EUROPEAN COMMISSION

ICT - INFORMATION AND COMMUNICATION TECHNOLOGIES

A Theme for research and development under the specific programme "Cooperation" implementing the Seventh Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities

Work Programme 2009-10

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This Work Programme for the ICT theme of the FP7 Specific Programme "Cooperation" defines the priorities for calls for proposals closing in 2009 and 2010 and the criteria that will be used for evaluating the proposals responding to these calls.

The priorities reflect the input received from the Programme Committee, the IST Advisory Group[1] (ISTAG), the European Technology Platforms[2] in ICT and other preparatory activities including workshops involving the main stakeholders. The Work Programme is also in line with the main ICT policy priorities as defined in the i2010 initiative[3] - a European Information Society for Growth and Employment.

The Work Programme will be updated on a regular basis.

[1] The ISTAG report on the recommendations for the Work Programmes in FP7, the strategic research agendas of the European Technology Platforms in ICT and other reports on preparation workshops and Commission internal groups are available on the IST Web page http://cordis.europa.eu/ist.
[2] http://cordis.europa.eu/technology-platforms/
[3] http://ec.europa.eu/i2010/

ICT - Information and Communication Technologies

1 Objective

Improving the competitiveness of European industry and enabling Europe to master and shape future developments in ICT so that the demands of its society and economy are met. ICT is at the very core of the knowledge-based society. Activities will continue to strengthen Europe's scientific and technology base and ensure its global leadership in ICT, help drive and stimulate product, service and process innovation and creativity through ICT use and ensure that ICT progress is rapidly transformed into benefits for Europe's citizens, businesses, industry and governments. These activities will also help reduce the digital divide and social exclusion.

2 ICT research drivers: The 2015-2020 ICT landscape

This Work Programme (WP) defines the priorities for the calls for proposals to be launched in the period 2008-09. Projects resulting from these calls will start having an impact on markets in the 2015-20 timeframe. By then, the global ICT/knowledge infrastructure – networks, devices, services – as well as the market structures, value chains and business models are likely to have changed considerably from today's situation. The research challenges in this WP are expressed with this in mind. They focus on high risk ICT collaborative research forming part of a medium to long-term agenda.

New breakthroughs in ICT will continue over the next decades to bring ever-more wide ranging applications that will continue to drive growth and innovation and ensure sustainability in our economies and societies. In the context of defining priorities for this WP, three future technology and socio- economic transformations stand out: the "*Future Internet*", the "*alternative paths to ICT components and systems*" and "*ICT for sustainable development*":

1. New network and service infrastructures will emerge replacing the current Internet and Web. The research effort in this field has to be refocused to ensure European leadership in developing the "*Future Internet*".
2. ICT based on nano-scale integration, new materials, photonics and organic electronics will provide new types of devices and intelligent systems. Research has to take into account also the *various new paths towards the next generation components and systems*, notably in the "beyond CMOS", photonics, micro-systems, embedded systems, organic and large-area electronics domains.
3. The future developments of ICT will be driven to a large extent by emerging societal challenges. In particular, the next generations of ICT will have to support the targets for lower carbon emissions not only with ultra low power consumption ICT devices and equipment but also through ICT solutions for better energy efficiency, lighting, virtual mobility and more efficient environmental simulation and monitoring. Support to this area is strengthened substantially and will address the various dimensions of ICT's contribution to sustainability.

In addition to the above transformations, the main mid-to-long term drivers for ICT research priorities identified for the first phase of FP7 remain valid today. These drivers include the high expectations of "more for less", i.e. more *functionality and performance* at lower cost as well as the need for better *scalability, adaptability and learning* capabilities of ICT systems. They also include stronger requirements for *reliability and security* of ICTs and the need to handle higher volumes and more complex *digital content and services* and to facilitate user control. More *innovation is also emerging from the use of ICT* in ever more challenging applications in particular for health and social care, for transport, for lifestyle, culture and learning, energy and the environment.

3 Priorities, features and structure

3.1 WP structure: Focus on a limited set of Challenges

Achieving the best possible impact for Community support requires focusing and concentrating effort on key RTD challenges. This Work Programme proposes a structure around *seven challenges* that should be addressed if Europe is to be among the world leaders in next generation ICT and their applications. The challenges are driven either by industry and technology objectives or by socio-economic goals. For each challenge precise targets and deliverables are identified in a 10 year time frame.

In pursuit of the challenge targets, a set of research *objectives* will be called for in 2007. These objectives are described in the next chapters of the Work Programme and will provide the focus for the Calls for proposals. For each objective, the Work Programme defines the *target outcome* of the supported research and the *expected impact* of these outcomes on the European economy and society.

3.1.1 Overcoming technology roadblocks and reinforcing Europe's industrial strengths

For European industry to be among the leaders in ICT in the next ten years, our researchers and engineers have to address *three major technological challenges***.** These have been identified in particular with the help of the European Technology Platforms in ICT and are as follows:

– *Pervasive and trustworthy network and services infrastructure* that will gradually replace the current Internet, mobile, fixed and audiovisual networks. The "*Future Internet*" is a major federating research theme within this challenge.

– Engineering of context-aware and easy-to-use ICT systems that self improve and self-adapt within their respective environments. The fields of *cognitive systems, robotics and interaction* remain priority research topics.

– The increasingly smaller, cheaper, more reliable and low consumption *electronic components and systems* taking into account the *alternative paths* to next generation technologies and building the basis for innovation in all major products and service.

3.1.2 Seizing new opportunities and applying ICT to address Europe's socio-economic challenges

Four challenges for ICT research are driven by socio-economic goals and are in line with the flagship initiatives of the i2010 policy framework:

- *Digital libraries and content* technologies that will help us handle complex information, preserve, develop and disseminate our cultural assets and improve our learning and education systems.

- ICT tools for *sustainable and personalised healthcare* ensuring delivery of quality healthcare at affordable costs and contributing to greater efficiency and safety of health systems.

- *ICT for mobility, environmental sustainability and energy efficiency* with more emphasis in the WP on the increasing role of ICT in reducing energy intensity and in bridging environmental information spaces and services.

- ICT for *independent living, inclusion and participatory governance* ensuring that all citizens can benefit from ICT and that ICT helps improve participation in public and active life.

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Research in *future and emerging ICT* will explore novel scientific foundations to overcome longer-term technology roadblocks and build new synergies between a wide range of scientific disciplines, as the bases to key future technologies.

3.1.3 Addressing synergies throughout the Programme

Breakthroughs in ICT increasingly come from cross-overs, combinations and convergence of technologies and disciplines at different levels, networks-services-devices. More and more, innovations come from the use of ICT in demanding application contexts.

In the more technology-led challenges, research is directed towards removing roadblocks and improving the capability of generic technology components, systems and infrastructures suitable for a range of applications. In the more application-led challenges, research is focused on new technology-based systems, products and services that provide step-changes in the capabilities of the resulting application solution.

The ICT Work Programme addresses a research problem through different angles corresponding to different technological challenges. One example is the research challenge related to the "Internet of Things" (IoT). One angle is offered by Objective 1.3 (a), concerned with the service architecture that enables the discovery of object properties and events. It is related to the governance of IoT type schemes, i.e whether events pertaining to objects should be stored locally, be advertised systematically or not, put in a common register, access policy questions etc. As such, it is a system-oriented Objective the mission of which is to define the service architecture within application schemes where objects can be under control of several organisations or entities over time. Another viewpoint is provided by Objective 1.1 (a) that targets novel architectural schemes at network level. That is, it works on the fundamental networking layers, i.e those dealing with routing and end-to-end connectivity. A third angle is given by Objective 1.4 addressing security and privacy in networks at the infrastructure level as well as the development of technologies to support security in networks of "tiny things". A fourth perspective is presented by Objective 3.5 (b) that targets system level integration, including programming of possibly opportunistic collections of smart networked objects, which may further invoke higher layer services. This integration addresses both functional requirements (e.g. reduced energy use) and non-functional aspects (e.g. real-time operating systems and – possibly ad-hoc - network protocol stacks).

3.2 The Joint Technology Initiatives (JTI) and Joint National Programme

JTIs are a pioneering approach to pooling public-private efforts, designed to leverage more R&D investments from Member States, Associated Countries and industry, and to reduce the tremendous fragmentation of EU R&D. Two JTIs related to the ICT Programme have recently been launched.

The focus of the ENIAC JTI in nanoelectronics will be industrial developments addressing mainly technology for the next generation of 'More Moore' and the 'More than Moore' domains. The ICT WP will typically cover the beyond CMOS fields and more advanced "More than Moore" domains preparing Europe for the design and manufacturing of the next generation components and miniaturised systems.

The ARTEMIS JTI will focus on developing industrial platforms for the development and implementation of embedded systems responding to industry requirements in specific application domains (e.g. for the automotive and aerospace sector, for smart homes and public spaces, energy efficiency, manufacturing etc.). In the embedded systems area, the ICT WP will typically address new concepts, technologies and tools for engineering next generation systems characterised by wide distribution and interconnection and responding, in addition to timeliness and dependability, to more stringent constraints in terms of size, power consumption, modularity and interactivity.

The Ambient Assisted Living (AAL) joint national programme will cover market-oriented R&D on concrete ICT-based solutions for ageing well with a time to market of 2-3 years, in particular with focus on involvement of SME's and the business potential. AAL will complement the ICT WP which will focus on longer tem research topics in this field which integrates emerging ICT concepts with 5-10 years time to market as well as essential research requiring larger scale projects at EU level, e.g. with strong links to standardisation.

3.3 Developing global partnerships

International cooperation represents the external dimension of the programme. It aims to support European competitiveness and to jointly address, with other regions of the world, issues of common interest and mutual benefit, thereby supporting other EU policies (sustainable development, environmental protection, disaster response, security …).

International cooperation activities proposed in this Work Programme have three main objectives:

- To jointly respond to major global technological challenges by developing interoperable solutions and standards.
- To jointly develop ICT solutions to major global societal challenges.
- To improve scientific and technological cooperation for mutual benefit.

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In addition to international cooperation activities addressed in the relevant objectives within the 7 Challenges and FET, horizontal international cooperation actions will be supported. By providing support to information society policy dialogues, this will contribute to increasing the participation of third country organisations in the Programme and will facilitate the widest diffusion and local exploitation of ICT research results.

3.4 General accompanying measures

Complementing the research agenda, three important priorities related to policy developments and innovation have emerged over the past few years. They concern the need to better

coordinate efforts to ensure the supply of high-quality ICT R&D skills in Europe, the need to raise awareness of the strong potential of pre-commercial procurement and also a co-ordinated approach to the setting-up of EU-level shared research facilities or excellence centres. To respond to these additional challenges, a set of Coordination Actions / ERA-NETs will help bring together the stakeholders to analyse the situation and agree on common priorities and actions for a selection of these topics

3.5 Involving SMEs and feeding innovation

The role of SMEs in innovation is undisputable. In ICT, they play a vital role in the development of new visions and in transforming them into business assets. They have a large capacity to focus their research effort and to take fast technical and business decisions. The Community research programmes in ICT provide major opportunities for SMEs to finance high-risk, early-stage research and development, to build strategic partnerships and to operate outside their local markets with higher value innovative products and services. This complements other SME-dedicated Programmes such as the recently launched Eurostars. This European innovation programme managed by EUREKA provides funding for market-oriented research and development specifically targeted to R&D-performing small and medium-sized enterprises.

Particular attention is paid to SMEs' needs and potential in the definition of the priorities of the ICT Work Programme. Building on the experience of SMEs' participation in ICT research under FP6 and in the first phase of FP7, the aim is to ensure that SMEs constitute an important part of the ICT research consortia together with large companies, universities, and public research labs.

The rules for participation in FP7 also encourage further SME participation. For SMEs in FP7 projects, the Community financial contribution may reach a maximum of 75% of the total eligible costs (as compared to 50% in FP6 and in previous Programmes). The ICT theme in FP7 is therefore expected to continue to draw a high number of innovative SMEs that are ready to undertake research and development both in emerging technology fields with high growth potential and in key ICT application fields.

3.6 Contributing to European and global standards

Standardisation is recognised as an important research outcome and as a visible way to promote research results. Contribution and active support to industrial consensus eventually leading to standards is strongly encouraged. Integrated Projects are considered as important vehicles to promote research results through standardisation, and in particular for the three major technological challenges. Set up of project clusters will also be encouraged, such that industrial consensus can be facilitated across project dealing with similar issues and such that smaller Streps project can be fully integrated in the picture.

For the four challenges driven by socio-economic goals, standards are also considered as important issues in the context of unified citizen access to Europe wide services.

The European legislation recognises at this stage three Standards Development Organisations. Insofar as possible, elaboration of downstream standards should be conceived with these organisations as target recipients. However, it is recognised that the ICT sector is evolving fast and that multiplicity of ad-hoc foras have emerged. Contribution to such foras can also be targeted by project results, but the European added value needs to be clearly justified.

Standards are also considered as an important element in the field of international co-operation. Beyond access to non available research capability in Europe, international co-

operation in the context of industrial research should have global consensus and standards as a main target.

3.7 Encouraging the use of Internet Protocol version 6 (Ipv6)

IPv4, with about 4 billion addresses, will not be enough to keep pace with the continuing growth and evolution of the Internet. IPv6, with its wide range of addresses, provides a straightforward and long term solution to the address space problem. Its ability to have simultaneously supported communications endpoints, not necessarily restricted at the device interface, allows applications to have independent addresses for each service, thereby allowing innovation beyond the current limitations.

Research projects wishing to have a durable impact on the ICT landscape and market should naturally base their developments on future-proof networking technologies. They should therefore consider carefully the choice of the Internet Protocol in their design. In May 2008 the Commission adopted an Action Plan to support the deployment of IPv6. Under this Action Plan, research projects funded by Framework Programme 7 and facing a choice of computer network protocol are encouraged to utilise IPv6 whenever possible.

3.8 Bringing the user in research cycles

Advanced user-driven open innovation methodologies such as Living Labs address the problem of bridging the gap between technologies and applications by integrating all relevant actors in a flexible service and technology innovation ecosystem. This helps bring the user in the loop at an early stage of the R&D cycle, thereby offering industry and businesses to better mature and exploit their research results.

Proposers are encouraged to apply these methodologies for better discovering new and emerging behaviours and use patterns, as well as for assessing at an early stage the socio-economic implications of new technological solutions.

The direct involvement of user communities is encouraged, as appropriate, across the Work Programme and in particular under the Future Internet experimental facility in Challenge 1, in the objectives under Challenge 7, as well as in the other challenges driven by socio-economic goals.

3.9 The socio-economic dimensions of ICT

As a general purpose technology, ICT impact the economy through the creation of new consumption and investment goods, new intra and inter-industries input-output relations and also through new processes and new business models. The deployment of ICT in firms does require complementary investments in skills and knowledge in order to be fully exploited. However, their impact on growth, productivity as well on the knowledge capital stock is significant and generally strongly underestimated.

Most R&D projects have a clear socio-economic dimension from the outset. This may include, for example, evidence-based impact assessment and pro-active initiatives in order to accelerate diffusion and societal acceptance. In addition, the programme will support social and economic research, launched through accompanying measures or calls for tenders, to better assess the impact of ICT at macro, industry and firm level, in particular by taking into account investments in intangibles (R&D, skills, new organisations and networks). This will complement assessments of the impact of individual projects and of the ICT programme as a whole.

3.10 European Technology Platforms in ICT and the Work programme

European technology Platforms (ETPs) bring together the main industry and academic research stakeholders in a particular field with the aim of better coordinating their research and related activities and achieving common goals. An important outcome of each ETP is a Strategic Research Agenda agreed by its members that also commit to its implementation. These Strategic Research agendas[4] constitute an important input to the Work Programmes in FP7.

The industrial and academic research stakeholders in ICT have set up European Technology Platforms in nine ICT fields. These cover the fields of nano-electronics, photonics, micro-systems, embedded systems, software and services, mobile communications, networked media, satellite communications and robotics.

3.11 Co-ordination of non-Community research programmes

The actions undertaken in this field in FP7 include the coordination of national or regional research programmes or initiatives (see Appendix 3) and the participation of the Community in jointly implemented national research programmes (Treaty Article 169). The actions will also be used to enhance the complementarity and synergy between the Framework Programme and activities carried out in the framework of intergovernmental structures such as EUREKA, EIROforum and COST.

The coordination of national or regional research programmes or initiatives are called for within several objectives in this Work Programme. In addition, the participation of the Community in national research programmes jointly implemented on the basis of Article 169 is implemented in the area of ICT for Ambient Assisted Living. Objectives under all Challenges as well as FET call for the coordination of national or regional research programmes or initiatives. An ERA-NET Plus action is called for in the photonics area.

3.12 Funding schemes

The activities supported by FP7 will be funded through a range of "Funding schemes" as specified in Annex III of FP7. These schemes will be used, either alone or in combination, to fund actions implemented throughout the Framework Programme. The funding schemes used for the research objectives identified in this Work Programme are the following:

1. Collaborative projects (CP)

Support to research projects carried out by consortia with participants from different countries, aiming at developing new knowledge, new technology, products, demonstration activities or common resources for research. The Funding Scheme allows for two types of projects to be financed: a) “small or medium-scale focused research actions” (STREP), b) “large-scale integrating projects" (IP).

2. Networks of Excellence (NoE)

Support to Joint Programme of Activities implemented by a number of research organisations integrating their activities in a given field, carried out by research teams in the framework of longer term cooperation.

3. Coordination and support actions (CSA)

[4] Individual Strategic Research Agendas of the European Technology Platforms in ICT are available on the following Web page: http://cordis.europa.eu/ist/about/techn-platform.htm

Support to activities aimed at coordinating or supporting research activities and policies (networking, exchanges, coordination of funded projects, trans-national access to research infrastructures, studies, conferences, etc). These actions may also be implemented by means other than calls for proposals. The Funding Scheme allows for two types of projects to be financed: a) "Coordination Actions" (CA), b) "Specific Support Actions" (SA).

This work programme specifies for each of the research objectives, the type(s) of funding scheme(s) to be used for the topic on which proposals are invited.

3.13 Links with other Programmes

Links with ICT in the CIP

The ICT theme in FP7 is one of the two main financial instruments in support of the i2010 initiative that is the Union's policy framework for the information society. The other main financial instrument is the ICT specific programme within the Competitiveness and Innovation programme (CIP). ICT in the CIP aims at ensuring the wide uptake and best use of ICT by businesses, governments and citizens. ICT in FP7 and ICT in the CIP are therefore complementary instruments aiming at both progressing ICT and its applications and at making sure that all citizens and businesses can benefit from ICT.

Links with the Research Infrastructure part of the Capacities Programme

Support will be provided to ICT-based research infrastructure (eInfrastructure) under the Research Infrastructures part of the Capacities programme. This will build on the success of the GEANT research network and the research-Grids infrastructure supported in FP6 and in the first phase of FP7 and will provide higher performance computing, data handling and networking facilities for European researchers in all science and technology fields. Coordination between this activity and the ICT theme in the cooperation programme will ensure that the latest and most effective technology is provided to European researchers. Support will also be given to other ICT research infrastructure under the targeted calls of the Capacities programme. These will cover areas such as ICT Living Labs, clean rooms for nano-electronics and Embedded Systems research facilities.

Links with the other Specific Programmes in FP7

In addition to the ICT theme in the Cooperation Specific Programme, the ICT research and development community will also be able to benefit from the other specific programmes that are open to all research areas including the Ideas, People and Capacities programmes.

4 Content of calls in 2008 and 2009

4.1 Challenge 1: Pervasive and Trustworthy Network and Service Infrastructures

The "Future Internet" is emerging globally as a federating research theme. The current Internet architecture was not designed to cope with the wide variety, and the ever growing number of networked applications, business models, edge devices, networks and environments that it has now to support. Its structural limitations in terms of scalability, mobility, flexibility, security, trust and robustness of networks and services are increasingly being recognised world-wide. The challenge is to comprehensively and consistently address

the multiple facets of a Future Internet, with energy efficiency also appearing as an important societal concern.

From a networking perspective, this entails a need to rethink architectures such that a wider variety of service types can be supported, novel types of edge networks such as wireless sensor networks may be integrated, and constraints imposed by new types of media applications such as 3D virtual environments can be supported. Mobility and ever higher end to end data rates also emerge as important design drivers, and so does security and trustworthiness. At network level, a clear challenge will be to provide the Internet with the flexible and ad-hoc management capabilities that have never been part of the "best effort" paradigm driving the original design. Novel radio and optical systems are important components of this overall network perspective.

These network infrastructures need to support an Internet of dynamically combined services with worldwide service delivery platforms and flexibly enable the creation of opportunities for new market entrant. The “third party generated service” is emerging as a trend supporting the move towards user-centric services, as shown by the advances in Service-Oriented-Architectures and in service front-ends as the interface to users and communities. Virtualisation of resources remains an important research driver enabling the delivery of networked services independently from the underlying platform, an important issue for service providers. Advances in these domains also require breakthroughs in software engineering methods and architectures addressing complexity in distributed, heterogeneous and dynamically composed environments, as well as non-functional requirements.

Networks and service platforms will become increasingly vulnerable as current developments lead to more complex and large-scale heterogeneous networks with massive distributed data storage and management capacity. They need to be made *trustworthy* which is defined in this context as: secure, reliable and resilient to attacks and operational failures; guaranteeing quality of service; protecting user data; ensuring privacy and providing usable and trusted tools to support the user in his security management. Trustworthiness needs to be considered from the outset rather than being addressed as add-on feature. Societal and legal issues increasingly impact technological choices. ICT must be developed to ensure a society based on freedom, creativity and innovation, whilst providing security for its citizens and critical infrastructures.

As the Internet has revolutionised the access to multimedia content and enabled collaborative user-generated content, requirements in this field have huge impact on a Future Internet. Advances in 3D processing give rise to innovative applications notably in gaming technologies and in virtual worlds. These place new types of traffic demands and constraints on network platforms, create new requirements for information representation, filtering, aggregation and networking. They drive demand towards novel search tools and raise issues of identity management, ownership and trading of virtual digital objects as well as right of use. These environments coupled with their usage rules drive the research towards a "3D Media Internet" as a basis of tomorrows networked and collaborative platforms in the residential and professional domains.

The Internet is also revolutionising the Enterprise and businesses environments, with the introduction of RFID technologies enabling more automated processes. These open the way towards an Internet of things, where multiplicity of tags, sensor, and actuators provide physical world information enabling new classes of applications combining virtual and physical world information. Open architectures supporting such environments as well as understanding of their impact on the Internet hence emerge as research drivers. Integration with the mainstream business management platforms as well as integration of multiple businesses in collaborative and ad-hoc environments needs to also be taken into account.

Finally, there is an increasing demand from academia and industry to bridge the gap between long-term research and large-scale experimentation through *experimentally-driven research*. A fundamental need in this approach is the set-up of *large-scale experimentation facilities*, going beyond individual project testbeds, which help putting together different research communities in an interdisciplinary approach, anticipating possible migration paths for technological developments which may be potentially disruptive, discovering new and emerging behaviours and use patterns in an open innovation context, as well as assessing at an early stage the socio-economic implications of new technological solutions. For their demonstration and experimentation, proposers under Challenge 1 are encouraged to use the dynamically evolving Future Internet Research and Experimentation (FIRE) facility and to federate their project testbeds within this facility.

Objective ICT-2009.1.1: The Network of the Future

Target Outcomes

a) **Future Internet Architectures and Network Technologies**

Overcoming structural limitations of the current Internet architecture resulting from an increasingly larger set of applications, of devices and edge networks to be supported.

- ***Novel Internet architectures and technologies*** enabling dynamic and efficient support of a multiplicity of user requirements and of applications with various traffic patterns, variable end-to-end quality of service, point-to-point or point-to-multipoint distribution modes, and supporting legacy and future service architectures. The target architecture enable scalability in terms of edge devices, service attributes, application environments and diverse technological domains. It should support personalised rich media networking, machine-to-machine communication, wireless sensor networks, ad-hoc connectivity networks as well as personal and body area networks. It should also be wireless-friendly, natively support mobility, be spectrum- and energy-efficient, support future very-high-data-rate all-optical connections as well as heterogeneous wired/wireless access domains. Routing and location-independent addressing or naming, dynamic peering, signalling, and end-to-end content delivery techniques are related research issues.

- ***Flexible and cognitive network management and operation frameworks*** enabling dynamic, ad-hoc and optimised resource allocation and control, administration with accounting that ensures both a fair return-on-investment and expansion of usage, differentiated performance levels that can be accurately monitored, fault-tolerance and robustness associated with real-time trouble shooting capabilities. The management architecture should target self-organised and self healing operations, cooperative network composition, service support and seamless portability across multiple operator and business domains.

Migration paths and coexistence through overlay, federation, virtualisation and other techniques should be investigated to support several network and management architectures including legacy systems. Benchmarking capability of the proposed architecture(s) is to be considered from the onset.

Clean slate or evolutionary approaches or a mix of those can be equally considered.

If third country partnership is felt relevant by proposers, priority should be for those third countries having established programmes in this field, notably Japan and the USA.

b) **Spectrum-efficient radio access to Future Networks**

- ***Next-generation mobile radio technologies*** that are cost-, spectrum- and energy-efficient and adapted for implementation in future high-capacity mobile radio systems. Key technology

building blocks expected to be addressed are adaptive modulation and coding schemes, multiple antenna and user detection schemes, cross-layer design and low–latency transmission schemes. They are expected to be complemented by co-operative technologies at base station and/or terminal level, novel network topologies and related dynamic channel modelling and estimation. Integrated projects are expected to take a comprehensive approach to the key technology building blocks and develop system evolution paths by jointly designing radio transmission techniques and radio interface protocol stacks and considering spectrum co-existence and sharing.

- ***Cognitive radio and network technologies*** reducing the management complexity and enabling seamless service provision in a radio environment with a large number of heterogeneous radio access technologies. These should support environment-aware, self-reasoning- and learning-capable mobile devices that can change any parameter or protocol based on interaction with the environment with or without network assistance.

- ***Novel radio network*** architectures enabling the innovative usage of licensed, unlicensed or unused radio spectrum with the aim of radical cost- and energy-reduction. Target environments range from short to medium distance including systems based on femto-cells, ad-hoc networks and vehicular networks, up to wide-area terrestrial and satellite-based radio access networks.

c) **Converged infrastructures in support of Future Networks**

- ***Ultra high capacity optical transport/access networks*** based on state-of-the-art photonics with transparent core-access integration, optical flow/packet transport and end-to-end service delivery capability, overcoming the limitations of segmentation between access, metro and core networks and domains, access network limitations, the need for energy efficiency. Integrated projects are expected to address also a network control plane supporting flexible management capability of multi-domain and multi-operator contexts with end-to-end carrier grade performance.

- ***Converged service capability across heterogeneous access:*** Breakthrough technologies and architectures for seamless ubiquitous broadband services, integrating wired and wireless, fixed and mobile technologies in hybrid access networks, including hybrid-satellite networks. These enable generic support for service portability across composite networks through the service-network interface, with ubiquitous access from any network, from any technological or administrative domain, from any location and with a variety of access devices.

d) **Coordination/ Support actions and Networks of Excellence**

- Coordination of research efforts to explore synergies across on-going national initiatives and with third countries (priority is with the USA and Japan); support actions to channel efforts towards standardisation initiatives and a coherent approach towards take-up and testing of new concepts leading to a European-led Future Internet.
- Support to integrated satellite and terrestrial systems with a focus on supporting both public service and private communication requirements.
- Research roadmaps, organisation of scientific and/or policy events, strategy and policy formulation.
- Networks of Excellence in new and emerging topics, with a clear and limited focus, requiring interdisciplinary teams of researchers.

Expected impact

- Strengthened positioning of European industry in the field of Future Internet technologies and reinforced European leadership in mobile and wireless broadband

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systems optical networks cognitive network management technologies..Increased economic efficiency of access/transport infrastructures (cost/bit)

- Global standards and European IPRs reflecting federated and coherent roadmaps.
- Wider market opportunities from new classes of applications taking advantage of convergence.
- Accelerated uptake of the next generation of network and service infrastructures.

Funding schemes

a), b), c): IP, STREP; d): NoE, CSA

Calls and indicative budget distribution

- ICT Call 4 - target outcomes b) and c):
  - IP/STREP: 110 M€ of which a minimum of 50% to IPs
- ICT Call 5 - target outcomes a) and d):
  - IP/STREP: 71 M€; of which a minimum of 50% to IPs
  - NoE: 6 M€; CSA: 3 M€

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Objective ICT-2009.1.2: Internet of Services, Software and Virtualisation

Target outcomes

a) **Service Architectures and Platforms for the Future Internet**

- ***Service front ends*** enabling communities of networked users easily to compose, configure, share and use services and providing device and context aware service adaptations. They facilitate the development of, search for and interaction with services, cover the service life cycle and take account of social network users having different levels of expertise.

- ***Open, scalable, dependable service platforms, architectures, and specific platform components,*** enabling automatic service description, discovery, composition, and negotiation with a multiplicity of reusable services, which may be mobile, multi-device, multi-context or nomadic. Evolution and interoperability of service platforms are also needed, and scale and complexity in dynamic, distributed heterogeneous environments, including open service networks, should be addressed. System management functionalities such as Service Level Agreement (SLA) management, Quality of Service (QoS), access rights and customer charging have to be supported, as should semantic interoperability and access to service repositories. Full account should be taken of the convergence of IT/telecom/content systems and opportunities for breaking down the barriers between the web and telecommunication services.

- ***Virtualised infrastructures*** extending the capabilities of distributed computing, storage and communication infrastructures to manage a multiplicity of underlying hardware and software resources and seamlessly integrate them within the composite service orientation paradigm enabling operations across heterogeneous technological and business domains. These virtualised infrastructures allow the flexible, dynamic, dependable and scalable provision of advanced services to support the various resource requests/needs of service platforms, including software as a service, resource as a service and other approaches.

b) **Highly Innovative Service / Software Engineering**

- ***Service / Software engineering methods and tools*** covering automatic support at run-time for decisions and changes that are currently adopted at design time. Focus is on innovative

approaches to very large, dynamic open service networks, user development of services/software, systems evolvability and acquisition, reasoning and incorporation of domain knowledge in all phases of the service/software life cycle. High-level description and executable languages for services/software with support for adaptation are in the scope of the research.

- ***Verification and validation*** methods, tools and techniques assuring the quality of open, large-scale, dynamic service systems without fixed system boundaries, addressing the complete service and software life cycle.

- Methods, tools and approaches specifically supporting the development, deployment and evolution of ***open source software.*** Investigation into the use of open source approaches for improving service engineering, deployment, management, evolution and take-up.

c) **Coordination and support actions**

- Support for standardisation and collaboration. Support to cross-sector coordination on convergence of IT, telecom and media; specific actions to build concepts and critical mass for services in the Future Internet.
- Maximisation of impact of projects in this area, including SME-oriented technology transfer actions such as dissemination and training.
- Application of open source models of development and innovation through rapid cycles of reuse and improvement to service engineering.

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Expected impact

- A major contribution to the Future Internet in terms of service development, management and interoperability in an environment of converged IT, telecom and media platforms.
- Deep technological advances in software/service engineering.
- A more competitive environment including infrastructure operators moved up the value chain with sophisticated service offerings on scalable infrastructure.
- Lowered barriers for service providers, in particular SMEs, to develop services through standardised open (source) platforms and interfaces.
- Massive uptake of high-added value services through innovative service front ends and a higher user empowerment and more advanced and dynamic online communities through platforms enabling "third party generated services".
- A strengthened industry in Europe for software, software services and Web services, offering a greater number of more reliable and affordable services, enabled by flexible and resilient platforms for software/service engineering, design, development, management and interoperability.

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Funding schemes

a), b): IP, STREP; c): CSA

Indicative budget distribution

- IP/STREP: 107 M€ of which a minimum of 50% to IPs

- CSA: 3 M€

Call

ICT Call 5

Objective ICT-2009.1.3: Internet of Things and Enterprise environments

Target outcomes

a) **Architectures and technologies for an Internet of Things**

- ***Architectures and technologies using open protocols, which enable novel Internet-based applications*** including – but not restricted to – business/enterprise scenarios, use information generated at the periphery of the network from the virtual and physical worlds with aggregation of those, and allow action on the physical world. Physical world event information are generated by tags, sensors, actuators and wireless devices. Related processes and applications may be object or location-centric and cover management capabilities of various classes of events, such as real world events (sensor based), behavioural/people events, or business events.

- ***Optimised technologies covering distribution of intelligence*** between the edge network and the more centralised business/process information system This includes service discovery systems as well as scalable, secure, open middleware necessary to put real world data into the context of various Internet applications with event processing, separation and filtering. Of particular importance are the integration and interoperability with the mainstream business/process management platforms and tools and the necessary management of varying data ownership across the edge device/object life cycle.

- ***Architectural models*** enabling an open governance scheme of the Internet of Things, without centralised gatekeeper lock-in of critical business/process functionalities.

If third country partnership is felt relevant by proponents, priority should be for those third countries having established links with the EU in this field, including the U.S., Japan, Korea, China, and India.

b) **Future Internet based Enterprise Systems**

Software platforms supporting highly innovative networked businesses on top of an Internet of Services. These platforms should enable increased flexibility of the resources managed by virtual organisations and facilitate dynamic outsourcing with third parties capability to aggregate services, act as intermediaries for delivery, and provide innovative new channels for consumption. Collaboration and interoperability are key features of these dynamic ecosystems supported by next generation knowledge management services, making use of semantically enriched information, including object/sensor information.

c) **International co-operation and co-ordination**

- Strategic visions covering the Internet of Things and/or integrated businesses going beyond current process-based or analytical approaches to include frameworks based on fuzzy logic, decisional or systemic approaches; research roadmaps, organisation of events.
- RFID: Exchange of best practices from field trials or the deployment of pilot projects as well as collaborative pre-normative research aiming at global standards, as part of the "Lighthouse priority project" decided at the EU-US Transatlantic Economic Council in April 2007. Organisation of the European follow-up of this initiative to support the established dialogue.

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Expected impact

- Strengthened competitiveness of European businesses in all sectors of the economy through more automated processes, new classes of applications, and more generic and

open architectures, and through the support to dynamic and composite business models for the delivery of customisable high added value products or services.

- European leadership in the supply of integrated business solutions exploiting the fast development of RFIDs and smart tags and taking advantage of fusion between the real world and the virtual web-based world.

Funding schemes

a), b): IP, STREP; c): CSA

Indicative budget distribution

- IP/STREP: 35 M€; the objective is to support at least 2 IPs

- CSA: 2 M€

Call

ICT Call 5

Objective ICT-2009.1.4: Trustworthy ICT[5]

Target outcomes

a) **Trustworthy Network Infrastructures**

- Trustworthy network infrastructures as well as communication, computing and storage infrastructures in the context of the development towards the Future Internet as a conglomerate of heterogeneous networks and systems. Work includes development of novel architectures with built-in security, dependability and privacy; secure interfaces and scalable dynamic security policies across multiple networks and domains; and trustworthy management of billions of networked devices, "things" and virtual entities connected in the Future Internet.
- Trustworthy platforms and frameworks for autonomously monitoring and managing threats, which need to be typically cross-border, cross-organisational, scalable, distributed, dynamically evolving and collaborative.
- Whilst developing technologies, projects should give adequate attention to aspects of usability, societal acceptance and economic and legal viability, through appropriate research, experimentation or demonstration in realistic, complex and scalable scenarios and contexts.

b) **Trustworthy Service Infrastructures**

- Trustworthy and privacy protecting service systems, platforms and infrastructures as part of the development towards the Future Internet, which support adaptability, interoperability, scalability and dynamic composition of services for citizens and businesses. Work includes flexible and dynamic mechanisms and risk-based methodologies to respond to threats and vulnerabilities, as well as to changes and conflicting demands in operating conditions, business processes or use practices through the full life cycle.
- Interoperable frameworks for identity management for persons, tangible objects and virtual entities, with emphasis on user-centricity and respect of privacy for personal users.

[5] *Trustworthy* is defined in this context as: secure, reliable and resilient to attacks and operational failures; guaranteeing quality of service; protecting user data; ensuring privacy and providing usable and trusted tools to support the user in his security management.

- Whilst developing technology, projects should give adequate attention to aspects of usability, societal acceptance, human behaviour and principles of human rights and legal and economic viability. This could involve multi-disciplinary research activities, experiments or demonstration in realistic, complex and scalable scenarios and contexts.

c) **Technology and Tools for Trustworthy ICT**

- In highly distributed networked process control systems and in networks of very high number of things. Understanding threat patterns for pro-active protection.
- For user-centric and privacy preserving identity management, including for management of risks and policy compliance verification.
- For management and assurance of security, integrity and availability, also at very long term, of data and knowledge in business processes and services.
- For assurance of trustworthiness of complex and continuously evolving software systems and services.
- In enabling technologies for trustworthy ICT. This includes cryptography, biometrics; trustworthy communication; virtualisation; and certification methodologies.

d) **Networking, Coordination and Support**

Support to networking, road-mapping, coordination and awareness raising of research and its results in trustworthy ICT.

Priority will be given to: (i) Emerging threats and vulnerabilities in the Future Internet, (ii) Security and resilience in design, performance and scalability of future software-based service systems, (iii) Economics of security addressing cost effectiveness and market compliance of security solutions, (iv) Promoting wide use of standards, certification models and best practices, (v) Legal and societal aspects related to technology development of trustworthy ICT; (vi) Coordination of national research actions in the field; (vii) International cooperation in fields where global action will create added value.

Networks of Excellence could be particularly relevant for the areas of (i), (ii) and (iii).

Expected Impact:

For IPs:

- Demonstrable improvement (i) of the trustworthiness of increasingly large scale heterogeneous networks and systems and (ii) in protecting against and handling of network threats and attacks and the reduction of security incidents.
- Significant contribution to the development of trustworthy European infrastructures and frameworks for network services; improved interoperability and support to standardisation. Demonstrable usability and societal acceptance of proposed handling of information and privacy.

For all projects:

- Improved European industrial competitiveness in markets of trustworthy ICT, by: facilitating economic conditions for wide take-up of results; offering clear business opportunities and consumer choice in usable innovative technologies; and increased awareness of the potential and relevance of trustworthy ICT.
- Adequate support to users to make informed decisions on the trustworthiness of ICT. Increased trust in the use of ICT by EU citizens and businesses. Increased societal acceptance of ICT through understanding of legal and societal consequences.

For networking, coordination and support actions (NoE/CSA):

- Improved coordination and integration of research activities in Europe or internationally in areas where that is beneficial for European research and innovation capacity. Broad support to research roadmaps and activities relevant for longer term research in the field of trustworthy ICT.

Funding schemes

a): IP; b): IP; c): STREP; d): NoE, CSA

Indicative budget distribution

- IP/STREP: 80 M€ of which a minimum of 50% to IPs

- NoE, CSA: 10 M€.

Call

ICT Call 5

Objective ICT-2009.1.5: Networked Media and 3D Internet

Target outcomes

a) **Content aware networks and network aware applications**

- Architectures and technologies for converged and scalable networking and delivery of multimedia content and services dynamically optimised with policies taking into account the content and adaptation needs, the user contexts, requirements and social relational network for a variety of contents, services that may include home management, applications, locations and mobility scenarios. They enable multiple user roles as content producer, user or manager.

- Maintaining the integrity and quality of media across media life cycle to optimise quality of experience in collaborative media creation and delivery scenarios, with optimised sharing, storage, retrieval, fusion capabilities. Open architectures making the most of both the ever increasing device/edge processing power and network bandwidth, especially for real time highly demanding immersive collaborative environments (e.g games). Enhancement of 2D scalable video coding, multi view point coding, 3D coding that can achieve optimised network awareness and device delivery are within scope.

b) **3D Media Internet**

- Architectures and technologies for Future Media Internet and 3D processing enabling mass distribution, caching, filtering, aggregation and networking of 3D content with optimised user quality of experience, Optimised impact on the performance of the underlying processing and networking platforms. Optimisation of real time rendering of complex scenes from personalised user perspectives and minimisation of latency experienced through the network and associated edge processing platforms.

- Technologies for 3D content representation with configuration/adaptation capabilities in multiple virtual worlds, with user controlled management of ownership, identification, trading, rights associated to presence in (possibly multiple 3D) domains.

- Architectures and technologies ensuring that 3D augmented worlds are tightly coupled to the physical world, for commercial or social applications, beyond games.

c) **Networked search and retrieval**

- Networked technologies and architectures with repositories and cached content optimising networked search, adaptation and access to relevant multimedia information composed of

several information sources, types and origins, including physical world event information. It covers interaction with content, media-to-network and to (mobile) device dynamic adaptation, search capabilities across distributed repositories and P2P networks, and adaptation to context and to specific application domains.

- Adaptive technologies based on relevance or contextual and user feedback enabling personalisation of multimedia networked search, as a function of user contexts, perception and usage profile.

d) **Immersive media experiences beyond HDTV and electronic cinema**

End to end architectures for next generation multimedia and cinema experiences beyond HDTV and current electronic and digital cinema with higher than today quality of experience, based on technologies enabling higher frame rates, wider colour gamut, higher contrast range, higher screen resolution, advanced version of spatialised sound, 3D capabilities, pervasive environments, immersive environments, multi viewpoint coding. Optimised end-to-end architectures should cope with the massive increase of throughput expected to be created with the above applications.

e) **Knowledge networks** to consolidate or establish European leadership in the fields covered in a).

For b) Support to integration of foundational research capacities to establish forward-looking 3D and Media Internet research agendas. Support to promotion of multidisciplinary education and sharing of research facilities.

For d) Integration of industry and academia research capacities to establish advanced research agendas in the field and support the sharing of research facilities.

f) **Support measures**

i) For a), b) Support to collaboration including with national initiatives and/or third countries, dissemination, research roadmaps, policy aspects, organisation of scientific and/or policy events.

ii) For c) support to co-ordination of activities at EU level in the domain of multimedia search, co-operation with third countries, research roadmaps and organisation of events of policy or research nature.

Expected impact

- Reinforced positioning of industry in Europe in networking and delivery of multimedia content and services, in 3D media Internet technologies, and in networked search. Strengthened European industry in multimedia experiences beyond HDTV and in electronic cinema.
- Wider market opportunities, including for content-related SME's, from innovative mass market or societal applications (e.g. games, entertainment, or education, culture, and service creations, based on novel networked media technologies and systems
- Wider uptake of networked and collaborative platforms based on a "3D media Internet".
- Global standards and European IPRs reflecting federated and coherent roadmaps.

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Funding schemes

a), b), c), d): IP, STREP; e): NoE; f): CSA

Indicative budget distribution

- IP/STREP: 70 M€ of which a minimum of 50% to IPs

- NoE: 6M€; CSA: 4M€

Call

ICT Call 4

Objective 1.6: Future Internet experimental facility and experimentally-driven research

Target outcomes

a) **Building the Experimental Facility and stimulating its use**: Building the prototype of the Future Internet Research and Experimentation (FIRE) experimental facility to support research for the Future Internet at different stages of the R&D cycle based on the design principle of "open coordinated federation of testbeds".

   The facility shall allow for: large scale experimentation with and comparison of visionary approaches for network architectures and technologies, service architectures and platforms, networked media and trustworthy infrastructures for the Future Internet; experimentation with systems based on cross-layer or non-layered approaches; direct involvement of user communities; assessment of the socio-economic and environmental impact of changes to the Internet. The facility should be dynamic, sustainable, open at all levels and based on open standards. Participation from INCO countries in particular at use level is encouraged.

   a1) **FIRE Components**: an operational prototype facility should be provided at an early stage in the project. Normally, at least 20% of the resources should be earmarked for gradually expanding the functionality of the prototype in a demand-driven and open way by federating testbeds providing additional functionality within the facility.

   a2) **FIRE Users**: using the mechanism of open calls, it is expected that another 20% of the resources are used for extending the use of the experimental facility for research groups that propose innovative usage scenarios exploiting the multiple dimensions and scale of the facility. These activities should exhibit a high degree of innovation in the use of the Facility, including system level experiments making a comprehensive use of several components of the facility, large scale experimentation, broad involvement of user communities, and assessment of socio-economic and other non-technological aspects. The results, lessons learnt and recommendations drawn must be of mutual interest, serving the needs of the users as well as helping the Facility operators to refine the concept of "open coordinated federation of testbeds" and the services provided by the Facility. Support of individual experiments should be focused on the setting up and running of the experiment and should typically not exceed 200 k€ per experiment.

b) **Experimentally-driven Research**: Visionary multidisciplinary research, defining the challenges for and taking advantage of the Experimental Facility above, consisting of iterative cycles of research, design and large-scale experimentation of new and innovative network and service architectures and paradigms for the Future Internet from an overall system perspective. The refinement of the research directions should be strongly influenced by the data and observations gathered from experimentation in previous iterations.

   Research should consider the Future Internet as a complex system and therefore address all the associated aspects in a holistic vision and at all relevant levels and layers. This includes the definition of relevant metrics as well as taking into account energy, low cost,

environmental or socio-economic aspects. This research will be linked to and an important driving element of the Experimental Facility.

c) **Coordination and Support actions**: coordination of related EU-level and Member States / Associated Countries activities, international co-operation with other initiatives in industrial and emerging countries, and collaboration on standardization in order to exploit synergies; multidisciplinary networking of research communities addressing both technological and socio-economic and environmental aspects of the Future Internet; co-ordination of experience research and user-driven open innovation activities establishing common concepts, roadmaps, methodologies and tools, including the sharing of best practices across pilots and sectors.

Expected impact

- Improved European competitiveness in Future Internet research and development by providing European researchers, in industry and academia, with a unique operational, sustainable, dynamic, and integrated large scale Experimental Facility, which is used by a significant number of Future Internet research projects in European and national programmes and beyond.
- Establishing the methodology of experimentally-driven research for the investigation of innovative concepts for the Future Internet taking a multidisciplinary and holistic approach.
- Assessment at an early stage of the technological, societal, economic and environmental implications of changes to the Internet.
- Strengthened European competitive position on experimentation environments through targeted international co-operation.
- Increased acceptance and use of the concept of user-driven open innovation through demonstrated benefits from complementary approaches of open testbeds, pilots, experience research, etc.

Funding schemes

a): IP; b): STREP; c): CSA

Indicative budget distribution

- IP/STREP: 45 M€ of which 25 M€ for IP (target outcome (a)) and 20 M€ for STREP (target outcome (b))

- CSA: 5 M€

Call

ICT Call 5

4.2 Challenge 2: Cognitive Systems, Interaction, Robotics

Engineering systems with the capability to sense and understand an unstructured environment is a challenge which goes beyond today's systems engineering paradigm. Present day systems engineering relies on specifying every eventuality a system will have to cope with in the execution of its task(s), and programming the appropriate response in each case. With the abundance of ever cheaper, smaller sensors, actuators and wireless tranceivers that link systems to the real world and with other systems, this approach faces serious limitations:

- The **real world** is generally too nuanced, too complicated and too unpredictable to be summarised within a limited set of specifications; there will inevitably be novel situations and the system will always have gaps, conflicts or ambiguities in its own knowledge and capabilities.
- Even in situations where unpredictable events are less likely, the problem of **extracting meaning and purpose** from bursts of sensor data or strings of computer code arises, because we don't have a formalisation of information processing that embodies semantics.

Challenge 2 aims to extend systems engineering to the design of systems that can carry out useful tasks (eg, manipulation and grasping, exploration and navigation, monitoring and control, situation assessment, communication and interaction), autonomously or in cooperation with people, in circumstances that were not planned for explicitly at design time. Specifically, such systems should be:

- *more **robust**:* performance should not degrade when they are presented with unexpected data;
- *more **adaptive**:* performance should be open (within reasonable constraints) to changing service requirements, without the need for extensive human intervention;
- *more effective:* performance should improve because they can predict or **anticipate** what might happen at some point in the future, near or far;
- *more natural:* performance should be tolerant to the ambiguity and **uncertainty** that is a consequence of dealing with humans, and performance should improve with time.

System capabilities in dimensions such as deliberation and learning, and innovation and creativity, would appear to be necessary to meet this aim. This clearly calls for design that shares some characteristics with the higher-level **cognitive** processes of the brain. For the purposes of this Work Programme a cognitive system can cope with the uncertainty (in the system's environment) that makes robust and adaptive performance difficult to achieve. It should also be borne in mind that it makes no sense to speak of robustness or adaptability without first **specifying the requirements** of interest: a robust lawnmower is different to a robust operating system or a robust planner.

Research and development efforts should aim at generating actual design principles. They will contribute to establishing scientific foundations for such principles. Alternatively, they may aim to achieve significant engineering progress, eg, through integration.

Manufacturers of robots of all sorts, autonomous vehicles, smart cameras and sensor networks will benefit from R&D efforts. Europe has strong manufacturing capabilities and a significant share of world market revenues in these sectors. The emergence of service robots and vision systems that operate outside structured manufacturing environments offer added opportunities for market expansion.

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Likewise automated machine translation stands to profit from more robust and adaptive methods for natural language understanding. With 23 official languages, the EU is at the forefront of multi-lingualism and it would be unrealistic to assume that the lingua franca in machine translation is, or will remain, English. A strategic challenge for Europe in today's globalised economy is to overcome language barriers through technological means.

Objective ICT-2009.2.1: Cognitive Systems and Robotics

Target outcomes

a) **New approaches towards understanding and solving key issues related to the engineering of artificial cognitive systems – see above**; among these issues are the following:

- representation / categorisation / recognition / interpretation of objects, events, situations, behaviours and affordances in realistically scaled real-world environments;
- the role and implementation of memory and learning in artificial systems;
- adaptive and anticipatory behaviour within incompletely specified environments;
- goal-setting and strategies for achieving goals;
- collective behaviour arising from the interplay of (possibly large numbers of) individual subsystems;
- modelling and design of (multimodal) interaction, communication and collaboration.

Projects are expected to demonstrate measurable progress on a suitable mix of these issues.

b) **New approaches towards endowing robots with advanced perception and action capabilities**, and towards developing pertinent benchmarks and tests. Of particular interest are:

- 3D sensing for everyday objects and environments;
- motion and affordance perception;
- learning and control strategies for linking perception and action;
- benchmarking with a focus on navigation and autonomy.

Projects are expected to demonstrate measurable progress on at least one of these issues.

Expected impact for a) and b)

- Leading-edge research capacity in Europe in cognitive systems engineering and robotics.
- Innovations in service robots, and industrial production and manufacturing processes.
- Widespread comparative assessment of robot performance (for different tasks and technologies).
- New market opportunities, and technologies for increased productivity and efficiency in EU industries.

c) **New ways of designing and implementing complete robotic systems** that operate largely autonomously in loosely structured dynamic environments and, where necessary, in close co-operation with people. Systems may be distributed and should integrate rich sensory-motor skills (for example, grasping, manipulation, locomotion) with high level cognitive competencies (for example, reasoning, planning and decision-making). As

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appropriate, they should be demonstrably more robust, dependable, flexible and adaptive, and safer than it is possible today, and improve their performance through learning.

d) **New, scientifically grounded system architectures integrating communication, control, and cognitive capabilities** to enable meaningful and self-sustaining autonomous action in real-world environments, natural interaction with people (where necessary), robust adaptation to changing operating conditions, and self-improvement. The viability and scalability of these architectures will be demonstrated through suitable experiments based on physical implementations and/or simulations of complete systems.

e) **A framework to facilitate cross-fertilisation between academic and industrial research efforts in robotics** through widespread experimentation with industry-strength platforms in academic research labs and through the joint definition of longer term scenarios and requirements to direct robotics research towards common goals; to assure a comparative assessment of performance through definition of suitable metrics and through benchmarking (supported by competitions or otherwise).

Expected impact for c), d) and e)

- Integrated and consolidated scientific foundations for engineering cognitive systems under a variety of physical instantiations.
- Significant increase of the quality of service of such systems and of their sustainability in terms of, for instance, energy consumption, usability and serviceability, through the integration of cognitive capabilities.
- Innovation capacity in a wide range of application domains through the integration of cognitive capabilities.
- Improved competitive position of the robotics industry in existing and emerging markets for instance in the following sectors: flexible small scale manufacturing; professional and domestic services; assistance and rehabilitation; construction, maintenance and repair; urban search and rescue; exploration and mining; entertainment, education and training.
- Consensus by industry on the need (or not) for particular standards. More widely accepted benchmarks. Strengthened links between industry and academia. (especially (e)).

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Research and development pertaining to targets (a), (b), (c) and (d) will be guided by demanding, yet pragmatic, application scenarios. Target environments may be, for example, difficult terrains, buildings, homes, public spaces, shop floors, power plants and other technical infrastructures. Functionalities include: exploration, monitoring, controlling all sorts of sensors and actuators and communication and interaction with people (also including advanced human-robot interaction).

The applicability of research results is expected to go beyond the scenarios through which they have been obtained. Proposals strictly focusing on applications that are targeted under Challenges other than Challenge 2 are not eligible under Challenge 2.

Pertinent research may be informed by neuro- and behavioural sciences and determine the requirements basic technologies have to meet in order to enable creating the targeted systems. Systems may for instance employ new sensor and sensor networking technologies or "intelligent" materials to enhance their functionality, performance, and efficiency of resource usage, and bring new functionalities, like self-configuration and self-repair, within reach of industrial realisation. Research will also significantly broaden the remit of machine learning and put stronger emphasis on intelligent process control in real-time.

f) **A "Virtual Institute"** integrating diverse research areas whose problems, techniques and solutions need to be brought together to understand cognitive systems and design useful new ones; they will develop a requirements- and capability-led understanding of cognitive systems that can be applied across multiple engineering and application domains.

Expected impact for f)

- Leading-edge research in Europe in cognitive systems engineering and robotics.

g) Co-ordinated **co-operation and communication** within a multidisciplinary robotics community in Europe, with concomitant outreach to potential users of robotic systems

h) Co-ordinated **co-operation and communication** within a multidisciplinary artificial cognitive systems research community in Europe, with concomitant outreach to potential industrial applications.

Expected impact for g) and h)

- Stronger cohesion among relevant communities; awareness built among wider (including non-professional) audiences of the potential of the technologies at issue.

Funding schemes

a)-b): STREP; c)-e): IP; f) NoE; g)-h) CA

Indicative budget distribution

153M€

Calls:

- ICT Call 4: target outcomes (b), (d), (f), (g)
  - IP/STREP: 73 M€ of which a minimum of 50% to IPs
- ICT Call 6: target outcomes (a), (c), (e), (h)
  - IP/STREP: 80 M€ of which a minimum of 50% to IPs

Objective ICT-2009.2.2: Language-based interaction

Target outcomes

a) **New architectures, models and tools for cost-efficient self-learning machine translation** systems, integrating advances from the relevant fields:

- Architectures and knowledge representation for self-learning machine translation;
- Novel language and translation models that support self-improving, knowledge-driven and interactive paradigms;
- Methods for automatic, dynamic and self-organising acquisition, processing and representation of linguistic (including semantic) knowledge;
- Models and theories of world knowledge, its relevance to the translating task and methods of formalisation.

The objective is to support one IP only that will cover two or more of these topics.

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Expected Impact

- Reduce by more than half the average quality difference between human translation and automatic translation, measured by adequacy-based quality indicators
- Practical and economically viable solutions for fully automatic provision of multilingual online content and services for the vast majority of EU languages
- Increase the average speed of human translation by a factor of 2 in eight years

b) **Specific solutions for key domain challenges**, taking into account the context in which automatic translation is applied:

- Portable, scalable and readily integrable solutions for fully automatic translation with adequate quality, especially in the on-line context;
- Self-learning and self-adapting approaches to automatic translation in an interactive and/or collaborative context, with adequate and economic interaction of the relevant actors (authors, translators, editors, end users);
- Novel, adaptive and interoperable solutions for managing multilingual content and communication;
- Methods for automated acquisition and annotation of language resources.

Each project should address one or more of the above listed topics.

Expected Impact

- Automated translation that is more interoperable, more adaptive, better capable of self-learning and more user-friendly
- Gaps in language coverage removed, and speed and quality of translation increased.

c) A **"Virtual Institute"** to:

- Federate a multidisciplinary community geared towards the new requirements for online multilingual communication;
- Establish and promote novel evaluation methods and metrics;
- Ensure networking between the machine translation research community and related activities, in particular knowledge management, semantic web, cognitive systems, (psycho-)linguistics, translation and computer science.

Expected Impact

- Leading-edge research in Europe fostered through self-sustained multidisciplinary networking in machine translation, language resources and evaluation.
- Improved ability to measure the performance of machine translation and the quality and coverage of language resources, through an open and standardized, adequacy-based evaluation infrastructure.

Extensive manual language-specific or topic-specific programming or adaptation are not in scope. Projects whose main emphasis is on input or output processes are not in scope.

Projects are expected to make appropriate use of the scientific advances in areas such as artificial intelligence, machine learning. They should be geared towards the new Internet paradigms involving interaction, collaboration and intelligent content.

Funding schemes

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a): IP; b) STREP; c) NoE

Indicative budget distribution

- IP/STREP: 20 M€; the objective is to support one IP only under a) in addition to STREPs
- NoE: 6 M€

Calls

ICT Call 4

4.3 Challenge 3: Components, systems, engineering

The component and systems business in Europe concentrates on added value operations, on systems integration, on new technologies and on enabling the end user industry to offer new technologies and total product/service solutions. The trends in miniaturisation, diversification, increasing software content and increasing emphasis on a systems approach remain valid and require significant improvements in chip design tools and methods. At the same time new opportunities are emerging in new technologies: beyond CMOS, photonics, organic and large-area electronics, 3D acquisition and visualisation, and new integration techniques. Increased multi-disciplinarity, integrated software/hardware systems, heterogeneous microsystems and the use of widely distributed systems for monitoring and control are growing challenges. In computing, mastering multi- cores and programming for ever-higher performance systems becomes essential. Cross-cutting issues such as efficient energy management and minimising the environmental footprint of manufacturing have become new desirable development objectives and are no longer seen as just an obstacle to performance.

Private equity capital, the increasing cost of manufacturing and research for the next generation of basic ***nanoelectronics*** technologies have been instrumental in the development of a few major global strategic R&D alliances close to manufacturing capabilities. Industrial R&D executed in Europe is shifting towards adding extra functionalities to the basic nanoelectronics technology, towards systems integration and to design innovative products. Institutional research is concentrating on long term or higher risk topics; on exploring multi-disciplinarity and on applied research into understanding and controlling new and complex systems.

Organic and large area electronics have very high market growth expectations with about half of the market for cheap and even disposable electronics, including RFID-tags and sensors. The EU has excellent R&D infrastructures and EU companies came early on the market with e-paper and e-tags products. It is also a leader in large area compound material photovoltaic cell manufacturing and in signage and lighting, expected to account for 20% of the market. The current trends are going beyond organic materials by including inorganic material. The technology is characterised by large area processing, by flexible products, and by the ability to create circuitry with modest upfront investment.

Photonics in core as well as in access networks, is gradually replacing electronics. Photonics is also an enabling technology that exploits advances in lasers, light sources, fibres, detectors, in materials (e.g. nanocrystals, organics, nanotubes) and in architectures / manufacturing processes (hybrid integration, silicon photonics and CMOS compatibility). It promises to play a major role in new areas such as energy saving (e.g. by improving photovoltaic and lighting efficiency), medicine, biology, environment and safety. The possibility to manufacture structures at the nanoscale - far below the wavelength - will radically change the traditional approaches by exploiting physical effects not accessible before. Europe has strong and recognized R&D capabilities in photonics including SMEs.

Microsystems integrate and interface multiple core technologies and related materials to implement a variety of functions. They are implemented through scalable homogeneous or heterogeneous hardware integration technologies in order to advance miniaturisation, functionality and reliability of the sensing, processing, actuating and communicating functions. Power autonomy (consumption and supply) is a common issue. Integration of multiple functions (sensing, logic, energy collection, wireless communication) into traditional materials, in particular textiles, is one of the priorities. In the medium term, there is growing industrial interest to integrate nanosensors in microsystems, mainly due to an increase in sensitivity, a device simplification and the associated cost reduction.

Embedded systems, computing and control: Inexpensive networking, sensing and sophisticated control is moving decision-making to the point-of-action, and value-added functions in software are driving the diffusion of embedded systems in an ever broader range of applications. Recent trends in embedded systems design include enhanced components and model-based methodologies for high-confidence systems able to overcome the challenge of complexity and the resulting low productivity. Computing systems are moving to multi-core and polymorphic architectures where radical rethinking of systems software, programming paradigms and abstractions is needed to overcome complexity. Engineering large distributed systems increasingly requires cooperative networked control systems, and optimisation and decision support methods and tools which are used to modernise physical infrastructures, to control complex processes in manufacturing, or to monitor and control systems performance.

Research addressing this Challenge in particular will encourage international cooperation under the Intelligent Manufacturing Systems (IMS) scheme.

Objective ICT-2009.3.1: Nanoelectronics technology

This objective focuses on the 'beyond CMOS' field, the advanced aspect of the 'More than Moore domain', their integration and their interfacing with existing technology. It also targets small volume oriented, flexible manufacturing with a high product mix and prepares for the future and for more disruptive approaches. The activities in this area are complementary to the activities in the ENIAC JTI[6].

Target outcome

a) **Miniaturisation and functionalisation**

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Beyond 22 nm devices, advanced components with lower scaling factors including non-CMOS devices and their integration and interfacing with very advanced CMOS to meet requirements of performance and function of components and a large variety of miniaturised (sub)-systems. Activities with a high risk factor or an industrialisation perspective beyond 2014 and having a generic development focus are targeted.

STREPs should address one or more of the following issues:

- increasing process variability and expected physical and reliability limitations of devices and interconnects;
- the need for new circuit architectures, metrology and characterisation techniques;
- interface and system integration technologies on a single silicon chip (System-on-Chip) and/or integration of different types of chips and devices in a single package (System-in-Package);
- new device structures for non-Si and Si based advanced integrated components to add functionality to circuits and (sub)systems;
- disruptive technologies and functional devices beyond the traditional ITRS shrink path ("Beyond CMOS"): new non-CMOS logic, analogue and memory devices, and their integration in and/or interfacing with CMOS;
- specific issues such as electro-magnetic interference, heat dissipation, energy consumption.

[6] The JTI research agenda addresses application-guided industrial cooperative research in the 'More Moore' and 'More than Moore' domains for the next generation components and systems and targets large strategic initiatives. In manufacturing, the JTI targets larger volume fabrication with emphasis on generic manufacturing improvements and equipment development. See http://www.eniac.eu

A Network of Excellence should address the merging of "Beyond CMOS" and advanced "More than Moore" devices and processes to create an extended CMOS backbone, to meet the challenge of the increasingly analogue behaviour of "Beyond CMOS" devices and of systems partially based on new architectures and on less reliably functioning devices.

b) **Manufacturing technologies**

- *New semiconductor manufacturing approaches, processes and tools* to reduce cycle time, enhance production quality, variability control and productivity; Improved equipment productivity and integration, quality control of novel materials and devices, and reduction of energy use, water and chemicals consumption, waste and environmental impact; Advanced models and simulation tools for flexible manufacturing and heterogeneous integration; interfaces to connect special processes (e.g. MEMS with CMOS); Novel approaches for advanced system integration and functionalized packaging, for thin film technology, 3D integration and wafer level packaging.
- *Joint assessments of novel process/metrology equipment and materials*, in close collaboration between equipment manufacturers, end-users, research institutions and academia, targeting initiatives ranging from proof-of-concept for potentially "disruptive" approaches to prototype testing.
- *Supporting 200/300 mm wafer integration platforms* hosted and supported by research institutes and short user-supplier feedback loops to the benefit of smaller suppliers.
- Process, metrology, equipment metrics, test wafers, carriers and physical interfaces to prepare for *450 mm wafer processing*.

IPs are expected to integrate approaches for flexible and sustainable short cycle time manufacturing. They may also address clustered joint equipment assessments or wafer integration platforms. STREPs should cover focused and complementary semiconductor manufacturing topics. The objective is to support at least 1 IP in addition to STREPs.

c) **Support measures**

a) Roadmaps, benchmarks and selection criteria for the industrial use of "Beyond CMOS" technologies with the aim to identify research gaps.

b) Access for academia and research institutes to affordable silicon in state-of-the-art technologies for prototyping and low volume production, and to related design expertise and commercial tools.

c) Stimulation of the interest of young people in electronics careers; training and education, including access for students and PhDs to production lines and research labs.

d) Linking of R&D strategies and stimulation of international cooperation, in particular with the USA, Russia, Taiwan and Japan.

e) Support and coordination of preparatory work for 450mm processing and equipment.

Expected impact

- Strengthened competitiveness of the European nanoelectronics industry through risk-sharing in generic developments and collaboration in advanced research between materials, equipment and component suppliers, integrators, semiconductor manufacturing plants and institutes.
- Contribution to the competitiveness and the attractiveness of Europe to investments in components miniaturisation, functionalisation and manufacturing.
- New electronics applications of high economic and socio-economic relevance.

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- Maintained European knowledge and skills at the frontier of nanoelectronics technology and in integrated miniaturised electronic systems.
- Increased critical mass of resources and knowledge in fields of European excellence to allow for further European partnership in the world-wide collaboration.
- Contribution to preserving a critical mass of manufacturing capacity in Europe.European research organisations maintained in leading positions.

Funding schemes

a): STREP, NoE; b): IP, STREP; c): CSA

Indicative budget distribution

- IP/STREP: 27.5 M€; the objective is to support at least 1 IP under b) in addition to STREPs

- NoE: 3M€

- CSA: 4.5M€

Call

ICT Call 5

Objective ICT-2009.3.2: Design of semiconductor components and electronic based miniaturised systems

This objective addresses generic platforms, methods and tools to cope with the design challenges in the next generations of technologies and with heterogeneous integration of different functions. The activities in this area are complementary to the activities in the ENIAC JTI[7].

Target outcomes

a) **Improved design platforms, interfaces, methods and tools** that meet the requirements of semiconductor companies, fab-less design houses and system developers, including :

- Design of energy efficient electronic systems, and thermal effect aware design;
- Integration of heterogeneous functions: 3D, System-in-Package, Network-on-Chip, wireless (microwave, mm-wave and THz) systems;
- Methods for reuse of IP blocks, test and verification;
- Design solutions for moving the application boundary between hardware and software to fit performance needs;
- Design platforms and interfaces for mixed/new technologies;
- New paradigms for design of reliable circuits with less reliable devices;
- Reliability-aware design including EMR/EMC requirements;
- Design for manufacturability taking into account increased variability of new processes;
- Better modelling of devices at all design levels into circuit/system design;
- Further standardisation, including interoperability aspects.

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[7] Design activities in the ENIAC JTI target large initiatives to develop tools and methodologies of common interest which will be demonstrated in application specific Sub Programs and specific TCAD, modelling, simulation and design activities embedded in application projects. See *http://www.eniac.eu*

The target is enhanced design competence and productivity taking advantage of the cooperation between system research, circuit design and process development. This will allow the gap between the ever increasing complexity of new systems and the low productivity of corresponding existing system design methods to be closed. Advances in the design platforms should enable the efficient realisation of very complex circuits, first time right, from the system architecture down to the transistor layer using deep submicron technologies and heterogeneous integration of different functions or different technologies, such as RF, mechanical, optical, sensors, high power or voltage in very compact systems and subsystems, including System-on-Chip and System-in-Package concepts and their implementation, and hardware dependent software integration.

At least one IP is expected to address the design platforms and modelling, complemented by STREPs addressing specific tools, methods or targeting specific needs.

b) **Support measures**

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- Bringing research results outside the consortia through a framework that embraces dissemination, training and education and access to supported project results, tools and methodologies.
- Set up of networked centres of excellence and a design infrastructure to validate research results and IP blocks.
- Stimulation of international cooperation in particular with Russia and India.

Expected impact

- Innovation in product architecture and increased efficiency in product design in the timeframe 2013 – 2015, with reduced system development cost and time to market.
- Capability in Europe to design in a reliable manner products that use the most advanced IC manufacturing and integration processes.
- Maintained leading position of Europe in product innovation and design for major application fields.
- Use of new devices for new functionalities.

Funding schemes

a): IP, STREP; b): CSA

Indicative budget distribution

- IP/STREP: 21.5 M€; the objective is to support at least 1 IP under a) in addition to STREPs.

- CSA: 3.5 M€

Call

ICT Call 4

Objective ICT-2009.3.3: Flexible, organic and large area electronics

Target outcomes

a) **Flexible, organic and large area electronic devices and building blocks**

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Co-development of processes, materials and devices for the fabrication of organic, flexible, heterogeneous and large-area electronic components. This includes materials, deposition methods and multiple-layer interfacing on single device architectures, including modelling, manufacturing and characterisation, as well as process-tolerant

design for many-device functional blocks. Reliability and recycling issues should also be considered.

Specific issues to be addressed include: device architecture and performance, device passivation/stability; highly productive in-line compatible processes capable of very small feature size and multi-layer registration; correlation between electronic material properties, process parameters and device performances; combination of manufacturing modes (substrate carrier, sheet to sheet, roll to roll, organic/inorganic process combinations), large area manufacturing.

Device demonstrators include: logic and analogue circuits with n and/or p type Thin Film Transistors (TFTs), power converters, batteries, memories, sensors, active RFIDs.

b) **Flexible or foil-based systems** using the building blocks based on organics, inorganics or their combination, homogeneous process integration of different functionalities complemented by heterogeneous component integration and 3D functional foil integration through their combination with flexible/stretchable substrates and interconnects to thin film discrete devices and thinned ICs.

Specific issues to be addressed include: one step foil lamination/interconnect, vias, foil passivation; multi-foils system design and integration; standardisation of foils' functionalities and lay-outs, reliability, low energy consumption.

Device demonstrators include: autonomous systems with energy scavenging and storage able to provide several functionalities like user input, physical/chemical sensing, signal processing, radio transmission & receive, signage.

c) **Network of Excellence** (only for a) and b) above)

- ~~a)~~ Structuring and integrating of the research capacities in the area,
- ~~b)~~ Training and education,
- ~~c)~~ Coordination of R&D,
- ~~d)~~ Promoting links between R&D institutions' activities and industrial needs.
- ~~e)~~ Standardisation

d) **Support measures** (only for a) and b) above)

- ~~f)~~ Stimulation of international collaboration.
- ~~g)~~ Coordination of related national, regional and EU-wide R&D programmes/activities.
- ~~h)~~ Access to prototyping and design competences.
- ~~i)~~ Training and education for SMEs.

Expected impact

- Reinforced leadership position of Europe in the creation of flexible or transparent electronics.
- Sustainable electronic device performance and manufacturing costs matching low capital investment requirements and new market opportunities.
- Contribution to the evolution of traditional industries in the EU, such as printing and clothing industries, towards the e-media revolution.

Funding schemes

a), b): IP, STREP; c): NoE; d): CSA

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Indicative budget distribution

- IP/STREP: 54.5 M€ of which a minimum of 50% to IPs
- NoE: 4M€
- CSA: 1.5 M€

Call:

ICT Call 4

Objective ICT-2009.3.4 Embedded Systems Design

The activities in this area aim at novel generic methods and integrated design environments that are applicable across application sectors; they are complementary to the activities in the ARTEMIS JTI, where embedded system design is not addressed as such but only in the context of specific applications[8].

Target outcomes

a) **Theory and novel methods for embedded system design**

New methods and tools that can increase system development productivity while achieving dependable, safe and secure embedded systems with predictable properties. Key issues encompass heterogeneity, i.e. building embedded systems from components with different characteristics; predictability of non-functional properties such as performance, fault tolerance, life expectancy and power consumption; comprehensive methods for robustness validation; adaptivity and self-awareness for coping with uncertainty, upgrades of components and self-configuration concepts; and, where appropriate, unification of approaches from computer science, electronic engineering and control.

The objective is to support one IP only to address end-to-end design methodologies and associated tool chains. STREPs should address specific methods and tools or target specific issues.

In case of international cooperation the work should address foundational research and provide mutual benefits. On-going cooperation activities with the US will continue and be extended to other countries

b) **Modules and tools for embedded platform-based design**

An integrated design environment for embedded systems that can be extended and customised. This covers software, hardware/software and system design tools for holistic design, from applications down to component and platform level. Important challenges encompass flexibility of the platform to support different applications, increased interoperability of tools primarily from SME vendors and openness in order to facilitate the entry of new industry players, support associated standardisation, easily import existing components and/or handle upgrades. Key issues include: (i) technology for efficient resource management, (ii) tools supporting design space exploration, in particular trade-offs when co-developing hardware and software; and (iii) advanced model-driven development.

The objective is to support one IP only to address design tool integration. STREPs should target specific issues or topics.

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[8] See the ARTEMIS WP sub-programmes at http://www.artemis-ju.eu

c) **Coordination of national, regional and EU-wide R&D strategies**

Initiatives to advance the European Research Area and to align research agendas in the field of embedded systems.

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Expected impact

- Significantly increased productivity of embedded system development.
- Improved competitiveness of European companies that rely on the design and integration of embedded systems in their products by reducing design costs and time to market.
- Emergence and growth of new companies that supply design tools and associated software. Stimulated high-tech European companies, in particular SMEs, which offer innovative products and services for embedded systems design.
- Reinforced European scientific and technological leadership in the design of complex embedded systems.

Funding schemes

a): IP, STREP; b): IP, STREP; c): CSA

Indicative budget distribution

- IP/STREP: 27.25 M€; the objective is to support one IP only under a) and one IP only under b) in addition to STREPs

- CSA: 0.75 M€

Call:

ICT Call 4

Objective ICT-2009.3.5 Engineering of Networked Monitoring and Control systems

The activities in this area address engineering technologies for large scale, distributed and cooperating systems for monitoring and control, including wireless sensor networks. These are not addressed as such by the ARTEMIS JTI to which they are complementary[9].

Target outcomes

a) **Foundations of complex systems engineering**

To achieve robust, predictable and self-adaptive behaviour for large-scale networked systems characterised by complex dynamic behaviour, through the development of novel abstractions and scalable methods for sensing, control and decision-making. The scope covers foundational multi-disciplinary research and proof of concept addressing the whole chain from modelling, sensing, monitoring and actuation, to adaptive and cooperative control and decision making. Activities to encourage and enable multi-disciplinary education in the areas of systems engineering and monitoring and control are welcome.

b) **Wireless Sensor Networks and Cooperating Objects**

To develop architectures, hardware / software integration platforms and engineering methods for distributed systems composed of heterogeneous networked smart objects that are enabled by sensors, actuators and embedded processors. This will contribute to better dependability, safety, security, cost and energy efficiency e.g. in manufacturing, process

[9] See the ARTEMIS WP sub-programmes at http://www.artemis-ju.eu

plants, buildings and large scale infrastructures (including environmental management systems). Research challenges include: methods and algorithms to support spontaneous ad-hoc cooperation between objects; network-centric computing with dynamic resource discovery and management; semantics that allow object/service definition and instantiation; lightweight operating systems and kernels; open wireless communication protocols for harsh (industrial or outdoor) environments; abstractions and support tools to enable (re)programming; virtual sensing and actuation through low-cost aggregation of sensors and actuators; and experimenting with novel large-scale applications of wireless sensor networks.

The objective is to support one IP only to address architectures and integration platforms, including design and demonstration, for very large scale systems of cooperating objects and wireless sensor networks. STREPs should target specific issues or topics.

c) **Control of large-scale systems**

To enable the optimal operation of large-scale dynamic systems through proactive process automation systems. Such systems should be based on process control algorithms, architectures and platforms that are scaleable and modular (plug & play) and are applicable across several sectors, going far beyond what current Supervisory Data Acquisition and Control (SCADA) and Distributed Control Systems (DCS) can deliver today. Pro-activeness requires novel predictive models for higher performance and fault adaptation and recovery. The architectures should facilitate re-use, enable QoS, and reduce the reconfiguration effort. Standardisation of monitoring and control systems in industrial environments is encouraged in all projects.

The objective is to support one IP only to architect, develop and demonstrate a new generation of open and proactive process automation monitoring and control systems, and to address associated standardisation. STREPs should target specific issues or topics.

d) **International cooperation**

Facilitation and promotion of cooperation with the Western Balkan Countries, U.S.A and India (separately) where this provide mutual benefits.

Expected Impact

- Strengthened competitiveness of the industry supplying monitoring and control systems through next generation process automation products that are superior in terms of functionality, accuracy, dynamic range, autonomy, reliability and resilience.
- Higher energy efficiency and reduction of waste and of resource use in manufacturing and processing plants; improved ease-of-use and simplified operation and maintenance of monitoring and control systems, also for non-experts; and more effective management systems for natural resources and the environment.
- Reinforced European inter-disciplinary excellence in control and systems engineering and associated modelling and simulation tools as well as in real-time computing, communications, wireless sensor (and actuator) networks and cooperating objects.

Funding schemes

a): STREP, NoE; b): IP, STREP; c): IP, STREP; d): CSA

Indicative budget distribution

- IP/STREP: 27 M€; the objective is to support one IP only under b) and one IP only under c) in addition to STREPs

- NoE: 4 M€

- CSA: 1 M€

Call:

ICT Call 5

Objective ICT-2009.3.6 Computing Systems

Target outcomes

-a) **Parallelisation & programmability**

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Automatic parallelisation, new high-level parallel programming languages and/or extensions to existing languages taking into consideration that user uptake is a crucial issue. Projects on programmability & parallelism of homogeneous or heterogeneous multi-core and/or reconfigurable architectures should adopt a holistic approach addressing issues related to the underlying hardware, the operating system and the system software. Research areas include beyond static auto-parallelisation by exploiting dynamic (run-time) information; new support environments including testing, verification and debugging, program & performance monitoring and analysis; and specific hardware support for parallel programming models.

-b) **Methodologies, techniques and tools**

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Continuous Adaptation: Multicore and/or reconfigurable systems that continuously adapt to a constantly changing environment by going beyond the strict separation between compiler, runtime and hardware.

Virtualisation: Virtualisation technologies that ensure portability, flexibility, optimised use of resources, and overcome legacy issues for multicore and/or reconfigurable systems. This includes hardware/software interfaces for efficient virtualisation as well as machine abstractions and performance models for virtualised homogeneous or heterogeneous systems.

Customisation: Rapid extension and/or configuration of existing systems, architectural templates and tool-chains to optimally address specific application needs and performance/Watt envelopes.

-c) **System simulation and analysis**

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Advanced simulation and analysis of complex multicore systems to drastically improve the simulation speed of new complex, homogeneous or heterogeneous, multi-core systems;

-d) **Technology implications**

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Advanced system architectures, tools and compilers for next-generation semiconductor fabrication technology (for example, 3D stacking). The key challenge is to bridge architecture, system and technology research efforts.

-e) **Coordination of R&D activities and strategies in High-Performance Computing**

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Initiatives to align research agendas and coordinate R&D activities in high performance computing in order to advance the European Research Area; taking into

account industrial and academic activities and programmes at regional, national and EU level as well as international supercomputing roadmaps.

Expected Impact

- Increased performance, power-efficiency and reliability of homogeneous or heterogeneous multi-core and/or reconfigurable on-chip computing systems.
- Accelerated system development and production, enabling new products to be realised with a considerably shorter time-to-market.
- Reinforced European excellence in multi-core and reconfigurable computing architectures, system software and tools.
- Strengthened European leadership in cross-cutting technologies that are applicable to all market segments of computing systems, from embedded to high-performance computing.
- Contribution to the creation of a European Research Area in High Performance Computing R&D.

Funding schemes

a), b), c), d) STREP e) CSA

Indicative budget distribution

- STREP: 24.7 M€

- CSA: 0.3M€

Call

ICT Call 4

Objective ICT-2009.3.7: Photonics

Target outcomes

a) **Photonics technologies, components and (sub)systems** driven by key applications/social needs. Cost-effective innovative device and system integration, including electronics/photonics integration (photonics on silicon) where applicable, are overarching issues:

1) *Communications*: the vision is future-proof networks and systems enabling unlimited bandwidth through integration, more optical processing and very high spectral-density photonic transmission and the reduction of power consumption at system and component level. Actions should target developing photonic components for any part of such networks, systems or interconnects with the overall aim of reducing network complexity, increasing protocol transparency, and increasing information throughput.

2) *Lighting and light sources*: (i) highly efficient LEDs and LED-based lighting systems for general illumination offering features like high colour rendering, tuneable output spectrum and adaptable light output level; (ii) efficient solid state laser sources and compact laser-based engines for display (e.g. projection, laser TV) and lighting applications. Specific targeted actions should address a particular technology or approach; larger-scale actions could integrate a broader range of related technologies, components and/or (sub)systems.

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3) *Biophotonics*: specific targeted actions on (i) molecular/functional imaging and/or (ii) minimally-invasive / point of care diagnosis and treatment monitoring. Particular emphasis is on the combination of technologies, components, (sub)systems and disciplines for medical and biological applications of photonics.

4) *Cost-effective high-performance imaging for Safety & Security*: specific targeted actions on (i) CMOS-compatible low-power uncooled image sensors with high dynamic range and single-photon imaging capability at video-rate readout speed and/or (ii) compact multi-feature imaging systems based on advanced smart pixel detector arrays with sub-picosecond timing precision, pixel-level hyper-/multi-spectral resolution, polarisation sensitivity, and intra-pixel on-chip pre-processing capabilities.

5) Specific targeted actions on *highly integrated components* for high average and high peak power lasers for ICT and industrial applications: (i) novel concepts for fibres and fibre lasers with integrated functions, such as filters, polarisers, frequency shifters, q-switches, etc.; (ii) diode lasers with new functions integrated in the semiconductor e.g. epitaxial structures for mode selection, Bragg gratings, integrated q-switches and saturable absorbers, etc.

Actions span from advanced research opening new opportunities to application-driven research with a view to industrialisation, with priority given to novel or "breakthrough" approaches rather than incremental developments.

b) **Cost-effective versatile foundry processes for photonic integrated components based on III-V semiconductors possibly combined with other materials**. The activities may also address the further module integration and packaging. The design/process interface shall be based on widely agreed concepts and standards and the design be supported by design-rule and library based platforms. Application oriented top-down design environments may also be addressed.

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c) **ERA-NET Plus action**

A joint call for proposals on a photonics topic of strategic interest, to be funded through an **ERA-NET Plus** action between national and regional programmes.

d) **Coordination and support actions**

- **SME and researchers support** through access to photonics technology and design expertise, prototype components and manufacturing facilities.

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- **International cooperation**: (i) Joint definition of procedures to measure and compare research/prototype LED/OLED lighting device performances; (ii) Exchange of best practices from field trials or deployment of mature LED/OLED lighting products; (iii) Development of LED/OLED lighting standards; (iv) International workshops on selected advanced photonics research topics; research roadmaps.

~~a)~~ **Education and training** (excludes direct support of conferences): (i) Secondary school level outreach activities to encourage interest in photonics, especially among girls; (ii) Transnational third level education programmes and curricula in photonics, emphasising its multidisciplinarity including entrepreneurship, and encouraging the participation of women.

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The participation of Canada, Russia and the United States is encouraged, where it is of clear mutual benefit.

Expected Impact

- Actions in photonics technologies should reinforce European leadership and industrial competitiveness in the relevant application domains, or provide opportunities for new practical applications.
- The foundry action should greatly reduce non-recurring engineering costs of photonic integrated components, and should provide a safe, easy and cost-effective access for SMEs, fab-less component suppliers and researchers to production of prototype samples and industrial volumes, with a smooth path from design to prototype and volume manufacturing in Europe.
- The ERA-NET Plus Action should foster closer cooperation and greater alignment between participating states' research activities in topics deemed strategically important and of joint interest.
- The SME and researchers support action should foster the broader take-up of advanced photonic technologies towards innovative products.
- International cooperation activities in photonics should lead to greater cooperation between European players and their counterparts elsewhere on common goals for mutual benefit which will further European interests.
- Education and training activities should foster a new generation with photonics skills and expertise, both technical and with the ability to exploit developments commercially in Europe, including the participation of women.

Funding schemes

a).1), 2): IP, STREP

a).3), 4) and 5): STREP

b): IP

c): ERA-NET Plus

d): CSA

Indicative budget distribution

- IP/STREP: 47 M€ of which a minimum of 50% to IPs

- ERA-NET Plus: 10 M€

- CSA: 3 M€

Call

ICT Call 5 (for a), b), d))

ICT Call 4 for c): ERA-NET Plus. Any funds remaining following the selection of an ERA-NET Plus action will be transferred to *Objective ICT-2009.3.8 Organic photonics and other disruptive photonics technologies*

Objective ICT-2009.3.8 Organic photonics and other disruptive photonics technologies

Target outcomes

a) **Organic Photonics**

Specific targeted actions to address organic, polymer, single molecule and carbon-nanotube based photonic components, including organic-inorganic hybrid components.

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Actions span from advanced research opening new opportunities to application-driven research with a view to industrialisation, with priority given to proof-of-principle or "breakthrough" approaches rather than incremental developments.

Work should aim at photonic functional components and can include the necessary research on the appropriate material.

Included are:

1) OLEDs (including OLEFET) and lasers for lighting, illumination, projection or display applications. Critical issues are: conversion efficiency, extraction efficiency, colour gamut, lifetime, intensity, wavelength, costs etc.

2) Organic photovoltaic cells. Critical issues are: conversion efficiency, lifetime, costs etc.

3) Light guiding structures. Critical issues are: waveguides, integrated circuits, micro-cavities, POF etc.

4) Organic photonic sensors, lasers and amplifiers. Critical issues are: lifetime, output power, wavelength regime, electric pumping etc.

b) **Disruptive / cutting-edge photonic technologies and materials**

Specific targeted actions exploiting effects at the limits of light-matter interaction in nanophotonics (i.e sub-wavelength structures, plasmonics, controlling the quantum degrees of freedom, metamaterials, photonic crystals, biological systems) for transition from advanced research to industrial applications, including photovoltaics;

Actions to structure and integrate advanced research activities across Europe in this area.

The participation of Australia, Russia and the United States is encouraged, where it is of clear mutual benefit.

Expected Impact

- Reinforced European leadership and industrial competitiveness, and new opportunities for practical application opened in new domains.
- Leading-edge research in Europe in photonic technologies and materials fostered through networking, structuring and integration of activities.

Funding schemes

a): STREP; b): STREP, NoE

Indicative budget distribution

- STREP: 25 M€

- NoE: 5 M€

Call

ICT Call 4

Objective ICT-2009.3.9: Microsystems and smart miniaturised systems

Target outcomes

a) **Heterogeneous Integration**

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Integrated and interfaced multiple core technologies and related materials for the next generation of microsystems and smart miniaturised systems. Particular emphasis is on innovative concepts of industrial relevance and crosscutting technological challenges that currently limit industrial take-up.

Focus is on: (i) the heterogeneous combination of elements to integrate higher levels of intelligence into multifunctional microsystems including multisensing, processing, wireless and wired communication, and/or actuation capabilities; (ii) smart systems based on innovative nanosensor devices and components, providing unprecedented levels of performance and representing a disruptive approach to known or new challenges; and (iii) the integration of multiple elements of the value chain of heterogeneous systems - materials, modelling, design, processes, devices, packaging, characterisation, testing - contributing to a more efficient manufacturing.

Proposals are expected to be highly innovative and to address exploitation perspectives in multiple application sectors.

b) Autonomous energy efficient smart systems

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Autonomous smart systems making use of efficient energy management and communication solutions for long-lasting operation.

This includes: (i) innovative approaches to energy scavenging, storage and transmission, power generation, accumulation and consumption, which can satisfy real-life needs, adapt to the environment and operate under a wide range of conditions; and (ii) reconfigurable, low power, adaptive miniature smart transceivers for short- and long-range wireless communications of sensor-based systems.

Projects should preferably address both the energy and the communication challenge.

c) Application-specific microsystems and smart miniaturised systems

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Technology development will address one of the following application sectors:

1) Biomedical:

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Proposals should address one of the following topics: (i) Lab-on-Chip (LoC) platforms, covering the value chain from research to validation in explicit contexts of drug discovery, diagnosis, and/or therapy; emphasis for diagnosis and monitoring applications is on integrating sample preparation and flexibility to multi-type assays; (ii) microinstrumentation for microinjection and cell-manipulation; and (iii) microsystems interacting with the human body, with particular emphasis on autonomous miniaturised active implants, bio-robots and non-invasive body microsystems for monitoring, diagnosis and therapy. Biosensors and microfluidic chips/components as such are not part of this call.

2) Telecommunications:

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Proposals should address Microsystems and smart systems for telecommunications and networking. Emphasis is on extreme miniaturisation for multifunctional networked RF applications, such as smart RFID, ultra-low power transceivers and reconfigurable antennas.

3) Environment and food/beverage:

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Proposals should address integrated multi-sensing microsystems for environmental applications (including water treatment) or food and beverage quality and safety. Emphasis is on reliability and cost reduction.

4) Transport, safety and security:

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Proposals should address (i) safety-critical microsystems and robust smart miniaturised systems for transport applications, with particular emphasis on smart systems for the full electric vehicle, or (ii) advanced sensor- and actuator-based systems for safety and security. Focus is on integrating networking capabilities and the possibility of operating in harsh environments.

~~-~~5) Smart Fabrics and Interactive Textiles (SFIT):

Proposals should address multi-functional textiles and fabrics, where sensing, actuating, communicating, processing and power sourcing are seamlessly integrated. The focus should be on one or more of the following aspects: (i) advanced solutions to overcome existing functional limitations; (ii) fibre-level components and systems and their integration into smart textiles; (iii) development and integration of stretchable and wearable electronics embedded in textiles; (iv) fully integrated Smart Fabric and Interactive Textile (SFIT) solutions for applications where distributed functions are essential. Proposals should also consider user friendliness, comfort, manufacturability, sustainability, cost and contribution to testing certification procedures, where appropriate.

A balanced coverage of the different application sectors is foreseen.

~~•~~d) **Coordination and support actions**

~~a)~~ Coordination between technology providers and users representing the whole value chain (R&D organisations, industrial providers and users and, when relevant, ethical experts, health insurance and consumer organisations) in the following sectors: "in vitro diagnostics" and "food/beverage quality".

~~b)~~ Techno-economic analysis of EU, Eureka and national project results in this research area, and recommendations for actions to optimise their joint value.

~~c)~~ Dissemination, promotion and public awareness of activities in the area.

~~d)~~ Identification of international cooperation opportunities in the area.

Expected impact

- Strengthened global competitiveness of European industry in microsystems and smart miniaturised systems.
- Wider use of smart systems in relevant application sectors, thereby strengthening the competitiveness of the user industries.

Funding schemes

a) IP, STREP; b): STREP; c) IP, STREP; d) STREP; e) CSA

Indicative budget distribution

- IP/STREP: 77 M€ with a minimum of 50% to IPs

- CSA: 3 M€

Call:

ICT Call 5

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4.4 Challenge 4: Digital Libraries and Content

Digital content is today being produced in quantities that are deeply transforming the enterprise and the creative industries. Conditions for production and consumption are also rapidly changing as more and more content is produced by users. Organisations, public and private, are faced with maintaining, managing and exploiting increasing amounts of data and knowledge, in environments that are continually changing. New ways of expressing and representing cultural and scientific content in digital form are creating new opportunities for people to experience and share assets.

Progress in ***knowledge modelling and processing*** has enabled the creation of innovative commercial and community services and is progressively transforming scientific discovery. Semantic web technologies are likewise starting to be used on an industrial scale by information providers and search engines alike to offer more sophisticated services. Conceptualising and producing digital content as a container of rich objects that can be individually selected and manipulated is emerging as a trend.

This increasingly complex content needs to be safeguarded for future access. ***Preservation*** needs to be intelligently planned, capturing and selection of content need to be automated and hardware and software dependencies must be overcome. Keeping the associated semantics as well as the digital objects, should guarantee the integrity and authenticity of the information as originally recorded.

If these challenges are met, richer content can bring new opportunities to the exploitation and ***sharing of Europe's rich cultural and scientific resources***. New services will engage users in new ways of experiencing and understanding cultural resources. They will enable the aggregation and annotation of objects available in digital libraries. 3D and visualisation will provide access, mainly through virtual re-creations of cultural and scientific artefacts.

More abundant, accessible, interactive and usable content and knowledge, coupled with shifts in demands (future of education and training systems, productivity, time to competency, focus on intangible assets) contribute to ***reshaping the way we learn:*** teaching methods are increasingly focusing on inquiry-based, problem-solving approaches; technologies are suggesting new ways to generate learners' engagement and motivation and to support innovation and creativity; learning is increasingly integrated into business processes, corporate knowledge management and human resources systems. The research is getting intrinsically cross disciplinary, requiring input from cognitive and social sciences, pedagogy, computer and neurosciences.

Objective ICT-2009.4.1: Digital libraries and digital preservation

Target outcomes

a) **Scalable systems and services for preserving digital content**: handling the whole workflow for different types of digital resources, guaranteeing their long term integrity and authenticity. Research should demonstrate the feasibility of systems and services proposed and assess their use by organisations in large scale testbeds (e.g. science, business and financial records, public records, multimedia/audiovisual and performing arts).

b) **Advanced preservation scenarios**: methods, models and tools for managing digital memory, focusing on challenging preservation problems which cannot be adequately handled by current models. These should result in:

- b1/ Methods and tools for **preserving complex objects**, addressing the life-cycle of composite digital information instances (eg multiple embedded structures, actionable objects, distributed and interlinked resources and ontologies, transient information and ephemeral data).
- b2/ **Intelligent digital curation and preservation** systems able to learn, reason and act autonomously, integrating tools and methods to support the complex decision making processes for appraisal, selection and management of diverse collections of digital resources. The system should ensure that the representation of the objects and their embedded semantic knowledge in order to support their future re-use. Appropriate verification scenarios should be integral component of the work.

c) **Innovative solutions for assembling multimedia digital libraries** for collaborative use in specific contexts and communities, enhancing scholarly understanding and experiences of digital cultural heritage. This includes work on the dynamic aggregation of cross-media resources across existing institutional digital libraries and repositories. Research should address scalability, interoperability and distributed architectures, aggregation and semantic search tools. Validation should address researchers and cultural heritage professionals but be open to wider audiences.

d) **Adaptive cultural experiences** exploring the potential of ICT for creating personalised views of various forms of cultural expression, reflecting individual narrative tendencies (i.e. adapt to the background and cognitive context of the user) and offering meaningful guidance about the interpretation of cultural works.

e) **Interdisciplinary research networks** bridging technological domains (eg computing models, knowledge representation, visualisation and graphics), information and archival sciences, and social and cognitive sciences to advance the state-of-the-art in well identified and focused application areas (eg digital preservation).

f) **Promoting the uptake** of EC-funded research enabling the deployment of new ICT-based cultural and memory preservation services, leveraging the impact of associated national initiatives; **roadmapping** and identification of future "Grand Challenges"; establishment of a **pan-European network of "living memory centres"** for validations, demonstrations and showcases.

Expected Impact

- Significant advances in the ability to offer easily customisable access services to scientific and cultural digital resources, improving their use, experiencing and understandings;
- Reinforced capacity for organisations to preserve digital content in a more effective and cost-efficient manner, safeguarding the authenticity and integrity of these records;
- Significant reduction in the loss of irreplaceable information and new opportunities for its re-use, contributing to efficient knowledge production;
- Leading edge research in Europe strengthened through restructuring of the digital libraries and digital preservation research landscape. Leveraged impact of research results.

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Funding schemes

a): IP); b) b1/: STREP; b2/: IP; c) IP d) STREP e): NoE; f): CSA

Indicative budget distribution

- IP/STREP: 56 M€ with a minimum of 50% to IPs

- NoE and CSA: 13 M€;

Calls

ICT Call 6

Objective ICT-2009.4.2: Technology-enhanced learning

Target outcomes

a) **Learning in the 21st Century**: large-scale pilots for the design of the future classroom (exploring both technology and teaching practices, for teachers and students, their orchestration for specific, justified age groupings or subjects), supporting individualisation, collaborations, creativity and expressiveness in more active, reflective and independent learning activities. Research should address innovation in learning and teaching, the underlining change processes, relevant new summative and formative assessment methods and novel solutions supporting the active participation of a wider community of stakeholders contributing to student's growth.

b) **Reinforce the links between individual and organisational learning, and creativity:** innovative solutions embedding learning experiences in organizational processes and practices, through systems embracing talent, knowledge, workflow, collaborative innovation and competency management. Solutions should cover effectiveness of learning content, new forms of collective intelligence and entail deeper understanding of the role of ICT for creativity, informal learning and collaborations (IP). Research should also address new ways of combining creative, cognitive and computational processes (STREP).

c) Innovative **adaptive and intuitive systems for learning** featuring affective and emotional approaches, including related new forms of assessing learning outcomes as well as feedback/guidance mechanisms (innovative diagnostic techniques) to the learner and the teacher. Work may relate to serious games and immersive environments and include advances in the combination of simulation, story telling, and collaborative learning. . The chosen field should be well justified in terms of learning efficacy.

d) **Revolutionary learning appliances** (including toys) and advanced cognitive tutors, able to promote specific cognitive processing or abilities. Proposals should address: specific social and learning problems; science, technology and maths; or specific tasks that impose high cognitive demands.

e) Focused **interdisciplinary networks** on specific emerging trends (e.g. serious games/mobility and learning), linking a limited set of established excellences and learning labs, and including appropriate mechanisms for cross-fertilisation between disciplines. These networks should leverage national research activities and achieve demonstrable visibility at international level.

f) **Awareness building and knowledge management** on the results of EU RTD projects in the field; exploratory/roadmapping activities for fundamentally new forms of learning; identification of Grand Challenges; socio-economic evaluations (including transfer and scalability mechanisms, in education and for SMEs); establishment of a pan-European network of living schools for validations, demonstrations and showcases.

Expected Impact

- More conducive, highly motivating and flexible learning places, supporting better education, competency development and employability
- Increased empowerment of both learners and teachers through better adaptation to individual learning needs
- Significant contribution to the global competitiveness of European players in a consolidating market
- Leading edge research in Europe strengthened through restructuring of the technology-enhanced learning research landscape. Leveraged impact of research results.

Proposals must include a methodologically sound evaluation of their expected impact.

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Funding schemes

a): IP; b): IP and STREP; c), d): STREP; e): NoE; f): CSA

Indicative budget distribution

- IP/STREP: 39 M€ with a minimum of 50% to IPs

- NoE and CSA: 10 M€

Calls

ICT Call 5

Objective ICT-2009.4.3: Intelligent information management

Target outcomes

a) **Capturing tractable information**: robust and performant technologies to acquire, analyse and categorise extremely large, rapidly evolving and potentially conflicting and incomplete amounts of information. These technologies will extract, correlate and integrate data from diverse sources and formats (multimedia and 3D content; heterogeneous databases; data streams from sensors and scientific equipment; social interactions and networked appliances; information from business processes and software services) while tracing provenance, evaluating trust level and assessing reliability. The scalability, flexibility and performance of such methods and techniques will be demonstrated by rigorous empirical testing over large-scale testbeds.

b) **Delivering pertinent information**: usable and customisable systems to improve the efficiency of the information lifecycle, starting from proactive diagnoses of information gaps and triggering goal-dependent search, acquisition, structuring and aggregation of relevant local, remote and streaming resources. Managing this information and making it actionable requires large-scale reasoning resulting in effective ranking, profiling and interpretation as well as versioning for time-dependent compliance and justification. Such systems will support the navigation, manipulation and consumption of digital information by means of adaptive user-information interactions based on the state of the art in the psychology of human perception and attention. The effectiveness of such systems will be validated with appropriately-sized groups or communities of representative users.

c) **Collaboration and decision support**: efficient and dependable problem solving and decision support systems for critical, information-bound domains in which our ability to share and exploit information is outstripped by the rate of its growth in size and complexity. Intended beneficiaries include organisations with complex business processes and access control policies; scientific communities collaborating on challenging projects and building very large datasets; teams of professional creators working on complex designs or multimedia materials; and web communities with sophisticated cooperation needs. The effectiveness of such solutions will be tested against the requirements of the respective groups or communities.

d) **Personal sphere**: intuitive systems that help individuals secure, manage, visualise and interpret their personal information, attention trail and social history so as to enable the provision of personalised and context-dependent information from multiple sources and services. A specific requirement and design principle is that such systems preserve privacy and implement auditable information disclosure policies that are under user control and whose application can be verified at all times. Their usability and rate of uptake will be monitored by means of verifiable quantitative indicators.

e) **Impact and S&T leadership:** networks and other initiatives designed to link technology suppliers, integrators and leading user organisations. These actions will help develop a common understanding, including vis-à-vis neighbouring disciplines, and ensure proactive cross-fertilisation between EU projects and other relevant industrial and national activities. They will address barriers hindering a wider deployment of research results, work towards establishing or advancing widely recognized standards, reference architectures and benchmarks, and increase awareness of the potential of the technologies at stake within broader audiences.

Expected impact

- Better leveraging of human skills, improved quality and quantity of output and reduced time and cost allowing users to concentrate on more creative and innovative activities.
- Increased ability to identify and respond appropriately to evolving conditions (e.g. in finance, epidemiology, environmental crises …) faster and more effectively. Reinforced ability to collaboratively evolve large-scale, multi-dimensional models from the integration of independently developed datasets.
- Higher levels of information portability and reuse by creating an ecology of systems and services that are dynamic, interoperable, trustworthy and accountable by design.
- Increased EU competitiveness in the global knowledge economy by fostering standards-based integration and exploitation of information resources and services across domains and organisational boundaries.
- Strengthened EU leadership at every step of the computer-aided information and knowledge management lifecycle, creating the conditions for the rapid deployment of innovative products and applications based on high quality content.

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Funding schemes

a): NoE, IP, STREP; b), c): IP, STREP; d): STREP; e): CSA, NoE

Indicative budget distribution

- IP/STREP: 62M€ with a minimum of 50% to IPs
- NoE/CSA: 8M€

Calls

ICT Call 5

4.5 Challenge 5: Towards sustainable and personalised healthcare

The health domain and its three main industries, pharmaceuticals, medical devices and eHealth, are dominant economic sectors with respect to employment creation and growth. Sustainable delivery of quality healthcare at affordable cost is a major challenge for European healthcare systems for a variety of reasons such as: (a) demographic change and increasing prevalence of chronic diseases; (b) inefficiencies, inadequate safety standards and quality control; (c) demanding citizens who require best-quality care and cover for the use of latest diagnostics and treatments; and (d) current focus on treatment rather than on prevention. This calls for changes in the way healthcare is delivered and the way medical knowledge is managed and transferred to clinical practice. ICT tools and services are key to implement these changes in such an information-intensive domain.

Advances in basic ICT components and the convergence of ICT-nano-bio technologies allow for the development of life saving applications with great business opportunities. ICT may offer useful capability to improve illness prevention and safety of care and to facilitate active participation of patients, thus opening new opportunities in personalised health and disease management. Recent capabilities of modelling, simulation and biomedical imaging, combined with the latest knowledge about diseases, give rise to a new generation of predictive medicine. In this challenge, support will go to ***highly interdisciplinary research*** aiming at:

- Improved productivity of healthcare systems by facilitating better management of chronic diseases at the point of need and quicker transfer of knowledge to clinical practice.
- Continuous and personalised care solutions, addressing the participation of patients in care and prevention processes, and responding to the needs of elderly people.
- Savings in lives and resources by focusing on prevention and prediction of diseases and on improved patient safety by optimising medical interventions and preventing errors.
- New ICT-based environments for biomedical research and predictive medicine that push the boundaries of technologies like grid computing, modelling and simulation.
- Reinforcing the leadership of Europe's eHealth and medical imaging/devices industries and attracting back to Europe research activities of the pharmaceutical industry.

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Successful outcomes will contribute directly to the priorities of the i2010 initiative and will be coordinated with the activities related to chronic disease management under the Competitiveness and Innovation Programme (CIP).

Objective ICT-2009.5.1: Personal Health Systems

Target Outcomes

a) **Minimally invasive systems and ICT-enabled artificial organs:** Solutions for remote monitoring and care, based on closed-loop approaches. Proposals are expected to develop technological innovations both at component level where required and at system level.

Solutions will integrate components into wearable, portable or implantable devices coupled with appropriate platforms and services. Emphasis will be placed on (i) the accuracy of measurements and operation of the devices; (ii) remote control of the devices by health professionals, as well as self-monitoring and autonomous regulation of the devices' own operation, to personalise and optimise care by considering changes in health status, activity levels or response to treatment; (iii) continuous, context-aware, multi-parametric monitoring of health parameters, activity, lifestyle, environment and operational parameters of the devices; (iv) analysis and correlation of the multi-parametric data with established biomedical

knowledge and expertise to derive clinically relevant and useful information; (v) clinical workflows to support remote applications, addressing also alarms and crisis management; and (vi) education and feedback to patients.

This target outcome focuses on the following four application domains only. Each proposal should undertake high risk research addressing only one of these domains:

- ***a1) Cardiovascular diseases***, focusing on management and treatment of patients with cardiovascular diseases at home, including early diagnosis of further complications by making use of heterogeneous data to build integrative risk assessment models.
- ***a2) Diabetes***, focusing on automated closed-loop glycaemic control at home. Major requirements refer to continuous, accurate glucose measurements (maximum 5% error level) with minimally or non-invasive methods, and to hypo-/hyper-glycaemia alarms.
- ***a3) Renal failure***, focusing on continuous daily dialysis at home (artificial kidney).
- ***a4) Liver failure***, focusing on continuous detoxification as transient therapy at home (artificial liver support).

In domains a3) and a4), the development of new sorption/filtration techniques is not in scope.

The objective is to support at least 2 IPs to be funded under a).

b) **Mental Health**: ICT based solutions for persons suffering from stress, depression or bipolar disorders (other mental disorders are not in scope). Interdisciplinary research will address the parallel development of technological solutions, as well as new management or treatment models based on closed-loop approaches. Emphasis will be on the use of multi-parametric monitoring systems, which monitor various metrics related to behaviour and to bodily and brain functions (e.g. activity, sleep, physiological and biochemical parameters).

The proposed systems will aim at (i) objective and quantitative assessment of symptoms, patient condition, effectiveness of therapy and use of medication; (ii) decision support for treatment planning; and (iii) provision of warnings and motivating feedback. In the cases of depression and bipolar disorders, the systems will also aim at prediction of depressive or manic episodes. The solutions will combine wearable, portable or implantable devices, with appropriate platforms and services. They will promote the interaction between patients and doctors and facilitate self-treatment and cognitive behavioural therapy where necessary.

The objective is to support at least 1 IP to be funded under b).

For target outcomes (a) and (b): All proposals will match clinical needs with technology solutions into novel service models. Scenario-based design and user-oriented approach will be inherent in the proposed solutions. Proposals will involve clinical opinion leaders and experts in regulatory approval. Considering advances in medical sciences, the solutions will aim to facilitate clinical practice and interdisciplinary disease assessment. The target group is only patients with diagnosed diseases (not healthy individuals). Proposals will address patient data security and confidentiality, and interoperability issues related to heterogeneous data sources, devices and links with electronic health records. All solutions will aim to demonstrate cost effectiveness and proof of concept with validation in clinical settings (i.e. technical validity, safety, efficiency and clinical outcomes, ideally with statistical significance).

c) **Support Actions.** c1) Prevention of diseases: To propose ICT research directions in the domain of disease prevention, considering issues like prevalence of diseases; ICT systems for measuring health parameters and motivating people to manage their health; validation; and sustainable business models. c2) Interoperability of Personal Health Systems: To promote the interoperability among Personal Health Systems (PHS) and also between PHS and other

eHealth systems such as electronic health records, in the landscape of continuous care, across multilingual and multicultural environments in Europe.

Expected Impact

- Reduced hospitalisation and improved disease management and treatment at the point of need, through more precise assessment of health status.
- Economic benefits for health systems without compromising quality of care.
- Reinforced leadership and innovation of the industry in the area of Personal Health Systems and medical devices. New business models for health service providers and insurance sectors. Where appropriate, demonstrated potential for patents and spin-offs.
- Improved links and interaction between patients and doctors facilitating more active participation of patients in care processes.
- Facilitating the development of prospective aspects of ICT-enabled prevention of diseases (for target outcome c1) only).
- Accelerating the establishment of interoperability standards and of secure, seamless communication of health data between all involved partners, including patients.

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Funding schemes

a-b): IP/STREP; c): CSA (SA only)

Indicative budget distribution

a-b): IP/STREP - 62 M€[10]; with more than 50% to IPs and with the objective to support at least 2 IPs under a) and at least one IP under b), in addition to STREPs.

c): CSA 1 M€. For each topic, up to one SA will be selected with maximum duration of 12 months and maximum EC funding of 600 k€ for c1) and 400 k€ for c2).

Call

ICT Call 4

Objective IST-2009.5.2: ICT for Patient Safety

Target outcomes

a) **ICT for safer surgery:** Innovative ICT based tools for training, pre-operative planning, and computer-aided surgical interventions. These tools will involve modelling, simulation and visualisation techniques using real-time or near real-time accurate, 3-D, anatomical predictive models, and be based on realistic models of tissues and organs capable of capturing the patient-specific and treatment-specific information. The tools will be used to predict the clinico-functional outcome of the surgical intervention while it is being planned or performed. Validation including quantitative indicators relating to improve quality and safety of surgical operation will be included.

[10] Area coverage has priority in the selection of proposals. Hence, selection will initially be made among the proposals which are ranked first in the five areas of a1), a2), a3), a4) and b), in terms of their relative scores. Further selection from the remaining ranked proposals is in terms of their relative scores, respecting the minimum number of IPs for a) and b), and the minimum budget for IPs.

The objective is to support at least 1 IP to be funded under a).

b) **ICT for integration of clinical research and clinical care:** Advanced environment for health professionals and researchers that enable seamless, secure and consistent integration or linking of clinical care information in electronic health records (EHR) with information in clinical research information systems, such as clinical trial systems. Results are expected to help health professionals to avoid double data entry, assist in automatic identification of patients for clinical trials, and to enable early detection of potential patient safety issues. Research will focus on areas improving semantic interoperability between EHR and clinical research systems. including definition and validation of a core data set that enables, scalable and standardised link between clinical research systems and EHR repositories. Proposals will address data protection and security needs and be fully compliant with all applicable legislation as well as best practice. It is expected that research results will be validated in well defined use cases with a high potential for improving patient safety.

The objective is to support at least 1 IP to be funded under b).

c) **ICT-enabled early detection of public health events** Development of advanced applications for early detection of public health events of potential concern (e.g. reports of human H5N1 cases) including innovative tools for interpretation and filtering of electronic written media information through natural language processing, intelligent text mining and free text interpretation. Research will also focus on conversion of voice/speech into text to include radio/TV/Internet broadcasts as searchable information sources, accuracy improvement through self learning cycles, multilingual search, cross lingual glossing and other semantic issues of particular importance to public health. The project should include researchers and international public health centres such as WHO, the European Centre for Disease Control, national public health bodies in EU and beyond, like for instance Canada, Japan, and USA.

d) **Support Actions.** State-of-the-art and research roadmaps in the following areas:

d1) User-friendly data input and output in clinical domain. The state-of-the-art report should cover the current or emerging data input and output paradigms, such as intelligent, predictive tools for electronic data entry; advanced speech and voice recognition; automated conversion of free text into consistent medical terminology for direct storage in the electronic medical records; intelligent interfaces for data output, parameterisation and visualisation of decision support and predictive models etc. The roadmap should develop recommendations for future research in these areas as well as the expected impact on quality and safety of care.

d2) Interoperability conformance testing approaches and tools for software and systems to enable large scale, consistent and safe health data and knowledge exchange. The roadmap will cover research needed to bring the patient safety aspects stronger into the focus of emerging and future interoperability conformance testing and will address the i) relation and synergy with the certification tools and methods for quality and safety of the electronic health records and other health information systems; ii) the potential of increasing the coverage of existing testing tools to detect and prevent safety threats such as errors and incompatibilities between eHealth software and products before deployment; and iii) semantic interoperability issues. It will take into account existing initiatives on conformance testing and on certification processes reaching out to implementers of connected/networked eHealth solutions. It should seek cooperation with similar developments in other parts of the world.

Expected impacts

- Improved patient safety in surgery through advanced ICT applications for training, pre-operative planning, and computer-aided surgical interventions.

- Earlier detection of adverse events, faster, cheaper and more accurate recruitment to clinical trials, considerable cost savings through reduction in paperwork and duplicative data entry.
- Bridging the gap between clinical research and medical practice, enforcing collaboration between pharmaceutical industry, healthcare IT industry, academic institutions and healthcare providers.
- Enhanced health security through innovative event-based surveillance tools. Accelerated adoption of electronic health record systems supported by more user-friendly interfaces for input and output of health data
- More efficient mitigating of patient safety risks by providing framework for testing of interoperability solutions for exchange of healthcare information.

Funding schemes

a) and b): IP/STREP; c): STREP; d1) and d2): CSA;

Indicative budget distribution

a) and b): IP/STREP - 27 M€; the objective is to support at least 1 IP under a) and at least 1 IP under b) in addition to STREPs

c) one STREP with maximum EC contribution of 2 M€

d1)-d2): one CSA for each topic with maximum EC funding of 500 k€

Call

ICT Call 4

Objective ICT-2009.5.3: Virtual Physiological Human

Target outcomes

Proposals are expected to address one of the following target outcomes:

a) Development of **patient-specific computer based models and simulation** of the physiology of human organs and pathologies. The models should be multiscale by integrating relevant aspects of anatomy and physiology across different levels (from molecular and cellular to tissue and organ levels). The emphasis should be on the integration of existing models rather than on development of new models. The use and benefits of the models must be demonstrated for a specific clinical need covering prediction of disease and/or early diagnosis. Any organ or pathology could be targeted as clinical application. If an initial phase of basic clinical research or data collection is needed it will represent less than 25% of the total effort. Access to existing computing facilities external to the consortium could be supported.

   The objective is to support at least 1 IP to be funded under a).

b) Development of **ICT tools, services and specialised infrastructure for the bio-medical researchers** to support at least two of the following three activities: i) to share data and knowledge needed for a new integrative research approach in medicine (biomedical informatics), ii) to share or jointly develop multiscale models and simulators, iii) to create collaborative environments supporting this highly multidisciplinary field. When necessary, computing power and data management could be sought through access to existing advanced grid infrastructures as well as

high performance computing resources such as the emerging petascale computing facilities. New tools, services and applications will also be evaluated on their effectiveness and their ability to interface with existing medical research infrastructures. Their targeted services will facilitate the clinical use of computer based organ and disease models as well as biomedical data. These tools and services will complement and be compatible with existing methods and standards (terminologies, ontologies, mark-up languages) like those used by the Network of Excellence –VPH NoE (FP7-ICT-Call 2). International Cooperation in this field is encouraged.

The objective is to support at least 1 IP to be funded under b).

c) Support action on **evaluation and assessment of VPH projects**. Assessment proposals will address at least the following three aspects: i) the optimal use and contribution to the shared tools and infrastructure, ii) the clinical achievements, iii) the market potential or penetration. The proposed methodology should take into account existing international efforts and promote global validation framework.

d) Coordination/Support action to develop an **observatory on the achievements and evolution of the broader Biomedical Informatics field** which builds on synergies between bioinformatics, medical informatics, and neuroinformatics. The action should incorporate intensive dissemination and training components and facilitate communication between projects, including VPH projects and those funded beyond the ICT priority, so that a productive, open European environment for cross-collaboration among the different fields involved can be sustained over time. In that respect, the action should take advantage of the achievements of previous Networks of Excellence and other projects funded under FP6.

Expected Impact

- More predictive, individualised, effective and safer healthcare.
- Accelerated developments of medical knowledge discovery and management, development of devices and procedures using in-silico environments.
- Improved interoperability of biomedical information and knowledge.
- Increased acceptance and use of realistic and validated models that allow researchers from different disciplines to exploit, share resources and develop new knowledge.
- Reinforced leadership of European industry and strengthened multidisciplinary research excellence in supporting innovative medical care.

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Funding schemes

a-b): IP/STREP; c-d): CSA

Indicative budget distribution

a) and b) IP/STREP - 61M€[11]; with more than 50% to IPs and with a minimum of 3 IPs including at least one under a) and at least one under b)

c) and d) CSA 2M€ [1 CSA per area with a maximum EC funding of 1M€]

[11] Considering the coverage of the projects already funded in this field, the selection of proposals targeting clinical applications other than cancer and cardiovascular diseases will be given preference in case of proposals with tied scores at the evaluation stage.

Call

ICT Call 6

Objective ICT-2009.5.4: International Cooperation on Virtual Physiological Human

The objective is to strengthen the international impact of the EC funded research in Virtual Physiological Human (VPH) and to facilitate global cooperation by linking on-going (at the time of the closure of the ICT-FP7 Call 4) EU projects with projects and initiatives that reflect common goals and objectives, such as the projects supported by Interagency Modeling and Analysis Group (IMAG) in the USA.

Target outcomes

Proposals are expected to address one or more of the following activities:

a) Interoperability: Joint development of interfaces between relevant scientific databases, web services, mark-up languages such as CellML, metadata and ontologies;

b) Tools and services for global cooperation such as collection and maintenance of tools and methods for modelling and simulation, curated models, and collaborative developments of interconnected libraries and data repositories;

c) Contribution to a global validation framework such as joint verification and validation of the models with specific reference to tools developed for clinical applications.

Partners from on-going EU projects which are relevant to the VPH area will be supported to cooperate with partners of on-going international projects that address one or more of the target outcomes a), b) and c). Preference will be given to proposals that address multiscale modelling and keep all results open and free for the research community. The proposal will include agreement from the on-going projects that engage in collaboration. Funding can be requested by all partners, including one or two Third Country organisations, to cover the coordination and clearly specified joint activities that are not undertaken by the projects they represent.

Expected Impact

- Strengthened impact and international cooperation of EU R&D in VPH through joint developments of interfaces, tools, services, and data repositories, facilitating model sharing as well as quality improvement of the common models, tools and services.
- Increased European research excellence by fostering closer cooperation with leading international organisations resulting in an increased potential for EU industry.

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Funding scheme

STREP

Indicative budget distribution

5M€

Call:

ICT Call 4

4.6 Challenge 6: ICT for Mobility, Environmental Sustainability and Energy Efficiency

Economic growth is increasing the demand for energy. To maintain its prosperity and competitiveness on global markets, Europe has to focus on energy efficiency in the most energy-intensive sectors[12]. The recent liberalisation of the energy market has stimulated the offer of eco-innovative solutions and new economic models at service supply level, at local level (cities, neighbourhoods) and at large.

Society at large is increasingly aware and sensitive to climate change impact and to the importance of a safe, clean and healthy environment to sustain quality of life. EU leaders have pleaded in favour of an integrated climate and energy policy[13]. In addition to reducing its gas emissions, Europe must also take measures to adapt to climate change and minimise adverse impact on people, the economy and the environment[14].

Transport accounts for ~30% of total energy consumption in the EU. While the EU is currently negotiating with the automotive industry on how to reach an average CO_2 emission of 120g/km for the new cars fleet by 2012, ICTs offer a new, complementary way of reducing CO_2 emissions and increasing safety of the whole transportation system. This includes dynamic transport management and control strategies involving multiple interactions with vehicles.

ICT for safe, clean and smart mobility

ICT continues to provide new intelligent systems that assist the driver to avoid accidents, provide drivers with real time information to avoid congestion, and optimise a journey or the engine performance to improve energy efficiency. Autonomous on-board systems are complemented with vehicle-to-vehicle and vehicle-to-infrastructure co-operative technologies and improved, flexible traffic network management. The future transportation system needs cleaner and more efficient vehicles, energy-efficient intelligent infrastructure (including cooperative traffic control and management systems), as well as new mobility concepts. Improving safety remains a key objective.

ICT for energy efficiency

ICT plays an increasing role in reducing the energy intensity of the economy, thus helping to decouple growth from energy consumption and creating new opportunities. Innovative ICT-based energy saving tools and techniques will help the European products and services to become more competitive and will foster the emergency of a new category of jobs and energy efficiency services. The power grid needs new ICT-based monitoring and control systems to take on its growing complexity and distribution and has to incorporate user-oriented energy trading facilities; optimisation in near-real time of the production/demand matching is the challenge to achieve energy positive buildings and neighbourhoods.

ICT for environmental sustainability and climate change adaptation

Improved connectivity of environmental systems is increasingly required as a result of the multiplication of international environmental commitments. Policy formulation and

[12] Buildings ~40 %, transport ~30% and industry ~30%.

[13] The European Council of 8-9 March 2007 set the combined targets of (i) reducing greenhouse gas emissions by 20% by 2020 (compared to 1990), (ii) increasing to 20 % the share of renewable energy sources by 2020 (compared to the present 6,5%) and (iii) saving 20 % of the EU's energy consumption (compared to projections for 2020).

[14] Green Paper "Adapting to climate change in Europe – options for EU Action", COM(2007)

environmental management increasingly rely on distributed monitoring and management systems able to interact with common protocols and semantics and to cope with higher complexity at various scales. ICT offer an enormous potential for bridging information spaces and stimulate environmental services in Europe. Moreover, adapting to climate change and the related more frequent and extreme weather events requires a strong effort to raise the European capacity to mitigate impacts of natural disasters.

ICT and urban infrastructures

Cities represent a particularly complex environment with acute sustainability challenges. Four out of five Europeans live in urban areas which consume about 80% of the energy in Europe. Cities import huge amount of resources through large infrastructures to consume them in various processes creating air, water and land pollutions. Urban transport faces congestion problems and accounts for up to 70% of pollutants from transport. Optimal management of urban complexity requires full integration of a wide range of technologies.

Objective ICT-2009.6.1: ICT for Safety and Energy Efficiency in Mobility

Target Outcomes

a) **ICT for Intelligent Vehicle Systems** for further improving road safety and overall performance of transportation systems. This includes advanced in-vehicle safety systems with improved performance and reduced costs, based on open standard elements; systems supporting autonomous driving (first in restricted environments and later on open environments); new approaches to crash avoidance including development of sensors and sensor networks; human machine interface design principles; advanced methods for traffic situation detection and communication (including vulnerable road users); and technologies for addressing digital footprint, data security and privacy of in-vehicle applications.

   Projects need to take an integrated approach to safety, considering together the infrastructure, vehicles, drivers and other transport users.

b) **ICT for Clean and Efficient Mobility** for further improving energy efficiency and reducing CO_2 emissions in all modes of transport. This includes new tools, systems and services supporting energy-efficient driving (eco-driving) based on on-board systems and/or co-operative infrastructure and energy-optimized, adaptive traffic control and management technologies and systems for urban areas and inter-urban road networks. It also includes methodologies for assessing the impact of advanced ICTs in energy efficiency and CO_2 reduction, aiming at international harmonisation and standardisation of the methodologies through co-operation with Japan and the USA.

c) **Coordination and Support Actions**

   A common research agenda for energy efficiency by enhancing international cooperation; increased user awareness and dissemination of research results by supporting the Intelligent Car Initiative and the eSafety Forum, by supporting standardisation and by preparing a common showcase for cooperative systems.

Expected impact

- World leadership of Europe's industry in the area of Intelligent Vehicle Systems and expansion to new emerging markets, improving the competitiveness of the whole transport sector and the automotive industry.

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- Significant improvements in safety, security and comfort of transport. This includes contribution towards the objective of reducing fatalities with 50% in the EU by 2010, and longer term work towards the "zero-fatalities" scenario.
- Significant improvements in energy efficiency, emissions reduction and sustainability of transport. This includes contribution to reduction in the energy consumption and congestion in road transport.

Funding Schemes

a) and b): IP, STREP; c): CSA

Indicative budget distribution

- IP/STREP: 48 M€, of which a minimum of 50% to IPs

- CSA: 5 M€

Call

ICT Call 4

Objective ICT-2009.6.2: ICT for mobility of the future

Target outcomes

a) **Field Operational Tests for Integrated Safety Systems and Co-operative Systems** to assess improvements in the efficiency of the transport system, in the safety of all road users and in making individual mobility more comfortable. This includes large-scale test programmes aiming at a comprehensive assessment of the efficiency, quality, robustness and user-friendliness of close-to market systems, before their full-scale deployment in Europe. Where needed, performance validation of safety-related co-operative systems can be envisaged in controlled proving ground environments emulating realistic levels of complexity.

   Projects need to collect statistically significant data allowing analysis of user acceptance, performance and benefits for road safety and efficiency of both autonomous on-board and cooperative systems, and to assess especially the impact of integration of in-vehicle safety systems with the co-operative systems including naturalistic driving tests, where possible building on initiatives promoted by Member States and/or Associated Countries.

   The objective is to support at least 2 IPs to be funded under a).

b) **ICT-based systems and services for Smart Urban Mobility and new Mobility Concepts** to address the environmental footprint and safety of mobility, while fostering economic growth. This includes innovative new tools, services and methods for demand management, moving from restrictive to permissive systems; ICT tools and services for logistics optimized for urban environments; use of ICT for replacing mobility (virtual mobility, telepresence); and new, multi-modal urban mobility concepts.

c) **Coordination and support actions**

   In the framework of the Intelligent Car initiative: research agendas, dissemination of results (user awareness campaigns), assessments of socio-economic impact and training.

d) **International cooperation**

   In accordance with the specific cooperation agreements with Japan and the USA, active exchange of information will be fostered through the creation of bilateral task force(s) and regular workshops which will establish a mechanism for mutual validation and

exploitation of programme results, e.g. methodologies, draft specifications and standards, and for accessing Field Operational Tests datasets.

Expected Impact

- Improved safety, efficiency and competitiveness of transport systems across Europe, towards the objective of reducing fatalities within the EU.
- Optimised mobility of people and goods in urban environments across different transport modes, through the provision of accessible and reliable logistics information services.
- Improved quality of life in urban environments, through the provision of innovative demand management and traffic control and management systems, as well as new mobility concepts which meet the increased demand, support economic growth, are environmentally sustainable and capable of accommodating future uncertainties and shocks.
- Wider uptake of intelligent vehicle systems and co-operative systems through proof-of-concept to all stakeholders in Field Operational Tests.
- Increased European research excellence by fostering closer cooperation with leading international partners.

Funding schemes

a): IP, STREP, CSA; b): STREP; c), d): CSA

Indicative budget distribution

- IP/STREP: 32 M€; the objective is to support at least 2 IPs to be funded under a) in addition to STREPs

- CSA: 5 M€

Call

ICT Call 6

Objective ICT-2009.6.3: ICT for energy efficiency

Target Outcomes

~~-~~a) **ICT tools for the future electricity market**

Architectures and tools enabling the emergence of an open electricity market that allows new roles for energy brokers, that makes it possible for third parties to operate as virtual power plants and that allows for the establishment of variable energy tariffs in near real-time. This includes specific service delivery platform and uniform energy and information interfaces that are open to different business models and that can self-configure and adapt to the varying requirements of a market still in its definition phase.

Projects must validate the use and the benefits of the resulting tools in concrete applications.

~~-~~b) **ICT support to energy-positive buildings and neighbourhoods**

~~a)~~ - Monitoring and control systems able to optimize, in near-real time, the local generation-consumption matching considering all possible elements (solar, fuel cells,

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micro-turbines, CHP - combined heat and power, heating, cooling, lighting, ventilation, etc).

~~b)~~ Information platforms built on customizable, adaptive and open service-oriented architectures providing connectivity to the energy grids and information to decision makers in order to facilitate the emergence of new local business models.

~~c)~~ Intuitive user interfaces that help end-users save energy while maintaining the desired comfort levels.

Projects shall include tests with concrete targets under real conditions.

c) **ICT services and software tools enhanced with energy features**

ICT services and software tools that incorporate parameters for controlling emissions and energy consumption. Examples include, but are not restricted to: CAD and simulation tools able to assess the full life-cycle energy associated with new products, processes and services before their realisation and including the influence of users' interaction; Enterprise Management Systems able to implement energy savings and emissions trading across industry boundaries. Definition of patterns, profiles, methods, energy consumption models and their interrelations resulting in building blocks for interoperable services and software tools.

The use and the benefits of the building blocks must be validated against concrete targets once integrated into concrete services and/or tools.

d) **Coordination Actions**

- Coordination of national/regional programmes on ICT for Energy Efficiency, advancing the European Research Area in this interdisciplinary domain, facilitating the exchange of best practices, identifying common R&D priorities and creating a common understanding of the implications of regulation and energy market liberalisation.
- Co-ordinated co-operation and communication within the multidisciplinary "ICT for energy-efficiency" research community in Europe, in view of delivering concrete outputs such us:
  - o R&D roadmap(s) based on international workshops on selected topics and wide public consultations.
  - o Interoperability frameworks and standards based on the exchange of best practices, the organisation of interoperability tests and the production of technical papers for standards bodies.
  - o Awareness raising based on the organisation of interdisciplinary workshops / conferences and press campaigns.
  - o Analysis of the implications on education and training systems of introducing ICT for Energy Efficiency as a cross-discipline path at the earliest stage.

Expected impact

- Reinforced European industrial and technological position in ICT-enabled energy efficiency technologies.
- Strengthened and consolidated European excellence in engineering at the intersection of control, computing, communications, energy and construction.
- The emergence of an open electricity market including local and virtual operators.

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- Energy savings in residential and commercial buildings of around 30%.
- Reduced energy intensity of the economy and behavioural changes in the society at large.

Funding schemes

a), b), and c): STREPS; e): CA

Indicative budget distribution

- STREP: 27 M€

- CA: 3 M€

Call

ICT Call 4

Objective ICT-2009.6.4 ICT for environmental services and climate change adaptation

Target Outcomes

a) **ICT for a better adaptation to climate change**

Easy-to-use, web-based systems for better preparedness, decision support and mitigation of climate change impact on population, utilities and infrastructures. Special emphasis is on scenario-based prediction, damage assessment, planning and training, 3D/4D modelling, simulation and visualisation, as well as sensor networks. Integrated solutions shall be validated in the urban context including for natural disasters, taking full advantage of recent advances in miniaturisation of sensors, wireless communications and increased computation power and data storage capacity.

b) **Flexible discovery and chaining of distributed environmental services**

Tools for an easy discovery of environmental service nodes on the Web and their on-demand adaptive chaining (or composition), taking full advantage of international open standards. This includes generic semantics frameworks and dynamic ontology services for the discovery of and access to distributed environmental resources in a multilingual multi-domain context. It also includes methods and protocols for service chaining and for the management of the effects of uncertainty propagation through service chaining.

Projects should be driven by the possibility for a range of users, including non ICT-skilled users, to plug-in their own use cases and get access to customised information and decision support.. Solutions shall be validated over different scenarios and allow for continued collaborative development by federated users communities.

c) **Analysis of ICT for sustainable urban environment**

One action is expected to deliver an analysis of ICT solutions supporting integrated urban management plans. This includes systems for spatial planning of urban and peri-urban areas supporting sustainable development patterns, as well as tools for managing higher complexity arising from the interaction of aspects like resources efficiency, pollution mitigation and the quality of life.

d) **Stimulation of an ICT-enabled environmental information service economy in Europe**

One action is expected to deliver an analysis of new business-oriented approaches supporting the increase of interoperable environmental services in Europe, encouraging the re-use of existing open architecture specifications and stimulating viable

environmental monitoring networks. Special attention shall be paid to aspects like stability and security of services, uncertainty assessment, multi-lingualism and user access management.

Expected impact

- Contribution to a *Single Information Space in Europe for the Environment*[15] in which environmental actors, service providers and citizens can collaborate through improved systems connectivity and semantic interoperability.
- Reinforced European leadership in ICT solutions for interacting environmental service nodes on the Web, and resulting new market perspectives for environmental and crisis management services.
- Reinforced role of ICT in establishing sustainable cities, leading to higher environmental performance in urban areas and better living environments for Europe's citizens.
- Strengthened European capacity to mitigate impacts of urban disasters, to save lives and to protect critical urban infrastructures.
- Stronger position of Europe with respect to the implementation of international environmental commitments.

Funding schemes

a), b): STREP; c), d): CSA

Indicative budget distribution

- STREP: 21 M€

- CSA: 3 M€

Call

ICT Call 4

Objective ICT-2009.6.5: Novel ICT solutions for Smart Electricity Distribution Networks (Joint Call between the ICT and Energy Themes)

Target Outcomes

In Smart Electricity Distribution Networks, the realisation of concepts dealing with customer integration, effective Demand Side Management and active networks requires the development of a flexible ICT infrastructure. Existing solutions have not yet reached the necessary performance and cost requirements, and further research is needed in this area to arrive at ICT infrastructures for the management of electricity distribution networks that are scalable, low-cost, secure, reliable, open, and provide self-healing capabilities.

Research could include issues such as dynamically reconfigurable ICT architectures, technologies and tools for ICT systems survivability when elements fail, cyber security, platforms integrating (near) real-time information from wireless sensor networks and external information systems such as weather forecasts.

Projects should have a predominant research component and include concrete targets and appropriate trial tests to validate and assess the proposed solutions, involving partners from both the ICT and Electricity communities. More than one project is expected to be funded.

[15] http://cordis.europa.eu/fp7/ict/sustainable-growth/workshops_en.html

Expected impact

- Improved performance of the electricity distribution grid in terms of reliability and quality of service, reduced maintenance costs and time of failure detection/solution.
- Pre-standardisation knowledge aiming at the adoption of universally accepted hardware and software solutions for the underlying ICT infrastructure to monitor and control the electricity distribution grid.
- Strengthened European excellence in engineering by consolidating cross disciplinary research on energy technologies and ICT.
- Reinforced European industrial and technological position in the global market of ICT for power system applications.

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Funding scheme

Collaborative Projects (IP/STREP)

Indicative budget

20 M€ (provided by the ICT Theme (10 M€) and the Energy Theme (10 M€)).

Call

FP7-ICT-ENERGY-2009-1

4.7 Challenge 7: ICT for Independent Living, Inclusion and Governance

ICT for independent living and inclusion

A number of societal trends will deeply transform the future markets of ICT for independent living, inclusion and participation. Firstly, ageing is beginning to change the shape of labour markets and is already strongly influencing the needs for care and 'lifelong participation' in society. The ICT literacy of the above-65 age group will improve significantly in the next decade. This will create mass commodity markets for well-being products and services – and unlock markets for assistive technologies-, fuelled by an estimated 3000 B€ of wealth and revenues of the above-65 population.

Secondly, citizens have increasing expectations in terms of full inclusion in society and economy, quality of life and exercising of rights. Driven by productivity increase, job creation, new services and new markets for inclusive ICT, the shorter-term impacts of e-Inclusion on the GDP in Europe is estimated to be of the order of 100 B€ (for the next 5 years alone).

Thirdly, the increasing political and commercial interests in the field combined with the disruptive potential of ICT are starting to change the constituency and value chains of e-Inclusion RTD. The presence of mainstream ICT companies in the field is growing rapidly and new value chains are emerging, integrating users, formal and informal health and social care providers, technology and service providers as well as local/regional authorities, building and insurance companies. Elderly people and people with disabilities are increasingly recognised as posing the most challenging requirements also for mainstream usage. Successfully meeting these needs translates into building key competitive strengths in global mass markets.

Finally, major technological developments drive R&D for e-Inclusion in new directions, characterised by more adaptive and less intrusive and smarter "intimate" solutions.

ICT for Governance and Policy Modelling

It is now recognised that on-line collaborations have the potential to trigger and shape significant changes in the way future societies will function. Extrapolation of the present exponential growth leads to scenarios where very large percentages of populations could, if equipped with the right tools, simultaneously voice opinions and views on major and minor societal challenges, and thereby herald the transition to a different form of dynamically participative "eSociety". While such scenarios are readily imaginable, it must be recognised that we currently do not have appropriate governance models, process flows, or analytical tools with which to properly understand, interpret, visualise and harness the forces that can be unleashed.

Objective ICT-2009.7.1 ICT & Ageing

This objective focuses on service robotics for ageing, which is still a longer term research topics and on open architectures and platforms for building interoperable ageing well applications and services, which require larger scale projects involving major players. These topics are both outside the scope of the AAL programme which will call for smaller-scale projects targeting innovative ICT solutions in specific areas of ageing well with a timeframe of 2-3 years to market.

Target Outcomes

a) **Service robotics for ageing well:** Integration and adaptation of modular robotic solutions that are seamlessly integrated in intelligent home environments and adaptable to specific user requirements for support to elderly people and their carers. These robotic solutions should undergo operational verification in real user environments. Examples of applications include support for daily living and care activities in the home. Work should be driven by ambitious, yet realistic usage scenarios with a potential to demonstrate a substantial increase in efficiency of care and independence of elderly people.

   Major challenges to be addressed include autonomous self-learning robotics solutions, sharing of contextual information with other artefacts in the surroundings of the user, navigation in unknown environments, precise manipulation of relevant objects and user robotic interaction taking into account the usability requirements of elderly people. The proposed R&D should cover all relevant aspects to allow for a full operational validation, including user acceptance, adequate safety , reliability and trust as well as ethical considerations. It is NOT intended to support development of basic robotics components.

b) **Open Systems Reference Architectures, Standards and ICT Platforms for Ageing Well:** this should facilitate, interoperability, systems integration and easy personalization to provide seamless and cost-effective end-to-end care support and services for independent living, smart workplaces and mobility of elderly people and for their carers. The work should focus on next-generation open solutions enabling physical and semantic interoperability of required sensors, devices, services and systems for ageing well. Work should build on - and consolidate - relevant ongoing progress in open middleware, communication standards and service-oriented architectures.

   Particular emphasis should be put on facilitation of solutions working across mobile and stationary environments, with adequate security, high reliability and low maintenance. Concrete contributions to relevant standardisation is expected as well as a clear approach for making the resulting work available to the wider community, including necessary tools. The research should verify the proposed open reference architectures and platforms in realistic application scenarios. This could also include new service concepts and easy integration with other home-based applications, in particular ICT solutions for personal health and energy efficiency, in order to ensure the widest potential of the open platforms.

   The objective is to support one IP only to be funded under b).

c) **RTD roadmaps and stakeholder coordination:** One support action is to be launched to continue development of RTD roadmaps and stakeholder coordination already started under FP7. One CSA is expected to be funded under c).

Industrial participation is important. Realistic test environments should allow for early user involvement and impact analysis during the RTD phases.

Expected impact

For 7.1.a)

- Increased efficiency of care and prolonged independence and quality of life of elderly people and their carers.
- Strengthened global position of European industry in service robotics for ageing well.

For 7.1.b)

- Wide use of open platforms and tools for creation and management of integrated ICT products and services for ageing well, personalised health and energy management in the home and on the move.

- Strengthened potential of Europe to become a global leader in the field of ICT and ageing well, including development of global interoperability standards in the field.

For 7.1.c)

- More efficiency and higher impact through consensus and common strategic visions or RTD roadmaps between relevant key stakeholders in ICT for ageing well in Europe and beyond.

Funding schemes

a): STREP; b): IP; c): CSA

Indicative budget distribution

- IP/STREP: 23M€; the objective is to select one IP only to be funded under b) in addition to STREPs funded under a)

- CSA: 1M€

Call

ICT Call 4

Objective ICT-2009.7.2 Accessible and Assistive ICT

Target Outcomes

a) **Embedded Accessibility of Future ICT:** Solutions for supporting developers in deeply embedding generalized accessibility support within future mainstream ICT-based products and services. Emphasis will be on the use of virtual environments and realistic user modelling and interaction on the basis of the "virtual user" concept, and on methods to adapt multi-modal system interfaces self-adapting to users' real-time accessibility needs. Accessibility support should encompass data rendering and interaction, in relation to vision, hearing, speech and dexterity/mobility impairments. It can also include access through external assistive technology.

   Methods and tools must be demonstrated in industrial development context, with integration in quality control work-flows or content management system, and accompanied by advanced training material. Accessibility of non-ICT goods can also be explored. Attention should also be given to systems based on new interaction paradigms like 3D or Virtual Reality, and their application in the integration of accessibility services into physical environments.

   One IP is expected to build a generic framework addressing user needs, modelling and simulation approaches from other domains and their extension, market/ economic factors and meeting the complexity of the industrial value chain.

   STREPs should cover specific research on 'virtual user' modelling and simulation and their application in high-profile domains of user and industrial relevance, such as, but not limited to, daily (assisted) living, (e-) accessibility of domestic equipment, rehabilitation.

   The objective is to support one IP only in addition to STREPs.

b) **ICT restoring and augmenting human capabilities compensating for people with reduced motor functions or disabilities:** Radically new ICT-enabled approaches to restore and augment the ability of people in their daily life with a focus on reduced motor functions. Research should aim for breakthroughs in the way humans interact with computers and how they may overcome their disability and augment their capabilities. The research should build on progress in non-invasive sensor and actuator concepts for

brain/neuronal-computer interaction (BNCI), smart bio-sensors, self-learning/adaptive systems and advanced signal processing.

Emphasis is put on smart system solutions compensating for limited signal bandwith that combine 1) design of HW/SW architectures including BNCI and different multi-sensor interfaces 2) programming abstraction and support tools to facilitate modularity and flexible integration 3) advanced sensing and control in real user environments at home or at work. This should open up possibilities for flexible usage in different application areas, in particular for individuals with disabilities. Possible spill-over into mainstream applications should also be considered.

c) **RTD research agendas & coordination of constituencies.** In areas a) and b), coordination actions to further align constituencies and prepare future joint research agendas and roadmaps. One CSA for each RTD area is expected to be funded.

Expected impact

For 7.2.a)

- Generalised accessibility support through ICT tools within future ICT and non-ICT products and services for people with disabilities and functional limitations.

For 7.2.a, b)

- Strengthened global position of European industry in assistive technologies.

For 7.2.b)

- Enhanced ability to seize new market opportunities driven by technologies that augment human capabilities for persons with disabilities.
- Consolidating and boosting European excellence in BNCI systems engineering and in combination of advanced micro-bio-nano technology, neuroscience and bio-psycho-sociology.

For 7.2.c)

- More efficiency and higher impact of RTD through common strategic visions and roadmaps on research priorities between relevant stakeholders in the relevant areas

Funding schemes

a) IP, STREP; b): STREP; c): CSA

Indicative budget distribution

- IP/STREP: 33M€; the objective is to support one IP only to be funded under a) in addition to STREPs funded under a) and b)

- CSA: 1M€

Call

ICT Call 4

Objective ICT-2009.7.3 ICT for Governance and Policy Modelling

Target Outcomes

a) **Governance and Participation Toolbox**

Advanced tools embodying structural, organisational and new governance models to empower and engage all types of societal groups and communities, enable them to exploit mass cooperation platforms and allow governments to incorporate their input. These tools will enable the creation, learning, sharing and tracking of group knowledge that cuts across language and cultural interpretation. They should also facilitate transparency and tracking of inputs to the policy making process. The toolbox must include security, identity and access controls to ensure privacy and, where appropriate, the delineation of constituency domains according to the specific needs of government applications.

b) **Policy Modelling, Simulation and Visualisation**

Real-time opinion visualisation and simulation solutions based on modelling, simulation, visualisation and mixed reality technologies, data and opinion mining, filtering and aggregation. This will encompass novel instruments which allow consideration of options based on the simulated behaviour and wishes of individuals, groups or society as a whole to understand the possible outcomes of government proposals, decisions and legislation.

The focus is on advanced tools and technologies to perform large-scale societal simulations integrating all possible variables, parameters, interferences, scenarios necessary to forecast potential outcomes and impacts of proposed policy measures. The tools should exploit the vast reserves of Europe's public sector collective data and knowledge resources which are also developing dynamically. Underlying functions to be integrated include translation, process modelling, data mining, pattern recognition and visualisation as well as other gaming-based simulation, forecasting and back-casting as well as goal-based optimisation techniques. The solutions will also take into account, but not be limited to, state of the art techniques on dynamics methodology to analyse and model complex systems, cooperative vs. competitive systems, and "cloud" computing applications resources for large scale data analysis.

c) **Roadmapping and Networking for 'participation, governance and policy modelling'**

(i) RTD roadmap to identify emerging technologies and potential applications. It will also consider emerging research directions and will include insight into research activities undertaken in non-EU countries.
(ii) A dynamic 'Network' to encourage networking of relevant stakeholders and teams working in these areas and to encourage multidisciplinary constituency building;

Two SSAs are expected to be funded under c): one SSA for 'roadmapping' (indicative duration of 12 months) and one for 'networking' (indicative duration of 24-36 months).

Expected Impact

- Improved empowerment and engagement of individuals, groups and societies in policy making processes. Increased trust of the citizens through transparency and feedback of their contributions.
- More efficient collection of feedback to continuously improve governance. Improved prediction of impacts of policy measures, with increased contribution and involvement of individuals and societies, and based on intelligent and optimised use of vast public sector knowledge resources.
- Strengthened competitive position of European industry in the fields of cooperation platforms, optimisation, simulation and visualisation tools.

Funding schemes

Areas a) and b): STREP; area c): SSA

Indicative budget distribution

- STREPs: 14 M€
- SSAs: 1 M€

Call

ICT Call 4

4.8 Future and Emerging Technologies

Future and Emerging Technologies (FET) fosters frontier research that will open up new avenues across the full breadth of future information technologies. FET acts as a pathfinder while having the agility to react to new ideas and opportunities, as they arise from within science or society. It promotes the exploration of radically new ideas and trends for future research and innovation and provides sustained support to emerging areas that require long-term fundamental research. It aims to go beyond the conventional boundaries of ICT and ventures into uncharted areas, often inspired by and in close collaboration with other scientific disciplines.

In this spirit, FET can be considered as the home for 'transformative research' that through its initiatives and actions can initiate and lead to a range of exceptional and unprecedented outcomes. For example, it can re-think or revolutionise entire disciplines, shape new ones or disrupt established technologies, practices or theories.

Excellence in collaborative purpose-driven research

FET fosters excellence in foundational and purpose-driven technology-oriented research that combines the best in science and engineering. FET research builds new bridges between science and technology and provides a basis for future research agendas and nurtures the new interdisciplinary research communities that will embrace them. FET improves long-term competitiveness in European ICT by exploring new and alternative technological paradigms that may lead to entirely new fields of economic activities, new industries or first-class high-tech SMEs.

A catalyst for change in interdisciplinary research

Radical breakthroughs in ICT increasingly rely on fresh synergies, cross-pollination and convergence with different scientific disciplines (for instance, biology, chemistry, nanoscience, neuro- and cognitive science, ethology, social science, economics) and with the arts and humanities.

This trans-disciplinary and high-risk research requires new attitudes and novel organisational models in research and education. FET promotes the exploration of such new research practices and methodologies. It, encourages the involvement of young researchers and high-tech SME's in radical interdisciplinary collaborations, and the early take-up of results by decision makers in society and industry, as new ways of achieving impact.

FET Proactive Initiatives & FET-Open

FET operates two complementary schemes that together aim at the consolidation of new and emerging foundational trends future information technologies and their applications, while remaining open and responsive to fresh and unexpected ideas and developments. The bottom-up, light and deadline-free **FET Open** scheme can pick-up new ideas and opportunities whenever they arise. **FET Proactive** nurtures new ideas in selected promising domains, aligned with economic and social challenges and priorities.

FET OPEN

Objective ICT-2009.8.0 FET-Open: Challenging current thinking

Target Outcome

FET-Open targets foundational breakthroughs that open the way towards radically new forms and uses of information and information technologies. It flexibly accommodates the

exploration of new and alternative ideas, concepts or paradigms that, because of their radical, fragile or high-risk nature, may not be supported elsewhere in the ICT Workprogramme. Research under FET-Open is aimed at achieving a first proof-of-concept and at developing its supporting scientific foundation. The novelty of this research comes from new ideas rather than from the refinement of current ICT approaches.

In addition, FET-Open targets support and coordination activities for high-risk and high-impact visionary research. These activities can be either thematically oriented (for example, stimulating the emergence of a new research community), or they may focus on horizontal issues in FET-type of research (for example, catalysing new visions and ideas, promoting new research modalities, attitudes and practices; or exploring new ways for achieving visibility and impact of the research). They aim at a broad and open participation from within Europe and, where relevant, beyond.

Expected Impact

- ~~a)~~ For STREP projects: contribution to the scientific foundations of future information and communication technologies that may be radically different from present day ICT. It may, for example, open new avenues for science and technology, or lead to a paradigm shift in the way technologies are conceived or applied. FET-Open research is not required to have direct short-term technological or societal impact but it will take concrete steps towards achieving its long-term vision, supported by a critical exploration of the potential implications for the environment and for society.
- ~~b)~~ For CSA actions: contribution to catalyse a lasting and transformative effect on the communities and practices for high-risk and high-impact research. These activities will lead to new and more dynamic, engaged and risk-taking research communities that can develop the new and non-conventional approaches that will be key to address the technological, societal and environmental challenges that Europe and the world are facing.
- ~~c)~~ All FET-Open activities should contribute to securing and strengthening the future potential for high-risk / high-impact visionary research. To achieve this, FET-Open is expected to generate new collaborations involving a broad range of disciplines, the established scientists as well as the talented young ones, and a diversity of actors in research, including small and independent research organisations and high-tech SMEs, whenever relevant in terms of the activities proposed. International collaboration should exploit synergies in the global science and technology scene, to increase impact and to raise the level of excellence world-wide.

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Funding schemes

STREP, CSA

Indicative budget distribution

61 M€[16]

Call

Continuously receivable from 1 January 2009 onwards, until 31 December 2010.[17] FET-Open applies a two-step submission scheme and FET-Open specific eligibility and evaluation criteria (see Appendix 5).

[16] Indicative budget which is expected to be committed for successful proposals from the cut-off dates up to and including 26/1/2010.

[17] It is planned that the call will be subsequently extended beyond 31/12/2010.

FET PROACTIVE

FET proactive will spearhead transformative research and support community building, and enhance Europe's innovation potential around a number of fundamental long-term challenges in ICT that will be key to the long-term sustainability of a technological future in Europe. In particular:

- **Computing Systems:** After 40 years of miniaturisation allowing combined gains in performance, cost, power efficiency and size, future computing systems are faced with increasingly conflicting ambitions for further performance improvements and reduced energy per operation, size and cost per function while maintaining data integrity. Research will investigate radically new approaches to computing based on inspiration from from physics in *Quantum Information Foundations and Technologies* and in *Molecular-Scale Devices and Systems*. Research will pursue alternative directions for architectures in *Concurrent Tera-Device Systems,* for individual devices in *Molecular-Scale Devices and Systems*, and focus on power issues in *Towards Zero-Power ICT*.
- **Computing and Communication Paradigms**: New inspirations for architectures, communication and in particular the distributed nature of processing – locally or system wide – are explored to address new requirements on optimisation of resources and mastering system complexity. Awareness in networked ICT systems is addressed in *Self-Awareness in Autonomic Systems*, while management of local interconnections is a key issue in *Concurrent Tera-Device Systems.* Alternative paradigms for communications are investigated in *Quantum Information Foundations and Technologies*, with an emphasis on secure communications. Inspiration for radically new paradigms is taken from the functioning of the brain in *Brain-Inspired ICT* or from chemical networks in cells in *Bio-chemistry-based Information Technology*.
- **Living with ICT**: Unifying the experience of acting with or without ICT support will progress towards harnessing the combined advantages of information processing by humans and by machines in *Human Computer Confluence*. Radically new forms of sensing and interactions will be studied in *Brain-Inspired ICT*, while specific sensing modalities may emerge from work in *Molecular-Scale Devices and Systems* and in *Bio-chemistry-based Information Technology.*
- **Widening the Horizon of ICT**: Opportunities for deploying ICT in new areas will be explored together with technological developments. These will aim for new ways of reaching societal benefits and responding to industrial needs using ICT. Examples include improving human health in *Bio-chemistry-based Information Technology* and in *Brain-Inspired ICT*, new forms of therapy in *Human Computer Confluence,* environment monitoring in *Towards Zero-Power ICT*, high precision sensing in *Molecular-Scale Devices and Systems*, and new forms of cognitive work and entertainment in *Human-Computer Confluence*.

The following themes will be addressed in pro-active initiatives:

Call 4: FP7-ICT-2009-4

ICT-2009.8.1 Concurrent Tera-Device Computing

ICT-2009.8.2 Quantum Information Foundations and Technologies

ICT-2009.8.3 Bio-chemistry-based Information Technology

Call 5: FP7-ICT-2009-5

ICT-2009.8.4 Human-Computer Confluence

ICT-2009.8.5 Self-Awareness in Autonomic Systems

ICT-2009.8.6 Towards Zero-Power ICT

Call 6: FP7-ICT-2009-6

ICT-2009.8.7 Molecular-Scale Devices and Systems

ICT-2009.8.8 Brain-Inspired ICT

Coordination Actions (CAs) will be called to support the coordination of research projects in each proactive initiative. Short duration coordination actions will also be called to help identify new trends and directions for the preparation of new proactive initiatives in 2011 and beyond.

Candidate topics for calls in 2011 and beyond include new breakthroughs arising from the initiatives launched in earlier calls of FP7, namely *Pervasive adaptation*, *Embodied Intelligence*, *ICT Forever Yours* and *Complex Systems Science for Socially Intelligent ICT*. Other topics include those presented in the series of consultations held in 2007 and 2008 and not covered by the present work programme, such as engineering social benevolence and creativity, designing socially-adaptive ICT, simplicity as a design principle in ICT, semantic and pragmatic technology for dynamic communities of practice, assembling information systems with bio-bricks and web science.

Use of Instruments and expected participation:

In the domain of FET Proactive, integrated projects will combine different aspects of multidisciplinary research, together with additional actions e.g. on wide dissemination, education, links with industry, international co-operation. They will assemble the set of multi-disciplinary research teams necessary to efficiently carry out the research and other activities. STREP projects will target a focused research topic with a limited set of teams. Involvement and participation of young researchers, high-tech SMEs and industry, as well as international partners from developed and/or emerging economies in any of the FET proactive initiatives is welcomed and encouraged. This will lead to increased European excellence in science and research, and foster collaboration with leading international organisations.

Objective ICT-2009.8.1: FET proactive 1: Concurrent Tera-device Computing

Integrated circuits and tightly-coupled systems will integrate up to 1000 billion devices by the year 2020. These will provide orders of magnitude improvement in performance and cost only with much higher concurrency and heterogeneous architectures tuned to specific application kernels. In parallel, device variability and failure rates will reach critical levels and power saving methods will be required at all system levels from transistors to architecture and software.

Target outcome

Radically new methods and tools for architecture design and programming of chips and systems beyond 2020, including compilers and run-time systems:

a) **Complexity of design and run-time of many-core heterogeneous systems**: Radically new concepts, design paradigms, methods and proofs-of-concept to address design, compilation and run-time complexity of computing engines with 100+ heterogeneous

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cores. Solutions should cover hardware, software and possibly reconfigurable hardware.

b) **Design of dependable systems with faulty components**: Methodologies and approaches for the design and construction of dependable systems in the face of critical levels of hardware or software faults and in the face of component variability.

c) **Breakthrough programming paradigms**: Radically new design and programming paradigms to enable effective programming of Tera-scale ICT Systems with 100+ cores, in terms of scalability, portability and dependability. They would enable high data throughput applications and new algorithms for the management of massive data sets.

The developments should be motivated by the requirements of wide classes of relevant applications in a time scale of 10-15 years. Proof of concept demonstrations should be developed in parallel with foundational advances.

Integrated projects should address at least two of the above topics, STREPs at least one.

Expected impact

~~a)~~ Reinforced ability to design, program and manage competitive concurrent computing systems beyond the year 2020, thereby supporting the European systems industry in extending its strengths to diverse future application domains while supporting scalability and portability of applications.

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Funding schemes

IP, STREP

Indicative Budget Distribution

IP/STREP: 15M€, of which a minimum of 50% to IPs

Call:

ICT Call 4

Objective ICT-2007.8.2: FET proactive 2: Quantum Information Foundations and Technologies

New perspectives in ICT that exploit the quantum nature of information offer modes of computing and communicating that are not mere down-scaling of silicon CMOS based architectures, thus providing a "beyond Moore" route to circumvent the bottlenecks associated with the extrapolation of present-day information processing and technologies.

Target outcome

a) **Quantum information theory, algorithms and paradigms**: new quantum algorithms, computation paradigms and communication protocols, quantum optimal control and quantum feedback methods.

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b) **Entanglement-enabled quantum technologies** exploiting several qubits for performing ICT tasks with unprecedented characteristics (e.g., quantum random numbers generators, improved atomic clocks, entanglement enhanced metrology, sensors and imaging) and engineering of entangled systems.

c) **Scalability of quantum processing systems**: devices realizing quantum algorithms with up to ten qubits, demonstrating fault tolerant computing and error correction on small scale systems, and demonstrating quantum simulation of systems that cannot be simulated classically.

d) **Long distance quantum communication**: technologies able to overcome the current distance limitation of quantum communication, e.g., by developing quantum repeaters realizing reversible interconversion of different types of qubits.

The research work should advance the state-of-the-art of QIPC and contribute to the transition of the field from upstream research to application-oriented research, e.g., through the increased reliability, scalability and interconnection of components. Interplay between theory and experiment should achieve complete and realistic schemes for coherent manipulation and high-precision performance.

Projects should address at least two of the above topics.

Expected impact

- a) Enable the scalability of quantum information technologies in the presence of environmental decoherence, hence facilitating their real-world deployment.
- b) Develop reliable technologies for the different components of quantum architectures.
- c) Identify new opportunities fostered through the transfer of entanglement technologies from laboratories to industries.

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Funding schemes

IP

Indicative budget distribution

15M€

Call

ICT Call 4

Objective ICT-2009 8.3: FET Proactive 3: Bio-chemistry-based Information Technology (CHEM-IT)

The research will aim at realising programmable information chemistry by revolutionising the means to very precisely direct, control and analyse the chemical processes in sophisticated bio-inspired chemical systems in order to exploit the information processing capabilities of such systems. In addition, the research should aim at implementing evolution and self-organisation into these systems. This could imply the need to control, synthesise, analyse, adapt and/or proliferate chemical (sub-)systems.

Target outcome

Foundations for a radically new kind of information processing technology inspired by chemical processes in living systems. This technology will exploit the information handling capabilities of such systems, as well as their ability to rapidly adapt/evolve and flexibly reconfigure in response to changing conditions by avoiding the constraints separating information handling from processes that create or reconfigure the physical system. Projects are expected to experimentally demonstrate in a physical implementation major steps towards the realisation of such advanced information processing systems. In addition, proposals should express a clear vision on the potential implementation and impact of the proposed concept in the field of information processing.

Expected impact

- Enable the development of ICT systems and devices that utilize interactions between components to assemble complex functional information processing materials.
- Enable a new generation of systems capable of interfacing with conventional IT systems that are self-replicating, self-repairing and/or capable of rapid adaptation/evolution as well as flexible reconfiguration in response to changing conditions.

Funding schemes

STREP

Indicative budget distribution

7 M€

Call

ICT Call 4

Objective ICT-2009.8.4: FET proactive 4: Human-Computer Confluence.

The initiative aims to investigate and demonstrate new possibilities emerging at the confluence between the human and technological realms. It will examine new modalities for individual and group perception, actions and experience in augmented, virtual spaces. Such virtual spaces would span the virtual reality continuum, also extending to purely synthetic but believable representation of massive, complex and dynamic data. Human-Computer confluence fosters inter-disciplinary research (such as Presence, neuroscience, machine learning and computer science) towards delivering unified experiences and inventing radically new forms of perception/action.

Target outcome

a) **On-line perception of and interaction with massive volumes of data:** new methods to stimulate and use human sensory perception and cognition to interpret massive volumes of data in real time to enable assimilation, understanding and interaction with informational spaces. Research should find new ways to exploit human factors (sensory, perceptual and cognitive aspects), including the selection of the most effective sensory modalities, for data exploration.

b) **Unified experience,** emerging from the unnoticeable transition from physical to augmented/virtual reality**:** new methods and concepts towards unobtrusive mixed or virtual reality environment (multi-modal displays, tracking systems, virtual representations…), and scenarios to support entirely unobtrusive interaction. Unobtrusiveness also applies to virtual representations, their dynamics, and the feedback received. Research could also explore how to extend unified experience to synthetic representations of massive volumes of data.

c) **New forms of perception and action:** invent and demonstrate new forms of interaction with the real world, virtual models or abstract information by provoking a mapping from an artificial medium to appropriate sensory modalities or brain regions. This research should reinforce data perception and unified experience by augmenting the human interaction capabilities and awareness in virtual spaces.

Proposals should address at least two of the above topics.

Expected impact

~~a)~~ New methods and tools to act across real and virtual spaces

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~~b)~~ • New means to present the massive amounts of data which future ICT systems will generate and collect to individuals and groups to allow them to explore and more fully understand the causes and consequences of phenomena

~~c)~~ • Improved ability to truly deliver presence experiences contributing both to progress in Presence research and enhancing the foundations for future applications of societal value

Funding schemes

IP

Indicative budget

15M€

Call

ICT Call 5

Objective ICT-2007.8.5: FET proactive 5: Self-Awareness in Autonomic Systems

The challenge is to create computing and communication systems that are able to optimise overall performance and resource usage in response to changing conditions, adapting to both context (such as user behaviour) and internal changes (such as topology). To achieve this, autonomic systems should enable nodes to build up an awareness relating to higher and even global levels, e.g. of patterns of use, system performance, network conditions and available resources. This requires breaking through the tradition of fixing abstraction layers at design time, which hide issues at lower layers (e.g., by hiding mobility, heterogeneity, or drops in performance), but inevitably limit the scope for optimising resource usage and responding to changing conditions.

Target Outcome

New concepts, architectures, foundations and technologies for:

• a) **Creating awareness** at the level of autonomic nodes, by allowing them to interactively and selectively collect information about the system, and use it effectively. A central question is how to link awareness of performance, conditions, available resources, etc., to the nature of information that is exchanged.

• b) **Dynamic self-expression**, namely the ability to autonomically use awareness to adapt the trade-off between abstraction and optimisation. There is a need for understanding the consequences of this principle on system behaviour and performance, and designing/experimenting with related features.

Projects should investigate how such systems can be embedded in a larger (technical or non-technical) context, and within this context support society and economy. They should take into consideration malicious behaviour and the system's ability to respond to arising needs.

Demonstration of new approaches should lead to a better understanding of their feasibility.

STREPs should address at least one and Integrated Projects should address in an integrated manner both topics.

Expected impact

- Lower management costs of large networked systems through the ability to adapt to changing environments and patterns of use, and through a greater degree of, flexibility and reliability

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- More efficient use of resources such as processing power, energy and bandwidth through autonomic decisions based on awareness

Funding schemes

IP, STREP

Indicative budget distribution

IP/STREP: 15M€, of which a minimum of 50% to IPs

Call

ICT Call 5

Objective ICT-2009.8.6: FET Proactive 6: Towards Zero-Power ICT

New disruptive directions are needed for energy-harvesting technologies at the nanometre and molecular scale, and their integration with low-power ICT into autonomous nano-scale devices for sensing, processing, actuating and communication.

Target Outcome

a) **Foundations of Energy Harvesting at the nano-scale:** Demonstration of radically new strategies for energy harvesting and local storage below the micrometer scale. Exploration and harnessing of potential energy sources at that scale including kinetic energy present in the form of random fluctuations, ambient electromagnetic radiation, chemical energy and others. Research may also address bio-mimicked energy collection and storage systems.

b) **Self-powered autonomous nano-scale electronic devices:** Autonomous nano scale electronic devices that harvest energy from the environment, possibly combining multiple sources, and store it locally. These systems would co-ordinate low-power sensing, processing, actuation, communication and energy provision into autonomous wireless nanosystems.

Expected impact

- Possibility of building autonomous nano-scale devices (from sensor to actuators), extending the miniaturisation of autonomous devices beyond the level of the "smart dust"
- New applications in a vast number of ICT fields such as intelligent distributed sensing, for health, safety-critical systems or environment monitoring

Funding schemes

STREP

Indicative budget distribution

7M€

Call

ICT Call 5

Objective ICT-2009.8.7: FET proactive 7: Molecular Scale Devices and Systems

The research addresses devices to represent, store, process and exchange information at the atomic and molecular scale, as a basis for fully functional ICT devices and systems. These devices and systems should rely on new scalable concepts and architectures enabled by

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atomic precision and control, exploit intrinsic properties of atoms and molecules, realize their interconnection, interface them to the mesoscopic world and ultimately have an impact on future information processing systems.

Target outcome

a) Investigation, development and demonstration of **physical implementations,** both at the single-molecule level and with small assemblies of concatenated, interconnected molecules, with the aim of achieving proofs of concept and demonstrating working devices or systems such as molecular computation, single molecular memories, molecule-based sensors, and scalable, functional arrays of molecules.

b) Exploration, design and development of **supporting technologies for molecular-scale information devices and systems** such as: a) **Measurement and control systems**, including atomic and molecular references and precision sensors and procedures to preserve data and operation integrity at design and system level , and b) **Simulation and modelling tools**, including hierarchical modelling (from ab initio and single device to system level).

c) Exploration and demonstration of **radically new characteristics and functionality** of molecular-scale systems by investigating new non-charge based information processing techniques, devices, architectures, self-assembly, programming, supported by experimental implementations.

Integrated Projects should cover at least two of the above topics and present a long-term vision towards future applied RTD.

Expected impact

- Opening of new avenues and exploration of new possibilities in ICT devices and technologies at the molecular scale
- Experimental demonstration of principle and feasibility of such devices
- New perspectives on potential applications with concrete advantages (e.g. energy consumption, data and operation integrity, speed…)

Funding schemes

IP, STREP

Indicative budget distribution

IP/STREP: 15M€, of which a minimum of 50% to IPs

Call

ICT Call 6

Objective ICT-2009.8.8: FET proactive 8: Brain Inspired ICT.

Recent advances in ICT and neuroscience enable a significant part of the human brain to be studied and modelled "in silico". This objective seeks to exploit such advances in order to better understand how the brain processes information and/or how it communicates with the peripheral nervous system (PNS), and to explore potential applications of this.

Target outcome

a) **Development of multi-scale models of information processing and communication in the brain and/or PNS**. Systemic study of the brain, combining recordings/imaging

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of brain activity on several spatial and/or temporal scales simultaneously. This research may also address higher-level cognitive processes. This multi-disciplinary research should foster joint progress and synergy in ICT and the bio- and neuro-sciences.

b) **Synthetic Hardware Implementations of Neural Circuits** that mimic information processing in the brain or PNS. These implementations should demonstrate either the emulation of significant functionality of a neural system (including a comparison with the biological counterpart) or the performance of other specified processing tasks.

STREP Proposals should address at least one and Integrated Projects a combination of the above topics.

Expected impact

- Improved design principles for bio-hybrid artefacts involving engineered components that directly communicate with the nervous system, relying less than current implants on brain plasticity or training in order to function.
- Computational systems that emulate human skills (e.g. by using the directed fusion of diverse sensory information) or exploit underlying principles for new forms of general purpose computing. These should demonstrate significant improvements in, for example, performance, fault tolerance, resilience or energy consumption over traditional ICT approaches.
- Improved diagnosis/treatment of neurological disorders through the use of a comprehensive model of neural and brain functioning.
- Experimental data archived with sufficient appropriate meta-data to facilitate re-use in another research contexts.

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Funding schemes

IP, STREP

Indicative budget distribution

IP/STREP: 15M€, of which a minimum of 50% to IPs

Call

ICT Call 6

Objective ICT-2009.8.9: Coordinating Communities, Plans and Actions in FET Proactive Initiatives:

Target Outcome

a) Coordination or support actions supporting the coordination and cooperation of the targeted research communities, assessing the impact and proposing measures to increase the visibility of the initiative to the scientific community, to targeted industries and to the public at large through dedicated events and/or media campaigns. These actions should also foster the consolidation of research agendas and the coordination of national, regional or international research programmes or activities. Each action should encourage the establishment and promotion of new educational curricula, also bridging and exploiting opportunities offered through Marie-Curie schemes and by the EIT. It should also promote international cooperation in foundational research on topics of the initiative.

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b) Coordination actions fostering the networking of research activities conducted at national or regional level, facilitating the mutual opening of national and regional research programmes where appropriate, e.g. for *Quantum Information Foundations and Technologies*. These actions should involve in particular national or regional research programme owners and aim at the eventual launch of an ERA-NET plus action in a subsequent phase.

Expected impact

- Reinforced coordination of research projects in proactive initiatives in current or previous calls
- Readiness for ERA-NET or ERA-NET Plus schemes where appropriate
- Strengthened European research excellence, including preparation of co-operation and co-ordination with international partners from outside Europe

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Funding Scheme

CSA

Indicative Budget Distribution

1.5 M€ at each call

Calls

ICT Call 4, ICT Call 5, ICT Call 6

Objective ICT-2009.8.10: Identifying new research topics, Assessing emerging global S&T trends in ICT for future FET Proactive initiatives:

Target Outcome

a) Short duration actions (typically 6-12 Months) to organise consultations of multi-disciplinary communities to formulate novel and widely supported FET research topics, initiatives and modalities in support of foundational research that could open up radically new avenues for future ICT. Proposals should concentrate on new emerging areas of research complementing the ICT FET Proactive portfolio. They may consolidate, revisit, or widen topics elicited in earlier calls and previous consultations on the work programme, or bridge with emerging new communities established through FET Open projects. The main objective should be to identify and motivate one or more new research avenues from a global perspective, the associated fundamental challenges, and to analyse the expected impact on science, technology and society.

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b) Actions that perform in-depth analyses of emerging global trends in multidisciplinary science and technology fields contributing to future ICT, in terms of assessment, measurement, risk analysis, critical mass and necessary resources.

Topics for FET Proactive Initiatives for 2011 and later calls will develop over the period and could be inspired by those highlighted in the introduction to FET Proactive under the heading *"Candidate topics for calls in 2011 and beyond"*

Expected Impact

~~a)~~• Novel widely supported and well motivated research topics to be considered as inputs for future work programmes in ICT, with an estimate of the effort required and a clear description of the expected impact.

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~~b)~~ • Increased motivation of research communities to embrace new directions of multidisciplinary exploration around ICT

~~c)~~ • Early identification and increased awareness of new trends emerging on a global scale in support of future proactive initiatives

Funding Scheme

CSA

Indicative Budget Distribution

0.5 M€ at each call

Calls

ICT Call 4, ICT Call 5, ICT Call 6

4.9 Horizontal support actions

Objective ICT-2009.9.1 : Horizontal support actions for international cooperation

In addition to international cooperation activities addressed in the relevant objectives within the 7 Challenges and FET, horizontal international cooperation actions will be supported under this objective.

Target outcome:

a) Support to Information Society policy dialogues and strengthening of international cooperation

The objective is to strengthen the international dimension of the EU ICT research programme by supporting the research dimension of Information Society policy dialogues jointly established between the European Commission and a number of third countries and regional organisations[18]. This includes in particular:

- the organisation of events synchronised with policy dialogue meetings, providing input for example, on common R&D priorities, opportunities and challenges,
- the identification and analysis of ICT policy and research priorities, including long term perspectives, in third countries which are aligned with the priorities of the EU and the provision of recommendations for future co-operation initiatives, including the identification of matching counterpart funding,
- the development of synergies with international dialogues and activities launched under the Capacities and People Specific Programmes, notably the INCO-NET schemes, and related activities by EU Member States and Associated States.

Target countries/regions:

1) Asia (notably ASEAN countries and India), Latin America and Africa;

2) Industrialised Countries, in particular but not exclusive to USA, Canada, Japan, Australia, New Zealand, Korea, Singapore.

b) Support to the uptake of European ICT research results in developing economies

The objective is to facilitate the widest diffusion and local exploitation of European ICT research results, through the piloting and testing of solutions adapted to local infrastructures, service needs, users, culture, and business and social structures. This could include the provisioning of public services (eg. e-government, e-health, e-education, water supply) as well as business-related applications (eg. e-commerce, m-banking) or solutions supporting sustainable development objectives, notably for the environment. Activities will:

- analyse and test the application of relevant technology as well as business models with a particular focus on socio-economic impacts and aspects such as affordability, deployment and local exploitation opportunities,

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[18] African Union, ASEAN, Latin America, Mediterranean Partner Countries, Brazil, China, India, Japan, Russia South Africa, and USA

- facilitate transformation of research results into local innovation, through the networking of relevant technology developers with local academia, incubators, SMEs, representatives from civil society as well as local authorities, notably for the provision of public services,
- promote transfer of know-how, best practices and technology through the establishment of self-sustainable partnerships and collaborative initiatives.

Activities should contribute, if applicable, to the implementation of established European research and innovation roadmaps.

Target countries/regions:

ACP and Mediterranean Partner Countries; other Developing Countries

c) Support the competitiveness of EU industry by identifying strategic partners and by developing international policy objectives and market development priorities

The aim of this action is to extend the constituency developing European technology and innovation roadmaps to key partners in third countries, particularly in the fields of Future Internet and ICT components and systems.

This can include activities such as the identification and assessment of relevant centres of competence in relevant countries or regions, the organisation of workshops and the exchange of best practices. This can also include the undertaking of comparative studies contributing to the assessment of the international positioning of European technology strategies and the formulation of policy objectives.

Impacts on future architectures, standards and access to future markets and services are particularly relevant. These support actions will strengthen the internationalisation of existing roadmaps through the creation of new partnerships and the search for higher levels of synergy.

Target countries/regions:

Emerging economies, notably Latin America

Activities covered under all of the above objectives (a), b) and c) should be covered in balanced partnership with well recognised third country organisations. In addition to leading technology developers, consortia are strongly encouraged to include experienced market research organisations, relevant industry representation and third country organisations/multipliers (e.g. national research authorities/agencies), recognised scientific experts in the field as well as communication specialists.

Expected impact

- Reinforced international dimension of the EU ICT research programme and higher level of international cooperation in ICT research and development with a focus on areas where the EU has a comparative advantage and where there are new leadership opportunities for Europe.
- Significant contribution to a reinforced competitiveness of EU industry in developing and emerging economies through a better adaptation of EU technology solutions to local markets and through the establishment of new strategic partnerships.
- Contribution to a higher level of digital inclusion and to the provision of innovative e-services of high socio-economic impact in developing economies.

Funding schemes

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a) and c): CSA (Support Actions)

b): STREP / SICA

Indicative budget distribution

12 M€:

- a): 3 M€ for target countries/regions 1) + 1 M€ for target countries/regions 2)
- b): 5 M€
- c): 3M€

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Call

ICT Call 4

Objective ICT-2009.2: Supplements to support International Cooperation between ongoing projects

Target outcome

Reinforced cooperation between ongoing FP7 ICT projects in the areas of Trustworthy ICT, Nanoelectronics, Micro/nanosystems, Embedded Systems, and ICT for mobility with "partner-projects" funded by agencies in other industrialised countries that have an appropriate S&T Agreement[19] or are member countries in the Intelligent Manufacturing Systems (IMS) initiative[20].

Actions will provide supplementary funding to support travel and meetings between researchers from the EU-funded project(s) and the partner-project(s). Eligible costs are restricted to travel and subsistence costs made for researchers active in the proposing EU-funded project when travelling to the partner-project country, as well as costs for organising meetings in the EU with the partner-project(s). Costs made by researchers working outside the proposing EU funded project are not eligible. Partner-projects must be able to demonstrate the availability of at least a similar budget for support to the cooperation before the grant is awarded.

Partner-projects should be complementary and the added value of cooperation should be justified in terms of joint results, exchange of knowledge or use of each other's facilities.

Expected Impact

1. Higher quality RTD results through cooperation with researchers in other countries.
2. Paving the way for more strategic partnerships in view of gaining access to knowledge, developing standards and interoperable solutions and strengthening European competitiveness

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Funding scheme

Additional funding to existing grant for IP or STREP, with a maximum of 100 K€ per proposing project, for the period of cooperation, depending on the number of researchers involved and the duration of the cooperation.

19 USA, TBC…

20 IMS member countries include Japan, South Korea and the USA, see Agreement under: http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2008:053:SOM:EN:HTML

Indicative budgets

- Trustworthy ICT: 0.5 M€
- Nanoelectronics, Micro/nanosystems, Embedded Systems, ICT for mobility: 0.8 M€

Call

- Call 4: Projects supported from WP 2007-08 Objectives: ICT-2007.1.4, 1.7, 3.1, 3.6, 3.7, 6.1, 6.2: 0.7 M€
- Call 6: Projects supported from WP 2009-10 Objectives: ICT-2009.1.4, 3.1, 6.1: 0.6 M€

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Objective ICT-2009.9.3 : General Accompanying Measures

Target outcome

a) Co-ordinated approach to assess the current and future situation with regards to ICT *R&D skills* in Europe and to engage in promotion actions aimed at building up and attracting more ICT research expertise in Europe. This includes awareness raising, agreeing on benchmarking and reliable data collection methods, setting, sharing and implementing best practices, evaluation and re-design of ICT curricula, international co-operation relating to the move of researchers and professionals and other relevant issues. This requires the active involvement of relevant stakeholders with sufficient influence on educational and training systems at Member State / Associated Country level and with access to information relevant to skill building. The action should take particular account of specific requirements from women and young people. One CSA is expected to be supported for a budget of up to 400 K€.

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b) Networking actions to raise awareness of *pre-commercial procurement* in Europe and exchange experiences between stakeholders, as well as to debate concrete mid-to-long term public needs that would require the development of new technology solutions with a potential role for pre-commercial procurement strategies. These actions should involve in particular states' procurement authorities. It is expected that 3 CSAs will be supported for a budget of up to 400 K€ each.

c) Co-ordinated approach to the setting-up of *shared research facilities or excellence centres*. Emphasis should be on complementary or common planning and investments in research infrastructures and centres. This requires a tighter coordination and collaboration between all stakeholders but especially between Member States / Associated Countries or between regional authorities. It is expected that 3 CSAs will be supported for a budget of up to 400 K€ each.

d) Coordination of the research in the economics of ICT by bringing together the main research groups in Europe addressing for example the assessment of ICT induced investment in intangibles, the assessment of the impact of ICT R&D expenditures and ICT R&D policy on productivity, the economic impact of ICT as an enabler of new inventions and R&D externalities in and between industries, and between countries. One CSA is expected to be supported for a budget of up to 500 K€.

e) A platform to facilitate access to finance for innovative SMEs participating in the ongoing ICT projects in the Framework Programme. Support will go to one Coordination and Support Action that enables efficient interactions between SMEs involved in the

projects and Venture Capital firms, Business Angels and other private equity firms investing in high growth SMEs in the ICT field.

Expected impact

- Reinforced ICT R&D expertise in Europe.
- Higher level of awareness of opportunities in pre-commercial procurement in Europe and improved collaboration between stakeholders.
- More cost-efficient and effective set-ups of shared research facilities and excellence centres.
- Improved understanding of the socio-economic impacts of ICT R&D.
- Improved access to finance for innovative SMEs.

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Funding scheme

CSA

Indicative budget

4M€

Call

ICT Call 4

5 Implementation of calls

	WP 09-10	Call 4	Call 5	Call 6	FET Open	Joint Call
1. Pervasive and Trusted Network and Service Infrast.	**557**					
1.1 Network of the Future	**190**	110	80			
1.2 Internet of Services, SW & virtualisation of resources	**110**		110			
1.3 Internet of Things for enterprise environments	**37**		37			
1.4 Security of ICT infrastructures & services	**90**		90			
1.5 Networked Media & 3D Internet	**80**	80				
1.6 Experimental Facility	**50**		50			
2. Cognitive Systems, Interaction, Robotics	**179**					
2.1 Cognitive Systems and Robotic Systems	**153**	73		80		
2.2. Language Based Interaction	**26**	26				
3. Components, systems, engineering	**375**					
3.1 Nanoelectronics Technology	**35**		35			
3.2 Design of Semiconductor Components and Electronic-based Miniaturised Systems	**25**	25				
3.3 Flexible, Organic and Large Area Electronics	**60**	60				
3.4 Embedded Systems Design	**28**	28				
3.5 Engineering of Networked Monitoring and Control Systems	**32**		32			
3.6 Computing Systems	**25**	25				
37 Photonics	**60**		60			
3.8 Organic Photonics and other Disruptive Photonics Technologies	**30**	30				
3.9 Microsystems and Smart Miniaturised Systems	**80**		80			
4. Digital Libraries and Content	**188**					
4.1 Digital libraries and preservation	**69**			69		
4.2 Technology-Enhanced Learning	**49**		49			
4.3 Intelligent information management	**70**		70			
5. Towards sustainable and personalised healthcare	**161**					
5.1 Personal Health Systems	**63**	63				
5.2 ICT for Patient Safety	**30**	30				
5.3 Virtual Physiological Human	**63**			63		
5.4: International Cooperation on Virtual Physiological Human	**5**	5				
6. ICT for Mobility, Env'l Sust. & Energy Efficiency	**154**					
6.1 ICT for Safety and Energy Efficiency in Mobility	**53**	53				
6.2 ICT for Mobility of the Future	**37**			37		
6.3 ICT for Energy Efficiency	**30**	30				
6.4 ICT for Environmental Simulation & Monitoring	**24**	24				
6.5: Novel ICT solutions for Smart Electricity Distribution Networks (Joint Call ICT-Energy)	**10**					10
7. ICT for independent living, Inclusion & Participatory governance	**73**					
7.1 ICT and Ageing	**24**	24				
7.2 Accessible and Assistive ICT	**34**	34				
7.3 ICT for Governance and Policy Modelling	**15**	15				
Future and Emerging Technologies	**171**					
FET-Open	**61**				61	
FET-Proactive	**110**	39	39	32		
Horizontal Actions	**17**					

9.1 International Cooperation	**12**	12				
9.2 Supplements to support International Cooperation between ongoing projects	**1.3**	0.7		0.6		
9.3 Other Horizontal Actions (ICT ERA-NET/CAs)	**4**	4				
Total	**1875**	791	732	282	61	10

….

Other expenditures

Independent experts assisting in proposal evaluations and project reviews

The ICT priority will support independent experts assisting in proposal evaluations, project reviews and for the ICT theme evaluation and monitoring.

ICT conference, studies, evaluations and reviews

In addition to calls for proposals, calls for tenders are also expected to be published on specific activities that the ICT priority will support. These include:

– The organisation of the ICT biannual conference.

– Studies including socio-economics and impact analysis studies and studies to support the monitoring, evaluation and strategy definition for the ICT priority in FP7 as well as publications and support to other events (e.g. information, communication, dissemination etc.).

Details will be provided in the texts of these calls for tender.

The International Human Frontier Science Programme Organisation

As foreseen in the Cooperation Specific Programme an annual subscription to the International Human Frontier Science Programme Organisation (HFSPO)[21] will be made jointly with the "Health" theme. This will allow EU non-G8 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 in Ottawa in June 2007 the Community subscriptions for 2009 and 2010 will be EUR 3.981 million and EUR 4.153 million, respectively. Out of the total Community subscription EUR 1,593 million will be paid in 2009 and EUR 1,661 million in 2010 from this Theme, and the remainder from the Health Theme.

IMS Secretariat

The ICT Theme will support the Intelligent Manufacturing Systems secretariat for an amount of 0.14 M€ in 2009.

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

ICT Contribution to General FP7 Activities

Risk Sharing Finance Facility

…

Other contributions

In addition to RSFF, the ICT priority will also contribute to other general activities including the Cordis service, EUREKA membership, the COST Programme and cross-cutting ERA-NETs. A summary of this contribution is given below:

TBC…

A summary table of all the above expenditures is given in Appendix 4.

Call title: ICT Call 4

- Call identifier: FP7-ICT-2009-1
- Date of publication: November 2008
- Closure date: 17 March 2009, at 17:00 Brussels local time
- Indicative budget: [*to be inserted according to table above*] … M€
- Topics called:

  [*to be inserted according to table above*] …
- Evaluation procedure:
  - A one-stage submission procedure will be followed.
  - The evaluation criteria and sub-criteria (including weights and thresholds), together with the eligibility, selection and award criteria, for the different funding schemes are set out in Annex 2 to this work programme.
- Indicative evaluation and contractual timetable: It is expected that the contract negotiations for the shortlisted proposals will start as of ...
- Consortia agreements: Participants in all actions resulting from this call are required to conclude a consortium agreement.
- Particular requirements for participation, evaluation and implementation: See Appendix 1
- The forms of grant which will be offered are specified in Annex 3 to the Cooperation work programme.

Call title: ICT Call 5

- Call identifier: FP7- ICT -2009-2
- Date of publication[22]: June 2009
- Closure date[23]: 22 September 2009, at 17:00 Brussels local time
- Indicative budget[24]: [*to be inserted according to table above*] …M€
- Topics called:

  [*to be inserted according to table above*] …
- Evaluation procedure:
  - A one-stage submission procedure will be followed.
  - The evaluation criteria and sub-criteria (including weights and thresholds), together with the eligibility, selection and award criteria, for the different funding schemes are set out in Annex 2 to this work programme.
- Indicative evaluation and contractual timetable: It is expected that the contract negotiations for the shortlisted proposals will start as of ...
- Consortia agreements: Participants in all actions resulting from this call are required to conclude a consortium agreement.
- Particular requirements for participation, evaluation and implementation: See Appendix 1
- The forms of grant which will be offered are specified in Annex 3 to the Cooperation work programme.

Call title: ICT Call 6

- Call identifier: FP7-ICT-2009-3
- Date of publication[25]: November 2009
- Closure date[26]: 16 March 2010
- Indicative budget: [*to be inserted according to table above*] … M€
- Topics called:

  [*to be inserted according to table above*] …
- Evaluation procedure:
  - A one-stage submission procedure will be followed.
  - The evaluation criteria and sub-criteria (including weights and thresholds), together with the eligibility, selection and award criteria, for the different funding schemes are set out in Annex 2 to this work programme.

[22] The Director-General responsible for the call may publish it up to one month prior to or after the envisaged date of publication.
[23] At the time of the publication of the call, the Director-General responsible may delay this deadline by up to two months
[24] …
[25] The Director-General responsible for the call may publish it up to one month prior to or after the envisaged date of publication.
[26] At the time of the publication of the call, the Director-General responsible may delay this deadline by up to two months

- Indicative evaluation and contractual timetable: It is expected that the contract negotiations for the shortlisted proposals will start as of ...
- Consortia agreements: Participants in all actions resulting from this call are required to conclude a consortium agreement.
- Particular requirements for participation, evaluation and implementation: See Appendix 1
- The forms of grant which will be offered are specified in Annex 3 to the Cooperation work programme.

Call title: FET Open

- Call identifier: FP7-ICT-2007-C
- Date of publication: November 2008

  Date from which proposals are receivable: 1 January 2009.
- Closure date: 31 December 2010, at 17:00, Brussels, local time[27]
- Indicative budget: 61 M€, which is expected to be committed for successful proposals from the cut-off dates up to and including 26/1/2010 (batch 5 to batch 8). A minimum of 10M€ and a maximum of 20M€ will be allocated per batch.
- Topics called:

Challenge	Objectives	Funding schemes[28]
Future and emerging technologies	ICT-2009.8.0 FET-Open: Challenging current thinking	CP (STREP only) CSA

Eligibility, evaluation, selection and award criteria: see Appendix 5 of the Work Programme for specific eligibility and evaluation criteria applicable to FET Open.

– Evaluation procedure:

- proposals for STREPs have to be submitted in two stages: first a *short*, strictly anonymous, proposal of maximum five pages (excluding a title page) is submitted describing the key objectives and motivation for the proposed work;
- *short* proposals may be submitted at any time from the opening of the call until the final closure date (currently 31/12/2010 – see footnote 48). They are evaluated anonymously as they come in with the help of remote evaluators;
- if the *short* proposal is successful, the proposers are invited to submit a *full* proposal by a specified cut-off date. This cut-off date is determined by the submission date of the *short* proposal, as indicated in the table below;
- *full* proposals are evaluated through a combination of remote evaluation and panels of experts that convene in Brussels; they are not evaluated anonymously.
- proposals for CAs are submitted in one stage and are not evaluated anonymously.

[27] It is planned that the call will subsequently be extended beyond 31/12/2010

[28] Each proposal should indicate the type of funding scheme used (IP or STREP for CP, where applicable; CA or SA for CSA, where applicable)

Batch	Short STREP proposal start date submission period	Short STREP proposal end date submission period	full STREP and CSA cut-off date (at 17:00 Brussels time)
5	7/5/2008	2/09/2008	20/01/2009
6	3/09/2008	6/01/2009	26/05/2009
7	7/01/2009	5/05/2009	22/09/2009
8	6/05/2009	8/09/2009	26/01/2010
9	9/09/2009	12/01/2010	6/07/2010
10	13/01/2010	11/05/2010	28/09/2010
11	12/5/2010	7/09/2010	25/01/2011
12	8/09/2010	4/01/2011	24/05/2011

FET-Open proposals submitted to batch 5 and FET-Open short STREP proposals submitted to batch 6 will be evaluated based on call text and eligibility, evaluation, selection and award criteria set-out in ICT Work Programme 2007/2008.

Indicative evaluation and contractual timetable:

– Evaluation results for *short* proposals: three months from proposal reception;

– Evaluation results for *full* proposals: three months from the cut-off or closure date.

- Consortia agreements*:* It is not mandatory that participants in RTD actions resulting from this call conclude a consortium agreement although such agreements are strongly recommended.

Call title: Joint Call ICT & Energy (FP7- ICT-ENERGY-2009-1)

- Call identifier: FP7-ICT-ENERGY-2009-1
- Date of publication [29]: November 2008
- Deadline[30]: 17 March 2009, at 17.00 h Brussels local time
- Indicative budget[24]: 20 M€, provided by the ICT theme (10 M€) and by the Energy theme (10 M€).
- Topics called:

Activity/ Area	Topics called	Funding Schemes
Challenge 6: ICT for Mobility, Environmental Sustainability and Energy Efficiency	FP7-ICT-ENERGY-2009-1: Novel ICT solutions for Smart Electricity Distribution Networks	*Collaborative project*

- **Evaluation procedure**:
  - A one-stage submission procedure will be followed.
  - Proposals will be evaluated in a single-step procedure.
- **Indicative evaluation and contractual timetable**: Evaluations of proposals are expected to be carried out during the month of ... It is expected that the contract negotiations for the shortlisted proposals will be open from ...

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[29] The Director-General responsible for the call may publish it up to one month prior to or after the envisaged date of publication

[30] Where the envisaged date of publication is either advanced or delayed, the deadline may be adjusted accordingly

- **Consortia agreements** are required for *all* actions.
- **Particular requirements for participation, evaluation and implementation**:

  The minimum number of participating entities required, for all funding schemes, is set out in the Rules for Participation: For Collaborative projects, the minimum condition shall be the participation of 3 independent legal entities, each of which is established in a Member State or Associated Country and no two of which are established in the same Member State or Associated Country.

  The general eligibility criteria as well as evaluation criteria and sub-criteria (including weights and thresholds) for the different funding schemes are set out in Annex 2 to this work programme.

  As a result of the evaluation, a ranked list of proposals retained for funding will be drawn up as well as a reserve list of proposals that may be funded in case budget becomes available during negotiations.

  The forms of grants which will be offered are specified in Annex 3 to this work programme.

6 Indicative priorities for future calls

Challenges are expected to remain largely valid beyond the first and second work programmes as they express aims to be achieved in a 10-15 years timeframe. For the next Work Programmes, changes will take place within the scope of the Framework and Specific Programmes. They will take into account the experience from the first calls as well as technological developments, socio-economic evolutions and political priorities.

Appendix 1: Minimum number of participants

Minimum number of participants[31] as set out in the Rules for Participation

Funding scheme	Minimum conditions
Collaborative project	At least 3 independent legal entities, each of which is established in a MS or AC, and no two of which are established in the same MS or AC.
Collaborative project for specific cooperation actions dedicated to international cooperation partner countries (SICAs)	At least 4 independent legal entities. Of these, 2 must be established in different MS or AC. The other two must be established in different international cooperation partner countries
Network of excellence	At least 3 independent legal entities, each of which is established in a MS or AC, and no two of which are established in the same MS or AC.
Co-ordination action	At least 3 independent legal entities, each of which is established in a MS or AC, and no two of which are established in the same MS or AC.
Support action	At least 1 independent legal entity

[31] MS = Member States of the EU; AC = Associated Country. Where the minimum conditions for an indirect action are satisfied by a number of legal entities, which together form one legal entity, the latter may be the sole participant, provided that it is established in a Member State or Associated country

Appendix 2: Funding schemes

1. Collaborative projects (CP)

Support to research projects carried out by consortia with participants from different countries, aiming at developing new knowledge, new technology, products, demonstration activities or common resources for research. The size, scope and internal organisation of projects can vary from field to field and from topic to topic. Projects can range from small or medium-scale focused research actions to large-scale integrating projects for achieving a defined objective. Projects may also be targeted to special groups such as SMEs.

The Funding Scheme allows for two types of projects to be financed: a) *"small or medium-scale focused research actions"*, b) *"large-scale integrating projects*".

a) *Small or medium-scale focused research actions* (STREP)

Purpose

Small or medium-scale focused research projects (STREP) are objective-driven research projects, which aim at generating new knowledge, including new technology, or common resources for research in order to improve European competitiveness, or to address major societal needs. They have clearly defined scientific and technological objectives directed at obtaining specific results, which could be applicable in terms of development or improvement of products, processes, services or policy.

STREPs target a specific research objective in a sharply focused approach. They have a fixed overall work plan where the principal deliverables are not expected to change during the lifetime of the project.

Size and resources

There must be at least three 'legal entities' established in different EU Member States or Associated countries. The entities must be independent of each other.

A higher number of participants may be specified on a call-by-call basis: check the call fiche.

The size, scope and internal organisation of collaborative projects can vary from research theme to research theme and from topic to topic. During FP6 the number of participants in STREPs for the IST priority varied from 6 to 15 participants and the EC contribution varied between 1 and 4 M€, with an average around the 2 M€.

Duration

STREPs are expected to last typically eighteen months to three years. However, there is no formal minimum or maximum duration.

Activities

The activities to be carried out in the context of a STREP can include:

a) research and technological development activities, reflecting the core activities of the project, aimed at a significant advance beyond the established state-of-the-art

b) demonstration activities, designed to prove the viability of new technologies that offer a potential economic advantage, but which cannot be commercialised directly (e.g. testing of product-like prototypes)

c) management activities, over and above the technical management of individual work packages, linking together all the project components and maintaining communication with the Commission.

SICAs

STREPs may also be used to support a special form of international co-operation projects, the so-called Specific International Cooperation Actions (SICAs) with ICPC countries in areas of mutual interest and dedicated to cooperation on topics selected on the basis of their scientific and technological competences and needs.

These SICAs have specific rules for participation. For the SICA projects there must be at least four independent legal entities of which at least two must be established in different Member States or Associated countries and at least two must be established in different ICPC countries in the target regions defined in the objective for the project.

A higher number of participants may be specified on a call-by-call basis: check the call fiche.

Financial Regime

Reimbursement will be based on eligible costs (based on maximum rates of reimbursement specified in the grant agreement for different types of activities within the project). In some cases the reimbursement of indirect costs is based on a flat rate.

The work programmes shall specify if other forms of reimbursement are to be used in the actions concerned. Participants in International Cooperation Partner countries (see Annex 1 of the work programme) may opt for a lump sum.

Specific Characteristics

The description of work (annex 1 to the grant agreement) is normally fixed for the duration of the project.

The composition of the consortium is normally fixed for the duration of the project.

b) *Large-scale integrating projects* (IP)

Purpose

Large scale integrating collaborative projects (IP) are objective-driven research projects, which aim at generating new knowledge, including new technology, or common resources for research in order to improve European competitiveness, or to address major societal needs. They have clearly defined scientific and technological objectives directed at obtaining specific results, which could be applicable in terms of development or improvement of products, processes, services or policy. As such, they may also be targeted to special groups, such as SMEs.

Large scale integrating projects have a comprehensive “programme” approach: including a coherent integrated set of activities dealing with a range of aspects and tackling multiple issues and aimed at specific deliverables; there will be a large degree of autonomy to adapt content and partnership (all types of stakeholders) and update the work plan, where/as appropriate.

Size and resources

There must be at least three ‘legal entities’ established in different EU Member States or Associated countries. The entities must be independent of each other.

A higher number may be specified on a call-by-call basis: check the call fiche.

The size, scope and internal organisation of collaborative projects can vary from research theme to research theme and from topic to topic. During FP6 the number of participants in IPs for the IST priority varied between 10–20 and the total EC contribution was between 4 and 25 M€, with an average around 10 M€.

Duration

IPs are expected to last typically three to five years. However, there is no formal minimum or maximum duration.

Activities

The activities to be carried out in the context of an IP can include (indents a) and/or b) being a must):

a) research and technological development activities, reflecting the core activities of the project, aimed at a significant advance beyond the established state-of-the-art

b) demonstration activities, designed to prove the viability of new technologies that offer a potential economic advantage, but which cannot be commercialised directly (e.g. testing of product-like prototypes)

c) activities to disseminate research results and to prepare for their uptake and use, including knowledge management and IPR protection

d) management activities, over and above the technical management of individual work packages, linking together all the project components and maintaining communication with the Commission

e) training of researchers and key staff, including research managers and industrial executives (in particular for SMEs and any potential users of the knowledge generated by the project). The training should aim to improve the professional development of the personnel concerned

f) other activities, if required

Financial Regime

Reimbursement will be based on eligible costs (based on maximum rates of reimbursement specified in the grant agreement for different types of activities within the project). In some cases the reimbursement of indirect costs is based on a flat rate.

The work programmes shall specify if other forms of reimbursement are to be used in the actions concerned. Participants in International Cooperation Partner countries (see Annex 1 of the work programme) may opt for a lump sum.

Specific Characteristics

A sequence of updates of the description of work (annex 1 of the grant agreement) may be provided for in the grant agreement.

Enlargement of partnership, within the initial budget, is possible.

2. Networks of Excellence (NoE)

Support to *a Joint Programme of Activities* implemented by a number of research organisations integrating their activities in a given field, carried out by research teams in the framework of longer term co-operation. The implementation of *this Joint Programme of* Activities will require a formal commitment from the organisations integrating part of their resources and their activities.

The funding scheme will support the long-term durable integration of research resources and capacities (researchers, services, teams, organisations, institutions) in fields of strategic importance for European research, through the establishment of a single virtual centre of research, in order to overcome demonstrable, detrimental fragmentation, thus strengthening European scientific and technological excellence on a particular research topic.

Networks of Excellence will aim at consolidating or establishing European leadership at world level in their respective fields by integrating at European level the resources and expertise needed for the purpose. This will be achieved through the implementation of a Joint Programme of Activities (JPA) aimed principally at creating a progressive and durable integration of the research capacities of the network partners while at the same time advancing knowledge on the topic.

Since Networks of Excellence are aimed at tackling fragmentation of existing research capacities, they should be implemented provided that:

- research capacity is fragmented in the (thematic) area being considered;
- this fragmentation prevents Europe from being competitive at international level in that area;
- the proposed integration of research capacity will lead to higher scientific excellence and more efficient use of resources.

The implementation of the Joint Programme of Activities will require a formal commitment from the organisations integrating part or the entirety of their research capacities and activities.

The Joint Programme of Activities (JPA) is the collective vehicle for achieving the durable integration of the research resources and capacities of the Network of Excellence. In order to do so, the JPA should consist of a coherent set of integrating activities that the participants undertake jointly. The JPA will have several components:

- activities aimed at bringing about the integration of the participants research activities on the topic considered, such as:
    - establishing mechanisms for co-ordinating and eventually merging the research portfolios of the partners
    - staff exchange schemes
    - complete or partial relocation of staff
    - establishment of shared and mutually accessible research equipment, managerial and research infrastructures, facilities and services
    - exploration of the legal requirements (facilitators/barriers) for durable integration,
    - setting up of joint supervisory bodies
    - measures for joint public relations …
- jointly executed research to support the durable integration, e.g. systemic development, or development of common tools, or at filling gaps in the collective knowledge portfolio of the network, in order to make the research facilities useable by the network. (NB: in addition to this research, participants in a network will pursue their “own institutional portfolio”, including research, development or demonstration in the area covered by the network itself. The latter research, development or demonstration activities are not part of

the “joint programme of activities” and thus will not be part of the eligible costs of the network)

- activities designed to spread excellence, such as:
    - The main component of these activities will be a joint training programme for researchers and other key staff;
    - Other spreading of excellence activities may include: dissemination and communication activities (including public awareness and understanding of science), and, more generally, networking activities to help transfer knowledge to teams external to the network.
    - Spreading of excellence may also include the promotion of the results generated by the network; in such a context, networks should, when appropriate, include innovation-related activities (protection of knowledge generated within the network, assessment of the socio-economic impact of the knowledge and technologies used and development of a plan for dissemination and use of knowledge), as well as any appropriate gender and/or ethical related activities
- all the network’s activities should be carried out within a coherent framework for the management of the consortium linking together all the project components and maintaining communications with the Commission.

3. Coordination and support actions (CSA)

Support to activities aimed at coordinating or supporting research activities and policies (networking, exchanges, trans-national access to research infrastructures, studies, conferences, etc). These actions may also be implemented by means other than calls for proposals.

The Funding Scheme allows for two types of actions to be financed: a) *“co-ordination or networking actions”*, b) *“specific support actions*".

a) *Coordination or networking actions* (**CA**)

Coordinating or networking actions will always have to be carried out by a consortium of participants, normally three from three different countries.

The coordination or networking actions cover the following activities:

> the organisation of events - including conferences, meetings, workshops or seminars -, related studies, exchanges of personnel, exchange and dissemination of good practices, and, if necessary, the definition, organisation and management of joint or common initiatives together of course with management of the action.

The coordination and networking actions normally stretches over a longer period.

b) *Specific support actions* (**SA**)

Specific support actions may be carried out by a single participant, which can be based in any member state, associated country or a third country. Therefore there are no restrictions on the size of the consortium.

Although normally awarded following calls for proposals, there are also the possibilities to award specific support actions through public procurement carried out on behalf of the Community or to grant support to legal entities identified in the Specific Programmes or in the work programmes where the Specific Programme permits the work programmes to identify beneficiaries.

The objective of specific support actions are to contribute to the implementation of the Framework Programmes and the preparation of future Community research and technological development policy or the development of synergies with other policies, or to stimulate, encourage and facilitate the participation of SMEs, civil society organisations and their networks, small research teams and newly developed or remote research centres in the activities of the thematic areas of the Cooperation programme, or for setting up of research-intensive clusters across the EU regions.

The specific support actions can be of different types covering different activities:

- monitoring and assessment activities, conferences, seminars, studies, expert groups, high level scientific awards and competitions, operational support and dissemination, information and communication activities, support for transnational access to research infrastructures or preparatory technical work, including feasibility studies, for the development of new infrastructures, support for cooperation with other European research schemes, the use by the Commission of external experts, management or a combination of these.

Appendix 3: Coordination of national or regional research programmes

The objective of these actions is to step up the cooperation and coordination of research programmes carried out at national or regional level in the Member or Associated States through the networking of research programmes, towards their mutual opening and the development and implementation of joint activities.

Under FP7 the coordination of national or research programmes is continued and reinforced.

Coordination projects can network four types of activities: (1) Information exchange – (2) Definition and preparation of joint activities – (3) Implementation of joint activities – (4) Funding of joint trans-national research actions:

- **ERA-NETs** and other coordination actions launched under FP6 wishing to submit a follow-up proposal under FP7 have to propose a strong coordination action focusing directly on steps three and four, in order to achieve mutual opening and trans-national research via joint/common calls, joint/common programmes or, if appropriate, other joint trans-national actions. New coordination actions, which address new topics and without any experience from FP6, should address at least the first three steps, but are encouraged to aim at the "four step approach", as described above.

- Under **ERA-NET Plus actions**, the Commission provides an incentive to the organisation of joint calls between national or regional research programmes by 'topping-up' joint trans-national funding with Community funding. These joint calls will entail the award of grants to third parties participating in calls for proposals launched under the ERA-NET Plus actions. These actions require programme owners or programme managers from at least 5 different Member or Associated States to plan a single joint call with a clear financial commitment from the participating national or regional research programmes. Full details of the ERA-NET Plus scheme are given in Annex IV of the Work Programme.

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Appendix 4: Distribution of budget commitment

The distribution of budget commitment over 2009-10 is presented below.

Indicative budget for the ICT Theme (2009-10 Work Programme)

TBC

Appendix 5: FET eligibility, evaluation, selection and award criteria

Eligible proposals under FET objectives will be evaluated according to three criteria - Scientific/Technological Quality, Implementation and Impact. A score will be awarded for each of these criteria, based on the considerations listed below.

In addition to the eligibility criteria set out in Annex 2 to this work programme, FET-Open short proposals are also subject to the following eligibility criteria:

1. The length of Part B should not exceed 5 A4 pages, excluding a title page.
2. Part B should be fully anonymous, meaning that none of the partners or authors should be explicitly mentioned or be otherwise identifiable.

	1. S/T quality (in relation to the topics addressed by the call)	***2. Implementation***	***3. Impact***
***short* STREP (FET Open)**	• Clarity of targeted breakthrough and its relevance towards a long-term vision. • Novelty and foundational character. • Plausibility of the S/T approach, as outlined.	*(not applicable to short STREP)*	*(not applicable to short STREP)*
	Threshold: 3.5/5		
STREP	• Clarity of targeted breakthrough and its relevance towards a long-term vision. • Novelty and foundational character. • Specific contribution to progress in science and technology. • Quality and effectiveness of the S/T methodology.	• Quality of workplan and management. • Quality and relevant experience of the individual participants. • Quality of the consortium as a whole (including complementarity, balance). • Appropriate allocation and justification of the resources to be committed (person-months, equipment, budget).	• Transformational impact of the results on science, technology and/or society. • Contribution at the European level towards the expected impacts listed in the work programme. • Appropriateness of measures envisaged for the dissemination and/or use of project results.
	Threshold: 3.5/5 **Weight:** **FET Open - 50%** **FET Proactive - 40%**	**Threshold: 3/5** **Weight: 20%**	**Threshold: 3.5/5** **Weight:** **FET Open - 30%** **FET Proactive - 40%**
IP (FET Pro-active)	• Clarity of objectives and their relevance towards the long-term vision of the proactive initiative. • Integration of research activities of appropriate	• Quality of workplan and management. • Quality and relevant experience of the individual participants. • Quality of the consortium as a whole	• Contribution at the European level towards the expected impacts listed in the workprogramme under the objective. • Transformational impact

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	multidisciplinary character. • Novelty and foundational character. • Specific contribution to progress in science and technology. • Quality and effectiveness of the S/T methodology.	(including complementarity, balance). • Appropriate allocation and justification of the resources to be committed (person-months, equipment, budget).	of the results on science, technology and/or society. • Appropriateness of measures envisaged for the dissemination and/or use of project results, and management of intellectual property.
	Threshold: 3.5/5 **Weight: 40%**	**Threshold: 3.5/5** **Weight: 20%**	**Threshold: 3.5/5** **Weight: 40%**
Coordination and Support Actions	• Clarity of objectives. • Contribution to the co-ordination and/or support of high-risk and high-impact research, for new or emerging areas or horizontally. • Quality and effectiveness of the coordination and/or support activities.	• Quality of workplan and management. • Quality and relevant experience of the individual participants. • Quality of the consortium. • Appropriate management of the resources to be committed (person-months equipment, budget).	• Transformational impact on the communities and/or practices for high-risk and high-impact research. • Appropriateness of measures for spreading excellence, use of results, and dissemination of knowledge, including engagement with stakeholders.
	Threshold: 3/5 **Weight: 40%**	**Threshold: 3/5** **Weight: 20%**	**Threshold: 3/5** **Weight: 40%**

Thresholds are set for each criterion, as indicated in the tables above. In addition, an overall threshold may also be set, as indicated in the table below. A proposal failing to achieve any of these threshold scores will be rejected.

	Overall Threshold
***short* STREP (FET Open)**	None
STREP	10.5/15
IP	None
Coordination and Support Actions	10.5/15

Glossary

3D	Three Dimensional
ACP	Africa, Caribbean, Pacific
CA	Coordination action
Call for Proposals	As published in the Official Journal. Opens parts of the workprogramme for proposals, indicating what types of actions (RTD projects, Accompanying actions etc.) are required. A provisional timetable for such Calls is included in the workprogramme
CIP	Competitiveness and Innovation Programme http://ec.europa.eu/enterprise/enterprise_policy/cip/index_en.htm
CMOS	Complementary metal-oxide semiconductor
COST	COST supports co-operation among scientists and researchers across Europe http://www.cost.esf.org/
CSA	Coordination and Support Action
EC	European Commission (ec.europa.eu)
EIROForum	Partnership of Europe's seven largest intergovernmental research organisations (http://www.eiroforum.org/)
ERA	European Research Area
ETP	European Technology Platform http://cordis.europa.eu/technology-platforms/home_en.html
EU	European Union
EUREKA	A Europe-wide Network for Industrial RTD (*www.eureka.be*)
Evaluation	The process by which proposals are retained with a view to selection as projects, or are not retained Evaluation is conducted through the application of Evaluation Criteria identified in the Workprogramme.
FET	Future and Emerging Technologies
FP	Framework Programme (EU – Seventh FP is FP7, etc. – *cordis.europa.eu*)
HFSP	Human Frontier Science Program (*www.hfsp.org*)
ICPC	International Cooperation Partner Countries (see list in Annex 1)
ICT	Information and communications technologies
ICTC	Information and Communication Technologies Committee
IMS	Intelligent Manufacturing Systems Initiative (*http://www.ims.org/*)
IoT	Internet of Things
IP	Large-scale integrating project
IP	Internet Protocol
IPR	Intellectual Property Rights
Ipv6	Internet Protocol Version 6
IST	Information Society Technologies (FP6 programme)
ISTAG	Information Society Technologies Advisory Group
ITRS	International Technology Roadmap for Semiconductors

JTI	Joint Technology Initiative
LED	Light Emitting Diode
LoC	Lab-on-Chip
NoE	Network of Excellence
OLED	Organic Light Emitting Diode
OLEFET	Organic Light Emitting Field Effect Transistor
P2P	Peer to peer
QIPC	Quantum information processing and communication
QoS	Quality of Service
RF	Radio Frequency
RFID	Radio Frequency Identification
RTD	Research and Technology Development.
SFIT	Smart Fabric Interactive Textile
SICA	Specific International Cooperation Actions
SiP	System in Package
SoC	Systems on a- Chip
SA	Specific Support Actions
SME	Small or Medium Enterprise
STREPs	Small or medium scale focused research action
TFT	Thin Film Transistor