ICT-FET

FP7

Work Programme

European Commission
Information Society and Media

Extract from Work Programme 2007 for ICT – Information and Communication Technologies under FP7

Future and Emerging Technologies

The challenge is the timely identification and substantiation of new directions that have a high potential for significant breakthrough and that may become the foundations of the information and communication technologies and innovations of tomorrow. This is especially important in areas where industry roadmaps still contain major roadblocks that cannot be addressed by incremental approaches.

Research will consist of radical interdisciplinary explorations of new and alternative approaches towards future and emerging ICT-related technologies, aimed at a fundamental reconsideration of theoretical, methodological, technological and/or applicative paradigms in ICT. It will deliver proofs-of-concept for radically new options where none existed before, or that demonstrate new possibilities where none were suspected. It will further establish a credible and sufficiently strong science and technology basis in such new and emerging areas, by supporting research for refining visionary concepts, by bringing them to the maturity level where investment from industry can be attracted, and by helping new interdisciplinary research communities to establish themselves as bridgeheads for further competitive RTD.

Expected impact

Future and Emerging Technologies (FET) research is long-term and high-risk but 'purpose driven'. It derives its *raison d'être* from the broader context of the ICT programme to which it explicitly contributes in at least two ways.

First, by being open to a broad spectrum of needs, opportunities and solutions, it avoids the risk of 'tunnel vision' in ICT research and acts as an early indicator of new directions and opportunities for research in ICT ('FET-Open').

Second, it serves as a pathfinder that prepares for future directions in which the ICT programme, together with industry, may create the critical mass that can really make a difference for Europe in the long run ('FET proactive'). These directions are motivated by fundamental long-term challenges in ICT that will be key to the long-term sustainability of a technological future in Europe, such as:

- Rethinking the nature of computing, where basic notions of information, computation and communication are revisited, and fundamental characteristics of matter (quantum behaviour, dynamics of atoms, molecules, cells, neurons, photons) are exploited to develop radically new types of logic and components ('QIPC and other quantum technologies' and 'Bio-ICT convergence').
- Opening new directions for the physical realisation of ICT beyond CMOS that can achieve greater miniaturisation, efficiency and integration; and to learn to design and manage massive numbers of such devices integrated in a single chip ('Nano-scale ICT devices and systems' and 'Massive ICT systems').

SEVENTH FRAMEWORK PROGRAMME

- To embrace change within ICT systems as a fundamental property, so that they can develop, grow, self-assemble, replicate, evolve, adapt, repair themselves and self-organise over long periods of time, while maintaining essential operational conditions of security and dependability ('Pervasive adaptation').
- To understand and harness the transformational forces of new ICTs on society, especially when large-scale deployment (of, for example, massive commercial services, high bandwidth mobile communication, immersive collaborative environments, surveillance systems or ubiquitous robotics) leads to emergent effects that are often unanticipated by the designers but readily exploited for new uses ('Science of Complex Systems for socially intelligent ICT').
- To respond to increasing expectation for trustworthy, dependable and long-lasting systems and information – expectations which current technologies can not meet ('ICT forever yours').
- To exploit the understanding of information processing in biological systems in order to develop new perspectives in ICT with clear advantages in terms of functionality, operating conditions (e.g., power needs, packaging requirements), resilience and adaptability, or to achieve technologies that can be naturally combined with biological systems ('Bio-ICT convergence').
- To master fundamental aspects of physical embodiment for smart devices in order to pave the way for a whole new range of smart artefacts (e.g. robots) of unprecedented diversity and behavioural characteristics ('Embodied Intelligence').
- To address the physical-virtual confluence that is enabled by advanced media and interface technologies but, if it is to become a broader enabler, needs new directions with a solid basis in research on human perception and action, the study of experiences, awareness, and the development of tighter couplings between the human and technological realms, leading to a re-conception of human-machine interaction and machine perception ('Human-Computer Confluence').

This research will establish the scientific and technological foundations of the technologies and innovations of tomorrow, in terms of knowledge, know-how and the readiness of a vibrant research community.

FET-Open will call for STREPs (2-stage submission procedure) and for coordination actions (CAs).

FET-proactive initiatives will call for STREPs, for IPs, or for both. In addition they will call for coordination actions (CAs).

The stimulation of international cooperation on foundational research in the areas addressed by a pro-active initiative is also encouraged. This is particularly relevant in Quantum Information Processing and Communication (QIPC), where such international cooperation will reinforce European leadership in this area. Similarly, international cooperation on foundational research promises to further enhance European leadership in nano-scale ICT devices and systems, and in complexity science, among others.

The 2007-2008 funding will be used to address the following themes in pro-active initiatives:

Call 1: FP7-ICT-2007-1

ICT-2007.8.1 Nano-scale ICT devices and systems

ICT-2007.8.2 Pervasive adaptation

ICT-2007.8.3 Bio-ICT convergence

Call 3: FP7-ICT-2007-3

ICT-2007.8.4 Science of Complex Systems for socially intelligent ICT

ICT-2007.8.5 Embodied Intelligence

ICT-2007.8.6 ICT forever yours

The following themes are likely to be among pro-active initiatives for funding in 2009-2010:

Massive ICT systems. The objective is to research, demonstrate and validate new computing architectures and algorithms that will allow designing, programming and managing future high-performance ICT components with up to one Tera (10^{12}) devices integrated in a single chip.

Human-computer confluence. To investigate an invisible, implicit, embodied or even implanted interaction between humans and system components, for natural interaction (including communication) in surrounding environments, themselves augmented with pervasive and ubiquitous infrastructures and services.

QIPC and other quantum technologies. To overcome major scientific, technological and theoretical challenges for quantum technology to deliver on its promise to radically outperform its classical counterpart not only in terms of processing speed, capacity and communication security, but also, in the ability to solve classes of practical problems which currently cannot be solved. This initiative also invites the exploration of a wider range of non-classical implementations of ICT. More generally, it will be important to strengthen international collaboration on foundational research in this area where Europe has established itself firmly at the leading edge.

FET-Open

Target Outcome

FET-Open addresses the widest possible spectrum of research topics that closely relate to Information and Communication Technologies as these arise bottom-up. Since the supported topics are not predefined by the Work Programme but identified by the researchers themselves, FET-Open flexibly accommodates the exploration of new research horizons. Unconstrained by established approaches, it offers the opportunity to try out an unproven idea where the risk is too high for a larger RTD investment to be justified. Once established as credible and valid, a research topic may gradually grow into a wider field, supported by a dedicated research initiative or be taken over by mainstream programme activities in ICT. Rather than doing blue-sky research, a project in FET-Open should contribute to the realisation of a clear long term vision in the ICT domain and the project's objectives must address a key challenge for the realisation of this vision.

Expected Impact

For STREP:

- ICT-relevant, visionary, high quality, long-term research of a foundational nature, involving bright new ideas of high-risk – high-pay-off, aiming at a breakthrough, a paradigm shift, or at the proof of a novel scientific principle, or
- Research refining the visionary ideas that have gone past the proof-of-concept phase to bring them to the maturity level where they could be taken up by the mainstream ICT programme objectives.

For CA:

- Emergence, shaping and consolidation of new and dispersed research communities and, where appropriate, the coordination of FET-relevant national or regional research programmes or activities or the stimulation of international cooperation in any area of relevance to FET. Each CA should aim at establishing critical mass, scientific excellence and multi-disciplinary diversity, as appropriate, around a new scientific discipline or research topic, defining future research directions, federating the research communities around a common challenge and contributing to the preparation of joint programs of work.

Funding schemes

CP, CSA (CA only)

Indicative budget distribution

65 MEuro

Call

Continuous, receivable from 19 March 2007 onwards

Objective ICT-2007.8.1: FET proactive 1: Nano-scale ICT devices and systems

Target outcome

To demonstrate unconventional solutions to increase computing performance, functionality or communication speed, or to reduce cost, size and power consumption of ICT components beyond the expected limits of CMOS technology.

Research should cover at least one of the following points:

- Demonstration of new concepts for **switches or memory cells**, to substantially improve performance, cost, integration density and/or power dissipation beyond those of ultimate CMOS technology using nanostructures or non-charge based approaches. Complementary challenges include circuit architectures, assembly and reconfiguration.
- Demonstration of new concepts, technologies and architectures for local and chip-level **interconnects** with substantial improvements over current solutions. Key drivers are: transmission speed, integration density, reduction in power consumption, integration of new functions, ease of design and manufacturing.
- Demonstration of **radically new functionalities** by the integration of blocks from a few nanometres down to the atomic scale into high added-value systems. Candidates include NEMS and NEMS arrays; approaches based on photons, plasmons, phonons; approaches exploiting internal degrees of freedom of atoms and molecules and based on atomic precision control and addressability.

Coordination actions (CAs) should support the consolidation of research communities, their visibility, the coordination of research agendas, the mapping and benchmarking of research at European level, and the identification of drivers to assess research in nano-scale ICT devices and systems. They also address the coordination of national or regional research programmes or activities. The initiative also encourages

international cooperation in foundational research on topics described above.

Expected Impact

Projects on switches, memories or interconnects should open, verify and assess new unconventional approaches to ICT. They should demonstrate proof of concept at laboratory level to prepare future applied RTD. Projects on new functionalities should open radically new directions in ICT devices and technologies and aim at experimental demonstrations of principle, feasibility and concrete advantages.

Funding schemes

CP, CSA (CA only)

Indicative budget distribution

20 M€:
- CP 19 M€ of which a minimum of 10 M€ to IP and a minimum of 4 M€ to STREP;
- CSA 1 M€ (CA only)

Call

FP7-ICT-2007-1

Objective ICT-2007.8.2: FET proactive 2: Pervasive adaptation

Target outcome

Technologies and design paradigms for massive-scale pervasive information and communication systems, capable of autonomously adapting to highly dynamic and open technological and user contexts. Adaptation strategies (bio-inspired, stochastic or others) will operate at different time scales and speeds, from short term adaptation to long-term evolution, and will imply changes in software, hardware, protocols and/or architecture at different levels of granularity and abstraction. Projects will focus on one or both of the following areas:

- **Evolve-able and adaptive pervasive systems,** able to permanently adjust, self-manage, evolve and self-organise in order to robustly respond to dynamically changing environments, operating conditions, and purposes or practices of use.
- **Networked societies of artefacts** that adapt to each other and to changing needs, collectively harness dispersed information and pursue immediate or long-term goals for context-sensitive service delivery in rapidly changing and technology-rich environments.

Both technological and user aspects (in a social context) need to be considered in a multidisciplinary and integrated approach, considering in particular aspects such as:

- **Adaptive security and dependability**: theories, techniques and architectures, able to cope with the volatile landscape of risks, threats, attacks and context dependent user expectations for privacy and security in evolving and heterogeneous pervasive systems.
- **Dynamicity of trust**: capabilities for establishing trust relationships between humans and/or machines that jointly act and interact within ad-hoc and changing configurations.
- **Security for tiny and massively networked devices**: efficient, robust and scalable cryptographic protocols, algorithms and other security and privacy mechanisms, including hardware-based ones, as well as collective, biologically or socially inspired ones.

Coordination actions (CAs) should support the consolidation of research communities, their visibility, the coordination of research agendas and, where appropriate, the coordination of national or regional research programmes or activities. The initiative also encourages international cooperation in foundational research on topics described above.

Expected impact

Projects should make key contributions to achieving a new generation of massively scalable systems that, in spite of heterogeneity, noise and often unreliable conditions, can display a fundamental capacity for self-controlled adaptation and organisation. They should foster new human-centric services, reducing management and maintenance cost, and ensure security and trust in pervasive applications, addressing the needs for both accountability and privacy.

Funding schemes

CP, CSA (CA only)

Indicative budget distribution

20 M€:
- CP 19 M€ of which a minimum of 10 M€ to IP and a minimum of 4 M€ to STREP;
- CSA 1 M€ (CA only)

Call

FP7-ICT-2007-1

Objective ICT-2007.8.3: FET proactive 3: Bio-ICT convergence

Target outcome

New perspectives in ICT that exploit the understanding of information processing in biological systems have demonstrable advantages in terms of functionality, operating conditions, resilience or adaptability or lead to systems that can be naturally combined with biological systems. Projects will integrate some of the following topics:

- **Novel computing paradigms**, derived from the information representation and processing capabilities of biological systems (networks of neurons or other cells), or from the computational interpretation of biological processes (molecular signalling, metabolism) and with measurable advantages over current approaches to difficult problems in information processing.
- **Biomimetic artefacts**: ad hoc hardware implementations of bio-inspired systems in areas where standard devices do not provide the required performance. This may use analogue and digital circuits, evolvable hardware, artificial cells, neuro-morphic chips or sensors for achieving life-like functionality or properties such as self organisation, robustness or growth.
- **Bidirectional interfaces** between electronic or electro-mechanical systems and living entities, at or close to the cellular level, with adequate control and/or signal processing algorithms, enabling direct interfacing to the nervous system or to other types of cells.
- **Biohybrid artefacts**, involving tightly coupled ICT and biological entities (e.g., neural or other types of biological tissue) for new forms of computation, sensing, communication or physical actuation or adaptation.

Coordination actions (CAs) should support the consolidation of research communities, their visibility, the coordination of research agendas and, where appropriate, the coordination of national or regional research programmes or activities. The initiative also encourages international cooperation in foundational research on its topics described above.

Expected impact

This multi-disciplinary research should foster joint progress and synergy in ICT and the bio-and neuro-sciences. Novel computing paradigms should lead to a fundamental rethinking of notions of information and computation that may be better suited for certain classes of problems and that can be implemented in biological, biomimetic or biohybrid devices. Such devices will need to satisfy requirements of, e.g., performance, resilience or energy consumption that are currently difficult to meet. Research on bio-interfaces and bio-hybrid devices should enable new bio-compatible ICT uses that rely on direct interactions between the technological and the living, such as for robust brain-machine interfacing or for powerful sensory-motor capabilities.

Funding schemes

CP, CSA (CA only)

Indicative budget distribution

20 M€:
- CP 19 M€ of which a minimum of 10 M€ to IP and a minimum of 4 M€ to STREP,
- CSA 1 M€ (CA only)

Call

FP7-ICT-2007-1

Objective ICT-2007.8.4: FET proactive 4: Science of complex systems for socially intelligent ICT

Target outcome

Key concepts and tools for a data-intensive science of large scale techno-social systems, i.e., systems in which ICT is tightly entangled with human, social and business structures which, as a result, mutually transform each other for instance through evolution of acceptance, trust, innovative uses and technology changes. Projects will develop systematic means to gain knowledge on such systems and to model, predict and characterise their behaviour, their dynamics and evolution. They will demonstrate the use of this understanding in novel paradigms and designs for socially intelligent ICT. Projects will integrate the following topics:

- **Theoretical and algorithmic foundations** for scaleable modelling and simulation of such multi-level systems, taking into account the relevant technological, psychological and social dimensions and with realistic diversity of behaviours, social and spatial structures and knowledge on how humans and technologies relate to and impact on each other (e.g., acceptance, use, trust).
- **Data-driven simulation**, tools and techniques able to cope with huge sets of heterogeneous and often unreliable data to efficiently reconstruct dynamic system

models at multiple levels. This includes data-rich probing technologies, protocols and experiments to gain realistic data on techno-social systems, and knowledge extraction based on scaleable and distributed methods.

- **Prediction and predictability:** mathematical and computational methods that help to characterize the nature and impact of transitions, novel properties and self-organising effects that can occur as systems massively scale up. . Understanding the limits of predictability will allow reliable, quantitatively accurate predictions leading to strategies for better guided ICT induced transformation or for keeping systems in their viability domain.

Coordination actions (CAs) should support the consolidation of research communities, their visibility, the coordination of research agendas, the coordination of national or regional research programmes or activities. The initiative also encourages international cooperation in foundational research on topics described above.

Expected impact

This research should contribute to a new multidisciplinary understanding of the ways in which ICT changes, moulds and becomes part of the systems to which it is applied, and lead to better targeted deployment of socially intelligent ICT systems. Breakthroughs will lead to deeper understanding and the ability to predict and design for instance new generations of autonomous information- or high-bandwidth communication systems by exploiting models of self-organisation, adaptability and social behaviour. Applications include e.g., massive service economies and other technology-dependent experimental economic models, ICT mediated communities, P2P systems, emergency management and disaster relief systems. Projects should indicate how efficient data gathering, simulation, prediction and control techniques can lead to more human-centric systems, can harness collective intelligence or behaviour, can support businesses and policy makers with best practices that have a clear and definable societal and economic added value or can contribute to solving long-term challenges such as sustainable growth, energy efficiency, or social inclusion.

Funding schemes

CP, CSA (CA only)

Indicative budget distribution

20 M€

Call

FP7-ICT-2007-3

Objective ICT-2007.8.5: FET proactive 5: Embodied Intelligence

Target outcome

New technologies and design approaches for building physically embodied intelligent agents and artefacts, with emphasis on the relationship between shape, function and the physical and social environment, and addressing one or several of the following:

- **Mind-body co-development and co-evolution** through permanent and extended multi-modal interaction of agents with the physical and social environment. Projects will develop a better understanding of the role of such interaction in open-ended learning and adaptation processes, including morphological change for shaping perception, cognition, cooperation and social intelligence. They will demonstrate qualitative and quantitative improvements in agent capabilities and characteristics.
- **Morphology and behaviour:** new design principles for sensing, actuation and locomotion components and for robot architectures that are based on a deeper understanding of the role of form and material properties in shaping behaviour, and of the ways in which these afford relationships and interactions with the environment and with other agents. Projects will aim to demonstrate advantages in physical and performance characteristics of the robot e.g., in terms of control, weight, flexibility, resilience, or other characteristics.
- **Design for emergence:** design paradigms and techniques for purposive agents where behaviour is not strictly programmed but robustly emerges from the interaction of the various components (each with local intelligence), the environment and its ubiquitous information resources. Projects will develop smart components and techniques for the design of ambitious classes of scalable robotic systems, incorporating where possible prior knowledge on tasks or environments, while leaving the necessary room for emergence and adaptation.

Coordination actions (CAs) should support the consolidation of research communities, their visibility, the coordination of research agendas and, where appropriate, the coordination of national or regional research programmes or activities. The initiative also encourages international cooperation in foundational research on topics described above.

Expected Impact

This research should advance the state of the art in intelligent systems and in particular in robotics and ICT, as well as in other disciplines (neuroscience, sociology, biology). It should bring essential contributions for achieving robotic systems of greater morphological diversity, for a larger spectrum of uses, more natural and safer to interact with and more easily integrated in everyday environments. This will be key to unlock the 'long tail' of the robotic service market by enabling a wide variety of affordable robots for specific uses.

Funding schemes

CP, CSA (CA only)

Indicative budget distribution

20 M€

Call

FP7-ICT-2007-3

Objective ICT-2007.8.6: FET proactive 6: ICT forever yours

Target outcome

The mass diffusion of digital systems and their pervasiveness in our everyday lives increases our expectations on the dependability, security and longevity of these systems. This requires new built-in mechanisms for enhancing confidence in their usage, for protecting them from malicious intents and for preserving them from the threat of ageing, in the context of highly decentralised and incremental development and deployment practices. Projects should focus on one or several of the following:

- **Eternal Systems**: to develop a theoretical and practical framework for extremely long-lived systems, requiring minimal intervention and management to thrive in spite of changes in usage, host device, network context or data- and data protection formats. Systems should be future proof, able to preserve and update their original functionality in a machine-independent way, and ultimately by being self-sustaining and evolving.
- **Knowledge, diversity and time**: New approaches for eternal and reliable access to knowledge assets, in which knowledge parts are produced locally, but exploited globally, and are endowed with 'a sense of time and context' to make them robust against ageing, diversity of use and evolving semantics.
- **Secure and dependable software:** methods and tools for high-level verifiably secure and dependable programming, and new metrics to aid assessability of the security and dependability of highly distributed and heterogeneous software or of ambient systems.

Coordination actions (CAs) should support the consolidation of research communities, their visibility, the coordination of research agendas and, where appropriate, the coordination of national or regional research programmes or activities. The initiative also encourages international cooperation in foundational research on topics described above.

Expected impact

The research should contribute to systems that are more versatile in their interaction with modules, systems and services in their environment: adapting to change in the environment with minimal intervention, harnessing dispersed and dynamic content by exchanging knowledge at a semantic level that is robust against diversity of origin and use, preserving and even changing original functionality and properties over time, providing security to their environment through verifiably secure programming models, and offering assessable security of systems in the context of their environment.

Funding schemes

CP (IP only), CSA (CA only)

Indicative budget distribution

20 M€

Call

FP7-ICT-2007-3

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For further information:

Future and Emerging Technologies
European Commission
Information Society and Media DG
Email: infso-ictfet@ec.europa.eu

http://cordis.europa.eu/fp7/ict/programme/fet_en.html

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