IST 2003

The Opportunities ahead

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Foreword

In 2000, the European Union put together a strategy to prepare the EU economy for the challenges of the new century. In what became known as the Lisbon Strategy, EU leaders set ambitious targets for Europe to achieve higher growth, more jobs and greater social inclusion. Information and communication technologies (ICTs) play a key role in meeting these objectives. They contribute to higher productivity and hence higher growth; they can improve the efficiency and quality of public services; and they improve quality of life by offering access to goods and services that were not available before.

The Union's information society policy is based on three interlinked pillars. Firstly, it stimulates the wider deployment and adoption of ICT-based products and services through initiatives such as eEurope, eContent and eTEN. The new eEurope 2005 action plan focuses on a number of specific priorities where Member States' governments can make a genuine difference in stimulating services, applications and content.

The second pillar is the development of a regulatory framework that ensures fair competition and eliminates the obstacles to the adoption of ICT. This is the aim of the new framework for electronic communication services which has been adopted at European level, as well as other directives in e-commerce, network security, electronic signatures and copyrights.

Research and development is the third pillar. Today, a new generation of ICT is emerging that will underpin future innovation and competitiveness. Grasping the opportunities presented by future ICT will be crucial for Europe in tackling the challenges ahead: EU enlargement, higher productivity, civil security, and an aging population — to name just a few.

As part of the Community's Sixth Framework Programme for RTD, covering the period 2002-2006, research in Information Society Technologies (IST) aims to ensure European leadership in technologies at the heart of the knowledge economy. Its focus is on the future generation of technologies that are people-centred and user-friendly, and where computers and networks are integrated into the everyday environment. Work under FP5 provided important foundations for this vision of "ambient intelligence", which are being further built upon in the new framework programme.

The research effort of IST is an essential element of the EU's information society policy. It mobilises the industrial and research community around medium to long-term goals, serving to strengthen European leadership in strategic areas and to open new opportunities to master key elements of the ICT value chain. IST research reinforces and complements the eEurope objectives by addressing the challenges 5-10 years ahead. It helps to aggregate the impact of public and private research effort on a European scale, by developing a European Research Area (ERA) in IST.

This book provides an insight into the contributions that IST research is making to our policy objectives and its impact on our drive towards an inclusive, knowledge-based economy and society.

Erkki Liikanen
Member of the European Commission
Responsible for Enterprise and Information Society

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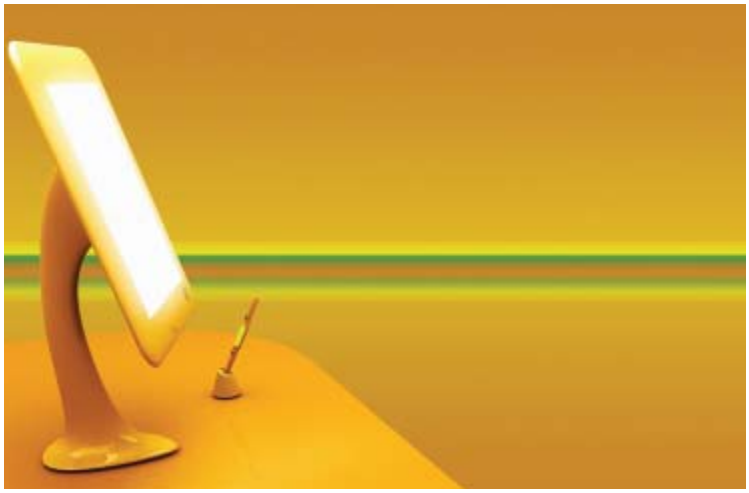
Introduction

At the beginning of the 21st century, the potential for information society technologies (IST) to enhance human lives has never been greater. For the economy, IST is central to the "race to knowledge" on which improved productivity and competitiveness depend. The IST industry itself is one of the largest economic sectors, while IST innovations underpin growth in many other markets. In public services, IST enables services to be delivered more efficiently, as well as new services that correspond to people's evolving needs. And for society at large, IST improves citizens' quality of life, by offering goods and services that did not exist previously or by improving access to those already available.



IST may also play a vital role in helping Europe to tackle the new challenges we see emerging. With enlargement, the number of EU citizens will almost double over the next five years. The EU will have to accommodate, and turn into assets, the further social, economic, cultural and religious diversity this brings. It also has to address the "productivity challenge": how to create wealth and prosperity in an enlarged Europe. European businesses should be able to take full advantage of technology development, mainly in IST, to adapt and benefit from the emerging networked business environment. Europe needs to improve its competitiveness and develop higher value products and services whilst ensuring a sustainable future. After recent events, security issues remain high on the political agenda and in citizens' concerns. Also, with the aging pyramid set to be reversed by around 2010, we have to come to terms with our "greying" population and its implications for the economy, and society as a whole.

Against this background, in Lisbon in 2000 the EU gave itself ten years to become the world's most competitive and dynamic knowledge-based economy, addressing simultaneously three objectives: competitiveness, employment and social cohesion. In Barcelona last year, one of the tools needed to achieve this was clearly delineated – to boost European research spending to 3% of GDP by 2010.

Three Pillars for the Information Society

The European Union's policy for the information society is at the heart of the Lisbon strategy. Its goal is to enable Europe to take full advantage of IST and to contribute to their progress within an inclusive, knowledge society for all. Information society policy is based on three interlinked pillars.

Firstly, it supports policies for the wider deployment and adoption of IST products and services. Over recent years efforts here have focused on eEurope, as well as the direct support to deployment initiatives such as eContent and eTEN. Community actions under the eEurope 2002 Action Plan have enabled a high and rapid growth in internet connectivity in Europe. In 2002, more than 90% of schools and businesses were already online and more than half of Europeans were regular users. Many more government services are available online and European researchers now benefit from the world's fastest research network. Building on these achievements, the eEurope 2005 Action Plan targets further measures to stimulate services, applications and content.

The second pillar is a new regulatory framework covering all services or networks that transmit communications electronically, which became applicable from 25 July 2003. This aims to develop and reinforce the single market, by promoting competition and safeguarding public and user interests across the communications sector. In e-commerce, the series of directives adopted are providing a more secure environment for e-commerce transactions, in particular cross-border trade, and ensuring an adequate level of consumer protection.

ABOUT THIS BOOK

This book shows how the IST Priority is working towards a vision of the future of IST that puts people first (**"ambient intelligence"**). It focuses on the use of IST within three key settings: by individuals and in the home (**intelligent spaces**); by enterprises and in the workplace (**the knowledge economy**); and by public services and society at large (**digital communities**). A fourth section covers core technologies which underpin future services and applications across these scenarios (**enabling technologies**).

The book presents a snapshot of the IST Priority at the current time, providing insights on what, in many ways, is a complex and intricate RTD effort. This edition focuses, in particular, on the transition from the 5th to the 6th Framework Programme of EU funded research. The articles outline the rationale for and objectives of IST research, as well as key technological challenges and policy issues relating to specific areas of the programme. They also summarise recent IST projects and describe results from certain completed projects. Each of the articles is referenced to relevant Strategic Objectives under the IST Work Programme 2003-2004.

Further information on results and achievements within the individual projects is available through the online service, IST-Results (www.cordis.lu/ist/results).

Research and development in IST, so as to ensure the mastering of technology and its applications, is the third pillar. Research supported at Community level has been instrumental in establishing and maintaining industrial and technology leadership in key fields such as mobile communications microelectronics, microsystems and consumer electronics. Europe has been, and remains, most successful in those areas where industry and the research community have built strong RTD collaborations at a European level, and where the research effort has been well articulated with deployment and regulatory initiatives.

Such joined-up thinking is needed now more than ever. Today, a new generation of IST is emerging driven by the convergence of computing, communications and knowledge technologies. This next wave of technologies will open the door to new devices and systems that will enable people and objects (artefacts) to interact in totally new ways. It will spawn new applications and services that will help build an all-inclusive knowledge society and economy. A sustained effort in IST research, linked to parallel efforts on deployment and regulation, is essential to ensure European leadership in these technologies and to enable all Europe's citizens and enterprises to benefit from their development.

European Support for IST Research: Leadership for Europe

In the Sixth Framework Programme (FP6) IST's objective is to ensure European leadership in the generic and applied technologies at the heart of the knowledge economy. It aims to increase innovation and competitiveness in European businesses and industry and to contribute to greater benefits for all European citizens. It focuses on those fields that need to be addressed at a European level, and so contributes to realising a European Research Area (ERA) in IST.

At a technological level, research focuses on the future generation of technologies in which computers and networks will be integrated into the everyday environment, and provide access to a multitude of

services and applications through easy-to-use human interfaces. It also supports underpinning research to investigate and experiment with future visions and emerging technologies at the frontier of knowledge in the IST field.

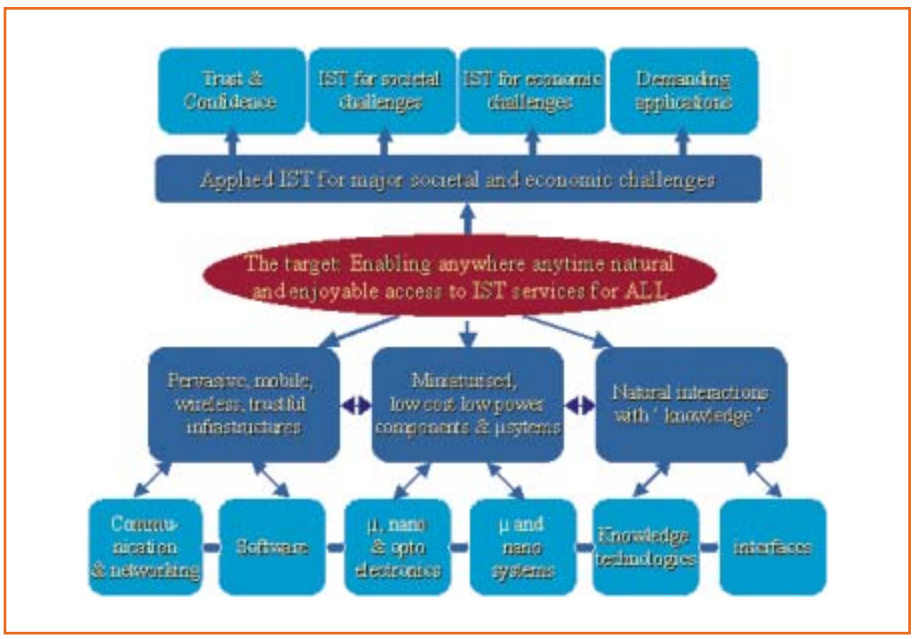
The FP6 instruments, such as integrated projects (IPs) and networks of excellence (NoEs), will enable the integration of various research activities from knowledge generation and technology development, through to their application and take-up. They provide an opportunity to combine, as appropriate, applied and generic technology research. This will help pull the technology developments with applications and services addressing the societal and economic needs, while also helping to focus the applied research on the development of relevant innovative technology platforms.

The IST thematic priority is managed by DG Information Society of the European Commission with the assistance of the IST Committee (ISTC) comprising representatives of each Member State and Associated State. The IST Advisory Group (ISTAG) provides the Commission with independent advice on the content and direction of RTD and on the exploitation of results. Both bodies have recently had their mandates updated to reflect the new requirements of enlargement, FP6 and the ERA.

The IST Work Programme has been elaborated on the basis of input from the ISTC and ISTAG, as well as the response to the Expressions of Interest and from preparatory activities launched in 2001/02 including workshops and roadmapping exercises. It is regularly reviewed and updated to reflect evolving circumstances and requirements. To give the research community more time to prepare, the published Work Programme covers two years: 2003-2004.

Work Programme 2003-2004 is focused on a limited set of Strategic Objectives (SOs) that are essential to realise IST's goals in FP6. The SOs have been defined to mobilise a critical mass of researchers Europe-wide and bring together the concentrated effort necessary to address the relevant challenges. They have been carefully identified to reinforce European strengths in areas where it has established industrial and technology leadership. They also aim to overcome weaknesses in areas which are critical for European competitiveness and socio-economic needs. Furthermore, the SOs should enable Europe to exploit new opportunities, respond to emerging needs, and ensure that technology advances are exploitable in innovative products and services. Thus, IST RTD follows an integrated approach that spans the entire value chain from technology components to applications and services.

Figure 1: The IST Priority in FP6



IST IN THE SIXTH FRAMEWORK PROGRAMME

The Information Society Technologies thematic priority is part of the EU's Sixth Framework Programme (FP6) for Research and Technological Development (RTD), covering the period 2002-2006. With €3.6 billion, the IST thematic priority has the largest budget of all the priority areas, reflecting its major underpinning role in realising European policies for the knowledge society.

Research in IST is structured around five key areas aligned to the major societal and economic challenges and to ensure the co-evolution of technologies and their applications (Figure 1). These areas are:

i) ***Applied IST research addressing major societal and economic challenges,*** focuses on extending the scope and efficiency of IST-based solutions and making them more accessible, in the most trusted and natural way, to citizens, businesses and organisations. Sub-areas are research addressing: solutions for trust and confidence; societal challenges in areas such as health, mobility, inclusion, risk management, environment, learning and cultural heritage; work and business challenges; and complex problem-solving in science, society, industry and business.

ii) ***Communication and computing infrastructures,*** focuses on improving the performance, cost-efficiency, functionality and adaptive capabilities of communications infrastructures as well as software and computing technologies. Sub-areas are: communication and network technologies; embedded systems; and software technologies and distributed systems.

iii) ***Components and microsystems,*** focuses on pushing the limits of miniaturisation and developing new applications and functions for key components and systems. Sub-areas are: micro-, nano- and opto-electronics; micro- and nano-technologies, microsystems and displays.

iv) ***Knowledge and interface technologies,*** focuses on improving the usability of IST applications and services and access to the knowledge they embody. Sub-areas are: knowledge technologies and digital content; and intelligent interfaces and surfaces.

v) ***IST future and emerging technologies,*** focuses on IST-related science and technology in emerging fields and which may be of strategic importance for economic and social development in the future.

In addition, the IST Priority supports the further development of research networking infrastructure as well as computing and knowledge grids. These activities are undertaken in collaboration with the Research Infrastructure part of FP6 within the Specific Programme *"Structuring the European Research Area"*.

Across the IST Priority, special emphasis is placed on measures to strengthen international co-operation; to promote innovation and the participation of SMEs; to improve human capital by developing IST-related skills; and to monitor and analyse the socio-economic trends and impacts of IST developments. The IST Priority is also contributing to policy developments in related areas.

Research for People

Over recent years, European research under IST has mobilised around a vision of the future in which information society technologies are more people-centred and easier to use. By taking fuller advantage of the possibilities IST has to offer we may boost the development and broader deployment of the knowledge society and bridge the digital divide. We should respond first and foremost to users' needs. Users should be able to access IST applications and services anywhere and anytime, whatever their age or impairment, and in the form that is most natural for them. Instead of making people adapt to technology, we have to design technologies for people.

Progress towards this world – which is often known as "ambient intelligence" (AmI) – is the guiding vision of IST research. In this AmI world, technology will be almost invisible embedded in all kinds of objects and everyday environments. Our interactions with the technology will be simple and effortless. In addition to reading and typing we will be able to interact intuitively using all of our senses. Rather than limited, text-based searches we will be able to access and manipulate rich content in a way that is context-aware. Today's discrete, low bandwidth networks will give way to interoperable networks with infinite bandwidth, while mobile voice telephony will be replaced by full multimedia mobile and wireless content. And the e-services that are now beginning to emerge will be widely deployed across society in ways that directly address users' needs.

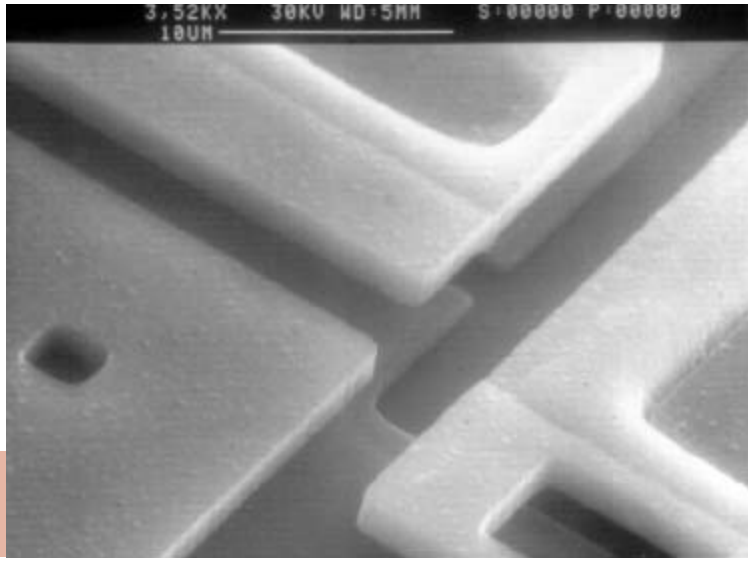
Customised advertising over interactive digital TV – developed under the iMEDIA project

An AmI world would have fundamentally new characteristics and functionality, and bring many innovative technical requirements (see Box 3). It also has important implications beyond the technological sphere.

Nevertheless, the technological building blocks for this vision of the future are already apparent. On the one hand it requires us to tackle the very small. Continuing the trend of the last 40 years, we need to push the limits of miniaturisation further and to minimise the costs and power consumption of microelectronic components. We need to explore new materials, such as organic and flexible materials for displays and sensors, so that they can be placed anywhere and take any shape. On the other hand, AmI is also about the very large. It requires us to build infrastructures that are reliable, pervasive, interoperable and trustful, and can be adapted to accommodate new applications and services. In addition, spanning these two extremes, AmI requires new means to interact with data and knowledge. Advances in knowledge technologies and intelligent interfaces promise to improve the usability of IST applications and services, and so make it easier for people to connect with knowledge and with each other.

Ambient Intelligence involves much more than simply giving every object a microchip and an IP address. One consequence of making computing and communications ubiquitous is that the world becomes considerably more complex. So as well as progressing along established trajectories we have to find new paradigms, models and ways of thinking. A people-first approach requires, for example, radical progress in computing and communications networks, in the software technologies that run them, the knowledge technologies needed to access and manipulate "smart" objects and content, and in the user interface. These are not discrete developments but a continuum. Adaptation of generic developments to meet the highly specific requirements of particular end-user applications represents a further challenge.

Realising this vision will require more than just technology. Important issues arise in other domains too. For instance, in the enterprise environment fundamental changes will be necessary in relation to contracts, taxation regimes and business practices. Ownership, control and access to personal data has to be addressed, as does the availability and protection of content (digital rights management). Technological advances will raise regulatory issues, such as the regulation of new network services. Other issues that impinge on the policy/regulatory sphere are spectrum licensing and standardisation.



An ultrasonic transducer on CMOS (Photo: INTEGRAM project)

THE CHALLENGE OF AMBIENT INTELLIGENCE

Ambient intelligence (AmI) presents a vision of the information society where the emphasis is on greater user-friendliness, more efficient services support, user-empowerment, and support for human interactions. People are surrounded by easy-to-use interfaces that are embedded in all kinds of objects and by an everyday environment that is capable of recognising and responding to individuals in a seamless, unobtrusive and invisible way.

What will this AmI World look like? We can get a better picture by considering the implications in everyday settings and spaces. The AmI Home, for instance, would be highly networked, connected to public networks and other homes at tens of megabits per second. Inside the home, the wireless network connects all appliances and displays, as well as the personal area networks of each person living in the house. Content – both broadcast and personal – is stored in a home server and accessible across the network. The home is a centre for e-work, for e-learning and for e-entertainment. For the sick, elderly or people with disabilities, it is also a place for technology-enabled care. Such a home would also be energy-conscious, able to intelligently manage its use of heat, light and other resources depending on the occupants' needs.

Similar scenarios can be envisaged for other environments such as the car, the office, leisure and cultural settings, public spaces and various general interest services. A key feature is the ability for seamless movement between these spaces: people on the move will become networks on the move as the devices they carry network together and connect with the different networks around them.

Thus, the AmI World will have very different characteristics to that of today. An AmI system will "know" itself, its environment and the context surrounding its use and act accordingly. It will be dynamic – able to configure and reconfigure under varying, and even unpredictable, conditions. It will find and generate its own rules on how best to interact with neighbouring systems, while always looking to optimise its own workings and its own relations with the environment. AmI systems will be resilient and able to recover from routine and extraordinary events that might cause some of their parts to malfunction. Since a virtual world is no less dangerous than the physical one, AmI systems would also be trustworthy, able to handle issues of safety, security and privacy.

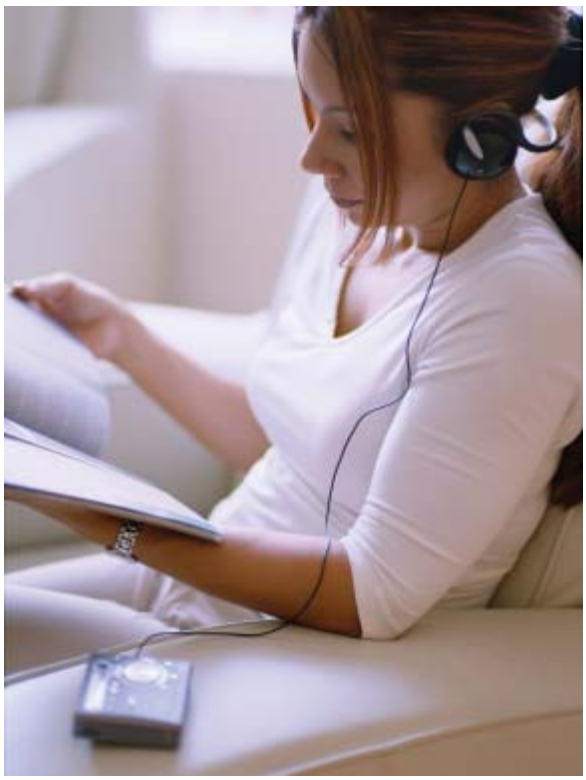
Realising these goals across different physical and social spaces will be a highly demanding exercise. The concept of AmI Space has emerged to describe the middle layer that bridges the gap between technologies and traditional end-user domains (health, transport, business etc). Any specific AmI space may be characterised through its environment – the home, car, workplace, personal area etc. – and provides a focus for the relevant RTD efforts. Each AmI space comprises a combination of infrastructures, hardware platforms, services and applications.

Adapted from: "Strategic Orientations and Priorities for IST in FP6", IST Advisory Group, June 2002. See: www.cordis.lu/ist/istag.htm

Towards the Vision: Achievements in FP5

Over the last four years, under the Fifth Framework Programme, the IST Programme (IST-FP5) has been working to make the people-first vision a reality. As a single integrated programme with wide coverage of IST-related research, IST-FP5 was able to progress AmI technologies on many fronts. Through RTD projects, take-up actions, studies, networks, conferences and other activities it brought together a wide range of researchers and engineers to progress new developments and probe new thinking.

Eight calls for proposals were made, resulting in over 2000 projects selected for support from an available budget of around €3.6 billion. Overall in FP5, there were some 15000 participants in IST projects comprising around 6000 separate organisations, including a strong representation of SMEs. While the commitment of the Programme's operational budget has now been completed, many projects will continue their research for several years to come. Their results will feed into the next generation of products and services, as well as into related actions under the new Framework Programme.



From those projects that have already finished and those which have recently produced interim results, some early signs of the expected impact of IST-FP5 research are beginning to emerge. These include:

Contributing to eEurope and beyond

Projects resulting from IST-FP5 calls made, and continue to make, significant contributions to the eEurope Action Plans in a number of areas. In smart cards, for example, several RTD projects addressed issues relating to the Smart Card Charter, while the work on dependability of information infrastructures also relates to eEurope objectives. Tangible progress towards eEurope's aims have resulted from trials and best practice actions in areas such as intelligent transport systems, e-health, e-government, e-business and e-content. In addition, activities in socio-economic research and socio-economic indicators have been directly targeted on eEurope objectives. Overall, IST-FP5 has established strong links between research and Europe's on-going policy development for the information society.

Development of long-term RTD strategies and visions

Several sectors of IST-FP5 targeted clear visions for the future around the AmI concept early on and have articulated strategies for achieving them. These sectors correspond to the areas where Europe has strong and well organised industrial and research communities that are able to define and work together towards long-term goals. FP6 presents the opportunity to refine and implement a coherent approach in these domains as part of a Europe-wide effort involving both Member States and private research. It also presents the opportunity for new thinking in those critical fields where long-term visions have yet to emerge.

Balanced long-term/mid-term portfolio

The number of research projects aiming at results that would be exploited in the five to ten year timeframe increased systematically during the life of IST-FP5 to around 40%. Despite this shift towards longer-term RTD, the balance in the participation of industry and academia has remained unchanged. In particular, the level of participation of SMEs (27% of participants and 24% of funding) has been almost stable since the very first calls.

Creating a world-class networking infrastructure

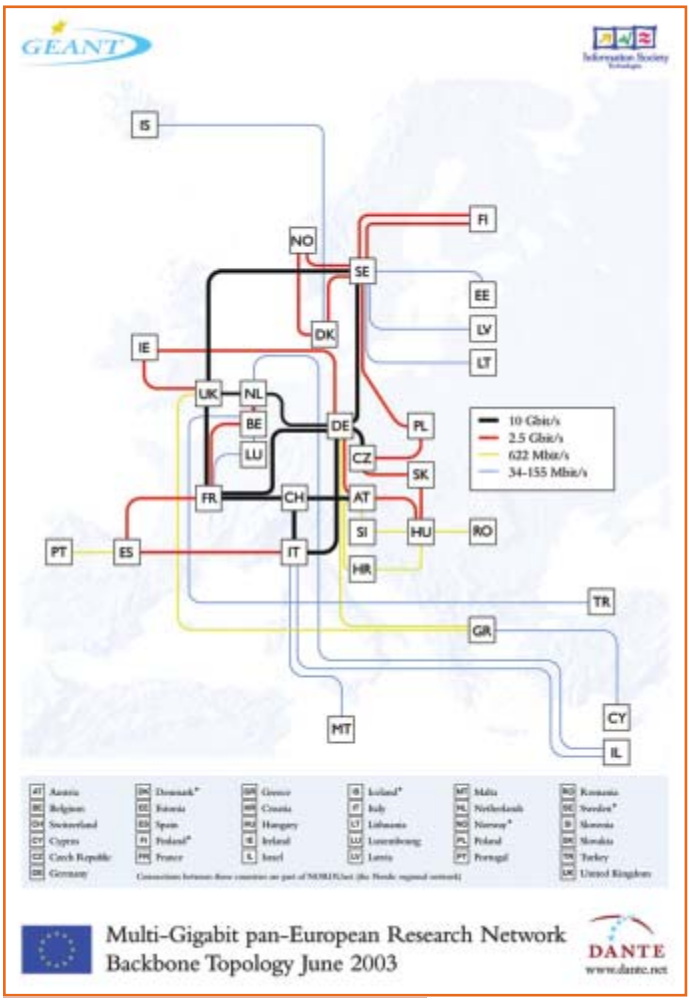
High-speed networks will open up new possibilities for collaborative learning and research. In line with the eEurope 2002 Action Plan, IST-FP5 financed a major investment in infrastructure which has given Europe the world's fastest research network backbone (GÉANT and grids). This not only provides a platform for the European research and education community but also improves connectivity between Europe and other regions. Further investments are foreseen under FP6.

Incubating new and challenging ideas

The Future and Emerging Technologies (FET) domain has proven to be an incubator for new and challenging ideas, in areas such as intelligent interfaces, quantum computing, nanotechnology, and bio-inspired computing. Some of these will become strategic for economic and social development in the future and will feed into future mainstream IST activities. FET has also been instrumental in shaping new research communities across Europe. The FET scheme is being continued under FP6 utilising two complementary approaches, one receptive and open, the other proactive and addressing specific research problems.

Broadening the constituency

Building on a long-standing involvement with key end-users for IST applications and services, IST-FP5 made substantial efforts to broaden this participation even further. This included engagement with: architects and interior designers (on workplaces of the future); economists and statisticians (on socio-economic models and policies); social and behavioural scientists (on usability and interfaces); the voluntary sector (on social inclusion); and artists and creative industries (on digital content and expression). This inter-disciplinary collaboration will be especially valuable in view of the long-term, issues-oriented approach being pursued under FP6.



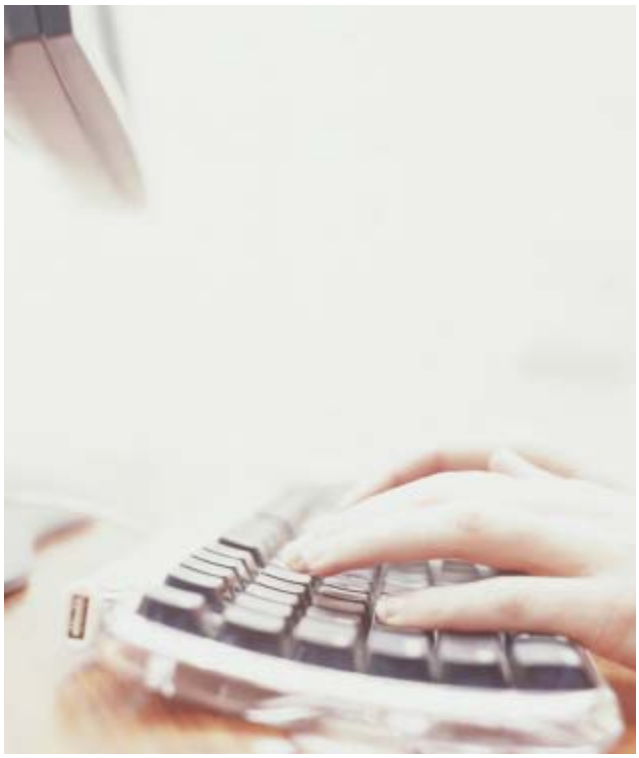
Network configuration of GÉANT – Europe's world-beating research network

Building consensus

Standardisation and industrial consensus are essential to the rapid development and take-up of IST. IST-FP5 reinforced the links to standardisation and industrial forums to ensure coherence in EU-wide technology deployment and in the creation of new open frameworks for fair competition and fast innovation. Examples are found across the Programme. They include working groups and task forces on issues such as IPv6, biometric security, and interoperability of business systems. Others are independent organisations sponsored by the Commission, that promote consensus in areas such as mobile communications, and transport information infrastructure. In addition, projects and project clusters provide European contributions to standardisation bodies (e.g. ETSI, CEN/CENELEC, ITU working groups), and to industry consensus frameworks (e.g. DAVIC, DVB, OMG, IEFT, W3C).

Encouraging international co-operation

Given the increasingly global nature of IST research, there are significant benefits to be gained for the EU through international co-operation in IST-related RTD activities. IST-FP5 was involved in a diverse range of international activities, including measures to promote access to the Programme amongst Candidate Countries and Newly Associated States.



Intensifying the Effort

In FP6, research within the IST Priority (IST-FP6) continues and intensifies this effort. Community actions have helped establish a framework within which the knowledge economy can grow. The challenge now is both to capture the benefits from current generations of IST through effective implementation and use, while at the same time gearing up to exploit the new technologies that are now emerging. Together with deployment policies and regulatory aspects, IST research under FP6 will form part of a more systemic approach to a new information society policy. It also aims to coordinate policies and research efforts across the Member States so that they contribute more efficiently to the development of a worldwide information society that preserves Europe's values and interests.

The IST-FP6 research effort will therefore reinforce and complement the eEurope objectives and look beyond them to the 2010 goals of the Union of bringing IST applications and services to everyone, every home, every school and to all businesses. The Community support for IST in FP6 will help mobilise the industrial and research community around medium to long term goals. It should facilitate the aggregation of public and private RTD effort on a European scale and enable the development of a European Research Area in IST. Thus, IST-FP6 is research for a purpose: while its vision is long-term, it responds to real-world drivers and real policy problems.

The new instruments, integrated projects (IPs) and networks of excellence (NoEs), will be used as a priority means to realise these objectives. These will give EU activities a greater impact and bring about a stronger structuring effect on research conducted in Europe. They will make it possible to assemble genuine critical masses of resources, to better coordinate national research efforts. In IST, they will also help ensure the co-evolution of technologies and their integration in application contexts. In addition, IST-FP6 will use the other instruments, where appropriate, including Specific Targeted Research Projects (STREPS), Coordination Actions (CAs) and Specific Support Actions (SSAs).

FP6 INSTRUMENTS

In common with the other thematic priorities, the IST Priority is implemented through a mix of "new" instruments, driven by the concepts of the European Research Area, and the more "traditional" instruments similar to those in FP5. As well as being a wider range of instruments, they are also more differentiated. Each has its own distinct character and its own distinct role to play in implementing the priority themes.

The "new" instruments are:

1) **Integrated Projects (IPs):** these support objective-driven research where the primary deliverable is new knowledge. Each project should contain an integrated set of activities within a coherent management framework. Research activities may be complemented by demonstration, innovation and training activities, as appropriate. IPs have a high level of management autonomy and are implemented through overall financing plans, with budgets up to tens of millions of euros.

2) **Networks of Excellence (NoEs):** these aim to tackle the fragmentation of European research by fostering a lasting integration of research capacities. As such, the main deliverable should be a durable structuring and shaping of the way that the relevant research is carried out. Research will focus on long-term and multidisciplinary objectives, implemented through a joint programme of activities. By networking European expertise in their respective fields, NoEs are expected to create genuine "virtual centres of excellence", and to have a mission to spread this beyond the original partnership. They enjoy a high level of management autonomy.

3) **Article 169:** this refers to an article in the Treaty that enables the Community to participate in research programmes undertaken jointly by several Member States, including participation in the structures created for the execution of those programmes. This is not strictly a new instrument, since it was available under previous framework programmes, but is potentially of great significance for the ERA. Joint implementation of national/regional programmes might be achieved through harmonised work programmes and common, joint or co-ordinated calls for proposals.

Other instruments available under the IST priority include:

4) **Specific Targeted Research Projects (STREPs):** an evolution from the shared-cost RTD projects in FP5, these support research, demonstration or innovation activities of more limited scope and ambition than Integrated Projects.

5) **Coordination Actions (CAs):** similar to the FP5 thematic networks, these are co-ordinated initiatives undertaken by a range of stakeholders involved in research and innovation.

6) **Specific Support Actions (SSAs):** an evolved form of the accompanying measures of FP5, covering activities such as conferences, seminars, studies and analyses, expert groups, operational support, dissemination, and information and communication activities.

In addition, **specific research projects for SMEs** are supported. These may be either co-operative research undertaken for the benefit of a number of SMEs on themes of common interest; or collective research carried out for industrial associations or industry groupings in sectors where SMEs are prominent.

The first Call of IST-FP6 was launched in December 2002 and closed in April 2003. Over 1400 proposals were received, together with an additional 95 for the joint call with Thematic Priority 3 "Nanotechnologies". Of the 1473 proposals submitted to IST, 348 (24%) were for integrated projects, while 755 were for classical research projects (STREPS). Overall, the proposals submitted provided good coverage of the work programme, and showed participation of SMEs within consortia at similar levels to FP5. Projects resulting from this call will be launched in late 2003: the first of many to exploit the opportunities ahead.

Further Information

Further information on FP6, including the specific programmes, new instruments and information events, is available on the following websites:

IST Priority, including Work Programme 2003-2004: www.cordis.lu/ist

FP6: http://europa.eu.int/comm/research/fp6/index_en.html

European Research Area: www.cordis.lu/rtd2002

Building the ERA in IST

The Sixth Framework Programme aims to be a cornerstone for the creation of a European Research Area. The IST Priority is contributing to this through a variety of measures designed to build critical mass in key areas of IST research.

The IST Programme is an important feature of the European research landscape for information and communication technologies. Nevertheless, it still accounts for only a tiny proportion of ICT-related RTD investments within the Member States and Associated States. One of the key objectives of the Sixth Framework Programme is to help build the European Research Area (ERA). This will help maximise synergy between national, regional and Community efforts and increase the impact of Community funding by building critical mass in key areas of IST research.

IST technologies have a unique opportunity to contribute to the ERA: the sector itself is one of the largest in the economy with a history of collaboration in certain areas (e.g. research networking). In addtion it plays a crucial underpinning role in many of the other thematic areas. The IST Priority is actively exploiting its links with both the management committee (ISTC) and the advisory group (ISTAG), both of which have had their mandates expanded to take account of the ERA dimension.

Beyond the direct efforts that will be undertaken via the work of the ISTC and ISTAG, IST's strategy for the ERA in FP6 is built around four priorities. Firstly, it will actively exploit the new instruments (IPs and NoEs) as a means of building the ERA "bottom-up". This is especially the case with NoEs, which aim to structure research efforts in specific thematic areas and facilitate the integration of isolated centres of expertise into virtual centres of excellence. The durability of the proposed integration will be a key factor in the selection of NoEs, and focus will be on the excellence of participants and the "quality of integration".

A second priority is to assist Member States in the generation of proposals for Coordination Actions in strategic IST areas. Such initiatives can be supported either directly within the IST priority in specific areas or under the third block of FP6 – *Strengthening the Foundations of the ERA* – where specific actions are envisaged for co-ordination of research activities carried out at national or regional level. This will be achieved through networking (and opening) of national and/or regional research programmes. Work is currently underway to identify areas that are suitable for coordination, networking and/or mutual opening. An IST ERA Working Group of Member States' representatives has been established to progress the preparation of strategic IST-ERA coordination activities and Member States are also collaborating in the setting up an IST RTD information Portal (see box).

Research networking (GÉANT and grids) is another locus of activity. A total of €300M, €100M from the IST Priority and €200M from the research infrastructures budget, has been earmarked to continue and expand on the work done in this area in FP5 (see p.84).

A gateway to national IST research

Although information on IST research at European level is relatively accessible, at national level such information is often difficult to find and lacks consistency. The IST domain is diverse and national activities tend to be spread across many different research agencies and themes. A single entry point for this information would provide the first steps towards strengthening the coordination between national and EU activities and bring clear added-value to policy-makers, research managers and the wider IST community.

The ERA IST Portal would be an electronic information exchange platform where a number of IST themes could be explored across all Member and Associated States. A feasibility study identified users' needs for such a system and explored sources from over 200 national websites. A prototype system was developed together with recommendations on how to implement the portal.

An initiative is underway to develop further ERA coordination in IST which will also involve the establishment of a supporting information system.

Leading the way to a European Research Area in IST

Finally, the IST Priority will continue, as in FP5, to exploit synergies with both the EUREKA and COST initiatives as a significant means for implementation of the ERA. COST Actions in IST are managed in close correlation with corresponding IST activities, thus very good synergy and complementarity has been maintained. These relations include support from COST Actions to IST thematic concertation meetings and workshops. EUREKA also has a very strong IST presence, especially in microelectronics, software intensive systems, packaging and interconnect. As the industrial actors are similar in the related IST areas, good synergies and relations to IST projects have emerged which contribute strongly to ERA goals. The development of Member State policies for EUREKA as an ERA instrument is ongoing and could be further addressed in future ERA policies.

In addition a number of ERA-related activities are currently underway with involvement of the Member States. FISTERA is a thematic network on foresight in IST, led by the JRC Institute for Prospective Technological Studies (IPTS) in Seville. It brings together actors and insights from national IST foresight exercises in the enlarged Europe, and is expected to provide input for IST ERA coordination measures. PROACT is a joint Finnish/French research programme on "proactive computing" (ambient intelligence). Launched in 2002, the three-year programme currently funds 14 projects involving French-Finnish consortia.

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Meeting the market

Recognising that research is only the first step to successful innovation, IST offers a variety of measures to support the exploitation of research results and the participation of SMEs.

The IST Priority provides opportunities for organisations of all types and sizes to pursue leading-edge research. But research alone is not enough. To fully achieve IST's objectives – improving the competitiveness of the European economy and the quality of life of European citizens – research results need to be taken up and used. With many of the FP5 RTD projects now either concluded or reaching maturity, efforts to support the dissemination and exploitation of research results are being intensified.

Much activity to support the take-up of results is undertaken by IST projects and accompanying measures. To complement these, a series of Programme-wide services have been launched to ensure effective access to and exploitation of this information. These provide a range of web-based services designed to extend the reach of innovations generated by the Programme to a much larger community of users. For instance, IST-Results is a news service and website that promotes projects' results and achievements directly to key target audiences (see box). A similar service, IST-TV, is setting up an internet video portal providing central access to videos on IST results for broadcasters and journalists.

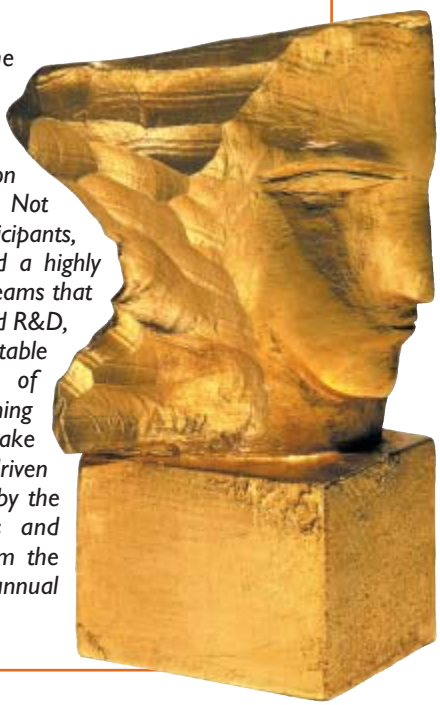
Several measures aim to broker partnerships between current or potential project participants and to improve awareness about the Programme and its results. Ideal-IST is a network of experts in 32 European countries (all EU Member States and Associated States) which provides help for companies wishing to participate in the IST Programme. The network disseminates information through workshops and conferences, complementing national awareness-raising efforts, and organises international partner brokerage events. An online partner search facility is also offered, targeted at specific calls and tasks.

Recognising the specific challenges for SMEs, IST places a special emphasis on making their participation as easy and rewarding as possible. In FP5 SMEs were deeply involved in the IST Programme, with almost two-thirds (63%) of funded projects having at least one SME contributor. Overall, one third of the participating organisations were SMEs, with over 2000 SMEs directly

THE EUROPEAN IST PRIZE

European IST Prize

Now in its ninth year, the European IST Prize is an award for ground-breaking products and services that represent the best of European innovation in information society technology. Not restricted to IST Programme participants, it provides public recognition and a highly visible profile to entrepreneurial teams that excel in generating novel ideas and R&D, and converting them into marketable products. The high standards of applicants and the competitive screening procedure for selecting the winners make this a distinguished prize for new IT-driven products. The prize scheme is organised by the European Council of Applied Sciences and Engineering (Euro-CASE), with support from the European Commission, and awarded at the annual IST Conference.



involved in the IST Programme, many in more than one project. Across the Programme as a whole, SMEs made up 24% of all the participation in signed contracts and accounted for a similar proportion of the IST budget.

Support for innovation- and SME-related activities continues to be a key feature under FP6, both at project level (IPs, NoEs and STREPs) and through "horizontal" actions. Existing regional and interregional networks, such as Ideal-IST and the IRCs, are likely to play a key role here. Other organisations and mechanisms, such as private investors, the EIB/EIF funds and the Structural Funds, could also be mobilised.

Various services help IST project participants get the most out of research results

Promoting IST innovation

In the Fifth Framework Programme the European Commission invested over €3.6 billion in research related to information society technologies, through thousands of transnational projects involving the private and public sectors. Now new FP6 projects are coming on stream. What is happening in your own area of interest? And how can you benefit from this massive investment?

The IST-Results service gives you online news and analysis on emerging results from these European projects. A team of journalists reports on prototype products and services ready for commercialisation as well as work in progress and interim results with significant potential for exploitation.

The service is promoted to new technology users in SMEs, large enterprises and public services, as well as information brokers and intermediaries. It helps companies to identify technologies ripe for exploitation, find business solutions and new product ideas, and keep track of new developments through early access to research results. Specialist services target two key constituencies: the Investors Service highlights news and links relevant to the financial community; and the Press Desk provides news leads for the media.

A regular dialogue is being established with projects, IST project officers and National Contact Points to source stories, provide feedback on published content and exchange ideas for future service development. But there is no need to wait for the Editorial team to contact you. You may submit ideas for news at any time by contacting: helpdesk@istresults.info

Strategic Objectives:	*General accompanying measures*	
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	Linda Jones (Results)	*linda.jones@cec.eu.int*
	Klaus Pendl (IST Prize)	*klaus.pendl@cec.eu.int*
Project References:	*IST-TV* *IST-2001-32799*	
Web:	*IST-Results: www.cordis.lu/ist/results*	
	Ideal-IST: www.ideal-ist.net	
	European IST Prize: www.ist-prize.org	

FET: IST's pathfinder

Building on a long tradition of support for basic research, IST's Future & Emerging Technologies action is exploring new frontiers in RTD that will lay the foundations for future research programmes.

The EU Framework Programmes have a strong tradition of support for research of a basic and long-term nature. For example, the Esprit programme actions on Basic Research (FP3) and Long-Term Research (FP4) aimed to lay the foundations for "next wave" technologies to underpin the future development of European information technology R&D. These schemes were open and responsive, and focused on community building and developing skills and infrastructure as well as on research.

Many of the activities launched under these actions have since passed into the "mainstream" RTD under the subsequent framework programmes. For instance the work on nanotechnology started 7 years ago under Esprit has now been diffused into industrially-oriented R&D on components in microelectronics and microsystems. Other examples are to be found in the early work on distributed systems and networks, computer vision, intelligent interfaces, language and speech technology, multifunctional microsystems, and quantum cryptography, to name just a few.

In the IST Priority, this pathfinder function is served by the Future and Emerging Technologies (FET) action. Building on its long tradition, in FP6 FET continues to pursue pioneering, visionary research, bearing high risk but balanced by prospects of high reward. It nurtures new research ideas, helps them to mature and thereby lays the bases for the industrial solutions of "the day after tomorrow". The problems addressed have a very long time horizon, where there is scope for highly innovative research and bold new ideas. Focusing on emerging fields and scientific disciplines, its research is highly interdisciplinary and the competences cannot be found in a single place.

FET's success is measured in the build-up of knowledge, the development of competences, the exploration of new research avenues, and the maturing of new science and technologies. The impact of this research work is visible at many levels. The scientific and technological achievements produced by the projects are widely publicised, including in the general press. Several FET initiatives have succeeded in placing Europe at a world-leading position in emerging research domains, for example in nanotechnology, quantum computing and information interfaces. FET has also helped create multi-disciplinary pan-European communities of scientists and researchers that drive progress in emerging fields.

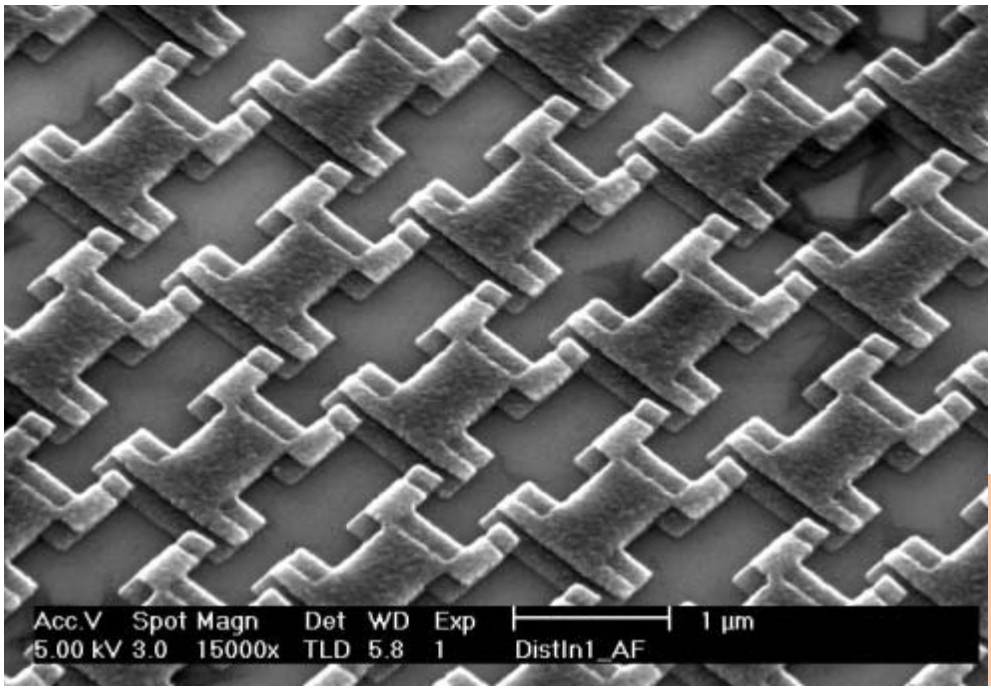
While FET's research horizon is long-term and most of the research work is carried out at universities and research institutes, representatives from industry are also taking part. They include major industrial players in areas such as: semiconductors, system integrators for consumers and professionals, and telecoms equipment providers and network operators. Although the outcomes are, by definition, unpredictable, FET's research results are often commercially exploited. In FP5 a spin-off company was created on average every 3 months as a result of work undertaken within FET projects.

A quantum leap for cryptography

id Quantique is a spin-off of the University of Geneva, Switzerland. Founded in October 2001 by four researchers of the Group of Applied Physics (GAP), the company is a leader in novel secure communication systems based on quantum photonics.

id Quantique currently has two products, both of which originate from the Esprit Project EQCSPOT. The first exploits a truly random physical quantum process to generate high quality random numbers for cryptographic purposes, numerical simulations, statistical studies or gambling. The second is a quantum key distribution (QKD) system that allows a cryptographic key to be exchanged with absolute security, guaranteed by the laws of physics. It can be deployed on existing optical networks and allows point-to-point key exchange over distances of more than 60 km.

The company and its founders have won numerous awards, including in 2001 a European Innovation Award from the Wall Street Journal Europe, and the annual prize of the De Vigier Foundation in June 2002.



SEM picture of a Josephson junction array, a potential circuit for quantum computing (Photo: Delft Technical University)

Research in FET is organised in two ways, through the Open domain (FET-Open) and through Proactive Initiatives. FET-Open is a bottom-up approach. Proposals may be submitted on any IST-related topic following a two-stage application process. In FP6, only STREPs, CAs and SSAs can be submitted to FET-Open.

The proactive scheme has a strategic character, setting the agenda for a small number of specific areas that hold particular promise for the future. Proactive initiatives run as targeted, mini-research programmes consisting of a set of autonomous but complementary projects. In FP6 only IPs and NoEs can be submitted. Proactive initiatives in 2003 are Disappearing Computer (p.34), Complex Systems (p.108), and Beyond Robotics (p.112). Further initiatives are being considered under the Work Programme for 2004, budget permitting (see box).

Proactive initiatives in 2004

Potential topics for FET support under FP6 have been the subject of a wide-ranging consultation. The leading candidates for proactive initiatives in 2004 and beyond are:

- *Quantum information processing and communication: Aiming towards novel computing and communication systems that exploit the properties of quantum mechanical operations.*
- *Molecular computing: As a follow-up to the Nanotechnology Information Devices initiative, this would possibly focus on molecular and biomolecular approaches to information processing systems, including devices, computational architectures and bottom-up nanofabrication.*
- *Global computing: Building on the earlier FP5 initiative, this would aim to establish foundational principles for the analysis and design of systems composed of extremely large numbers of autonomous, mobile and interacting computer entities.*
- *Life-like perception and cognition systems: Aiming towards systems that are bio-inspired, and building on successful work under the earlier initiatives on Neuroinformatics for Living Artefacts and Life-like Perception Systems.*

Strategic Objectives: *Future and Emerging Technologies*

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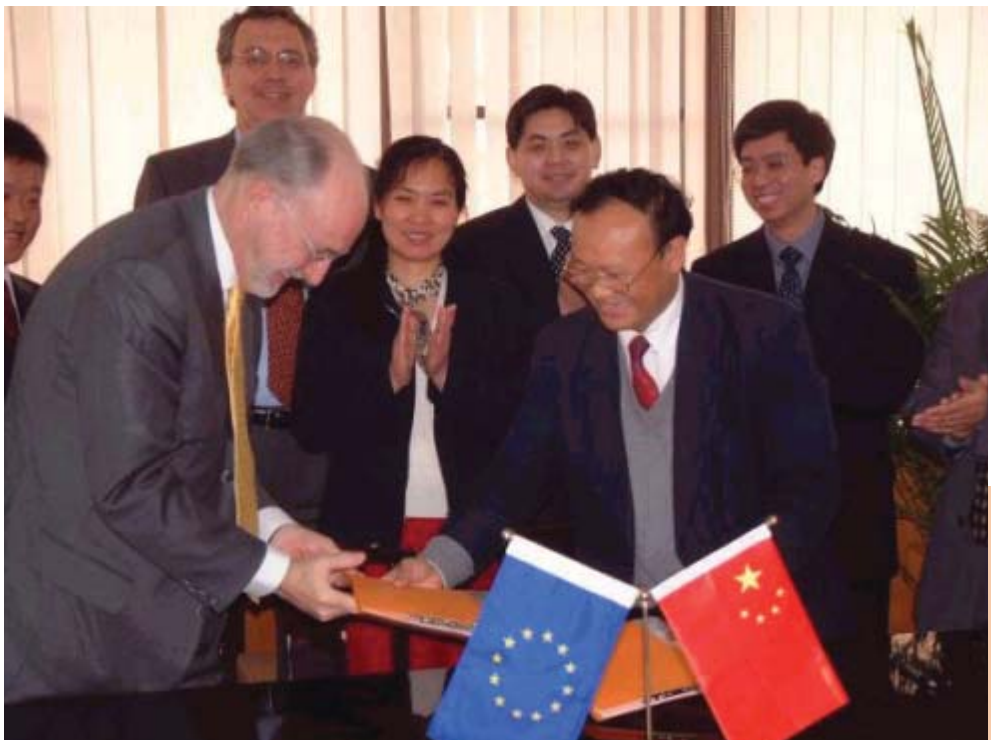
A global information society

International co-operation in IST research brings benefits for both Europe and its partners.

Given the increasingly global nature of information and communication technologies, there are significant benefits to be gained for the EU through international co-operation in IST-related RTD activities. Collaboration with researchers from outside the EU can help achieve global consensus on interoperability and standards. International co-operation promotes the exchange of technological know-how and skilled researchers worldwide. It can strengthen business co-operation and open global markets to European IST solutions. Also it helps fill the shortage of IT skills in Europe and prevent the brain drain, especially from the Candidate countries.

Like other areas of the Sixth Framework Programme, the IST Priority is open to researchers from across Europe under association agreements between the EU and the individual countries concerned. Researchers from associated candidate countries can submit proposals for IST research projects and receive funding on essentially the same basis as EU participants. IST also has a budget of €90M available to support participation of so-called "INCO target countries", which include the former Soviet Union, Mediterranean



Following the EuroChina 2002 event, the EU is supporting China in turning the Beijing Olympics 2008 into "the Digital Olympics"

Be in India in 2004!

Following the success of the EuroChina 2002 event, the European Commission is organising a similar event with India in 2004. The EuroIndia Cooperation Forum on the Information Society will be held in New Delhi from 24th-26th March 2004.

The event offers European delegates a stimulating mix of plenary presentations and innovative parallel workshops along distinct streams and themes. Its prime focus being Euro-Indian co-operation, EuroIndia2004 is fully geared up to organise Networking Meetings and Get in Touch presentations which will offer participants the opportunity to multiply business contacts. In addition, the Exhibition will allow companies to showcase their business and research activities, network with potential Indian partners and increase their market awareness.

Over 10,000 visitors from 40+ countries and over 750 exhibitors attended EuroChina2002. New Delhi is expected to prove just as inviting. Further details are available at the event website: www.euroindia2004.org.

region, the western Balkans, and developing countries. In addition, researchers from a number of other countries around the world may participate in IST through science and technology co-operation agreements with the EU, bringing their own funding.

The new instruments will be used to support international co-operation activities in a variety of ways. Most integrated projects (IPs) will have an international dimension, whose purpose will be to address one or more of the competitiveness issues listed above. For instance, an IP may include market access-oriented activities, including for the demonstration, take-up or dissemination of technologies in emerging countries with the participation of local organisations. An IP may also conduct RTD in a third country where skills exist that are more appropriate or less expensive. Such an international dimension may either be built into the project from the start or be added later, for example through synchronised calls organised with funding agencies in third countries. In other cases an IP may start with a strategic and geographical purpose where substantial co-operation in IST with a specific third-country or region is needed to reach critical mass.

Networks of Excellence (NoEs) will be used largely to achieve access to the best technological know-how in specific thematic areas. When attracting excellent scientists from the former Soviet Union, the Mediterranean third-countries, the western Balkan region, and the developing countries in general, NoEs will generally provide them with financial support. Finally, targeted research projects, concerted actions and support measures will be used, when appropriate, to finance international co-operation activities of the sort supported by IST under previous Framework Programmes.

In addition to RTD within the IST Priority, the deployment of IST-related technologies is supported under a series of regional initiatives. The EUMEDIS Programme promotes IST-related co-operation within the Euro-Mediterranean region, and is currently the Commission's largest international IS initiative. As well as funding regional IS applications projects, the initiative is enhancing the region's network infrastructure through connection to the GÉANT European high-speed network. In Latin America, the @LIS initiative is supporting a series of demonstration and take-up projects and is also financing the interconnection between GÉANT and Latin American research networks. And in Asia, the Asia IT&C Programme is funding around 40 projects in key IST application areas.

Co-operation with other industrialised countries is also encouraged, with an emphasis on joint initiatives that enable a pooling of expertise. Examples are to be found in current dialogues with the United States on issues such as critical infrastructure protection (p.44) and networked embedded systems (p.88). USAnet and IST-EC provide brokering services for the US and Canada respectively, promoting closer RTD contacts with the EU. Both projects offer information on technology transfer opportunities, RTD funding and databases of potential project partners.

Strategic Objectives: *General accompanying actions*

Project References:

IST-EC	*IST-2001-33029*	*www.ist-ec.org*
USAnet	*CT-2000-50003*	*www.usanet-online.com*

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Web:
www.cordis.lu/ist/int
@LIS: europa.eu.int/comm/europeaid/projects/alis/index_en.htm
ASIA IT&C: europa.eu.int/comm/europeaid/projects/asia-itc/index_en.htm
EUMEDIS: europa.eu.int/information_society/international/mediterran/index_en.htm
EuroIndia 2004: www.euroindia2004.org

Mainstreaming IST innovation

Designed to support the deployment of telecommunications-based services with a trans-European dimension, the European Commission's eTEN Programme complements and enhances the IST RTD activities.

Health records is one of many areas benefiting from support under the eTEN Programme

Research and development is an inherently uncertain process. Just because something works and appears to be useful, there is no guarantee it will be used. Successful research and development represents only the first stage in bringing a new product or service to market. For a product or service to be actually launched, many additional factors have to be taken into consideration. In particular, users need to be shown that the product or service has tangible and significant benefits and that it will be easy to assimilate within their organisations and their modes of operation. Positioned downstream of the IST Programme and national RTD efforts, the eTEN Programme provides the opportunity to validate and deploy IST-based innovations.

Part of the EU's policy to assist the realisation of the Single Market, eTEN aims to accelerate the take up of e-services. It focuses on public services, particularly in areas where Europe has a competitive advantage, thereby strengthening economic and social cohesion in Europe and reducing disparities between the levels of development of European regions. As a key instrument of the eEurope Action Plan 2005, it supports the establishment of operational services of common interest ("e-services") based on electronic data transmission networks. In 2003, eTEN focuses on the practical realisation of eEurope's objectives for e-services, addressing the deployment of a broad set of applications and generic services in the areas of e-government, e-health, e-inclusion, e-learning and trust and confidence.

Online dispute resolution for e-commerce

OnlineConfidence offers an online dispute resolution service that gives buyers and sellers access to an effective, transparent, independent and fair out-of-court process. Sellers indicate their participation by showing the OnlineConfidence Trust Seal on their web sites. This confirms that a trusted third party has verified the existence of the company, and that they have agreed to the conditions of the dispute resolution system. The underlying technology was developed in the Esprit project Netprise.

eTEN supports many types of projects, from market validation (studies on technical and commercial feasibility) to initial deployment of systems and services. In addition, support and co-ordination actions aim to stimulate trans-boundary initiatives and to identify and remove barriers to effective interconnection and interoperability. Many eTEN projects have their origins in earlier RTD projects under the IST Programme or its predecessors.

The priority in 2003 is on initial deployment actions for e-services. These should cover the total value chain and have the active involvement of and/or support from a relevant and dedicated user population in order to provide for a strong customer base at launch.

In e-government, for instance, the eTEN project VASCO offers oil spill monitoring services for the Mediterranean sea via multiple remote sensing satellites. The data gathered is analysed and the pollution data is extracted and then combined with weather and hydrographic information to produce a total picture about the oil spill situation and how it will evolve. Users – environmental managers and oil companies – are alerted about the event via e-mail, fax or SMS. The underlying technology was developed under the Esprit project RAMSES.

Building on the Telematics project EQUALITY, SERCAL is a service platform to support independent living among the elderly and disabled. The service affords the social care operator 24-hour access to his clients, using low-cost call centre technology. The services are provided at the front office either through immediate service delivery (client visiting the front office or care-providers visiting the client and accessing the information through mobile phone), or mediated service delivery through a telephone, PC/web phone (client contacts the front office online).

For e-learning, TEN-A offers an online brokerage and delivery service, linking educators and trainers for the exchange and distribution of learning resources. Registered users are able to exchange learning resources in a variety of different formats (web-courses, PC presentations, video, etc.) and to access live lectures using two-way videoconferencing. The system builds upon standards-compliant solutions and standard industry products developed in the IST project UNIVERSAL.

Towards the European e-Health Insurance Card

To date, the process of proving entitlement to healthcare services and benefits has relied mainly on paper documentation. However, in line with the modernisation of the healthcare sector, many Member States have already replaced paper documents by electronic alternatives, such as smart cards. The EU is encouraging and supporting this development. In a recent communication, the Commission set the goal for a pan-European electronic health card by 2008.

The eTEN project NETC@RDS is validating an operational environment for e-health cards, including the agreements between healthcare organisations and the administrative requirements. Health agencies from Austria, France, Germany and Greece are participating in the project and will provide mutual acceptance of their respective health cards. Several scenarios, using on-line and off-line solutions, are being evaluated.

The technical research and standardisation were supported by the Telematics Programme in the two projects TRANSCARDS and NETLINK, which also set up pilot applications.

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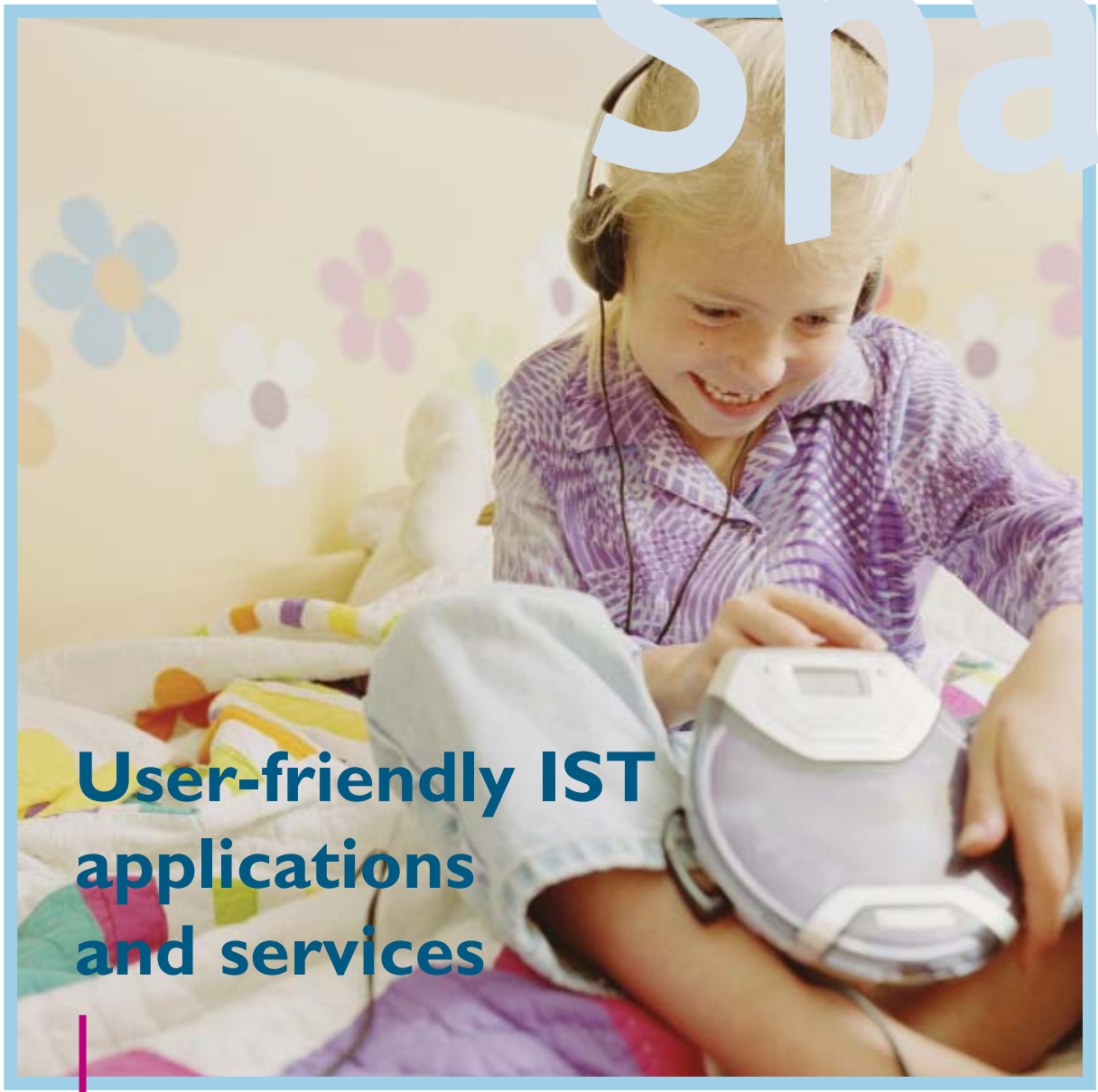
Intelligent Spaces



User-friendly IST applications and services

The impacts of the information society on our daily lives are increasingly apparent. Today, more than 50% of the European population uses the internet on a regular basis, a proportion that continues to increase. Over 70% use digital mobile phones and these will become an alternative method of accessing internet services as the new 3G networks become available. New IST applications enable people to access e-commerce, e-learning, e-health and other services directly from their homes, bringing particular benefits for the young, the elderly and those with special needs. Our everyday spaces, such as the home and the car, are no longer just passive environments, but are our interface to a whole new world of interactive services to help us live, work and play.

The EU's information society policy aims to enable all Europeans to benefit from these developments. The eEurope initiative has done much to improve connectivity: internet penetration in European homes has doubled in recent years while internet access prices have fallen. Web accessibility guidelines have been adopted and are being recommended in Member States. More government services are becoming accessible within the home, while a smart card infrastructure is emerging to support all sorts of commercial and e-government services. In the regulatory sphere, a new regulatory framework covering all electronic communications is now being adopted by the Member States. The EU has also put in place a legal framework for e-commerce that has helped improve consumer confidence.

eEurope 2005 continues this further through a commitment to further stimulate services, applications and content. At the Barcelona Council in 2002, the EU stressed the importance of technological convergence around open platforms for preserving citizens' freedom of choice. It committed to achieving widespread access to new services and applications, notably through digital TV, 3G mobile communications, the further development of electronic identification and authentication, and a universal access to broadband.

Relevant research themes are found across the IST Priority. RTD on privacy and trust supports eEurope's aims to promote a culture of security in the design and implementation of ICT-based products and services. Developments in micro- and nano-technology are making possible a new generation of medical sensors and implants that will have a major impact in e-health. Work on home platforms and on in-vehicle systems is contributing to the open platforms and standards necessary for equipment to be linked together within their own information space. Research on interactive and mobile content, mixed reality and interfaces is opening up major new delivery channels in, for example, e-learning, e-commerce, mobility and tourism.

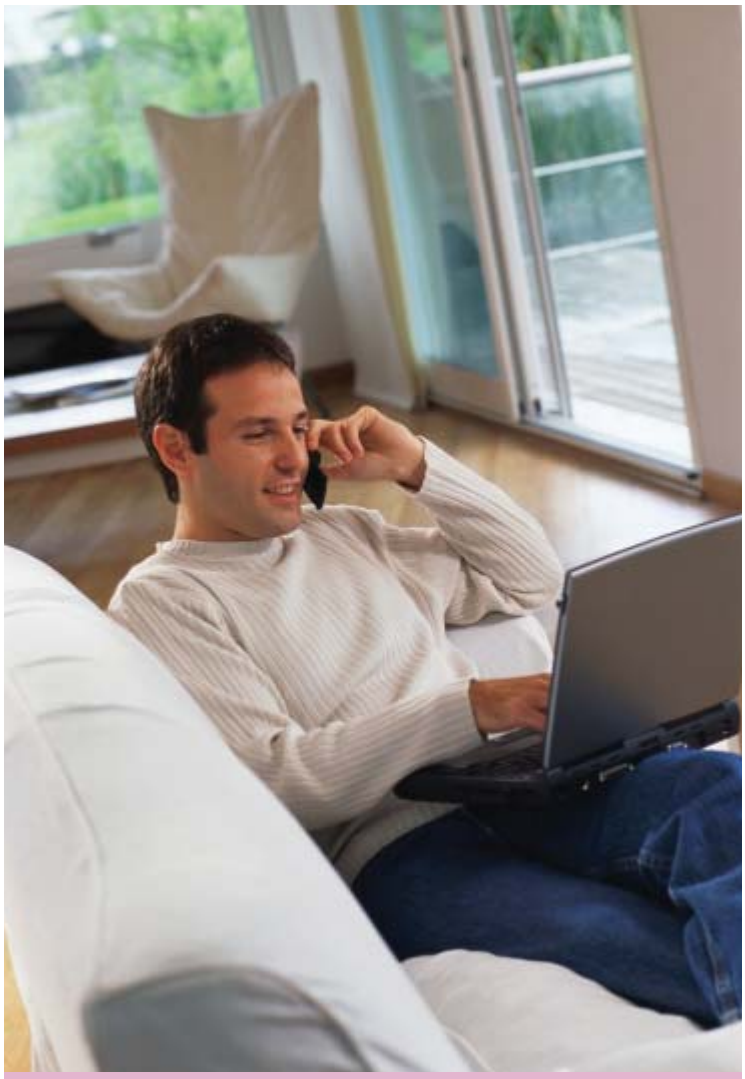
Looking to the longer term, work under the Disappearing Computer initiative, part of IST's Future & Emerging Technologies action, anticipates a situation where even everyday objects such as pens, paper and clothes are likely to acquire communication capabilities.

Privacy in a networked world

The evolution towards smart personalised environments based on open and public networks requires major changes in how we approach privacy and identity management. In the ambient intelligence space, security is the new frontier.

As open and public networks and information systems become an essential part of business and daily life, the more security becomes a necessity. We are already surrounded by a host of information devices: smart mobile phones, handheld PDAs and PCs. In the future, personal area networks and embedded computer chips will be everywhere – in our cars, our homes and even our clothes – as we see the emergence of smart digital environments ("ambient intelligence" or AmI). In this highly inter-networked world, where resources will be shared dynamically, users need means to control their privacy and security and to be assured of the identity and trustworthiness of others.

The AmI space is very different to that we are used to. People will participate in a multiplicity of relationships – one-to-one, one-to-many and many-to-many – which will overlap, interleave and evolve. Some will be short-lived and may even be established temporarily and instantaneously. The ambient environment will be populated not just by nomadic people but also by mobile and autonomous things. For instance, constantly moving intangible agents will manifest themselves to users through means such as caches, software and downloadable applications. Security in this space will require solutions very different from today's systems which are predicated on relatively stable, well-defined, consistent configurations. For a world with ambient intelligence, we need new security paradigms and models.



The growth of networks in everyday life calls for new approaches to security

The EU's response to the security challenges posed by the information society is based on a mix of regulatory, organisational and technological measures. Partially as a follow-up to the eEurope 2002 Action Plan, the legal framework is being developed to increase co-ordination between Member States towards achieving a sufficiently high level of trust, confidence and security in Europe. Key measures over the last few years in relation to privacy and trust include the 1999 directive[1] on electronic signatures and the 2002 directive[2] on processing of personal data.

The eEurope 2005 Action Plan identifies, among other measures, the need to promote a 'culture of security' in the design and implementation of ICT-based products. This will help in developing best practices and standards and for raising awareness of security

Privacy on the move

Following the success of GSM, Europe enjoys a strong position in mobile/wireless communications technologies and services. To maintain this lead, developers need to consider the security and privacy of future systems. PAMPAS aimed at ensuring that future mobile services and systems satisfy security, privacy and identity management requirements. The project identified research challenges in the area of mobile privacy and security, and derived a roadmap for applied strategic research within FP6. It also helped to build a constituency of relevant interests and stakeholders. Besides open research aspects, the concluding assessment also identifies needs with respect to standardisation and regulation.

risks for all users. In this context, the potential threats to human rights that might arise from security in the AmI space need to be investigated and, where necessary, balanced with an appropriate mix of technical, legal and regulatory measures as well as best practices at a European level.

Under FP5, work on privacy and identity was addressed as part of a wider effort on RTD for trust and security. The main topics covered were: cryptography, electronic signatures, public key infrastructure, security processes and technologies, biometrics and privacy-enhancing technologies, and smart card technology. During the latter stages four roadmap projects were launched to help mobilise the community and lay the groundwork for FP6, the complete set of deliverables being publicly available.

RAPID has developed a strategic roadmap for applied research in privacy and identity management. Working with leading experts from industry, academia and NGOs, the project developed a detailed technology roadmap for future RTD activities. The plan covers domains of privacy enhancing technologies, IT security, law and socio-economic issues. STORK brought together key players from academia and industry to formulate a common research agenda to meet current and future needs in cryptology. PAMPAS focused on the area of privacy and security for mobile systems and applications beyond-3G (see box). Finally, BIOVISION studied the successful future deployment of biometrics in Europe and produced a roadmap that aims to ensure use of these technologies is secure, user-friendly, socially acceptable and ethical. In July 2003, major European players launched the European Biometric Forum (EBF) to help realise the opportunities set out in the roadmap.

Work under FP6 will focus on the challenges of privacy and identity in a highly networked world. Building and providing trust and confidence in AmI scenarios requires specific needs and requirements to be met at all levels: content, network and device. Specific security policies will need to be expressed consistently at every level and then enforced coherently. The AmI space is also characterised by the scale and volume of connected devices and systems. These, too, present new security requirements in terms of the new mediation services that will be needed to realise variable and adaptable security levels.

[1] A Community framework for electronic signatures, Directive 1999/93/EC, 13 December 1999

[2] The processing of personal data and the protection of privacy in the electronic communications sector, Directive 2002/58/EC, 12 July 2002

Strategic Objectives:	*Towards a global dependability and security framework*		
Project References:	*BIOVISION*	*IST-2001-38236*	*www.eubiometricforum.com*
	PAMPAS	*IST-2001-37763*	*www.pampas.eu.org*
	RAPID	*IST-2001-38310*	*www.ra-pid.org*
	STORK	*IST-2001-38273*	*www.stork.eu.org*
Commission Contacts:	*Alain Jaume*	*alain.jaume@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/dependability-security/home.html*		
	www.cordis.lu/ist/ka2/rmapsecurity.html		

Towards ambient healthcare

Developments in micro- and nano-technology are making possible a new generation of medical sensors and implants that will have a major impact in e-health.

An integrated glucose sensor and insulin pump developed under the ADICOL project. The sensor is implanted under the skin to continuously measure and display the blood sugar concentration.

Clinicians have long used electronic implants as therapeutic aids. Since the introduction of the first cardiac pacemaker in 1960, the range and sophistication of medical implants have increased considerably. Current applications include cochlear implants for deafness, neurostimulators for treating certain neurological conditions, and various programmable drug infusion devices. With the advent of MEMS – micro-electrical-mechanical systems – and microsystems a new generation of implantable devices and systems is emerging that will be much smaller and smarter than those of the past.

Microsystems are tiny machines that integrate mechanical elements, sensors, actuators and electronics on a common silicon substrate, often combining silicon with other materials in the same component. They are fabricated using processes similar to those used to produce integrated circuits, that selectively etch away part of the silicon or add new structural layers to form mechanical, electromechanical or sensing devices. Through their combination of size and functionality, microsystems will make possible things that we simply cannot do today, so enabling further advances in healthcare both in clinical diagnosis and treatment. Next to IT peripherals, medical and biomedical applications are predicted to be the largest market sector for microsystems over the next 10-15 years.

For instance, micro-implants could be used to monitor and control the delivery of a drug based on metabolic signals on a patient's condition. They could be used to compensate for loss of function or stimulate the body's natural repair processes (e.g. for wound healing). Micro-imaging sensors could be used to examine internal organs in place of unpleasant endoscopy procedures, so bringing benefits both to the diagnosis and management of certain medical conditions. Mass-produced microsystems should become low-cost measurement and monitoring devices, replacing high-cost analysis equipment. And when dispersed into the home or as part of wearable devices, MEMS-based sensors could be key components in future systems for home-based care and monitoring personal well-being.

IST has funded a variety of projects concerned with medical devices through the FP5 action lines on both e-health and microsystems. Early projects focused on

Novel approach to wound care

WUNSENS deals with the problem of chronic skin wounds, for example ulcers and diabetic lesions, which affect two million European sufferers annually. Current medical practice for treating these wounds is highly subjective and varied. The project aims to develop a tool that will eliminate the subjectivity in the assessment of wound condition with at least the same degree of accuracy as current practice.

Its integrated solution includes a novel vision-based system for measuring the size of wounds and a microbial sensor for quantifying the status of microbes in the wound. An accompanying database helps clinicians monitor the wound's status and response to treatment.

biomedical sensors, covering all types of sensors for the detection and measurement of physical or biological parameters. Examples include: a microsystem for bioanalysis based on an optical microchip (BIOMIC); a micro-machined magnetic immunoassay technique using standard silicon CMOS technology (MICROBIOL); a sensitive integrated biosensing system for measuring prostate specific antigen (PSA) in treating prostate cancer (PAMELA); and a novel biomolecular transistor (SAMBA). Further projects addressed the integration of such components within home-care and remote monitoring systems.

Later FP5 projects target more integrated complex systems rather than isolated sensors, actuators or microsystems. They address technical challenges relating to the merging of multidisciplinary technologies, system integration aspects, control techniques, connectivity and interface specificities.

As an example of this approach, SALIWELL is developing a dental implant to correct for insufficient saliva production. The work integrates micro-sensors and micro-actuators with software, interactive interfaces and builds on a wide range of disciplines. TUBA is trying to develop implantable medical devices to assist patients with a "drop foot" syndrome. The device combines a micro-fabricated inertial system, a planar RF transmitter/receiver and a micro-sensor to determine the relative position of the receiver form. IVP is creating probes with advanced performance at reasonable prices. The devices will integrate illumination, optics, tilting and movement, realised as disposable visual capsules for gastroenterological examinations.

Microsystems will be an essential ingredient of ambient intelligence in healthcare settings, since the underlying micro- (and increasingly nano-) technology, when integrated into wearable or implantable systems, will be a key tool for monitoring and managing health status. In FP6, research for basic component technology for micro- and nano-systems will aim at improving the cost-efficiency, performance and functionality of such devices, so increasing their level of integration with ambient and networked services. Key themes will be miniaturisation and integration of a wide range of functions.

Smart fabrics for wearable health management

One of the major drawbacks of current portable health monitoring systems is the lack of comfort. Progress in textile engineering and microtechnologies offer opportunities for completely new and comfortable applications for health and healthcare.

WEALTHY is developing a "wearable" interface, by integrating smart sensors (in the form of fibre and yarn), advanced signal processing techniques and modern telecommunication systems, on a textile platform. One of the objectives is to ensure a high degree of freedom and let the user perform his/her normal activities. This "smart biomedical cloth" will have a wide range of uses. For instance, it could monitor the users during everyday tasks and physical exercise. It could also trigger alerts and warnings in emergency situations, as well as automatically transmit physiological or clinical parameters back to doctors.

Strategic Objectives: *Ehealth*
Micro and nano systems

Project References:			
	BIOMIC	*IST-2000-28214*	
	IVP	*IST-2001-35169*	*ivp.ims-chips.de*
	MICROBIOL	*IST-2001-33011*	
	PAMELA	*IST-1999-13478*	*www.imec.be/PAMELA*
	SALLIWELL	*IST-2001-37409*	
	SAMBA	*IST-2000-29685*	
	TUBA	*IST-2001-32750*	
	WEALTHY	*IST-2001-37778*	*www.wealthy-ist.com*
	WUNSENS	*IST-2001-52058*	*www.wunsens.info*

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Web: *www.cordis.lu/ist/so/ehealth/home.html*
www.cordis.lu/ist/so/micro-nano/home.html

Networked homes

The increasing array of digital communication devices in our homes calls for new networked solutions for media storage, searching and retrieval. In future, access to such information will extend beyond the home, as households become linked together into mini-broadcasting networks.

Today, the average home is equipped with an increasing number of highly sophisticated devices. Once a humble means for voice communication, mobile phones now allow access to a whole range of information and multimedia. PDAs are appearing on the market with sufficiently high quality screens and large memories to display DVD films. Hi-fi equipment supports the retrieval and storage of streamed audio directly off the internet. Digital photography and digital video are booming. And, not to be forgotten in the corner, the PC continues to deliver ever more processing power and storage capacity at an ever lower (or at least constant) price. Our homes are becoming our own personal world of communications.

This proliferation of digital technologies brings exciting new opportunities, but also new problems. One key issue is storage. Before long the average home will have to deal with many gigabytes of information – photos, home videos, music etc. We need to be able to store and manage digital media reliably. A second issue is retrieval. Having created photos on a digital camera, we may wish to move them to a PC for editing or to a widescreen digital TV to show our friends. We may even wish to give our friends access to our home network so they can view the images remotely from their own home. This last scenario raises a further prospect: how to link individual home networks together into distribution networks that respect the rights of the content owners.

In FP6, research into home platforms is addressed in the context of the general shift towards networked audio-visual systems and services. The focus is two-fold. Firstly, user-friendly home network solutions that allow information to be moved, organised and retrieved within a heterogeneous home environment. Secondly, extended home AV platforms that allow the sharing of digital AV content between homes (or home-offices). Key areas of interest are home server portals, home AV portals, and interoperability between home networking technologies and their integration with global networks. The target is for low-cost and user-friendly home AV platforms that can be reconfigured to the users' requirements.

Significant contributions in this area have been made by projects launched under the FP5 action lines on home environments and end-to-end user services. For instance, myTV developed the world's first prototype of a personal video recorder (PVR) system based on TV-Anytime open standards. Open standards, as being developed by the TV-Anytime forum, are essential for a strong evolution of this new business. SHARE-IT! envisages the networking of PVRs as a new content distribution model to complement and enhance traditional broadcasting (see box).

The introduction of IPv6 and mobile IP into wireless home networks is being addressed under FUTURE HOME. It aims to produce a communications platform capable of automatically configuring connections between different devices and terminals to provide ubiquitous access throughout the home. With a strong

Content sharing in home-to-home networks

Personal video recorders (PVRs) with local storage will revolutionise the way people watch television, making broadcast times and schedules irrelevant. The SHARE-IT! system aims to utilise the broadband infrastructure and recent developments in peer-to-peer networking mechanisms to organise a network of PVRs into a distributed content repository in which both broadcast and user-generated content can be stored and accessed.

If a programme has been pre-stored in the network the user will be able to access it even if he missed the original broadcast. He would also be able to connect to the system remotely to view and manipulate stored content. Or he could grant another user access to a limited set of his own content on the SHARE IT! system, possibly in another home. Personalised virtual channels could be created, mixing broadcast content stored locally and on networks, and groups of users could share content based on their interests.

Browsing photos stored on a home network on a PDA (Photo: SPATION project)

emphasis on usability, the system will interface with both high-speed media traffic (audio, video etc.) and low-speed control and automation flow (i.e. interconnections between various home appliances). Open and scalable "base stations" for home networks and generic device interfaces are being developed. Detailed usage scenarios are also being researched based on families' real life living patterns.

Browsing from the couch

Your photographs, music and videos are stored in several devices in the house, yet to find what you are looking for you don't even need to get up from the couch. Using wireless communication your handheld queries the home system to search for your content: videos, photographs, MP3s – whatever. Powerful content analysis algorithms quickly find the right media without having to scroll through hundreds of results. When content is found you can store it in the handheld to take away or direct it to any display in the house to enjoy together.

This is the scenario envisaged by SPATION, an IST project concerned with the storage and retrieval of information in the home. It is creating a distributed storage space by interconnecting consumer electronics devices and developing methods to analyse content to support searching. Meta-data is used to organise a distributed home storage environment in a way that is transparent to the user. Uses include moving content from one device to another, transferring to friends, making a play-list for a portable device, and controlling devices in the home providing new ways of interaction.

Strategic Objectives:	*Networked audiovisual systems and home platforms*		
Project References:	*FUTURE HOME*	*IST-2000-28133*	*future-home.org/fh/public/*
	myTV	*IST-1999-11702*	*www.extra.research.philips.com/euprojects/mytv/*
	SHARE-IT!	*IST-2000-28703*	*www.extra.research.philips.com/euprojects/share_it*
	SPATION	*IST-2000-28304*	*www.extra.research.philips.com/euprojects/spation/*
Commission Contacts:	*Carlos Morais-Pires carlos.morais.pires@cec.eu.int*		
Web:	*www.cordis.lu/ist/so/audiovisual/home.html*		
	www.cordis.lu/ist/directorate_d/audiovisual/index.htm		

When technology disappears

The Disappearing Computing initiative is laying out the design and engineering foundations that will underpin the development of future forms of ambient computing.

Despite major advances in software and hardware, personal computers remain difficult to set-up and use – a real deterrent to an "information society for all". A new generation of smart objects ("artefacts") is emerging that will make IST quicker and easier to use and less costly. The Disappearing Computer II (DC-2) initiative, part of IST's Future and Emerging Technologies (FET) action, anticipates just such a world. Researchers are looking at how IT can be diffused into everyday objects ("artefacts") and how interactions between these smart artefacts can be used to support and enhance our everyday lives.

DC-2 is the second phase of an FET proactive initiative first launched in 1999. So far, research projects have explored how to develop new smart artefacts and how to design and embed them into everyday objects. They have also researched how small collections of such artefacts may act together so as to produce new functions. Now, a number of new ideas are emerging about how to "glue" together a large number of smart artefacts into bigger networked systems, making it possible to design and develop interactive technology environments well adapted to people and their activities.

While the overall mission of DC-2 remains the same, its focus is now re-oriented towards the design and development of open system architectures for interconnecting an unbounded set of such smart artefacts, i.e. any number from tens up to several thousands. These may be of many types and forms – embedded in everyday objects such as clothes, pens, papers, tables or standalone mobile devices and entities. Collections of such artefacts are expected to give rise to new, people-centred and trusted environments that provide new functionalities, applications and interactive behaviours that are neither pre-defined nor foreseeable. Thus work under the DC-2 initiative is very closely linked to the IST Priority's long-term vision of "ambient intelligence".

Realising these new computing, networking and interaction environments requires challenging research that goes far beyond what is possible with today's PC-world and advanced mobile network architectures. For instance, we require new domains to support the design of people-centred environments and the concept of "the real world is the interface". We also need open and scalable architectures for interconnecting such artefacts, a new generation of tiny operating systems and middleware, and new lightweight distributed networking protocols and technologies.

A practical realisation must also represent the confluence of what people want and what future technology can offer. Thus, as well as technological research, DC-2 projects will also study people's behaviours, conceive realistic scenarios of everyday use and implement research prototypes, where the architectures are evaluated against scenarios applied in a diversity of real-world settings.

Strategic Objectives: *Future & emerging technologies: the disappearing computer*

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www.disappearing-computer.net

Independence at home

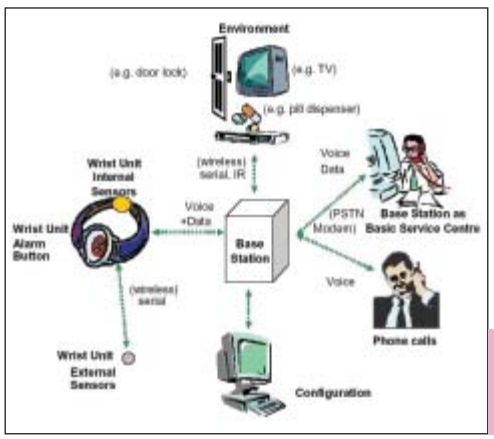
Information and communication technologies in the home promise a more independent lifestyle for people with disabilities.

Before long, home automation systems will bring ambient intelligence into the heart of domestic life. Microprocessors in home and office devices will enable them to communicate with each other and with the wider world through the internet. Everything from our PC, TV and VCR to lighting, heating, air conditioning, ovens, washing machines, answering machines and security alarms will be capable of remote monitoring and control. As well as supporting modern citizens' busy lifestyles, the ICT-enabled home of the future may prove a key to a fuller life, and even a lifesaver for those who are disabled, elderly or unwell.

Several FP5 projects have already addressed the home as a care environment, developing platforms, frameworks and methodologies. They provide a sound foundation for further work in FP6, where home environments remains a key feature of the strategic objectives on eHealth and eInclusion. Research for eInclusion targets intelligent systems to empower older persons and people with disabilities. It will concentrate on an integrated approach to intelligent housing that takes notice of the residents' requirements and preferences.

Intelligent housing environments depend on more than basic devices or isolated computing platforms. They require a holistic integration of sensors with networks, data, work organisation and human interfaces, all respecting the householders' rights to independence, privacy and choice of who will share data about them. Recent projects reflect this approach.

For instance, CONFIDENT targeted home support for persons with severe disabilities to enable them to access personal, social and operational assistance. Its intelligent control unit monitors sensors and wearable devices and communicates the results to remote care and support organisations via broadband networks (UMTS, cable). DOC@HOME has addressed the home care of persons with chronic diseases. Interactive monitoring enables the patient to regulate his or her own condition, yet alerting medical people of critical conditions. And TELECARE is developing a system for remote home supervision of the elderly based on agent technology.



Schematic of the wrist-worn alarm device developed under the SILC project

Time for an independent life

Increasing numbers of older people live in single-person households, and means have to be found to ensure personal safety and support their daily living. SILC is developing an innovative wrist-worn alarm device that offers more than the traditional "red button" facility. It incorporates biometric sensors that trigger an alarm call via a telecommunication link when critical conditions of the user are detected. To encourage permanent use, added-value features are being provided, such as PDA functionality, a cordless phone and home environmental control.

Strategic Objectives:	*eInclusion*		
Project References:	*CONFIDENT*	*IST-2000-27600*	*http://212.73.32.174/Fundacion/Confident*
	DOC@HOME	*IST-2000-25363*	*www.curonia.com/eur/Project%20Web%20Site.htm*
	SILC	*IST-2000-27524*	*www.fortec.tuwien.ac.at/silc.html*
	TELECARE	*IST-2000-27607*	*www.uninova.pt/~telecare*
Commission Contacts:	*Per Blixt*	*per.blixt@cec.eu.int*	
	Manuel Monteiro	*manuel.monteiro@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/einclusion/home.html*		
	www.cordis.lu/ist/so/ehealth/home.html		

Learning for life

New technology promises more efficient, individualised lifelong learning processes, at the same time empowering a widening spectrum of European citizens.

As we adapt to rapid changes in society and the world of work, and portfolio careers become the norm, we all recognise the need for lifelong learning. Employees are moving in and out of work and between working tasks in a world where skills, disciplines and jobs mutate rapidly. As individuals take greater responsibility for their own personal development, they need to access work- and lifestyle-related learning opportunities throughout their lives. People are looking to learn where, when and how they need – at the office, in the factory, with friends, in the café, on the road. Such learning should be self-determined, tailored and personalised to their needs. Thus, we have to think in terms of flexible individual learning solutions available ubiquitously and with complete mobility.

Information and communications technologies (ICT) allow us to completely refashion the paradigms of learning. On the one hand, this will improve the cost-efficiency and effectiveness of learning, for individuals and organisations, independent of time, place and pace. On the other hand, it also makes it possible to extend learning to those who may be marginalised by traditional methods, for example the socially disadvantaged, the isolated, the homebound and those with disabilities and impairments. All of this implies ongoing and far-reaching research on technology, devices, human interfaces, communication standards, pedagogical models, information management and educational meta-data representations that enable users to customise their own learning programmes, whether independently, in groups or by working with mentors in blended learning approaches.

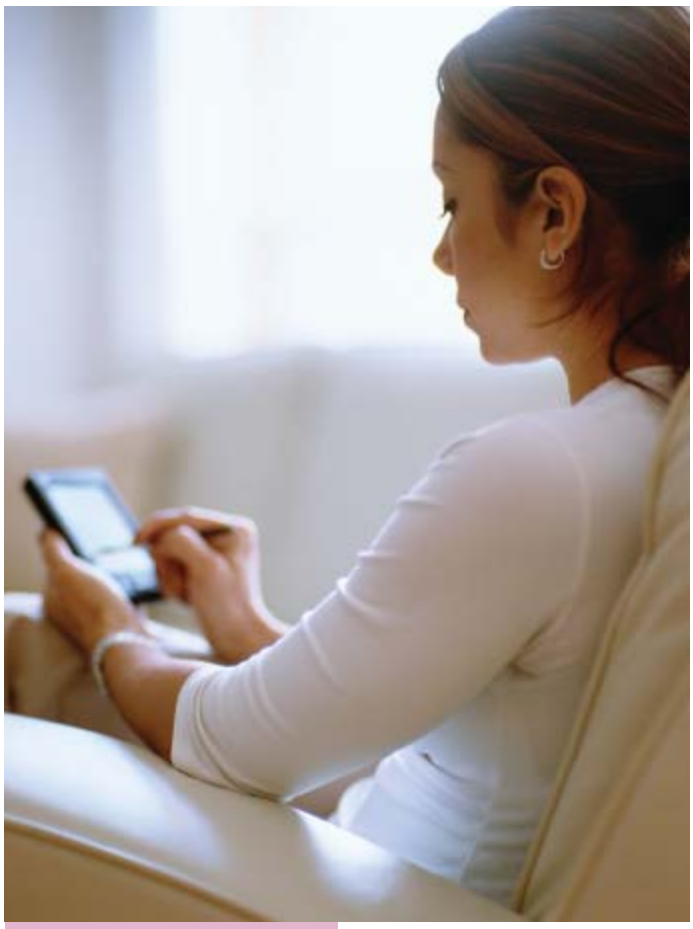
At policy level, building on earlier RTD results, actions under the eEurope 2005 Action Plan also reflect this trend towards unconstrained, independent learning. For instance, the concept of "virtual campuses" born and developed in the two previous framework programmes is now broadly promoted to ensure that all students and researchers have online access whenever and wherever they are. eEurope also aims to exploit the opportunities of e-learning to reskill workers for the knowledge society. A wide ranging agenda on supporting the use of technology for learning will be further promoted under the forthcoming eLearning Programme, 2004-2006.

From an RTD perspective, early explorations are being made by FP5 projects in the sector Technology Enhanced Learning. For instance, projects funded under the action lines Self-Learning for Work and The Learning Citizen put strong emphasis on flexible, adaptive and individualised learning. The overall goal is to investigate how ICT is able to support individuals throughout their lives through self-directed and personal, work-enabling learning services and resources that are flexibly delivered. A particular emphasis is given to the development of social skills.

KNOWLABORATION investigates the self-learning process and explores the in depth factors that either inhibit or enable this process. It aims to establish an inter-organisational collaborative environment which will offer individual employees access to the knowledge captured or generated within a learning network. The resulting Learning Management System will be a fully personalised environment that accommodates individual learning styles and incorporates dynamic,

Learning in the real world

M-LEARNING aims to attract young adults to learning, focussing in particular on disadvantaged groups. These are characterised by low literacy, aversion to conventional education and training programmes and "IT poverty" resulting from inequality of opportunity in the digital divide. It proposes short learning experiences using learning games, micro-portals, voice technology and tutor system guides. Research into the motivation, preferences and behaviour of young adults currently using mobile phones and handheld electronic games will assist in the design of products likely to be attractive to them. Test applications will involve a series of quick learning experiences designed to help with literacy and numeracy skills. Trials of more substantial learning experiences will be hosted in internet cafés or local online learning centres, while future access may be also via digital television.



Technology offers people more flexible ways of learning

online support and assessment tools. It will support the interaction between the individuals involved in terms of knowledge sharing and decision making.

aLFanet focuses on the continuous training needs of corporate firms. It is developing an interactive, adaptive and personalised e-learning system featuring agent technology that will provide staff with the opportunity to learn and experiment on work-related matters. At the same time the employees' organisations can control and efficiently manage intellectual capital, promoting the evolution of employees in specialised and multidisciplinary areas of work.

Recent developments in the field of wireless communications and satellite systems have created new possibilities for technology users. By using these technologies in conjunction with laptop computers a new learning paradigm – mobile learning – is emerging. How can people access knowledge effectively using mobile devices? MOBILEARN aims to find out through a series of trials. The first targets the world of work (giving managers online access to MBA course databases via mobile networks); the second targets museums and galleries in Florence (where visitors provided with mobile devices have access to context-sensitive information about the objects on display); and the third trial, European Resuscitation, provides non-specialists with access to basic medical knowledge.

This goal of utilising technology to support individualised lifelong learning processes is a key theme in IST for learning under FP6. Research aims towards the development of open systems and services in support of ubiquitous, experiential and contextualised learning and virtual learning communities. The work will take account of pedagogical and organisational aspects in relation to new technologies, and demonstrate next-generation learning solutions in sizable field experiments. Further projects will be launched end of 2003 following a strong response to the 1st Call.

Strategic Objectives:	*Technology-enhanced learning and access to cultural heritage*		
Project References:	*aLFanet*	*IST-2001-33288*	*www.rtd.softwareag.es/alfanet*
	KNOWLABORATION	*IST-2001-32505*	*www.knowlaboration.net*
	M-LEARNING	*IST-2000-25270*	*www.m-learning.org*
	MOBILEARN	*IST-2001-37187*	*www.mobilearn.org*
Commission Contacts:	*Alma Cardi*	*alma.cardi@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/learncult/home.html*		
	www.cordis.lu/ist/directorate_e/telearn/index.htm		

Wireless gets personal

Future generations of mobile and wireless communications will be user-centric, enabling us to access personalised services anywhere, anytime. Research targets the technological breakthroughs necessary to realise this general access network.

Future wireless systems will be user-centred

Digital mobile communications is one of the great success stories of recent years, offering people levels of mobility and services never available before. The deployment of true broadband mobile technology, known as Universal Mobile Telecommunications System (UMTS), offers the next window of opportunity for growth of mobile services. Despite very difficult market conditions, the first of these so-called third generation (3G) networks are now starting commercial services in the EU. Like GSM before it, the groundwork for UMTS owes much to the EU's strategic policy decisions articulated with Community RTD programmes, which enabled early Europe-wide consensus.

This is not the end of the road for mobile, however. While 3G systems will inevitably take time to reach their full potential, research attention is turning to the longer term, paving the way for systems in a 2010 timeframe and beyond. Already it is apparent that the jump to the next generation of mobile communications technology will be very different to the transitions of the past. Future systems will not just be about higher data rates ("UMTS Phase 2") or public networks. Nor should they be technology driven – just another way to sell new terminals. Rather, they must put user needs centre stage – seamlessly integrating the many different communication systems we see emerging today so as to deliver personalised enhanced services to users.

Personal wireless networks

Short-range wireless technology will play a key role in scenarios where people are connected "anywhere, anytime" by different types of communication links. Several IST projects are investigating the potential of ultra-wideband (UWB) radio technology.

UCAN will provide a generic platform for a self-organising wireless personal area network containing high accuracy in-door positioning functionality. All aspects of a functioning UWB system are being investigated, including the air channel characterisation, coexistence issues, and the communication system. Ad-hoc networking and positioning aspects will be demonstrated as a potential component of the future communication infrastructure.

PACWOMAN is looking at the long-term requirements for scalable, secure, low-power terminals operable with personal, community and wide area networks. These terminals need to be scalable in terms of data rate (100 bps to megabits), cost (throwaway to premium value) and functionality. They will exploit novel modulation techniques, be operable for about six months between battery charges, and discover their current radio and service environment.

Wireless broadband connectivity solutions for interconnecting home entertainment devices are targeted by ULTRAWAVES. The system will support high-quality, high data-rate transfers between devices such as DVDs, HDTV, PDAs, MP3 players and digital camcorders and cameras without using cables.

Early preparatory work, under FP5 and elsewhere, has characterised "systems beyond 3G" as a horizontal communications model, where different terrestrial as well as satellite access networks and technologies are combined to complement each other in an optimum way catering for different services requirements and operational conditions. They may include the personal level (personal, body area/ad hoc networks), the local/home level (W-LAN, UWB), the cellular level (GPRS, UMTS), and the wider area level (DxB-T, BWA). The resulting access landscape is complemented by a satellite overlay network, providing notably a global multicast layer (e.g. S-DMB).

The main challenges in 3G research and development were to develop a new high-bandwidth air interface, as well as advanced radio access network concepts. The next steps in wireless will relate primarily to solving interoperability issues across multiple networks and a variety of "connected devices". In this context, managing service complexity becomes the main issue. We will need to find solutions where a multitude of terminals and devices are endowed with wireless communication abilities. We will need to overlay many independent but interoperable networks. And we will need to accommodate a wide range of requirements on data rate, quality of service, security, availability and price according to users' expectations.

Building blocks for this interconnected world are already apparent. Standardisation has acted as a catalyst for wireless up to now, but as the pace of innovation quickens a common technological denominator becomes harder to find. Reconfigurability will be a key enabler to support such a heterogeneous and generalised wireless access providing a solution to the proliferation of new standards. Full implementation of IPv6, the new internet protocol, will also be essential to realise sufficient address space across all the different access levels. The continuous increase of mobile service penetration imposes a growing demand for spectrum. A new approach to spectrum management is needed since the efficient use of the available spectrum resources is becoming a key issue.

IST's research on mobile and wireless systems follows this user-centric approach and aims to realise the vision of "optimally connected anywhere, anytime". Building on substantial results under FP5 action lines, RTD is placed in a system context and addresses the technological breakthroughs necessary to evolve towards a general access network.

The flying office

Imagine you are flying in an aircraft – your secretary calls on your mobile to tell you that the boss changed your presentation. You switch on your laptop, connect wirelessly to your company intranet, and download the file. An illusion? Not according to WIRELESS CABIN. The project is developing wireless radio access for passengers in aircraft cabins via a satellite bearer. The technology will support UMTS mobile phones, W-LAN and Bluetooth interfaces and will be demonstrated in a long-haul Airbus A340-600 aircraft.

Strategic Objectives:	*Mobile and wireless systems beyond 3G*		
Project References:	*PACWOMAN*	*IST-2001-34157*	*www.imec.be/pacwoman/*
	UCAN	*IST-2001-32710*	*www.ucan.biz*
	ULTRAWAVES	*IST-2001-35189*	*www.ultrawaves.org*
	WIRELESS CABIN	*IST-2001-37466*	*www.wirelesscabin.com*
Commission Contacts:	*Bartolomé Arroyo-Fernandez*		*bartolome.arroyo-fernandez@cec.eu.int*
	Jorge Pereira		*jorge.pereira@cec.eu.int*
Web:	*www.cordis.lu/ist/so/mobile-wireless/home.html*		
	www.cordis.lu/ist/directorate_d/cnt/index.htm		

Participation for all

The digital divide that excludes many European citizens from full participation in the information society can be relieved if we practice design for accessibility in new products and services. RTD is promoting this approach as part of a comprehensive policy mix.

Today, new technologies bring many possibilities to enhance our quality of life. Nevertheless, many European citizens face barriers to full participation in the information society, for example elderly people and people with disabilities, and demographic trends suggest increasing numbers may face discrimination as the digital age progresses. If we are to realise the goal of a knowledge-based society for all, we have to make new technologies and systems accessible to all, and to apply technology to the task of genuinely empowering citizens to play a full role in society.

A wide range of specialised assistive technologies and equipment have been developed, often by SMEs, that help compensate for human functional limitations and give people with disabilities relative independence. European RTD has played a pivotal role in the development of the field over the last ten years, starting with the TIDE initiative. Through these programmes, researchers have demonstrated how ICT can be used to compensate for lack of sensory, motor or cognitive functions and to augment and enhance human abilities. They have also looked at how mainstream technologies can be made accessible to people with disabilities to facilitate independent living, using a so-called "design-for-all" approach (see box).

While there have been some notable successes, this work has taught us very clearly that "add-on" assistive support systems are only part of the solution. Many people, not just those with physical impairments, find difficulties in accessing and using modern ICT systems and risk exclusion from their benefits as a result. These include those that may be excluded through economic, geographic, educational and linguistic factors. Thus, the term "eAccessibility" is used to refer to the access which new ICTs can provide to people – both to the real world and to the growing digital world. eAccessibility implies a need for new technologies and systems themselves to be accessible – especially to disadvantaged groups – and a need to develop specific technologies to allow people with disabilities to participate actively in society.

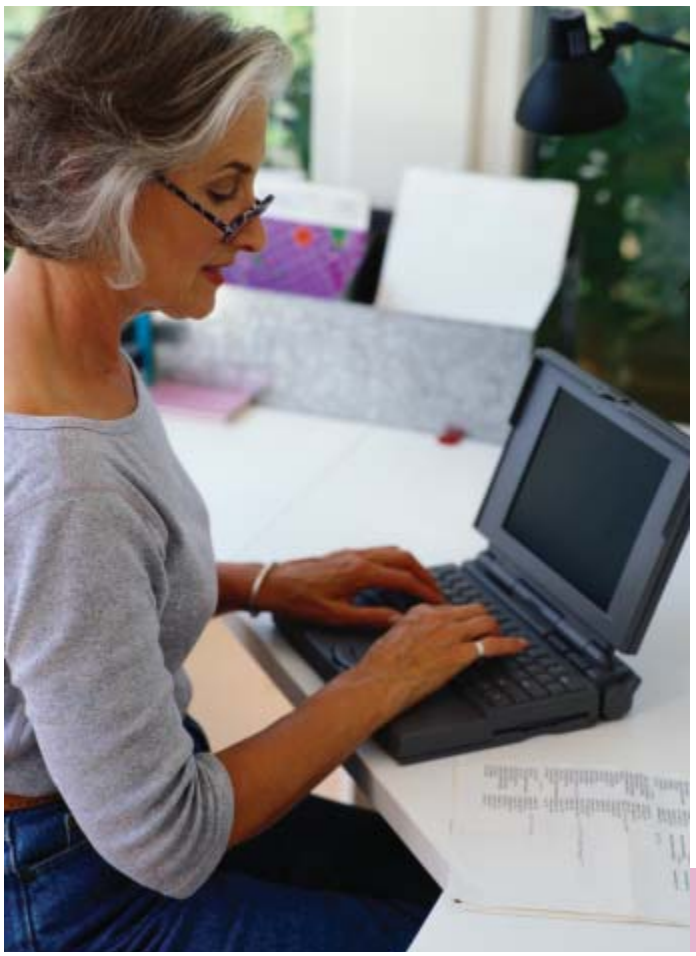
Research and technological development is now part of a comprehensive EU policy mix on eInclusion and eAccessibility issues. The eEurope 2005 Action Plan targets eInclusion to enhance skills, open opportunities and improve participation as an engine of productivity and growth. It is viewed as a horizontal building block that cuts across all areas of the action plan. The accessibility of terminals and other aspects of telecoms services are addressed in the directives establishing the EU's new telecoms policy. An eAccessibility Expert Group has been set up to build links between Member States, identify the challenges and opportunities, lay down policy guidelines and objectives, and steer relevant research. The Commission is also actively supporting the World Wide Web Consortium's (W3C) Web Accessibility Initiative (WAI), notably through the FP5 support measure WAI-DA.

Distinct standards for smartcards

A number of standards already exist for smartcards, including standards relating to access to smartcard systems by people with disabilities, but these were developed for dedicated systems and are not sufficiently specified to suit open interoperable environments. A new CEN Workshop Agreement (CWA) enables compliance with these existing smartcard standards to be extended to open solutions.

The CWA includes the specification of data necessary to enable smartcard handling systems to respond in a consistent manner to the user as well as supporting specific user preferences and requirements. By adopting the CWA, procuring bodies can move to more flexible business models. Cardholders benefit by being able to use more terminals to access the services they use, and by the opportunity of having every terminal respond in a common way to their individual needs.

The CWA is based on work carried out in the FP4 project DISTINCT, which developed DISTINCT ID as a tool to enable the interoperability of smartcards within and across multi-national sites.



IST can open up access for all

In FP6, relevant IST issues are taken up in the strategic objective on eInclusion. The research aims to promote eInclusion as a horizontal building block in the information society and is conducted in association with two other Priorities: "Citizens and Governance in a Knowledge Society" and "Support to EU Policies". It will develop intelligent systems to empower disabled and aging citizens to play a full and independent role in society. IST research priorities will focus on the integration of advanced interfaces, low-cost sensors and robotics in assistive devices, on information modelling and web semantics, and the development of intelligent housing for persons with special needs. Networks will be fostered between research teams, so strengthening research in the twin domains of assistive technologies and of mainstream design-for-all products and services.

Beneficial design for all

The traditional approach to enhancing accessibility through building specialised equipment and interfaces fails in a world with a rapid pace of technological development and multi-component products. On the other hand, the design-for-all (or universal design) approach brings great benefits to ICT systems, usually at little extra cost.

DASDA recognised that system designers had little awareness of design-for-all concepts. Accordingly, it identified and contacted developers, producers, procurers and marketing people to ensure that they understood that accessibility should not be an add-on but an early specification requirement. Drawing content and best practices from other FP5 IST projects, DASDA generated a range of educational and training materials and helped disseminate projects' results.

Strategic Objectives:	*eInclusion*		
Project References:	*DASDA*	*IST-1999-14166*	
	WAI-DA	*IST-1999-13470*	*www.w3.org/WAI/WAIDA*
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Web:	*www.cordis.lu/ist/so/einclusion/home.html*		

My computer, my friend

To get the most out of information systems they need to be easier and more intuitive to use. Interfaces that rely on a full range of interactions will make future applications more user friendly, and so help make ambient intelligence a reality.

Despite the efforts of designers and engineers over many years, most people still find ICT applications, devices and services complex. As users, either we waste time in trying to get the service or device to function as intended or, more likely, we give up altogether. Only the most enthusiastic or technically-aware are prepared to invest the time and effort into getting the most out of the system. We still have a long way to go to make applications truly "user friendly".

It is now widely agreed that future systems will have to take user behaviour into account, based on awareness of how people communicate and interact, and what they want to do and achieve. We need to design systems that are easier and more intuitive to use. As well as the usual keyboard, this means an ability to recognise and respond to actions such as touch, pointing, speech, gesture and expression. In a multilingual world, the ability to access information and services in different languages is also a key concern. These so-called multimodal interfaces offer the prospect of making machines, systems and services much more productive.

In FP5 the IST Programme launched a portfolio of around 50 projects concerned with natural and multi-modal communication across a wide range of scenarios. The research aimed to enhance the naturalness of human-computer interactions and the effectiveness of interpersonal communications. Areas covered included multilingual input-output with speech, language, multi-modal interaction and technology-mediated communication between people. Key issues were the performance, reliability and scalability of embedded speech and language technologies for applications in the home, e-work and on the move.

For instance, the M4 project will demonstrate a smart meeting room, equipped with multimodal sensors, that should provide better structure to the way in which meetings are run and documented (see box). FAME targets new tools for human-human communication integrating speech, vision and dialogue. An "information butler" will facilitate communication between people at separate locations and from different cultures, working on solving a common problem. This agent will be context-aware and able to blend information from both electronic and physical channels. The result will be a demonstration of integrated computer-enhanced human-to-human communication, with a public demonstration planned for the Barcelona Cultural Fair in 2004.

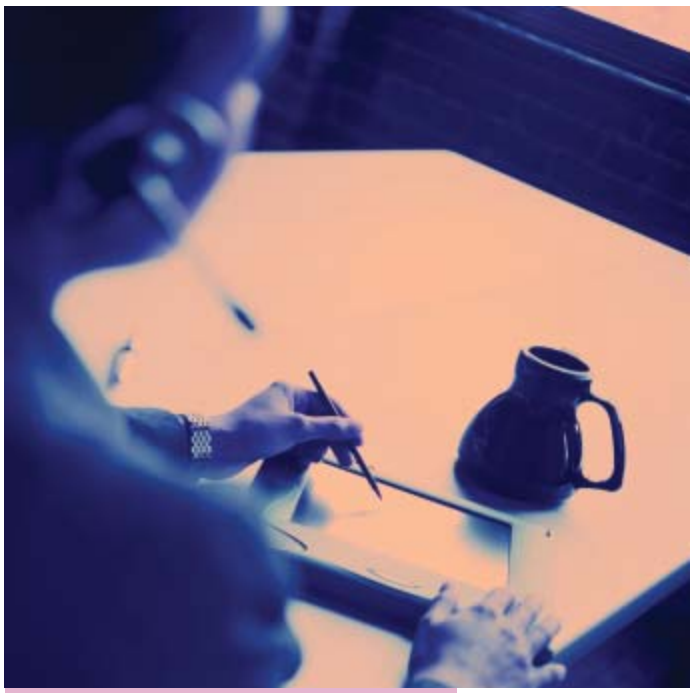
In the area of multilingual communication, ALERT has developed an automated system for monitoring media sources (e.g. newspapers, newswire, radio, television, internet) in three languages – French, German and Portuguese. Users are alerted when the system finds a match for an item fitting their profile. Also, NESPOLE! has demonstrated automatic speech-to-speech translation in e-commerce and e-service environments.

Research in FP6 targets the development of natural and adaptive multimodal interfaces that respond intelligently

Multi-modal meetings

Meetings, meetings – we all have too many of them! And once they are over there is nothing to show except pieces of paper. The M4 project aims to remedy this by providing better structure to the way meetings are run and documented. A smart meeting room, equipped with multimodal sensors will enable the collection and annotation of a multi-modal meetings database.

For each meeting, audio, video and textual information are recorded together with interactions within the meeting itself, for example mouse tracking from a PC-based presentation or laser pointing information. Audio information comes from close talking and distant microphones, as well as binaural recordings. Video information comes from multiple cameras. All of these different streams are available to be structured, browsed and queried within an easily accessible archive.



Multi-modal approaches will help make IST applications more user-friendly

to speech and language, vision, gesture, haptics and other senses. The focus is on interaction between and among humans and the virtual and physical environment, through intuitive multi-modal interfaces that are autonomous and capable of learning and adapting to the user environment. Work will span from basic research in areas such as machine learning and accurate vision and gesture tracking, to system level integration. Proof-of-concept will be demonstrated in challenging application domains, such as wearable interfaces and smart clothes, intelligent rooms and interfaces for collaborative working tools, and cross-cultural communications.

Following a good response in the 1st Call, three IPs and four NoEs are expected to be launched within these priority areas, together with a series of STREPs to bootstrap research in emerging research domains.

Talk to my agent!

NECA is one of the first attempts at introducing expressive capabilities in internet applications through the deployment of 'emotional agents'. The project is developing a virtual space populated by affective conversational agents. The agents are able to express themselves through emotional speech and non-verbal expression, so as to convey meaning.

The agents' usefulness is being evaluated in two online applications. The Socialite scenario provides a virtual meeting venue for internet users. Users choose among a set of available agents, instruct them about their personal preferences and send them into the virtual world to make contact with other agents. The eShowroom scenario is a prototype of a new showroom for online shopping. Visitors to the showroom receive product information by watching two or three agents discuss the product using customised descriptions. Demonstrators of both scenarios are available at the project website.

Strategic Objectives: *Multimodal interfaces*

Project References:

ALERT	*IST-1999-10354*	*alert.uni-duisburg.de/start.html*
FAME	*IST-2000-28323*	*www.fame-project.org*
M4	*IST-2001-34485*	*www.dcs.shef.ac.uk/spandh/projects/m4/*
NECA	*IST-2000-28580*	*www.ai.univie.ac.at/NECA/*
NESPOLE!	*IST-1999-11562*	*nespole.itc.it*

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www.cordis.lu/ist/directorate_e/ic.htm

A mixed up world

Whilst most people nowadays are familiar with the concept of virtual reality, this is only one end of a spectrum of real-virtual experiences. IST's research on rich-media environments is leading the way to new high-sensory interactive applications.

In modern systems the frontier between the real and the virtual is increasingly blurred. Animated computer graphics are being mixed and integrated with high resolution real world images to create new sensory environments. This "mixed reality" (MR) can be thought of as a continuum. At one end is virtual reality where the application environment is modelled in detail to bring to life a virtual world. At the other end is augmented reality, where the emphasis is on enhancing real world environments through virtual interfaces. In between there is scope for all sorts of real-virtual combinations.

Drawing on developments in computer vision, computer graphics and advanced audio-visual representation and coding techniques, MR will lead to a new generation of visual interfaces that will help move IST beyond the desktop. As well as visualising real world objects, future MR applications will enable users to interact with them to enjoy a rich sensory experience. Potential applications include new reality environments for education and tourism, new solutions for workplace design and training, and complex problem-solving in science and engineering.

IST has a portfolio of around 20 FP5 projects covering mixed reality and advanced imaging. They address augmented reality, new technology for rich, mixed-media content creation, and advanced interaction mechanisms. A considerable number of publications from these projects have been submitted to international journals and conferences, and several public demonstrations have been organised at major conferences. Project results have often been incorporated into existing or new products and in some cases participating companies have formed commercial partnerships or created new start-ups to exploit results. All projects are monitoring and contributing to standardisation groups such as Web3D, IETF and MPEG.

Among the later FP5 projects, LIFEPLUS is looking into new immersive environments which recreate ancient frescos and historical scenes. Visitors to a historical site are tracked and presented with audio-visual information through a see-through head-mounted-display, to help them put their exploration in context. The work focuses on key technologies to render lively animations and simulations in real-time. Also focusing on cultural heritage, ARTNOUVEAU is defining roadmaps for future research in new user-centred approaches for experiencing arts and culture.

AMIRE targets the efficient creation and modification of MR applications. Using a component-based approach, authoring tools are being developed that will enable users to build and exploit MR applications more easily. Physically correct simulation and real-time visualisation of objects with complex reflective properties is being investigated in REALREFLECT. Its research will contribute to improving the realism of computer graphics, especially for applications where look and feel are important such as interior design.

Given their significance as an enabler for IST applications, rich-media technologies continue to be supported under the Sixth Framework Programme. The work focuses on environments

Eye-to-eye meetings

Current videoconferencing systems lack the interactivity experienced in face-to-face meetings. VIRTUE has developed a new generation of videoconferencing based on tele-immersion – a technology for creating 3D real-time images that are so realistic they can fool our senses into thinking our fellow speakers are in the same room.

The VIRTUE system consists of a desk with a large plasma display and four cameras mounted around it. The speaker sits in front of the screen and can conference with up to two other people at the same time. Images from the cameras are combined through an image-processing software system to appear as if they were coming from virtual cameras placed behind the screens. This placement means people can look straight into the screens to find what seems to them to be eye contact.

The virtual meeting environment developed under project VIRTUE

that enable people to access and interact with hybrid 3D multimedia signals and objects in a wide range of application domains. Such approaches should include means to represent, identify, locate and describe rich media objects and preserve users' security and choice. Research draws on RTD in related fields such as sensors and displays, computer vision, audio-visual data manipulation and storage. New projects from the 1st Call will be launched in late 2003.

ARTHUR's virtual roundtable

Monday morning, 9 am, Architect's Office: The two architects have activated the ARTHUR system, a small black box in the middle of the table. The structural engineer approaches the holographic simulation floating inches above the table and waves his right hand. Immediately, the virtual display zooms in on the building being developed. Another wave of the hand activates the virtual system menu. He deactivates the layer containing the outer skin of the building and the bearing structure, a system of columns and beams made of reinforced concrete, becomes visible.

A simulation of detailed structural stress within the bearing structure commences automatically. The columns on the ground floor, which naturally bear the largest part of the total load, light up in a very dark red, showing that the strain is way past the legally permitted level. Moreover, the central column actually snaps under the total weight, further straining the remaining columns. The engineer activates the virtual menu. Two additional columns appear and once again, the stress simulation commences. This time, all the columns light up green.

Slipping the black box into his pocket, he leaves the office and heads for the building site to show the changes to the craftsmen on location using the ARTHUR system.

Strategic Objectives: *Networked audiovisual systems and home platforms*

Project References:

AMIRE	*IST-2001-34024*	*www.amire.net/index.html*
ARTHUR	*IST-2000-28559*	*www.fit.fraunhofer.de/projekte/arthur/index_en.xml*
Art.live	*IST-1999-10942*	*www.tele.ucl.ac.be/projects/art.live/*
ARTNOUVEAU	*IST-2001-37863*	*www.artnouveau-net.org*
LIFEPLUS	*IST-2001-34545*	*www.miralab.unige.ch/subpages/lifeplus/*
REALREFLECT	*IST-2001-34744*	*cg.cs.uni-bonn.de/project-pages/RealReflect/default.html*
VIRTUE	*IST-1999-10044*	*www.virtue.eu.com*

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www.cordis.lu/ist/directorate_d/audiovisual/index.htm

Life on the move

Mobile services and applications offer vast potential for the European economy, and for people's personal and working lives. Research focuses on the open standards and interoperable platforms necessary for new applications and services to emerge.

The advantages of mobile information services will be apparent in many daily life situations. With the synergy of cellular and broadcast networks, people will be able to use interactive broadband services in an affordable way while on the move, just as they can via the fixed network. Cars, trains, planes, airport lounges, street kiosks, etc, will all permit access to new mobile applications and services, as of course will a new generation of personal devices, such as mobile phones and PDAs. For consumers to fully benefit from these exciting technologies, it is necessary to put in place the platforms, standards and business models to enable suppliers of new products and services to enter the market.

Mobile and broadband content and services form one of the key areas of the eEurope 2005 Action Plan, which identifies the mobility dimension as fundamental to new generations of services, to e-inclusion and to ubiquitous access. With a longer term perspective, IST research under FP5 addressed many facets of mobile applications and services. Key areas were: platforms, systems and services; interoperable fee-collection and payment systems; safety, security and rescue services; location-based services (LBS); navigation and digital mapping; tourism; and m-commerce support.

System integration and open platforms are key themes. For instance, a common approach to in-vehicle telematics that supports service roaming is targeted by 3GT. The project will finalise and test specifications based on OSGI, an emerging open standard for in-vehicle information systems. ITSWAP has examined the feasibility of delivering travel information via WAP. Studying technical, ergonomic and commercial aspects, it has made standards recommendations to the WAP and GATS fora. AMBIESENSE is targeting context sensitivity of mobile information services for business travellers and tourists with an approach based on wireless context tags. Placed, say, in a museum, airport or city, these tags would interact with a mobile terminal, providing the user with links to retrieve information from the network.

Many mobile services will be location-aware, requiring the ability to pinpoint the user's location. Satellite positioning systems are one method of doing this. Here, GAUSS has proven an approach based on GPS/GNSS positioning and S-CDMA/UMTS mobile systems for road and inland waterway applications, while GUST has supported European efforts on satellite navigation terminals.

Following the success of the LOCUS and C-GALIES projects in contributing to legislation for the Enhanced European Emergency Call Service ("E-112"), E-MERGE is aiming to extend this to a pan-European in-vehicle E-112 service ("ecall"). It is investigating the technical, organisational and commercial frameworks necessary to develop common specifications for the in-vehicle emergency call and its handling, including cross-border and language issues.

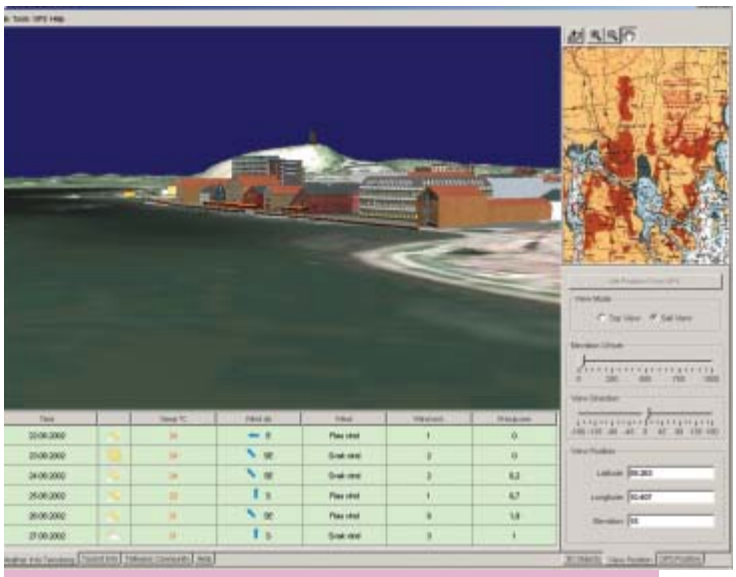
Vehicle navigation and advanced driver assistance systems depend on a digital map, stored on-board the vehicle. ActMAP has brought together key actors in

For whom the mobile tolls

The future of transport tolling in Europe will depend almost certainly on radio devices, so that the driver does not have to stop. DELTA has achieved a common interface to integrate dedicated short-range communications (DSRC) devices with common in-vehicle electronic equipment. It has validated its prototypes under operational motorway conditions with fee collection and travel information services. PISTA is extending this work to the international dimension in a trial covering five European countries. This aims for interoperable, multifunctional, vendor-independent solutions and is being considered by CEN as the basis for a possible standard.

Focusing on both motorway tolling and ticketing for public transport, TELEPAY has developed a payment system based on mobile phones, where the user receives a virtual e-ticket via SMS-WAP and then confirms it. This is useful for tourist as well as transport applications. Four field trials have shown user acceptance of the system and highlighted areas requiring further work, notably on the legal and commercial feasibility of the concept.

the map, service, and vehicle industries to address the problem of how these maps can be kept up-to-date in real time. The work focuses on a standard model and a data exchange format for the on-line updating of cartographic information.



A tourist information system developed under project TELLMARIS

Further work on mobile applications and services will be undertaken under FP6. The aim is to foster innovative applications and services for the mobile user across a wide range of settings and work environments. Key areas of interest are: adaptive and context-aware systems, mobile security, open interoperable platforms, LBS compatible with satellite positioning systems, interoperability across inhomogeneous networks with roaming capabilities, and linkage to electronic payment systems and to government resources.

Connected tourists

Accounting for 5.5% of GDP and 6% of employment, the tourism industry is an important one for Europe and has much to gain from mobile information services. FP5 projects in this area are aiming toward tourism information systems based on open standards and protocols.

Projects such as M-TOGUIDE and CAPITAL ITTS (urban tourism) and WEBPARK (tourism in protected areas) use LBS to link tourists with context-aware and personalised guidance and information. PARAMOUNT is investigating mobile communications and navigation services for mountainous regions, including map downloading, 3D visualisation, avalanche prediction, routing and guidance information and rescue support. TELLMARIS focuses on an application for boat tourists in the Baltic region, delivering 3D visualisations to mobile terminals.

Strategic Objectives: *Applications and services for the mobile user and worker*

Project References:

3GT	*IST-2001-36080*	*www.ertico.com/activiti/projects/3gt/home.htm*
ActMAP	*IST-2001-34141*	*www.ertico.com/activiti/projects/actMAP/home.htm*
AMBISENSE	*IST-2001-34244*	*www.ambiesense.com*
CAPITAL ITTS	*IST-2000-30038*	*www.eu-capitals.net*
DELTA	*IST-1999-12087*	*www.ertico.com/activiti/projects/delta/home.htm*
E-MERGE	*IST-2001-34061*	*www.e-merge.org*
GAUSS	*IST-1999-20532*	*http://galileo.cs.telespazio.it/gauss/*
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M-TOGUIDE	*IST-2001-36004*	*www.mtoguide.org*
PARAMOUNT	*IST-2000-30158*	*www.paramount-tours.com/*
PISTA	*IST-2000-28597*	*www.pistaproject.com*
TELEPAY	*IST-2000-28269*	*www.ertico.com/activiti/projects/telepay/home.htm*
TELLMARIS	*IST-2000-28249*	*www.tellmaris.com*
WEBPARK	*IST-2000-31041*	*www.webparkservices.info*

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Knowledge economy

IST-enabled change in organisations and work

As recognised in the EU's Lisbon strategy, the ability to create, share and exploit knowledge is increasingly central to competitive advantage, wealth creation and better standards of living. IST has a key role to play here, since it facilitates the rapid and open sharing of knowledge on which innovation and competitiveness depend. Use of IST improves enterprise productivity and enables individuals and teams be more creative. It is becoming an intrinsic part of all products and services, and is creating new ways of working and new types of businesses. The IST industry itself is now one of the largest economic sectors, providing employment for more than 12 million Europeans. Beyond this, IST underpins major developments in all other fields of science and technology.

European businesses and workers have been quick to grasp these opportunities. Almost 90% of enterprises with more than 10 employees now have internet access, 70% have a website and 50% say they use the internet as a business tool. Furthermore, after a cautious start, European SMEs are closing the gap with large enterprises. The EU has helped foster this position by putting in place a new regulatory framework for electronic communications services and a legal framework for e-commerce. Under the eEurope initiative internet connectivity – including broadband – has been extended while internet access prices have fallen. And the GoDigital initiative has provided a forum to help SMEs to use e-business better.

eEurope 2005 commits to expand on these achievements to maintain a dynamic e-business environment. It proposes a series of actions to promote take-up of e-business so as to increase the competitiveness of European enterprises and raise productivity and growth through investment in ICT, e-skills and new business models. These include a review of legislation to remove barriers to e-business, and further measures in relation to interoperability, trust & confidence, e-skills and SME take-up.

Research has an important contribution to make here. European e-business RTD aims to lay the technological foundations for an affordable, secure and barrier-free European e-marketplace for all. It looks beyond current enterprise applications to find secure, interoperable e-business solutions to support business processes across the whole value chain. It also seeks solutions to enable enterprises, especially SMEs, to exploit the potential of dynamic collaborative business networks – virtual enterprises and clusters. In addition, research is helping to find new solutions and working practices to improve the productivity of today's knowledge workers.

The effective management of knowledge and intellectual assets is emerging as a key success factor in the digital economy. Research is contributing more people-focused approaches to managing knowledge and smarter ways of handling digital resources, especially audio-visual content. In manufacturing, new technologies (such as microelectronics and microsystems) and approaches (such as "extended product") can help companies generate and retain value.

The networked enterprise

To succeed in competitive markets European enterprises are turning to collaboration within virtual organisations. European e-business RTD focuses on strategic, long-term challenges so as to exploit the potential of dynamic collaborative business networks.

The increasing pace of modern markets is forcing companies to be more flexible, innovative and responsive. In particular, enterprises are adapting their traditional business models in favour of collaborative ones that allow them to enter into and exit from markets much faster and at much lower cost. These collaborative business practices, facilitated by technology, are giving rise to new organisational forms – so-called smart or virtual organisations (SOs/VOs).

A VO is a set of business entities that forms an alliance or partnership to provide value-added products and services. The collaboration may be either static or dynamic but differs from other business relationships in that companies pool resources and competencies to exploit a specific market opportunity. In so doing, they acquire the critical mass necessary to become a qualified partner of big enterprises, without losing the agility afforded by the SME's lean structure.

These open and flexible business networks depend on affordable and dependable technical infrastructure, as well as organisational and business innovation. By doing business within a network of interdependent enterprises, SMEs will benefit from a collaborative environment, a sharing of resources, and the creation and exchange of knowledge.

In FP5, the IST Programme's Smart Organisations cluster comprised around 40 RTD projects looking at issues in this domain. These covered the whole VO lifecycle from various perspectives: legal issues and frameworks; reference models and architectures; platforms to support business collaboration; business processes and functions; and socio-economic research. During the latter stages a series of consolidation activities were launched. One of the key measures is VOSTER, a clustering activity that collects, analyses and synthesises results from a number of RTD projects.

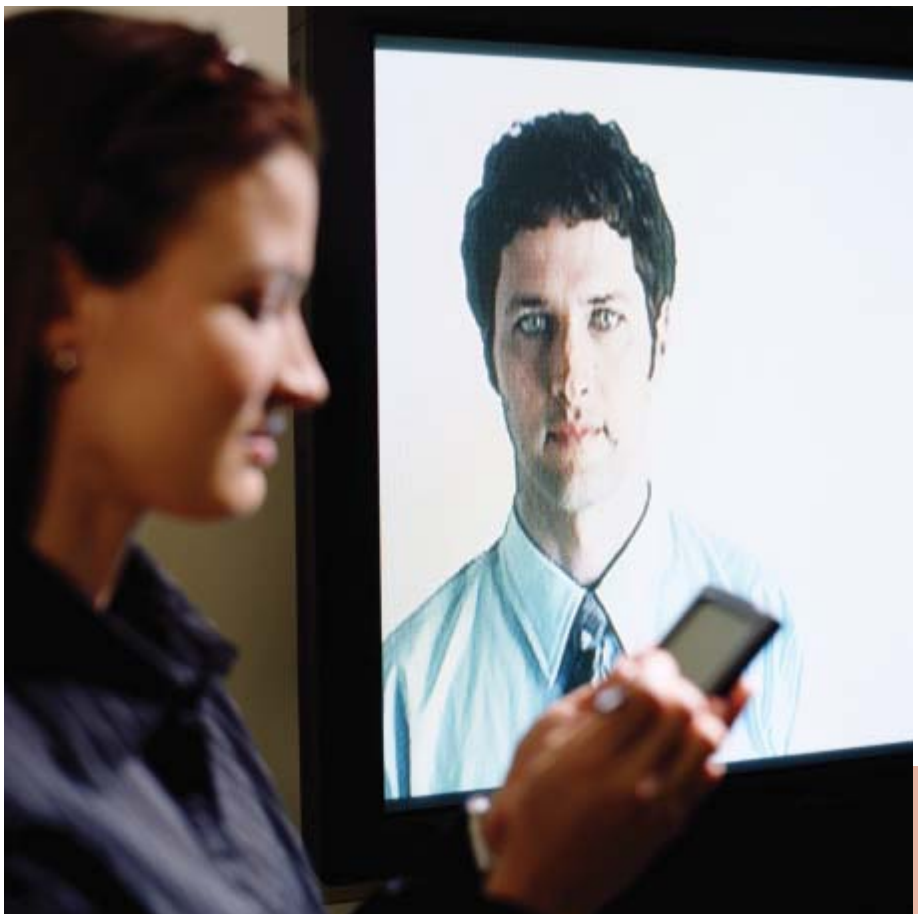
The challenge now, in FP6, is to develop the new generation of technologies, applications and services that will enable European organisations to function as networked knowledge-based businesses. This will be achieved through supporting innovative, world-class e-business research which, together with new policies and regulation, will support future development and growth. It focuses on long-term challenges: namely radical improvements in the way future organisations, products and services are created and managed, and in how businesses interact with their customers. The dominant issues here are interoperability and collaboration.

The interoperability of enterprise applications is a central issue in VOs. Although willing to co-operate and inter-operate with others to fulfil the common goals of the VO, every enterprise has its own conditions and requirements. For instance, it may wish to maintain its rights to local choices and solutions (e.g. proprietary enterprise applications). Or it may wish to protect or restrict access to its proprietary

Towards Plug-and-Do-Business

Building on the work of an earlier expert group, the IDEAS network has developed a strategic roadmap on interoperability in enterprise applications and software. The network elaborated roadmaps around three main research themes: architectures, ontologies and enterprise modelling. These domains take into account not only the technology, but also the organisation and semantics. The roadmaps set a vision to determine the real challenges and needs to be met by European industry over the next ten years, and helped create consensus among the relevant stakeholders.

The results are being progressed in two FP6 initiatives. The ATHENA integrated project focuses on technologies to enable seamless interoperability (technical, business and semantic) between enterprises. It will establish the European Interoperability Institute to facilitate community building, transfer research results and address industrial aspects. Related to this, INTEROP will be a network of excellence for organisations involved in interoperability research.



European enterprises must make the most of networked, knowledge-based collaboration

information. Hence, there is a tension between the obvious needs for co-operation among organisations (which would call for adoption of common standards), and the suitability of certain proprietary or legacy solutions that can more readily meet local conditions. We need to find ways of accommodating these "incompatible systems" within global e-business standards.

The second long-term RTD issue is collaboration. Here the challenge is to easily re-design and integrate business processes across enterprise boundaries, so that multiple enterprises can closely cooperate to achieve shared business objectives. Future networks will be based on well-founded models and theories, generic infrastructures, and be able to call on reliable and re-usable tools and services. In short, they will become "breeding environments" for sustainable, long-term VOs.

The roadmap project VOMAP identified and characterised the key research challenges needed to fulfil this vision, based on the concept of dynamic business ecosystems. The ideas developed will be taken forward in ECOLEAD, an integrated project developing technologies for networks of collaborative enterprises.

Strategic Objectives:	*Networked businesses and governments*		
Project References:	*IDEAS*	*IST-2001-37368*	*www.ideas-roadmap.net*
	VOMAP	*IST-2001-38379*	*www.vomap.org*
	VOSTER	*IST-2001-32031*	*cic.vtt.fi/projects/voster*
Commission Contacts:	*Joël Bacquet*	*joel.bacquet@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/business-govt/home.html*		
	www.cordis.lu/ist/directorate_d/ebusiness/index.htm		

Content goes interactive

The burgeoning array of media technology platforms presents many opportunities but also hurdles for multimedia creators and consumers. IST's research on cross-media content is helping to deliver a smarter and more interactive infrastructure that will enable users to work with content in more flexible ways.

Sports broadcasting could be a key market for mobile content

Digital media have become part of everybody's lives: TV, film, radio, internet, mobile phones are used in hundreds of millions of European households. Today's digital technologies – PCs and networks – allow users to manipulate and interact with multimedia in increasingly flexible ways. The same technology also allows content to be carried across different platforms.

This is only the start of the content revolution, however. Today's systems offer limited interactivity and functionality, that does not go much beyond browsing menus and downloading streaming media. In future systems, based on digital cross-media platforms, users will have much greater control of the content itself, including objects and sequences within the file or content stream. Over the next ten years content will evolve from today's relatively passive forms into new "smart" content that is truly interactive and context-aware, and is accessible on the move.

To meet these demands we need to overhaul the digital content value chain to make it more flexible (e.g. less linear), more adaptable to users' individual needs and situations, and more cost-effective through new business models. With a growing variety of media platforms, producers and content creators are looking for solutions that allow content to be easily adapted for a variety of channels and formats. The ultimate goal is device-independent content, where we "create once, publish many times, interact everywhere". This goes further than simply reshaping and resizing content – it should also be re-formulated. Several of the constituent technologies exist or are emerging – the problem is to integrate them and scale them up to a level where they become directly usable.

By way of example, imagine a scenario where you find yourself with a new camcorder and after six months have generated several hundred digital photos and 10 hours of video. The files are loaded on your PC,

Video on the move

A fundamental step in establishing new, intelligent, multimedia-rich services for mobile users is the provision of a common technology base. This will lead to concrete applications and services with strong potential appeal to a large customer base.

INMOVE is contributing to this process by designing and testing an authoring system for building intelligent mobile/wireless audio-visual applications and services. Services will be delivered across various mobile/wireless networks (2.5/3G and unlicensed bandwidths, Bluetooth and WLAN) utilising IPv6 capabilities. New video-based services are being demonstrated in two applications: remote surveillance (e.g. for personal and residential security) and sports broadcasting.

together with gigabytes of existing material. A smart content analyser would sort them automatically into content-based themes, e.g. "beach holidays", "the children growing up", "our cat" etc. You would then author your own presentation, and be able to distribute personalised sets of photos and video clips to family members via their PC, PDA or mobile.

IST has a portfolio of around 90 FP5 projects in the interactive electronic publishing area, involving some 500 organisations. They are researching into audio/video creativity, mobile multimedia, personalised content, human representation, virtual reality, interactivity and entertainment, as well as into new business models. Cross media convergence is at the heart of these activities (see boxes).

In the Sixth Framework Programme, EU research is continuing the long-term effort to develop added-value content technology. RTD in the 2003/04 IST Work Programme is targeted in several ways: it aims at cross-media content in promising leading-edge sectors, especially entertainment and leisure; it focuses on the added-value of interactivity for the user; and it concentrates on cross-platform customer technologies, ranging from TV, radio, music and cell phones, to portable or wearable information devices.

The strategy addresses key links in the digital content value chain, covering both content creation and content programming. In content creation the research aims to develop technologies to support the creation of new, compelling forms of content for interactive, creative or artistic consumption. The emphasis is on creativity and design, intuitive tools and visionary methods. Research should aim to develop innovative functionalities within authoring systems, which allow them to reach new, more sophisticated levels of interactivity. Research on content programming environments addresses the need for open, robust and scalable systems and services that meet the needs of digital content suppliers and aggregators. The emphasis is on operational issues such as storage, management and delivery systems. In both areas RTD will be complemented by measures to improve the research infrastructure (e.g. through technology assessment and best practice), to explore the impact of new technologies, and support the integration of digital rights management solutions in the production chain. New projects selected under the 1st Call will be launched shortly.

The future for mobile entertainment

Mobile entertainment has mass market potential that could drive the adoption of the next generation of mobile devices. The mGain project is studying mobile entertainment technologies, business models, concepts and culture to gain a comprehensive picture of the field.

Mobile entertainment genres, consumer demographics and the emerging mobile culture are being studied to understand the factors that make successful mobile entertainment products. Existing and forthcoming (e.g. ultrawideband and J2ME) technologies are being studied from an entertainment perspective to identify the implications for mobile entertainment developers. And analysis of the mobile entertainment market will identify revenue sources and value chains and suggest appropriate business models (e.g. micro payments). The work is expected to lead to follow-on activities under FP6.

Strategic Objectives:	*Cross-media content for leisure and entertainment*		
Project References:	*INMOVE*	*IST-2001-37422*	*www.inmove.org*
	mGAIN	*IST-2001-38846*	*www.mgain.org*
Commission Contacts:	*Pascal Jacques*	*pascal.jacques@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/multimedia/home.html* *www.cordis.lu/ist/directorate_e/kmcc.htm* *www.elpub.org*		

Future workspaces

The advent of the new economy, with its emphasis on exploiting intellectual assets, challenges many of our conventional views on work. IST's research on new working environments will lead to solutions that improve the productivity of today's knowledge workers.

Today's e-professionals have very different expectations of work. They are largely location-independent and no longer need to be bound within a particular office building. They are highly creative and demand more stimulating working environments than those of the industrial age. And as value creation comes to depend increasingly on teamwork, they are looking for work solutions that enable them to bring together and then manage multi-skilled teams. Thus, in an era where success depends on innovation and collaboration, the productivity of knowledge-based workers is emerging as a key factor in competitive advantage.

Technology can help here by creating workspaces that stimulate creativity and knowledge sharing. Physical spaces can be made more attractive and accessible by making coherent use of flexible technologies such as ergonomics, virtual reality and mobile and wireless systems. Our working practices can benefit from developments in organisational knowledge management, teamwork management and co-operative working environments. Large companies, SMEs, micro-enterprises and freelancers, all need to work together without boundaries within workspaces designed to suit their unique circumstances, needs and objectives.

Relevant research issues were addressed under FP5 action lines on intelligent workplaces, knowledge management, flexible and mobile working, and socio-economic analysis in e-work and e-business. RTD included consideration of aspects such as new workplace design, tools and environments for knowledge sharing and collaboration, user-centred e-work solutions, corporate social responsibility, and models and scenarios for technology development and deployment. The activities take an holistic view of the modern working environment, addressing far more than simply new desktop ICT tools.

In the Sixth Framework Programme, this tradition is continued in IST's research on new working environments. With a long-term perspective, the emphasis is in supporting individuals in their various professional roles within the information society. Research addresses new ICT-supported roles in all areas of work – skilled and unskilled "e-workers" as well as e-professionals and knowledge workers – aiming at as wide a participation as possible in the e-economy.

In essence, the research aims to put ambient intelligence (AmI) into a business setting. One focus is on collaborative working environments, including industrial workspaces, that support knowledge work and decision-making. As well as organisational change management, research addresses communities of practice, centreless work organisation, "disappearing organisations" (e.g. through use of peer-to-peer and grids), and the dynamics of cybercommunities. Related to this, research will consider knowledge management in information dense and/or media-rich working environments so as to enhance the value of collaborative workspaces.

In workplace design, the emphasis is on extended and mobile workspace environments for individuals and groups that take account of innovative technologies

Valuing the e-economy

Intangibles – R&D, proprietary know-how, intellectual property, workforce skills, world-class supply networks and brands – are now the key drivers of wealth production, while physical and financial assets are increasingly regarded as commodities. New statistical, accounting and IPR concepts and tools are needed to enable company boards, shareholders and investors to judge management performance and differentiate good, bad and delinquent corporate stewardship.

PRISM investigated the measurement and reporting of these intangibles. The project undertook leading-edge research supported by original case studies and disseminated the results to interest groups Europe-wide. The findings highlighted, among other issues, that the design of physical space has a very significant impact on the creation and sharing of knowledge.

Today's knowledge workers are looking for stimulating work environments

such as natural multimodal interfaces, virtual reality and wearable computing. Trust, security and privacy within such shared workspace environments is also a key concern. Other research trajectories include development and demonstration of new work environments in specific sectoral or regional settings, and further study of the socio-economic aspects of changing work roles. All of the research objectives are closely linked to legal and policy issues in relation to the networked knowledge-based economy, in particular eEurope and the efforts towards a Single European Electronic Market (SEEM).

Better by design

e-Locus is a cluster initiative drawing together nine IST projects researching new workspace concepts. Through networking and sharing of information, it is helping researchers to understand the changes in new workspaces and methods, and the capabilities of knowledge technologies. One objective is to evaluate the extent to which human factors are taken into account in the design of future technologies and equipment. This in turn will open the way to design solutions that better integrate people within future AmI environments. Such solutions will apply beyond the office, since the new tools, space and ways of working will be part of our lives both within and outside of work.

Strategic Objectives:	*Applications and services for the mobile user and worker* *Networked businesses and governments*		
Project References:	*E-LOCUS* *PRISM*	*IST-2001-38790* *IST-2000-29665*	*e-locus.fundaciontekniker.es* *www.euintangibles.net*
Commission Contacts:	*Paul Hearn* *Michael Ziegler*	*paul.hearn@cec.eu.int* *michael.ziegler@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/mobile-services/home.html* *www.cordis.lu/ist/directorate_f/ework/index.htm*		

Towards business ecosystems

European SMEs are closing the gap with large enterprises and grasping the opportunities presented by e-business. As the knowledge economy matures, the long-term challenge is to equip SMEs to play their full part in local and regional business networks.

Small and medium-sized enterprises (SMEs) are the backbone of the European economy. Accounting for 99% of enterprises, Europe's 19 million SMEs are the main source of new jobs and play a key role in enabling Europe to compete in world markets. Although they tend to get lumped together under the one label, in reality SMEs are highly diverse. Some are dynamic and flexible with an innate ability to innovate and respond to changing conditions. Others are traditional, based on family involvement and embedded in local business environments. Still others are start-ups, fragile organisations striving to exploit niche markets or technologies.

Having been slow to embrace e-business, SMEs' attitudes are changing. Surveys show the mid-sized enterprises have already closed the gap with large enterprises and the small- and micro-enterprises are catching up rapidly. Around 84% of European SMEs are now connected, 70% have a website and 50% say they use the internet as a business tool[1].

Connectivity is only the start, however. Beyond this, SMEs need to think and act smart to reap the benefits of e-business. Firstly, they should rethink and adapt the way the organisation works when using ICTs. Secondly, they have to be part of the evolution of clusters from informal alliances of business partners into collaborative networks of enterprises – virtual enterprises – with highly inter-linked infrastructures and business processes. Finally, enterprises must equip both employees and management with the skills to work in a dynamic business environment. Only by grasping these issues will SMEs begin to realise the full potential of ICT to improve productivity.

In FP5, the IST Programme supported a range of projects aimed at accelerating the take-up of e-business technology in SMEs. Across the key action *New Methods of Work and Electronic Commerce* more than 70 take-up projects were launched to transfer leading-edge technologies to industry and other end-users. Hundreds of SMEs throughout Europe participated in these projects, together with so-called "catalysts" – local or regional organisations that

SMEs need to think and act smart to reap the full benefits of e-business

Showcasing the best of e-business

The European e-Business Showcases report profiles a set of 22 of the IST RTD take-up projects. The showcases are clustered into four areas that reflect key e-business themes: virtual enterprises, business processes, e-commerce, and business applications. In addition, a series of short "learning papers" discuss specific aspects of the e-business environment and their implications for SMEs. The showcases, together with others available online, show through convincing examples that e-business is a successful business concept and a tool for SMEs to become more competitive.

Together with the book, an online forum has been created to allow the exchange of views and ideas. It links up the readers with the companies in the individual showcases and with the authors and others involved in compiling the study.

worked with the SMEs to help them adapt their business processes towards ICT use. The SMEs were able to adapt emerging technologies to their business needs by sharing development effort and jointly achieved results between themselves. The take-up projects thus became the means to leverage the results of IST research and to contribute to the implementation of the eEurope initiative at local level. A selection of the projects has recently been published as a set of "European e-business showcases" (see box).

Looking to the future, the challenge is to facilitate the transition of SMEs to the knowledge economy, and in particular to find means to support partnering and collaboration. Instead of focusing on the early adopters, deployment activities need to shift towards wider exploitation by the "early majority", and towards more advanced SME e-business solutions for the long term. SMEs do not operate in isolation, but rather as part of local "business ecosystems" comprising other SMEs, larger enterprises, local authorities and business intermediaries. Given the diversity of SMEs, success will require the close involvement of actors at local and regional levels.

A new integrated project funded under the FP6 1st Call addresses these challenges. DBE (short for Digital Business Ecosystems) aims to apply new theories from emerging scientific fields (complexity theory, biology, economy, linguistics) to develop new models and technologies for SMEs to operate as agents in future highly complex networks. Beyond this paradigm shift, the project will support Community policies in relation to local development, SMEs and European Research Area.

[1] E-business Watch, 2002. (www.e-business-watch.org)

Strategic Objectives: *Networked businesses and governments*

Commission Contacts: *Francesco Nachira francesco.nachira@cec.eu.int*
Peter Fatelnig peter.fatelnig@cec.eu.int

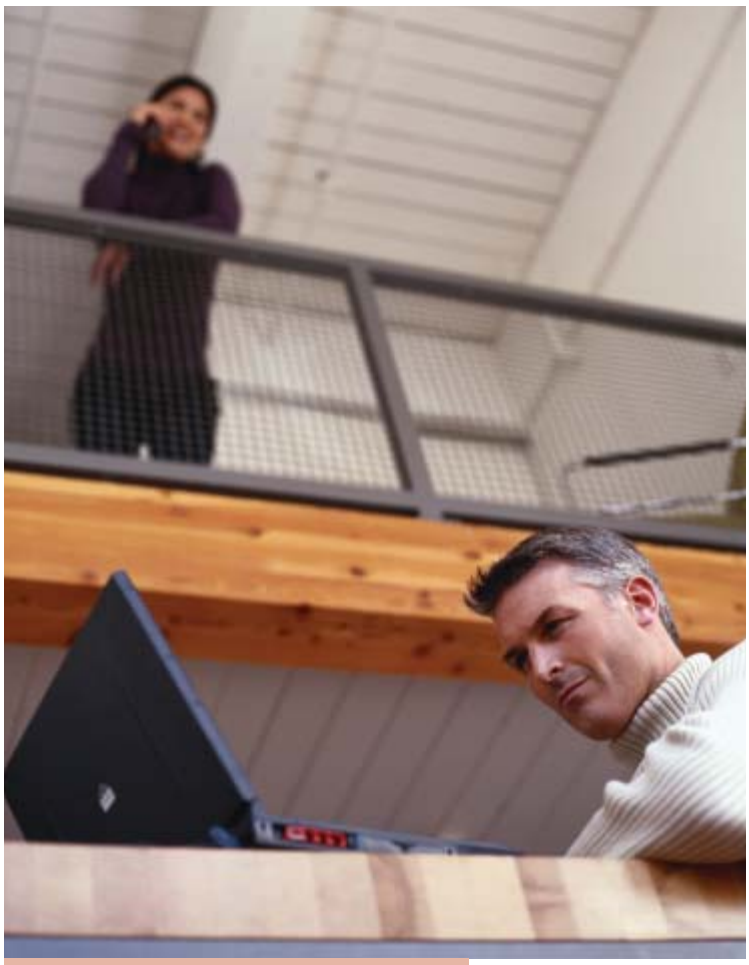
Web: *www.cordis.lu/ist/so/business-govt/home.html*
www.cordis.lu/ist/directorate_d/ebusiness/index.htm
European e-Business Showcase Forum: europa.eu.int/information_society/eeurope/index_en.htm

Services for the next generation intern

The new IPv6 protocol will underpin future IST developments, including wireless communications, home networking, peer-to-peer services and grid computing. Proactive European policy is ensuring rapid take-up of the new protocol.

The internet has evolved over a period of more than 25 years, during which the method used for all internet applications to communication, the Internet Protocol (IP), has remained unchanged. The designers of the 1970s never foresaw the growth of the internet in the form we have it today, with the result that the existing addressing method, IPv4, (akin to telephone numbering) is under increasing strain. Migration to the next generation protocol, known as IPv6, is both a far reaching and also a very necessary development if we in Europe, and in the world, are to reap the benefits of future IST.

The primary motivation for IPv6 is a shortage of address space, since IPv4 does not allow us to identify anything like enough end-point addresses for the communicating, mobile world of the future. Other important characteristics of IPv6 include its ability to support auto-configuration, security and class of service capabilities (so enabling the labelling and prioritising of services which can then be charged accordingly). It also has flexibility for added functions, more efficient packet routing and "end-to-end" security and privacy. Thus, the new protocol has many advantages over its predecessor.



IPv6 will lead to a wide range of new services

The move to IPv6 is gathering momentum and has been driven in large measure by European policy-making. In 2001, the Europe-wide IPv6 Task Force developed a comprehensive Action Plan, whose recommendations were largely adopted in a Council Communication, *IPv6 Priorities for Action,* in February 2002. The Council Conclusions of June 2002 initiated a programme to facilitate the transition to IPv6 and renewed the IPv6 Task Force with a mandate to regularly review and update the plan of action (see box). IPv6 also figures as a key sub-objective of the eEurope 2005 Action Plan.

Quality of service for IPv6 networks

A major problem for all IP-based networks is achieving and guaranteeing end-to-end quality of service. 6QM is developing a measurement framework consisting of a measurement device and a server. By capturing and time stamping packets, it will measure delay, loss and jitter, using the 6NET and Euro6IX networks as validation test beds. The results will be guidelines and a knowledge base about tools and specifications for measures.

Exploiting the IPv6 opportunity

The IPv6 Task Force is a stakeholder group driving the implementation of IPv6 in Europe. It comprises senior representatives of European ISPs, telecoms operators, equipment supply industries, and key applications sectors, and provides a focus for European initiatives.

Following Council endorsement of its earlier recommendations (see main text), the Task Force's second phase focuses on dissemination and take-up. The target is to play an instrumental role in the deployment and coordination of IPv6 in Europe on a large-scale by 2005 and beyond. It monitors academic, market and industry activities, disseminates results and maintains an action plan, known as the IPv6 Roadmap. It also maintains close links with standards bodies and with other IPv6 initiatives worldwide. The Task Force is supported through the thematic network IPv6TF-SC.

One of the results of this proactive policy was the funding of a vibrant set of projects under the IPv6 cluster of FP5. Many are still on-going and are achieving encouraging results. Research aims to ensure that the new protocol can be implemented over a wide variety of core and access network media, including wireless domains where mobility is a necessary user service. To disseminate results to the widest possible audiences, EUROv6 is building an IPv6 application and services demonstration platform to help entrepreneurs identify investment opportunities. Besides permanent demonstrations in Brussels, Basle and Madrid, EUROv6 has a portable demonstration unit.

Among the many current projects, SATIP6 is examining the special issues facing IPv6 when deployed over satellite links. In the short term, it plans to adapt DVB-RCS for IPv6, and in the longer term address advanced mobility, security, and next generation terrestrial network integration. Its field trial will feed HIPERLAN2 and VDSL access networks. OverDRIVE is addressing the application of hybrid cellular and broadcast networks to unified IPv6-based unicast and broadcast multimedia services in vehicles. It aims to use dynamically allocated capacity from each network as necessary. A continuous on-board vehicular trial has been achieved in Paris.

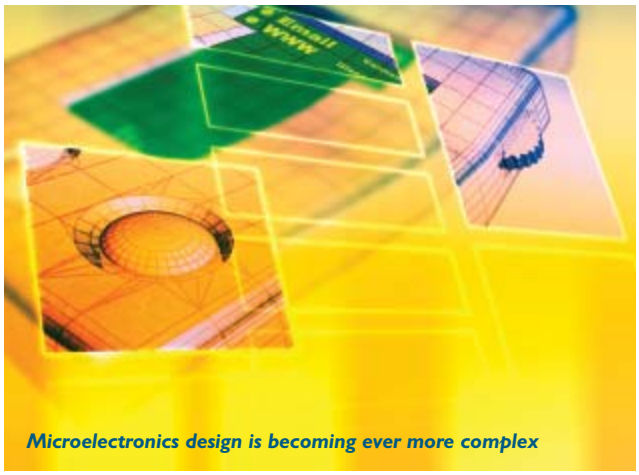
GÉANT, the pan-European research network, has spearheaded the Europe-wide availability of IPv6 in the research sector. By the time of the Global IPv6 Summit in Madrid in May 2003, the third of a series of such summits, a number of IPv6 large-scale trial networks were operational on GÉANT and implementers were able to connect with others for interoperability tests. Following these successful testbeds, IPv6 connectivity is now being extended to all of the national networks and a full commercial-scale production service will be launched across Europe in October 2003. Networks connected to GÉANT will be able to use either version of IP interchangeably.

Further research on IPv6-enabled applications and services will be pursued under FP6, where it will underpin many of the developments of broadband services, applications, mobile networking and research networks.

Strategic Objectives:	*Broadband for all* *Mobile and wireless systems beyond 3G* *Research networking testbeds*		
Project References:	*6NET*	*IST-2001-32603*	*www.sixnet.org*
	6QM	*IST-2001-37611*	*www.6qm.org*
	Euro6IX	*IST-2001-32161*	*www.euro6ix.org*
	EuroV6	*IST-2001-38200*	*www.eurov6.org*
	GÉANT	*IST-2000-26417*	*www.geant.net*
	IPv6TF-SC	*IST-2001-37583*	*www.ipv6tf-sc.org*
	OverDRIVE	*IST-2001-35215*	*www.ist-overdrive.org*
	SATIP6	*IST-2001-34344*	*satip6.tilab.com*
Commission Contacts:	*Pascal Drabik*	*pascal.drabik@cec.eu.int*	
	Bernard Barani	*Bernard.barani@cec.eu.int*	
Web:	*www.ipv6tf.org* *www.6link.org*		

Reuse by design

Within a few years integrated circuits will reach the level where we are able to put one billion transistors on a single chip. Only through reusing system elements will we be able to design what we can make.



Microelectronics design is becoming ever more complex

In microelectronics, the drive towards ever-more sophisticated end-user applications and greater design complexity is creating a "design gap", where increases in the desired levels of system functionality are far outstripping the productivity gains in the systems design process. Design costs are escalating, while suitably skilled IC designers are in short supply. This calls not just for minor improvements in the design process but a step change. For the design of 1 billion gate systems to be both practical and cost-effective, we have to improve design productivity by a factor of 10 by 2010.

Designers are looking for methods, tools and architectures that allow them to design better and faster at system level. One means of achieving this is to re-use and exchange intellectual property (IP) from one application to another. For this we need standardised architectures that allow the use of reconfigurable systems blocks. We also require system-level methods and tools that provide a seamless path from specification right through to implementation.

Reconfigurability is also important from a market perspective. In the IC market, unit costs are falling while fabrication costs are increasing exponentially. To recoup their investments, semiconductor manufacturers either need new, high volume applications, which are hard to find, or to re-use the same IP blocks for different markets.

Work on design methods and tools in FP6 addresses this design productivity gap from a number of perspectives, with a particular emphasis on reconfigurability and reuse. It focuses on novel approaches to better and faster design at system level, as well as specific challenges in areas such as mixed-signal design, low power design, RF circuits and packaging.

Reconfigurable processors for telecoms

PRO3 targeted efficiency improvements in the embedded, programmable hardware architectures used in telecoms networks. Specifically, it aimed to accelerate the execution of the protocols used for telecom and data transport. The approach chosen was to extend a high performance RISC core with reconfigurable, pipelined programmable hardware. The resulting PRO3 processor was implemented in a high performance ATM switch controller and a TCP/IP network interface card for high-end servers.

In commercial applications, the PRO3 processor would reduce equipment costs, increase flexibility and programmability, and offer better performance. Cost reductions of around 30% are expected in a market worth around €200m. The results are being commercialised by Hyperstone AG (who own the IP on the RISC processor) and Lucent (who manufacture the end-user equipment). Hyperstone also benefited from the project by porting their existing processor from 0.35 micron to 0.25 micron and later to 0.18 micron technology.

Strategic Objectives:	*Pushing the limits of CMOS and preparing for post-CMOS*	
Project References:	*PRO3*	*IST-1999-11449*
Commission Contacts:	*Philippe Reynaert*	*philippe.reynaert@cec.eu.int*
	Markus Korn	*markus.korn@cec.eu.int*
Web:	*www.cordis.lu/ist/so/cmos/home.html*	

Designing in value

Future products and services will be designed to offer customers increasing value and enable manufacturers to respond faster and more flexibly to the ever-increasing market demands.

Today's manufacturing environment is increasingly competitive, with customers demanding ever more advanced and sophisticated products, greater choice and shorter delivery times. To satisfy this demand for differentiated and customised products companies with different expertise must collaborate. But they need to do so in ways that ensure the value chain remains flexible, so as to realise the full benefits of rapid product innovation and open competition.

In addition, manufacturers are looking to make their products smarter by designing in added-value services as part of the customer offering. This "extended product" approach combines a product with services and enhancements that improve marketability. The customer proposition may subsist more in the benefits of the value-added elements than the physical product itself. Enhancements can incorporate tangible features that make the product more intelligent, customised or user-friendly, including embedded features like maintenance. Other aspects, such as services, engineering or software, are intangible and make the offering more information or knowledge intensive.

It is likely that ICT technology will create future products that are ambient-aware at a low cost by making them knowledgeable about their geographical position (GPS), their neighbourhood (wireless networked), and always connected (mobile and broadband).

In FP6, IST is addressing this aspect through joint research with Thematic Priority 3 (Nano-technologies, intelligent materials and production processes). The work aims to further strengthen Europe's competitive position by developing technologies and methodologies for extended service and product development concepts. It focuses on holistic approaches to products and associated services; optimising the value creation process within the manufacturing supply chain; and demonstrating holistic product design in a rich variety of industrial sectors. Global standardisation initiatives in this area will also be supported.

Work is expected to build on and help aggregate member and associated states' efforts, and to support international activities such as the Intelligent Manufacturing Systems (IMS) initiative and the Eureka Factory initiative.

Towards flexible customer-oriented products

Current IST projects address many aspects of extended products and flexible manufacturing. LICOPRO, an IMS RTD project, is experimenting with extremely flexible production environments for low production volumes in sectors such as automotive suppliers and telecoms. REMUNE is developing novel approaches for the manufacture of telecommunications products that will enable value-added services to be added through their entire lifecycle. The IMS network SMART-FM is promoting the adoption of standardised approaches to information management in the furniture manufacturing industry across the whole product lifecycle. EXPIDE is a clustering activity for IST projects with interests in new business processes in dynamic enterprises as they relate to value chains and extended products.

Strategic Objectives:	*Products and services engineering 2010*		
Project References:	*EXPIDE*	*IST-1999-29105*	*www.biba.uni-bremen.de/projects/EXPIDE*
	LICOPRO	*IST-2001-37603*	*licopro.com*
	REMUNE	*IST-2001-65002*	*solinet.com/remune*
	SMART-FM	*IST-2001-52224*	*smart-fm.funstep.org*
Commission Contacts:	*Florent Frederix*	*florent.frederix@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/engineering2010/home.html*		
	www.cordis.lu/ist/directorate_d/ebusiness/index.htm		
	EUREKA Factory initiative: www.eureka.be/ifs/files/public/eureka/umbrellas/factory/welcome.htm		

The knowledge grid

Grids are a key tool for mastering complexity in critical applications. IST's grids research targets the next generation of technologies that will make grid applications easier to use and exploit their potential beyond e-science.

Grids – collections of information and computer resources connected over high-speed networks – are revolutionising computing. They are central to the resource sharing that is an essential part of e-science and also facilitate collaboration within virtual organisations, both large and small. By turning computer cycles and data storage into commodities, they push back the boundaries of computing into realms that could not be contemplated before. From a policy perspective, grids will be important in accelerating the implementation of a European Research Area and will also help realise eEurope's goals for accessible e-services. Although still in its infancy, grids seems set to be the dominant computing paradigm of the next 20 years.

The evolution of grids has already undergone several distinct phases. They started out as a means for sharing computing resources, initially by linking supercomputers. The next stage was the sharing of data through the addition of data repositories as well as special devices like scientific instruments, telescopes and medical equipment. The marriage of web technology with the first generation grid technology led to new grid services. Now the focus is shifting to knowledge-sharing: using grids to enable collaborations between different organisations while respecting their individual security.

The knowledge-grid would open up new frontiers, enabling data to be discovered, mined and published in "grid space" across the internet. In so doing, it will bring the potential of grid (and peer-to-peer) approaches to complex problems that cannot be solved with current technologies, in fields such as engineering, medicine, genomics and drug design, environment and business. To achieve this, however, we need to make existing services more accessible and user-friendly. Only high-level functionalities should be exposed, and in a standard and interoperable way, with the detailed implementation hidden in the background. This simplification – "virtualisation" – of grid constituents will enable all kinds of resources to be represented in an abstract and scalable way.

This emphasis on grids as tools for connecting people and knowledge calls for new grid technologies. The Next Generation Grid (NGG) must be based on agreed interfaces and protocols, in much the same way is happening with the web today. It must be easy to program and offer services that are scalable. It must be resilient and support industrial-strength applications. And it must offer users appropriate means to ensure delivery of service on aspects such as trust, provenance, auditability, and traceability.

Simplifying grid functionalities will make it easier to solve complex problems

IST's work to support emerging grid technologies is undertaken in close co-operation with national grid projects and wider international efforts. Around 20 projects have already been launched, representing total EU funding of around €58M. These focus on developing applications of grid technologies, developing and integrating the intermediate software (or middleware) and validating related technologies. A series of testbeds are also supported that aim to enable a wide range of academic and industrial users to share information and computer infrastructure in real time.

For instance, DAMIEN has developed middleware that allows application developers to port their applications to grid environments and to make the usage of distributed applications easier. GRIDLAB is developing software to enable generic applications to adapt to changing grid environments and to be able to fully exploit dynamic resources. Its Grid Application Toolkit (GAT) will allow the construction of fundamentally innovative applications. While prior work on grids has concentrated on pooling hardware resources, COG is demonstrating the viability of an information grid in which data resources are pooled. The project addresses the problem of accessing and relating corporate data stored in different formats and computer systems. GRIDSTART is a support measure that aims to maximise the impact of EU-funded grid and related activities and coordinates European inputs into the Global Grid Forum, the world's leading technology forum for grids.

The FP6 preparatory activities highlighted the need for a more significant RTD commitment. Grid research is now a Strategic Objective in the IST Priority and is managed by a new Unit dedicated to this topic. The available research budget has more than doubled compared to FP5, to around €125M.

Next generation grid infrastructures is one of two focus areas. The research aims towards radically new approaches to architectures, design and development for grids that support open standards and high levels of built-in security. Areas of interest include programming environments, resource management, customisable middleware, and interoperability with existing grid and web services. Economic and business models for new services are also addressed. Further projects will be launched in early 2004 from proposals submitted under IST's 2nd Call.

Solutions for grid interoperability

GRIP is concerned with the interoperability of Globus and UNICORE, two leading middleware technologies central to the operation of the grid. GLOBUS, a US-backed development, and UNICORE, which was developed in Europe, are complementary technologies each with unique features for grid computing.

The GRIP project is developing software to facilitate the interoperation of the two technologies combining the strengths of each system. The solution will be demonstrated in two inter-grid applications in the areas of meteorology and biomolecular science. GRIP will also make UNICORE compliant with the Open Grid Services Architecture (OSGA) and contribute to international grid standards.

Recently, Japan adopted UNICORE as the underlying middleware for its National Research Grid Initiative. This $100M initiative plans to build an infrastructure making over 100 teraflops available for scientific applications.

Strategic Objectives:	*Grid-based systems for solving complex problems* *Research networking testbeds*		
Project References:	*COG*	*IST-2001-38491*	*www.cogproject.org/*
	DAMIEN	*IST-2000-25406*	*www.hlrs.de/organization/pds/projects/damien*
	GRIDLAB	*IST-2001-32133*	*www.gridlab.org*
	GRIDSTART	*IST-2001-34808*	*www.gridstart.org*
	GRIP	*IST-2001-32257*	*www.grid-interoperability.org*
Commission Contacts:	*Wolfgang Boch*	*wolfgang.boch@cec.eu.int*	
Web:	*www.cordis.lu/ist/grids/index.htm* *www.gridstart.org* *www.geant.net*		

Innovation in micro-technologies

The Europractice Service helps European industry gain competitive advantage through exploiting the latest developments in microelectronics and microsystems.

Microelectronics and microsystems are now a critical driver of innovation in a wide range of industries. They are key to making products smaller, cheaper, smarter and more reliable, and also open up many possibilities for new products and systems with greater added value. They allow designers to combine different complex functions in an integrated manner. Mastering these technologies is essential for Europe to remain competitive.

Despite their many advantages, European enterprises, especially SMEs, still face many barriers in accessing these advanced technologies. They involve new approaches to design and testing, access to specialised fabrication facilities, and specialist skills. Access can be costly and time-consuming. The various Europractice Services help to address these issues.

Launched in 1995, Europractice covers four main areas: integrated circuits, microsystems, IC and microsystems software, and training.

The IC Service aims to stimulate and assist the wider take-up of advanced electronics technologies by European industry and provides access to the newest semiconductor technologies for experimentation by academics and institutes. It provides low-cost access to ASIC prototyping for universities and research centres, covering not only the newest small dimensional CMOS technologies but also specific processes such as high or low voltage processes. ASIC prototyping for industrial customers and small volume manufacture are also available under the Europractice IC label, but operate on a self-financing basis since early 2003.

The Software Service offers a range of leading-edge design tools. Its portfolio covers tools and IP from a broad range of vendors and is continuously being enhanced as new design methods and tools emerge. Recent additions include tools for system-on-chip design and simulation of complex microsystems. Both the ASIC and Software Services have a strong customer focus on academic research and education, which would not be able to obtain such services from the market.

The Europractice Microsystems (MST) Service helps reduce the perceived risks and costs associated with these technologies by offering potential users a range of services, reducing their costs and providing a clear route to system manufacturing and product supply. The initiative offers a complete service, from idea to product including: contract research; feasibility and proof-of-concept studies; prototyping and low volume production; access to large-scale industrial manufacturing facilities; custom design; software; and training.

The MST Service continues to experience strong demand. In 2002, the Service integrated 24 new partners, including several new centres in the accession countries. More than 1300 new commercial contacts were made during the year, with average cost per project up by around 30% – a sure sign of more ambitious projects in years to come. SME activity held up well, despite a slight downturn in Europractice activity overall. The medical, instrumentation and telecoms sectors accounted for 70% of the market,

Europractice MST: A catalyst for high-tech growth

Since its launch in 1995, the Europractice MST Programme has contributed to the formation of at least 14 start-up companies and the creation of over 300 jobs. Many of these are "spin-offs" from European R&D organisations or high-technology companies involved in delivering Europractice services. In 2002 three new start-ups were formed. Altogether the Europractice start-ups have raised over €60m from private investors – more than 15 times the amount of EU funding for these projects over the period.

To further support microsystems start-ups, companies are assisted to write a business plan, validate their business model, analyse their IPR position, and assess the market potential of their technologies, and to present their plans to venture investors e.g. at a funding forum in Frankfurt in October 2003.

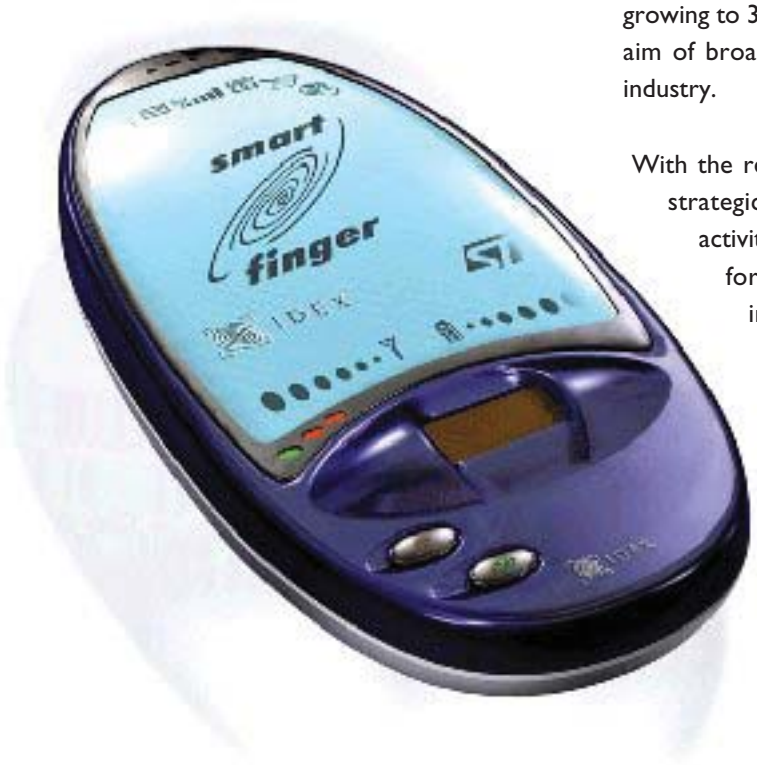
Micro-sensors for fingerprint recognition

Smartfinger® is a 500-dpi capacitive swipe sensor with only a single row of sensitive elements. When a finger is pulled across the sensor surface, the line of sensor elements captures a series of one-dimensional (line) images of the fingerprint. In addition the speed and pull direction of the finger is measured at every time instant. Based on this information, a two-dimensional image of the finger is reconstructed.

The sensor employs an active capacitive sensing principle, detecting whether the electrical loop between an external AC drive electrode and the capacitive sensing elements is closed (finger print ridge) or open (valley). The detected signals are digitised and converted to a gray-scale image of the fingerprint pattern.

The technology was developed by IDEX, a Norwegian company specialising in finger print recognition. SINTEF Electronics, a Europractice partner, contributed to ASIC and sensor design.

The Smartfinger PDA with integrated fingerprint and pointer sensor (Photo: IDEX)



offering room for expansion in other sectors in the years to come. With the proportion of customers having no previous experience of microsystems growing to 30%, Europractice continues to achieve its aim of broadening the uptake of MST in European industry.

With the refocusing of IST research in FP6 around strategic goals, access, take-up and training activities may be handled differently in future, for instance as an integral part of the integrated projects and networks of excellence (NoE) launched in the relevant areas. Capitalising upon and structuring the "problem-solving and industry support" tasks in universities, institutes and engineering companies, Europractice-like service networks will be stimulated using the NoE concept accompanied by specific support and coordination activities.

Strategic Objectives: *Pushing the limits of CMOS and preparing for post-CMOS*
Micro and nano systems

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www.cordis.lu/ist/directorate_c/mnd/index.html

A European e-marketplace

Despite substantial progress at EU and national levels, European businesses still face many barriers in accessing e-business. RTD has an important role to play in establishing an affordable, secure and barrier-free European e-marketplace open to all.

The Single Market has brought enormous benefits for the European Union. By harmonising technical standards, regulations and conditions of trade, Single Market rules have created a level playing field for businesses across the EU and enabled them to compete better in world markets. But as yet we lack a similar approach for the electronic sphere. Online markets are subject to the same Single Market legislation, as well as specific regulations governing the e-commerce environment such as the directives on electronic signatures, distance selling, data protection and copyright. But we are still far from integrating policy, legislation and technology in a way that enables European enterprises to operate in electronic markets freely and without constraints.

In the Single European Electronic Market (SEEM) all firms would be able to access affordable, barrier-free B2B e-business. Sellers would be able to offer their products through efficient electronic marketplaces, including e-auctions. Buyers would be able to source products and raw materials with ease across the EU or even wider, and to select them by quality, quantity and price. Both parties would benefit from an e-marketplace environment that offers the highest levels of trust, security and dependability for electronic trade. And, reflecting collaboration as a growing imperative in business, networks of companies – suppliers, customers, subcontractors, freelancers – would be able to create added-value products and services within a common B2B environment.

European enterprises will benefit from a single European e-marketplace

From stable to table

Agri-food is a mature sector, characterised by relatively modest economic growth rates and a background of consumer spending that has steadily decreased in the household budget. The sector is predominantly SMEs and micro-businesses and has been slow to adopt ICT solutions. Its key challenge is to simultaneously meet customers' desire for diversity and choice, supermarkets' demands for high quality and reliability, and strict regulatory requirements on food health and safety.

The roadmap project AFORO created a vision and workplan to transform agriculture and food industries into digital companies. SEEM was identified as contributing to this transformation in a number of ways. For instance, it could provide the means to monitor food safety throughout the value chain, from raw material to point of sale, and so improve consumer confidence. Other applications of ICT within the sector include harmonised Europe-wide approaches to food labelling, land management systems, and e-auctions.

The European approach here has three pillars. At policy level, the eEurope 2005 Action Plan targets a dynamic e-business environment and is pursuing a package of measures in relation to e-skills, interoperability, trust & confidence and SME take-up. In the regulatory sphere, relevant legislation is being reviewed and reformed to remove barriers to intra-European (and wider) e-trade.

Technology is the third pillar for building the SEEM. The vision is of a pan-European infrastructure that offers interoperability between enterprise and business sectors, and where there is a common understanding of underlying business processes. Such an infrastructure would have embedded solutions for trust and security, as part of a "culture of security" that pervades the electronic business environment. Thus, the SEEM will be highly complex. It will contain many millions of entities – organisations, individuals or web services – willing to collaborate and interact. It will involve very large data flows and the ability to search among very large numbers of entities. Also, the SEEM implies a large number of entities working together to support business collaboration or solve complex problems through distributed analysis. These challenges require further targeted research.

Many of the technology foundations for the SEEM were addressed under the FP5 Key Action on New Methods of Work and Electronic Commerce (KA II). This included work on e-business within specific sectoral settings, provisions for secure payments, data and intellectual property protection, value creation in dynamic value chains, take-up measures for SMEs, and research on socio-economic, regulatory and policy aspects. These projects are producing substantive results (see boxes).

FP6 will build on these to get the bigger picture. Its goal is to move beyond solutions for individual business processes, enterprises or sectors towards an interoperable infrastructure for European business as a whole. It must be an integrated effort, where advances in technology and standards go hand-in-hand with regulatory and policy developments. Research will draw together and progress current trends in areas such as open platforms and standards, open source, agent technology, broadband networks, grids and peer-to-peer computing, mobility and content, and the semantic web. Further work to contribute to the development and implementation of future EU policies regarding the SEEM will be undertaken in Priority 8 "Support to EU Policies".

The impact of technology on society

What are the dynamics of the digital economy? SEAMATE aims to find out. It is making estimates, for the first time at EU level, of the socio-economic impact of IST on the EU-15, Norway and Switzerland. The approach combines a dynamic macroeconomic analysis with detailed treatment of industrial sectors and consumers/households.

So far the research shows that the performance of EU economies, the dynamics of IST and related knowledge-based activities are interwoven in multiple feedback loops. A variety of factors contribute to boosting productivity: investment in R&D and physical capital; improvements in IST performance; intellectual property and workforce skills; and the role of entrepreneurship and venture capital. Growth opportunities in the new economy are driven both by technological innovation and by IST production and use. The continued diffusion of IST will be dependent on increased competition, improved awareness among people and companies, and further evolution in the European regulatory framework.

Strategic Objectives:	*Applications and services for the mobile user and worker* *Networked businesses and governments*		
Project References:	*AFORO*	*IST-2001-37258*	
	SEAMATE	*IST-2000-31104*	*www.seamate.net*
Commission Contacts:	*Bror Salmelin*	*bror.salmelin@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/mobile-services/home.html* *www.cordis.lu/ist/directorate_f/ework/index.htm*		

Unlocking knowledge systems

Information overload threatens the utility of current networks, especially the internet. The semantic web and related developments will make the web a more user-friendly resource and help unlock the knowledge embedded in multimedia content.

Over the last ten years, the World Wide Web has evolved into a vast – and indispensable – medium for information, communications and transactions. The downside of this success has been information overload – an explosion of resources that makes it increasingly difficult to access and utilise information and services in ways that add value in our daily lives. Recently the concept of the semantic web has emerged with the aim of making web resources more machine-understandable. By enabling the context (semantics) of information to be identified and interpreted, the semantic web will bring structure to the web and make it a much more useful, and user-friendly, resource. Also, the concept of web services, where online transactional services are loosely coupled through common directories and exchange protocols, is starting to gain ground.

The addition of semantics is only the first step, however, and will not in itself solve the problem of information overload. As well as being able to generate semantic meta-data, we need to be able to structure, filter, retrieve and maintain it in a meaningful way – so as to turn "data" into "knowledge". Thus, the longer-term vision is of semantic-based knowledge systems, which "industrialise" key parts of the knowledge lifecycle.

For this to happen we need breakthroughs on several fronts. Global collections of knowledge bases should emerge, at first in information-intensive sectors such as science, infotainment and health. Knowledge acquisition and annotation need to be (semi)-automated, thus removing a serious bottleneck in building knowledge bases. New types of semantic-based search engines need to evolve to take advantage of these developments.

Furthermore, knowledge systems will need to reach new levels of scalability. For example, systems may need to support many agents working together or information retrieval scenarios where the content is highly personalised to the users' requirements. Machine learning and inference play an important role in knowledge systems. Breakthroughs can be envisaged for limited systems that can learn continually, or continuously, and which can function over long periods of time. Finally, the quality, value and trustworthiness of content will be a key concern. New generalised trust and confidence models will be needed, based on semantic links and references.

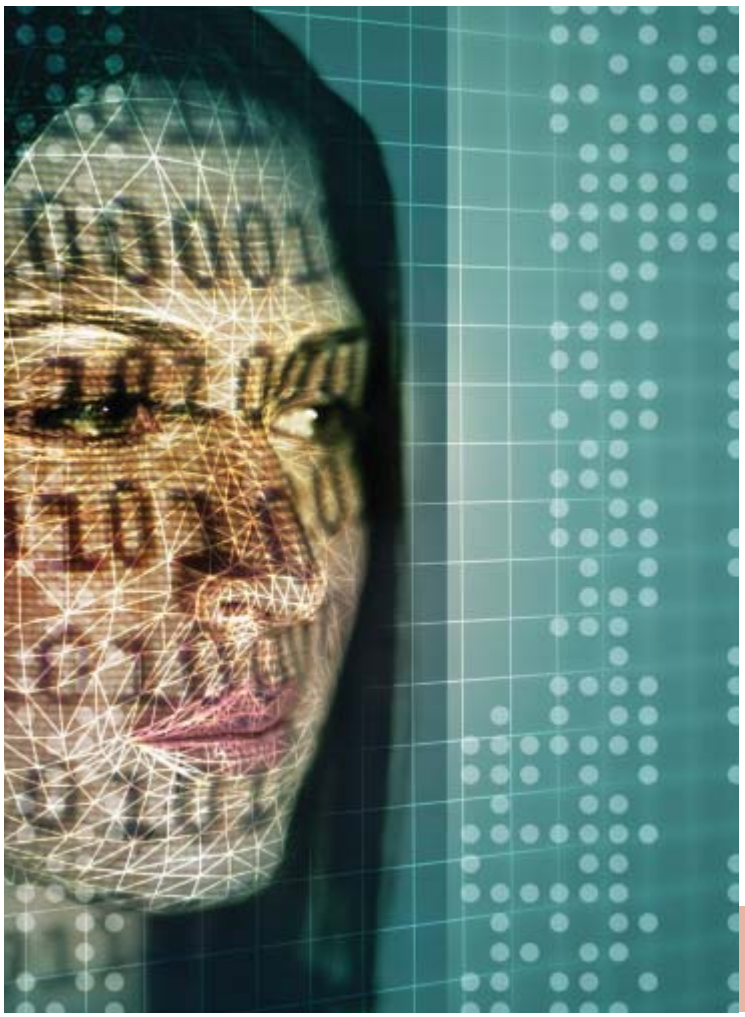
IST's FP5 action line on the Semantic Web resulted in around 30 projects relating to semantic content and services, involving over 250 research and industry organisations. This RTD has helped build critical mass in Europe, in particular through supporting the worldwide effort on Semantic Web Advanced Development led by W3C. IST's SWAD-Europe project is extending this work in Europe, providing targeted research, demonstrations and outreach to ensure semantic web technologies move into the mainstream of networked information systems.

In FP6, the RTD has both deepened and broadened. The research aims at maximising the automation of the complete knowledge lifecycle and achieving semantic interoperability between web resources and services. Key contributing developments to

Knowledge sharing on the semantic web

SWAP is developing technology that will allow users to apply their individual views on knowledge and, at the same time, let them share knowledge effectively.

Current knowledge repositories are mostly centralised systems with little flexibility and individualism, but with administration overhead. SWAP addresses the problem by pursuing a personalised knowledge management solution that considers everyone's computer a peer from which semantic knowledge is harvested, reused and queried. It aims at a high-quality knowledge management solution with low start-up costs and low administration overhead. SWAP's objective is to achieve synergy between two prominent fields of development – P2P (peer-to-peer) and semantic web.



Semantics will help make information systems more manageable

this research will be: content-based multimedia analysis; knowledge representation and reasoning; information/database methods; multi-agent frameworks; adaptive information systems which work under real-life constraints; machine learning and natural language processing. A batch of new projects (IPs, NoEs and STREPs) will be launched shortly from submissions in the 1st Call.

Intelligent web services

Web services are finding favour as a way for organisations to integrate their enterprise systems and support business collaborations. They promise a new level of service on top of those in the current web, but in order to use their full potential appropriate means of description need to be found. Current technology using UDDI, WSDL and SOAP provides limited support in mechanising service recognition, configuration and combination, comparison and automated negotiation. IST's SWWS project addresses this problem by linking web services with the semantic web.

The project will provide a semantic web based web service platform covering a wide range of potential e-business applications. It will enable web services to be discovered using a semantics-driven approach, and web service mediation to take place for the automatic and mechanised interaction between web service providers and requesters. The end result will be a scalable semantics-based web service environment where business partners can share services seamlessly across dynamic business communities.

Strategic Objectives:	*Semantic-based knowledge systems*		
Project References:	*SWAD-Europe*	*IST-2001-34732*	*www.w3.org/2001/sw/Europe/*
	SWAP	*IST-2001-34103*	*swap.semanticweb.org*
	SWWS	*IST-2001-37134*	*swws.semanticweb.org*
Commission Contacts:	*Franco Mastroddi*	*franco.mastroddi@cec.eu.int*	
	Brian Macklin	*brian.macklin@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/knowledge/home.html*		
	www.cordis.lu/ist/directorate_e/kmcc.htm		
	www.ktweb.org		

Digital Communities

IST for user-centred services and infrastructures

To realise the true potential of the Information Society, the benefits of IST need to be accessible to everyone, irrespective of age, gender, social status, or special needs. The development of user-centred IST applications and infrastructures for general and public services is essential to the realisation of a digital society.

Europe has made great strides in this area over recent years, partly aided by EU policies. Almost all schools are now connected, health professionals are increasingly using the internet to communicate with their patients and with each other, and many more government services are available online. GÉANT, Europe's high-speed research network, is a major achievement here, and points the way for further deployment and greater commercial use of the internet in Europe. European researchers now benefit from a world-class infrastructure for e-science that is enabling them to work in fundamentally new ways, and push back the boundaries of knowledge. Many of the solutions now being implemented in societal areas have their origins in RTD pioneered under Community programmes over the last decade.

In the Sixth Framework Programme, the IST Priority's RTD relating to societal applications focuses on long-term challenges and issues. Integration is a key theme. In e-health, for instance, RTD is aiming to draw together key technologies and knowledge bases within a health knowledge infrastructure to support personalised healthcare. Similarly, in risk management IST's research is laying the foundations for Europe-wide technology infrastructures and service platforms for improved civil protection. Complementing current policy actions on e-Safety, IST's research on intelligent transport systems is addressing long-term issues that will integrate technology developments from the vehicle and infrastructure perspectives.

New delivery paradigms is another recurring theme. eGovernment research targets equal and open access for all, while at the same time streamlining processes and enabling more effective collaboration. In e-learning, IST is opening up new opportunities for collaborative learning, whilst in e-culture IST can make cultural experiences more accessible and enjoyable for all and also help cultural institutions adjust to the new digital environment.

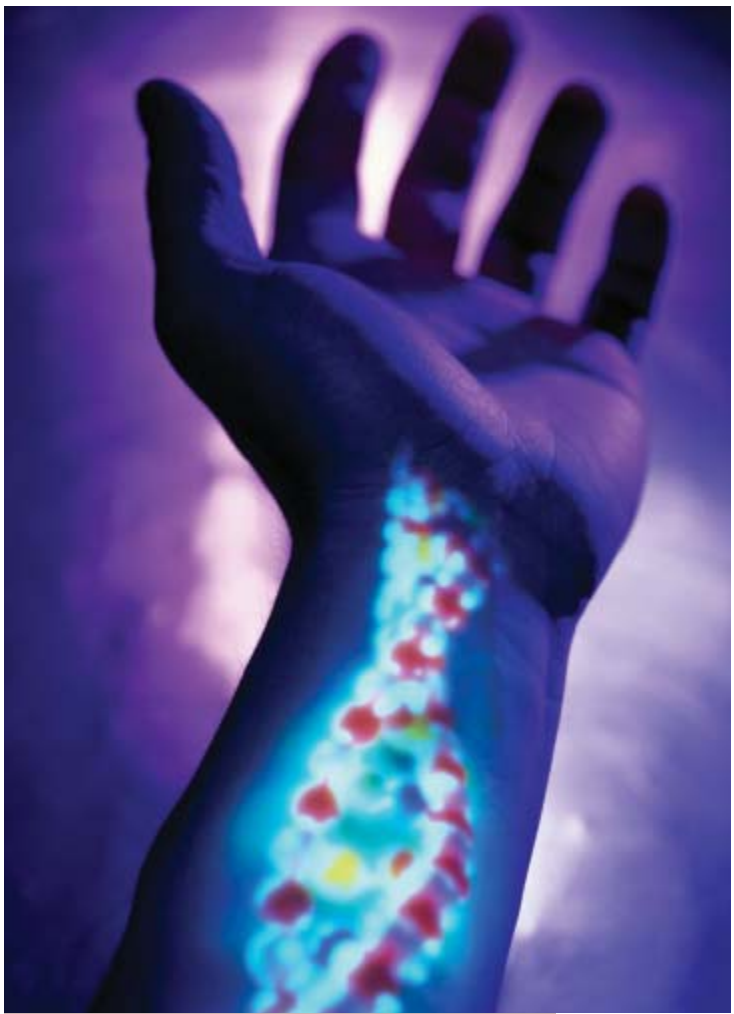
As more and more economic and societal activities involve the use of digital technologies, dependability and security is a common issue. Open source solutions are also being pursued as a means to help public authorities cut the cost of implementing innovative IST applications. Research on grids is targeting a new generation of user-friendly applications that will accelerate the wider use of grid computing in all areas of business and society.

Knowledge for health

Healthcare is evolving from an institutional focus to an emphasis on customised, personal care. By drawing together key technologies and knowledge bases, RTD for e-health aims to put in place the health knowledge infrastructure to support personalised healthcare.

Healthcare is facing huge changes. New drugs and advances in medical technology are opening the way to more effective treatments, while the unravelling of the human genome is leading to totally new treatment regimes. Clinical practices are changing, too, requiring health practitioners to collaborate across disciplines and organisational boundaries. And the whole philosophy of healthcare is shifting, towards treating patients at the point of need and a greater emphasis on health promotion and disease prevention. All this is against a background of an aging population and ever-increasing societal expectations of health.

Information and communications technologies (ICT) are making important contributions here, and paving the way towards completely new approaches to healthcare provision. European research on RTD for health – or what has come to be called "e-health" – reflects how this contribution is evolving. Early research under the framework programmes focused on "computers for doctors" and "networks for healthcare professionals". Today, the emphasis is shifting to citizens and patients, or in other words to personalised medicine that responds very specifically to the needs of the individual patient. Personalisation applies in many ways: not only to monitoring, diagnosis and treatment itself, but to delivery at the point of need, in the home for example. This will bring the double benefits of improving healthcare while making its delivery more cost-effective.



Personalised healthcare will draw together information from medicine, genetics and neurosciences

Although substantial expertise in e-health technologies has been accumulated over the years, for various reasons this has been slow in filtering through to the user community. European policy for e-health aims to remove barriers to take-up of such technologies through a combination of policy, regulatory and deployment actions. These include proposals, under the eEurope 2005 Action Plan, to introduce a European electronic health insurance card by 2008 and guidelines on the accessibility and content of health-related websites. Other initiatives address the deployment of broadband health networks between points of care and the setting up of online health services. Selected services are being expanded to a trans-European level through the eTEN network programme. The high-level eHealth conference, hosted by the Commission in May 2003, provided an opportunity for stakeholders to exchange experience and included the first eEurope Awards in e-Health.

While deployment actions continue, e-health RTD in FP6 aims towards a "knowledge for health" approach that will equip Europe for the longer term challenges arising from societal and technological change. The vision, essentially, is to use IST to empower citizens, patients and healthcare professionals to achieve better individual healthcare and well-being. To achieve this, we need to create a "health knowledge infostructure" – an intelligent and ubiquitous environment where health professionals and citizens are able to manage and share many health-related information streams. It implies the management of real time and accumulated knowledge from diverse sources such as medicine, genetics and behavioural sciences in a readily accessible form for all to use as required. This essentially holistic approach requires RTD programmes to be much wider and more multidisciplinary than in the past, involving players and funding sources from across the medical/health spectrum from genetics to public health.

Research will focus on three areas. Further research will be undertaken into biosensors and implantable and wearable devices that are able to communicate securely and interact with points of healthcare delivery. New (often open source) software tools will support the best possible decisions for prevention, diagnosis and treatment, providing access, via grids where appropriate, to dispersed and heterogeneous data sources. Researchers in medical informatics, bio-informatics and neuro-informatics will network together to create a new generation of e-health systems.

Three current projects illustrate the knowledge infrastructure theme. INFOGENMED is tackling the fundamental problem of data integration. It aims to show how data from large databases and in different formats can be brought together to improve patient care and epidemiological methods. The targeted products include: tools for data location, access and integration; a vocabulary server to bridge languages and terminologies; assistance tools such as flowcharts and data visualisation; and a field validation trial. HKIS focused on data integration leading to more flexible approaches for cancer treatment (see box).

BIOINFOMED brought together 30 experts to understand the role that informatics might play in the advancement of genomic medicine and research. Their white paper identified many solutions, including the use of informatics to support functional genomics, individualised healthcare, genomic medicine and enabling technologies. It also outlined a research agenda for further developing areas of synergy.

Individualised cancer treatment

Oncology – the study of Europe's second highest cause of death – finds it hard to provide adapted treatments because it is difficult to predict the aggressiveness of a tumour or its response to treatment. Recent years, however, have seen the prospect of multi-parametric analysis of tumours together with the measurement of thousands of DNA parameters, their gene expression and protein variants. Combining this with accumulating knowledge of gene sequences, protein functions, population polymorphisms and tumour histories, makes possible individually adapted treatment. The bottleneck is data integration. HKIS is addressing this issue with an easy-to-use environment offering worldwide access to heterogeneous database platforms.

Strategic Objectives:	*eHealth*		
Project References:	*BIOINFOMED*	*IST-2001-35024*	*bioinfomed.isciii.es*
	HKIS	*IST-2001-38153*	
	INFOGENMED	*IST-2001-39013*	*www.infogenmed.net*
Commission Contacts:	*Jean-Claude Healy*	*jean-claude.healy@cec.eu.int*	
	Sofie Norager	*sofie.norager@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/ehealth/home.html*		

Seamless e-government

IST's research for e-government aims to create equal and open access for all, while at the same time streamlining processes and enabling more effective collaboration.

Most governments in Europe have sought to use e-government as a key tool for modernising public services and re-engineering administrative processes. These first-generation services have tended to be delivered along departmental lines, and so have been confusing for citizens to access. Also, this fragmentation has prevented administrations from realising economies of scale and created major barriers to sharing information and integrating processes across government.

The need for a more user-centred approach is now widely recognised. When people (or businesses) interact with government they want to do so in ways that relate to their individual requirements – not some departmental or process view. They are looking for services that are accessible, secure and easy-to-use rather than constrained by organisational boundaries. We need to apply technology to improve the quality of publicly-funded services, while at the same time streamlining processes and easing the burden on public sector employees. As well as re-engineering their back-offices, administrations should be able to share knowledge and resources seamlessly, build more effective collaborations and thus become more productive and deliver better value for taxpayers. Furthermore, as recognised in the eEurope Action Plan, as a major customer of IST technologies and applications, public authorities can provide a crucial pull for new networks and services.

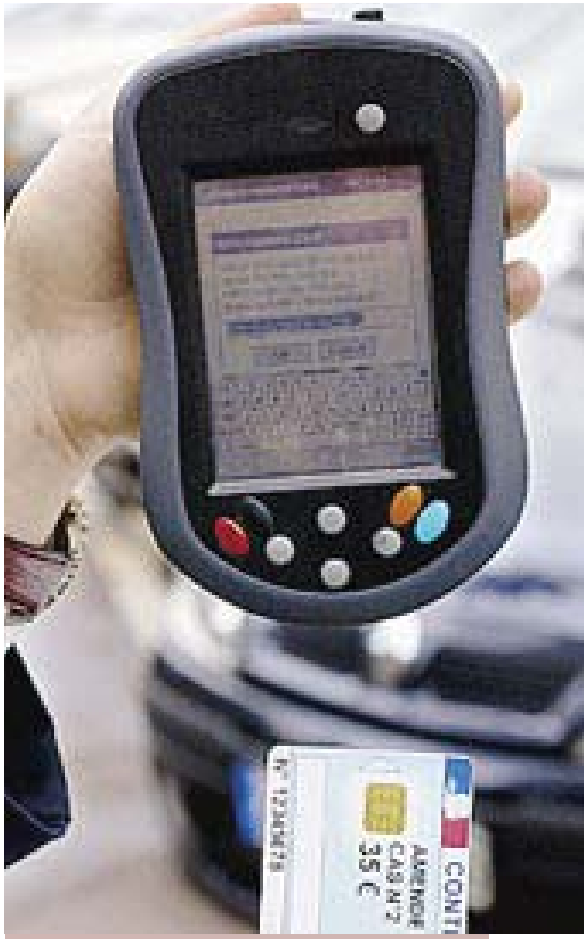
The implementation of e-government can be seen as a progressive process, similar to the "e-adoption ladder" commonly quoted for e-business. Beyond placing traditional public services online, digital technologies enable the offer of new services that are mobile, pan-European and personalised. At the top-most levels of the ladder, administrations are looking to integrate their e-government activities with their existing processes, and ultimately to transform the organisation through new processes and services. But while the model is similar, the circumstances are different. Public administrations do not operate in a competitive marketplace; nor do they appraise investment in the same way as private enterprises. They need specific solutions that meet the public services' particular requirements and constraints.

In the Sixth Framework Programme, IST's research for e-government supports world-class visionary research which responds to the emerging needs of European society over the next ten years, characterised by greater diversity, flexibility and mobility. RTD is structured around two core challenges: firstly, the 'front-office' where advanced e-government services are provided to businesses and citizens that are interactive and secure; and secondly, the 'back-office' where user-driven organisational transformation will help European administrations become more dynamic, interoperable and service-driven. The work emphasises the use of open standards as means of ensuring the interoperability of e-government solutions. Open source approaches are also being investigated. IST research is expected to be a catalyst for further e-government policy developments and through them to increase the scale and impact of e-government investment in Europe. Efforts to build a European Research Area in e-government-related research will be important here.

FP5 projects are already making important contributions. For instance, EMPLOY has developed innovative multimedia tools to support the

Your online advisor

Citizens are familiar with having conversations with people when they contact public administrations and are looking for the same level of accessibility in online services. AVANTI is trying to replicate this conversation with the computer. Its idea is to replace a standard internet interface with a far simpler one, based around an on-screen character called an 'avatar'. This character is able to speak to the citizen in their own language, understand their responses in natural language and act according to their requests. The consortium has also developed a sophisticated natural language processing component and a conversation manager, and have interfaced this with the administration's systems and databases.



An e-ticketing system for collecting traffic fines, developed under project CLIPCARD

management of the EU Structural Funds. The system has been tested and validated by the Regional Policy DG of the European Commission, which is promoting its use by all Member States and Candidate Countries. CLIPCARD targets a smart-card based system for the payment of traffic fines, replacing current paper slips.

FASME has delivered a prototype for an employment documentation system based on JavaCards. The system will help mobile workers moving from one EU country to another in dealing with issues such as change of residency and car registration. An integrated platform for one-stop government is the target of eGOV. Based on open standards and technologies (e.g. XML/RDF, web services), the platform includes a portal where information and services are grouped around life-events and business episodes.

Recognising the need to disseminate best practices and reward exemplary achievements, IST has launched the e-Europe Awards for Innovation in e-Government. The first awards were presented at the eGovernment 2003 Conference in Como, Italy in July 2003. Also concerned with information exchange, e-Forum provides a place for discussion on future needs for e-government and a resource centre for e-government knowledge.

Benchmarking the information society

Accurate and reliable statistics are crucial to our understanding of economic and social phenomena, but current statistics fail to capture the many new facets and trends of the emerging information society. SIBIS has developed new statistical indicators which track Europe's increasingly service-oriented, knowledge-driven economies.

Its set of indicators reflect the priorities and targets of the eEurope Action Plan. Based on extensive surveys, a series of 10 reports has been published covering the EU Member States, Candidate Countries, Switzerland and USA. These document the current state of European society with regard to a range of IS variables and, by providing insights on the rate of change of these indicators, will strongly contribute to policy development. In addition, the SIBIS eEurope Indicator Handbook details indicator definitions and construction in a way appropriate for use by statistical agencies.

Strategic Objectives:	*Networked businesses and governments*		
Project References:	*AVANTI*	*IST-2000-28585*	*www.avantiproject.org*
	CLIPCARD	*IST-2001-32148*	*www.clipcard.fr*
	EEurope AWARDS	*IST-2001-38016*	*www.e-europeawards.org*
	EGOV	*IST-2000-28471*	*www.egov-project.org*
	E-FORUM	*IST-2001-38625*	
	EMPLOY	*IST-1999-10007*	*www.employproject.org*
	FASME	*IST-1999-10882*	*www.fasme.org*
	SIBIS	*IST-2000-26276*	*www.sibis-eu.org*
Commission Contacts:	*Frédéric Loeurng*	*C6-egovernment@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/business-govt/home.html*		

Security in openness

As more and more economic and societal activities move into the e-space, so critical business and social processes are becoming more vulnerable to accidental or malicious failures of information systems. The European Dependability Initiative supports EU policies on critical infrastructure protection (CIP), from both the near-term and long-term perspectives.

In the digital environment, security issues are global. As businesses become more knowledge-centred, information is a key commercial and economic asset. The infrastructures of modern life, such as banking and finance, healthcare, energy, transportation and others, rely on ICT and are mutually dependent. Also, factors such as deregulation and globalisation are blurring the boundaries between sectors and legal jurisdictions. Hence, critical infrastructure protection (CIP) is coming to be recognised as a key challenge for the future development of the information society.

With digital technologies becoming more pervasive, our approach to security is changing. No longer is it a matter of "keeping the bad guys out", but rather of ensuring the resilience of systems to disruptions for whatever reason, be it malice, accident or neglect. Instead of "security in obscurity", where the security layer is made up of incompatible technologies often bolted on as an afterthought, we need a more open approach where security technologies are based on common standards and designed in from the beginning. This "security in openness" will be essential as we move towards systems and platforms based on open standards and towards greater use of mobile and embedded devices.

The European Commission's role here is threefold: it sets the regulatory framework, launches policy initiatives, and funds innovative RTD. Regulatory measures include a common approach and specific actions in the area of network and information security[1] and on attacks against information systems[2]. Under eEurope 2005, the Commission has recently proposed the setting up of a European Network and Information Security Agency (ENISA). This will serve as a centre of competence for both Member States and EU institutions on cybersecurity matters. The Agency will also provide assistance to Member States' authorities and build on existing resources and expertise in the area of network and information security, like the computer security incident response teams (CSIRTs).

The European Dependability Initiative (DEPPY) is a major R&D initiative under the IST Programme to develop technologies, systems and capabilities to tackle the emerging dependability issues. The experience gained in DEPPY since its launch in 1998 has shown that to meet these challenges there is a need to integrate many research efforts and resources. These range from security, fault tolerance, reliability, safety and survivability, to areas such as network engineering, psychology, human factors and econometrics.

In total in FP5, 16 R&D projects on dependability were funded. Areas covered have included: intrusion tolerance in largely-distributed systems; methods and tools for assuring dependability; dependability benchmarks for COTS; advanced tools for embedded systems design; and management and control systems for electrical supply and for telecoms networks. Three projects (EISPP, ECSIRT and TRANSIT) directly supported eEurope's objectives in relation to CSIRTs.

Later projects aimed specifically to prepare the ground for further research initiatives in FP6, in particular with a view to ambient intelligence scenarios. ACIP tackled

An holistic view of dependability

AMSD focused on a global and holistic view of dependability. The project addressed future needs in this field covering not only RTD (reliability, safety, security, survivability, etc.) but also education and training and means to encourage IST RTD projects to use dependability best practice. It initiated moves towards the creation of such an initiative via road mapping and constituency- and consensus-building activities.

The results are an overall dependability roadmap that considers dependability in an holistic way, and a detailed roadmap for dependable embedded systems. The latter covers application and technology assessment and a research agenda.

The growth of information networks calls for pervasive security

the area of simulation and modelling for CIP. The resulting roadmap describes how computer-based tools could be used to identify and evaluate the state-of-the-art in CIP, to analyse mutual dependencies of infrastructures and cascading effects, and to model different scenarios to determine gaps, deficiencies and robustness.

WG-ALPINE looked at survivability and loss prevention in ICT-enabled enterprises. The Working Group approached the problems from a user perspective, with special emphasis on the view of SME integrators. It brought together representatives from key professional communities, such as law, audit and insurance, to achieve consensus on suitable solutions for SMEs. Taking into account the findings of these and other roadmap projects, AMSD focused on an overall dependability roadmap (see box). These roadmaps were complemented by the work of DDSI, which provided policy support on dependability issues, including a dialogue with the equivalent community in the US.

This EU-US partnership will be developed further under FP6. A joint R&D agenda will be developed, leveraging results from the EU's roadmap projects where relevant. In addition, contacts with funding agencies, such as the National Science Foundation, are being established with a view to building concrete collaborations between NSF projects and those from the 1st Call of FP6. Working mechanisms to turn such opportunities into practice are also being investigated.

[1] Council Resolution on a common approach and specific actions in the area of network and information security, 2002/c 43/02, 28 January 2002
[2] Proposal for a Council Framework Decision on attacks against information systems, COM(2002) 73 final, 19 April 2002

Strategic Objectives:	*Towards a global dependability and security framework*		
Project References:	*ACIP*	*IST-2001-37257*	*www.eu-acip.de*
	AMSD	*IST-2001-37553*	*www.am-sd.org*
	DDSI	*IST-2000-29202*	*www.ddsi.org*
	ECSIRT.NET	*IST-2001-37558*	
	EISPP	*IST-2001-35200*	
	TRANSITS	*IST-2001-39118*	
	WG-ALPINE	*IST-2001-38703*	*www.opengroup.org/alpine*
Commission Contacts:	*Andrea Servida*	*andrea.servida@cec.eu.int*	
Web:	*http://deppy.jrc.it*		
	www.cordis.lu/ist/so/dependability-security/home.html		

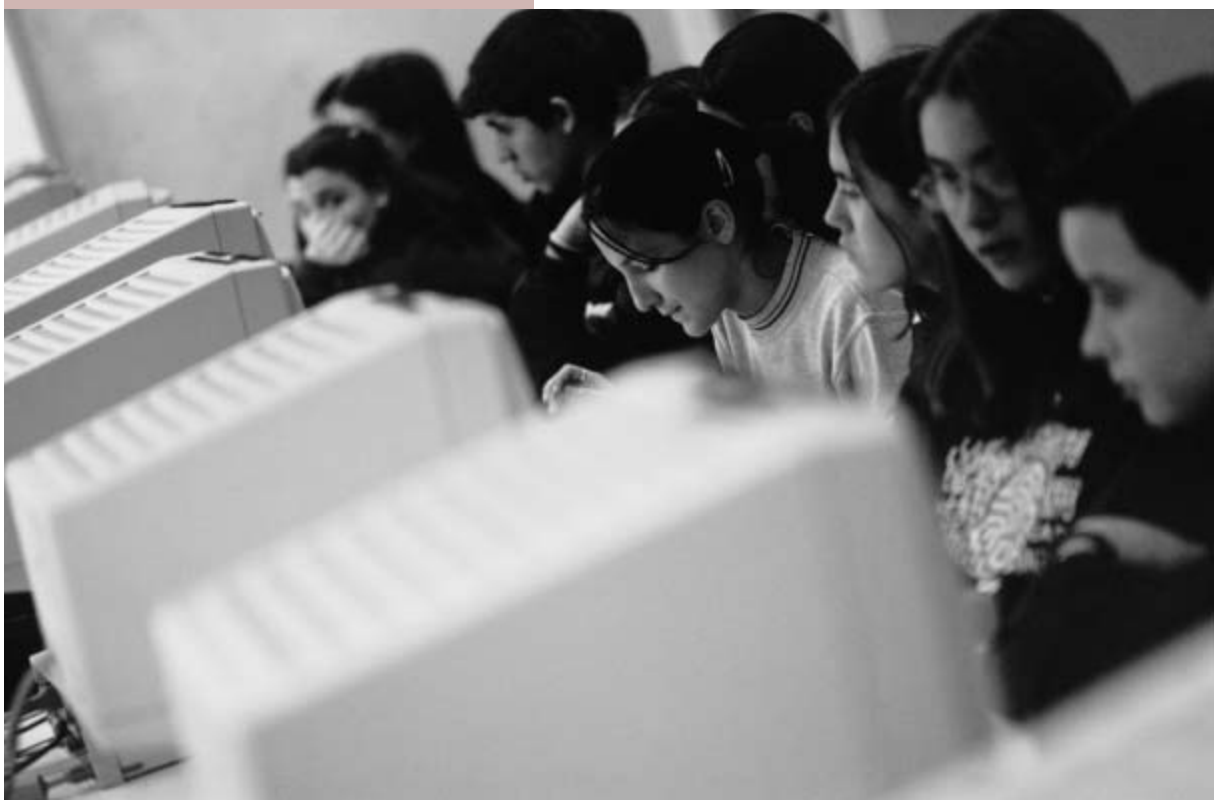
Learning together

New technologies open up new opportunities for co-operation between learners and institutions in dynamic online learning communities.

Much has been said about our changing society, and the challenges it presents to the way we will all have to learn and go on learning throughout our working and personal lives. The learning revolution will embrace new technology to allow people to follow their own choices of self-paced, tailored and individual learning experiences. Despite this emphasis on personalisation however, we must not underestimate the importance of the collaborative dimension of learning. As individuals we learn by interacting with our peer-group; as institutions we profit by sharing resources; and as training providers we work best if we develop materials in teams. As people find each other and exchange ideas, good relationships develop and a community forms. This community – whether within an institution, company or just a self-organised social group – becomes an incubator where new knowledge, skills, and competencies develop.

Technology is contributing here through a generation of networked computer-supported collaborative

Collaborative learning is an incubator for new ideas



Broadband resources for European schools

In schools and higher education institutions, traditional forms of learning in a classroom setting are being complemented by e-learning. The development of e-learning has increased demand for high quality electronic learning resources or "learning objects", accompanied by flexible content management systems.

CELEBRATE, bringing together all the European Schoolnet members, is developing a wide range of electronic learning objects, capable of being used and re-used in a range of formats in a new generation of managed learning environments. These are being made available, via a demonstration portal, to schools that are already participating in broadband pilots in six European countries.

learning (CSCL) tools that bring the power of collaboration to schools, universities and workplaces. FP5 projects under the School of Tomorrow, Flexible Universities and Self-learning for Work action lines are demonstrating new cooperative approaches to teaching and learning. For instance, CELEBRATE is demonstrating the use of high-quality learning resources for e-learning environments (see box).

ITCOLE has developed a web-based environment for collaborative learning and knowledge building in schools. This is a shared electronic workspace for students and teachers in synchronous and asynchronous collaboration, including tools for community and team building. Real-time feedback on several aspects of collaboration helps teachers manage the process of knowledge building. Practical models for the use of CSCL tools were generated and refined into a set of best practice guidelines, thus overcoming some of the problems inherent in existing practice. A large-scale evaluation in schools across Europe helped ensure a good match between the new learning models and the local practices of each trial location. A full working prototype CSCL system is available free of charge to educational institutions under open source terms.

In the future, new and emerging technologies will offer greater computer power in flexible environments, and new infrastructures capable of delivering high-volume and complex content, e.g. complex VR or 3D environments. Connectivity for the individual, via new ranges of mobile and fixed devices, is bringing new services and, through these technologies, changing the way we interact with others across widely different geographical locations. Research on virtual collaborative learning communities and how they can exploit the opportunities of these technologies forms one of the key themes in IST's current and forthcoming research on technology-enhanced learning.

Some pioneering work has already started under FP5 to explore the potential of broadband and grid technologies for learning. Experimental research integrating new powerful developments of grid and the leading-edge of current and emerging ICT technologies (e.g. mobile, broadband) lead us to a significant new learning scenario. In this learner-centred scenario, learning results through interaction, conversation, exchange and sharing of knowledge, and enhanced presence within dynamic virtual communities.

New projects under FP6 aim to tackle these issues looking at both research into how new collaborative learning paradigms can be supported through these new technologies. They will also develop early test-bed applications of new collaborative learning infrastructures and services, involving co-operation at institutional/organisational level and between individuals in online learning communities.

Creating a European Learning Grid infrastructure

Grid technologies promise an infrastructure that will allow the various actors in the learning process to collaborate and share high-quality learning data and innovative solutions for learning and training. LEGE-WG is investigating the application of grid computing for e-learning. It is creating a network of national centres of excellence in distributed, co-operative learning environments. Forging links between experts in e-learning and grid computing, it will create pedagogical models and technical innovations. These are expected to lead to RTD projects, learning strategies, and an understanding of necessary legislative and regulatory developments.

Strategic Objectives:	*Technology-enhanced learning and access to cultural heritage*		
Project References:	*CELEBRATE*	*IST-2001-35188*	*www.eun.org/eun.org2/eun/en/index_celebrate.cfm*
	ITCOLE	*IST-2000-26249*	*www.euro-cscl.org*
	LeGE-WG	*IST-2001-38763*	*www.zeusconsult.gr/LeGE-WG*
Commission Contacts:	*Alma Cardi*	*alma.cardi@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/learncult/home.html*		
	www.cordis.lu/ist/directorate_e/telearn/index.htm		

Open source for e-services

Open source software helps cut the cost of software development and accelerate the take-up of innovative solutions amongst users. European developers can exploit these capabilities for competitive advantage.

Open source software has emerged as one of the most intriguing phenomena of the information society. Over the last decade, the free and open source software (F/OSS) movement has grown steadily, to the point where it is now an established feature of the mainstream software market.

While some of the claims associated with open source can be applied equally to proprietary and closed software, open source does have a number of positive and original features, as was also noted by ISTAG[1]. It is a powerful means to disseminate innovation and can help cut costs and exploit synergies among users of the same technology. Open source can also play a key role in a commercial strategy as a means to establish a community of users and form an infrastructure for user-supplier networks. For these reasons, European companies should consider exploiting open source for strategic competitive advantage and facilitating where appropriate the broad diffusion of the results of the Framework Programme.

The IST Programme has been an active player in support of innovation in this area. Under FP5, projects with F/OSS dimensions were funded under several action lines and these were informally clustered. Key objectives were to foster a critical mass of development of free software in Europe and make available European-based support services for free software projects. A series of take-up actions were also funded. In 2001, a dedicated call on free software development resulted in a series of new projects on e-government and e-security, areas where open source is recognised as making significant contributions in improving trust, confidentiality and security.

OpenRouter developed an open architecture router/firewall device to meet the requirements of the SME & SOHO environment. The system uses open source software on an embedded platform, GNU/Linux running on Intel StrongARM and features LAN, WAN and wireless interfaces. A trusted public key infrastructure based on open source solutions is targeted by EU PKI, to be specified and demonstrated with major industrial partners.

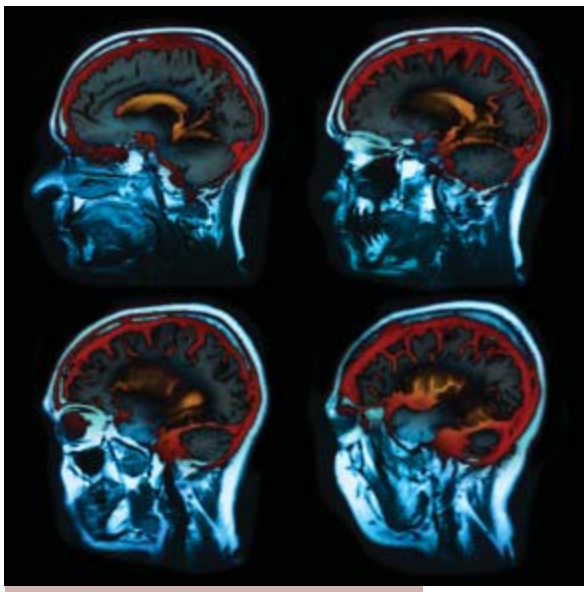
In healthcare, SPIRIT has set-up a multilingual portal providing news and best practice advice on F/OSS-related developments (see box). PICNIC developed a series of services and tools to support regional healthcare providers in delivering new forms of patient-centred care. All of the solutions follow the open source model and are available in the public domain. SMARTIE provides a collection of F/OSS medical decision support software, called MedNotes, to cover a wide range of medical needs and different user platforms (PalmOS, WinCE). Finally, OpenECG is consolidating European interoperability efforts in computerized electrocardiography (ECG) based on open source tools.

One particularly important market is e-government: European administrations spend around €6.6 billion per year on IT, and a recent survey for the Commission suggests considerable savings could be made by them sharing OS resources. Some public authorities in the EU are already specifying F/OSS for new software projects because of its flexibility, transparency and cost advantages. THREE ROSES has

Open source telephony solutions

VoiceXML is the new lingua franca for telephony applications, supported by all of the major players. VoiceXML is a standardisation effort for telephony-based IVR (interactive voice response) applications, such as voice mailboxes, ticket reservation, car sharing, chat or payment services, allowing interaction with databases which may be connected to the internet. The standard is endorsed by W3C and will be a key driver in IVR services.

The PUBLICVOICE XML project has demonstrated an open source implementation of the VoiceXML standard together with European community radio stations. Some of the stations, such as Vienna's Orange 94.0, contributed to the user requirements phase and integrated VoiceXML into their content management and archiving systems. Complete open source implementations are available for both the Windows and Linux platforms.



E-health is one of many areas to benefit from open source solutions

focused on e-government services and e-business solutions that could be promoted by public administrations in their local context. Special attention is being paid to the development and support of open source e-learning solutions for the public sector. The benefits and disadvantages of adopting F/OSS technology are also being examined.

While no longer a priority area in its own right, open source is present in many areas of the IST Work Programme, in particular in encouraging the development of open standards and interoperability. Relevant areas include e-business, e-government and e-health, and open development platforms for software and services. Regarding the latter, F/OSS is seen as a means to increase a quick adoption of the technology and as a key enabler for open standards. It should also enable the rapid transfer of research results and improve interoperability between services.

Accelerating citizen-centred care

SPIRIT is a multilingual portal for best practice open source news and software for healthcare. The service provides healthcare providers with free access to a variety of resources – in particular best practice F/OSS applications – being developed in Europe and around the world. Sources of F/OSS applications and components include government agencies, medical teaching institutes, and other healthcare providers.

The Spirit virtual community also supports networking between healthcare informatics professionals so as to increase awareness of and involvement with open source healthcare solutions. Other activities are disseminating open source research results, groupware applications, audio/video conferencing facilities, mailing lists, and website hosting for open source healthcare projects.

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[1] Software Technologies, Embedded Systems and Distributed Systems: A European Strategy towards an Ambient Intelligent Environment, ISTAG WG9, 2002

Strategic Objectives:	*eHealth* *Networked businesses and government* *Open development platforms for software and services*		
Project References:	*EUPKI*	*IST-2001-34340*	*www.eupki.org*
	OpenECG	*IST-2001-37711*	*www.openecg.net*
	OpenRouter	*IST-2000-28503*	*www.inaccessnetworks.com/projects/openrouter*
	PUBLICVOICE XML	*IST-2001-34546*	*www.publicvoicexml.org*
	SMARTIE	*IST-2000-25429*	*www.smartie-ist.org*
	SPIRIT	*IST-2000-26162*	*www.euspirit.org*
	THREE ROSES	*IST-2001-37967*	*www.prelude.portal.org/3roses*
Commission Contacts:	*Dirk van Rooy (Software Technologies)*		*dirk.van-rooy@cec.eu.int*
	Frédéric Loeurng (eGovernment)		*C6-egovernment@cec.eu.int*
	Yves Paindaveine (eHealth)		*yves.paindaveine@cec.eu.int*
Web:	*www.cordis.lu/ist/so/sw-platforms/home.html* *www.cordis.lu/ist/so/business-govt/home.html* *www.cordis.lu/ist/so/ehealth/home.html*		

Accessible culture for all

Information and communications technologies are transforming the cultural sector. IST's research focuses on making cultural experiences accessible and enjoyable for all, whilst also helping memory institutions adjust to the new digital environment.

All systems go for lift-off! – the ASH project's virtual control room (Photo: ASH project)

For many European archives, libraries and museums being digital is no longer an option but a necessity. With conventional resources being digitised and others being "born digital", cultural institutions are having to take care of both analogue and digital collections. The conversion of all sorts of cultural contents into bits and bytes opens up opportunities for reaching traditional and new audiences in ways that were unimaginable a decade ago. But the integration and management of new digital technologies also affects how cultural institutions perform their societal role.

Recognising the importance of cultural heritage in education and learning policies, the eEurope 2005 Action Plan proposes that all European museums, libraries, archives and similar institutions should be connected to broadband networks by the end of 2005. With a longer term perspective, relevant research has taken place under the FP5 action lines on digital cultural heritage. The work focuses on technical and organisational issues regarding distributed collections and very large-scale digital repositories. This includes content management and long-term preservation. Models for future virtual collections and guidelines for integrating real and virtual objects and collections are also emphasised.

Scientific heritage is an important part of our collective heritage and several projects have focused on making this area more understandable and accessible. For instance VAKHUM addressed human kinematics, an area of medical scientific knowledge. It collected data on the way our joints behave in normal and abnormal scenarios and presented this by way of virtual reality simulations. Three fully interactive 3D models have been built, showing motion of the hip, knee and ankle joints. These models can be manipulated in a variety of ways to get a full understanding of how each of the joints works. The system will help medical staff and students to better understand functional anatomy.

Not rocket science

Astronomy and space command a high public profile, but many people are put off serious interest in the subject by a perception that it is complicated to understand. The ASH project has tried to change all that by developing a highly-visual and user-friendly learning environment.

ASH's virtual control room is an electronic learning environment resembling a real space control centre. Using the latest in audio-visual interfaces, 3D object management and agent technology, users work collaboratively to plan and perform a simulated space mission and play various roles necessary to make the mission a success. It gives people an approachable experience of the subject and so easier access to the underlying science, while also emphasising the importance of collaboration in current-day research. The system is targeted at high-school students (16-18 years old), but will fascinate people of all ages.

Another project, ASH, focused on an entirely different area of science – space and astronomy (see box).

To help decision-makers in the cultural heritage sector to build and exploit the emerging digital landscape, the IST Programme commissioned a major foresight study looking at trends in the European cultural heritage sector over the next five years. The resulting report, known as the DigiCULT Report[1], provides a strategic roadmap for future developments. Building on these findings, DIGICULT-FORUM has been launched. This is a network of 50 culture and technology experts that monitors technological trends and related issues affecting the future of the European cultural heritage sector. Through publications and workshops it helps practitioners to identify key issues, find solutions and apply them in their own situations. Technology watch reports provide summaries of emerging technology areas such as tagging, human interfaces, games, virtual reality and customer relationship management. Thematic reports provide more detailed analysis of particular subjects, the first three being integrity and authenticity, asset management systems, and interoperable semantic tools for content management.

IST's research on digital culture in FP6 underlines the importance of improving the accessibility and visibility of Europe's cultural heritage and of recognising its commercial value. Advanced electronic library services is one theme, with an accent on providing high-bandwidth access to distributed and highly interactive repositories of European culture, history and science. Intelligent heritage and tourism environments will also be addressed, with the aim of re-creating and visualising cultural and scientific objects and sites in a way that enhances the user experience. In both areas, RTD will address system integration as well as further fundamental research.

The learning game

Computer and video games are very popular nowadays, especially with young people. Edutainment combines gaming environments with learning experiences to enable people to learn in an enjoyable way. RENAISSANCE has brought this approach to the study of social history by building a collaborative virtual community that reconstructs a renaissance court.

A player gains a portal to this community and plays the part of a courtier. He or she can exchange information, gossip, fight or form alliances at choice, but always experiencing the social conventions of the day. A basic set of standard characters in the virtual environment ensures that a minimal social structure exists all the time. An evaluation agent checks users' behaviour in real time using advanced intelligent system technology. Consequences of users' actions are determined by a knowledge base of historically valid information about codified behaviour rules.

[1] Technological Landscapes for Tomorrow's Cultural Economy, Digicult Project, 2002. Available at www.digicult.info

Strategic Objectives:	*Technology-enhanced learning and access to cultural heritage*		
Project References:	*ASH*	*IST-1999-10859*	*www.ashproject.org*
	DIGICULT FORUM	*IST-2001-34898*	*www.digicult.info*
	RENAISSANCE	*IST-1999-12163*	*www.renaissance-project.com*
	VAKHUM	*IST-1999-10954)*	*www.ulb.ac.be/project/vakhum*
Commission Contacts:	*Bernard Smith*	*bernard.smith@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/learncult/home.html*		
	www.cordis.lu/ist/directorate_e/pech.htm		

Creating the e-Infrastructure

GÉANT, Europe's high-speed research network, has created a world-class infrastructure for e-science. With the further development of grid middleware on top of GÉANT, Europe will have at its disposal an e-infrastructure to support a wide range of societal and business applications.

Scientific research is increasingly reliant on collaboration across electronic networks. In Europe, the highly robust infrastructure needed to support e-science and the evolution towards grids is being provided by a new world-class high-speed network called GÉANT. This very high performance, pan-European network service interconnects Europe's national research and education networks (NRENs) at multiple gigabit speeds. With a backbone throughput of 10Gb/s, GÉANT links over 3100 research and education organisations in more than 32 countries. It serves a dual role, providing not only an infrastructure to support researchers but also a platform for network research itself on issues such as quality of service, all-optical networks and IPv6. Already, around 40 research communities have expressed interest in using GÉANT to meet their own e-science needs (see box).

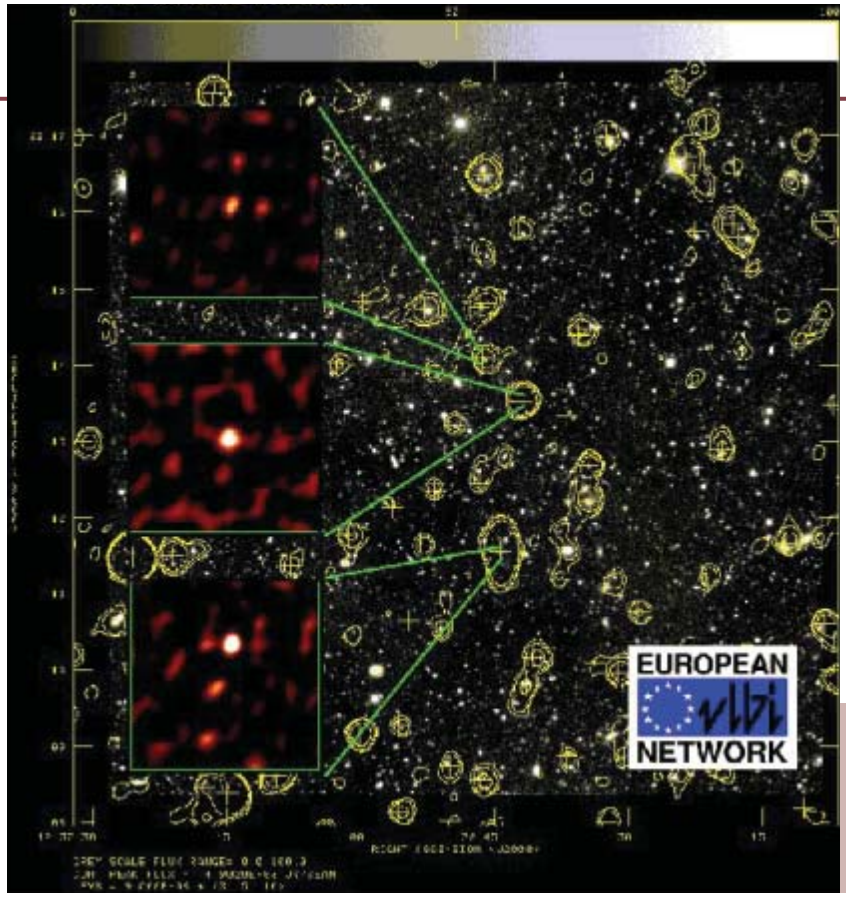
In technical terms, the network is based on a multigigabit/s (Gb/s) resilient core, exploiting dense wavelength division multiplexing (DWDM) optical technology. During 2002/3 both the capacity and connectivity of the GÉANT network have continued to increase. Connectivity to international networks has also been improved, notably through the upgrading of trans-atlantic capacity from 2.5 Gb/s to 7.5 Gb/s for each of three dedicated links, one of which is IPv6 enabled. By the end of 2002, GÉANT was carrying more than 1 petabyte (1015) of data per month (equivalent to 1.3 million CDs), with the volume of research traffic doubling every 6 months.

One of GÉANT's most significant achievements has been in IPv6, where it has provided the pan-European backbone network enabling the rollout of IPv6 services to the NRENs across Europe. Following a series of successful testbeds, the first two NRENs enabled IPv6 connectivity to GÉANT in April 2003 and a full production service across Europe will be launched in October 2003. A global IPv6 service is expected by the end of the year, demonstrating the IPv6 inter-working between the various regional research backbones around the world and the first step towards global research networking.

With research increasingly undertaken at a global scale, research networks are a means to strengthen co-operation with other regions of the world. As well as connectivity to networks in North America and Asia-Pacific, GÉANT has helped bridge the digital divide between developed and developing countries. For instance, it has assisted Latin American countries to set up a new research backbone, known as ALICE, which will be fully operational by mid-2004. A new network infrastructure within the Mediterranean region is also due to come on stream in early 2004 and a further initiative, SEEREN, aims at strengthening connectivity in the Balkans.

In parallel with the GÉANT developments, Europe has witnessed remarkable achievements in the area of grids, namely with the releases and demonstrations of the first reference implementations of OGSA (Open Grid Services Architecture) by IST-sponsored testbed projects. The continued maturation of grid and networking technology is expected to lead to the emergence of a new infrastructure paradigm that in time will come to be seen as a commodity service. The creation of such an "eInfrastructure", which will provide fully integrated communication and information processing services, is a key objective of the European Research Area. This grid-enabled infrastructure has the potential to dramatically change the way in which people work and do business over the internet, and is seen by many as the enabling technology for the next generation of science and business applications.

In the Sixth Framework Programme, a total of €300 M has been allocated for topics related to GÉANT and grid infrastructures, a doubling of the budget compared to FP5. Reflecting their capital-intensive nature, the majority of these activities are being undertaken through the Research Infrastructures priority within the Specific Programme on Structuring the ERA. The work is driven by four inter-linked objectives: reinforcement of the network infrastructure to the



Radio sources in the Hubble Deep Field. The inset sources show radio emission detected by the EVN and thought to arise from the enormous energy released by super-massive black holes. (Photo: VLBI)

100Gb/s level and beyond; further contributions to improving global connectivity; support for pan-European high performance grid infrastructures supporting the various scientific domains; and the promotion of large-scale experimentation on next generation networks. Further projects will be launched in 2004, following recent calls; these include a number of projects that will establish a grid empowered infrastructure and a revitalised GÉANT network infrastructure.

GÉANT's big bang for astronomy research

The European VLBI Network (EVN) is a distributed network of large radio telescopes that are located across Europe and beyond (see www.evlbi.org). Signals from telescopes around Europe are combined together by a purpose-built supercomputer, the EVN Correlator, operated by the Joint Institute for VLBI in Europe (JIVE). The correlator generates up to 1 terabyte (10^{12}) of data for a single 12 hour observation. Astronomers experience long delays in obtaining access to this data, however, due to a reliance on tape-based recording systems. These have low bandwidths and need to be physically shipped from the telescopes to JIVE.

A new project, the eVLBI will allow VLBI data to be transferred directly from the telescopes to the Correlator in real-time. Under the leadership of GÉANT, a consortium of NRENs and European radio observatories has been established to carry out a proof-of-concept trial of eVLBI. This project will connect up to five radio telescopes to the EVN correlator at JIVE in real-time, via the NRENs and GÉANT. In addition to simply improving the reliability of the EVN, a fibre based VLBI array will transform the range of science that can be conducted. The more data the astronomers are able to store the more sensitive their observations become. For this reason, VLBI astronomers have essentially an insatiable desire for more bandwidth and higher data rates.

Strategic Objectives: *Research networking test-beds / Research Infrastructure*

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EU grid projects: www.gridstart.org

Risky business

Risk management in Europe is an emerging field which lacks harmonised systems, procedures and data resources. The research for risk in the IST programme is laying the foundations for Europe-wide technology infrastructures and service platforms for improved civil protection.

Despite the comforts of modern life and our sophisticated 21st century technology, we are all still exposed to risks in various ways. Natural catastrophes, such as floods, earthquakes and landslides, appear to be on the increase in Europe. The recent awareness of terrorist threats has added to a raft of other man-made risks such as chemical spills, industrial accidents and forest fires. And worldwide a distressing number of armed conflicts bring in their wake humanitarian crises. One way or another, we all have to come to terms with risks.

At present, risk management is still an emerging discipline. The organisations involved – civil protection authorities, police, environmental agencies, NGOs and others – run systems that tend to be incompatible between different agencies and countries. Risks are usually underestimated, and there is no clear methodology for handling inter-related risks and how they impact on vital infrastructure and services. Jurisdictions may be blurred, leaving no clear responsibilities for the generation of information. Actions may be planned and executed with a limited understanding of the size and severity of an event, which hampers the authorities in promoting appropriate measures. Furthermore, even if the magnitude of the event is adequately recognised, the totality of information available from various sources may be only partially utilised.

Information and communication technology (ICT) can make a major contribution to the management of risk

Satellite imaging of forest fires around Rome (Photo: ESA)

Coordinated emergency response

Building on results from an earlier IST project FORMIDABLE, EGERIS aims to provide regional and national authorities with effective ICT support for emergencies in the preparedness and response phases. The project focuses particularly on telecoms, a weak link in the management chain.

The operational architecture covers three levels: mobile command centres in the field; functional command centres (such as those operated by the rescue or emergency services); and the overall operational command centre coordinating the emergency. Systems are being developed for open IP communications, handheld communications and vehicle-mounted information centres. These will host a full range of communication, information and decision-making functions. The pilot trial covers four European sites.

by improving planning and control across the risk management chain. At the front of the chain, the risk assessment stage, ICT enables risks to be modelled, forecast and monitored more effectively, so allowing mitigation measures to be introduced in some cases. It can also help agencies to be better prepared by providing training, early warning and capitalising on past experience. While at the response stage following an event, ICT can help all involved gain a common view of a particular situation and so aid coordination, command and control.

Risk-related research under FP6 aims at the development of open platforms, integrated systems and components for improved risk management, civil security and environmental management. Its objective is to foster the emergence of a European info-structure and European service platforms based on interoperable components and sub-systems. Key technology research will address sensors with communication and location capabilities, and tools for modelling, simulation, decision support and visualisation. Where appropriate, these will be seamlessly integrated with earth observation data. Systems research will focus on harmonised and standardised info-structures and service platforms for environmental and crisis management, featuring new concepts in the prevention and management of industrial and terrorist threats. Technologies for supporting humanitarian aid delivery and for humanitarian demining will also be supported, in particular for delimiting areas of risk and hazard.

A key technical problem in risk management is the provision of information, especially the geo-spatial data on which environmental monitoring and disaster relief critically depend. Although these data will be highly distributed, they need to have a common architecture and common framework of meaning (semantic architecture) so that rapid access is available as needed to any person or system. The information architecture needs to be backed by scalable decision support and visualisation tools. Further work in this area will take account of two wider initiatives: GMES, a joint EU-ESA initiative on earth observation data; and INSPIRE, a recent initiative of the European Commission with Member States and accession countries that aims to improve access to high quality geo-spatial information.

Progress on anti-personnel landmines

Anti-personnel landmines are a horrific feature of recent conflicts that affects many countries around the world. The EU has actively supported research in this area under FP5 and earlier framework programmes, in support to EU policies and operational efforts. Significant progress has been made, notably in the use of ground penetrating radar (GPR) and data fusion methods linking inputs from more than one sensor type. Sensors which are capable of detecting the minute traces of explosives found around buried mines could also be applied in civil security applications.

Future research in humanitarian demining will focus primarily on the techniques of "area reduction". The aim here is to accurately delineate an affected area so as to allow agencies to intensify their efforts within clearly defined areas known to contain mines. As well as significantly reducing the need for painstaking detection and clearance, this allows non-mined land to be quickly returned to productive use. Efforts focus on surveying by low-flying unmanned aerial vehicles equipped with multiple sensors to define the limits of the mined area, and ICT systems to support human interpretation of the information gathered.

Strategic Objectives:	*Improving risk management*		
Project References:	*EGERIS*	*IST-2000-28345*	*www.egeris.org*
Commission Contacts:	*Guy Weets*	*guy.weets@cec.eu.int*	
	Russell Gasser	*russell.gasser@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/risk-management/home.html* *Global Monitoring for Environment and Security: www.gmes.info* *Infrastructure for Spatial Information in Europe: http://inspire.jrc.it* *EUDEM2 (Demining): www.eudem.vub.ac.be*		

The road to safety

Information and communication technology can help relieve the pressure on Europe's roads and airways, while also making them safer.

Europe's transport infrastructure is under increasing strain. With the car accounting for 80% of personal travel and around three million new vehicles per year taking to Europe's roads, congestion is widespread. Travel delays are estimated to cost European citizens and businesses more than €120 billion per year, and when the environmental impacts are taken into consideration the true costs are even higher. To this must be added the all-too-high cost in human lives: there are 1.3 million road accidents per year in Europe resulting in 40,000 deaths and 1.7 million injuries. With annual passenger growth averaging 6-7% p.a., Europe's airports and airways too are under strain.

Integrated safety and intelligent transport forms an important strand in European policy making. The European Commission has a multifaceted role to play in this field: it facilitates a Europe-wide consensus on priorities and activities, supports relevant R&D, sets vehicle-type approval procedures, and ensures that telecommunications regulations support road traffic safety. It also helps to remove obstacles to Intelligent Integrated Road Safety Systems, for example by means of standardisation. eSafety is a joint industry-public sector initiative for improving road safety through the use of new ICT. Under the eSafety Action Plan, the eSafety Forum has recently been set-up to build consensus on implementing a range of new road safety technologies. A number of recent Communications have also addressed e-safety issues[1].

IST's research on intelligent transport systems (ITS) under FP5 addressed both the vehicle and infrastructure perspectives and, particularly during the latter stages, the integration of the two. A major effort has been devoted to advanced driver assistance systems (ADAS), a generic term used to describe various in-vehicle safety applications, such as adaptive cruise control, collision-avoidance, lane departure warning, and emergency braking. By receiving information from outside of the vehicle, such systems are able to assess the risk of an accident occurring and can either warn the driver, so that he can take appropriate action, or initiate the appropriate action automatically. The project portfolio mainly covers two areas: the development of integrated ADAS safety systems and the development of common platforms and technologies.

Optimising individual systems is not enough, since the driver of the future will have to cope with multiple systems. COMUNICAR developed and tested an advanced information management system that harmonised the presentation of messages from ADAS, transport telematics, in-car entertainment and the traditional displays. EDEL is investigating a vision enhancement system for night driving. Based on novel illumination and near-infrared sensors, the system will detect potential dangers and obstructions. The display shows not only the presence but also the distance, speed and trajectory of other objects. Since drivers take little notice of simple images, image processing will be used to highlight obstacles, showing speed and trajectory.

Advanced electronic control of the power train of trucks is being investigated by PEIT. It addresses the electronic power stability (ESP), that is control of the

The electronic convoy

Around 30% of road accidents involve trucks and half of these are rear-end collisions. IST's CHAUFFEUR project developed an "electronic tow-bar" that allows one vehicle to automatically follow another at a safe speed and distance. The two vehicles are coupled electronically. While the first is steered conventionally by a driver, the second follows the leading one automatically.

The recently-completed CHAUFFEUR2 project took this technology a stage further, allowing one truck to follow another whether or not it is equipped with the same technology. A further function, known as platooning, permits more than one vehicle to be towed electronically, where only the leading vehicle is physically steered by a driver. The system uses adaptive cruise control, vision sensing and data fusion. In the final demonstration in May 2003, a three-vehicle platoon was successfully demonstrated.

Demonstration of an automatically-steered three-vehicle convoy (Photo: CHAUFFEUR2 project)

vehicle dynamics, before and during jack-knifing, trailer oscillation, rollovers and lane departures. Even the most skilful of drivers find these situations hard to control once they have started. The prototype will incorporate active steering, differential braking, steer-by-wire, brake-by-wire, tyre friction measurement and electrical energy management.

Safety research under FP6 will concentrate on integrated and global approaches, where the interaction between driver, vehicle and road environment are addressed together. A focus of the research will be on-board ADAS that help the driver but leave him or her in overall control. Other priority areas are: advanced sensors, communication systems, and dependable software and interfaces for both vehicles and aircraft. For road transport, secure communications, advanced positioning and mapping technologies, and value-added location-based services will also be addressed. Work on vehicle and information infrastructure management systems will emphasise the dual needs of safety and efficiency.

When milliseconds count

In modern vehicles air bags, to both front and side, help protect drivers and their passengers from the worst effects of a crash. However, these are passive safety devices that are usually triggered only after an accident. Might it be feasible to anticipate a crash before it happens, and so give even greater protection? That is the question that CHAMELEON tried to answer. It developed a system to detect dangerous situations based on passive safety devices. In trials, the feasibility of the approach was proven, giving valuable tens of milliseconds for the pre-triggering of air bags and the tensioning of seat belts. The sensors are being further developed.

[1] Communication on Information and Communication Technologies for Intelligent Vehicles, May 2003; and Communication on the Third Road Safety Action Plan

Strategic Objectives:	*eSafety for road and air transport*		
Project References:	*CHAMELEON*	*IST-1999-10108*	
	CHAUFFEUR II	*IST-1999-10448*	*www.chauffeur2.net*
	COMUNICAR	*IST-1999-11595*	*www.comunicar-eu.org/index.html*
	EDEL	*IST-2001-34076*	*www.edel-eu.org*
	PEIT	*IST-2000-28722*	*www.eu-peit.net*
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Web:	*www.cordis.lu/ist/so/esafety/home.html*		
	www.europa.eu.int/information_society/programmes/esafety		

Preserving cultural memory

Europe's rich archives of historical memory and cultural heritage are at risk unless we protect them from the ravages of physical deterioration and equipment obsolescence. Coordinated research and policy actions are helping to ensure these vital resources are preserved.

For some time, the capture of Europe's cultural heritage in digital form has been recognised as vital in exploiting the opportunities brought by the new digital world. Digitisation of cultural and scientific collections – books, pictures, films, museum artefacts, etc – contributes to their conservation and preservation. It also creates new educational opportunities and can be used to encourage tourism. It provides a rich basis for the development of new content and services, a key policy objective under eEurope 2005. And, not least, digitisation offers citizens improved access to their local and community heritage.

Queen Victoria's funeral, Feb 1901, one of the first historical events to be captured on film

Access to digital preservation

Within the cultural sector there is a lack of awareness about how to handle existing digital preservation and how to plan effectively for the future. Knowledge and skills are fragmented and there is no coherent research agenda. The ERPANET network provides a platform for co-operation, collaboration and exchange of results and experience in the preservation of digital content.

The network has recently launched two new services. ErpaAssessments are authoritative added-value commentaries on key publications and projects in the field of digital preservation. The editors source new and critical contributions relevant from over 100 journals, review the findings and contextualize them for the digital preservation community. ErpaAdvisory is a multi-lingual web portal that provides access to digital preservation resources and best practice examples. The network has also proposed a Digital Preservation Charter.

As well as the translation of physical ("analogue") collections, increasing amounts of data and content are being created in digital form. These are the heritage of tomorrow, and the preservation and reuse of these digital assets will form both the cornerstone of future economic growth and the future memory of our societies. However, the fast pace of change in the technological landscape makes ensuring long-term access to this material a challenge. Storage media may degrade, technological developments make systems obsolete, and information can be rendered inaccessible by changes in encoding formats. Hence, alongside digitisation, preservation of digital media in an accessible and usable form is emerging as a key research issue.

At policy level, a coordinated European approach to digitisation and preservation issues is being pursued under the Lund Action Plan, named after a landmark meeting of national experts held in Lund, Sweden in April 2001. Implementation of the Action Plan is being supported through MINERVA, a network of European ministries from the EU and other countries, while at practitioner level further support for digital preservation is provided by ERPANET (see box).

The MINERVA network provides national representatives with a forum for open discussion on the harmonisation of digitisation policies and for the exchange of best practices. A series of working groups has been set up to address specific thematic issues. These include benchmarking, identification of good practices and competence centres, interoperability and IPR, and issues relating to quality and user needs. In February 2003, the National Representatives Group published its first official report describing progress in implementing the Lund Action Plan and a further report is planned before the end of the year. A good practice handbook is also planned, together with a major conference to be held in Parma, Italy in November 2003.

Preservation and restoration aspects of digital content continue to be addressed in FP6 under IST's strategic objective on Technology-Enhanced Learning and Access To Cultural Heritage. Research aims towards more automated (and hence cost-effective) digitisation of analogue material, as well as new approaches to the digital restoration and preservation of film and video material, and more effective management and exploitation of digital memory assets. Further projects will be launched shortly, following submissions under the 1st Call.

Cost-effective film preservation

Around half of European broadcasting archives from the early twentieth century are thought to be under threat of loss by media deterioration and equipment obsolescence. Current preservation techniques are expensive and time-consuming. PRESTO targets cost reductions of at least 30% in the archival process, through greater automation and more cost-effective use of new technologies.

The project team has examined metadata models and surveyed network and server-based distribution models that broadcasting organisations throughout Europe expect will replace their traditional "tapes on shelves" approaches. A survey and state-of-the-art review has critically evaluated the state of old analogue technologies and equipment, highlighted new techniques for preservation, given real life examples and estimated representative costs. The end-result was a series of detailed specifications for a number of "key links" – the new tools necessary to make preservation more cost-effective. This work is expected to be developed further under FP6.

Strategic Objectives:	*Technology-enhanced learning and access to cultural heritage*		
Project References:	*ERPANET*	*IST-2001-32706*	*www.erpanet.org*
	MINERVA	*IST-2001-35461*	*www.minervaeurope.org*
	PRESTO	*IST-1999-20013*	*presto.joanneum.ac.at*
Commission Contacts:	*Bernard Smith*	*bernard.smith@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/learncult/home.html*		
	www.cordis.lu/ist/directorate_e/pech.htm		

Grids for all

While grids hold great potential in a number of fields, their deployment is hampered by the complexity of current grid technologies. A new generation of user-friendly applications will accelerate the wider use of grid computing.

Despite rapid increases in processing power, users' requirements continue to outstrip computer technology. As they tackle ever-more complex problems, scientists and engineers are looking for new solutions that not only allow them to process their data more quickly but also to access and share very large datasets and to visualise and manipulate their results.

As the internet revolutionised access to information, so grids will revolutionise the accessibility of applications. They allow all sorts of computer and information resources – supercomputers, data repositories, storage, scientific instruments – to be linked in a kind of worldwide virtual laboratory. This brings users a whole new world of possibilities. By linking into global resources, grids present opportunities to solve complex problems that could not be tackled before. And by enabling an effective sharing of data, grids will open the way to new forms of global collaboration.

Like the web before it, the grid started out as a tool for the scientific community. Grid research originally focused on optimising computationally-intensive problems, such as pharmaceutical design and modelling of fluid flow. Subsequently, grid techniques have begun to be applied to more data-intensive tasks, such as data analysis in high-energy physics, astronomy and earth observation. This is only the beginning, however. The true power of grids will only be realised when we start to apply grid principles – linking people with physical and informational resources on a global scale – to solve problems in all applications and end-user sectors.

Current grid applications are complicated to use. They require users to master many different kinds of resources, in much the same way that the first computers required programmers to have a detailed knowledge of machine code. Despite several research and engineering efforts in the design of the first generation grid middleware, the grid infrastructure is still visible. The Next Generation Grid must be much more user-friendly. It should enable users to solve their problems in a simple way, without them having to be aware of all the complexity behind.

Overcoming these current limitations so as to accelerate the use and wider deployment of grid systems is one of the key objectives of IST's grids research in FP6. RTD aims to provide an "applications pull" by enriching grids with new capabilities and functionalities required for complex problem-solving across a wide range of application domains. The challenge is to move grids from tools for computation and data analysis, to systems for knowledge discovery – how to discover and extract useful knowledge from huge amounts of data.

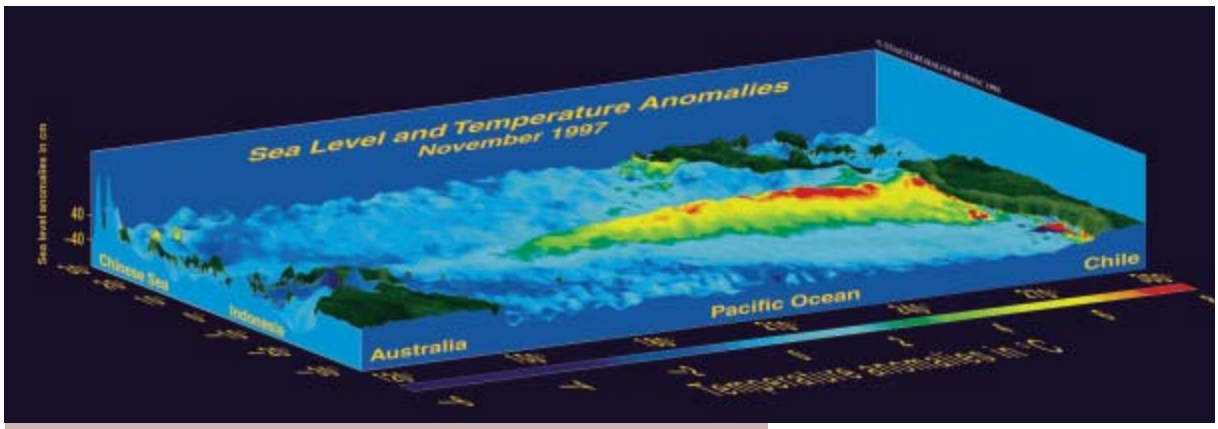
Current projects already address grid applications in several domains. For instance, FLOWGRID is demonstrating on-demand services for computational fluid dynamics (CFD) simulations and visualisations

Grasping the business opportunity

Application service provision (ASP) is becoming a popular computing model in business, but is limited by weaknesses concerning resource management, security, service level and pricing.

The GRASP project aims to demonstrate a new ASP model based on a combination of grid technologies and commodity technologies (such as Microsoft .NET, web services, XML, SOAP, etc.). The ASP middleware, realised using these technologies, will be characterised by a high level of scalability, reliability and security, and will support the advanced service, accounting and management functionality necessary for a business platform.

The solution will be evaluated for three different business models that fully exploit the grid technologies: a one-to-many model (classical ASP with one provider and many clients); a many-to-many model (where resources are heterogeneous and distributed and the clients can make available their resource to receive an income); and a federated model (where the provider is constituted by a federation of ASPs). The project will demonstrate the innovative and advanced services necessary to support new virtual organisations.



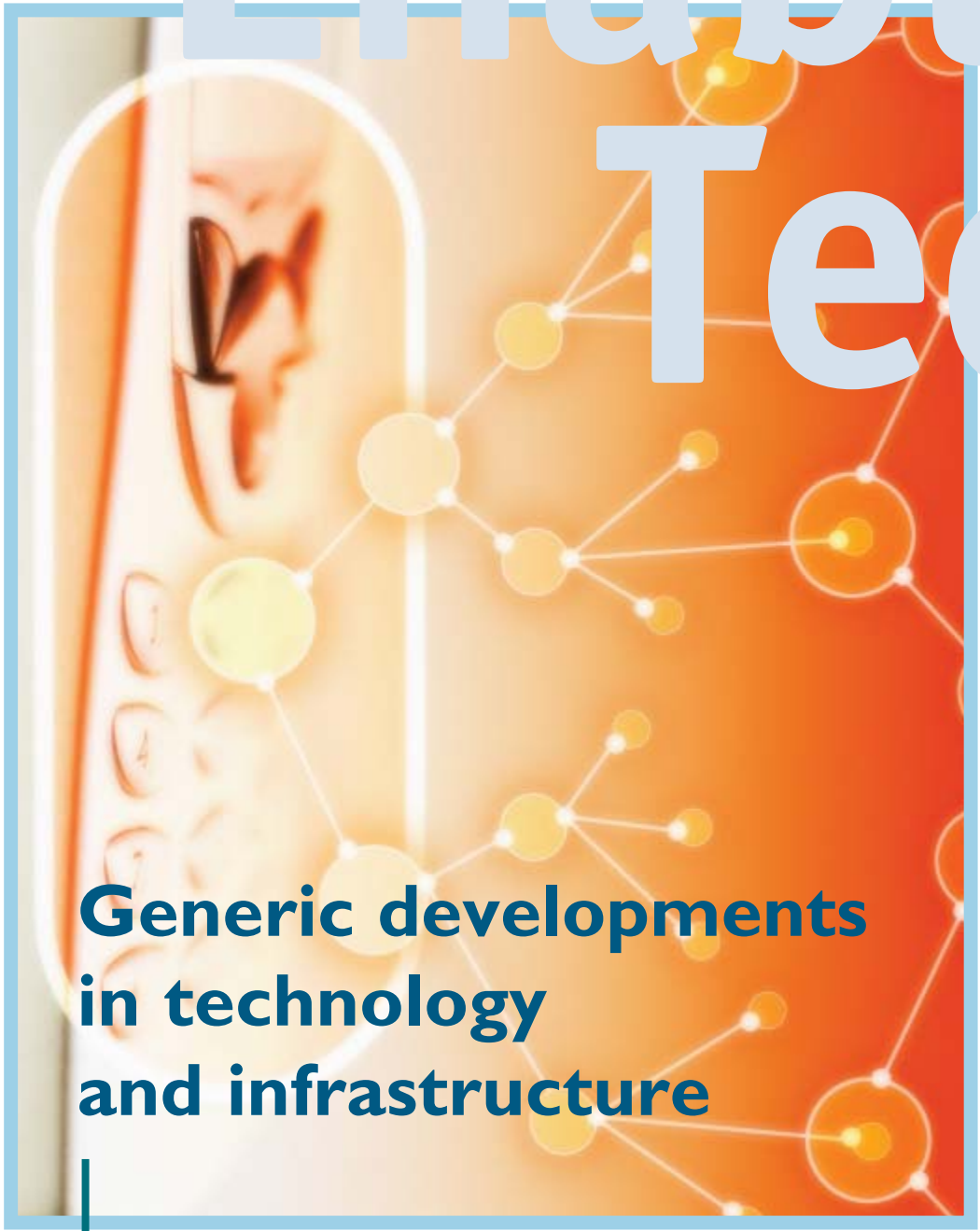
Grids can help researchers tackle complex problems, such as this visualisation of the 1997 El Nino event in the Pacific Ocean (Photo: ESA)

using grid computing. OPENMOLGRID is developing tools for molecular design based on a UNICORE-enabled distributed computing environment, and CROSSGRID focuses on techniques for large-scale grid-enabled real-time simulations and visualisations. In the medical field, MAMMOGRID is applying grid technology to develop a Europe-wide database of mammograms and support collaboration between healthcare professionals. GEMSS will provide medical practitioners with access to grid-enabled tools for improved pre-operative planning and near real-time surgical support. The applicability of grid technologies to industry is being demonstrated by GRASP (see box) and the LeGE-WG network is exploring the use of grid applications in learning.

The evolution towards knowledge-intensive applications calls for technologies and services that enable us to interact with grid systems in more sophisticated ways. Technologies of interest include next generation tools and environments for modelling, simulation, data-mining and visualisation. We also need technological solutions in areas such as trust and security, and collaborative working in virtual organisations. Some aspects will be domain-specific (physics needs different functionality to biology, for example), but there should also be opportunities for communities having similar requirements to join forces and share common layers. Many of the developments in semantic-based knowledge representation are also relevant and we can expect increasing convergence with grids research. Here early explorations are being made by the GRIA project, which is investigating business models and processes that make it feasible and cost-effective to offer and use computational services securely in an open grid marketplace.

Strategic Objectives:	*Grid-based systems for solving complex problems*		
Project References:	*CROSSGRID*	*IST-2001-32243*	*www.eu-crossgrid.org*
	FLOWGRID	*IST-2001-38433*	*www.unizar.es/flowgrid*
	GEMSS	*IST-2001-37153*	*www.ccrl-nece.de/gemss*
	GRASP	*IST-2001-35464*	*eu-grasp.ne*
	LEGE-WG	*IST-2001-38763*	*www.zeusconsult.gr/LeGE-WG/presentation.asp*
	MAMMOGRID	*IST-2001-37614*	
	OPENMOLGRID	*IST-2001-37328*	*www.openmolgrid.org*
Commission Contacts:	*Wolfgang Boch*	*wolfgang.boch@cec.eu.int*	
Web:	*www.cordis.lu/ist/grids/index.htm*		
	www.gridstart.org		

Enabling Technologi



Generic developments in technology and infrastructure

Community IST research is working towards a vision of the future where users have "anywhere, anytime" natural access to IST services (so called "ambient intelligence", or AmI). Underpinning this vision is a set of key technologies that will provide the main building blocks for this user-centred approach.

Central to the AmI vision is the concept of embedded networks. In microelectronics, research continues to push towards microprocessors that are smaller and more powerful. Developments in microsystems allow sensing, actuating, storage and other capabilities to be engineered at the micro-scale to produce hugely powerful and versatile microdevices. These micro-technologies, together with related developments in embedded software, are being integrated within a growing array of "smart" devices and products to enhance their functionality and performance. Increasingly, such devices are being linked together to form massively distributed computer systems.

While they largely target developments in the 2010 timeframe, many of the generic technology activities are complementary to eEurope's aims to fully exploit broadband networks and services. These include, in particular, research relating to optical fibre access networks, broadband wireless services (beyond 3G), broadband satellite access systems, convergence of fixed and mobile networks, including the transition to the next generation internet protocol (IPv6), and research on trust and security.

EU research aims to reinforce the long-term competitiveness of the European IST supply industry, in particular by enabling industry to exploit the opportunities arising from convergence: the blurring of the boundaries between different delivery networks and business sectors driven by more flexible technologies and standards. EU policy here emphasizes the role of open standards, providing interoperability across multiple platforms, as the most effective means for ensuring that demand for services is user-driven.

Although accounting for only a relatively small part of overall research funding in this sector, EU RTD activities can have a structuring role by helping to aggregate national and private efforts towards a true European Research Area in IST. For instance, EU efforts complement Eureka initiatives in strategic technology areas such as microelectronics, micro-nano-technology and software. The EU also contributes to wider international efforts on issues such as microelectronics, mobile communications, critical infrastructure protection and embedded systems.

In many areas of technology development, increasing system complexity is becoming an obstacle to further progress. Hence, with a long-term perspective, research in relation to complex systems is seeking radically new approaches to deal with the extremely large-scale, dynamic systems that are now emerging, while research on cognitive systems and intelligent robotics targets systems that are capable of adaptation and learning.

Our small future

European research in microsystems focuses on emerging application challenges and will be a key enabler for the IST vision of ambient intelligence.

Without doubt microsystems is a dynamic, fast evolving, high tech area, holding considerable business potential. Already today this challenging subject covers a very diverse and broadening field of industrial applications and includes a growing set of technologies. Applications are found in many market sectors, especially products for the medical, industrial, communications, automotive and chemical markets. Examples are DNA chips, drug delivery systems, smart cards, accelerometers for automotive air bags, and inkjet printer heads.

At present the microsystems field is driven by silicon-compatible batch processes. However, non-silicon and in particular polymer technology, and the use of new functional materials and improved material properties are becoming major driving factors of growing importance. The area is gradually changing from being technology-oriented towards being application-driven. To better exploit the application potential and opportunities offered by the new devices, processes and materials greater emphasis is required on applied research. Also, the diversity of the field calls for a collaborative approach with co-operation across different disciplines and organisations.

Europe is already well positioned in microsystems and has an excellent research base. What is needed now is to refocus around the application challenges, so as to enable European companies, both suppliers and end-users, to play a full role in exploiting microsystems technologies. The new framework programme presents the opportunity to enhance critical mass in key topics and to avoid further fragmentation.

Building on the foundations established in earlier programmes, microsystems research in FP6 will follow a flexible, objective-oriented approach combining research, innovation, take-up and structural activities. It will integrate complementary expertise from industry and academia across different scientific and engineering disciplines, and bring together users and suppliers. The technological objective is to further improve the cost-efficiency, performance and functionality of microsystems and to increase the level of integration and miniaturisation. This "microsystems-in-the-system" approach will combine device developments with their implementation within a wide range of intelligent – mostly communicating – products and applications.

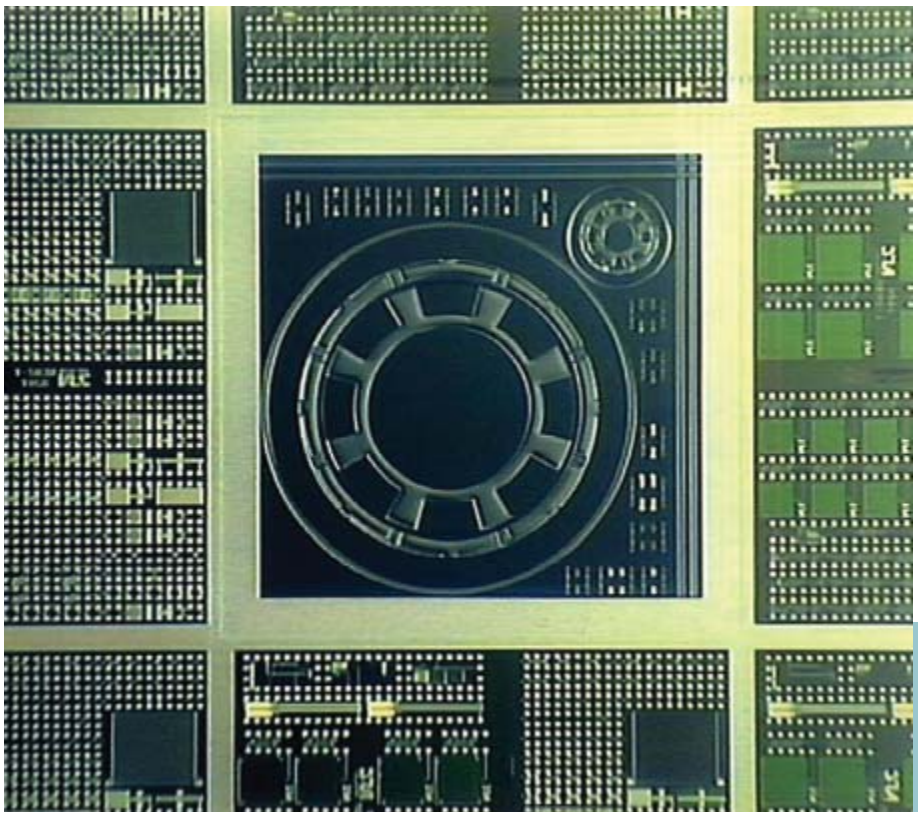
Applications-oriented microsystems development – "research for a purpose" – is driven by several requirements which can be grouped under key research objectives. For example, further work is required to integrate sensing, actuating, computing, processing and power in a wide range of materials, in particular for flexible and portable applications. Another priority is to allow systems to shrink to very small form factors, through a focus on size, weight, connections and low power consumption. This will improve the quality, functionality, performance and cost-effectiveness of "small and smart" products in a

Leadership in RF-MEMS

Innovation in wireless communication systems has triggered research into the application of microelectromechanical systems (MEMS) in RF circuits (RF-MEMS). Use of MEMS components, which makes the RF modules tunable, has two major advantages. Integration with other (passive) RF components in one process becomes possible, leading to further miniaturisation. Secondly, MEMS components outperform their discrete solid-state counterparts in several key parameters.

Despite the worldwide effort on MEMS, several crucial issues remain to be solved. These include, among others, packaging, hermeticity and reliability, and high power operation (especially when switching under RF power). IST has a portfolio of around 15 FP5 projects in this area, all of which focus either on RF components or systems. A common concern, addressed by all of the projects to some extent, is packaging, reflecting its importance as a key condition in bringing the RF-MEMS functionalities to market.

The cluster holds regular meetings, most recently alongside the 4th MEMSWAVE Workshop in Toulouse in July 2003, which was attended by more than 100 people.



Two gyroscopes (1mm and 4mm diameter) integrated on a CMOS wafer (Photo: INTEGRAM project)

wide range of applications. We also need to improve and intensify the way in which people interact with devices, machines and the ambient environment. This will require optimisation of the interface and interaction mode drawing on many different disciplines.

System-level packaging is important in the total foodchain of microsystems development. Research here aims to increase the density and performance of these technologies for all "small tech" applications and to validate the concepts for industrial exploitation. Finally, research should explore the application potential of micro-nano technology and large-area systems, focusing on how they integrate with and interface to macro ("real world") systems. This latter aspect will contribute to building the "ambient intelligence landscape", allowing intelligence and "emotion" to be embedded in many different products and environments.

A series of new projects covering these areas, for a total amount of €100M, will be launched in autumn 2003 following a strong response to the 1st Call.

The European MST scene is a patchwork of initiatives, comprising alongside EU RTD other European, national and private research programmes. Although accounting for only a relatively small part of the overall picture, EU funding can have a structuring role here, by helping to aggregate national and private efforts towards a true ERA in microsystems. In particular, the work will be closely co-ordinated with EURIMUS, the Eureka microsystems initiative. As well as RTD, measures will be supported to promote multidisciplinarity (training, human mobility etc.) and to stimulate entrepreneurship.

Strategic Objectives: *Micro and nano systems*

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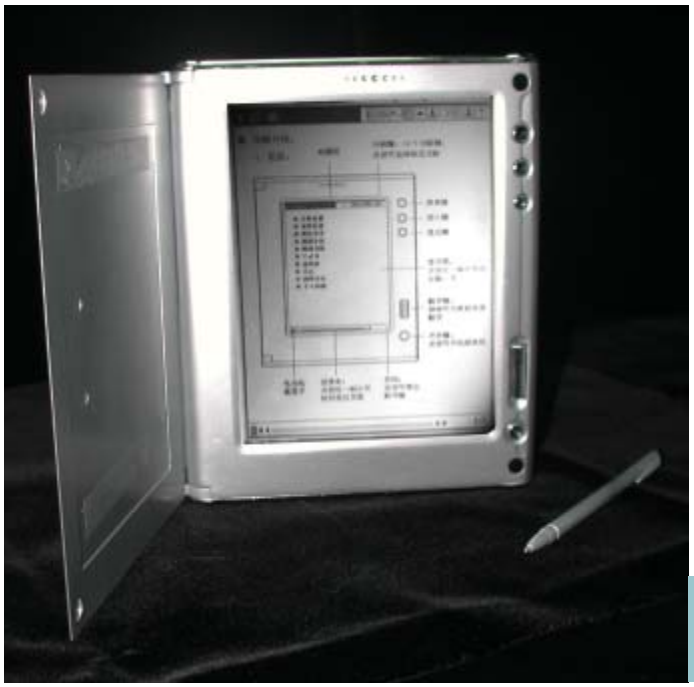
www.cordis.lu/ist/directorate_c/mnd/index.html
EURIMUS: www.eurimus.com

Future displays

Displays will be key in making future interface systems more intuitive and user-friendly. IST's research in advanced displays is helping European industry to stay at the forefront of this strategic technology.

Display technologies account for an important share of the ICT equipment market and are a major focus for innovation and competition. Current solutions only partly satisfy their respective market needs and often limit system design and usability. In the coming years, users will have access to a wealth of new networked products, applications and services through a new generation of natural and intuitive interfaces. Displays will remain one of the cornerstones of such future interface systems and will be contributing with a range of technologies tailored to an ever increasing number of different application needs.

It is essential that Europe retains a stake in such strategic technologies. European companies are already very active in RTD and licensing, focusing primarily on the manufacture of customised displays for EU markets. So far, they have been weak in local high-volume manufacturing, where profitability is very low. As an area with significant scope for innovation, displays has long been a focus for EU RTD programmes. European research is helping to contribute to technological building blocks and to strengthen academic and industrial collaboration in next generation display technologies.



A prototype e-book application using BiNEM technology (Photo: Nempotic)

Under FP5, the IST Programme financed 17 projects concerned with advanced display technologies, with a total Community funding of €35M and a total budget of €75M. A further nine projects were financed under the Growth Programme, with a total Community funding of €19M, primarily basic research on new materials. The overall portfolio addressed a wide range of technologies and application areas, the main ones being liquid crystal displays (LCDs), flexible emission displays (FEDs), organic/polymer light-emitting diodes (O/PLEDs). Others

No need for batteries!

Smart cards are being used in a wide variety of applications and are required to carry an increasing amount of information. The IST projects CARBINE and FORMAT aimed to provide the smart card market with a thin, flexible, low consumption bistable display solution that was compliant with the market specifications and could be easily integrated into actual cards. The work involved the development of a thin, reflective LCD display on a flexible substrate, together with low consumption control and command circuits. The various electro-optic components were then integrated onto plastic substrates.

The solution is based on BiNem®, an LCD technology that is able to retain the display content without a power supply. Basic principles of BiNem®, were first validated under Esprit and the technology is now being commercialised by the French company Nemoptic. Since its formation three years ago, Nemoptic has grown rapidly and now employs 45 people. The company is currently working with a major Asian supplier to mass-manufacture e-books and PDAs and with a European supplier targeting industrial and telecom applications, all incorporating BiNem®, technology.

being investigated are liquid crystal on silicon light valves for projection technology, large area electronics on glass and flexible substrates, and various aspects of optical materials, components and equipment.

FP5 projects reflect an increasing interest in polymer display technologies and novel display solutions. For instance, MULTIPLEYE is investigating a novel display interface that is fully wearable and portable, while FLEXled targets further developments in flexible substrate technologies. LCOS4LCOS is demonstrating the technical and economic feasibility of liquid-crystal-on-silicon technology for single lightvalve, low-cost video-projectors for the consumer.

The main interest in polymer-LEDs relates to their compatibility with solution processes and ink-jet printing for low cost manufacturing. Since being discovered in Europe a decade ago, several EU companies now benefit from R&D agreements and licensing with all the major display makers world-wide. STEPLED aims to take this technology further, focussing on better light efficiency in polymer materials for light-emitting displays. It is seeking a better understanding of the science which controls the spin states of polymer-based LEDs, and to use this knowledge to direct the next phase of industrial development. The project should establish the best route to achieving higher efficiencies in polymer-based LEDs and is expected to make a decisive impact in the technological directions taken by European industry in the future.

PHOTOLEDD focuses on a novel photopatternable OLED (p-OLED) with unique 3D visualisation capabilities built-in, and associated fabrication processes as the basis for making full colour p-OLED-on-silicon displays. The technology is based on polarised emission of RGB emitter materials which are expected to provide the basis for a new display with a unique stereoscopic 3D effect.

In IST-FP6, research on displays has two key objectives. Firstly, it aims to establish and facilitate the industrial exploitation of organic electronics and organic display technologies, in particular for flexible and affordable large-size applications. Specifically, the work will aim to demonstrate compatibility with very low-cost manufacturing techniques, such as printing. The second objective is to develop display solutions for very small form factor, high information content applications and to integrate and demonstrate them in complete systems. Examples include lightweight transparent eyeglasses with microdisplays or microprojectors. Research on 3D displays is also envisaged, with a focus on breakthroughs for developing 3D and realistic animated holographic-like representations.

The challenge is to define technical topics corresponding to future industrial priorities in the field, while at the same time keeping the research agenda sufficiently open to attract true innovations. A call with an estimated budget of €25-30M has been launched mid-2003 with results expected by the beginning of next year.

Strategic Objectives:	*Advanced displays*		
Project References:	*CARBINE*	*IST-2000-29450*	*www.nemoptic.com/carbine/index.htm*
	FLEXLED	*IST-2001-34215*	*www.extra.research.philips.com/euprojects/flexled/*
	FORMAT	*IST-2000-30121*	*format.gemplus.com/format/index.html*
	LCOS4LCOS	*IST-2001-34591*	*www.lcos4lcos.info*
	PHOTOLEDD	*IST-2001-37181*	
	STEPLED	*IST-2001-37375*	*www.stepled.org*
Commission Contacts:	*Marc Boukerche*	*marc.boukerche@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/displays/home.html*		
	www.cordis.lu/ist/directorate_c/mnd/index.html		

Networked viewing

Driven by the convergence of the IT, telecoms and media industries, we are seeing the emergence of universal communications networks. EU research aims to help European industry exploit the emerging markets for networked audio-visual systems and services.

Today the audio-visual and media industries are changing fundamentally. Broadcasting, once a one-way medium, is becoming more interactive through the success of digital television. At the same time, telecommunications has evolved from "plain old fixed telephony" into a platform for a wide range of mobile services – opportunities that will be expanded even further by the third generation services now being launched in Europe. And of course the rapid growth of the internet has brought new applications and services driven by the IP world – e-mail, online chat, e-commerce, e-learning, audio-streaming, etc..

The result is the much-quoted "convergence": a blurring of the boundaries between the different delivery networks and business sectors driven by more flexible technologies and standards. The success of home theatres, DVDs, networked games and streaming of audio-visual (AV) material via the internet show that many people want to use the opportunities brought about by the new communications technologies.

In business terms, the AV economy is far from reaching its full potential as markets are still relatively fragmented. The introduction of more and more interactive and rich-media services presents European media industry and service providers with new challenges and opportunities. Bearing in mind the global nature of both the equipment and content industries, the stakes are very high. Removing the remaining barriers to the widespread access to new services and applications is a key objective of the eEurope 2005 Action Plan. In its recent communication on open platforms[1], the Commission emphasised that a multi-platform environment is most likely to develop where demand for services is user driven. The use of open standards is likely to be the most effective way to achieve this, by ensuring interoperability at service and consumer levels.

This evolution towards a landscape of fully networked AV systems and services forms a new Strategic Objective within the IST Priority. RTD aims towards audio-visual services that are scalable and network-independent and provide access to rich-media AV materials. Such services need to operate over a heterogeneous infrastructure with variable bandwidth and quality of service availability, and to hide the complexity from end-users and network managers. They should allow anytime-anywhere access to AV programming, whether through wired or wireless networks around the home, or when on the move through mobile telecoms and broadcast pipes. Key technology aspects are storage, personalisation and delivery with high quality-of-service.

Projects from FP5 are already making substantial contributions to this approach. Several address the possibilities for simultaneous use of broadcast and telecoms networks to deliver new services to end-users. By utilising the multicast capabilities of broadcasting and the point-to-point capabilities of telecoms, they enable an efficient use of transmission channels. Building on earlier projects, CISMUNDUS

Future broadcast and internet convergence

The nature of television has changed significantly over recent years, but the possibilities are still not fully exploited. Focusing on the convergence of the internet and broadcasting, IST's SAVANT project aims to bring new added-value services to both conventional and digital television platforms. Building on established standards and technologies (DVB-MHP, ISO/IEC, MPEG-7 & -21, IETF and W3C), it is demonstrating the advantages of novel services for both content providers and consumers.

The SAVANT architecture is designed as an end-to-end delivery system. It supports the creation of different types of content in a way that facilitates transmission over various delivery channels to multimedia terminals with various capabilities. Users will access services that are adapted to their specific environment, depending on the access terminal, network conditions and personal preferences. Existing standards are being extended to include sophisticated solutions and hooks for all the elements involved in the new enhanced services.

Users are looking for flexible ways to network audiovisual devices and systems

addressed this concept in terms of services, server-terminals and network co-operation aspects. The project specified a system architecture for service delivery over co-operating DVB-T and UMTS/GPRS networks, as well as specifications for terminals and a local gateway.

Extending the capabilities of the Multimedia Home Platform is the goal of GMF4iTV. It will develop a new user interface for iTV that will enable interactivity with moving objects. Work focuses on efficient content analysis algorithms to identify the moving objects, and authoring tools to enable the composer to link the video content. ICE-CREAM is investigating new concepts for interactive and personalised programming. For instance, when watching a football match the viewer is offered the opportunity to replay the key action during the game. The user selects from a number of thumbnail replays or 3D reconstructions and the selected clip is then shown as an inset while the live game runs in the background.

Mobile meets broadcasting

Current wireless transmission systems have very different characteristics. In the mobile world, UMTS/GPRS operates at up to 2 Mbit/s whilst the broadcasting standard, DVB-T, has a transmission capacity much higher than this. Combining the two would create an interactive medium with significant potential.

This is the focus of the CONFLUENT project. It aims to lay the foundations for the commercial exploitation of "anywhere" services combining UMTS and DVB-T. New handheld terminals are being developed capable of high-speed operation with low power consumption. Service scenarios to exploit the new services are also being investigated, together with APIs (middleware) necessary to support the hybrid service and network concepts for mobile/portable terminals.

[1] Communication: Barriers to widespread access to new services and applications of the information society through open platforms in digital television and third generation mobile communications, COM(2003)410, 09/07/2003

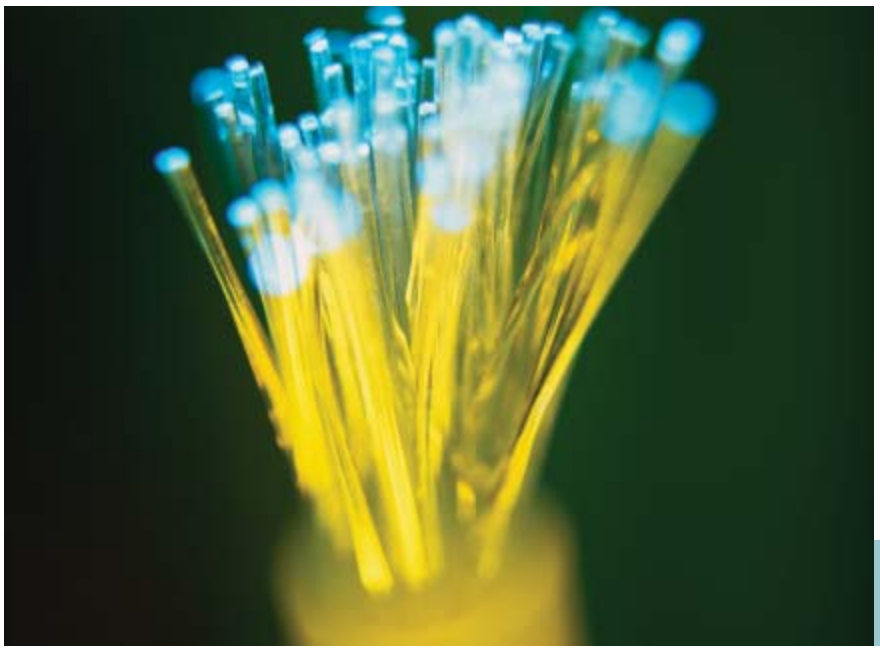
Strategic Objectives:	*Networked audiovisual systems and home platforms*		
Project References:	*CISMUNDUS*	*IST-2000-29255*	*www.brunel.ac.uk/project/cismundus/home.htm*
	CONFLUENT	*IST-2001-38402*	*www.brunel.ac.uk/project/confluent/home.html*
	GMF4iTV	*IST-2001-34861*	
	ICE-CREAM	*IST-2000-28298*	*www.extra.research.philips.com/euprojects/icecream/index.htm*
	SAVANT	*IST-2001-34814*	*www.ist-savant.org*
Commission Contacts:	*Carlos Morais Pires*	*carlos.morais-pires@cec.eu.int*	
	Leo van Noorden	*leo.van-noorden@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/audiovisual/home.html*		
	www.cordis.lu/ist/directorate_d/audiovisual/index.htm		

New frontiers for photonics

Already the backbone of telecoms networks, photonics is set to become a mainstream technology in many industry sectors. The challenge now is to push the boundaries in materials, devices and integration necessary to realise these new applications.

Over the last 20 years optics and photonics have become pervasive in a wide range of industrial applications. The technology has become the heart of a new industry, building on microelectronics with which it is increasingly linked. In telecoms, photonic technologies are already widely deployed in the optical fibre networks which make up the core of modern communication infrastructures. The challenge now is to further increase the bandwidth of these core networks – beyond the terabit/s range – and to exploit photonic technologies in the access network. In addition, there are many opportunities for optical technologies outside the telecom sector, in applications such as healthcare, sensing, environment and lighting.

Under FP5, around 70 projects addressed optical technologies with total funding from the IST Programme of around €150 million. These covered a wide variety of issues, from optical networks, to photonic components, novel devices for storage, sensing and imaging, advanced displays, and emerging fields such as quantum computing. A portfolio of 28 projects focused on photonic components, divided in broad terms between optical sources and optical devices.



Photonics research is advancing on many fronts

Full bandwidth for broadband

One answer to the ever-increasing demand for communication bandwidth is to transmit multiple wavelengths through a single fibre. This approach, known as wavelength division multiplexing, multiplies the data rates without any additional investment in new fibres. At present, however, it is difficult to use the whole of a fibre's bandwidth due to the performance of amplifiers and single-mode emitting sources available to cover all the necessary wavelengths. Furthermore, network monitoring requires widely tunable single mode sources.

BIGBAND is investigating a novel class of semiconductor structures that can overcome these bandwidth and tunability restrictions. It aims to develop devices and systems based on InP-based quantum dot (QD) structures covering the whole wavelength range from 1.4-1.65 μm. The work involves the development of QD structures optimised for different applications, and incorporating them into new devices, such as external cavity lasers, ultra-wideband semiconductor optical amplifiers and single mode tunable lasers.

Achieving these goals would open the door to a new generation of low-cost very high capacity broadband applications.

One of the key areas of interest is optical interconnects – the means by which the optical components are linked to conventional silicon-based components, either from board-to-board, from chip-to-chip, and ultimately within the chip (optoelectronic integrated circuits). The IO project, for instance, develops an optical interconnect family for a two-dimensional high bandwidth interconnect between ICs. The approach is based on optical waveguides comprised of plastic optical fibres and advanced layered glass sheets, that are able to be integrated with printed circuit boards. The viability of the approach was demonstrated in a key application area – high-performance core IP routers. Also concerned with optical interconnects, HOLMS is developing opto-electronic packaging technology that is compatible with standard electronic assembly processes. The project focuses on memory latency issues and proposes a new approach to fast memory access for computer chips.

The processing of radiofrequency (RF) signals directly in the optical domain is a particularly promising area. In this application photonic-based devices, circuits and subsystems are employed to directly process the RF spectrum conveyed by one or more optical carriers. This approach has many advantages, for instance, the special characteristics of photonic circuits make them suitable for flexible and broadband processing of RF signals, allowing the same subsystem to be used for a broad range of RF signal characteristics. Potential applications include active antennas for mobile communications, imaging and millimetre wave systems, and switching in advanced optical networks. LABELS is exploring the emerging possibilities to process microwave signals in the optical domain, and NEFERTITI is networking the European research community on broadband fibre radio techniques and related integration technologies.

Europe is well positioned in photonics research but good practical and theoretical skills are in short supply. To this end, OPTRANET promotes career and training opportunities at all levels – students, technicians and engineers – and raises awareness in schools.

In IST-FP6, photonic components is a strategic objective in its own right, reflecting its importance as an enabling technology for future applications. The research has three main priorities. Firstly, further fundamental work on advanced materials and components, including compound, polymer/organic and nano-photonic-based structures. Secondly, advanced devices, both hybrid and monolithic, and integrated photonic circuits, will be researched. Finally, further work is envisaged in advanced solid-state light sources. Aspects such as manufacturability, scalability, packaging and standardisation will be addressed across all areas.

Projects are expected to address research challenges for 2010 and beyond with a strong application focus. Key contexts here are: telecommunication and infotainment (e.g. components for low-cost high bandwidth networks and terabyte storage); healthcare and life sciences (e.g. minimally invasive photonic diagnostics and therapies, biophotonic devices); and environment and security (photonic sensors and imagers). Around 80 EoIs were submitted in 2002 and are expected to lead to a series of projects under this Strategic Objective following the 2nd Call.

Strategic Objectives:	*Optical, opt-electronic, and photonic functional components*		
Project References:	*BIGBAND*	*IST-2001-34813*	*www.physik.uni-wuerzburg.de/TEP/Website/projects/bigband/bigband.htm*
	HOLMS	*IST-2001-35235*	*www.phy.hw.ac.uk/~phykjs/OIC/Projects/HOLMS/index.html*
	IO	*IST-2000-28358*	*www.intec.rug.ac.be/io/*
	LABELS	*IST-2001-37435*	*http://labels.upv.es/*
	NEFERTITI	*IST-2001-32786*	*www.ist-nefertiti.org/*
	OPTRANET	*IST-2001-35394*	*www.optra.net*
Commission Contacts:	*Henri Rajbenbach*	*henri.rajbenbach@cec.eu.int*	
	Ronan Burgess	*ronan.burgess@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/photonic-components/home.html*		
	www.ist-optimist.org		

Embedded system design

Current design approaches constrain the commercial exploitation of embedded systems as they move from niche to mass-market applications. Research aims towards more system-centric approaches so as to improve the productivity of the design process and enhance product functionalities.

Embedded systems – systems where software and hardware are integrated to perform a specific function – are of increasing importance in a wide variety of applications. Sectors such as transport, telecommunications, power distribution and industrial control have long relied on embedded systems in situations where safety, security or reliability is critical. Over recent years they have made their way into mass market products and services, such as cars and a wide range of electrical and electronic appliances – cameras, televisions, washing machines, mobile phones and even toys. This rapid growth in the use of embedded technologies is explained by the fact that they offer system and service developers the opportunity to innovate and add value.

As embedded systems are used in a wider range of products and the functionality of individual systems increases, we face limitations in current design approaches. We need to find ways to reduce the costs of designing systems for a particular application, while at the same time optimising quality and reducing the time to market. This calls for a system-centric approach to design. Designers should have a global design view where the focus is on the end result – the user application. System-centric approaches should enable us to determine trade-offs between cost and quality, taking into account specific features of hardware, software and the environment.

Progress in this field raises non-trivial research problems. For instance, we need unified computation and interaction models that support the reuse and adaptation of existing system components. We also need to be able to build systems that are "right first time" and meet rigorous requirements in terms of reliability, safety, security and trust. Real-time issues are crucial here, such as the correct handling of real-time constraints and new approaches to analysis, verification and testing. With a view to the ambient intelligence vision, we also need to learn how to build robust networks of embedded systems that are able to communicate, adapt and self-configure.

One of the most demanding areas of control systems is where the system must react to some – even unexpected – physical event and produce a response within a specified period of time. Failure to meet a deadline can lead to catastrophic consequences. These so-called hard real-time applications arise frequently in transport and process control (see box). For embedded systems to realise their potential in mass markets, advances in hard real-time systems are needed that deliver the performance characteristics of current systems at compatible costs. The ARTIST network is coordinating the EU's RTD efforts in advanced real-time systems so as to improve awareness among academia and industry. The network has started to develop a series of roadmaps charting future research directions and is helping to facilitate international collaboration.

In the Sixth Framework Programme, IST's RTD on embedded system design aims towards concepts, methods and tools for these highly complex systems. It focuses on the development of components and systems with verifiable characteristics ("warrantable"),

High integrity design for real-time systems

Despite the explosion of interest in new applications of distributed, real-time and embedded systems, the technologies to build reliable and secure software are still inadequate. Java, with its increased development productivity, better code quality, inherent security, and support for distributed computing, would be ideal for this application domain. HIDOORS is seeking to overcome a series of technical difficulties and enable the use of Java for distributed, real time systems.

The project is developing new modelling tools, improving the memory and run-time performance of Java, and integrating the results into an existing software development environment. The results will be implemented in several time-critical application domains: industrial automation, avionic control, automotive diagnosis and naval control systems.

in particular for the correct handling of complex real-time constraints. It will also address models and methods to support the design of ultra-stable dependable embedded systems.

More system-centric approaches will improve the productivity of embedded system design

Time-triggered architectures approach the market

Time-and-event triggered architectures are an innovative European-funded technology for safety-critical real-time applications such as fly-by-wire or drive-by-wire. Its key characteristic is that all significant events, including tasks and messages, do not occur at random points in time, but rather have to adhere to a pre-determined schedule. Time-triggered systems (TTS) thus offer important advantages compared to classical systems, such as predictability concerning their real-time behaviour, which make them uniquely suited for complex, highly dependable real-time systems.

With a view to major applications in the automotive sector, the RISE project is developing embedded software applications for cars based on TTS approaches. The work focuses on new concepts and methods combining event-triggered and time-triggered dynamics. Researchers are developing such embedded reactive software, as well as supporting tools covering the whole development lifecycle that all together will lead to an increased productivity and time to market of new digital functions and services in cars.

Strategic Objectives:	*Embedded systems*		
Project References:	*ARTIST*	*IST-2001-34820*	*www.artist-embedded.org*
	HIDOORS	*IST-2001-32329*	*www.hidoors.org*
	RISE	*IST-2001-38117*	
Commission Contacts:	*Tom Clausen*	*tom.clausen@cec.eu.int*	
	Alkis Konstantellos	*alkis.konstantellos@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/embedded-systems/home.html*		

Software everywhere

Research on software technologies and distributed systems will be key to realising the ambient intelligence environment, as well as providing core technology and infrastructure for software and service development in many other fields.

Telecoms networks rely increasingly on complex software

Software and service technologies are of increasing importance to the European economy and society. They form the basis of a global industry, worth some €63 billion per year in the EU alone[1] and are a major source of innovation and growth. In addition to the software vendor industry itself, around 70% of software development takes place in large European non-software industries for their own systems, products and services[2]. Highly software-intensive industries are telecoms, automotive, aerospace, consumer electronics and engineering. Thus, a competitive European software and service industry reinforces Europe's strengths in many other industrial sectors.

The global competition between some large actors, together with the disparate introduction of software across many different industry sectors and technological cultures, has led to a mishmash of methods and tools, often with little attention to interoperability. However, the growing complexity and distribution of systems, products and services nowadays requires large capital investments in development environments that seamlessly integrate all aspects of the development process. Such environments allow greater automation in design, code development, testing, verification, evolution and maintenance. By building such environments based on open standards and extended for specific industrial domains, Europe has a major opportunity to underpin the competitiveness of its indigenous software capabilities.

The ability to compete in software technologies will be even more important in future, as we head towards systems that are not only more intelligent, intuitive

Blueprints for more effective telecoms

Telecoms services rely increasingly on complex software to manage and maintain their network infrastructures. These software architectures must integrate different business models, user requirements and technologies. OMG's Model Driven Architecture (MDA) is a generic approach for getting to grips with the complexity of large software systems. It focuses on business models and user requirements as a unifying element in the process of software systems integration.

The MODA-TEL project is adapting the MDA approach to telecoms systems and delivering guidelines for applying MDA to any kind of systems and services. It gives companies the opportunity to develop their systems faster and cheaper without neglecting quality, especially where a system needs to be implemented on different platforms. Software engineers are provided with a blueprint of the type of system they have to develop and can then reason about the resulting system characteristics. For system manufacturers, MDA reduces development costs and makes the time-to-market more predictable.

and user-friendly, but also "embedded" in our working and living environment ("ambient intelligence" – AmI). This will involve large, complex, distributed systems and depend on seamless networking. The realisation of AmI will require massive deployment of application software, middleware and control software, as well as the infrastructure for efficient development and deployment of such software. Its success thus depends on our ability to effectively engineer and develop the increasingly complex software infrastructure, together with all the software needed for intelligent devices to provide the required functionality.

IST's research on software and service technologies under FP6 aims towards the open development and run-time environments for software and services necessary to improve the productivity of the development process and support the drive towards AmI. It will provide the next generation of methodologies, middleware and tools to support developers through all phases of the software lifecycle, from requirements analysis through to deployment and maintenance. Research will be applicable to broad classes of software systems and services (networked and distributed systems, embedded software and value-added user services), and provide foundations for future approaches to software engineering.

Later FP5 projects reflect this shift towards open and modular development environments and high level methods and tools for systems design, development and integration. For instance, MODA-TEL is developing OMG's Model Driven Architecture for telecoms system development and operation (see box). Also concerned with modular approaches, MASTER aims at automating the adoption of MDA for modelling complex software families, focusing on air traffic management.

Another focus for open platforms is enabling the introduction of value-added end-user services. Among projects in this area, CONSENSUS supports the cost-effective development of applications to run on many different mobile devices (see box), and WISE is producing integrated tools and methods to engineer services for the wireless internet.

Cost-effective development for mobile applications

At present programmers have to adapt the user interfaces in mobile devices through a time-consuming manual process. CONSENSUS aims to overcome this by developing building blocks for an automatic adaptation process that considers usability constraints for the targeted devices.

Programmers will be able to develop browser-based applications for a variety of different mobile devices with minimal manual adaptation. The tool uses an XML-based mark-up language to specify the description of the user interface. In addition, application-dependent information enables a rendering engine to adapt the complexity of the application's input and output to the interface constraints of the different devices.

The results are expected to speed the development and maintenance of mobile user interfaces for existing and new mobile applications.

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[1] European Information Technology Observatory 2003

[2] Software Technologies, Embedded Systems and Distributed Systems: A European Strategy towards an Ambient Intelligent Environment, ISTAG WG9, 2002

Strategic Objectives:	*Open development platforms for software and services*		
Project References:	*CONSENSUS*	*IST-2001-32407*	*www.consensus-online.org*
	MASTER	*IST-2001-34600*	*www.esi.es/en/Projects/Master/master.html*
	MODA-TEL	*IST-2001-37785*	*www.eurescom.de/modatel/*
	WISE	*IST-2000-30028*	*www.wwwise.org*
Commission Contacts:	*Peter Diry*	*peter.diry@cec.eu.int*	
	Michel Lacroix	*michel.lacroix@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/sw-platforms/home.html*		

Overcoming complexity

Complex systems research offers promising new approaches to the design, build and control of very large-scale, dynamic information systems.

Modern ICT systems are growing ever larger and more interdependent, making them increasingly difficult to design, test, control and maintain. Conventional engineering methods will soon hit a complexity barrier due to the exponential growth of interconnections among a rapidly increasing number of system components. In a societal and business context, ICT systems have allowed new forms of interaction and led to macroscopic behaviour that is difficult to predict. Everywhere, system complexity – the high level of interdependence between often very heterogeneous system components – is becoming an obstacle to further progress. We need new approaches to deal with the extremely large-scale, dynamic systems that are now emerging.

Recent research suggests we have much to learn from the real world here. Systems such as living organisms, animal societies, ecosystems, as well as markets and cultural groupings are each made up of highly connected, heterogeneous components. Although having only local, limited knowledge of the entire system, the components are able to organise their behaviour and interactions in a way that regulates the functioning of the system overall and allows it to adapt to changes in the environment. Researchers call these complex adaptive systems.

Complex Systems Research is a new initiative under IST's Future & Emerging Technologies (FET) action. It aims to create a new generation of scale-free, autonomously evolving IT systems building on design and control paradigms derived from complex system analysis. Such systems – large-scale networks, societies of simulated or embodied agents, electronic circuits, information repositories, etc – must incorporate mechanisms that regulate and adapt their behaviour. As a result, they are able to guide their growth and become self-organising.

The research has many possible goals. One is to apply the complex adaptive system framework to design IT systems that run themselves: in other words, that are autonomous and self-regulating, adaptable to changing environments, robust and scalable. Another goal could be to conceive components – physical artefacts or software agents – that are 'aware' of each other and able to communicate with each other and the real or virtual environment. Living organisms could also be used as models to inspire novel computational systems, such as micro-robots and micro-fabricated or bio-engineered 'programmable' sensors or chips. Ultimately, the aim is to build a framework – an information science of complex adaptive systems – that will help ground new complex system-based design paradigms in a clearly developed set of concepts, methods and tools.

An increasingly complex world demands new approaches

As a multidisciplinary research effort, the initiative will mobilise researchers from many fields, including evolutionary and developmental biology, (statistical) physics, sociology, mathematical economics, and neuro-science, as well as IT researchers and engineers working in areas such as distributed computing, networking, systems modelling and control, computational AI and cognitive sciences.

Strategic Objectives:	*Future & emerging technologies: complex systems research*	
Commission Contacts:	*Ralph Dum*	*ralph.dum@cec.eu.int*
	Pierpaolo Malinverni	*pierpaolo.malinverni@cec.eu.int*
Web:	*www.cordis.lu/ist/fetco.htm*	

The understanding machine

Research on cognition aims towards systems that are able to interact with the real world in an intelligent and reasoned way. The introduction of such cognitive capabilities could spur the next big leap in the information revolution.

In the ambient intelligence vision we are able to interact with "smart" devices embedded in any/every physical object or environment. Using sensors to provide a window on the real world, these devices will sense our surroundings and respond by interacting with us or with one another. In reality we are still a long way from this, however. For instance, visual recognition capabilities enable robots to undertake intricate tasks on a factory production line, but they still cannot help out in the home. And telephone speech recognition allows customer services to be automated – but only in very specific application domains. Such systems are limited to constrained conditions and artificial environments, whereas the real world is endlessly variable.

How do we build systems that can interact with the real world in an intelligent and reasoned way? Until now we have built systems that either operate in carefully controlled environments or react to the real world based on programming. Systems that respond purposefully to the real world rather than just reacting must operate between these two extremes. Such systems must combine perception with the ability to explicitly represent heuristics, and to learn and reason in order to realise specific goals.

The construction of these "cognitive systems" will be a highly demanding task. It will require the integration of technologies and knowledge from several disciplines to provide the capabilities and the versatility to interact with and interpret the real world. In addition, it requires the ability to integrate information from multiple sensors and cues so as to interpret context and recognise real-world constraints. As yet constructing and maintaining a coherent world model from the contributions of a variety of sensors in a perceptual system is a largely unsolved problem. Recent developments in artificial intelligence, cognitive neuroscience, miniaturisation of sensors, and cheap and plentiful computing power make this a realistic goal however.

Cognitive systems is a new area of IST research in FP6. It focuses on methodologies for and construction of robust and adaptive cognitive systems that are able to interpret, physically interact and communicate in real-world environments for the purpose of performing goal-directed tasks. The research will integrate perception, reasoning, representation and learning, and aim to realise complete systems matched to real-world applications. It is expected to lead to fundamental insights on the nature of cognition, perception and learning, architectures for cognition, autonomous systems, and social interaction.

Perception and reasoning – the ultimate goal

We are already seeing steady progress in the field, as witnessed, for example, by advances in machine vision. Slowly but surely we are progressing towards systems that are aware and that "know" what they are doing. Ultimately, the introduction of cognitive capabilities into systems will provide a quantum leap in functionality and flexibility and is likely to spur the next big step in the information revolution.

Strategic Objectives: *Cognitive systems*

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www.cordis.lu/ist/directorate_e/ic.htm

Broadband access for all

Removing obstacles to broadband access will encourage the growth of new services and is a key European policy objective. New access technologies and network architectures will help ensure all European users are able to benefit from broadband services.

Power line communication is a promising approach for universal broadband access

Broadband is essential to the realisation of an information society for all. Affordable, high bandwidth access enhances the user's experience, enabling them to get more out of existing services and, more importantly, opening up opportunities for entirely new services. By delivering more capacity and greater speed, a universally accessible broadband infrastructure helps increase the value of services and service features. This symbiotic relationship between infrastructure deployment and service provision is recognised in the eEurope 2005 Action Plan, which targets the removal of obstacles to broadband networks as a key policy objective.

Despite some significant progress in the roll-out of broadband in the EU over recent years, still less than 10% of households have broadband internet access. Progress in individual Member States is very uneven, and overall the EU and the Candidate countries lag behind countries such as Korea and Canada. With the recent downturn in the telecoms sector, network operators face a major challenge in realising the substantial investments necessary to make broadband more widely available, particularly for non-urban, rural and remote regions.

What do we mean by "broadband" exactly? Well, it is more than just bandwidth. As well as capacity, a "broadband for all" approach can be characterised in terms of increasing speed – 10-100 Mbit/s in the next decade is considered as a typical objective. Such systems also need to be affordable, offer a multi-service capability, support "always-on" connections, and cater for convergence between the fixed and mobile networking worlds. And as applications (and users) becoming more demanding, broadband networks must be stable so as to support reliable, end-

Plug in, log on!

Power line communication (PLC) has been around since the 1930's but was never seriously considered as a medium for communication due to its low speed, poor functionality and high cost. However, recent developments in modulation techniques and technology have enabled PLC to become a realistic and practical means of communication.

The main advantage of PLC over other access technologies is that no new cabling is required as all the cables are already there. Every building, be it offices, apartments or houses, has the network already installed. This permits a computer or any other device with an access card to be plugged into any socket in any room and receive the signal without extra wires.

6POWER takes into consideration all these aspects and is adapting and integrating products, applications and services that run with IPv6 and related protocols over power lines, at speeds of over 45 Mbps. Field trials are being undertaken covering a variety of applications and services, including VoIP, multi-conferencing and audio/video streaming.

to-end service provision. Hence, alongside proactive policy actions and a fair regulatory framework, RTD has an important part to play in reducing barriers to broadband deployment.

Technologies for future broadband networks are addressed under IST's Strategic Objective on Broadband for All. Its goal is to develop network technologies and architectures that allow a generalised availability of broadband access to European users, including those in less-developed regions. Research aims at a range of optimised technologies that permit low-cost broadband access. Technologies of interest include optical fibre, fixed wireless access, interactive broadcasting, satellite access, xDSL and power line networks (see box).

Among current projects in this field, HARMONICS focuses on a reconfigurable fibre-feeder infrastructure with wavelength routing and timeslot allocation. This cost-effective shared-fibre infrastructure, e.g. Passive Optical Network (PON), is feeding various last-mile customer access networks such as HIPERLAN2 and VDSL. In GIANT, an optical access network optimised for packet transmission at Gigabit/s speed is implemented in a GigaPON to cope with future needs of higher bandwidth and service differentiation. GEMINI offers existing (and next-generation) customised and personalised Intelligent Network (IN/PSTN) services in an IP-based environment to meet the demands of multi-party, multi-connection and multimedia calls. SCAMPI is developing a scalable monitoring platform for the internet to enable, accelerate and promote the development of monitoring tools for improving services and technology.

Solutions should allow the access portion of the network to match the evolution of the core network in capacity, functionality and quality-of-service for end-users. The work is expected to lead to a European consolidated approach regarding regulatory aspects and for standardised solutions.

Protocols for multi-hop networks

Future IP-based networks will need to support a wide range of fixed and wireless access technologies and usage scenarios in an integrated and scalable way. 6HOP is studying how multi-hop heterogeneous wireless IPv6 networks (e.g. WLAN or ad hoc networks) can support scalability, mobility of users, packet routing and adaptation to varying link conditions. End-to-end optimization for services with respect to throughput, power consumption and implementation complexity will be provided.

Strategic Objectives:	*Broadband for all*		
Project References:	*6HOP*	*IST-2001-37385*	*www.cwc.oulu.fi/projects/6hop/*
	6POWER	*IST-2001-37613*	*www.6power.org*
	GEMINI	*IST-2001-33465*	*gemini.otenet.gr*
	GIANT	*IST-2001-34523*	*www.alcatel.be/Giant/*
	HARMONICS	*IST-1999-11719*	*www.ist-harmonics.net*
	SCAMPI	*IST-2001-32404*	*www.ist-scampi.org*
Commission Contacts:	*Pertti Jauhiainen*	*pertti.jauhiainen@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/broadband/home.html*		
	www.cordis.lu/ist/directorate_d/cnt/index.htm		

Beyond robotics

Inspired by nature, researchers are embarking on radically new approaches to IT systems that are able to learn from and adapt to changes in their environments.

While traditional approaches to robotics, such as machine vision and artificial intelligence (AI), have achieved some success, it is apparent that real breakthroughs will require new, more open-ended approaches. In nature, intelligence manifests itself in behaviour arising from interactions of living organisms with the environment. Hence, instead of studying artificial intelligence from the viewpoint of simulated 'thinking' by computers, this suggests we should focus research on intelligence in the context of embodiment and interaction with the real world. We need to study IT systems that are independent and capable of adaptive learning.

Incorporation of IT into embodied artefacts poses a wide range of interdisciplinary research challenges far beyond classical robotics and computer science. The Beyond Robotics initiative, part of IST's Future & Emerging Technologies (FET) action, aims at consolidating and progressing European research in embodied information technologies. The work builds partly on the earlier FET initiatives Neuroinformatics For Living Artefacts and Life-Like Perception Systems. It addresses a broad range of scientific communities, including computer science, advanced robotics, machine learning, perception and cognition, neuroscience, biology, biomechatronics, etc.

The initiative has three ambitious and challenging long-term objectives. Firstly, it targets the development of cognitive companions – intelligent robots whose "purpose in life" would be to serve their human masters. Such a "companion" would continuously interact with its master and so must be able to evolve to acquire the necessary skills and competencies. The constant exposure to new environments and settings, as well as direct natural communication with humans imposes, significant demands in perception, learning and reasoning capabilities to ensure robust real-time performance over years of use.

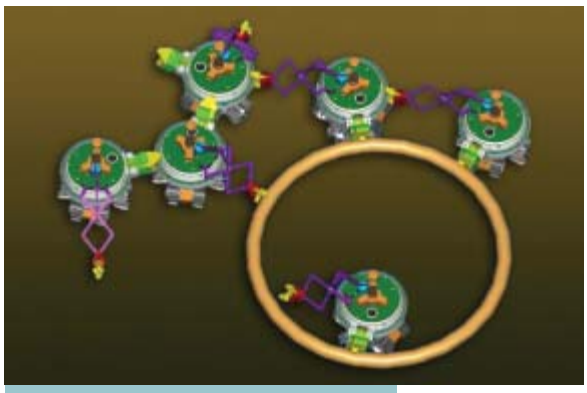
A second objective is hybrid bionic systems that interface information systems with the human nervous system. These would augment and substitute for human deficiencies in areas such as perception, physical action and interaction with other people. For this, systems require a tight coupling between the person and the artefacts, e.g. intelligent prosthetics (artificial sensory organs, arms, limbs, etc.). They must be flexible enough in terms of physical interaction and skill/task adaptation to function as an integral part of the human body. They should also support high-fidelity, two-way interfaces to the nervous system or other advanced interfaces to accommodate human functionalities like manipulation or walking.

The third area of interest is robot ecologies. The objective here would be to develop teams of autonomous robotic agents exhibiting collective behaviour and intelligence. The robots would be able to self-organise, adapt, co-operate and evolve in order to attain a global objective. Achieving the co-ordination, adaptation and evolution necessary to jointly accomplish a wide variety of different tasks is an open issue. Other challenges include task distribution, co-ordination and knowledge sharing within heterogeneous systems capable of (co-)operating in the real world.

Projects under the Beyond Robotics initiative will help to identify the most promising research directions. They are expected to result in major breakthroughs relating to the understanding of cognitive, learning and perception functions and in how to exploit this knowledge for building complex cognitive systems. The long-term industrial impact has several dimensions from bioengineering, prosthetics and rehabilitation to

"Living" building blocks for self-designing artefacts

Inspired by developmental biology, HYDRA is developing a physical model of self-assembling cells in 3D space. Each cell will cooperate with other cells and will be able to make choices as to investment in movement, perception and communication. It is expected that this design will lead to task specialisation of the cells (division of labour) similar to social insects experiencing queuing and bottleneck situations.



Self-organising mini-robots developed under the SWARM-BOTS project

service robotics, new entertainment and games, environmental monitoring, crisis management, and nanotechnologies.

Current projects launched under FET's earlier initiatives anticipate these approaches. POEtic is investigating a novel digital electronic circuit, in the form of a flexible computational substrate or artificial tissue, capable of integrating the three biological models of self-organisation: phylogeny (P), ontogeny (O), and epigenesis (E). This tissue will be the basis for the creation of POE-based machines, capable of evolution, growth, self-repair, self-replication, and learning.

Using a parallel investigation of an artificial and a natural system, AMOUSE aims to construct a robotic mouse. Equipped with visual sensors and artificial whisker system, the robot will perform experiments on navigation and learning based on multisensory cues. NEUROBIT is creating a hybrid bionic system that couples portions of living mammalian nervous tissue, kept alive in-vitro, to a mechanical robot. The resulting hybrid system will be "trained" to control the robot in real-time.

Aimed at bridging the micro and the nano worlds, MiCRoN is developing a multi-microrobot manipulating system to handle micron-sized and mesoscopic objects with nanometre precision. The system will be based on a cluster of five to ten small (cm^3) mobile robots each equipped with onboard electronics for control and communication. These robots will be able to co-operate autonomously to accomplish tasks ranging from the handling of biological cells to the assembly of micro-parts.

Swarming intelligent robots

Recent studies have thrown new light on the self-organising and self-assembling capabilities shown by social insects and other animal societies – so-called swarm intelligence. IST's SWARM-BOTS project draws on these insights to design and implement a novel approach to self-organising and self-assembling artefacts.

A swarm-bot is an artefact composed of a number of simpler, insect-like, robots (s-bots), built out of relatively cheap components, capable of self-assembling and self-organising to adapt to their environment. The s-bots will be set specific tasks, such as forming and changing shape, and navigation on rough terrain. Both cases will consider situations in which a single s-bot cannot accomplish the task and the cooperative effort performed by the s-bots aggregated in a swarm-bot is necessary.

Strategic Objectives:	*Future & emerging technologies: Beyond robotics*		
Project References:	*AMOUSE*	*IST-2000-28127*	*www.ifi.unizh.ch/ailab/projects/amouse/*
	HYDRA	*IST-2001-33060*	*hydra.mip.sdu.dk/home.html*
	MICRoN	*IST-2001-33567*	*wwwipr.ira.uka.de/~micron/*
	NEUROBIT	*IST-2001-33564*	*www.tils.com/neurobit/*
	POEtic	*IST-2000-28027*	*www.poetictissue.org*
	SWARM-BOTS	*IST-2000-31010*	*www.swarm-bots.org*
Commission Contacts:	*Pekka Karp*	*pekka.karp@cec.eu.int*	
	Jacques Lacombe	*jacques.lacombe@cec.eu.int*	
Web:	*www.cordis.lu/ist/fetro.htm*		

The push to nano

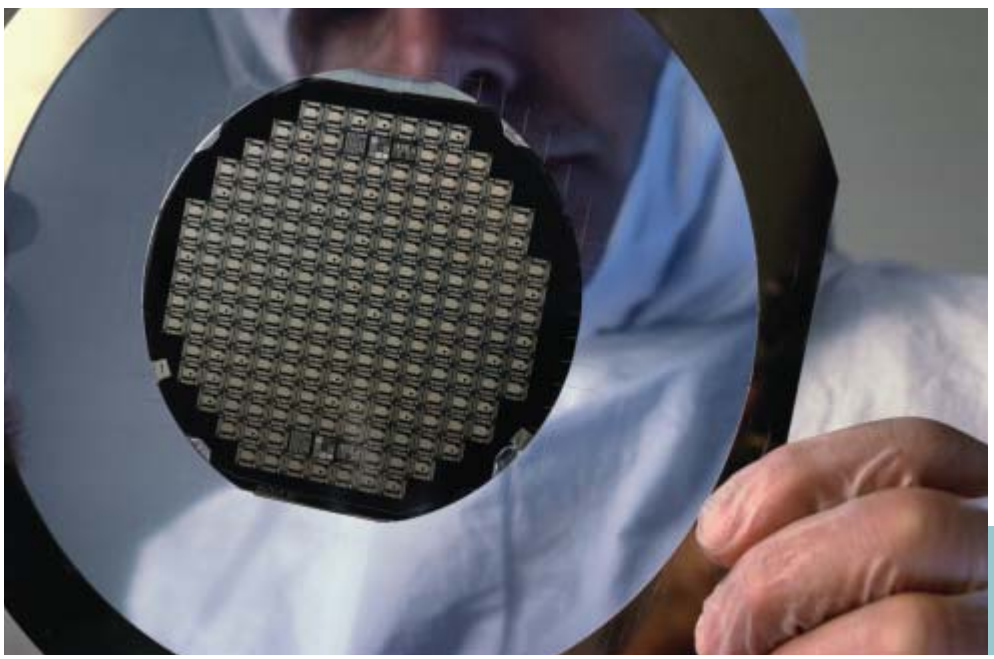
As more and more product functionality is embedded in silicon, microelectronics has become central to value creation in many industries. European RTD contributes to the international effort to push the limits of the current CMOS technologies and prepare for the post-CMOS era.

Microelectronics is the oil in the machine of the information society. Beyond the obvious examples in computing and telecommunications, electronics also accounts for an increasing share of the cost of products and services in sectors such as automotive, consumer products and healthcare. Worldwide, the total value of the semiconductor business chain is approaching 1% of global GDP. Hence, microelectronics underpins a large variety of industrial developments as more and more product functionality becomes carved in silicon.

While the current applications will continue to develop further, they will be joined by a proliferation of new – and high volume – applications as chips become embedded in everyday objects, creating the ambient intelligence landscape. Early examples of this are to be seen in smart cards and in the radio frequency "tags" used for industrial laundry, medical applications and logistics. In future, individuals will have chips in 100s to 1000s of objects that will seamlessly enhance their everyday lives. These chips will need to be powerful and networked, yet cheap, small, light and consuming minimum power.

These requirements all push in the direction of smaller circuit dimensions but higher functionality, and hence will continue to drive the shrinking according to "Moore's law". As we push towards ever-smaller feature sizes, micro-electronics is becoming "nano-electronics" and encountering a whole range of new problems – physical limits and technological bottlenecks. At the same time, the field is converging with developments in photonics and nanotechnology. These opto- and nano-applications will be delivered on silicon platforms – at least initially – and will be able to exploit the low-cost mass manufacturing base created for silicon systems.

Microelectronics research in FP6 will push the limits of the current CMOS technology and prepare for the post-CMOS era. It aims to develop, ahead of the ITRS international roadmap, semiconductor devices shrunk by an order of magnitude down to the 5nm size, as well as alternative post-CMOS devices. Research also aims to tackle key challenges in relation to the "design-productivity" gap. Priorities are the integration of advanced and non-CMOS devices into the basic silicon technologies, developments in ultra-high frequency and high power applications, and lithography.



We are approaching the end of the CMOS era

Pushing the limits of lithography

Lithography is at the heart of IC manufacturing, defining to a large degree both the performance of the products, as well as the productivity and costs of the manufacturing process. Using techniques similar to photography, lithography allows steady miniaturisation by enabling the size of IC components to be resolved at ever smaller levels – at present down to 100 nanometres. These feature sizes are significantly smaller than the wavelength of the light used to produce them (193nm).

To reach features sizes of 65nm and smaller, as demanded by the ITRS, current optical lithography must use sources operating in the deeper ultra-violet range. UV2LITHO is aiming to accelerate the introduction of a 157nm lithography process for the sub-65nm node. Work focuses on possible resist options and demonstrating manufacturing capability in a pilot 65nm production line. As an example of a cross-programme co-operation, UV2LITHO forms part of FLUOR, a EUREKA/MEDEA+ project looking at the manufacturing scale-up of the next generation of lithography technologies. It is also linked to 157CRISPIES investigating new photoresist materials.

With a longer term perspective, SOARING addresses extreme ultra-violet (EUV) lithography core technology for the sub-65nm range. It is developing a set of critical components for radiation sources, optics and resists. The performance of these components will be validated in producing 50nm features in silicon using test equipment.

Future miniaturisation goals require RTD efforts on many fronts, including further optimisation of processes to achieve very small gate sizes, development of new materials and optimisation of existing materials, and novel approaches to architectures and circuit design. Projects funded by the IST Programme under FP5 have made major contributions to these international efforts and provide every confidence that the ITRS goals will be achieved.

For instance, ARTEMIS is developing advanced process steps and device architectures for the 65nm node. It targets physical gate lengths from 45nm down to 25nm and extends results and solutions from two previous IST projects, ULTRA II and HUNT. A related project, NESTOR, will provide a first assessment of three new multi-gate architectures for 25nm devices that are potentially scalable down to the 10nm range.

Other key challenges arise following the wafer fabrication stage (so-called back-end processes). For instance, ULISSE concentrates on critical aspects of interconnects, in particular the use of ultra-low dielectric ("low k") materials to reduce parasitic capacitances. Selected low k materials are being characterised and simulations developed to analyse their impact on overall device performance. ACTION is a Semiconductor Equipment Assessment project that assesses the use of an ultra-low k dielectric CVD tool in a 300mm production site.

Projects launched under FP6 will use the new instruments to mobilise around specific RTD challenges. Following the 1st Call, a series of new projects will be launched in late 2003 focusing on areas such as next generation lithography, high-power systems, new devices and nano-CMOS, and nanoscale fabrication processes.

Strategic Objectives:	*Pushing the limits of CMOS and preparing for post-CMOS*		
Project References:	*157CRISPIES*	*IST-2000-30143*	
	ACTION	*IST-2001-34197*	
	ARTEMIS	*IST-2001-34404*	*www.imec.be/artemis/*
	NESTOR	*IST-2001-37114*	*www-leti.cea.fr/commun/europe/nestor/nestor.htm*
	SOARING	*IST-2001-35254*	
	ULISSE	*IST-2000-30043*	*www-leti.cea.fr/commun/europe/ulisse/ulisse.htm*
	UV2LITHO	*IST-2000-30175*	*www.imec.be/uv2litho/*
Commission Contacts:	*Georg Kelm*	*georg.kelm@cec.eu.int*	
	Bernard Netange	*bernard.netange@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/cmos/home.html*		
	Semiconductor Equipment Assessment: www.sea.rl.ac.uk/index.htm		
	MEDEA+: www.medea.org		

Networked embedded systems

The emergence of systems of systems and the increasing complexity of IST applications call for new approaches to embedded intelligent devices.

We are on the verge of a new era of IST, where computing and communications capabilities are being embedded into a growing range of physical devices and everyday objects linked together through networks. Some of these developments are obvious – for instance PDAs and internet-enabled mobile phones – but often IT is buried inside larger (or smaller) systems in ways that are not easily visible to end-users. By opening up new means to collect, share and process information, these networked systems of embedded processors have the potential to change radically the way we live and interact. Whether as part of a networked infrastructure or as components in products, embedded systems are essential building blocks in enabling our surroundings to become more intelligent and responsive.

This trend towards embedding computing and communications capabilities quite literally everywhere brings demanding new challenges. Whereas we interact directly with our desktop computers, embedded systems will be integrated into objects and devices that bear little resemblance to a computer system. They will also have to operate under tight physical constraints, for example in terms of limited energy, adequate heat dissipation, low bandwidth, and memory limitations. Mechanisms of networking and thus linking objects will be performed in an ad-hoc and autonomous manner without direct interaction of the user who, in turn, benefits from full plug-and-play, easy to use and reliable end-to-end services. Many of these applications will place a high emphasis on issues such as safety, privacy, security and reliability.

Research on embedded systems in FP6 aims towards this next generation of hardware/software systems embedded in intelligent devices. For networked embedded systems, the emphasis is on middleware and platforms that hide the underlying complexity from the user while at the same time provide efficient distribution of resources at low cost. One focus is on middleware for wireless devices, e.g. mobile phones or PDAs, that makes easier the design, programming, verification and maintenance of systems including such devices. Scalable and self-configuring platforms that offer services for ad-hoc networking of very small devices at large scale will also be addressed.

Three application domains, in particular, stand to benefit from networked approaches to embedded systems. The first is consumer electronics, where all sorts of digital gadgets and services are being introduced – digital cameras and videos, DVD players, digital television – that are increasingly connected in ad-hoc ways. Networked embedded systems will help link such devices in home networks and provide a bridge to the digital world of the internet. Closer attention to system design aspects should also make such devices easier to use. An existing project in this area is OZONE, which is investigating technologies and services based on networks of consumer-oriented devices. A three-layer architectural framework is being developed that will support service discovery, interoperable middleware and a powerful computing platform. The solution will be evaluated in extensive user trials.

Other domains of interest are networked sensors and the advanced control of networked applications (see boxes).

Embedded systems RTD presents very demanding scientific challenges, where each region has its own

See all, hear all

The vision of ubiquitous computing requires the development of devices and technologies which can be pervasive without being intrusive. The basic components of such a smart environment will be small nodes (sensors) with sensing and wireless communications capabilities, able to organise flexibly into a network for data collection and delivery. Such a network would have to operate within very tight resource constraints, for instance limited energy, processing power and memory.

EYES is conducting research into networks of self-organising and collaborative energy-efficient sensors able to operate under these conditions. The work focuses on the development of new architectural schemes, communications protocols and algorithms that enable individual sensors to be networked together to deliver smart services.

Consumer electronics will be one area to benefit from networked embedded systems

specialisms and expertise. Since 2000, the IST Programme has developed strong relations with the US in this area, notably through the National Science Foundation and DARPA, the US defence research agency. As well as continuous dialogue at policy level, a series of joint events have been held and collaborations between the two RTD communities are being encouraged. This collaboration is on-going and is expected to lead to a joint call during 2004/5.

The flying team

Unmanned aerial vehicles (UAVs) have a wide range of civilian uses including aerial photography, broadcasting, traffic surveillance, weather and atmospheric monitoring, fire fighting and agriculture. In many cases two or more UAVs (helicopters or airships) need to work together in a coordinated way. Controlling such a system is a highly demanding task, however, especially where different types of UAVs are involved.

COMETS is investigating the real-time coordination and control of multiple UAVs. It aims to design and implement a distributed control system that enables the UAVs to work together for cooperative detection and monitoring. Researchers are designing and implementing a new control architecture and control techniques, as well as integrating distributed sensing techniques and real-time image processing capabilities. These concepts and systems will be demonstrated in stringent real-world conditions, namely fighting forest fires.

Strategic Objectives:	*Embedded systems*		
Project References:	*COMETS*	*IST-2001-34304*	*www.comets-uavs.org*
	EYES	*IST-2001-34734*	*eyes.eu.org*
	OZONE	*IST-2000-30026*	*www.extra.research.philips.com/euprojects/ozone/*
Commission Contacts:	*Corinna Amting*	*corinna.amting@cec.eu.int*	
	Merce Griera I Fisa	*merce.griera-i-fisa@cec.eu.int*	
	Rolf Riemenschneider	*rolf.riemenschneider@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/embedded-systems/home.html*		

Next generation networks

Strong growth of multimedia services is placing our communications networks under increasing strain. IST's research on next-generation and all-optical networks aims to lay the foundations for a new common infrastructure for broadband multimedia services.

Developments in technology and the growth of new multimedia services are placing huge demands on our communications networks. Over recent years internet traffic has been growing at hundreds of percentage points per year, a trend that is expected to continue unabated. And whereas today's internet applications are mainly asymmetric, the increasing interest in digital imagery, peer-to-peer applications and interactive TV will shift the capacity requirements of networks towards a more symmetrical profile. Already more than 10% of internet traffic is video streaming applications.

The goal in next-generation networks (NGN) research is to develop a new common architecture of networks that can evolve to handle multimedia services in an integrated and convergent way. Access networks must permit optimised access for a range of technologies – optical fibre, fixed wireless, interactive broadcasting, satellite, xDSL, power lines networks etc.

New concepts in network management will lower operational costs and provide improved functionality for new services. Multi-service capability will allow a single physical access network infrastructure to be shared by multiple services, so allowing a reduction in capital and operational expenditures for installation and maintenance. Also, increased bandwidth is required to support the expected evolution in user requirements and internet-related services. The WINMAN approach has been to provide an integrated network management solution which is capable of providing end-to-end IP services on hybrid

Future networks will provide a new common architecture for multimedia services

End-to-end quality of service across the internet

A major limitation of the internet is its lack of service level guarantees due to its basic design for best-effort packet delivery. The provision of end-to-end quality-of-service (QoS) is a wide-open research issue whose solution will transform the internet into the global multi-service network of the future.

MESCAL proposes scalable, incremental solutions that enable the flexible deployment and delivery of inter-domain QoS across the internet. It focuses on two aspects: the definition of QoS-based connectivity services to be provided by stakeholders; and the means to engineer network resources to meet agreed performance and capacity targets for the contracted services.

transport networks from IP, ATM, SDH, WDM towards IP/WDM.

All-optical communications networks represent the best means of meeting the bandwidth requirements of future broadband applications and internet services. Most of the terabytes of information that today flow across the global core telecoms networks are already carried on multi-wavelength optical fibre links. The challenge is to extend and build on the existing optical network, ultimately by direct optical fibre connections into the home. This requires further work on the integration of optical core network technologies with access technologies such as wireless (mobile and fixed), satellite, xDSL, cableTV and a multitude of different protocols (including ATM, Ethernet and IP).

Recent achievements here include DAVID's and LION's results on integrating data and voice over dense wavelength division multiplexing (DWDM) (see box), and STOLAS's work on optical (burst) switching of IP signals over WDM networks. ESTA evaluates a 10 Gigabit version of Ethernet to be deployed over LAN, MAN and WAN environments.

IST projects in the areas of photonics and optical networking technologies are clustered under the OPTIMIST thematic network. The network facilitates the exchange of information and best practice across photonics-related areas, and maintains a "Photonics Roadmap" setting out future research requirements. In 2003, OPTIMIST companies set up the EU Photonics Industry Consortium as a forum to continue the network's activities and provide a voice for the European photonics industry.

The NGN-Initiative project facilitated IST research projects to contribute towards the development of a general next generation networks roadmap and benchmark reports.

Performance improvement in core optical networks

As the volume of internet traffic continues to grow, network operators are looking for solutions to transport this IP traffic over metropolitan, national and international distances in the most efficient way. DAVID investigated data and voice integration of DWDM as a means to enhance the performance of transport networks, and so cut the cost of deploying new broadband applications.

LION investigated the great interest in automatic switched optical networks (ASON) to provide the capabilities of implementing automatic network functions such as network dimensioning in a multi-domain (NGN) environment. It uses DWDM and its multi-wavelength capacities, and Generalised Multi-protocol Label Switching (G-MPLS) to achieve optimised distribution of the functions on various networks (and network layers) in a data-centric context.

Strategic Objectives:	*Broadband for all*		
Project References:	*DAVID*	*IST-1999-11742*	*david.com dtu.dk*
	ESTA	*IST-2001-33182*	*www.aspen.uk.com/index.cfm?PID=56*
	LION	*IST-1999-11387*	*www.telecom.ece.ntua.gr/lion/*
	MESCAL	*IST-2001-37961*	*www.mescal.org*
	NGN-Initiative	*IST-2000-26418*	*www.ngni.org*
	OPTIMIST	*IST-1999-12501*	*www.ist-optimist.org*
	STOLAS	*IST-2000-28559*	*www.ist-stolas.org*
	WINMAN	*IST-1999-13305*	*www.winman.org*
Commission Contacts:	*Pertti Jauhiainen*	*pertti.jauhiainen@cec.eu.int*	
Web:	*www.cordis.lu/ist/so/broadband/home.html*		
	www.cordis.lu/ist/directorate_d/cnt/index.htm		

The evolution of technology is in our hands

Postscript

Visions: Opportunities further ahead

Ultimately the future is in our hands and we must decide which way we want to go. IST's Vision Book project is exploring new ways of thinking about the future and how to involve people in this process.

Information and communication technologies are playing an increasingly important role in our lives: one only has to look to the influences of mobile communications and the internet to see their implications. What more will the future hold as new generations of ICTs emerge? IST's Vision Book project aims to find out.

Vision development is an important and often neglected process. Thinking about where we are going and why is important – but not necessarily easy. The book aims to help the process of reflection by presenting a range of ideas, thoughts and images of the future relating to ICTs, in a way that is engaging, visually stimulating, and easy to understand. It provides a glimpse of future possibilities, to help us decide which way we may want – or not want – to go. Future concepts can help breakthrough thinking that is 'stuck' in the present. Rather than present dry facts, figures and statistics, visions and concepts may give people inspiration and open up new lines of thinking: new paradigms.

Many companies and international organisations have already used this approach to help drive innovation, explore opportunities, and forge common views. There is an opportunity to learn from these experiences and create something new.

The Vision Book will cover diverse scenarios of possible futures relating to people, information technology, and culture. Its series of 'future concepts', ranging from 5 to 25 years ahead, combine technological, human and societal perspectives in visual and understandable terms. Some are utopian, some disturbing; some may seem reasonable and others impossible. Yet the purpose of these 'landscapes of future Information Societies' is not to predict exactly what will happen, but rather to provoke thinking and provide inspiration for strategic decision-making. Each 'future concept' draws on expertise from a diversity of areas: from nano-technologies and ambient systems through to healthcare, the environment and new forms of governance; as well as interaction design, social psychology, culture and economics.

The Vision Book project is open and participatory. The book blends and builds on knowledge from a diversity of invited authors from across Europe and beyond. Authors will create and write the chapters, both individually and in groups, and a series of workshops is being held for authors to meet and exchange ideas. A website will support the process of creating the book and later, once the book is published, it will provide a forum for gaining readers' feedback and their own contributions.

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Glossary

This list excludes acronyms relating to specific IST projects and initiatives

3D	three-dimensional
ADAS	advanced driver assistance system
ADSL	asymmetric digital subscriber loop
AmI	ambient intelligence
ANSI	American National Standards Institute (www.ansi.org)
API	application programming interface
AR	augmented reality
ASIC	application-specific integrated circuit
ASON	automatically switched optical network
ASP	application service provider
ATM	asynchronous transfer mode
AV	audio-visual
BAN	body area network
BPR	business process re-engineering
BWA	broadband wireless access
CA	coordination action (in FP6)
CAD/CAM	computer-aided design/computer-aided manufacture
CAN	community area network
CBMI	content-based multimedia indexing
CBSE	component-based software engineering
CDMA	code division multiple access
CEN	Comité Européen de Normalisation (European Committee for Standardisation) (www.cenorm.be)
CERT	computer emergency response team
CIP	critical infrastructure protection
CMOS	complementary metal oxide semiconductor
CNT	carbon nanotube
CRM	customer relationship management
CSCL	computer-supported collaborative learning
CWA	CEN Workshop Agreement
DAB	digital audio broadcast
DAVIC	Digital Audio-Visual Industry Council (www.davic.org)
DG	Directorate-General
DSL	digital subscriber loop
DSP	digital signal processing
DSRC	direct short-range communications
DTV	digital television
DVB	digital video broadcast
DVB-RCS	DVB-Return Channel via Satellite
DVD	digital video disc
DWDM	dense wavelength division multiplexing
DxB-T	digital audio/video broadcast – terrestrial
EC	European Commision (www.europa.eu.int/comm)
EFC	electronic fee collection
EIB	European Investment Bank (www.eib.org)
ERA	European Research Area
ESA	European Space Agency (www.esa.int)
eTEN	Trans-European Networks Programme
ETSI	European Telecommunications Standards Institute (www.etsi.org)
EU	European Union
EWIS	European Early Warning Information System
F/OSS	free/open source software
FET	Future and Emerging Technologies
FP5	Fifth Framework Programme for Research & Technological Development (www.cordis.lu)
FP6	Sixth Framework Programme for Research & Technological Development
FPGA	field programmable gate array
GaAs	gallium arsenic (semiconductor)
Gbit / GB	gigabits / gigabytes (10^9)
GHz	gigahertz
GIS	geographical information system
GMES	Global Monitoring for Environment and Security (http://gmes.jrc.it)
G-MPLS	generalised multi-protocol label switching
GNSS	Global Navigation Satellite System
GPR	ground-penetrating radar
GPRS	general packet radio service
GPS	global positioning system
GSM	global system mobile
GTRN	Global Terabit Research Network (www.indiana.edu/~gtrn/)
HDI	high-density interconnect
HMI	human-machine interface
HTML	hypertext mark-up language
IC	integrated circuit
ICT	information and communication technologies
IEEE	Institute of Electrical and Electronic Engineering (www.ieee.org)
IEFT	Internet Engineering Task Force (www.ietf.org)
IMS	Intelligent Manufacturing Systems Initiative (www.ims.org)
InP	indium phosphorous (semiconductor)
IP	integrated project (in FP6)
IP	Internet Protocol
IP	intellectual property
IPR	intellectual property rights
IPv6	Internet Protocol version 6
IRC	Innovation Relay Centre
IRTF	Internet Research Task Force (www.irtf.org)
ISDN	integrated services digital network
ISO	International Standardisation Organisation (www.iso.org)
IST	information society technologies
IST	Information Society Technologies Programme (www.cordis.lu/ist)
ISTAG	Information Society Technologies Advisory Group
ISTC	Information Society Technologies Committee

ITRS	International Roadmap for Semiconductors (http://public.itrs.net/)
ITU	International Telecommunications Union (www.itu.org)
JRC	Joint Research Centre (www.jrc.cec.eu.int)
KA I	Key Action I: Systems And Services For The Citizen (in FP5)
KA II	Key Action II: New Methods Of Work And Electronic Commerce (in FP5)
KA III	Key Action III: Multimedia Content And Tools (in FP5)
KA IV	Key Action IV: Essential Technologies And Infrastructure (in FP5)
KM	knowledge management
LBS	location-based services
MAN	metropolitan area network
Mbit / MB	megabits / megabyte (10^6)
MDA	Model Driven Architecture (www.omg.org/mda/)
MEMS	micro-electromechanical system
MHP	Multimedia Home Platform (www.mhp.org)
MHz	megahertz
MOEMS	micro-optoelectromechanical system
MOSFET	metal oxide semiconductor field effect transistor
MPEG	Motion Picture Expert Group (http://mpeg.telecomitalialab.com)
MPW	multi-project wafer
MST	microsystem technology
NAS	Newly Associated States
NGG	next generation grid
NGI	Next Generation Internet initiative (www.ngi.gov)
NGN	next generation network
NID	nanotechnology information device
nm	nanometre (10^{-9} m)
NoE	network of excellence (in FP6)
NRENs	national research and education networks
NVM	non-volatile memory
OEM	original equipment manufacturer
OFDM	orthogonal frequency division multiplexing
OGSA	Open Grid Services Architecture (www.globus.org/ogsa)
OLED	organic light emitting diode
OSGI	Open Services Gateway Initiative (www.osgi.org)
OWL	web ontology language (www.w3.org/2001/sw/WebOnt/)
P2P	peer-to-peer (technology)
PAN	personal area network
PDA	personal digital assistant
PKI	public key encryption
PLC	power line communications
PLED	polymer light emitting diode
PVR	personal video recorder
QD	quantum dot
QIPC	quantum information processing and computing
QoS	quality of service
RDF	resource description framework (www.w3.org/RDF/)
RFID	radio-frequency identification device
RN	research network
RTD	research and technological development
SCM	supply chain management
SDH	synchronous digital hierarchy
S-DMB	satellite-digital multimedia broadcast
SDR	software defined radio
SEEM	Single European Electronic Market
SiGe	silicon germanium (semiconductor)
SME	small and medium-sized enterprise
SMS	simple messaging service
SO / VO	smart organisation / virtual organisation
SOAP	simple object access protocol (www.w3.org/tr/soap/)
SOC	system-on-a-chip
SOHO	small-office home-office
SOI	silicon-on-insulator
SSA	specific support action (in FP6)
STREP	specific targeted research project (in FP6)
S-UMTS	satellite-universal mobile telecommunication system
Tbit / TB	terabits / terabytes (10^{12})
TD-CDMA	time division/code division multiple access
THz	terahertz
TTP	trusted third party
T-UMTS	terrestrial-universal mobile telecommunication system
UDDI	universal description, discovery and integration (for web services) (www.uddi.org)
UMTS	universal mobile telecommunications system
URL	universal resource locator
USB	universal serial bus
UWB	ultra-wideband
VDSL	very high-speed digital subscriber line
VME	virtual mobile environment
VoIP	voice-over-IP
VR	virtual reality
W3C	Worldwide Web Consortium (www.w3c.org)
WAI	Web Accessibility Initiative (www.w3c.org/wai)
WAN	wide area network
WAP	wireless application protocol
W-CDMA	wideband code division multiple access
WDM	wavelength division multiplexing
W-LAN	wide-area local area network
WP 2003/2004	IST Work Programme 2003-2004
WSDL	web services description language (www.w3.org/tr/wsdl)
WWW	world-wide web
XML	extensible mark-up language (www.w3.org/XML)

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Project Index

Projects referenced in this book are listed below. Full details of all IST-FP5 projects, plus new projects being launched under FP6, are available on ISTweb at www.cordis.lu/ist/projects.htm. The site includes a search facility.

Programme Index

Articles in this book are referenced to Strategic Objectives and other measures in the IST Work Programme 2003/2004. The IST Work Programme includes further details of the Strategic Objectives, their focus areas, budgets and the timing of calls for proposals.

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The Annual Publication of the IST Thematic Priority presents an overview of the programme's activities and achievements. It describes technical challenges and policy issues addressed by the work programme and highlights some of the recent RTD projects and results. The transition from the Fifth to the Sixth Framework Programmes and the linkages between research activities and other EU policies are also described. The presentations focus on the use of IST within three key settings: by individuals and in personal spaces; by enterprises and in the workplace; and by public services and society at large. A fourth section covers enabling technologies which underpin future services and applications across these scenarios. Covering IST development from many different perspectives, the book shows how IST research is contributing to a knowledge society for all. Further information on the IST Priority is available at www.cordis.lu/ist