EUK-03-2016 (RIA)	1.50	
Overall indicative budget	6.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

EUK-01-2016, EUK-02-2016, EUK-03-2016	Additional admissibility criterion:
	- Participants in the EU collaborative projects are required to conclude a coordination agreement with the participants in the coordinated project funded by MSIP (Ministry of Science, ICT and

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[53] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

	Future Planning) or IITP (Institute for Information and Communications Technology Promotion). A final draft of this agreement has to be provided with the proposal.
	Additional eligibility criteria:
	• Proposals submitted to this call which do not include coordination with a South Korean proposal submitted to MSIP or IITP for evaluation will be considered ineligible.
	• The proposed project duration shall not exceed 36 months.
	• The Korean authorities can consider non-eligible proposals with participation of partners from third countries (countries other than South Korea, EU and Associated states). Consultation to MSIP or IITP representatives is highly advisable before submitting proposals involving third country organisations.
	• Proposals will only be selected on the condition that their corresponding coordinated South Korean project will be funded by MSIP or IITP.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme with the following exceptions:

EUK-01-2016, EUK-02-2016, EUK-03-2016	Criterion 3 "Quality and efficiency of the implementation": additional evaluation sub-criterion: Balanced effort between the two coordinated projects and a research plan properly involving coordinated research activities between Europe and South Korea, that ensure a more genuine EU-South Korea cooperation and represent an added value to the activities.
	Criterion 2 "Impact": additional evaluation sub-criterion: Standards are an important element in the field of international cooperation. Beyond access to additional research capability, international cooperation in the context of industrial research should have global consensus and standards as a main target. Contribution to the elaboration of new standards or adoption of standards through implementation of research results.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

<u>Consortium agreement</u>: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Other actions[54]

1. External expertise

This action will support:

- The use of appointed independent experts for the monitoring of running projects, where appropriate, as well as for the evaluation of applications submitted to prize contests.

- The use of individual independent experts to advise on, or support, the design and implementation of EU research policy. In order to attract experts with sufficiently high-calibre expertise a special allowance of EUR 450/day will be paid to the experts appointed in their personal capacity who act independently and in the public interest.

Type of Action: Expert Contracts

Indicative timetable: All along the two years according to operational needs.

Indicative budget: EUR 6.50 million from the 2016 budget and EUR 6.50 million from the 2017 budget

2. Digital Assembly Events 2016 and 2017

DG CONNECT is organising the Digital Assembly Events 2016 and 2017. DG CONNECT plans to procure via Framework Contracts and call for tenders for indicatively 10 contracts before the end of 2017. The events are expected to take place in the 3rd calendar quarter of 2016 and in the 2nd calendar quarter of 2017. The call for tenders are expected to be launched on the 1st and 2nd calender quarter of 2016 and 2017.

Type of Action: Public Procurement

Indicative budget: EUR 1.00 million from the 2016 budget and EUR 1.00 million from the 2017 budget

3. ICT conferences, studies and other activities

In addition to calls for proposals, other actions are also expected to be undertaken on specific activities that the DG CONNECT will support. These include:

- The organisation of the ICT conference and the organisation of an ICT proposers' day. DG CONNECT plans to conclude service contracts in 2016, and also use existing

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[54] The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.
The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

Framework Contracts for this purpose. The events are expected to take place in the 4th calendar quarter of 2017 and in the 3rd calendar quarter of 2016 respectively. Indicative budget in 2016: EUR 5.5 million. DG CONNECT plans to procure via framework contracts and calls for tender for a total of indicatively 15 contracts before the end of 2017 for the two events, depending on the operational needs. The calls for tenders are expected to be launched in the 1st calendar quarter of 2016 and 2017 respectively.

- Studies including socio-economics and impact analysis studies and studies to support the monitoring, evaluation and strategy definition for the ICT priority of LEIT in H2020. DG CONNECT plans to procure via framework contracts and calls for tender indicatively 40 study contracts before the end of 2017. The calls for tenders are expected to be launched in the 2nd and 3rd calendar quarter of 2016 and 2017. Indicative budget in 2016: EUR 4.1 million. Indicative budget in 2017: EUR 4.5 million.

- EUROSTAT subvention for benchmarking ICT Take up by households and by enterprises. Indicative budget in 2016: EUR 2 million. Indicative budget in 2017: EUR 2 million.

- Policy support activities, including benchmarking activities, evaluation and impact assessments, cross-cutting aspects of digital skills, the development of ad hoc support software, possibly using existing Framework Contracts. DG CONNECT plans to procure via framework contracts and calls for tender indicatively 10 contracts before the end of 2017. The calls for tenders are expected to be launched in the 2nd and 3rd calendar quarter of 2016 and 2017. Indicative budget in 2016: EUR 2.6 million. Indicative budget in 2017: EUR 3.0 million.

- Publications and support to other events (e.g. information, communication, dissemination etc.), either through the use of existing Framework Contracts, or the launch of indicatively 15 calls for tenders during 2016 and 2017. The calls for tenders are expected to be launched in the 2nd and 3rd calendar quarter of 2016 and 2017. Indicative budget in 2016: EUR 1 million. Indicative budget in 2017: EUR 1.5 million.

Details will be provided in the texts of these calls for tender.

Type of Action: Public Procurement

Indicative budget: EUR 15.20 million from the 2016 budget and EUR 11.00 million from the 2017 budget

4. Intelligent Manufacturing Systems interregional Secretariat

The IMS interregional secretariat will be supported with an amount of EUR 150 000 in 2017.

Type of Action: Subscription

Indicative budget: EUR 0.15 million from the 2017 budget

5. ICT Horizon Prizes

A series of ICT-related Horizon Prizes are being prepared for announcement by the end of 2016 and in 2017. The specific rules of the contest are subject to the outcome of an on-going study for the development and design of inducement prizes under Horizon 2020. Full details of these Horizon Prizes will be provided in the 2016 WP revision.

Type of Action: Inducement prize

The common Rules of Contest for Prizes are provided in part F of the General Annexes.

Indicative budget: EUR 10.00 million from the 2017 budget

6. Ground-breaking Horizon Prize on Big Data technologies

The purpose of this Horizon prize scheme is to launch an ambitious sectorial challenge open to EU contestants for Big Data technologies in the field of prediction and deep analytics, with the aim to stimulate real break-through for technology bottlenecks.

The challenges will be identified and designed by the CSA resulting from ICT-16, call H2020-ICT-2015. The CSA will also assist in implementing and administering the contest. Full details of this Horizon Prize will be provided in the 2016 WP revision.

Type of Action: Inducement prize

The common Rules of Contest for Prizes are provided in part F of the General Annexes.

Indicative budget: EUR 2.00 million from the 2017 budget

Budget[55]

	Budget line(s)	2016 Budget (EUR million)	2017 Budget (EUR million)
Calls			
H2020-ICT-2016-2017		463.50	604.50
	from 09.040201	*463.50*	*604.50*
H2020-EUJ-2016		7.00	
	from 09.040201	*7.00*	
H2020-EUB-2017			7.00
	from 09.040201		*7.00*
H2020-EUK-2016		6.00	
	from 09.040201	*6.00*	
Contribution from this part to call H2020-DS-2016-2017 under Part 14 of the work programme		23.50	18.50
	from 09.040201	*23.50*	*18.50*
Contribution from this part to call H2020-FTIPilot-2016 under Part 18 of the work programme		17.85	
	from 09.040201	*17.85*	
Contribution from this part		83.00	33.00

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[55] The budget figures given in this table are rounded to two decimal places.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

to call H2020-IND-CE-2016/17 under Part 17 of the work programme	*from 09.040201*	*83.00*	*33.00*
Contribution from this part to call H2020-IOT-2016/2017 under Part 17 of the work programme		79.00	35.00
	from 09.040201	*79.00*	*35.00*
Contribution from this part to call H2020-NMBP-2016/2017 under Part 5.ii of the work programme			5.00
	from 09.040201		*5.00*
Contribution from this part to call H2020-SFS-2016-2017 under Part 9 of the work programme			7.00
	from 09.040201		*7.00*
Contribution from this part to call H2020-SMEInst-2016-2017 under Part 7 of the work programme		60.00	66.00
	from 09.040201	*60.00*	*66.00*
Other actions			
Prize			12.00
	from 09.040201		*12.00*
Expert Contracts		6.50	6.50
	from 09.040201	*6.50*	*6.50*
Public Procurement		16.20	12.00
	from 09.040201	*16.20*	*12.00*
Subscription			0.15

	from 09.040201		*0.15*
Contribution from this part to action Prize Cryptography Prize under Part 14 of the work programme			1.00
	from 09.040201		*1.00*
Estimated total budget		**762.55**	**807.65**

ICT for the Factories of the Future

Manufacturing is still the driving force of the European economy. Manufacturing activity in Europe provides about 20% of all jobs (more than 30 million persons) in 25 different industrial sectors and over 2 million companies, largely dominated by SMEs. The digital transformation of manufacturing processes and products including the related change of business models and the shift from products to product-related services is expected to provide a major contribution to the EU goal of increasing the value of industry from 15% to 20 % of GDP.

With a highly educated workforce, excellent research centres and a strong ICT industry in professional and vertical markets, Europe has many assets that enable it to benefit from advances in digital technologies in all sectors. However, businesses and mainly SMEs face a critical dilemma today. On one side, global competition is growing and reducing margins and the capacity to invest. On the other side, digital technologies are moving fast and their impact on the whole value chain from products and manufacturing processes to business models is drastic. For many companies and notably SMEs and mid-caps, it is extremely difficult to keep up with technology and assess at any time which investment to be done and by when. Likewise, knowledge and support are missing on how to migrate existing setups to novel ICT-based manufacturing environments considering human, automation and organisational factors.

To improve Europe's ability to compete on the global markets, the three topics under this theme support the integration of digital technologies in all stages of the manufacturing process from cradle to grave, enabling Europe to stay at the forefront of delivering highly innovative, high quality products and services at competitive prices.

Through research and innovation actions (RIA), topics FoF-11 supports the adoption of emerging digital technologies from cyber-physical systems, autonomous systems, the Internet of Things, big data analytics, in the manufacturing processes covering as appropriate the complete chain including logistics and circular economy aspects. Focus is on digital automation along two dimensions: (1) collaborative manufacturing across all processes including logistics, and (2) discrete factory automation. RIAs should target highly innovative applications that exploit advanced innovative ICT in the continuous and discrete process industry at TRLs 3-5. Through innovation actions (IA), topic FoF-12 addresses the next phase of I4MS (ICT Innovation for Manufacturing SMEs) with special emphasis on supporting the organic growth of the I4MS ecosystem through linking I4MS competence and innovation hubs with industrial clusters and the smart specialisation strategies of Europe's regions including the pooling of resources from Horizon 2020 and ESIF (European Structural and Investment Funds). Through RIA and IA actions, topic FoF-13 focuses on Photonics laser-based production. In order to multiply impact on the European industry and economy, platform building is emphasised across topics FoF-11 and FoF-12.

This area is part of the Public Private Partnership Factories of the Future, which is co-managed by LEIT-ICT and LEIT-NMP. It builds on the suggestions made by EFFRA through

their Strategic Research and Innovation Agenda (SRIA). The area addresses as well some aspects recommended by the SPIRE industrial associations (Sustainable Process Industry Resource and Energy Efficiency) in their SRIA. Manufacturing in the context of this area is therefore to be understood in the broad sense of manufacturing of discrete and continuous goods.

FOF-11-2016: Digital automation

<u>Specific Challenge</u>: Manufacturing value chains are distributed and dependent on complex information and material flow requiring new approaches inside and outside the factory both on process and product lifecycle level, from design and engineering over production to maintenance and recycling. Global competition and individualized products make it difficult for manufacturing companies to share information, to produce in collaborative networks across value chains.

Advances are needed in value- and supply-chain centric communication and collaboration schemes that merge machine, human and organizational aspects and enable manufacturing companies, especially SMEs, to respond to ever stricter requirements for being integrated into production process chains. Production architectures need to be more responsive to dynamic market demands which require radical change of production topologies to achieve dynamic production re-configurability, scaling and resource optimization. The challenge is to fully exploit the digital models of processes and products and to synchronise the digital and physical world respecting security and IPR protection requirements. This shall allow manufacturers to move from centralised production and logistics to de-centralised planning and control or hybrid combinations thereof.

<u>Scope</u>:

a. Research and Innovation Actions

Proposals are expected to cover at least one of the two themes identified below thereby exploiting advanced ICT like Cyber Physical Systems (CPS), Internet of Things (IoT), Cloud-models, robotics, 3D printing, machine-to-machine (M2M) communication, advanced human-machine-interaction, modelling & simulation, artificial intelligence methodologies and data analytics, as well as security by design. RIAs shall develop reference implementations of platforms in a multi-sided market ecosystem and include user-driven proof-of-concept demonstrations and validation in several different scenarios. Proposals should contain an outline business case and industrial exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

1. **Collaborative manufacturing and logistics.** Target is to develop the "operating system" of the connected factory of the future and to integrate better manufacturing and logistics processes through platforms that enable and optimise communication and collaboration among supply networks, enterprises, machines and objects. Research issues to be addressed include: real-time architectures for interoperability; management

of the data deluge from the myriad of monitoring and tracking objects and their fusion with other information sources within the factory and supply chain. Concepts are to be validated through pilots on business and system level to establish new economic collaboration models. Special emphasis will be on ICT security, knowledge protection, and trust in collaborative infrastructures.

2. **Novel architectures for factory automation**. Research should explore novel de-centralised, modular, scalable and responsive automation architectures of primarily discrete factory automation systems that support new trends in manufacturing like re-shoring and mass-customisation. Research should encompass the virtualisation of the traditional automation pyramid from sensor-control to enterprise-level and/or methods and models for the synchronization of the digital and real world, as well as integration of novel architectures into existing production systems. Special emphasis is on innovative concepts for shared situational awareness; on self-adjustment of digital models triggered by smart objects, on real-time co-simulation methods; and on handling of large amounts of sensor and process data.

The Commission considers that proposals requesting a contribution from the EU up to EUR 8 million would allow area i) to be addressed appropriately. For area ii) 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. Minimum one proposal per area will be selected.

b. Coordination and Support actions

CSAs shall support industrial consensus building both with suppliers and users across Europe, addressing future factory automation systems built on CPS and the IoT; pan-European platform building, and collaboration on manufacturing issues across all relevant PPPs.

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

- Innovative services, models and practices optimising manufacturing and logistics processes;

- Quantified drastic reductions in the effort for integration or reconfiguration of today's hierarchical automation systems through advanced de-centralised or hybrid architectures;

- Better and faster reaction to market changes by being able to use holistic global and local optimization algorithms in a collaborative sustainable value chain.

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.

FOF-12-2017: ICT Innovation for Manufacturing SMEs (I4MS)

<u>Specific Challenge</u>: For Europe's competitiveness in manufacturing, it is crucial that advances in ICT are taken up in engineering and manufacturing "at large" as soon as they have the appropriate maturity level. The topic will support fast adoption, and wide spread technology transfer of advanced ICT-based solutions for manufacturing across the business process chains – from "cradle to grave".

<u>Scope</u>: As Phase 3 of I4MS (www.i4ms.eu) this topic addresses the adoption of the next generation of ICT advances in the manufacturing domain. Focus is on emerging innovative technologies and processes, which need to be customised, integrated, tested and validated before being released on the market. Special emphasis is on strengthening European SMEs and mid-caps along the value chain by adopting new concepts linked to innovative business and/or service models.

a. Innovation actions must address all of the following three aspects.

1. Establishing across Europe networks of multidisciplinary competence centres offering "marketplaces" for companies that want to experiment with digital technologies in manufacturing of discrete or continuous goods. Centres should have the capacity to offer access to technology platforms and skills for developing and testing innovative technologies and applications, including access to design and manufacturing, rapid prototyping and equipment assessment initiatives. They should also act as brokers between suppliers and users of the technology products. Competence centres are encouraged to link to existing/emerging regional (smart specialisation) or national innovation hubs. If Horizon 2020 funding is complemented by ESIF or other regional or national funds: Horizon 2020 funding shall be used for carrying out highly innovative experiments that will multiply the impact of local initiatives to a European scale, and will build partnerships between businesses in Europe.

2. Carrying out a critical mass of cross-border experiments bringing together different key actors along the full value chain to customise the technologies according to the requirements of the users. Driven by the requirements of first-time users, **Application Experiments** bring together the actors of the value chain and the experts necessary to enable new users to develop novel products or services and assist them in customising and applying these in their respective environments. Experiment descriptions in proposals should include an outline of the initial exploitation plan and business scenario, which will be developed further in the proposed experiment. To remain flexible on which experiments will be carried out, the action may involve financial support to third parties, in line with the conditions set out in part K of the General Annexes. The consortium will define the selection process of additional users and suppliers running the experiments for which financial support will be granted (typically in the order of EUR

20 000 – 100 000[56] per party). Maximum 50% of the EU funding can be allocated to this purpose[57].

3. Activities to achieve long-term sustainability of the competence centres and the eco-system. This includes the development of a business plan for the competence centres and the marketplace, of which an outline business case and industrial exploitation strategy should be described in the proposal, as outlined in the Introduction to the LEIT part of this Work Programme. In addition, investors should be attracted to support business development of SMEs and mid-cap actors in successful experiments. Such activities would include also dissemination.

Proposers should cover at least one of the following four areas of technologies for adoption in manufacturing. Proposers are encouraged to support the building of pan-European ecosystems of emerging platforms and are expected to collaborate on reinforcing the European I4MS ecosystem, and to establish links to related activities, e.g. in the IoT Focus Area, the Joint Undertaking ECSEL, and the SPARC or big data PPPs.

i. **CPS and IoT:** Adoption and piloting of CPS/IoT in smart production environments, with special focus on scalable, modular and re-configurable automation systems across the process chain especially for SMEs.

ii. **Robotics**[58]**:** New robot systems that are cost effective at lower lot sizes, with the benefit of long-term improvements in productivity, the ability to work safely in close physical collaboration with human operators; and that are intuitive to use and adaptive to changes in task configuration. Key for fast adoption is the availability of flexible and easy to apply material feeding solutions. Step changes to at least two of the following abilities are therefore considered necessary: configurability, interaction capability, decisional autonomy in terms of context-awareness, and dependability.

iii. **Modelling, simulation and analytics**: HPC Cloud-based modelling, simulation and analytics services with special emphasis on sustained service models; on providing real-time support; and on addressing comprehensively security and privacy issues at all levels.

iv. **Digital design for additive Manufacturing**: Supporting the broad uptake of innovative additive manufacturing equipment and processes particularly focusing on the link between design tools and production, changes in business models, process chains and stakeholder relations.

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[56] 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.

[57] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

[58] The area of Robotics within the I4MS scheme is complementing the areas RTD-FoF2-2016 and LEIT-ICT Robotics topics

The Commission considers that proposals requesting a contribution from the EU up to EUR 8 million would allow the areas to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. It is expected that a minimum of one innovation action is supported for each area of technologies.

b. Coordination and Support actions

To advance the European I4MS innovation ecosystem the network of Innovation multipliers leveraging investment in research and innovation is to be reinforced. The aim is to achieve broad coverage in technological, application, innovation, and geographic terms. Its tasks and services shall include maintaining a single innovation portal for newcomers; sharing of best practices and experiences; dissemination; identifying new innovative ICT technologies that can benefit from this scheme, brokering between users and suppliers; leveraging further investment by mapping and matching competences in and between regions, and by linking up with regional/national initiatives and by stimulating organic growth. For these support actions, close cooperation with the European Factories of the Future Association (EFFRA[59]) is required.

Expected Impact: Proposals should address all of the following impact criteria, providing metrics to measure success when appropriate:

- Exploration of new application areas for advanced ICT in manufacturing at large: Attract a significant number of new users of advanced ICT in the manufacturing sector, in particular SMEs and the mid-caps.

- More innovative and competitive technology suppliers, in particular SMEs, both on the level of ICT and on the level of manufacturing equipment, able to supply manufacturers with new equipment, components, and tools for improved manufacturing and engineering operations.

- More competitive European service providers through provisioning of new types of services; through strengthening the presence on local markets.

- Creation of a self-sustainable ecosystem of competence centers, users and suppliers supported by services available through a marketplace, covering a large number of regions and their smart specialisation.

- A critical mass of pan European experiments that demonstrate innovative, sustainable business models covering the whole value chain leading to quantifiable increases in market shares and/or productivity of European companies and/or industrial capacities in Europe.

Type of Action: Innovation action, Coordination and support action

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[59] Web link www.effra.eu

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

FOF-13-2016: Photonics Laser-based production

Specific Challenge: Laser-based manufacturing has become very competitive and is one of the back-bones of modern production technologies. Highly accurate mass production is available for a wide range of products in a wide range of industries. Whilst laser processing is highly flexible, the change from one production lot to the next usually requires operator intervention, reconfigurations and costly down times to adjust current processing tools to the new task. The trend to individualisation requires a high degree of digitization as well as tools and systems which are highly autonomous and automated to reduce production time and costs.

Additive manufacturing (AM) offers a number of advantages over conventional manufacturing including the unprecedented freedom of design for example in terms of geometry, material composition and intrinsic properties of the work piece. Whilst laser-based AM is used for prototyping and has begun to penetrate some smaller markets, it is not yet competitive on a larger scale especially with respect to production speed and costs. In order to increase the productivity of laser-based AM and to bring it a significant step further towards industrial manufacturing a better mastering of all stages of the process chain and their interaction is necessary.

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

From "design to piece" – Excellence in laser-based additive industrial manufacturing[60]: From Design to the final work piece, the topic addresses laser-based additive industrial manufacturing of metallic materials. All process chain steps may be addressed, for example CAD, modelling of the additive process, the additive process itself including the use of several materials in a single work piece, process control and quality assurance, the combination of additive and subtractive processes, surface finish and precision, etc. Materials for AM and their quality control are considered as a step. Proposals must cover at least two important steps in the process chain and the relevant links between them. The goal is to significantly improve the overall performance in terms of speed and costs whilst producing high quality work pieces. Standardisation aspects should also be addressed as appropriate. Proposals should be driven by concrete business cases and include the relevant partners of the value chain and proposals should contain an outline business case and industrial exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

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

b. Innovation Actions

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[60] Theme a. is complementing the topic RTD-FOF1-2016

Rapid individualised laser-based production: Develop and set-up efficient, highly flexible high throughput pilot facilities on the basis of existing processes for laser-based production and to validate them in real settings. This will require advances in a number of aspects, including intelligent networking and machine cooperation, data handling, modelling, work piece handling, beam delivery, integration of different processes; monitoring, process control etc. Actions must be industry driven and include the key stakeholders running the pilot facility. Proposals should contain an outline business case and industrial exploitation strategy.

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

Expected Impact: Proposals should describe how the proposed work will contribute to the following impact criteria and provide metrics, the baseline and targets to measure impact.

a. Research & Innovation Actions

- Reinforced industrial leadership in laser-based Additive Manufacturing.

- Substantially improved production speed, improved productivity and substantially reduced costs of Additive Manufacturing.

b. Innovation Actions

- More efficient, more flexible and higher throughput of individualised laser-based production.

- Improved competiveness and strengthened Europe's market position of laser-based manufacturing industry (equipment and suppliers) and the end-user industry.

Type of Action: Research and Innovation action, Innovation action

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

Conditions for the Call - Industry 2020 in the Circular Economy

Opening date(s), deadline(s), indicative budget(s):[61]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 15 Oct 2015			
PILOTS-01-2016 (IA) PILOTS-02-2016 (IA)	32.00 [62]		08 Dec 2015 (First stage) 24 May 2016 (Second stage)
FOF-01-2016 (RIA) FOF-02-2016 (IA) FOF-03-2016 (IA) FOF-04-2016 (RIA) FOF-05-2016 (CSA)	77.00 [63]		21 Jan 2016
FOF-11-2016 (RIA)	51.00 [64]		
FOF-11-2016 (CSA)	2.00 [65]		
FOF-13-2016 (RIA)	15.00 [66]		

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[61] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[62] of which EUR 32.00 million from 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing'.

[63] of which EUR 77.00 million from 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing'.

[64] of which EUR 51.00 million from 'Information and Communication Technologies '.

[65] of which EUR 2.00 million from 'Information and Communication Technologies '.

[66] of which EUR 15.00 million from 'Information and Communication Technologies '.

FOF-13-2016 (IA)	15.00 [67]		
SPIRE-01-2016 (IA) SPIRE-02-2016 (RIA) SPIRE-03-2016 (IA) SPIRE-04-2016 (RIA) SPIRE-05-2016 (CSA) SPIRE-06-2016 (CSA)	74.00 [68]		21 Jan 2016
Opening: 10 Nov 2015			
CIRC-03-2016 (CSA)	1.50 [69]		08 Mar 2016
CIRC-04-2016 (RIA)	3.00 [70]		
CIRC-05-2016 (RIA)	3.00 [71]		
CIRC-01-2016-2017 (IA)	60.00 [72]		08 Mar 2016 (First stage) 06 Sep 2016 (Second stage)
CIRC-02-2016-2017 (IA)	20.00 [73]		
Opening: 10 May 2016			
PILOTS-03-2017 (IA) PILOTS-04-2017 (IA) PILOTS-05-2017 (RIA)		48.00 [74]	27 Oct 2016 (First stage) 04 May 2017 (Second stage)

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[67] of which EUR 15.00 million from 'Information and Communication Technologies '.

[68] of which EUR 74.00 million from 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing'.

[69] of which EUR 1.50 million from 'Climate action, environment, resource efficiency and raw materials'.

[70] of which EUR 3.00 million from 'Climate action, environment, resource efficiency and raw materials'.

[71] of which EUR 3.00 million from 'Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy'.

[72] of which EUR 60.00 million from 'Climate action, environment, resource efficiency and raw materials'.

[73] of which EUR 20.00 million from 'Climate action, environment, resource efficiency and raw materials'.

[74] of which EUR 48.00 million from 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing'.

Opening: 20 Sep 2016			
FOF-06-2017 (RIA) FOF-07-2017 (RIA) FOF-08-2017 (IA) FOF-09-2017 (IA) FOF-10-2017 (IA)		85.00 [75]	19 Jan 2017
FOF-12-2017 (IA)		32.00 [76]	
FOF-12-2017 (CSA)		1.00 [77]	
SPIRE-07-2017 (IA) SPIRE-08-2017 (RIA) SPIRE-09-2017 (IA) SPIRE-10-2017 (RIA) SPIRE-11-2017 (CSA) SPIRE-12-2017 (CSA)		80.00 [78]	19 Jan 2017
Opening: 08 Nov 2016			
CIRC-01-2016-2017 (IA)		40.00 [79]	07 Mar 2017 (First stage)
CIRC-02-2016-2017 (IA)		30.00 [80]	05 Sep 2017 (Second stage)
Overall indicative budget	353.50	316.00	

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[75]   of which EUR 85.00 million from 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing'.

[76]   of which EUR 32.00 million from 'Information and Communication Technologies '.

[77]   of which EUR 1.00 million from 'Information and Communication Technologies '.

[78]   of which EUR 80.00 million from 'Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing'.

[79]   of which EUR 40.00 million from 'Climate action, environment, resource efficiency and raw materials'.

[80]   of which EUR 30.00 million from 'Climate action, environment, resource efficiency and raw materials'.

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

For two stage procedure:

- Information on the outcome of the evaluation: Maximum 3 months from the final date for submission for the first stage and maximum 5 months from the final date for submission for the second stage; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission of the second stage.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

CIRC-03-2016	Due to the nature and objectives of this action, participants must be regional authorities and/or national/regional/local structures responsible for the implementation of Smart Specialisation strategies.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme with the following exceptions:

	For single-stage and second-stage evaluations, the threshold for the criteria Excellence and Impact will be 4. The overall threshold, applying to the sum of the three individual scores, will be 12.
	In case of equal overall scores in the ranked list, the priority order of proposals will be established in accordance with part H of the General Annexes, except that proposals will be ranked on the basis of individual scores for the Impact criterion before the Excellence criterion.
	In case of equal overall scores in the ranked list, the priority order of proposals will be established in accordance with part H of the General Annexes, except, when comparing *ex aequo* proposals of different topics, the proposals will be ranked first according to the position in the topic ranked lists

<u>Evaluation Procedure</u>: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

<u>Consortium agreement</u>: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Call - Internet of Things

H2020-IOT-2016/2017

Internet of Things - Focus Area (IoT- FA) ambition is to foster the take up of IoT in Europe and to enable the emergence of IoT ecosystems supported by open technologies and platforms. It will be addressed through a complementary set of activities structured around Large Scale Pilots.

IoT Pilots will make use of the rich portfolio of technologies and tools so far developed and demonstrated in reduced and controlled environments and extend them to real-life use case scenarios with the goal of validating advanced IoT solutions across complete value chains with actual users and proving its enormous socio-economic potential.

Support actions provide consistency and linkages between the pilots and complement them by addressing horizontal challenges critically important for the take-up of IoT at the anticipated scale. These include ethics and privacy[81], trust and security, respect for the scarcity and vulnerability of human attention, validation and certification, standards and interoperability, user acceptability and control, liability and sustainability. A coordination body will ensure an efficient interplay of the various elements of the IoT-FA and liaise with relevant initiatives at EU, Member States and international levels.

Research and innovation effort in specific IoT topics will ensure the longer-term evolution of Internet of Things.

A novelty in Horizon 2020 is the Pilot on Open Research Data which aims to improve and maximise access to and re-use of research data generated by projects. Projects funded under the IoT call of the Work Programme 2016-17 will by default participate in the Pilot on Open Research Data in Horizon 2020.

Projects have the possibility to opt out of the Pilot. Participation in the Pilot is not taken into account during the evaluation procedure. In other words, proposals will not be evaluated favourably because they are part of the Pilot and will not be penalised for opting out of the Pilot.

A further new element in Horizon 2020 is the use of Data Management Plans (DMPs) detailing what data the project will generate, whether and how it will be exploited or made accessible for verification and re-use, and how it will be curated and preserved. The use of a DMP is required for projects participating in the Open Research Data Pilot. Other projects are invited to submit a DMP if relevant for their planned research. Only funded projects are required to submit a DMP.

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[81] In the context of this call, the concept of privacy refers to the EU legal provisions applicable at the moment of pilot implementation in relation to both the "right to privacy" (right to respect for private and family life) but as well to the "right to protection of personal data".

Further guidance on the Pilot on Open Research Data and Data Management is available on the Participant Portal.

Proposals are invited against the following topic(s):

IoT-01-2016: Large Scale Pilots

Specific Challenge: The challenge is to foster the deployment of IoT solutions in Europe through integration of advanced IoT technologies across the value chain, demonstration of multiple IoT applications at scale and in a usage context, and as close as possible to operational conditions. Compared to existing solutions, the roadblocks to overcome include i) the integration and further research and development where needed of the most advanced technologies across the value chain (components, devices, networks, middleware, service platforms, application functions) and their operation at large scale to respond to real needs of end-users (public authorities, citizens and business), based on underlying open technologies and architectures that may be reused across multiple use cases and enable interoperability across those; ii) the validation of user acceptability by addressing, in particular, issues of trust, attention, security and privacy through pre-defined privacy and security impact assessments, liability, coverage of user needs in the specific real-life scenarios of the pilot, iii) the validation of the related business models to guarantee the sustainability of the approach beyond the project.

Scope: Pilots are targeted, goal driven initiatives that will propose IoT approaches to specific real-life industrial/societal challenges. Pilots are autonomous entities that involve stakeholders from supply side to demand side, and contain all the technological and innovation elements, the tasks related to the use, application and deployment as well as the development, testing and integration activities. Large scale validation is characterised by the fact that it will be possible to operate the functional entities implemented in the pilot under load and constraints conditions close to operational load one's, either with real traffic/request/processing loads, or with emulated loads where full implementation is not possible. Demonstration to operate the system across multiple sites, scalability to large amount of heterogeneous devices and systems, as well as with large amount of real users are expected. Pilot work plans should include feedback mechanisms to allow adaptation and optimisation of the technological and business approach to the particular use case.

Use of experimental testbeds, such as FIRE[82], and real-world demonstrations may support IoT technologies validation before they are deployed in field trials. Given the considerable amount of work carried out on M2M/IoT and Cyber Physical Systems architectures (e.g. IoT-A) open platforms (e.g. FIWARE, CRYSTAL, UniversAAL) and standards (e.g. oneM2M) over the last few years, pilots are encouraged to exploit this previous work where applicable with the objective of further demonstrating the generic applicability and interoperability of these and/or other architectures, platforms and standards, and to identify where standards are missing or should evolve, as well as needed pre-normative activities.

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[82] Future Internet Research and Experimentation

IoT finds applicability in a broad range of industry, business and public services scenarios. On the basis of European relevance, technology readiness and socio-economic interest the following areas have been identified to be addressed with Large Scale IoT Pilots.

Pilot 1: Smart living environments for ageing well

The objective is to deploy innovative and user-led pilot projects capable of supporting and extending independent living at home for older adults based on Internet of Things (IoT) technologies. The smart living environments should be based upon an integrated system of a range of IoT-based technologies and services with user-friendly configuration and management of connected technologies for homes and outside.

They should provide seamless services and handle flexible connectivity while users are switching contexts and moving in their living environments. The proposed pilots should also demonstrate feasibility of integration with other relevant application domains such as energy, transport, or smart cities. The solutions shall build upon advanced IoT technologies, using and extending available open service platforms, standardised ontologies and open standardised APIs. Proposals shall address integration, standardisation and interoperability work on required ICT platforms, services and data sources, as well as on innovation in organisational and business models for service delivery.

Proposed solutions should take into account the specific requirements for accessibility, usability, cost efficiency, personalisation and adaptation arising from this application sector. They should be based on active user engagement from the outset and should involve a multi-disciplinary approach in order to ensure the understanding of user needs and their evolution, safeguarding ethics and privacy and the assessment of impact. This should include quality of life for older adults and their careers, care system efficiency gains, business and financing models and organisational changes required for service delivery.

A clear methodology for socio-economic impact assessment should be included. Large scale pilots should demonstrate the benefits of smart living environments based on IoT in terms of prolonged independent and safe living of older adults at home with good quality of life. The number of users involved and duration of pilot services should be sufficient to ensure statistical significance in impact analysis, with a minimum of 4 pilot sites in 4 countries.

Pilot 2: Smart Farming and Food Security

The implementation of Precision Agriculture has become possible thanks to the development of sophisticated sensors, robots and sensor networks combined with procedures to link mapped variables to appropriate farming management actions. Those sensors, either wired or wireless, integrated into an IoT system gather all the individual data needed for monitoring, control and treatment on farms located in a particular region. Such future Internet of Things scenario would bring data management to a new level by establishing interactions between the concerned objects, help them exchange information in efficient ways and enable them to execute autonomously appropriate interventions in different agricultural sub-sectors (e. g. arable crops, livestock , vegetable and fruit production) and their associated post-production

value chain through to the consumer. The introduction of the IoT scenario would allow monitoring and control of plant and animal products during the whole life cycle from farm to fork. It should thereby also help farmers' decision making with regard to the use of inputs and management processes. The challenge is to design architectures to "program" or track each object for optimal behaviour, according to its role in the Smart Farming system and in the overall food chain, decreasing use of water as well as other natural resources and inputs, lowering ecological footprints and economic costs as well as increasing food security. It also enables consumers to access trustworthy traceability information throughout the whole food chain.

Proposals shall include an adequate combination of different farms to ensure that the deployment of the technology is adapted to the needs of different types and sizes of farms across Europe. Activities should allow for a wide geographic coverage within Europe and benefit both conventional and organic agro-food chains. In addition, proposals shall cover at least three sub-sectors (e.g.arable crops, livestock, vegetable and fruit production).

Proposals should fall under the concept of multi-actor approach[83] and allow for adequate involvement of the farming sector in the proposed activities.

Pilot 3: Wearables for smart ecosystems

Demonstration of innovative wearable solutions and services integrated in interoperable IoT ecosystems. Wearables are integrating key technologies (e.g. nano-electronics, organic electronics, sensing, actuating, localization, communication, energy harvesting, low power computing, visualisation and embedded software) into intelligent systems to bring new functionalities into clothes, fabrics, patches, watches and other body-mounted devices. They assist humans in monitoring, situational awareness and decision making. Particular attention should be devoted to actuating functions providing whenever feasible fully automated closed-loop solutions. Prototype development and demonstration are expected for healthcare, well-being, safety, security and infotainment applications. Actions should be driven by concrete business cases, open design approaches and user requirements, taking into account data protection and liability concerns. They should involve the actors of the entire innovation value chain, potentially including creative and artistic actors, and aim at demonstrations in real world settings. The number of users involved should be sufficient to ensure statistical significance in impact analysis.

Pilot 4: Reference zones in EU cities

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[83] The multi-actor approach aims at more demand-driven innovation through the genuine and sufficient involvement of various actors (end-users such as farmers/farmers' groups, fishers/fisher's groups, advisors, enterprises, etc. As a minimum, this material should feed into the European Innovation Partnership (EIP) 'Agricultural Productivity and Sustainability' for broad dissemination as 'practice abstracts' in the common EIP format for practitioners. Facilitation/mediation between the different types of actors and involvement of relevant interactive innovation groups operating in the EIP context, such as EIP Operational Groups funded under Rural Development Programmes, are strongly recommended.

Building on the past results and achievements[84] in some cities in Europe, a large scale pilot will cover a series of cities to operate as reference zones for showcasing and experimenting new citizen-centred IoT services. Starting from users' expressed preferences and needs, these cities will experiment and test similar new services and solutions, also through involvement of creativity hubs such as fablabs, co-working spaces, and gather experience at scale and evaluate citizens' acceptability and endorsement. It will enable SMEs to use open demonstrators to test innovative new services. This includes advanced solutions for traditional services' provisioning e.g. water management but also solutions that are at the edge of authorised business practices or regulation (ex: sharing of electricity, autonomous vehicles) and thus require dedicated testing zones. Whenever applicable, pilots will provide evidence of access to city areas where legal contexts are adapted to the demonstration requirements (i.e. 'reference zones'). Federation and interoperability between platforms may be considered as appropriate, as well as the ability to integrate data from different service providers. The number of users involved and duration of pilot services should be sufficient to ensure statistical significance in impact analysis, with a minimum of 4 pilot sites in 4 countries.

Pilot 5: Autonomous vehicles in a connected environment

The pilot addresses the added value and the potential of applying IoT for autonomous vehicles in a connected environment.

It should test scenarios of deployment of safe and highly and fully autonomous vehicles (up to SAE[85] international level 5, full automation) in various representative use case scenarios, exploiting local and distributed information and intelligence. Core technologies include reliable and real-time platforms managing mixed criticality car services, advanced sensors and Internet information sources around which value-added apps may be constructed, efficient navigation and improved decision-making technology, interconnectivity between vehicles, vehicle to infrastructure communication. Using advanced technologies for connectivity is seen as an asset. The selected scenarios will provide proofs of concept showing how such technology provides benefits affecting users on a daily basis, for instance on the highways or in urban congested environment, either on dedicated lanes or mixing autonomous connected vehicles and legacy vehicles. To make a real step towards future large scale deployment and to demonstrate dependability, robustness and resilience of the technology over longer period of time and under a large variety of conditions, priority will be given to permanent installations and sustainable pilots rather than to temporary prototypes or demonstrators.

These evolutions are expected to be supported by an open service platform which may have access to all in vehicle embedded information sources and to car surrounding information, in view of providing value-added apps e.g. intelligent maintenance. Key barriers to the deployment of such vehicles and ecosystems such as robustness of the perception, how to keep users of highly and fully automated vehicles sufficiently engaged and overall user acceptance are in scope, as well as economic, ethical, legal and regulatory issues.

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[84]   E.g. FIRE and FIWARE

[85]   Society of Automotive Engineers, J3016 standard

Specific Pilot considerations:

- Mapping of pilot architecture approaches with validated IoT reference architectures such as IoT-A enabling interoperability across use cases;

- Common or interoperable object connectivity/functionality/intelligence approaches on various levels – protocols, data formats

- Common or interoperable set of IoT related enablers and services. Pilots are requested to address the elements that provide the basis for interoperability with related fields outside the pilot especially for key aspects such as object identification/naming, service publication characteristics, search, semantic properties.

- For the incorporation of users of the pilots, developers of additional applications, replication of the pilot through new sites or new connected devices, and complementary assessment of the acceptability of the use case where appropriate, the actions may involve financial support to third parties in line with the conditions set out in Part K of the General Annexes. Each consortium will define the selection process of the third parties for which financial support will be granted (typically in the order of EUR 100 000 to 300 000[86] per party). Up to 20% of the EU funding requested by the proposal may be allocated to the purpose of financial support to third parties[87].

- Exchange on requirements for legal accompanying measures.

- Involvement of social scientists and representative user groups, in order to design systems that are useful and acceptable for people/citizens and optimise testing and experimentation.

- Integration of objects, devices and systems in an IoT environment adapted to the expressed needs of the users.

Pilots Implementation:

Pilots in the selected areas will clearly identify the supply and demand sides. The effort devoted to supply and demand should be balanced for each pilot.

The supply side represents the technological part of the pilot and addresses all the ICT elements that constitute the proposed approach. This includes:

- definition of the IoT architecture;

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[86] 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.

[87] It is recommended to also use established networks reaching out to SMEs like the Enterprise Europe Network and the NCP network for calls publications and awareness raising towards SME's.

- IoT platform choice, technologies , necessary adaptations, trade offs required for the application requirements, and their management,

- Retained platform deployment conditions, of non technological nature

- development and operation of the distributed IoT nodes;

- management and adaptation of involved sensing, actuating, processing, energy supply, storage technologies at node level (setting, programming, conditioning);

- integration of devices, objects and systems in an IoT environment;

- approaches to interoperability and openness;

- security and privacy approaches;

- contribution and compliance to relevant IoT standards;

The demand/user side of the pilot covers all the application and usage related elements. This includes:

- definition, design, implementation and testing of multiple use-case scenarios;

- setting up application(s) requirements in terms of performance, scale, reliability, cost, usability, maintenance;

- interoperability needs and testing;

- security and privacy needs;

- feed-back to IoT supplier for technology optimisation;

- users/citizen awareness, involvement and acceptance;

- pro-active uptake of societal (RRI-SSH) issues;

- impact, added value and affordability assessment;

- mechanisms for replication;

- business and sustainability models;

- pilot conclusions and validation from the user side;

- dissemination of results in relevant communities;

- contribution and compliance to relevant IoT standards.

Pilot projects are expected to contribute to the consolidation and coherence work that will be implemented by the CSA supporting the activities defined under "Horizontal Activities"

below. This requires that they contribute to clustering their results of horizontal nature (interoperability approach, standards, security and privacy approaches, business validation and sustainability, methodologies, metrics, etc.).

The Commission considers that proposals requesting a contribution from the EU up to EUR 30 million (pilot 2), up to EUR 20 million (pilot 1), up to EUR 15 million (pilots 3, 4) and up to EUR 20 million (pilot 5) would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts. It is expected that at least one large pilot is supported for each area.

Expected Impact: Pilots 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.

Pilots' impact should go beyond involved partners and will aim at influencing external communities by putting in place appropriate mechanisms.

- Validation of technological choices, sustainability and replicability, of architectures, standards, interoperability properties, of key characteristics such as security and privacy;

- Exploration and validation of new industry and business processes and innovative business models validated in the context of the pilots.

- User acceptance validation addressing privacy, security, vulnerability, liability, identification of user needs, concerns and expectations of the IoT solutions

- Significant and measureable contribution to standards or pre-normative activities in the pilots' areas of action via the implementation of open platforms

- Improvement of citizens' quality of life, in the public and private spheres, in terms of autonomy, convenience and comfort, participatory approaches, health and lifestyle, and access to services.

- Creation of opportunities for entrepreneurs by promoting new market openings, providing access to valuable datasets and direct interactions with users, expanding local businesses to European scale, etc.

- Development of secure and sustainable European IoT ecosystems and contribution to IoT infrastructures viable beyond the duration of the Pilot.

For Pilot 1:

- Proposals should show clear evidence of the benefits of the proposed solutions for active and independent living and quality of life of older persons compared to current state of the art based on appropriate methodologies and metrics.

Type of Action: Innovation action

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

IoT-02-2016: IoT Horizontal activities

Specific Challenge: The challenge is to ensure a sound coherence and exchanges between the various activities of the Focus Area, and notably cross fertilisation of the various pilots for technological and validation issues of common interest across the various use cases. Issues of horizontal nature and topics of common interest, such as privacy, security, user acceptance, standardisation, creativity, societal and ethical aspects, legal issues and international cooperation, need to be coordinated and consolidated across the pilots to maximise the output and to prepare the ground for the next stages of deployment including pre-commercial or joint public procurement. A related challenge is to foster links between communities of IoT users and providers, as well as with Member States' initiatives, and to connect with other initiatives including contractual Public-Private-Partnerships (e.g. in the area of Big Data, Factories of the Future, 5G-infrastructure), Joint Technology Initiatives (e.g. ECSEL), European Innovation Partnerships (e.g. on Smart Cities), other Focus Areas (e.g. on Autonomous transport), and RRI-SSH issues.

A related challenge addresses inter-operability and integration, through open IoT platforms across application areas such as FIWARE, CRYSTAL or SOFIA. It addresses the reference implementation of promising IoT standards serving the interoperability and openness objectives, by consolidating results obtained through standard implementation and pre-normative activities at the platform and/or pilot levels.

Scope: Proposals should cover one of the following set of activities (a or b):

a. Co-ordination of and support to the IoT Focus Area

- Focused Action level coordination ensuring consistent exploitation of the outcomes of the various projects forming the FA*:* coordination of the projects and related pilot areas through mapping of pilot architecture approaches; interoperability and standards approaches at technical and semantic levels for object connectivity, protocols, data formats, privacy & security, open API*s;* exchange on requirements for legal accompanying measures; development of common methodologies and KPI for design, testing and validation and for success and impact measurement; federation of pilot activities and transfer to other pilot areas, facilitating the access for IoT entrepreneurs/API developers/Makers and SME in general. The corresponding activities will be developed and consolidated together with the pilots at FA level, and include where appropriate results from other relevant activities in the Factory, smart city, and vehicle domains.

- Horizontal support: further development and exploitation of security and privacy mechanisms towards best practices and a potential label ("Trusted IoT"); legal support in

relation to data ownership and protection, security, liability, sector-specific legislations; contribution to pre-normative activities and to standardization both horizontally and in various application areas, also linked with IoT Governance. The corresponding activities will be developed and addressed in the pilots and consolidated at programme level under this horizontal support activity line. Promotion for sharing of conclusions and road-mapping with similar activities in countries and regions outside Europe, including convergence and interoperability of European and non-European IoT reference architectures/platforms. Exploitation of the combination of ICT & Art for stimulating innovation and acceptance; preparation for the next stages of IoT deployment including through pre-commercial or joint public procurement.

The Commission considers that proposals requesting a contribution from the EU up to 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 minimum of one proposal will be funded.

b. RRI-SSH support to IoT

- Pilots shall be citizen-driven, involving existing and local communities at an early stage and addressing a combination of sustainability areas. The corresponding activities should accompany the pilots, analyse societal, ethical and ecological issues related to the pilots, and develop recommendations for tackling IoT adoption barriers including educational needs and skill-building. Consortium participation requires at least two entities from domains different than ICT technologies (e.g. social sciences, psychology, gerontology, economy, art, etc.).

The Commission considers that proposals requesting a contribution from the EU up to EUR 1 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:

- Ensure efficient and innovative IoT take-up in Europe, building on the various parts of the initiative (pilots, research, horizontal actions)

- Efficient information sharing across the programme stakeholders for horizontal issues of common interests

- Extension and consolidation of the EU IoT community, including start-ups and SMEs

- Validation of technologies deployment, replicability towards operational deployment

- Validation in usage context of most promising standards and gap identification

- Strengthening of the role of EU on the global IoT scene, in particular in terms of access to foreign markets.

Type of Action: Coordination and support action

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

IoT-03-2017: R&I on IoT integration and platforms

Specific Challenge: The future design of the Internet of Things applications will depend crucially on the development of sophisticated platform architectures for smart objects, embedded intelligence, and smart networks. Most of the today's IoT systems are however mainly focused on sensors, whereas in the future actuation and smart behaviour will be the key points.

Research driven by ambitious use cases and benefiting from innovation areas in components, systems, networking and web technologies needs to be carried out to respond to the ever increasing needs of future IoT systems in terms of scalability, heterogeneity, complexity and dynamicity. IoT platforms should be open and easy-to-use to support third party innovation

Scope:

- Architectures, concepts, methods and tools for open IoT platforms integrating evolving sensing, actuating, energy harvesting, networking and interface technologies. Platforms should provide connectivity and intelligence, actuation and control features, linkage to modular and ad-hoc cloud services, Data analytics and open APIs as well as semantic interoperability across use cases and conflict resolution. The work may also address the emergence of an open Web of Things like environment with search capabilities, so that "thing events" can be published, consumed, aggregated, filtered, re-published and searched for. Platforms should be compatible with existing international developments addressing object identity management, discovery services, virtualisation of objects, devices and infrastructures and trusted IoT approaches. Proposed research and innovation should take advantage of previous work and build on existing platforms, such as FIWARE, CRYSTAL or SOFIA, if appropriate.

- IoT security and privacy. Advanced concepts for end-to-end security in highly distributed, heterogeneous and dynamic IoT environments. Approaches must be holistic and include identification and authentication, data protection and prevention against cyber-attacks at the device and system levels. They should address relevant security and privacy elements such as confidentiality, user data awareness and control, integrity, resilience and authorisation.

Proposals should address above mentioned topics, verification and testing, and identify the added value of the proposed approach specific to IoT in comparison to generic solutions. They are expected to include two or more usage scenarios to demonstrate the practicality of the approach.

The Commission considers that proposals requesting a contribution from the EU of between EUR 3 and 5 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: Two or more of the following criteria should be addressed, with success metrics where appropriate.

- Evolution of platform technologies and contribution to scientific progress enabling novel, advanced semi-autonomous IoT applications.

- Strengthen the industrial EU technological offer of innovative IoT solutions

- Contribution to emerging or future standards and pre-normative activities

- Increase of IoT usability and user acceptance, notably through strengthened security and user control

- Support emergence of an open market of services and innovative businesses

- Promote the adoption of EU platforms in European and international context

Type of Action: Research and Innovation action

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

Conditions for the Call - Internet of Things

Opening date(s), deadline(s), indicative budget(s):[88]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 20 Oct 2015			
IoT-01-2016 (IA)	100.00 [89]		12 Apr 2016
IoT-02-2016 (CSA)	4.00 [90]		
Opening: 14 Dec 2016			
IoT-03-2017 (RIA)		35.00 [91]	25 Apr 2017
Overall indicative budget	104.00	35.00	

Pilot 1 in IoT-01-2016 will be jointly funded by ICT-LEIT "Leadership in enabling and industrial technologies Information and Communication Technologies" and SC1 "Health, Demographic Change and Wellbeing". A budget of max. 10 M EUR will be equally contributed by SC1 and ICT-LEIT. Thus, the max. total budget for Pilot 1 is 20 M EUR.

Pilot 2 in IoT-01-2016 will be jointly funded by ICT-LEIT "Leadership in enabling and industrial technologies Information and Communication Technologies" and SC2 "Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy". A budget of max. 15 M EUR will be equally contributed by SC2 and ICT-LEIT. Thus, the max. total budget for Pilot 2 is 30 M EUR.

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[88]   The budget figures given in this table are rounded to two decimal places.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[89]   of which EUR 15.00 million from 'Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy', EUR 10.00 million from 'Health, demographic change and wellbeing', EUR 75.00 million from 'Information and Communication Technologies '.

[90]   of which EUR 4.00 million from 'Information and Communication Technologies '.

[91]   of which EUR 35.00 million from 'Information and Communication Technologies '.

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Digital Security Focus Area

H2020-DS-2016-2017

ICT-driven transformations bring opportunities across many important sectors but also vulnerabilities to critical infrastructures and digital services, which can have significant consequences on the functioning of society, economic growth and the technological innovation potential of Europe. These challenges are being addressed through innovative approaches that cross the boundaries of individual H2020 pillars, calls and challenges. Therefore the main research & Innovation activities in Digital Security are grouped in a dedicated focus area cutting across LEIT–ICT and Societal Challenges parts of the work programme, including evidently the Societal Challenge 7 on "Secure Societies", but also the Societal Challenge 1 on "Health, demographic change and wellbeing".

Proposals are invited against the following topic(s):

DS-01-2016: Assurance and Certification for Trustworthy and Secure ICT systems, services and components

Specific Challenge: The constant discovery of vulnerabilities in ICT components, applications, services and systems is placing our entire digital society at risk. Insecure ICT is also imposing a significant cost on users (individuals and organisations) who have to mitigate the resulting risk by implementing additional technical and procedural measures which are resource consuming.

Smart systems, highly connected cyber-physical systems (CPS) are introducing a high dynamism in the system to develop and validate. Hence, CPS are evolving in a complex and dynamic environment, making safety-critical decisions based on information from other systems not known during development.

Another key challenge is posed by domains, such as medical devices, critical infrastructure facilities, and cloud data centres, where security is deeply intertwined and a prerequisite for other trustworthiness aspects such as safety and privacy.

The challenges are further intensified by the increasing trend of using third party components for critical infrastructures, by the ubiquity of embedded systems and the growing uptake of IoT as well as the deployment of decentralized and virtualized architectures.

In order to tackle these challenges, there is a need of appropriate assurances that our ICT systems are secure and trustworthy by design as well as a need of certified levels of assurance where security is regarded as the primary concern. Likewise, target architectures and methods improving the efficiency of assurance cases are needed in order to lower their costs.

Scope: a. Research and Innovation Actions - Assurance

Providing assurance is a complex task, requiring the development of a chain of evidence and specific techniques during all the phases of the ICT Systems Development Lifecycle (SDLC for short: e.g. design verification, testing, and runtime verification and enforcement) including the validation of individual devices and components. These techniques are complementary yet all necessary, each of them independently contributing towards improving security assurance. It includes methods for reliability and quality development and validation of highly dynamic systems.

Proposals may address security, reliability and safety assurance at individual phases of the SDLC and are expected to cover at least one of the areas identified below, depending on their relevance to the proposal overall objectives:

- Security requirements specification and formalization;

- Security properties formal verification and proofs at design and runtime

- Secure software coding;

- Assurance-aware modular or distributed architecting and algorithmic;

- Software code review, static and dynamic security testing;

- Automated tools for system validation and testing;

- Attack and threat modelling;

- Vulnerability analysis;

- Vendor (third-party) application security testing;

- Penetration testing;

- Collection and management of evidence for assessing security and trustworthiness;

- Operational assurance, verification and security policy enforcement;

- Adaptive security by design and during operation.

Proposal should strive to quantify their progress beyond the state of the art in terms of efficiency and effectiveness. Particular importance within this context should be placed on determining the appropriate metrics.

Proposals should take into account the changing threat landscape, where targeted attacks and advanced persistent threats assume an increasingly more important role and address the challenge of security assurance in state-of-the-art development methods and deployment models including but not limited to solutions focussing on reducing the cost and complexity of assurance in large-scale systems.

Proposals should include a clear standardisation plan at submission time.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 4 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

The outcome of the proposals are expected to lead to development up to Technology Readiness Level (TRL) 3 to 5; please see part G of the General Annexes.

b. Innovation Actions – Security Certification

Proposals should address the challenge of improving the effectiveness and efficiency of existing security certification processes for state-of-the-art ICT components and products including the production and delivery of the corresponding guidance materials.

In terms of effectiveness, proposals should address, amongst other factors, emerging threats, compositional certification and reuse of components in the context of certified systems and certification throughout the operational deployment of a product or a service.

In terms of efficiency, proposals should strive to reduce the cost and duration of the certification process.

Proposals may address security certification in any area of their choice. Consortia submitting proposals are expected to approach the selected topic as widely as possible including all necessary actors – e.g. industry, academia, certification laboratories - and involve the relevant certification authorities from at least three Member States in order to achieve added value at a European level.

Proposals are encouraged to work towards moderate to high assurance level protection profiles as a way to validate their results.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 4 million would allow this specific challenge to be addressed appropriately. Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

The outcome of the proposals are expected to lead to development up to Technology Readiness Level (TRL) 6 to 7; please see part G of the General Annexes.

c. Coordination and Support Actions

To complement the research and innovation activities in security assurance and certification in this topic, support and coordination actions should address the following:

Building trustworthiness: economic, legal and social aspects of security assurance and certification

- Study in depth the economic and legal aspects related to assurance and certification (including European-wide labelling), EU and International regulatory aspects;

- Explore and identify the interplay of relevant social, cultural, behavioural, gender and ethical factors with ICT systems with regards to their trustworthiness and security, actual or perceived

- Identify barriers and incentives in the market for certified products in the consumer and/or enterprise market;

- Produce a comprehensive cost/benefit model for security assurance and certification;

Engage with multidisciplinary communities and stakeholders.

The Commission considers that proposals requesting a contribution from the EU of up to EUR 1 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:

- European ICT offering a higher level of assurance compared to non-European ICT products and services.

- ICT products and services more compliant with relevant European security and/or privacy regulations.

- ICT with a higher level of security assurance at marginally additional cost.

- Facilitation of mutual recognition of security certificates across the EU.

- Increased market uptake of secure ICT products.

- Increased user trust in ICT products and services.

- Reduction of negative externalities associated with deployment of insecure ICT.

- More resilient critical infrastructures and services.

- Progress beyond the state-of-the-art in the effectiveness and efficiency of the areas addressed by the proposals.

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

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

DS-06-2017: Cryptography

Specific Challenge: In line with technological developments and emerging threats, the improvement of performance and efficiency of cryptographic solutions is a persistent need across ICT.

Scope: Proposals may address one or more of the areas/challenges described below but not necessarily all of them:

- Functional encryption solutions that offer more flexibility and make it feasible to process encrypted data held on the Internet. Research should aim for solutions beyond the current only partial homomorphic encryption algorithms under development.

Activities should also deal with measurement of information leaked when allowing for flexibility and preserving data formats. Additionally, means to reduce this leakage (e.g., anonymization or obfuscation) should be researched.

- For application areas such as the Internet of Things, implantable medical devices and sensor nodes that harvest energy from the environment there is a need for ultra-lightweight cryptology. Additional means to protect privacy in these applications (e.g. anonymity in communications) should be developed.

Even if Moore's law would hold for the next 10-15 years, the progress in bandwidth and storage capacity grows faster than the computing power; and so this means that there is a need for ultra-high-speed cryptographic algorithms that are fully parallelizable and energy efficient as well as high speed encryption applied directly to the physical layer, for example using quantum cryptography. This challenge is related to the challenge of ultra-lightweight cryptology but the optimization target is very different and hence completely different designs are expected.

- Implementation (hardware or software) is often the weak point of the strongest cryptographic protocols: physical cryptanalysis, including tampering, side channel, faults injection attacks, has to be taken into account in the early phases of a development. A specific attention should be paid to the security of the implementation and its validation.

While development tools today include support for good software practices that avoid many common implementation errors, these tools insufficiently support good practices that can bring cyber-secure primitives and applications. Therefore, more progress is needed in the development of toolkits that integrate encryption seamless in their toolbox environment.

- Authenticated encrypted token research for mobile payment solutions and related applications. Most currently existing payment solutions emulate a credit or debit card payment scheme. Tokenized payment solutions can effectively reduce the risk of cyber-fraud and open options for alternative payment options to European citizens. The proposals should aim to create a real e-currency without compromising security or opening doors for criminals. Different projects may be envisaged, such as an e-€ wallet that can be held on a mobile and

used to pay anywhere anytime combining convenience, flexibility and security without compromising the instrument with (inflated) transaction costs or possible criminal misuses.

- Innovative cryptographic primitives and complementary non-cryptographic privacy-preserving mechanisms to enforce privacy at various levels (e.g. pairing based cryptography).

- New techniques, such as quantum safe cryptography, which are secure from quantum computers and other advances in computing and cryptanalysis.

- Proposals on quantum key distribution addressing challenges such as improved performance (higher bit rates, increased loss and noise resilience), network integration (coexistence on existing infrastructure) and the development of new protocols beyond key distribution. Proposals on quantum key distribution should include experimentation and validation with end-users in realistic and relevant scenarios such as for mobile communication backhauling, optical access networks or data-centre to data-centre communication.

- Automated proof techniques for cryptographic protocols.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 million and 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.

The outcome of the proposals are expected to lead to development up to Technology Readiness Level (TRL) 3 to 5; please see part G of the General Annexes.

Expected Impact:

- Increase the trustworthiness of European ICT services and products and the competitiveness of the European cryptography and smart card industry.

- Increased trust in ICT and online services.

- Protecting the European Fundamental Rights of Privacy and Data Protection.

- Communication networks with automatic interference detection.

- Improvement in performance and efficiency of cryptography beyond the state of the art.

- Protection against emerging threats such as quantum computation.

Type of Action: Research and Innovation action

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

Conditions for the Call - Digital Security Focus Area

Opening date(s), deadline(s), indicative budget(s):[92]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 20 Oct 2015			
DS-03-2016 (RIA)	11.00 [93]		16 Feb 2016
DS-01-2016 (RIA)	13.50 [94]		12 Apr 2016
DS-01-2016 (IA)	9.00 [95]		
DS-01-2016 (CSA)	1.00 [96]		
Opening: 24 Mar 2016			
DS-02-2016 (IA)	22.00		25 Aug 2016
DS-04-2016 (RIA)	4.00		
DS-05-2016 (CSA)	3.00		
Opening: 14 Dec 2016			
DS-06-2017 (RIA)		18.50 [97]	25 Apr 2017

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[92] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[93] of which EUR 11.00 million from 'Health, demographic change and wellbeing'.

[94] of which EUR 13.50 million from 'Information and Communication Technologies '.

[95] of which EUR 9.00 million from 'Information and Communication Technologies '.

[96] of which EUR 1.00 million from 'Information and Communication Technologies '.

Opening: 23 Mar 2017			
DS-07-2017 (RIA)		10.00	24 Aug 2017
DS-07-2017 (IA)		8.00	
DS-08-2017 (IA)		18.00	
Overall indicative budget	63.50	54.50	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

DS-05-2016	Proposals addressing strand 1. "Synergies between H2020, EU Member States and associated countries R&I activities and cybersecurity innovation clusters" shall be of a 4 year duration.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal with the following exceptions:

DS-05-2016	Only the best proposal may be funded for strands 1, 2 and 3.
DS-01-2016	Only the best proposal may be funded for part c) Coordination and Suport Action.

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[97] of which EUR 18.50 million from 'Information and Communication Technologies '.

<u>Consortium agreement</u>: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

Other actions[98]

6. Cryptography Prize

Cryptography is one of the core technological building blocks in cybersecurity to ensure the confidentiality and integrity of data. The purpose of this Horizon prize scheme is to launch an ambitious sectorial challenge open to EU contestants in the field of cryptography and provide visibility to European research and innovation excellence in cybersecurity.

Type of Action:

The common Rules of Contest for Prizes are provided in part F of the General Annexes.

Indicative budget: EUR 1.00 million from the 2017 budget[99]

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[98] The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.
The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

[99] of which EUR 1.00 million from 'LEIT-ICT'.

Other Topics

SFS-05-2017: Robotics Advances for Precision Farming

Specific Challenge: The specific challenge here is to help attain high levels of precision in modern farming through the smart use of robotics. The technological challenge is to develop and demonstrate new robotics technologies in real-world scenarios involving such as automated mobility around irregular farmland areas, accurate sensing of crop and livestock conditions, and dextrous manipulation of farmed produce. Farming is facing many economic challenges in terms of productivity, cost-effectiveness and increasing labour shortage. Precision farming automation will increase farm productivity, reduce manual labour for laborious tasks and help to make farm holdings more sustainable. Many modern farmers already use high-tech solutions, e.g. digitally-controlled farm implements and even unmanned aerial vehicles. There are partially and fully automatic devices for most aspects of agricultural functions from grafting to seeding and planting, from harvesting to sorting, packaging and boxing, and livestock management. However, current systems still have significant drawbacks, in particular in terms of flexibility, efficiency, robustness, high operator cost and capital investment.

Precision farming using robotics technology applied to existing systems on a 1:1 scale where appropriate (the scale may differ according to the specific agricultural application) can lead to more resource-efficient and environment-friendly agricultural production. Roboticised precision farming not only promises to increase yields by optimising growth and harvesting processes, but could also lead to lower fertiliser and pesticide usage and improved soil quality through more targeted interventions. Robots can also gather operational data on a broader basis than human-operated devices. However, there is insufficient cross-over between emerging generic advances in field robotics and the more specific, practical needs of the modern farming community.

Scope: Research and Innovation Actions will focus on the design, development and testing of robotics systems for precision farming, including autonomous or semi-autonomous farm vehicles or sophisticated sensors and intervention mechanisms. The actions will prioritise technologies such as selective harvesting, more targeted weed reduction or environment friendly fertilization, and / or livestock management, based on better planning and targeted intervention, using sensors (local and aerial, even maybe earth observation satellite). This will also allow the tagging of agricultural produce or livestock for better traceability and subsequent big data processing, optimizing the whole agricultural process.

The Commission considers that proposals requesting an EU contribution of EUR 2-4 million would allow for this specific challenge to be addressed appropriately, but this does not preclude the submission and selection of proposals requesting different amounts.

Expected Impact:

- significant increase in farm productivity with more environment-friendly processes (e.g. reduced water use, toxic substance use and soil compaction);

- increase in the safety, reliability and manageability of agricultural technology, reducing excessive human burden for laborious tasks.

<u>Type of Action</u>: Research and Innovation action

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

Conditions for the Call - Sustainable Food Security – Resilient and resource-efficient value chains

Opening date(s), deadline(s), indicative budget(s):[100]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 15 Oct 2015			
SFS-09-2016 (RIA)	7.00		17 Feb 2016
Opening: 27 Oct 2015			
SFS-12-2016 (CSA)	3.00		17 Feb 2016
SFS-19-2016 (ERA-NET-Cofund)	15.00		
SFS-24-2016 (CSA)	2.00		
SFS-25-2016 (CSA)	2.00		
SFS-41-2016 (ERA-NET-Cofund)	10.00		
SFS-01-2016 (RIA)	12.00		17 Feb 2016 (First stage)
SFS-02-2016 (RIA)	10.00		13 Sep 2016 (Second stage)
SFS-03-2016 (RIA)	5.00		
SFS-06-2016 (RIA)	7.00		

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[100] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

SFS-07-2016-2017 (RIA)	8.00		
SFS-11-2016 (RIA)	12.00		
SFS-14-2016 (RIA)	11.00		
SFS-15-2016-2017 (RIA)	7.00		
SFS-21-2016/2017 (RIA) SFS-23-2016 (RIA)	12.00		
SFS-26-2016 (RIA)	10.00		
SFS-31-2016 (RIA)	5.00		
SFS-33-2016 (RIA)	6.00		
SFS-37-2016 (RIA)	9.50		
SFS-38-2016 (RIA)	12.00		
SFS-42-2016 (RIA)	5.00		
SFS-44-2016 (RIA)	5.00		
SFS-45-2016 (RIA)	5.00		
SFS-18-2016 (FPA)			13 Sep 2016
SFS-04-2017 (CSA)		2.00	14 Feb 2017
SFS-05-2017 (RIA)		7.00 [101]	
SFS-13-2017 (IA)		6.00	
SFS-22-2017 (IA)		6.00	
SFS-35-2017 (IA)		12.00	

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[101] of which EUR 7.00 million from 'Information and Communication Technologies '.

SFS-36-2017 (COFUND-EJP)		35.00	
SFS-43-2017 (RIA)		10.00 [102]	
SFS-48-2017 (IA)		7.00	
SFS-07-2016-2017 (RIA)		12.00	14 Feb 2017 (First stage) 13 Sep 2017 (Second stage)
SFS-08-2017 (RIA)		8.00	
SFS-10-2017 (RIA)		15.00	
SFS-15-2016-2017 (RIA)		7.00	
SFS-16-2017 (RIA)		9.00	
SFS-17-2017 (RIA)		10.00	
SFS-20-2017 (RIA)		6.00	
SFS-21-2016/2017 (RIA)		5.00	
SFS-27-2017 (RIA)		10.00	
SFS-28-2017 (RIA)		10.00	
SFS-29-2017 (RIA)		5.00	
SFS-30-2017 (RIA)		12.00	
SFS-32-2017 (RIA)		12.00	
SFS-34-2017 (RIA)		6.00	
SFS-39-2017 (RIA)		20.00	
SFS-40-2017 (RIA)		9.00	

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[102] of which EUR 10.00 million from 'Climate action, environment, resource efficiency and raw materials'.

SFS-46-2017 (RIA)		5.00	
SFS-47-2017 (RIA)		5.00	
Overall indicative budget	180.50	251.00	

Indicative timetable for evaluation and grant agreement signature:

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

For two stage procedure:

- Information on the outcome of the evaluation: Maximum 3 months from the final date for submission for the first stage and maximum 5 months from the final date for submission for the second stage; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission of the second stage.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

SFS-11-2016	Due to the specific challenge of this topic, in addition to the minimum number of participants set out in the General Annexes, proposals shall include at least two participants from third countries.
SFS-42-2016	Due to the specific challenge of this topic, in addition to the minimum number of participants set out in the General Annexes, proposals shall include at least five participants from Africa.
SFS-48-2017	In the context of the EU-China Urbanisation Partnership, each project shall involve at least one city from Member States and/or Associated Countries and one Chinese city, where demonstration activities will be performed as defined in the topic text.
SFS-41-	Due to the specific challenge of this topic, in addition to the minimum number of participants set out in the General Annexes, proposals shall include at least five participants from Africa.

2016	
SFS-25-2016	Only legal entities from EU Member States and Associated Countries, in charge of national research and innovation programmes and policy in the Societal Challenge 2 - Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy, are eligible to participate in the consortium.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme.

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal with the following exceptions:

SFS-21-2016/2017, SFS-23-2016	At least one project (above the evaluation threshold) per topic will be funded

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.

NMBP-13-2017: Cross-cutting KETs for diagnostics at the point-of-care

Specific Challenge: Research and technology development at the interface of key enabling technologies has the potential to provide novel technological Micro-Nano–Bio integrated Systems (MNBS) platforms to enhance the ability to sense, detect, analyse, monitor and act on phenomena from macro (e.g. body, organ, tissues) to nano scale (e.g. molecules, genes). These developments have a high potential for facilitating personalised and preventive healthcare. However, the translation of laboratory proven concepts to the clinical environment involving pre-clinical and clinical testing, prototyping, and small series manufacturing is currently lagging. Business development and market growth are therefore still limited. The challenge is to bring new promising laboratory proven MNBS concepts for addressing priority healthcare needs from the laboratory to the clinic.

Scope: The focus is on further development into a clinical setting of novel MNBS platforms, techniques and systems that have already been proven in a laboratory setting (laboratory Proof-of-Concept). These must pertain to one or more of the following:

 a. In vitro/in vivo diagnostics that are deployed at the point of care;

 b. Therapy monitoring at the point of care.

Proposals should pay attention to facilitate clinical data harvesting, e.g. for medical regulatory purposes and/or to enhance epidemiological monitoring of health and disease patterns. As relevant, the proposed activities should address sex and gender specific aspects[103].

Proposals should demonstrate clear compliance with applicable Good Laboratory Practice /Good Clinical Practice /Good Manufacturing Practice, and be consistent with ISO and other regulations (both national and European). The translation from the pre-clinical phase to early clinical testing, including design and pilot manufacturing in appropriate volume for clinical testing (small series), pre-clinical and early clinical testing is a necessary part of the work-up. Attention should be paid to the requirements for Health Technology Assessment (HTA). Standardisation issues have to be taken into account where appropriate.

Activities are expected to commence at Technology Readiness Levels 3/4 and reach 5-6.

A significant participation of SMEs with R&D capacities is encouraged.

The Commission considers that proposals requesting a contribution from the EU between EUR 3 and 5 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: Proposals should address one or more of the following impact criteria and provide metrics to measure and monitor success.

- Address priority needs in healthcare diagnostics and / or therapy monitoring, for the benefit of patients;

- Provide affordable systems with unique features that address specific well identified requirements in healthcare;

- Progress the development of advanced integrated MNBS based diagnostic health platforms, techniques or systems from the laboratory Proof-of-Concept to the clinical setting;

- Establish a world-class European competitive industrial R&D and manufacturing competence in Micro-Nano-Bio Systems integration for healthcare diagnostics applications;

- Strengthening the industrial value chain and progress to marketisation;

- Early involvement of regulatory bodies and patients in the new developments.

Proposals should include a business case and exploitation strategy, as outlined in the Introduction to the LEIT part of this Work Programme.

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[103] *See definition of the 'gender dimension approach' in the introduction of this Work Programme part.*

This topic will be co-funded by LEIT-ICT and LEIT-NMBP within the context of a Cross-KET initiative for Health, for a total budget of EUR 15 000 000.

Type of Action: Research and Innovation action

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

Conditions for the Call - Call for Nanotechnologies, Advanced Materials, Biotechnology and Production

Opening date(s), deadline(s), indicative budget(s):[104]

Topics (Type of Action)	Budgets (EUR million)		Deadlines
	2016	2017	
Opening: 15 Oct 2015			
BIOTEC-02-2016 (RIA) BIOTEC-03-2016 (RIA)	32.00		08 Dec 2015 (First stage) 24 May 2016 (Second stage)
NMBP-01-2016 (RIA) NMBP-02-2016 (RIA) NMBP-03-2016 (RIA) NMBP-23-2016 (RIA) NMBP-26-2016 (RIA)	78.08		08 Dec 2015 (First stage) 24 May 2016 (Second stage)
NMBP-09-2016 (RIA) NMBP-10-2016 (RIA)	32.00		
NMBP-17-2016 (IA) NMBP-18-2016 (IA)	32.00		
BIOTEC-04-2016 (CSA)	10.70		21 Jan 2016

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[104] The Director-General responsible for the call may decide to open the call up to one month prior to or after the envisaged date(s) of opening.

All deadlines are at 17.00.00 Brussels local time.

The Director-General responsible may delay the deadline(s) by up to two months.

The deadline(s) in 2017 are indicative and subject to a separate financing decision for 2017.

The budget amounts for the 2016 budget are subject to the availability of the appropriations provided for in the draft budget for 2016 after the adoption of the budget 2016 by the budgetary authority or, if the budget is not adopted, as provided for in the system of provisional twelfths.

The budget amounts for the 2017 budget are indicative and will be subject to a separate financing decision to cover the amounts to be allocated for 2017.

NMBP-24-2016 (CSA) NMBP-27-2016 (CSA) NMBP-30-2016 (CSA) NMBP-31-2016 (CSA) NMBP-32-2016 (CSA) NMBP-33-2016 (CSA) NMBP-36-2016 (CSA)			
BIOTEC-01-2016 (ERA-NET-Cofund) NMBP-11-2016 (ERA-NET-Cofund) NMBP-21-2016 (ERA-NET-Cofund)	30.00		21 Jan 2016
NMBP-08-2016 (RIA)	16.00		21 Jan 2016
Opening: 10 May 2016			
NMBP-04-2017 (RIA) NMBP-05-2017 (IA) NMBP-06-2017 (RIA) NMBP-07-2017 (RIA) NMBP-22-2017 (RIA) NMBP-25-2017 (IA) NMBP-28-2017 (RIA) NMBP-29-2017 (RIA) NMBP-35-2017 (RIA)		114.19	27 Oct 2016 (First stage) 04 May 2017 (Second stage)
NMBP-12-2017 (RIA) NMBP-14-2017 (RIA) NMBP-15-2017 (RIA)		40.00	

NMBP-19-2017 (RIA) NMBP-20-2017 (IA)		32.00	
BIOTEC-05-2017 (RIA) BIOTEC-06-2017 (IA) BIOTEC-07-2017 (RIA)		48.00	27 Oct 2016 (First stage) 04 May 2017 (Second stage)
Opening: 20 Sep 2016			
BIOTEC-08-2017 (CSA) NMBP-16-2017 (CSA) NMBP-31-2017 (CSA) NMBP-34-2017 (CSA)		5.20	19 Jan 2017
NMBP-13-2017 (RIA)		15.00 [105]	19 Jan 2017
Overall indicative budget	230.78	254.39	

<u>Indicative timetable for evaluation and grant agreement signature:</u>

For single stage procedure:

- Information on the outcome of the evaluation: Maximum 5 months from the final date for submission; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission.

For two stage procedure:

- Information on the outcome of the evaluation: Maximum 3 months from the final date for submission for the first stage and maximum 5 months from the final date for submission for the second stage; and

- Indicative date for the signing of grant agreements: Maximum 8 months from the final date for submission of the second stage.

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[105] of which EUR 5.00 million from 'Information and Communication Technologies '.

Eligibility and admissibility conditions: The conditions are described in parts B and C of the General Annexes to the work programme with the following exceptions:

NMBP-32-2016	Support will be given only to a consortium of formally nominated NCPs in the area of LEIT-NMBP.

Evaluation criteria, scoring and threshold: The criteria, scoring and threshold are described in part H of the General Annexes to the work programme with the following exceptions:

	For single-stage and second-stage evaluations, the threshold for the criteria Excellence and Impact will be 4. The overall threshold, applying to the sum of the three individual scores, will be 12.
	In case of equal overall scores in the ranked list, the priority order of proposals will be established in accordance with part H of the General Annexes, except that proposals will be ranked on the basis of individual scores for the Impact criterion before the Excellence criterion.
	In case of equal overall scores in the ranked list, the priority order of proposals will be established in accordance with part H of the General Annexes, except, when comparing *ex aequo* proposals of different topics, the proposals will be ranked first according to the position in the topic ranked lists

Evaluation Procedure: The procedure for setting a priority order for proposals with the same score is given in part H of the General Annexes.

The full evaluation procedure is described in the relevant guide published on the Participant Portal.

Consortium agreement: Members of consortium are required to conclude a consortium agreement, in principle prior to the signature of the grant agreement.