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Work Programme 2014-15
Part I - Excellent Science

Draft V2.15 – 20 June 2013

1. Future and Emerging Technologies

Future and Emerging Technologies (FET) aims at radically new technologies by exploring novel and high-risk research directions emerging from science and cutting-edge engineering. It promotes research beyond what is known, accepted or widely adopted and fosters novel and visionary thinking to open promising paths towards powerful new technologies. The supported research will be interdisciplinary and positioned between research driven by science and research driven by societal challenges or by industrial competitiveness bringing closer science and engineering. It will contribute to accelerating the transition from upstream research to research carried out in Societal Challenges and LEIT.

FET is realised through three lines of activities:

- **FET Open** supports early-stage joint science and technology research for exploring new foundations for radically new future technologies. A bottom-up selection process will build up a diverse portfolio of targeted projects. Early detection of promising new areas, developments and trends, along with attracting new bold-visioned and high-potential research and innovation players, will be key.
- **FET Proactive** will nurture emerging themes and communities by addressing a number of promising exploratory research themes with the potential to generate a critical mass of inter-related projects that, together, make up a broad and multifaceted exploration of the themes and build a European pool of knowledge. Through this line of activity FET engages in the coordinated exploration of a new theme, as well as in the consolidation of promising future technologies to be taken up by industry and society.
- **FET Flagships** support ambitious large-scale, science-driven research aimed at grand interdisciplinary S&T challenges. Such activities require and will benefit from the alignment of European and national agendas, and provide a strong and broad basis for future technological innovation and economic application in a variety of areas, as well as novel benefits for society.

These lines of activity contribute, each in their own way, to a variety of societal challenges and areas of future industrial leadership. In addition, a special FET initiative in computer science focusses on **the next generations of high-performance computing** (HPC) as a key driver of innovation in ICT (e.g. in low-power embedded systems) and an essential generic enabler for advanced modelling, simulation and big-data applications.

As key impact FET aims at shaping the future technology landscape and fostering European thought-leadership on new and emerging technologies. The combination of a bottom-up spirit and a broadly based participatory agenda-setting assures that FET explores radically new avenues while remaining sensitive to future needs from industry and society. By promoting interdisciplinary collaboration that go well beyond the strictly technological and 'hard' scientific disciplines, FET promotes dialogue and cooperation between science, industry, citizens and policy makers on how to turn new technological possibilities into an opportunity for industry and a benefit for society. This will boost long-term innovation potential in Europe both from the abundance of novel ideas and the actors ready to take them forward.

The silo-breaking research collaborations in FET will also improve readiness across Europe to take up new research and innovation practices, especially those driven by advanced developments in information and communication technology, like open-data, advanced simulation, e-Science and open collaboration. These are essential tools for building operational links between science, technology and innovation, as well as across disciplines, so that even the most advanced results can find their way to foster industrial leadership and for addressing societal challenges.

FET research is well placed for global collaborations that can raise the level of excellence and accelerate the impact from global alliances. Thus, participation of excellent non EU partners in FET activities, whenever necessary and essential, is welcome.

A. CALLS

Call FET-Open - fostering novel ideas

Specific Challenge

Supporting a large set of early stage, high risk visionary science and technology collaborative research projects is necessary for the successful exploration of new foundations for radically new future technologies. Nurturing fragile ideas requires an agile, risk-friendly and highly interdisciplinary research approach. Attracting and stimulating the driving role of new high-potential actors in research and innovation, such as young researchers and high-tech SMEs, is also important for nurturing the scientific and industrial leaders of the future.

Scope

Proposals are sought for collaborative research projects with all of the following characteristics:

- **Long-term vision**: the research proposed must address a new, original or radical long-term vision of technology-enabled possibilities that are far beyond the state of the art and currently not anticipated by technology roadmaps.
- **Breakthrough S&T target**: research targets concrete and ambitious breakthroughs that are arguably crucial steps towards achieving the long-term vision and that are plausibly attainable within the life-time of the proposed project.
- **Foundational**: the breakthroughs that are envisaged are foundational in the sense that they can establish a basis for a new line of technology not currently anticipated.
- **High-risk**: the potential of a new technological direction depends on a whole range of factors that cannot be apprehended from a single disciplinary viewpoint. Thus, this high-risk has to be countered by novel concepts and ideas, and by a strongly interdisciplinary research approach, where needed expanding well beyond the strictly technological realm
- **Novelty**: the research proposed finds its plausibility in new ideas and concepts, rather than in the application or incremental refinement of existing ones.
- **Interdisciplinary**: the proposed collaborations are interdisciplinary in the sense that they go beyond current mainstream collaboration configurations in advanced science and technology research, and that they aim to advance different scientific and technological disciplines together and in synergy towards a breakthrough.

Expected Impact:

Projects will aim at one of the following two impacts:

- Establish Proof-of-Principle of a new technological possibility, together with its scientific basis, as foundational contribution for a radically new line of technology, or
- Establish a solid baseline of feasibility and potential for a new technological option , ready for early take-up within an emerging innovation eco-system of high-potential actors.

In addition, projects will aim at the active involvement of new and high-potential research and innovation players.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 80M€ in 2014, 80M€ in 2015

Call FET-Proactive - nurturing emerging themes and communities

Novel areas and themes need to be matured, by working towards structuring emerging communities and supporting the design and development of transformative research themes. The main benefits of this structuring yet explorative approach are emerging novel areas that are not yet ready for inclusion in industry research roadmaps, and building up and structuring of new interdisciplinary research communities around them. It makes the step from collaborations between a small number of researchers, to a cluster of projects that each address aspects of a novel research theme to jointly explore possibilities for, and long-term implications of future technologies that matter.

FET Proactive initiatives have one of the following strategic objectives:

- An exploratory objective will explore a variety of directions and build up new research alliances around promising emerging themes. This will encourage new inter-disciplinary collaborations around a new area or theme, sifting through a wide range of options in order to get a better understanding of which ones may be the more promising directions towards future technologies.
- A pathfinding objective will aim at translating science into concrete technological directions by projects that build on proofs-of-concept and that want to take them to a next level of development. This will consolidate a technological direction to a point where it is mature enough for hand-over (to LEIT, societal challenges, FET Flagships, industry,…).

Nine candidate topics have been identified for funding in the coming years, for a total budget of 235M€. Considering the latest figures of the budgetary programming, a total amount of [60-82M€] is foreseen for 2014 and 2015. The exact budget available will depend on the budgetary needs for implementing the FET Flagships, whose contractual model is still under discussion with the legal and budgetary services. FET Proactive initiatives which, in the end, will not be among the priorities for funding in 2014 or 2015, may be taken up in future workprogrammes.

The working list of topics is the result of combining early signals from the FET-Open portfolio of FP7 with the results of an open consultation with external and internal stakeholders, both for the identification of specific challenges and for their more concrete scoping. Concerns of avoiding overlaps or feeding into other activities within H2020 are further reflected in expected impacts.

1. Understanding time for new technologies
2. Symbiosis between artificial and natural systems
3. Adaptive bottom-up construction
4. New possibilities at the nano-bio-chem interface
5. Knowing, doing and being: Cognition beyond problem solving
6. Ecological ubiquitous technology
7. Exploiting light-matter interaction
8. Quantum simulation and networking
9. Global Systems Science

Topic 1: Understanding time for new technologies

Specific Challenge

In most of the modern sciences and technologies, time is considered as the background with respect to which processes are measured. In contrast, the primary goal of this initiative is to challenge this view by reconceptualising time itself and to explore the implications for future and emerging technologies. A deep understanding of time in physics has been fundamental for modern technologies. Many more disciplines are concerned with time –philosophy, psychology, history, geology, computer science, biology and neuroscience – not to mention arts like literature, cinema or music. This points at many different motivations and methods to study and use time – often at vastly different scales and levels of abstraction. What can be learned from this in terms of future technologies to, for instance, understand, model, program, manipulate, stop, create, invert, multiply, perceive or differently experience and use time in its multiple manifestations? This initiative seeks to explore new technological possibilities deriving from these and other conceptions of time.

Scope

Projects should focus on some of the following topics, covering in each project both conceptual/theoretical and technology-oriented lines of work, in close interaction:

- Study temporal information processing and our cognitive functioning with respect to the perception and qualitative experience of time. Develop models and technology to measure and manipulate the perception and experience of time. Investigate and demonstrate implications in technological systems like, for example, in robotics, virtual and augmented reality or cyber physical systems.
- Investigate different subjective notions of time and their relationships as they occur across different time scales, or how they vary according to cultural, contextual and personal differences, as emphasized by anthropology or the study of time related pathologies.
- Develop techniques for encoding such different notions of time in computing, modelling and simulation languages that can deal with different time spans (e.g., from real-time reactivity, over biological or bio-dynamical rhythms, to diurnal or longer cycles of use and repetition) in a variety of applications.
- Understanding and exploiting the properties of time beyond the currently accessible scales. Search for the manifestation of quantum effects at very short time (and space) scales. Investigate the impact on quantum information theories.
- Revisit the fundamentals of time, for example from the concept of time as an emergent entity, considering time as a thermodynamics process and studying the relation between time and entropic processes.
- Study of the role of time at vastly different time scales, from quantum world processes to the age of the Universe, and investigate the relation to the different biological processes and its impact on the human being (e.g. at the biological or psychological level).

This initiative will not support research on novel devices to measure time as presently understood; neither will it fund work on time optimisation in industrial processes or activities.

Expected impact

By advancing knowledge on different aspects of time, projects will demonstrate technological impacts such as, but not limited to, the following:

- Technology that takes into account the variability of human time perception and its impact on various human activities, for instance in terms of memory, learning and decision making.
- Technologies for time-related pathologies (diagnosis, biological understanding, mitigation, treatment) and a better understanding of how biological processes influence our perception of time and, thus, our cognition capabilities.
- Understanding of complex processes at multiple time scales (e.g., disease development), may lead to medical devices that evolve to engineer chronobiomimetic therapeutic solutions.
- Understanding the properties of time at ever smaller time (and space) scales will have a profound impact on the fundamental understanding of nature (e.g., from quantum information theory) and on the development of small scale technologies, where both gravitational and quantum effects should be taken into account.
- Raised societal awareness and understanding of important insights on the notion of time, thus not only through scientific and technological work but also, for instance, through various media or artistic intervention.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 20M€

Topic 2: Symbiosis between artificial and natural systems

Specific Challenge

Nature and biology provide many examples of systems with outstanding and attractive properties, for example with respect to long-term viability, efficiency, adaptability or resilience. Bio-inspired technologies have made tremendous progress by copying some of the underlying key principles. This objective goes beyond inspiration from nature and bio-mimicry and seeks to explore hybrid artificial-natural systems in which the nature and complexity of interactions can be considered to be a kind of mutually beneficial symbiosis as it is found in nature – or better.

Scope

Proposals are expected to combine concepts and knowledge from different disciplines towards creating a persistent and constructive ('win-win') symbiosis between artificial and natural systems, by addressing one or more of the following topics:

- Development of modelling techniques and architectural principles related to natural, artificial or hybrid symbiotic systems.
- Deeper understanding of essential properties of symbiosis in nature such as energy and resource sharing and self-regulation, waste conversion, the intertwining of metabolic processes, mutual-adaptation and co-evolution.
- Design of symbiotic interactions between humans and technology at and possibly across the molecular, cell, tissue or organism levels.
- Design of symbiotic interaction of artificial and other (non-human) natural systems such as micro-organisms, for the development of radically new concepts in areas such as artificial photosynthesis, synthetic biology or unconventional computing.

Expected impact

- New hybrid systems and system functionalities that far outperform existing devices when dealing with real-world problems. New theories, methods and algorithms advancing our understanding of natural and hybrid systems.
- Build-up of core competence in the relevant highly interdisciplinary areas narowing the gap between biological sciences, social sciences and technology for building hybrid systems.
- Impacts for future symbiotic technologies, hereby also considering the influences of the new technologies on humans and nature, and methods to promote biocompatible, positive co-evolution and co-adaptation of symbiotic systems.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 25M€

Topic 3: Adaptive Bottom-up Construction

Specific Challenge

This initiative aims to explore techniques and methodologies for bottom-up design, manufacturing, and construction of materials and physical artefacts at various size scales, ranging from the nano-scale (e.g. atomic, molecular, cellular) up to the macro-scale. The long term challenge is to achieve growth or self-assembly of such artefacts, possibly in a scale-invariant way. Inspiration can be found from biological processes like morphogenesis or epigenetics, or in the study of self-organisation, adaptation or evolution in order to design and assemble complex functional materials, artefacts or larger complex structures in cost-effective, reliable and adaptive ways, under relatively affordable conditions (cost and others).

Scope

Proposals are expected to address a combination of the following topics:

- Understand the theoretical aspects of interaction and dynamics among various physical entities and across different physical scales, and their role for achieving certain capabilities, functionalities and properties at aggregate level, such as safety, robustness and the ability to continuously adapt and learn.
- Explore and experiment self-assembly of under-actuated/un-actuated entities that can aggregate or reconfigure in a non-random purposeful manner, integrating strategies of growth, development or evolution to continuously adapt to changing conditions or requirements. This includes new composite, adaptive and reactive materials, bio-materials, and artefacts from nano to macro scales.
- Develop multi-scale models and simulation strategies and experiment methods for bottom-up building of macroscopic structures with complex architectures and characteristic features from nano to macro levels starting from the controlled assembly of selected building blocks to create new functionalities and truly adaptive materials and systems able to respond to their environments.

Expected impact

- Advanced multi-functional self-composing and self-healing materials with excellent structural / mechanical and durability properties that could be used in innovative construction in the future.
- New modular and self-reconfigurable artificial systems of various scales, that can develop, adapt and learn from their environment
- New self-assembled and/or adaptive bio and nano-electronics systems for new forms of computing, biomedical applications (drug delivery, hyperthermia therapy), nanosensors (air security), and others.
- Create artificial biological entities and machines such as molecular assemblers able to sense and manipulate individual molecules and atoms by assembling living things from the bottom up.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 35M€

Topic 4: New possibilities at the nano-bio-chemistry interface

Specific Challenge

This initiatives explores new possibilities at the intersection of nanotechnology, (cell-)biology, (bio-) physics, chemistry, information science and mathematical modelling. This is aimed at new tools and techniques for advancing research (e.g., in neuroscience or biology), at the conception of novel systems, materials (e.g., synthetic or hybrid ones) or at applications such as new implants, drug delivery and in medicine. Where relevant, long-term biocompatibility, longevity and self-sufficiency (e.g., in term of energy) will be taken into account. Strong synergies between the different disciplines are expected for jointly exploring such new technological possibilities and their implications.

Scope

Proposals are expected to address a combination of the following topics:

- Complex biomimetic and biocompatible materials and artefacts with active interfaces to their host, for instance for regeneration of tissue, prosthetic devices or long-lasting implants.
- New techniques for information sharing between devices operating on and within biological substrates.
- New technologies and methodologies for interfacing with biological systems in mechanical, chemical, optical or electrical ways at the level of cells or below and in-vivo, for probing, imaging and/or control.
- Platforms for imaging of, and controlled interaction with biochemical processes far beyond current capabilities of complexity and automation, for instance for artificial cells
- New forms of computation or information storage, implemented directly within nano-bio-chemical substrates.
- Novel approaches to molecular motors or self-propelled molecular objects, artificial cells or micro-organisms.

Expected impact

Projects will contribute in concrete terms to achieving one of the following impacts:

- New therapies, drug screening and drug delivery techniques, diagnosis, prosthetics and implants.
- Multi-functional bio-materials, e.g., for energy generation, storage or harvesting.
- New practices and methodologies from in-vivo imaging and experimentation/research techniques.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 25M€

Topic 5: Knowing, doing and being; cognition beyond problem solving

Specific Challenge

This initiative addresses the interdisciplinary fundamentals of knowing, thinking, doing and being, in close synergy with foundational research on future artificial cognitive systems and robots. It aims at renewing ties between the different disciplines studying knowledge (especially beyond the 'declarative' and action oriented kind of knowledge), cognition (e.g., perception, understanding, learning, action) and related issues (e.g., embodiment, thinking, development, insight, knowledge as a social construct, identity, responsibility, culture…) from various perspectives (e.g., neural, behavioural, social, epistemological), enriching the basis for research that takes artificial cognitive systems beyond the level of dull task execution or problem solving.

Scope

Proposals are expected to address at least one of the following topics:

- New concepts and new generic paradigms in cognitive systems such as new approaches to embodiment, learning, reasoning, autonomy, new theories of agency, knowledge and mind, not limited to prior anthropocentric or bio-mimetic models. Projects will demonstrate these paradigms in robust control of future robotic systems in challenging environments, possibly co-habited with human or other cognitive artefacts. Work will also cover new morphological designs such as nano- and micro-robots, multi-robot systems or unconventional robot shapes.
- Integrative studies of knowing, thinking, doing and being that bridge between low-level (e.g., neuronal, physiological) and high-level (e.g., belief, intention, identity) descriptions. These multidisciplinary studies are expected to go well beyond addressing the perception-action loop, and to tackle issues such as development, experience, understanding, the notion of self, empathy, social belonging and culture. They will develop in close synergy with technological experiments, for instance in robotics, cyber physical settings or large scale simulations that reflect, test and refine insights gained.
- Approaches for understanding the long-term development of individual and social knowledge and identities, especially in highly heterogeneous and dynamic settings (reflecting aspects of e.g., diversity, urban change, migration, social divides, inter-disciplinarity, etc.). Projects are expected to take into account the role of technologies and infrastructures in this, as well as how technology can facilitate societal changes.

Expected impact

- New foundations for future robotics and other artificial cognitive systems with clear progress beyond current capabilities and design concepts.
- A deeper understanding of non-performative aspects of social robotics, development and interaction in mixed human/technological settings.
- Understanding the origins and development of synergies and divides in socio/technical contexts and ways to influence them.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 35M€

Topic 6: Ecological ubiquitous technologies

Specific Challenge

The aim is to explore new ways of avoiding overall environmental impact of technologies, by seeking new holistic paradigms for future mass-technologies, i.e., ubiquitous ones. This should go well beyond incrementally reducing impacts along a single dimension (like energy consumption or use of materials).

Scope

Projects will address at least one of the following topics:

- new conceptual frameworks, core technologies, design and life-cycle approaches that take ecological and sustainability concerns to the limit, including aspects of fitness for purpose (for instance pro-simplicity and slow technologies), use and reuse (includes a socio/economical dimension like from eco-incentives), flexibility of functionality, noise pollution, change over time, reliance on what is available from other devices or from the environment ('functionality scavenging'), serviceability, gentle degradation, toxicity, etc.
- demonstration of ubiquitous solutions with zero-impact along multiple dimensions like energy, material footprint (common instead of rare), locality of resources, social impact from use, end-of-life, quality of use, stresses, etc.
- techniques to measure, model and predict the negative impacts of mass deployment of ubiquitous technologies at various market and time scales, and to quantify their 'eco-scalability' properties and trade-offs.

Expected impact

- New approaches to various ubiquitous technologies (e.g. ICT, nanotechnologies, novel materials, energy technologies) and infrastructures to reduce their potential long-term negative impacts.
- proof-of-concept of functional near to zero negative impact devices that are meant for large scale consumption or deployment
- Increasing awareness of eco-scalability issues and alternative design approaches in industry and society.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 25M€

The second scope bullet can be partially implemented using the prize instrument (will require a separate topic in the WP).

Topic 7: Nanoscale Opto-mechanical devices

Specific Challenge

The various interactions between electromagnetic and mechanical degrees of freedom in nano-scale systems are beginning to be understood, for instance from research in cavity optodynamics, and have been delivering a lot of basic science results, both in the classical and in the quantum regime (e.g. for realising a quantum ground state through optomechanical cooling). This initiatives seeks to explore the technological implications, towards new components and systems that outperform current technologies and that can be envisaged for practical usage.

Scope

Proposals are expected to address a combination of the following topics by an appropriate mix of theory development, simulation and modelling, and proof-of-concept development:

- Achieve practical generation, manipulation, control, and readout of nanomechanical motion in a broad range of frequencies including high frequencies, using electromagnetic radiation rather than electrical signals;
- Build integrated devices containing multiple nanoscale mechanical and optical elements, allowing to play with light and sound in independent as well as in coupled ways.
- Establish new possibilities, for instance to exploit integrated nano-optomechanical devices as optical nonlinearities for silicon photonics, for novel electro-optic interfaces to link nano-electronics with nano-optics, for efficient single-photon IR detection, for small-scale mechanical to electrical/optical energy conversion, the use of optical levitation or of transformational techniques in both the optical and acoustic domains.

Fundamental or applied research on light-matter interaction that does not exploit mechanical degrees of freedom will not be supported under this initiative (covered under LEIT).

Expected impact

Project will contribute in concrete terms to achieving at least one of the following impacts:

- New devices and device functionalities (e.g., metrology, storage, switching) in unexplored frequency domains that outperform existing devices in terms of key performance characteristics.
- New routes to practical feasibility (e.g., at room temperature) from using light instead of electrical signals for manipulating mechanical degrees of freedom, for a variety of purposes.
- New basis for future photonics technology and opto-electro integration at the nano-scale.

Projects will also contribute to build-up of core competence in the new material science and processing techniques needed, which is a crucial asset for European leadership in this area. However, proposals that are only focused on CMOS integration techniques will not be supported (covered under LEIT).

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 20M€

Topic 8: Quantum simulation and networking

Specific Challenge

Devices that exploit quantum phenomena such as superposition and entanglement have the potential to enable radically new technologies. Several promising directions are now well known, for instance in computation, communication, security, metrology, sensing, simulation and material science. However, bridging from the scientific results to concrete engineering technologies has proved difficult. This objective challenges the research community to develop solutions using quantum technology to address real world problems.

Scope

Proposals are expected to address one of the following topics:

- Research and development for quantum simulation to solve a specified problem in a relevant application domain e.g. in the life sciences or material science that is fundamentally beyond the reach of classical computing;
- Research and development of quantum communication beyond point-to-point, i.e., towards a secure, addressable multi-hop and scalable quantum communication network.

Expected impacts

- New technologies and devices, based on quantum properties, with far better performance characteristics than existing devices.
- New tools based on quantum technologies for solving problems in fundamental and applied science
- Build-up of core competences for the wider exploitation of quantum technologies in mainstream engineering.

Instruments, funding level, budget

CP, funding level: 100%, budget 30M€

Topic 9 Global Systems Science (GSS)

Specific Challenge

The challenge is to improve the way scientific knowledge can stimulate, guide, and help evaluate policy and societal responses to global challenges like climate change, financial crisis, pandemics, and global growth of cities. Policy challenges shall be addressed by radically novel tools for producing and delivering scientific knowledge to the policy processes.

GSS will put to full use the abundant data on social, economic, financial, technological, and ecological systems available today. GSS-emphasises system thinking and the need to link with all pertinent actors in the policy process – citizens, policy makers, NGOs… GSS will build on results from, among others, Complex Systems Science, Science of Networks, Mathematics of Big Data, digital social science, etc.

Scope

All projects should address the below points:

- Theoretical foundations of GSS among others understanding systemic risk, crisis, decision making under uncertainty, mathematics of Big Data, algorithmic game theory for use in policy, understanding cascading effects in networks….
- Contributions to solve real world problems in one of the selected policy areas: systemic risk in finance/economics, global problem of cities, global pandemics, global energy systems, climate change impact.
- Policy informatics, i.e. development of ICT tools to generate and better absorb the scientific evidence-base in the policy process and societal dialogue: computing platforms to simulate highly interconnected systems, data platforms and (mathematical) tools for analysis of (often unstructured) data and novel data visualization tools.
- Societal informatics, i.e. development of society/human-centred ICT tools to allow citizens to actively participate in the policy process, to collectively gather data and analyse evidence, and novel methods to better judge and use scientific evidence: e.g. games, gamification, and narratives to convey model results and present data.

Expected impact

Impact will be judged by

- Level to which research proposed is rooted in policy needs and will lead to results that are well beyond the state-of-the-art
- Level of use/uptake of GSS tools and methods in the selected policy areas by societal stakeholder and by policy makers, in particular by EC policy directorates
- Capacity of GSS to help integrate societal responses across policy domains by development of a system-wide integrated evidence base of data and models.

Instruments, funding level, budget: budget XX M€

CP, funding level: 100%, budget 20M€

Topic 10 Coordination and Support Activities

Specific Challenge

The challenge is to make Europe the best place in the world for collaborative research on future and emerging technologies that will renew the basis for future European competitiveness and growth, and that will make a difference for society in the decades to come.

Scope

Activities should address at least one of the following topics:

- stimulating a creative and risk-taking attitude for interdisciplinary research on new foundations for science and technology involving a broad range of actors in research and innovation, including young researchers, entrepreneurs and high-tech SMEs;
- facilitating broad participatory dialogue on emerging sciences and technologies, and their relevance for, and potential impacts on, citizens and society;
- structuring emerging themes and the relevant interdisciplinary communities, expanding well beyond the purely technical realms, at the European level, and exploring synergies and dialogue with related international initiatives;
- identifying and pathfinding promising future directions for science and technology research;
- supporting development and take-up of new research methods and practices, for instance to improve interdisciplinary synergies (including with the social sciences and humanities) or citizen participation;
- enhancing visibility and stimulating appropriation and take-up of FET research towards impact and innovation, especially in ways not anticipated by the projects, for instance using new media and artistic channels or targeting new audiences (e.g. for development);
- assessment of direct and indirect impacts of FET research on the science and technology landscape and its perception by individuals and society;
- coordination with national research agendas, policies and support activities, including support for a call for transnational projects in FET-related topics (ERA-NET) – this bullet possibly to be transferred to a separate topic.

Expected impact

- European thought-leadership on new and emerging technologies with a strong engagement of scientists, citizens, innovators and policy makers.
- Improved long-term innovation potential in Europe both from the abundance of novel ideas and the actors ready to take them forward.
- Improved readiness across Europe to engage in silo-breaking research collaboration and to take up new research and innovation practices.
- Improved understanding of impact mechanisms for long-term science and technology research.

Instruments, funding level, budget: budget XX M€

CSA, funding level: 100%, budget 2,3M€

ERANET, funding level: 100%, budget 10M€

Call FET-Flagships - tackling grand interdisciplinary science and technology challenges

Disclaimer: It should be noted that the contractual aspects and modalities for supporting the Flagships (for example by using a framework partnership agreement) is the subject of on-going discussion with the legal and budgetary services. It is still to be decided if each Flagship would be implemented through a single or multiple projects.

FET Flagships are science-driven, large-scale, multidisciplinary research initiatives oriented towards a unifying goal, aiming at transformational impacts on science and technology and substantial benefits for European competitiveness and society. The goals of such initiatives are visionary and highly ambitious in terms of scientific challenges, resources required and coordinated efforts that require cooperation among a range of disciplines, communities and national, regional and European programmes. FET Flagships are based on partnerships extending over a long period (in the order of 10 years duration) that enable effective coordination of efforts.

The selection of the FET Flagships has been carried out through a competitive process that was initiated after the Commission's communication "Moving the ICT Frontiers"[1]. This has resulted in the final selection of two FET Flagships through a call in 2013 (FP7-ICT-2013), namely Graphene and the Human Brain Project. A collaborative project funded by the EU has been launched for each Flagship in October 2013, with the aim of building up the initiative during a ramp-up phase which lasts until spring 2016.

The **Graphene** FET Flagship constitutes a major effort of Europe to achieve a leading position in a technology with great potential for future industrial applications. It will exploit the properties of Graphene, a revolutionary carbon-based material which has the potential to become the wonder material of the 21st century, finding its way to a vast range of applications from photonics to aircraft wings to artificial retinas. The initial consortium consists of 75 research organisations and industrial partners from 17 EU Member States and Associated Countries, with 136 principal investigators, among which 4 Nobel laureates. Graphene builds on existing national research programmes in the area of Graphene, which show a rapid increasing in funding (in the order of 50M euro in 2012). More details about Graphene and the research roadmap can be found at http://www.graphene-flagship.eu.

The goal of the **Human Brain Project** (HBP) is to combine all existing knowledge about the human brain and to reconstruct it in supercomputer-based models and simulations. The models will offer the prospect of a new understanding of the human brain and its diseases and of completely new computing technologies. The initiative will produce brain-inspired 'neuromorphic' computing systems that could drastically reduce power-consumption and costs. In response to the urgent need in healthcare to combat brain disease and its associated costs to society, HBP will identify new drug targets and simulate personalised treatment. The initial consortium involves 85 European and international institutions from more than 20 countries. More details about HBP and the research roadmap can be found at http://www.humanbrainproject.eu/.

[1] COM(2009) 184

The objectives in this specific challenge aim at ensuring the continuation of the two initiatives after this ramp-up phase. In this new phase, the EU-funded part of each FET Flagship will be implemented through projects, each of which advances the respective initiative towards its goals and objectives. These projects will possibly be funded under a framework partnership agreement, which will establish a relation between the EC and the two consortia that execute the FET Flagships (as detailed below). This work programme contains a call to establish the framework partnership agreement. It also includes a first call for projects using specific grant agreements. Later work programmes will include calls for further projects.

Framework Partnership Agreements

The call for proposals for the framework partnership agreements will select the two consortia with which the EU intends to establish a long term collaboration regarding the implementation of the FET Flagships, Graphene and the Human Brain Project. There is no budget assigned to this call. The partnership agreements are aimed at ensuring a stable and structured environment which will be of interest to all the stakeholders in the FET Flagship (Graphene or HBP). It will set out the general rights and obligations of the parties signing the agreement; however it will not constitute an obligation of the EC to conclude any specific grant agreements. It will extend over the indicative period 2016 to 2023 to guarantee an overall continuity and coherence, corresponding to the projected duration of Graphene and HBP.

The Framework Partnership Agreement will set out the objectives of the initiative, a roadmap of actions to be taken over the full initiative (in the order of 10 years), a planning of the requirements and usage of resources, as well as performance indicators that identify the results and the progress of the initiative at any point in time. The FPA will also specify the modalities regarding specific grant agreements.

Specific Grant Agreements

For each Flagship, a first call for specific projects is published simultaneously with the above call for the establishment of a framework partnership agreement. The call for specific projects invites for proposals from the partners of the framework partnership agreement. Each selected proposal will be implemented through a specific grant agreement.

Topic 1: Graphene Framework Partnership Agreement

The objective is to identify a consortium which has the capacity to lead the Graphene FET Flagship towards its goals and establish a framework partnership agreement with this consortium, as detailed above.

Consortia responding to the call may include research institutes, universities, industry, SMEs as well as other organisations that can play a role in the realisation of the Graphene FET Flagship. They should provide scientific leadership to a common European effort, as well as carrying out key parts of the research activities.

Scope

The Framework Partnership Agreement will set out objectives of the initiative, a broad roadmap of actions to be taken over the full initiative (in the order of 10 years), a planning of the requirements and usage of resources, as well as performance indicators that identify the results and the progress of the initiative. The FPA will also specify the modalities regarding specific grant agreements.

The applicant consortia should demonstrate the capacity to:

- Carry out research activities that fulfil the aspirations of the FET Flagship
- Foster activities in the areas of education, innovation, dissemination, ethics and society
- Create synergies with related activities taking place at regional, national, transnational and global level

Expected impact

- Stable and structured environment for the benefit of the realisation of the Flagship
- Overall continuity and coherency in the execution of the Flagship

Instruments, funding level, budget:

Framework Partnership Agreement

(no funding)

Timing

Call 2015

Topic 2: Graphene FET Flagship Specific Projects

The objective is to support the implementation of the Graphene FET Flagship through specific projects in the context of the framework partnership agreement detailed above.

Proposals should progress the Graphene FET Flagship accordance with the defined roadmap. This includes the complete range of scientific and technological challenges involved, e.g. development and exploration of material aspects of Graphene, health and environmental issues, fundamental science for Graphene , the production of Graphene or Graphene film, high-frequency electronics, optoelectronics, spintronics, sensing, flexible electronics, energy applications and nanocomposites. Other 2D materials may also be considered.

Scope

a) A core project that takes a coordinating role within the initiative, possibly including supporting the functioning of an organisation which implements the Flagship.

This project should ensure in particular (i) actions to ensure the overall continuity and coherence in the management of the Flagship initiative, including the coordination of the set of complementary EU funded projects, (ii) the governance of the Graphene FET Flagship initiative, and (iii) the collaboration of the programme with other initiatives or programmes at regional, national, transnational or global level. This includes in particular collaboration with related ERANET project(s). The project may also address research topics such as material aspects of Graphene, environmental issues, fundamental science, etc.

Proposals should describe how they will continue the activities carried out during the ramp-up phase with the relevant disciplines and stakeholders, how resources brought together in the ramp-up phase will be used and/or strengthened, and how it will provide efficient coordination under strong scientific leadership. Proposals should also detail activities in areas such as education, innovation, dissemination, ethics and societal aspects.

b) Further projects that complement the Core Project ("Complementary Projects") by focussing on specific research areas. Possible topics include the use of Graphene in flexible electronics, energy applications, nanocomposites, etc. Proposals should demonstrate how they draw on and contribute to the activities set in place by the Flagship initiative.

Expected impact

- Contribution to the strategic goal of the Graphene FET Flagship and the realisation of its research agenda.
- transformational impact on science and technology and substantial benefits for the European economy and society in the area of Graphene and other 2D materials
- European leadership in the area of Graphene and other 2D materials
- strengthening of the interfaces between ICT, material science and other disciplines

Instruments, funding level, budget: budget XX M€

CP

Funding level: 100%, budget: [50-85M€]*

* Indicative figure. Exact modalities for committing the necessary 50M€/year (on average) are still being discussed.

Timing

Call 2015

Topic 3: Human Brain Project Framework Partnership Agreement

The objective is to identify a consortium which has the capacity to lead the Human Brain Project (HBP) FET Flagship towards its goals and establish a framework partnership agreement with this consortium, as detailed above.

Consortia responding to the call may include research institutes, universities, industry, SMEs as well as other organisations that can play a role in the realisation of the HBP FET Flagship. They should provide scientific leadership to a common European effort, as well as carrying out key parts of the research activities.

Scope

The Framework Partnership Agreement will set out objectives of the initiative, a broad roadmap of actions to be taken over the full initiative (in the order of 10 years), a planning of the requirements and usage of resources, as well as performance indicators that identify the results and the progress of the initiative. The FPA will also specify the modalities regarding specific grant agreements.

The applicant consortia should demonstrate the capacity to:

- Carry out research activities that fulfil the aspirations of the FET Flagship
- Foster activities in the areas of education, innovation, dissemination, ethics and society
- Create synergies with related activities taking place at regional, national, transnational and global level

Expected impact

- Stable and structured environment for the benefit of the realisation of the Flagship
- Overall continuity and coherency in the execution of the Flagship

Instruments, funding level, budget:

Framework Partnership Agreement

(no funding)

Timing

Call 2015

Topic 4: HBP FET Flagship Specific Projects

The objective is to support the implementation of the HBP FET Flagship through specific projects in the context of the framework partnership agreement detailed above.

Proposals should progress the HBP FET Flagship in accordance with the defined roadmap. This includes the complete range of scientific and technological challenges involved, e.g. development of the neuroscience platform; elaboration of an internet accessible 3D mouse brain atlas and encyclopaedia; federation of data and knowledge on the human brain; mathematical and theoretical foundations of brain research; further development of the models, simulators and building tools for the brain simulation platform; further development of the HPC platform; maintenance of the 4 other HBP platforms' environment and architecture; further development of the Medical Informatics Platform; federation of clinical researchers, hospitals and industries; data collection regarding the multi-level organisation of the mouse and human brains; neuromorphic Computing; neuro-robotics; future neuroscience applications and future medicine applications.

Scope

a) A core project that takes a coordinating role within the initiative, possibly including supporting the functioning of an organisation which implements the Flagship.

This project should ensure in particular (i) actions to ensure the overall continuity and coherence in the management of the Flagship initiative, including the coordination of the set of complementary EU funded projects, (ii) the governance of the Graphene FET Flagship initiative, and (iii) the collaboration of the programme with other initiatives or programmes at regional, national, transnational or global level. This includes in particular collaboration with related ERANET project(s). The project may also address research topics such as the neuroscience platform, mathematical and theoretical foundations, etc.

Proposals should describe how they will continue the activities carried out during the ramp-up phase with the relevant disciplines and stakeholders, how resources brought together in the ramp-up phase will be used and/or strengthened, and how it will provide efficient coordination under strong scientific leadership. Proposals should also detail activities in areas such as education, innovation, dissemination, ethics and societal aspects.

b) Further projects that complement the Core Project ("Complementary Projects”) by focussing on specific research areas. Possible topics include neuromorphic Computing, neuro-robotics, future neuroscience applications, future medicine applications, etc. Proposals should demonstrate how they draw on and contribute to the activities set in place by the Flagship initiative.

Expected impact

- Contribution to the strategic goal of the HBP FET Flagship and the realisation of its research agenda
- transformational impact on science and technology and substantial benefits for the European economy and society in the area of neuroscience and neuromorphic computing
- European leadership in the area of neuroscience and neuromorphic computing
- strengthening of the interfaces between ICT, neuroscience and other disciplines

Instruments, funding level, budget: budget XX M€

CP

Funding level: 100%, budget: [50-85M€]*

* Indicative figure. Exact modalities for committing the necessary 50M€/year (on average) are still being discussed.

Timing

Call 2015

Topic 5: Policy environment for FET Flagships

Specific Challenge

The overall challenge is to foster a common European effort through activities involving national, regional as well as global research programmes, and contributing dissemination efforts, impact assessments and other actions in order to support and strengthen the FET Flagship initiatives. This also extends to enhancing the interplay between FET Flagships and other Union policies and the transfer of technologies towards exploitation. Any proposal has to demonstrate that it adds value beyond the activities implemented in each the FET Flagships Graphene and HBP.

Scope

a) An ERA-NET between national and/or regional funding agencies aiming at supporting the FET Flagships Graphene and Human Brain Project. Proposals should build on the FET Flagship ERA-NET selected in 2013 (call FP7-ICT-2013-11) and should describe how they will coordinate national and/or regional efforts with the common research roadmap. Proposals should include a call for transnational projects to support the two flagship initiatives.

b) Proposals supporting one or more of the following actions:

- The dissemination of information on the FET Flagship initiatives and their results
- Supporting collaboration between the FET Flagships and international programmes

- Assessing the impacts of FET Flagship initiatives, including through metrics and indicators
- Analysing market potential and supporting technology transfer
- Collection of information need for policy making, e.g. through consultation actions and surveys

Expected impact

a)

- enhanced complementarities and synergies of regional, national and European research programmes and initiatives
- networking between national funding agencies and creation of a discussion forum for matters of interest related to the two FET Flagships
- strengthening of the two flagship initiatives through transnational projects that complement the core and complementary projects in the areas of Graphene and Human Brain Project
- reduction of the fragmentation of the European Research Area (ERA)

b)

- enhanced flow of information from FET Flagships towards in particular policy makers and the wider public
- enhanced complementarities between FET Flagships and related initiatives, in particular those at a global level
- improved understanding of impacts of FET Flagships on science, technology, economy and society
- Better use of opportunities for technology transfer, innovation and exploitation
- Improved availability of information need for policy making

Instruments, funding level, budget: budget XX M€

a): ERA-NET

b): CSA

Funding level: 100%, budget a) 10M€ and b)2M€

Timing

a) Call 2015

b) Call 2014

Call Computer Science: Towards Exascale High Performance Computing

High Performance Computing (HPC) is crucial asset for the EU's innovation capacity and is of strategic importance to the EU's scientific and industrial capabilities, as well as to its citizens. The European strategy in HPC aims at ensuring European leadership in the supply and use of HPC systems and services by 2020. The implementation of this HPC strategy in Horizon 2020 combines three elements: (a) developing the next generation of HPC towards exascale; (b) providing access to the best supercomputing facilities and services; and (c) achieving excellence in HPC applications. A Public Private Partnership (PPP) with the European Technology Platform in HPC (ETP4HPC) (establishment expected by the end of 2013) will provide the framework for the implementation of elements (a) and (c) of the HPC strategy, based on the Strategy Research Agenda (SRA) of the ETP4HPC.

The focus of this call is on element (a) of the HPC strategy and the research and development for advanced applications and co-design of element (c). The support for elements (b) and the infrastructure aspects of HPC applications in element (c) of the strategy will be provided by the e-Infrastructure part of the Excellent Science pillar.

This calls aims at leveraging the existing European strengths for building the next generation of extreme performance computing by 2020 and taking advantage of the new opportunities created from the transition from peta to exascale computing.

The goal is to achieve world-class extreme scale computing capabilities in platforms, technologies and applications, while ensuring that a broad spectrum of mid-range and entry-level HPC systems can be built using the targeted technologies in order to maximize the exploitation potential and develop a sustainable European HPC Ecosystem.

This activity will be coordinated with complementary work in LEIT/Advanced Computing, LEIT/Photonics, and ECSEL (Electronic Components and Systems for European) that will develop basic system technology that is relevant to the needs of exascale computing (e.g. microprocessors, photonics components, interconnects or system software, programming environments for critical/real time systems, etc.).

Activities under this call have been identified for a total budget of 148M€. Considering the latest figures of the budgetary programming, a total amount of [98-140M€] is foreseen for 2014 and 2015. The exact budget available will depend on the budgetary needs for implementing the FET Flagships, whose contractual model is still under discussion with the legal and budgetary services. Computer Science activities which, in the end, will not be among the priorities for funding in 2014 or 2015, may be taken up in future workprogrammes.

Topic 1: HPC Core Technologies with Application Validation

Specific Challenge

The aim is to develop extreme-scale HPC systems as well as extremely efficient mid-range and entry-level HPC systems that are balanced at all levels (including e.g. CPU capabilities, memory bandwidth, interconnect performance, I/O performance) and their design is driven and validated by ambitious applications including extreme-data applications.

Scope

Proposals should target the full range of HPC core technologies (processors, memory, interconnect and storage) and their integration into HPC systems. Projects should have a holistic, multi-domain optimisation and co-design approach driven by ambitious applications and aiming at radical overall system performance improvement while at the same time addressing the following issues:

- Energy efficiency at every level of the HPC system architecture. Gains in energy efficiency achieved by closer integration of the system components should be investigated. Energy-aware performance metrics should be employed providing a holistic way of understanding power consumption across the full HPC system architecture.
- Balance of compute, I/O and storage performance covering all the elements of the I/O stack from middleware to data storage devices. The aim is to reduce the gap between the performance of the storage and the performance of the compute subsystem. Special attention should be given to big-data applications.
- Scalability, concurrency and locality in the presence of millions of cores. The overall system design should facilitate application scalability and radically improve data locality.
- Resilience of extreme-scale HPC systems with huge component numbers.

Expected impact

- Strengthened European research and industrial leadership in core HPC technologies
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda
- Development of competitive European technology for building a wide range of extreme performance computing systems
- European industry and research at the forefront of the development of energy-efficient high performance computing platforms
- Platforms with clear and highly ambitious scalability targets towards exascale

Instruments, funding level, budget: budget XX M€

- CP, Funding level: 100%, Budget: 60 million

Timing

2014

Topic 2: Programming Environments for Extreme Parallelism

Specific Challenge

Programming methodologies, environments and tools for extremely-parallel programming, enhancing code portability and quality, reduce software development and maintenance costs while taking into account extreme-data requirements, energy consumption, fault tolerance and legacy codes.

Scope

Focus is on the following areas:

- Programming methodologies, environments and tools: development of new programming models, domain-specific languages and programming paradigms to facilitate the effective exploitation of advanced computing systems from large scale systems to extreme scale systems. The programming and performance analysis tools should support the effective utilisation of the full system capabilities by applications in particular for extreme parallelism and extreme data. Special attention should be given to support for legacy code, support for heterogeneous systems and energy consumption.
- APIs for Future Extreme Scale Systems: New interfaces and APIs for extreme-scale systems ensuring interoperability. Communication and dissemination activities towards relevant standards bodies and research programmes are fundamental components of the work. International cooperation aspects should be addressed if necessary in order to maximise the impact of the results.

Expected impact

- Strengthened European research and industrial leadership in extreme-scale programming environments
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda
- Development of competitive European technology for programming a wide range of extreme performance computing systems

- Impact on standards bodies and other relevant international research programmes and frameworks

Instruments, funding level, budget: budget XX M€

- CP, Funding level: 100%, Budget: 29 million

Timing

2014

Topic 3: Mathematics and Algorithms for Extreme Parallelism

Specific Challenge

Rethink the mathematics and reinvent the algorithms for extreme scale parallelism. The target should be ultra-scalable algorithms with quantifiable performance for existing or visionary applications including data-intensive and extreme data applications.

Scope

Work should include energy-aware algorithms and take into account the projected characteristics of exascale-class systems based on low-power computing platforms. Specific issues are quantification of uncertainty, multiscale and extreme data. Software engineering for extreme parallelism should be addressed. Open source development is privileged.

Expected impact

- Strengthened European research and industrial leadership in mathematics and algorithms for extreme-scale systems
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda
- Development of a competitive European position in extreme parallelism and extreme data applications
- European excellence in mathematics and algorithms for extreme parallelism

Instruments, funding level, budget: budget XX M€

- CP, Funding level: 100%, Budget: 10 million

Timing

2014

Topic 4: HPC Ecosystem Development

Scope

a) ***Coordination of the HPC strategy***: The aim is to support the implementation of a common European HPC strategy through coordination of the activities of stakeholders such as the European Technology Platform for HPC (ETP4HPC), PRACE, application owners and users (including emerging HPC applications), the European exascale computing research community, the open source HPC community, etc. The work will include activities for promoting a joint community structuring and synchronisation as well as other non-research activities such as the development of Strategic Research Agenda for High Performance Computing (including the roadmap for exascale in Europe), the link to the H2020 Societal Challenges, the mapping and analysis of related national and international R&I programmes/activities/research agendas in HPC towards exascale, coordination with and participation in relevant international activities, etc. Specific actions for attracting young talent into HPC should be included.

b) ***Excellence in High Performance Computer Architecture*****:** The aim is to prepare the establishment of a virtual distributed European Research Centre in High Performance Computer Architecture. Excellence of participating teams is of crucial importance. Specific long-term research topics should be put forward as well as ways of performing research in these topics and harmonising computer architecture curricula. Activities to strengthen links to venture capital and promoting entrepreneurship should be included.

Expected impact

- Strengthened European research and industrial leadership in the supply, operation and use of HPC systems;
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda
- Development of competitive European technology for building and exploiting a wide range of next-generation extreme performance computing systems.
- Structuring the efforts of stakeholders for implementing the European HPC strategy
- Reinforced cooperation in international endeavours on HPC software and systems towards exascale
- European Excellence in High Performance Computer Architecture

Instruments, funding level, budget: budget XX M€

- a) CSA, Funding level: 100%, Budget: 2.5 million

- b) CSA, Funding level: 100%, Budget: 1.5 million

Timing

2014

Topic 5: System Software for Extreme-Scale Systems

Specific Challenge

Efficient, flexible, robust and scalable system software to effectively manage extreme-scale systems supporting a wide range of workloads and taking into account extreme parallelism, extreme data, energy consumption, resilience as well as heterogeneous computational, memory and storage resources. Open source development is privileged.

Scope

Proposals should focus on methodologies and tools for extreme-scale systems in the following areas:

- Operating System
- Interconnect management
- Cluster management
- Resource management

Expected impact

- Strengthened European research and industrial leadership in the operation and use of HPC systems
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda
- Development of competitive European technology in system software for extreme scale systems
- European excellence in exascale-class operating systems and runtimes

Instruments, funding level, budget: budget XX M€

- CP, Funding level: 100%, Budget: 23 million

Timing

2015

Topic 6: Emerging HPC Workloads

Specific Challenge

The work should address the impact of emerging HPC workloads and applications on the full HPC stack (tools, programming models, algorithms, user interfaces, system software, hardware), taking into account that different usage and delivery models target different users, with widely different backgrounds and competencies.

Scope

Research should focus in the following areas:

- "HPC for Extreme Data workloads" addressing Extreme Data workload characterizations and their impact in processor designs, run-time, OS and programming languages and tools; new methods in data migration and storage; highly dynamic, uncertain and streaming of data of unprecedented sizes and the impact in algorithms and systems; data standards enabling cross-disciplinary data processing and interoperability based on innovative data services (e.g. storage access, indexing, metadata, etc.)
- "HPC as an instrument" to achieve special goals that requires dedicated and specialized resources, e.g. catastrophe response, real time and interactive HPC data-driven use, etc.
- "Industrial Usage of HPC as a commodity" addressing the deployment and consumption of HPC solutions and results at a wider scale extending the HPC user base.

Expected impact

- Strengthened European research and industrial leadership in HPC systems through early identification of emerging requirements
- Contribution to the realisation of the ETP4HPC Strategic Research Agenda
- Strengthened European industry and research in the supply, operation and use of HPC systems;
- Improved European competitiveness in emerging HPC applications and usage models

Instruments, funding level, budget: budget XX M€

CP, Funding level: 100%, Budget: 20 million

Timing

2015

Topic 7: Targeted Opening with Russia

Specific Challenge

The emphasis should be on mathematics and algorithmic collaboration with Russia as well as on common HPC programming interfaces and tools interoperability.

Scope

Research should be in the following areas:

- New mathematical and algorithmic approaches for existing or emerging applications for extreme scale systems
- Programming models and APIs for extreme scale systems
- Development of tools for extreme scale systems

Expected impact

- Alignment of research in mathematics and algorithms for extreme parallelism and extreme data with Russia
- HPC tools interoperability with Russia

Instruments, funding level, budget: budget XX M€

CP, Funding level: 100%, Budget: 2 million

Timing

2014 or 2015

B. OTHER ACTIONS (not subject to calls for proposals)

The International Human Frontier Science Programme Organisation

Pro memori, pending decision (may be funded by other sources such as MSCA, ERC,…).

An annual subscription to the International Human Frontier Science Programme Organisation (HFSPO)[2] will be made. This will allow the EU (representing the EU27 – EU-G4) Member States to fully benefit from the Human Frontier Science Programme (HFSP) and provide increased visibility for European research. According to the conclusions of the Intergovernmental Conference held on 11 June 2013 the Community subscriptions for 2014 and 2015 will be EUR 4,847,281 and EUR 4,944,165, respectively.

C. PERSPECTIVES FOR 2016

- FET-Open will be continued throughout the duration of H2020.
- FET proactive initiatives and Computer Science activities that are not prioritised for funding under the current workprogramme will be considered for the subsequent workprogramme under H2020 as of 2016.
- For FET-Flagships, future workprogrammes under H2020 will aim to support the evolving research and innovation strategies of the Graphene and HBP FET Flagships and the realisation of their respective research agendas.
- Further workprogrammes under H2020 will aim to support the evolving HPC strategy, based on the Strategy Research Agenda (SRA) of the ETP4HPC.

[2] The European Community is a Management Support Party (member) of the HFSP Organisation (HFSPO) and has funded HFSP under previous Framework Programmes

2 Research Infrastructures

A. CALLS

Specific Challenge 2.1: Development, deployment and operation of e-infrastructures

This Specific Challenge supports the development and deployment of e- infrastructures that will make every European researcher digital, helping Europe lead a global movement towards open, interconnected, data-driven and computer-intensive science and engineering. The topics address data-centric science and engineering, computational infrastructure, research and education networks such as GÉANT, and virtual research communities and environments.

e-Infrastructure is expected to support all other areas of Horizon 2020, including Societal Challenges, LEIT, FET and ESFRI, both in the general sense of providing the infrastructure needed for research and innovation in these areas, as well in the specific sense of production-level e-infrastructures servicing the computing and data needs of any project in the framework programme. Acquisition of ICT systems should be therefore avoided in H2020 projects to the extent that they can be adequately serviced by e-infrastructures.

Innovation is mainstreamed in all topics that are relevant. This has several facets, e.g. opening the use of e-infrastructure to industry and SMEs as in Topic 3; driving innovation by the very advanced needs of e-infrastructure as in the open research activity under GÉANT (Topic 4); building partnerships between industry suppliers and e-infrastructure providers as in the case of data and compute clouds (Topic 6) or the PPP on HPC; and systematising technology transfer from e-infrastructures to the market by launching a dedicated support action (see Topic 2).

This work programme gives strong emphasis to the *development of human capital* especially in areas that suffer from shortages in supply or where new skills and professions need to emerge, e.g. in computational sciences, e-infrastructure operation or "data science". In addition to Topic 11 that is dedicated to education, training and skills, Topics 5 (Community Data Services), 2 (Centres of Excellence for computing applications), 3 (HPC Competence Centres for SMEs) and 9 (virtual research environments) are expected to develop strong activities in human capital.

Software cuts across almost all Topics with some sub-topics being exclusively devoted to software, e.g. 2 on computing application codes or 6(7) on database software for extremely large datasets. All software to be developed under the programme needs to be open source with a "cc by" type of license, unless it can be well justified that it should be otherwise. Finding ways to mix commercial software from ISVs within service offerings is encouraged.

International cooperation is necessary to ensure that EU e-infrastructures are interoperable with those of 3rd countries and reach out to resources, facilities and human talent wherever these are located. International cooperation is therefore encouraged "bottom up", i.e. in any project proposal where proposers think that international partners should be involved. Furthermore, coordination and support actions are invited under Topic 12, targeted cooperation with Russia is foreseen in Topic 2, a coordinated Call with Brazil is foreseen in Topic 3bis and support to the Research Data Alliance is envisaged in Topic 8.

Governance and business models for e-infrastructures should aim at ensuring that a minimum level of service is available throughout the EU in order to avoid a *digital divide* between developed and less developed regions. The continuing use of structural funds from ERDF to build capacities and e-infrastructure at national level is greatly encouraged.

Clear business plans for *financial sustainability* are expected by all proposals that develop or offer services. Business models may greatly vary depending on the service in question, from "government pays" to subscription-based, to "user-pays" or per-use payments. Income by national or European projects that want to buy services, or income by industry, is relevant in many cases and should be enabled. Sustainability of long term data preservation is a major challenge and difficult to contemplate without committed institutional funding. Partnering with the private sector is welcomed where appropriate.

Projects should share basic operations services such as accounting, monitoring, service registry, user support, incident management etc.; such services should not be (re)developed when they already exist unless sound justification is provided in the project proposal. Furthermore, all services developed by projects should be made discoverable, e.g. by listing in searchable catalogues or registries of digital research services on offer, including metadata for describing and accessing the service.

All proposals are requested to suggest clear metrics (key performance indicators) for monitoring their results and impact.

CHALLENGE 1 – High Performance Computing (HPC)

This challenge responds to the priority of implementing the e-infrastructure part of the EU strategy on High Performance Computing (HPC), in particular the provision of Tier-0 services, the infrastructure for computing applications (Centres of Excellence) and a network of HPC Competence Centres for SMEs. This is reflected in Topics 1, 2 and 3. A Public-Private Partnership (PPP) in HPC (establishment expected by the end of 2013) will provide the framework for the implementation of the HPC strategy, addressing in particular the Centres of Excellence in computing applications and the development of HPC technologies towards exascale computing (supported in the FET part of the Excellent Science pillar).

Topic 1: Pan-European HPC infrastructure and services

Specific Challenge

The overall challenge is to pool and rationalise HPC resources in Europe in order to create a world-class infrastructure, and to provide state-of-the-art services and access to this infrastructure to users, independently of location.

This topic contributes to the implementation of the EU strategy on High Performance Computing (HPC), in particular to provide access to the best supercomputing facilities and services for both industry and academia, and complements the activities of the Public-Private Partnership (PPP) in HPC to implement the HPC strategy.

Scope

Proposals should address the following actions:

(1) Provide a seamless and efficient Tier-0 service to users Europe-wide based on promoting research excellence and innovation; this includes peer-review procedures for the allocation of computing time; transparent billing; and specific services adapted to the needs of ESFRI projects, Horizon 2020 projects/programmes, large institutional users or industry. Tier-0 are those services provided at pan-European level with machines devoted to the pan-European infrastructure more than 50% and having a minimal performance to be periodically defined by the consortium;

(2) Carry out activities (training, service prototyping, software development etc.) that build on national HPC capabilities (Tier-1) and are necessary to support Tier-0 services or a functional European HPC ecosystem;

(3) Ensure openness to new user communities and new applications; promote industrial take-up of HPC services in particular by SMEs;

(4) Implement inclusive and equitable governance and a flexible business model to ensure long term financial sustainability; the business model should allow financial or in-kind contributions by research projects/programmes, institutions, industry and regions or countries;, based on an auditable cost model for the operation of HPC Centres providing European services with different financing sources;

(5) Develop and maintain the strategy for the deployment of a rich HPC ecosystem with different machine architectures - evolving towards exascale - including the implementation roadmap at EU

and national level and the specifications and technical requirements for a varied set of Tier-0 systems ensuring a broad coverage of user needs;

(6) Working in synergy with:

- the Centres of Excellence (see next Topic – CoEs for computing applications);

- the European Technology Platform for HPC; the pan-European HPC infrastructure will provide technical specifications to guide the research activities for future exascale prototypes and systems;

(7) Design and execute training and skills development programmes tailored to the needs of research in academia and industry in order to stay at the forefront of scientific breakthroughs, as well as introduction of scientific computing and HPC in academic curricula;

(8) Develop an international cooperation policy and associated activities;

The infrastructure should provide core and basic services in coordination with other e-infrastructure providers to promote interoperability and a seamless user experience, in accordance with Topic 4. Interworking with other computing infrastructures such as clouds and grids should be ensured.

Expected impact

- Improved services and procedures to access the infrastructure and the common services, and improved allocation schemes to ensure openness to new user communities and applications

- Increased amount of computing cycles available to researchers at European level through user-friendly and efficient procedures, helping Europe to stay at the forefront of scientific breakthroughs and innovation;

- Increased number of industrial organisations (in particular SMEs), EU projects and institutional users benefiting from access to services including training in HPC;

- Increased investment in HPC infrastructure in Europe (national, regional and EU);

- Long term financial sustainability through flexible business models and inclusive governance;

- Linking demand and supply in the European HPC ecosystem, with improved collaboration of the procurers with technology developers and suppliers to foster innovation;

Instruments, funding level, budget:

CP; Funding level: 100%, Budget: 15 M€

Timing

Call 2014

Topic 2: Centres of Excellence for computing applications

Specific Challenge

The overall challenge is to establish a limited number of Centres of Excellence (CoE) for the application of HPC in scientific and industrial domains, focusing on scientific, industrial or societal challenges. These Centres will develop a culture of excellence, both scientific and industrial, placing computational science at the centre of scientific discovery and industrial competitiveness. CoEs may be "thematic", addressing specific application domains such as medicine, life science or energy; "transversal" on computational science (e.g. algorithms, analytics, numerical methods etc.); or "challenge-driven", addressing societal or industrial challenges (e.g. ageing, climate change, clean transport etc.); or a combination of these types.

This topic will be carried out in the frame of the Public-Private Partnership (PPP) in HPC, contributing to the implementation of the EU strategy on High Performance Computing (HPC), in particular to achieving excellence in HPC application delivery and use.

Scope

The CoE's are expected to be:

(1) integrated: encompassing not only HPC software but also relevant aspects of hardware, data storage, connectivity, security, etc.;

(2) multidisciplinary: with domain expertise co-located alongside HPC system, software and algorithm expertise; and

(3) user-driven, with the application users and owners playing a decisive role in governance;

(4) distributed with a possible central hub, federating capabilities around Europe, exploiting available competences, and ensuring synergies with national/local programmes;

Proposals for CoEs will address:

- Provision of services such as: developing, optimising (including if needed re-design) and scaling towards peta and exascale computing; testing, validating and maintaining HPC application codes and managing the associated data; quality assurance; co-design of hardware, software and codes; consultancy to industry and SMEs; research in HPC applications; and addressing the skills gap in computational science.
- Working in synergy with- the European Technology Platform for HPC and with the pan-European HPC infrastructure, including by identifying suitable applications for co-design activities relevant to the development of HPC technologies towards exa-scale
- Sustainability embracing a wide range of service models and obtain funding from a mixture of sources, including through sponsorship by industry. Clear business plans need to be presented in the proposal.

- Creating communities around specific codes that impact the target sectors, involving ISVs where appropriate, and exchange of best practices in particular for SMEs.
- A governance structure driven by the needs of the users. Commercial management expertise will be needed along with technical expertise to manage industry clients and supply chains.

8-10 CoEs are expected to be funded in this Topic in order to test the concept. A follow up Call is expected in the future that will build on the results and lessons learnt from the present Call.

International co-operation is encouraged where there are clear mutual benefits and the partners have the relevant HPC capacity. Participation by Russian partners will be preferentially evaluated.

Expected impact

Improved access to computing applications and expertise that enables researchers and industry to be more productive, leading to scientific excellence;

Improved competitiveness for companies and SMEs through access to CoE expertise and services;

European leadership in applications that address societal challenges or are important for industrial applications through better code performance and better code maintenance and availability;

More scientists and engineers trained in the use of computational methods and optimisation of applications.

Instruments, funding level, budget

CP; Funding level: 100%, Budget: 22 M€ from the 2014 budget and EUR 15 M€ from the 2015 budget for projects selected from a reserve list drafted in 2014 but not funded.

Timing

Call 2014

Topic 3: Network of HPC Competence Centres for SMEs

Specific Challenge

[this will be part of the Innovation challenge jointly with RTD.B3]

The aim is to support one network of HPC competence centres to promote services anywhere in Europe and the dissemination of best practice in HPC use for SMEs.

This topic contributes to the implementation of the European HPC strategy, in particular to foster the use of HPC by SMEs. HPC competence centres have been set up in some Member States to facilitate access of industry and in particular SMEs to HPC services.

The network will address coordination, outreach, training and the exchange of best practice and software components between the participating national and regional competence centres, complementing their current activities and services with actions of a clear European added-value that cannot be performed at local level. Direct support to adoption of HPC by specific SMEs is not expected to be carried out by this network. This action will be complementary to the actions carried out in the ICT Work Programme 2014-2015 in the Specific call for manufacturing, (FoF) ICT Innovation for Manufacturing SMEs (I4MS).

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Scope

Proposals should address at least the following actions:

(1) networking of existing HPC competence centres providing HPC services to exchange best practices and pool technical, expertise or business resources;

(2) awareness raising and visibility activities of the benefits of HPC for SMEs;

(3) identification of the pool of SMEs and available expertise in the different business areas at European level, and mechanisms to match SME needs and the available expertise;

(4) training (in synergy with the activities carried out by PRACE and other organisations providing specific training for SMEs in HPC);

Expected impact

- The Network of HPC Competence Centres will be a reference for best practices for supporting SME competitiveness through access to HPC;

- Increased number of SMEs that are aware of the potential and/or become users of HPC;

- Establishment of a focal point at European level for expertise in HPC use by SMEs;

- Increase in the size of the HPC market (services, ISVs, computers).

Instruments, funding level, budget:

CSA; funding level: 100%, Budget: 2 M€

Timing

Call 2014

Topic 3bis: Collaboration with Brazil - High Performance Computing (HPC) and Advanced Computing

Specific Challenge

[See LEIT 1.A.10.2.B]

CHALLENGE 2 - CONNECTIVITY

This challenge contributes to implementing the recommendations of the GÉANT Expert Group aiming at developing GÉANT as the European communications commons and as a global hub for research, innovation and education.

Topic 4: Research and Education Networking – GÉANT

Specific Challenge

The overall challenge is to further develop and maintain GÉANT as the European communications commons that supports the acceleration of compute- and data-intensive collaborative research and education through innovative services, operational excellence and global reach.

Scope

GÉANT will:

(1) Provide cost-effective and reliable services for very high-speed connectivity, identity inter-federation, resource virtualisation, mobility and trust in order to support knowledge communities, ensuring digital continuum of services to users anywhere in the EU.

(2) Enable talent anywhere in the world to cooperate with their peers in Europe through interoperable services, as well as extend beyond the traditional researcher base into wider public services where appropriate.

(3) Advance the state-of-the-art of the communication commons by constant development of both innovative multi-domain services and their use, and by translating this innovation into a competitive European ICT sector, for instance through specific open calls, pre-commercial procurement; or public-private partnerships between industry, academia and user communities to develop, experiment with or validate novel technologies in the telecom and internet domains; and exploring with industry possibilities of service provisioning through aggregation of demand and brokerage, new business models, best practices or coordination.

(4) Means to cope with the changing environment by structuring the governance of the European communications commons for accountability, measurability, transparency and sustainability; focusing on flexible services geared towards users; stimulating development of GÉANT's human capital (including training and exchange schemes); and aligning the regulatory, standardisation and policy framework to enable full exploitation of the communications commons.

GÉANT should provide core and basic operation services including identity federation, in coordination with other e-infrastructure providers to promote interoperability and a seamless user experience.

Expected impact

By 2020 GÉANT is the European communications commons where talent anywhere is able to collaborate with their peers around the world and have instantaneous and unlimited access to any resource for knowledge creation, innovation and learning, unconstrained by the barriers of the pre-digital and the present digital world. Europe is the hub for research networking excellence world-wide. The GÉANT governance is able to cope with the changing environment and the GÉANT community collaborates intensively with European industry and academia, produces innovative solutions grounded on business needs and drives the internet evolution.

Instruments, funding level, budget: budget 25 M€ for 2015.

This topic is expected to be carried out within a Framework Partnership Agreement (FPA) implemented through CP.

Given the specific nature of this topic, the proposal shall be submitted solely by legal entities operating the NRENs or legal entities created by the NRENs to contribute to the deployment of connectivity and services on a pan-European scale (e.g. DANTE, TERENA, NORDUnet).

Funding level: Maximum 100% re-imbursement rate for all costs.

Budget: 25 M€

Timing

Call 2015

CHALLENGE 3 - DATA

Challenge 3 supports the e-infrastructure needed to ride the wave of "big data", on the basis of the policy orientations provided by the High-Level Group on Scientific Data3 and the "framework for action"4 published in March 2013. This is implemented through Topics 5 to 8. Topic 7 supports also the implementation of the e-infrastructure required for Open Access as defined in the Communication on Scientific Information [ref].

Topic 5: Community data services

Specific Challenge

The challenge is to deploy future-proof community-driven research data e-infrastructures (community "data networks") addressing societal challenges, e.g. Our Planet/Climate, Our Environment, Our Species, Our Oceans, Our Universe, Our Health, Our Education, Our Information. The e-infrastructure should provide reliable on-demand services (i.e. access, storage, preservation, discovery, analytics, compute, mash-up of interdisciplinary data) adapted to the specific requirements of broad research communities, where relevant in cooperation with other e-infrastructures. This requires adapting the service architectures to address requirements in terms of data volume, distribution, heterogeneity, discoverability, processability, etc.; open data and compute services with new ways of handling metadata - the descriptive information about the scientific attributes being studied – as well as the way to translate them; fostering cross-disciplinary data interoperability; and functions allowing data citation and promoting data sharing and trust.

This topic complements Topic 6: the latter addresses services that are largely transversal and generic; whereas Topic 5 addresses more discipline-specific work, building on the services to be deployed under Topic 6.

Scope

Each project is expected to:

(1) Define the semantics, ontologies, the “what" metadata, as well as defining the best computing models and levels of abstraction (e.g. by means of open web services) to process the rich semantics at machine level (the so called “how" metadata). Support community efforts towards using and evolving open Web standards such as those related with Linked Open Data for data provisioning.

(2) Support proof of concept, prototyping and deployment of advanced data services and environments, providing the “researcher, educator, student, librarian” a toolset and desktop with easy to use functionalities and access to top-of-the-range connectivity and computing.

(3) Engaging scientific and user communities to collaborate in building the common data e-infrastructures (together with projects to be funded under Topics 6, 7, 8 and 10), as well as in education on data management, quality-control, sharing and reuse.

Expected impact

Researchers can access on-line a much larger fraction of the data they produce; this will be measured by cross-border data traffic over the research networks in Europe as a proxy.

Interoperability between data enables novel research, leading to innovation and new insights.

Researcher's efficiency and productivity rise thanks to reliable services and infrastructures for discovering, accessing, and reusing data.

Research communities adopt common approaches to data management lifecycle (data and metadata curation) which leads to economies of scale.

Trust in a community's data improves.

Instruments, funding level, budget:

CP; Funding level: 100%, Budget: 45 M€

Timing

Call 2015

Topic 6: Managing, preserving and computing with big research data

Specific Challenge

The challenge is to develop and deploy integrated, secure, permanent, on-demand service-driven and sustainable e-infrastructures. These e-infrastructures should incorporate advanced computing resources and software to increase the available capacity to manage, store and analyse extremely large, heterogeneous and complex datasets. The e-infrastructures will provide services cutting across a wide-range of scientific communities and addressing a diversity of computational requirements, system and service architectures, formats, types, vocabularies and legacy practices of scientific communities that generate and use the data. Proposers are encouraged to leverage on prior work on open prototype services and to use discoverable service catalogues, common APIs, service-level agreements (SLAs) and transparent billing.

This topic complements Topic 5: it addresses services that are largely transversal and generic; whereas Topic 5 addresses more discipline-specific work, building on the services to be deployed under Topic 6.

Scope

The proposals should address at least one of the first five (5) actions, or actions 6 or 7 individually:

(1) Establishing a federated pan-European data e-infrastructure to provide cost-effective and interoperable solutions for data management and long term preservation. The needs for data access, replication, annotation, search, compute, analysis and reuse of information across disciplines should be accommodated in different research and education contexts. All these functions should expose standard interfaces for interoperation with other data sources to aggregate them or to be aggregated. Sustainability is of paramount importance. Robust business models should be proposed to encourage investment from all stakeholders. Foreseen challenges are technical, legal and organisational, including engaging e-infrastructure operators and other service providers (such as those receiving support under Topics 5, 7, 8 and 10) ;

(2) Services to ensure the quality and reliability of the data e-infrastructure, including certification mechanisms for repositories and certification services to test and benchmark capabilities in terms of resilience and service continuity of e-infrastructures;

(3) Federating institutional and, if possible, private data management and curation tools and services used across or at some point of the full data lifecycle, including approaches for identification of open data sources and data collected with sensitive or restricted access features. Services and tools should be federated on the basis of an open architecture and should offer or coordinate support to the development of Data Management Plans;

(4) Large scale virtualisation of data/compute centre resources to achieve on-demand compute capacities, improve flexibility for data analysis and avoid unnecessary costly large data transfers.

(5) Development and adoption of an standards-based computing platform (with open software stack) that can be deployed on different hardware and e-infrastructures (such as clouds providing

infrastructure-as-a-service (IaaS), HPC, grid infrastructures…) to abstract application development and execution from available (possibly remote) computing systems. This platform should be capable of federating multiple commercial and/or public cloud resources or services and deliver PaaS adapted to the scientific community with a short learning curve. Adequate coordination and interoperability with existing e-infrastructures (including GÉANT, EGI, PRACE and others) is recommended

(6) Support to the evolution of EGI (European Grid Infrastructure) towards a flexible compute/data infrastructure capable of federating and enabling the sharing of resources of any kind (public or private, grid or cloud, etc.) in order to offer computing and storage services to the whole European scientific community. The proposal will address operations for supplying services (IaaS, PaaS, SaaS) at European level, engagement of and tailoring of services to new user communities and dissemination activities.

(7) Proof of concept and prototypes of data infrastructure-enabling software (e.g. for databases and data mining) for extremely large or highly heterogeneous data sets scaling to zetabytes and trillion of objects. Clean slate approaches to data management targeting 2020+ "data factory" requirements of research communities and large scale facilities (e.g. ESFRI projects) are encouraged.

Expected impact

- Increased availability of scientific data for scientific communities independently of them having already embraced or not e-science; this will be measured by cross-border data traffic over the research networks in Europe as a proxy.

- Better optimisation of the use of IT equipment for research.

- Avoiding lock-in to particular hardware or software platforms in the development of science.

- Scientific communities embrace storage and computing infrastructures as state-of-the-art services become available and the learning curve for their use becomes less steep; this will be measured by the storage capacity available for pan-European use as well as by the number of users of EGI and other production e-infrastructures in this area.

Instruments, funding level, budget

CP; Funding level: 100%, Budget: 40 M€, out of which max 8 M€ for subtopic (6)

Timing

Call 2014

Topic 7: e-Infrastructure for Open Access

Specific Challenge

The challenge is to deliver a robust e-infrastructure supporting Open Access policies, including for Horizon 2020, based on already existing e-infrastructures (institutional and thematic repositories, aggregators, etc.). The infrastructure should support reliable and permanent access to digital scientific records. A key element will be capacity building to link literature and data in order to enable a more transparent evaluation of research and reproducibility of results.

Scope

Proposals should address all the following actions:

(1) Service-driven data e-infrastructures responding to general and specific requirements of researchers and research organisations for open access to and deposit of scientific information (including journal articles, books, monographs, conference proceedings, thesis, grey literature, software and data, as well as services linking literature, data and software). These e-infrastructures will further develop the research capacity through a coordinated and participatory architecture linking institutional and thematic repositories across Europe with scientific information to be used by humans and machines. An essential part of this service-driven approach will be researcher helpdesks designed to support the producers and users of scientific information, as well as human networks to support data sharing and implementation of Open Access policies in Europe. The e-infrastructure should be incorporated as a legal entity within the first year of the project. Relevant indicators on the take-up of open access in Europe including for both publications and data should be elaborated and reported upon regularly.

(2) Developing proof of concept and prototyping new services in support of open science (e.g. new forms of publishing, innovative services based on data mining, new forms of peer review etc.), assisting researchers and educators in everyday tasks. This includes piloting a mechanism to stimulate publishing in open access journals by paying authors part or all of the article processing charges they incurred after the end of their grant agreement with the Commission; this service should contribute to the development of a sustainable and competitive market for scientific open access publishing. Proposals should consider barriers (including legal) to data sharing in the context of these new services and assess the possibility of pan-European information sharing agreements considering the authentication and authorization infrastructure described in Topic 10.

(3) Supporting the global interoperability of open access data e-infrastructures and linking with similar platforms across the globe in order to complement the physical access to research facilities with data access and to ensure that Europe plays a leading role in international collaborations.

It is expected that one proposal will be selected

Expected impact

The intellectual capital of Europe is available to researchers, business and citizens to generate economic and scientific advances now, and that capital is safely preserved for further exploitation by future generations. Open Access publications resulting from Horizon 2020 funded research are available and easily findable online. Accurate science metrics for Horizon 2020 can be produced with almost no effort. Most of the European institutional repositories (at least 80%) as well as the principal thematic repositories are part of the same interoperable repository network.

Instruments, funding level, budget

CP; funding level: 100%, Budget: 7 million

Timing

Call 2014

Topic 8: Towards global data e-infrastructures - RDA

Specific Challenge

The challenge is to support the European contribution to the development and operation of global data infrastructures by strengthening and consolidating Europe's contribution to the Research Data Alliance (RDA) and ensuring that RDA serves its main aim, namely to foster research data interoperability at global level. RDA is an open international forum to create consensus on solutions and best practices to specific problems hampering data exchange and interoperability.

Scope

Actions will support all of following points:

(1) the definition, operation and monitoring of the governance structures of the Research Data Alliance (RDA); secondment and exchange of staff where appropriate;

(2) the active participation of European stakeholders (organisations and individual experts) in RDA and leadership initiatives in strategic working group activities; EU industry involvement and innovation will be promoted in particular;

(3) engaging scientific communities having underdeveloped data infrastructures in defining the best practices for data exchange and interoperability; and

(4) establishing the coordination mechanisms at European level (national research funders, European education and research associations) and with international organisations dealing with standardisation, research data and education issues (IETF, W3C, CODATA, OECD, UNESCO, …).

Expected impact

Europe will be in leading in enabling the use of the world's store of research data in multi-disciplinary, data intensive global scientific collaborations. It will help the development and adoption of relevant international open standards based on the best practices of a large spectrum of research communities. It will engage research communities at early stages of standards development and address common data requirements for new services bringing together users and technology providers. It will promote sustainable models for research data sharing and install trust in the adopted solutions.

Instruments, funding level, budget

CSA; funding level: 100%, Budget: 3 million

Timing

Call 2014

CHALLENGE 4 – e-INFRASTRUCTURE INTEGRATION

This challenge supports the integration of e-infrastructure resources and services across all layers (networking, computing, data, software, user interfaces), in order to provide seamless services tailored to user needs. Integration will be facilitated by supporting various ways of achieving interoperability, by deploying common or interoperable core services and service building blocks and by user-driven integration through VREs, and by supporting building of skills to answer to the new technical requirements.

Topic 9: e-Infrastructures for virtual research environments (VRE)

Specific Challenge

The objective is capacity building in interdisciplinary research communities to empower researchers through development and deployment of service-driven digital research environments and tools tailored to their specific needs. These virtual research environments (VRE) should integrate resources across all layers of the e-infrastructure (networking, computing, data, software, user interfaces).

Scope

Each VRE should abstract from the underlying e-infrastructures using standardised building blocks and workflows, well documented interfaces, in particular regarding APIs, and interoperable components. Over time VREs will be composed of generic services delivered by e-infrastructures and domain specific services co-developed and co-operated by researchers, technology and e-infrastructure providers, and possibly commercial vendors. The VRE projects should clearly identify and build on requirements from real use cases, e.g. for integration of heterogeneous data from multiple sources and value-added services for computing, simulation, and data exploration, mining and visualisation. They should re-use tools and services from existing infrastructures and projects at national and/or Community level as appropriate.

VREs may target any area of science and technology, especially interdisciplinary ones, including ICT, mathematics, web science and social sciences, arts and humanities. Proposals should indicate the number of researchers they target as potential users.

Expected impact

VREs are expected to result in more effective collaboration between researchers and higher efficiency and creativity in research; accelerated innovation in research via an integrated access to potentially unlimited digital research resources, tools and services across disciplines and user communities; and enabling researchers to process structured and qualitative data in virtual and/or ubiquitous workspaces.

Instruments, funding level, budget:

CP; Funding level: 100%, Budget: 19 M€

Timing

Topic 10: Provisioning of core services across e-Infrastructures

Specific Challenge

The overall objective is to harmonise and/or deploy a set of core infrastructure services (e.g. resources) for use by both production e-infrastructures and e-infrastructures under development. Core services are considered those that 1) ensure interoperation of and 2) are needed across a broad range of e-infrastructures and research communities.

Scope

The proposals will address one of the two following actions (one proposal per action will be funded):

(1) Development and promotion of the uptake of a **Digital Identifier e-infrastructure** for digital objects (articles, datasets, collections, software, nomenclature, etc), contributors and authors which cuts across geographical, temporal, disciplinary, cultural, organizational and technological boundaries, without relying on a single centralized system but rather federating locally operated systems to ensure interoperability. The requirements of all relevant stakeholder groups (researchers, libraries, data centres, publishers, etc.) will be addressed;

(2) Deployment and promotion of a **pan-European identity federation** for researchers, educators and students, in compliance with existing identity inter-federation efforts. The action will involve (research and education) institutions in EU Member States, existing identity federations, e-infrastructure providers and libraries. It should aim to overcome technical, organisational and legal obstacles for the implementation of an integrated and interoperable authentication and authorisation infrastructure (AAI) and to lower barriers for entry of organisations not already participating in identity federations, e.g. by providing scalable policy negotiation mechanisms, as well as legal guidance notably in data protection. It should also encourage the use of security token translation services to enable interoperability of different AAIs, as well as accounting services for enabling interoperability and aggregation in recording the usage of resources securely and reliably, including for the highly distributed heterogeneous infrastructures envisaged for global research data. Guest identities and alternative methods of identification (e.g. social media identities) are encouraged e.g. in order to allow public access at large. Assessment of penetration of existing identity federations at national level and development of training activities for data professionals on issues related to AAI enabled collaboration and data sharing (data privacy, intellectual property, cultural barriers, etc.) should be foreseen.

Expected impact

- The interoperability of e-Infrastructure services is improved, therefore access to resources and collaboration between scientists are facilitated;

- Duplication of efforts for developing services common to many e-infrastructures is reduced;

- Extensive use of Digital Identifiers opens new prospects for advanced services for science and education and for encouraging openness and building trust;

- The federation of identities allows a European-wide single sign-on service enabling researchers to collaborate within secure and trusted virtual research environments where scientific resources and content can be accessed, used, stored and shared.

- The deployment of the AAI infrastructure should facilitate sharing of information resources at pan-European level.

- Expansion of the coverage of national identity federations for network, services and applications; all research institutions are able to participate in identity federations even with low level of technical or organisational preparedness

Instruments, funding level, budget

CP; Funding level: 100%, Budget: EUR 5 million; the intention is to fund one proposal in each of the above two actions where possible

Timing

Call 2014

Topic 11: Skills and new professions for e-infrastructures

Specific Challenge

[this will be part of a Challenge on Skills jointly with RTD.B3 – and maybe RTD.B2]

The changing methods of (digital) science and research require that researchers, professors and students receive adequate support in computing and networking, as well as in handling, analysing and storing large amounts of data and content. This is the scope of work of the emerging professions of e-infrastructure operators, research technologists, data scientists and data librarians for which formal education hardly exists today. Professional recognition of this community and the development of appropriate curricula, training and skills are crucial to ensure effective services to institution staff and students. Training opportunities should be available at all levels and for all communities potentially engaged in research related activities.

Scope

Proposals should address one or more of the following actions:

(1) Defining or updating university curricula for the e-infrastructure competences mentioned above, and promoting their adoption.

(2) Developing and executing training programmes (including for lifelong learning) for the above mentioned professionals working as part of a team of researchers or supporting research teams.

(3) Support the establishment of these professions as distinct professions from that of a researcher. Create a reference model which defines their competencies, supported by case studies and best practices relating to e-Infrastructures skills, human resources management, support tools and related institutional practices. Develop alternatives means for recognising non-research contributions by research technologists and data scientists.

(4) Support networking and information sharing among already practicing e-infrastructure experts, research technologists, data scientists and data librarians working in research institutes and in higher education.

(5) Awareness raising activities; establish and promote e-Infrastructures community champions to advocate on new jobs and skills needs at schools, universities and scientific communities.

Expected impact

The number of high level education institutions offering degrees for e-infrastructure experts, research technologists, data scientists and data librarians will increase. Graduates and practitioners in these fields will have access to degrees, programmes and information sharing tools to improve their skills. The majority of European researchers will thus have access to training on e-infrastructures in case they have the need to develop related skills. The number of individuals able to design, develop and maintain e-science tools and services will increase significantly.

Instruments, funding level, budget:

CSA; Funding level: 100%, Budget: 2 M€

Timing

Call 2015

CHALLENGE 5 – POLICY AND INTERNATIONAL

Topic 12: Policy development and international cooperation

Specific Challenge

[this will be part of a Challenge on policy jointly with RTD.B3]

The overall challenge is to coordinate national and/or regional policies and programmes for e-infrastructures, to develop complementarities and cooperation between e-infrastructures and activities implementing other Union policies (such as regional, cohesion, industrial, health, employment, or development policy), and to ensure coordination between different Union funding sources to optimise e-infrastructures investments in Europe. The aim is also to facilitate the cooperation of European e-infrastructures with their non-European counterparts, ensuring their global interoperability and reach and potential technology transfer from projects.

Scope

Proposals will support one or more of the following actions:

(1) The dissemination of information on the e-infrastructure programme and project results, including project concertation;

(2) Stakeholder initiatives, including a user forum to provide orientations for e-infrastructure service interoperability and integration;

(3) Policy coordination with the major national and European policy makers, including the collection of information needed for policy making e.g. through consultation actions and surveys;

(4) Support to monitoring results and assessing impact of the Horizon 2020 e-infrastructure activities, including through metrics and indicators;

(5) Monitor and analyse the take-up of digital science and e-infrastructures by researchers per country, region and research domain or community;

(6) Support to technology transfer from the e-infrastructures projects to the market;

(7) Support to international cooperation with developing countries and regions in connectivity, services, use cases and applications.

Expected impact

A consistent and dynamic European policy for research infrastructures is developed and is coordinated EU-wide. Support actions provide solid ground for future choices and help in decision making and deployment of e-infrastructures. Impact and results analysis is available in real time and can inform policy choices. Novel technology and services with market potential is identified and span off to the market. Support measures for international cooperation address specific issues regarding reciprocal use, openness or co-financing of e-infrastructures, as well as ensure Europe's persistent presence and influence in the global e-infrastructure.

Instruments, funding level, budget:

CSA; Funding level: 100%, Budget: 4 M€

Timing

Call 2014

B. OTHER ACTIONS (not subject to calls for proposals)

C. PERSPECTIVES FOR 2016

(to be done)