The European Union's IST Research Programme: Overview and support to signal processing R&D

Eric Badiqué

European Commission

Abstract

The paper starts with a broad overview of European support mechanisms to collaborative research. An analysis of the current portfolio of projects running under the Information Society Technologies (IST) Programme follows. It then focuses on current activities that relate to signal processing within the IST Programme. Examples of key projects addressing various applications are given. Finally, the main orientations of the European Commission's proposal for support within the next Framework Programme - to start in 2007 - are described. Large sections of the text are based on already published Commission documents.

1 Introduction

Facing an increasingly severe global competition, Europe must ensure that growth and competitiveness remain sufficiently high if its current standard of living is to be preserved. Knowledge is Europe's greatest resource to achieve this and European research programmes contribute to developing and sharing this knowledge across Europe. These programmes support research that is relevant to the needs of European industry, to help it compete internationally, and to develop its role as a world leader in certain sectors. They also provide support to European academic research in order to promote and spread excellence in key research areas that are essential to future wealth creation.

Among the major research areas that benefit from EU support, Information and Communication Technologies (ICT) is an essential element addressing many of the policy priorities of the European Union. Progress and breakthroughs in ICT are driven by miniaturisation, by the convergence of computing, communications and media technologies, by the need to build systems that can learn and evolve, and by the cross-over between ICT and other science and technology fields. This next wave of technologies will make systems "smaller, cheaper, and smarter", "always best connected", and their applications even more wide ranging. It will open the door to new networked devices and systems that will enable people to interact with their surroundings and with each other in totally new ways. Signal processing technologies are at the heart of many of these developments.

2 Information Society Technologies and the current EU Framework Programme

The sixth EU research Framework Programme[1] (FP6) started in 2003 and will come to an end in 2006. For ICT, the programme was defined in a changing environment:

– ICT research is increasingly organised on an international scale, as firms seek to relocate their R&D activities in the face of accelerating competition in global markets,

– innovation processes are more open, with wider and faster exchange of ideas, people and resources,

– technology chains are increasingly complex, making it more difficult for any single player to establish industrial leadership in any ICT field,

– new promising fields are emerging at the cross-over between ICT and other disciplines such as biotechnologies, materials and cognitive sciences.

At the same time, ICT are becoming more pervasive: we see their growing impact all around us, in the way we live, work, play and interact with each other. New ways of using ICT are at the origin of innovations in most products, services and processes. EU policy aims to enable Europe to take full advantage of ICT.

Community supported research provides a stable institutional framework for rapid partnership development. Experience has shown that in the ICT areas where a focused research effort was undertaken at European level, successes were achieved such as in microelectronics and mobile systems. Europe's approach to ICT research today needs to build on these successes.

2.1 IST in FP6: coverage and main targets

The focus of IST in FP6 is on the future generation of technologies in which computers and networks will be integrated into the everyday environment, rendering accessible a multitude of services and applications through easy-to-use human interfaces. This vision of "ambient intelligence" places the user, the individual, at the centre of future developments for an inclusive knowledge-based society for all. Realising the vision requires a coherent and integrated research effort that addresses the major societal and economic challenges and ensures the co-evolution of technologies and their applications.
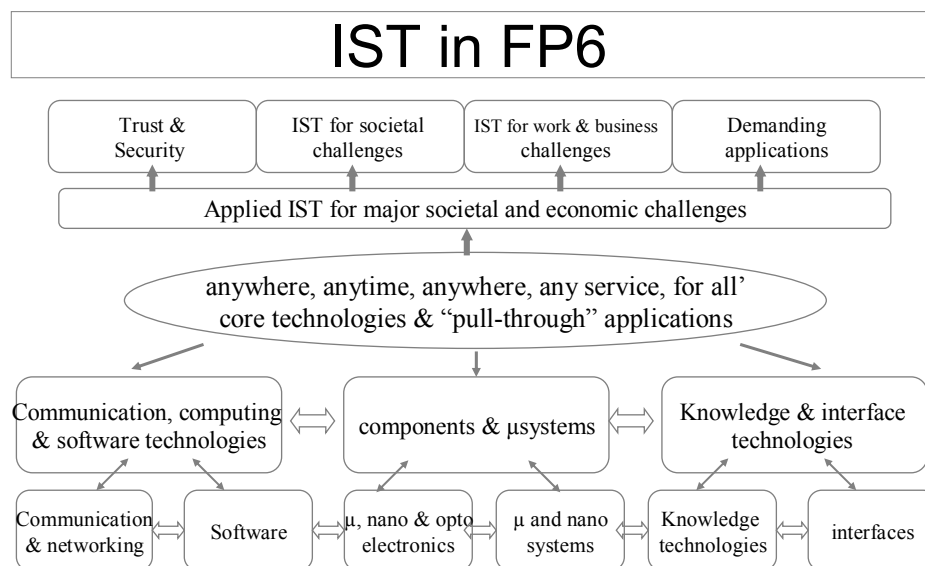

Figure 1: IST Programme activities in FP6

In order to ensure concentration of effort and critical mass, it focuses on a limited set of Strategic Objectives. The distribution of resources between the Strategic Objectives aims also at reinforcing European strengths in areas where Europe has established leadership whilst seizing new opportunities and ensuring the co-evolution of technologies and applications. An overview of areas of activity covered by the Programme is given in Figure 1.

2.2 Support Instruments

Within FP6, Integrated Projects (IPs) are used as a priority means in order to improve concentration of effort. Specific Targeted Research Projects (STREPs) address specific parts of the technology or value chain or explore new ideas. Networks of Excellence (NoEs) are used to structure research in specific IST domains. Other instruments such as Coordination Actions (CAs) and Specific Support Actions (SSAs) are also available to help structure a particular domain of activity.

As a result of the first 2 major calls for Proposals around 75% of the funding was allocated to IPs and NoEs and 25% to other types of projects. IPs amounted for 57% of funding , STREPs 25% and NoEs around 15%. The average budget of FP6 projects so far is about 9 M€ for an IP, 6 M€ for a NoE, 2 M€ for a STREP and 1 M€ for CAs and SSAs. This is to be compared with an average of 1,6 M€ in FP5. IPs are on the average 5 times larger than STREPs in the previous FP (FP5). A supplementary indicator of the concentration level reached in FP6 is that for the same budget volume (around 1B€), 800 projects were launched in the 1st FP5 call whereas 226 were started in the first FP6 call. The average funding for FP6 projects is therefore around 3 times the average for FP5.

The average number of participants in IPs is 24. For NoEs the average is 33. For STREPs the average number of participants is around 9 compared with an overall average of 8 in FP5 projects. The average funding per participant per year is around 150 Keuro. An average IP mobilises around 70 researchers per year and the largest ones (in terms of budgets) can go up to 250 researchers per year. In STREPS (or FP5) the average is/was around 15-20 researchers per year. The average number of participants for FP6 new instruments projects is therefore three times the average for FP5.

Although it is still early to assess impact, new instruments appear to have enabled the further concentration and integration of effort needed in Europe. They have stimulated new thinking and motivated European researchers to come up with more ambitious proposals.

2.3 Analysis of the current IST portfolio

At mid-term for FP6, around 450 projects have been launched. At the time of writing, the 4th call for proposal is under evaluation and will result in a new wave of projects to be started by the end of 2005. The following sections provide a broad overview of the impact that can be expected, mainly from projects launched in the first half of FP6.

✓ **Reinforce leadership where Europe has demonstrated strength**

Research supported at European level has been instrumental in establishing and maintaining industrial and technological leadership in key fields including Microelectronics, Microsystems, mobile and broadband communications, audio-visual systems and consumer electronics. The objective of current actions is to <u>maintain and further develop Europe's position on the global scale</u> through an improved structuring of the research activities ensuring a high level of continuity of action with FP5 and the

consolidation of a critical mass. This is the case for Microelectronics and Microsystems where Europe is strong. This is also the case in the mobile area where projects support a common European approach towards the evolution of advanced mobile and wireless systems, with a focus on systems beyond 3G.

At the same time, projects are pushing the limits of technology across the board, taking us from the micro to the nano scale and from silicon-based to new materials, adding sensing, actuating and other functions on chips at the micro and nano-scale to components for computing and communication or improving broadband delivery capabilities. Projects show that the main trends are towards ever-increasing integration and complexity which brings enormous management challenges. This is the case in the design of core ICT technologies, in the integration into large-scale systems and in the increasing interdependencies between systems and networks. Systems-on-chip design, system-in-package in nanoelectronics or quality of service management for delivery of multimedia content over heterogeneous networks are typical examples. Technology chains are becoming more and more complex at all levels. These trends are likely to be reinforced as we move to FP7.

Success in these key areas will have a wider impact since basic technologies, components and systems will be put to use in other fields. One example is microelectronics, as the tools and methods will be important for the whole design community in many industrial sectors (ranging from computing, telecoms, consumer, transport, health). Another example is the impact of micro systems on the health, quality of life and agrofood industry sectors through large multi-disciplinary IPs.

> All together, European strengths are reinforced through more than 450 MEuros funding from IST, an increase of 30% as compared to FP5. 50 to 60 % of this funding goes to large integrated projects.

✓ **Seize new opportunities**

In addition to consolidating and reinforcing its current position in some well-established industrial sectors, Europe should also explore new opportunities that will lead to future markets. New exploitation fields are opening up for devices as well as for software-based systems and Grid services.

In opto-electronics, while the scientific and technological breakthroughs have so far been driven mainly by broadband communications, innovations are now spreading out to other sectors like sensing, security, environment and healthcare. The technological transition process from microsystems to nanosystems will open up a whole new set of applications which so far were unfeasible. Totally new approaches at nano-micro level will exploit innovative physical phenomena and materials for new functionalities.

Embedded technologies are the fastest growing sector in Information Technologies. They are key to the competitiveness of existing industrial sectors and are leading to the emergence of new markets and business opportunities. Organic electronics and light efficient organic display technologies will deliver conformable displays such as e-paper, wearable or woven displays for small hand-held or medium size terminals. 3D multi-viewer dynamic visualisation is the next step for mid-range and large size displays.

New software technologies are about to bring a revolution in the way users interact with content and handle knowledge. As the integration and interoperability increases between different sectors, the need for semantics also increases as a mediator between the structure and content of the different knowledge bases. Semantics will also be necessary to compose, federate and create complex services. The Semantic Web will create a world where agents, search engines, and other programs can decipher the real meaning of a web page, and thus retrieve computer readable facts, integrate and reason about those facts, answer questions, solve problems, and generally bring a new level of intelligence to the WWW that is unimaginable with today's technology.

Context awareness, cognition and multi sensorial interactions are key elements toward more intelligent interfaces and environments that will have cognitive, learning, reasoning and adaptation capabilities and will be able to augment human senses.

Around 420 MEuros funding from IST is currently invested in preparing Europe for the exploitation of new opportunities in opto-electronics, interfaces and displays, embedded systems and security. This is an increase of nearly 50% as compared to FP5.

In GRID research the portfolio shows that the shift from e-Science in framework 5 projects to generic support of industrial and business applications in FP6 is well taken-up. New projects have a strong industrial orientation covering essential sectors, such as aerospace, automotive, finance, media and health. The new projects are expected to offer new opportunities for added value IT, telecommunication and application service providers.

✓ **Continued support to leading and challenging applications**

Europe is well positioned to exploit new markets that will emerge from the deployment of societal applications based on the next generation of ICT technologies and services. The current portfolio includes a large number of projects that contribute to the roll-out of e-Government services the support of e-Business in particular for small organisations, the application of ICT to health care, the full inclusion of all citizens in society, the improvement of our safety on roads or in the air, the development of mobile applications as well as to the exploitation of novel technologies in education, learning and cultural expression.

Upward of 520 MEuros has been granted to projects developing societal applications.

In Networked Government, the challenge is to help modernize public administrations and governments by implementing electronic procurement, supply chain management, electronic invoicing and semantic and workflow support to administrative processes. For Networked Business, the main issues are the effective networking of enterprises (to supply value-adding goods and services on demand), the development of digital ecosystems (to foster local/regional economic growth through new forms of dynamic business interactions among organisations and business communities), the enhancement of the product and the product lifecycle processes (to increase value for the customer and enable manufacturers to respond faster and in a flexible way to ever increasing market demands), and enterprise interoperability (to give European enterprises the means to seamlessly and securely interoperate with each other).

In health care, ubiquitous personal health management systems, software tools supporting health professionals and research into advancing health knowledge by using results from genomics will provide new ways of treating patients. E-Inclusion

projects help develop intelligent systems that <u>empower persons with disabilities and ageing citizens to play a full role in society</u> and to increase their autonomy. Integrated Safety Systems for road transport will contribute to <u>preventive systems for the road vehicle of the future</u> and driver-system interfaces and interactions.

Research in Technology Enhanced Learning focuses on personalisation and on handling dynamic or adaptive learning objects, that can be more flexibly adapted to different learning contexts. As with learning, the work in Access to Cultural Heritage has a strong societal relevance: the ability to <u>access Europe's vast collection of cultural heritage</u> stored in museums, libraries and archives (and visible at Europe's sites and monuments) is an essential component in learning and in sustaining cultural identity.

- ✓ **Support to research at the frontier of knowledge**

  It is also essential to explore <u>new paradigms and concepts that will become the mainstream research themes of tomorrow</u>. This is what the Future and Emerging Technologies (FET) field in the IST priority is aiming at.

  The <u>FET Open</u> scheme is open to the widest possible spectrum of research opportunities that relate to information society technologies as these arise bottom-up. It supports research on new ideas involving <u>high risk, embryonic research and proof-of-concept, and high quality long term research</u> of a foundational nature.

  The <u>FET pro-active</u> scheme sets the agenda in a small number of specific areas – proactive initiatives – that hold particular promise for the future. The mission of FET is to address hard problems in science and technology and to act as the <u>pathfinder for the IST Programme</u>.

  Prospects for further advances rely increasingly on the <u>cross-overs between ICT and many other science and technology fields</u>, as well as on the further convergence between sub-areas within the

  > All together, more than 120 MEuros are contributing to the search for new research paradigms, paving the way for the next research agenda

  ICT field. The convergence between bio-technologies, cognitive technologies, nano-technologies and materials, and ICT is particularly promising. These could develop as major research themes as part of FP7.

  The area of artificial cognition is an active domain of research in the programme. Exploratory research in FET centres on the contribution of various disciplines to the engineering of systems that can learn, evolve and grow. The "cognitive systems" SO reinforces that research, focussing on the integration of methods and technologies to realise comprehensive and integrated systems. There is a <u>high potential for long term industrial impact</u>, since the artificial systems developed by the projects provide enabling technologies for robotics, natural language understanding, man-machine interaction and complex real world systems.

3 Signal processing in the IST Programme

An analysis of the current IST projects portfolio shows that signal processing is a key activity in many of the research areas covered by the Programme. Many projects work on developing signal processing components or integrating them in various applications. These cover for example communication systems, design of multimodal interfaces or advanced healthcare

technologies. Many other examples are available on the IST CORDIS web site or on IST Results [2].

3.1 Advanced signal processing systems and applications in FP5 (Cross Programme Action)[3]

Support to signal processing R&D from the IST Programme is not a novelty. At the end of the previous Framework Programme (FP5), a dedicated so called 'Cross Programme Action' was launched with a focus on Signal Processing. The objective was to foster interdisciplinary research and development of high-performance applications based on signal processing technology. This theme was called once in 2001 and resulted in 5 projects having a combined funding support of ~10M€ and covering a wide spectrum of activities as follows:

- *Ultrasound system technology with high-image resolution capabilities* - ADUMS (36 months; 2M€ funding; 7 partners) developed an advanced 4D (3D-Spatial + 1D-Temporal) ultrasound system technology. The technology is applicable in wireless communications echo cancellation and signal distribution by directional antennas, volumetric ultrasound for medical imaging, 3D underwater sonar camera for divers, mine hunting, underwater inspection and 3D non-destructive quality inspection of materials.

- *Universal sound codec* - ARDOR (36 months; 2,9M€ funding; 6 partners) delivered a universal sound codec that adapts to the time-varying characteristics of the input signal and to time-varying network and application constraints, such as bitrate, quality, latency, and channel errors. It features a rate-distortion optimisation control system, using an innovative perceptual distortion measure.

- *Noise reduction algorithms* - ANITA (30 months; 1,7M€ funding; 5 partners) addressed one of the strongest needs of Professional Mobile Radio communication users: to significantly improve the quality of their communications in particularly harsh acoustical environments. The project developed innovative DSP-based solutions for in-car and street applications. The research included innovative noise reduction algorithms combined with microphone arrays.

- *Digital Alias-free Signal Processing* - DASPTOOL (36 months; 1.4 M€ project; 6 partners) targeted the area of high performance Digital Alias-free Signal Processing (DASP) by developing the second generation DASP technology. Progress was based on exploitation of an innovative hybrid double sampling method. A new class of algorithms and hardware/software tools and devices, based on such sampling, was developed and offered for high performance direct digital processing of RF and microwave signals at frequencies up to several GHz.

- *Biomedical modelling and simulation* - PLACEBO (24 months; 2,2M€; 9 partners) addressed biomedical modelling and simulation and developed an advanced high performance computational environment for solving ordinary or partial differential equations using techniques based on neural network models. It resulted in a computational framework that is able to assist both doctors and bioengineers into experimentally studying and analysing complex biomedical models in an easy-to-use and efficient way.

3.2 Signal processing for communications [4]

Communication remains a challenging sector for signal processing. It is perhaps where signal processing has had the most spectacular impact in the past few years. Digital mobile telephony and broadband over copper lines are two key examples of great market successes enabled by advances in signal processing. Two related examples of current IST-supported activities are given below.

Linking together a large number of leading research groups, NEWCOM (60 partners; 30 months; ~5 M€ EU contribution) is a European network that contributes to research on analysis and design of algorithms for signal processing in wireless systems. This includes algorithm analysis and evaluation, performance-metric development and benchmarking.

To push further the limits of broadband delivery, one important challenge is to increase the total bandwidth currently available to the end user over copper. U-BROAD (7 partners; 24 months; 1.9 M€ EU contribution) addresses ultra high bit rate-over-copper technologies for broadband multi-service access and aims to develop and integrate advanced access technologies for the delivery of 'true broadband' content over Ethernet-based networks to the customer premises, while providing interfaces to both legacy and next generation core networks. This includes the development of new techniques of signal processing and communications algorithms for extending copper bandwidth.

3.3 Signal processing for the Audio-Visual sector [5]

Advanced signal processing is key to every single element of the audio-visual delivery chain, from the capture of the signal in the camera and microphones, all the way to the rendering of the image and sound to the user. IST projects support innovative developments along the entire chain.

On the sensor side, an example is METACAMERA (4 partners; 35 months; ~1.4 M€ EU contribution) that addresses the real-time handling of wide bandwidth picture content from the high resolution, high frame rate cameras that will be demanded for future E-cinema and broadcast applications. The work includes resolution conversion and hardware accelerated frame rate format conversion.

To help federate and structure the work at the European level, the network of excellence VISNET (24 months duration; 2.200.000 € EU contribution ; 15 partners) has been launched to create a sustainable world force of leading research groups in the field of networked audiovisual (AV) media technologies. Most of its activities strongly relate to speech and image processing. This includes in particular: object modelling for animation, scene rendering and interaction; AV content coding and transcoding; transmission over heterogeneous networks; audio/speech analysis; video analysis and processing of human faces; semantic video segmentation and tracking; multimodal analysis.

On the display side COHERENT (5 partners; 30 months; ~2.15 M€ EU contribution), is a good example of a highly innovative approach to advanced audio-visual interaction. Six leading European organisations are creating a new networked holographic audio-visual platform to seamlessly support real-time collaborative 3D interaction between geographically distributed teams. The display component is based on innovative holographic techniques that can present, at natural human interaction scale, realistic animated 3D images to an unlimited number of freely moving simultaneous viewers. As much as the increased processing power required to capture, code, transmit and handle 3D signals, this type of display brings new challenges to signal processing.

3.4 Signal processing for health [6]

Similarly to other application fields that are essential to our well being, the health sector both benefits from progress in signal processing and brings about new challenges. Immense progress has been achieved in medical visualisation and this has transformed the way doctors establish diagnosis and treat patients. New signal processing technologies are helping physicians to push the limits further in terms of monitoring, early diagnosis and targeted treatment.

A tool that would help monitor and quickly assess people under extreme stress or people under other special psychological conditions would be extremely valuable to the health community. AUBADE (EC contribution: 2,000,000 €; Duration: 24 months; 6 partners) will implement an intelligent, multisensorial wearable system that will be able to ubiquitously monitor and classify the personal psychological condition of users using signals obtained from their faces through the extraction of facial characteristics.

Doctors need an intelligent system for improved health status monitoring of critically ill patients. CLINICIP (EC contribution 7,500,000€; Duration: 48 months; 13 partners) provides a local system comprising biosensors for the determination of glucose in the blood. Based on the continuous measurement, an adaptive control algorithm generates advice and thus represents a decision supporting system in an early project stage. Within a closed loop system intensified insulin treatment will make use of calculation results leading to the external regulation of glucose.

In today's society, helping all citizens to fight cardio-vascular diseases by preventive lifestyle and early diagnosis is a priority. The mission of the MyHeart Integrated Project (EC contribution 16,000,000€ ; Duration: 45 months; 33 participants) is to gain knowledge on a citizen's actual health status through continuous monitoring of vital signs. The approach is to integrate system solutions into functional clothes with integrated textile sensors. The combination of functional clothes and integrated electronics and on-body processing is defined as intelligent medical clothes.

In a complementary fashion, the NOESIS system (EC contribution 4,400,000€; Duration: 36 months; 13 partners) will assist health professionals in the diagnostic process in the complex domain of cardiovascular disease. Research is conducted in several areas, including multimedia information retrieval based on content similarity, classification algorithms based on hybrid methods combining fuzzy clustering, self organising maps, and dynamically generated distributed ontologies.

Biopatterns provide clues about underlying clinical evidence for diagnosis and treatment of diseases. Typically, they are derived from specific data types, e.g. genomics information and vital biosignals such as the EEG. A bioprofile is a personal dynamic 'fingerprint' that fuses together a person's current and past bio-history, biopatterns and prognosis. BIOPATTERN (EC contribution 6,400,000€; Duration: 48 months; 31 partners) is a Network of Excellence (NoE) to reduce fragmentation in the new field of biopattern and bioprofile analysis which will underpin eHealthcare in the post genome era. The NoE brings together leading researchers in intelligent biosignal analysis, medical informatics and bioinformatics from academia, the healthcare sector and industry in a new way to harness expertise and information.

3.5 Signal processing for multimodal interfaces [7]

Research in the domains of human-computer interaction and multilingual systems aim at developing interfaces that bring together the different human modalities of communication. Human-machine interaction should be as as natural, responsive and intuitive as any interaction between humans. Citizens should be able to access, receive and use information in their own language. Signal processing has much to contribute to these objectives whether they address speech recognition, tangible interfaces or multimodal systems.

Speech-to-speech (SST) translation has been an exciting prospect for many years. TC-STAR (11 partners; 36 months; ~10.99 M€ funding) aims to establish a breakthrough in SST research to significantly reduce the gap between human and machine performance. In addition to SST, it addresses speech recognition, spoken language translation, and speech synthesis. The focus is on the development of new algorithms and methods, integrating relevant human knowledge which is available at translation time into a data-driven framework.

Making dialogue interfaces more conversational, robust, intuitive, and user-adaptive is essential. TALK (8 partners; 36 months; ~4.4 M€ funding) focuses on basic research for adaptive multimodal and multilingual human-computer dialogue systems. The project develops adaptive multimodal dialogue systems. It also extends the use of abstract representation, in particular the use of domain ontologies, to increase robustness and reconfigurability of dialogue systems. The project will build showcases for in-car and in-home information and control.

Speech understanding service is a key element of multimodal man-machine interaction. DIVINES (7 partners; 36 months; ~2.22 M€ funding) addresses universal automatic speech recognition and focuses in particular on feature extraction, modelling and adaptability as well as systems usable in noisy situations.

Vocal interaction between humans and machines should be robust, natural, and flexible. HIWIRE (7 partners; 36 months; ~1.80 M€ funding) is creating an embedded robust multimodal dialogue systems with flexible speech input in mobile, open and noisy environments (e.g. aeroplanes, cars, street etc.). The project focuses on two main targets: improved robustness against the environment (mostly unpredictable noises like those encountered in cockpits with dense audio traffic or factory noise) and improved tolerance to user behaviour (including speakers' vocal individuality, different accents, non-native speech, dialogue skills, etc).

If any physical objects could be transformed into a tangible interface this would allow users to communicate freely with their computers. The TAI-CHI project (6 partners; 36 months; ~2.35 M€ funding) develops acoustics-based remote sensing technologies to do just that. The research includes the analysis of acoustic transmission behaviours in various media, development of novel acoustic transducers for various application scenarios, development of acoustic signal processing algorithms and establishment of intelligent tangible interfaces.

Two Networks of Excellence have also been established to help structure the work in this important area. HUMAINE (26 partners; 48 months; ~4.95 M€ funding) focuses one emotions and human-machine interaction and in particular face and speech detection and synthesis algorithm in order to extract emotional clues. The objective is to develop systems that can register, model and/or influence human emotional and emotion-related states and processes - 'emotion-oriented systems'. Finally, SIMILAR (31 partners; 48 months; ~6.05 M€ funding) brings together some of the best European laboratories in Human-Computer

Interaction (HCI) and Signal Processing to develop multimodal interfaces that respond efficiently to speech, gestures, vision, haptics and direct brain connections.

4/ Framework 7 perspectives

On 6 April 2005 the European Commission adopted a proposal for a new EU programme for Research [8]. The proposal provides new impetus to increase Europe's growth and competitiveness through various support mechanisms to research and innovation. The programme places greater emphasis than in the past on research that is relevant to the needs of European industry. It will also for the first time provide support for the best in European investigator-driven research, with the creation of a European Research Council. Focus will be on excellence throughout the programme, a requirement if it is to play its role in developing Europe's global competitiveness.

4.1 The EU Commission FP7 proposal

The Commission has put forward an ambitious proposal for the EU Seventh Research Framework Programme 2007-2013 (FP7). Subtitled "Building the European research area of knowledge for growth", FP7 is designed to respond to the competitiveness and employment needs of the EU. The Commission proposes in particular to double the FP7 budget compared with FP6, rising to EUR 67.8 billion over the period 2007-2013. According to the Commission proposal, FP7 will be organised in four specific programmes.

Cooperation: the objective will be to gain European leadership in key areas through co-operation of industry and research institutions. Support will be given to research activities carried out in trans-national cooperation, from collaborative projects and networks to the coordination of national research programmes. The Cooperation programme is organised into sub-programmes. Nine themes have been identified:

- ➢ Health
- ➢ Food, agriculture and biotechnology
- ➢ Information and communication technologies
- ➢ Nanosciences and nanotechnologies, materials and new production technologies
- ➢ Energy
- ➢ Environment (including climate change)
- ➢ Transport (including aeronautics)
- ➢ Socio-economic sciences and the humanities
- ➢ Security and Space

In addition, two themes are covered by the Euratom Framework Programme; fusion energy research and nuclear fission and radiation protection.

Ideas: the objective is to strengthen the excellence of our science base by fostering competition at European level. An autonomous European Research Council will be created to support "frontier research" carried out by research teams, either individually or in partnership, competing at European level, in all scientific and technological fields, including engineering, socio-economic sciences and the humanities.

<u>People</u>: The aim is to reinforce career prospects and mobility for our researchers Activities supporting individual researchers, referred to as "Marie Curie" actions, will be reinforced with the aim of strengthening the human potential of European research through support to training, mobility and the development of European research careers.

<u>Capacities</u>: Here the objective is to develop research capacities, so that the European science community has the best possible capacities at its service. Activities will be supported to enhance research and innovation capacity throughout Europe: research infrastructures; regional research driven clusters; stimulating the research potential in the EU's "convergence" regions; clustering regional actors in research to develop "regions of knowledge"; research for and by SMEs; "science in society" issues; "horizontal" activities of international co-operation.

There is a strong element of continuity with the past in the proposed Seventh Framework Programme. Projects undertaken by consortia of European partners will remain at the core of the programme, and the themes for these projects will remain more or less as now. The programme will continue to develop the concept of a European Research Area. Funds will be used to develop and increase those elements of previous programmes that worked well: Marie Curie, SME actions, collaborative projects, Networks of Excellence. The aim of continuity will be strengthened through a programme that lasts 7 years (with the possibility of a mid-term review).

The programme will have more focus than in the past on developing research that responds to the needs of European industry, through the work of Technology Platforms and the new "Joint Technology Initiatives". These will be projects in fields of major European public interest on subjects identified through dialogue with industry, in particular in the European Technology Platforms.

The programme will also establish for the first time a "European Research Council", funding the best of European science, as assessed by peer review of European scientists. This will be the first time that a body like this has existed at European level, identifying the very best of European research wherever and however it is carried out.

4.2 The Information and Communication Technologies theme [9]

In the face of increasing world-wide competition Europe needs a distinctive approach to research; one that plays to our strengths, enables us to seize new opportunities and recognises European specificities. Research supported at European level will be essential to back industrial and technological leadership in key fields including mobile and broadband communications, microelectronics, microsystems and consumer electronics.

Mastering of ICT and its applications is also crucial to the future of major industries such as automotive, aerospace, telecommunications, manufacturing and media. And, it is central for addressing societal challenges such as those related to the ageing population and security. In addition, competition and deregulation has opened the door to a range of new players whose involvement is key for future technology development and use. As new ICT become more and more the fabric of our economy and society, Europe must ensure its independence with respect to provisioning and controlling key underpinning ICT.

European ICT research should be guided by objectives that reflect the new global reality. We have to find a balance between continuity and change. While realising the vision adopted in previous Framework Programmes, we also have to align research in a way that responds to

the emerging policy and market contexts and put us in a position to exploit future opportunities. The objectives of European ICT research is threefold:

1. **to strengthen the competitiveness of European industry**: by building on strengths and fostering the ability to master ICT for innovation and growth,
2. **to reinforce the competitive position of the European ICT sector**, by enabling it to build industrial and technology leadership, and
3. **to support EU policies**, by mobilising ICT to meet public and societal demands.

In addition, and as a function of these three objectives, ICT research should aim to strengthen the European science & technology base in ICT-related fields, including the opening up to co-operation at the international scale.

Progress and breakthroughs in ICT are driven by miniaturisation, by the convergence of computing, communications and media technologies, by the need to build systems that can learn and evolve, and by the cross-over between ICT and other science and technology fields.

This next wave of technologies will make systems "smaller, cheaper, and smarter" and "always best connected", and their applications even more wide ranging. It will open the door to new networked devices and systems that will enable people to interact with their surroundings and with each other in totally new ways.

In line with this, the following converging directions have been identified by the industrial and academic research community for ICT research in Europe:

- **Mastering complexity and scalability**. This includes pioneering new approaches to miniaturisation, mastering networked, embedded and wireless systems, providing the broadest bandwidth and designing systems that can contextualise, learn and adapt.

- **Accelerating cross-fertilisation with other science and technology fields**. Progress in these evolving core ICT technologies will require the insights of a broader set of scientific and technological disciplines to address performance requirements that conventional approaches cannot.

- **Building intelligent environments** and concentrating on integrated systems engineering. There is a need to research and develop mock-ups, test-beds and large-scale platforms for simulating, testing and validating systems. With myriads of interconnected devices, we need to explore how to tap into all this computing and networking power in a way that can be adapted to different needs.

- **Promoting innovation from the use of ICT in many application areas** and bringing services and technology developments closer together while including non-technological elements. European ICT research should focus on those application domains where ICT is the main innovation driver. Key domains will include: the enterprise, health and social care, and security and safety.

- **Supporting new research and knowledge infrastructures** by reinforcing Europe's research networking and computing infrastructures as well as shared research facilities.
- **Opening Europe further to cooperation in ICT research at the international scale** with targeted actions specific to each domain.

FET	Nano-electronics, photonics and micro/nano-systems

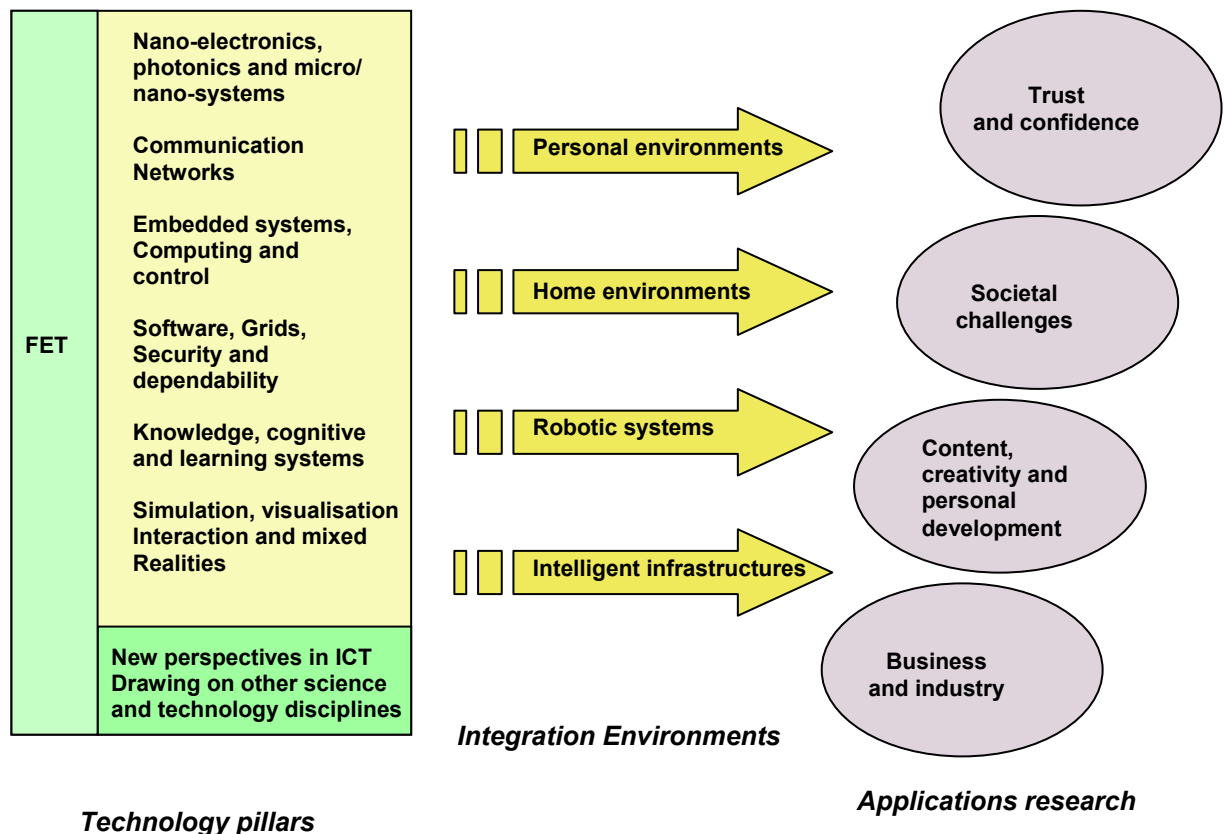Technology pillars   Integration Environments   Applications research

Figure 2: Proposed coverage of the FP7 ICT Theme

Figure 2 above provides an overview of the proposed coverage for the ICT theme in FP7. Signal processing research is likely to continue to play an important role right across the Programme. It will benefit from several important enablers such as processing power, software and grid infrastructures, the multiplication of low cost sensors and hardware devices etc.. But it will also have to face new challenges – ever higher levels of complexity, highly heterogeneous and distributed systems, stronger requirements for intelligent systems, dramatic increase in amount of data to be processed.

All of these challenges are strongly related to the converging directions identified above and underlying the Programme. Whether the objective is the mastering of complexity and scalability, the cross-fertilisation with other science and technology fields, the building of intelligent environments or the promotion of innovation from the use of ICT in application areas, signal processing will provide part of the answer.

5 Conclusions

Information and Communication Technologies occupy a unique and increasing role in today's economy and society. They are the key to improving productivity; they are central to mastering innovation; and they are essential to modernising public services. If innovation is the engine of the knowledge economy, then ICT are its fuel. Europe has no choice but to be a player in these strategic technologies.

The technologies we see around us today will not be enough to ensure we remain competitive tomorrow. New opportunities are emerging, many in areas where Europe already enjoys industrial and technological leadership. Signal processing research and technology development is one of the areas where Europe can continue to play a leading role, with the continuing support of the EU Framework Programme.

Disclaimer: The opinions expressed in this paper are those of the author and do not necessarily reflect the views of the European Commission.

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[1] www.cordis.lu/ist/

[2] http://istresults.cordis.lu/index.cfm

[3] www.cordis.lu/ist/cpt/signal.htm

[4] www.cordis.lu/ist/directorate_d/cnt/index.htm

[5] www.cordis.lu/ist/directorate_d/audiovisual/index.htm

[6] www.cordis.lu/ist/directorate_c/ehealth/links.html

[7] www.cordis.lu/ist/directorate_e/ic/index.htm

[8] www.cordis.lu/fp7/

[9] ftp://ftp.cordis.lu/pub/ist/docs/strategy_paper_final_website.pdf