Press Releases

Digital Agenda: FET flagships, six cutting edge projects to change the face of Future and Emerging Technologies

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Six research projects selected to compete for two top spots in the area of research into future and emerging technologies (FET) have been announced today by the European Commission at the FET11 conference and exhibition in Budapest (see IP/11/530). The six contenders will receive around €1.5 million each to refine their proposal for one year, after which only two will be selected. This MEMO gives details of the six research projects concerned.

Graphene-driven: revolutions in ICT and beyond (Graphene)

What is the problem?

Graphene is a form of pure carbon where the carbon atoms are arranged in large, flat sheets that look like atomic chicken wire. This structure gives it many properties which could be exploited for new types of carbon-based electronics, photonics and quantum computing. But graphene's potential is still poorly understood, and its analysis requires highly sophisticated methods.

The Graphene solution?

A Graphene flagship would drive forward the development of graphene electronics, widely recognised throughout the ICT sector as one of the most likely and attractive solutions to sustaining the evolution of ICT devices and technologies beyond the limits achievable with silicon.

By exploiting the unique electrical and optical properties of graphene, the flagship would create novel electronic components with ultra-fast operational speeds and electronic devices with transparent and flexible form factors. The flagship would also investigate fabrication methods and advance cheaper graphene materials which combine structural functions with embedded electronics, in an environmentally sustainable manner.

The future flagship would extend beyond mainstream ICT to incorporate novel sensor applications and composite materials that take advantage of the extraordinary chemical, biological and mechanical properties of graphene.

What can Europe expect to gain?

Carbon has been the driving force behind several technological revolutions: energy production in the 19th century and plastics in the 20th century. Now carbon promises a third technological revolution, this time in ICT. A Graphene flagship would place Europe's microelectronics industry at the heart of innovation in this sector.

Coordinator: Dr Jari Kinaret

Coordinating institute: Department of Applied Physics, School of Physics and Engineering

Physics, Chalmers University of Technology, Sweden

Getting to know your grey matter: 'The human brain project' (HBP)

What is the problem?

Neuroscience has come a long way in the past three decades, yet the ultimate object of research — the human brain — manages to defy our careful ministrations and attention. With some 50-100 billion neurons, the complexity of our brain continues to largely baffle the research community, which is now turning to the power of ICT as the key to progress.

Supercomputers come in different forms, but they are the largest, fastest or most powerful computers available. Many of today's supercomputing solutions actually cluster or harness the power of numerous computers, linking them together to make them more powerful, so they can tackle data and processing heavy jobs like quantum physics, climate research, genomics and of course brain research.

Only through the incredible capacity of supercomputers to perform billions of simultaneous calculations can brain scientists hope to discover —and then exploit — exactly what goes on inside our heads.

The HBP solution?

The proposed HBP flagship intends to build the necessary informatics, modelling and supercomputing infrastructure which will be required to perform unprecedented simulations of the human brain. But this ambitious aim will require a highly interdisciplinary and coordinated research effort. Research will be required in a wide variety of areas including high-performance computing, neuro-morphic computing (emulating brain circuitry to perform complex calculations), brain-machine interfaces and robotics.

The work of these different collaborative groups will be brought together in the proposed Facility for Brain Simulation which will be located at the École Polytechnique Fédérale de Lausanne in Switzerland.

This facility will create numerous models based on the work of flagship teams and analyse their output. It will also create and manage an internet-accessible 'simulation cockpit', through which researchers from all over world would be able to conduct *in silico* experiments and interact collaboratively with data, models and simulations.

What can Europe expect to gain?

The human brain has capabilities unmatched by current computing systems. It is a very fast, massively parallel, distributed machine with negligible energy consumption (just 20-30 watts). It is resilient to damage; it can categorise patterns in rapidly varying noisy data; it can learn and adapt; it can predict the consequences of its own behaviour and that of other intelligent agents; it can think, express itself in language, and understand or learn the language of others. Information and communications technology with only a fraction of these capabilities would transform 21st century science, technology and indeed the social fabric.

Coordinator: Professor Henry Markram

Coordinating institute: Brain Mind Institute, Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland

'Zero-power intelligent autonomous systems-of-systems' (Guardian Angels)

What is the problem?

Smart sensor and control technologies are all around us, from home heating thermostats to active car safety features. Technology plays the role of guardian angel, helping us from our infancy to old age in complex or dangerous situations and environments.

These mostly tiny and embedded sensing, computation and communication technologies are often required to work indefinitely or in portable devices. But a perennial problem raises its head with all electronics: how can we power these little sensors?

The Guardian Angel solution?

The simple answer to the big 'power-supply' question on which this project is based isthat we don't power them but rather that they take care of themselves. Guardian angel technologies must be zero-power. In other words, they must have the ability to extract energy from their immediate environment, wherever they happen to be. A Guardian Angels flagship would provide the coordination and impetus across Europe for researchers to work together on energy harvesting systems. They would develop disruptive materials and devices to reduce the energy consumption of computational components and also harvest solar and thermal energy and generate power using vibrations and electromagnetic waves.

The scientists would also explore new bio-inspired energy production, for example synthetic photosynthesis. The overarching aim of the flagship would be to create new low-energy nano-electronics and systems which could scavenge energies of tens of mW per cm2 (or per mm3), far beyond what has been achieved with today's technologies.

What can Europe expect to gain?

We are quite used to plugging in our computers, and regularly charging our mobile phones; electronic devices depend largely on traditional electrical energy sources, whether supplied by the mains or batteries. There is a huge market for zero-power devices, for portable gadgets, wearable health monitors and critical safety technologies which must have uninterrupted power. The scope of zero power technology is hard to quantify, but should usher in a new era of autonomous 'guardian angel' systems which will become our revolutionary, smart companions, improving many aspects of our lives: our health, our safety and even our relationships.

Coordinator: Prof. Adrian Ionescu

Coordinating institute: Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland

Soft, gentle and friendly robots: 'Robot companions for citizens' (RoboCom)

What is the problem?

Global society is facing many new and critical challenges: the ageing of the population, increasing urbanisation and an urgent need to preserve our environment. But a new generation of robotic technologies can come to the help of humans in all these areas. This new class of machines - soft, gentle and sentient robot companions - will help us to maintain our quality of life in a changing world. They will work alongside us at home, at work, in factories and hospitals. But before these robots can be given such responsibilities they must acquire the necessary skills to interact with us physically, emotionally, socially, and above all safely.

The RoboCom solution?

A RoboCom flagship would bring together scientists from the information, communication and robotics technology communities to combine their expertise and begin to integrate all the components necessary for building safe, interactive robot companions. These novel robots will be ubiquitous and user-friendly, preserving or augmenting human capabilities and experience, extending the active, independent life of citizens, and maintaining our planet.

Robot companions are soft, sentient, predictive and hybrid machines. Their bodies will be made of purpose-designed new materials (such as artificial bio-materials or hybrid materials containing living tissue) which combine solid moving parts with flexible, compliant and self-healing properties. Thanks to research into the human brain and other animals, these robots will also have new levels of perceptual, cognitive, emotive and behavioural capabilities including advanced social intelligence based on internal cognitive models of themselves and of the environment.

What can Europe expect to gain?

These companion robots will help to improve our quality of life and will increasingly become a key enabling technology providing affordable welfare for all citizens, young and old alike. The proposed RoboCom FET flagship will also help to transform the entire robotics industry, creating a completely new generation of real-world technologies employing breakthrough biomimetic, adaptive and self-organising principles thanks to new scientific insights and technological innovations.

Last but not least, the flagship will shift industry from its current information-focused ICT base to a much broader action-oriented information, communication and robotics paradigm.

Coordinator: Professor Paolo Dario

Coordinating institute: Italian Institute of Technology, Scuola Superiore Sant'Anna (IIT@SSSA), Italy

The FuturICT knowledge accelerator: creating socially interactive information technologies for a sustainable future' (FuturICT)

What is the problem?

It is easy to believe in the inevitability of advances in ICT. Microchips, mobile phones, the internet all stemmed from research and transformed society. But

technology research, development and uptake do not occur in a vacuum. They all occur within a social context, but still little is understood about how society influences the direction and speed of technological change. Today, the ICT industry forges ahead and promises that technology will be at the heart of our future sustainable world. But should we not find out more about how that world may tick?

The FuturICT solution?

One of the greatest challenges for scientists today is to reveal the hidden laws and processes which bind people together and make societies work — at local, national and global scales. For it is only by understanding people and how they interact with one another that we can really get a full sense of the drivers and barriers to scientific and technological developments. Today we hear a lot about the increasing need for more robust, trustworthy and adaptive ICT, but how and where will they work, what does society want out of such advances?

The proposed FuturICT flagship seeks to integrate ICT, 'complexity science' and the social sciences to facilitate a symbiotic co-evolution of ICT and society. Building on the globe-spanning ICT system, FuturICT will establish a 'nervous system' of society providing data to facilitate social awareness and new models of techno-socio-economic systems. In turn, insight from these models will inform the development of a new generation of socially adaptive, self-organised ICT systems.

FuturICT intends to turn the massive quantity of social data into knowledge and technological progress. It will collect and analyse a mass of information from dynamic data sources, ranging from crowd sourced sensor information through digital media, social networks and blogs, to public infrastructure. This data could be used to assess shifts in collective opinions and social attitudes, changes in consumer behaviour, emergence of tensions in communities, demographics, migration, mobility patterns, or health trends.

In particular, the flagship proposes to build a sophisticated social simulation, visualisation and participation platform, known as the Living Earth Platform. This platform will model societies and could be used by policy-makers and citizens, for example to detect and mitigate crises, and identify areas for targeted technological development.

What can Europe expect to gain?

The FuturICT project would be the first large-scale research project worldwide to foster the scientific and ICT breakthroughs needed to address the challenges of humanity in the 21st century, from financial, economic and social instability to crime and conflict. By creating realistic global-scale simulations and techno-socio-economic models, the flagship would provide an important platform to drive fundamental breakthroughs in the social sciences and economics. For industry, FuturICT would increase the resilience and usability of large-scale ICT systems through socially inspired system engineering and a better understanding of the social context for technological developments.

The Living Earth Platform would also be used by public authorities and policy-makers, for example, to predict and prevent crises or test the social and economic effect of policies.

Coordinator: Professor Steven Bishop

Coordinating institute: Department of Mathematics, University College London

IT gives medicine the personal touch: 'Modelling in health and medicine' (ITFoM)

What is the problem?

In the past, advances in ICT was primarily driven by the demands of 'large' physics (like CERN spawning the web) and the need for big business applications including multimedia entertainment platforms. Medicine has greatly benefited from these developments, but only played a minor role in shaping the R&D agenda. But this is about to change; the arrival of new, data-rich, individualised medicine calls for intensive data analysis and modelling technologies likely to surpass the limits of today's ICT capacity — each individual is made up of 100 trillion cells, each containing 30 000 genes. The future of medicine depends on the development of radical new data integration and ICT infrastructures.

The ITFoM solution?

Europe needs to set the stage for this information focused medicine of the future. The ITFoM flagship would develop novel workflows and ICT architectures that would make all relevant genomic and clinical information accessible to the patient and their doctor along with imaging, pathological, environmental and individual patient histories. These zetabytes of data would then enable better medical understanding by revealing pathological patterns, and would power individualised patient models to help doctors deliver better diagnoses and treatment.

A key challenge in this process will be to develop and deploy standardised interfaces for different data sets and suppliers, as well as sophisticated modelling tools. An important task for ITFoM would be to generate procedures to facilitate data integration and data access via the web or specialised networks. Researchers also need to find new ways to handle the massive data files that individualised medicine will soon generate (an entire human genome, which could soon be sequenced in just a few hours, is about six gigabytes of data).

What can Europe expect to gain?

We are entering a new era of medicine and with the supporting ICT systems, citizens will benefit from bespoke treatments and regimes, optimised to fit their individual metabolism, environment and genetic make-up. This new information-intensive healthcare will offer more specific and better tested treatment, enable preventive medicine, and improve clinical outcomes whilst reducing the costs of medical treatments. Furthermore, the technological advances required for individualised medicine will increasingly influence the wider ICT field and benefit many other areas.

Coordinator: Prof. Hans Lehrach

Coordinating institute: Max Planck Institute for Molecular Genetics, Dept. of Vertebrate Genomics, Germany

For more information:

The Flagship programme: http://cordis.europa.eu/fp7/ict/programme/fet/flagship

Flagship brochure:

http://cordis.europa.eu/fp7/ict/fet-proactive/docs/flagshipcons09-02_en.pdf

Digital Agenda website:

http://ec.europa.eu/information_society/digital-agenda/index_en.htm

Neelie Kroes' website: http://ec.europa.eu/commission_2010-2014/kroes/

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