The Future of the Internet

A Compendium of European Projects on ICT Research Supported by the EU 7th Framework Programme for RTD

European Commission
Information Society and Media

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ISBN 978-92-79-08008-1

Printed in Belgium

PRINTED ON CHLORE FREE PAPER

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European Commission
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Preface

Viviane Reding
Member of the European Commission responsible for Information Society and Media

The Internet has already profoundly changed our economic and social world. The developments we have seen so far are just a beginning. If today's Internet is a crucial element of our economy – the future Internet will play an even more vital role in every conceivable business process. It will become the productivity tool "par excellence". The Internet itself is a fantastic tool for connecting people together into an enormous social networking project.

The cultures and values governing the Internet have changed. From its early days the Internet has been founded on the principles of openness and free access shared by a community of developers. Today, the Internet faces many conflicting challenges in terms of cultures and values it serves.

Let me give you a couple of examples:
- The Internet is a vector of a more "integrated" global world. It is thus a powerful force for enhancing transparency and informing citizens. Some communities are however seeking to fragment it into islands which will create barriers to the free flow of knowledge on line.
- Openness and connectivity end-to-end are key features of the success of the Internet, yet there is pressure now emerging to limit these features so as to foreclose the internet in order to give key investors more reliable streams of revenue.
- Security and authentication have become issues of great concern for businesses, public administrations and citizens. These issues are not yet adequately addressed in the Internet and we have to go very carefully in order to increase trust without compromising openness.

We need to strike the right balance between different interests as the Internet expands and deepens its role in our lives. To this end, the European Commission will contribute to the 5 priorities identified by the Internet Governance Forum: openness, security, access, diversity and critical Internet resources.
The use of the Internet in public policies will considerably grow in areas such as education, culture, health and e-government. These topics will be at the core of our contribution to the OECD Seoul Summit in June.

In the longer term, we have to prepare the future Internet, including for example, a 3D-Internet. This has already been pioneered through virtual environments such as "Second Life".
Turnover in online gaming has grown threefold over the past 5 years, and virtual worlds are estimated to attract more than 60 million users worldwide. In addition to the new technological requirements placed on the underlying network infrastructure, a "3D Internet" will raise many new challenges, such as the management of multiple identities, monetisation of virtual assets and applicable rules, or privacy of "digital avatars".
Such graphic and rich environments require high speed and high quality applications. But today's Internet was not designed with 100 Megabit-per-second data rates in mind. Moreover, the fact that we approach 4 billion mobile users worldwide has profound implications on the design of the future Internet, an Internet on the move. We also see growing machine-to-machine communications - RFID is just the first example. Again, new technology means new applications which need to comply with the users' rights to privacy and confidentiality.

This is why the "Future Internet" is at the heart of the 7th Framework Programme. So far some 300 million Euro of our ICT budget have been dedicated to this issue. We now have a golden opportunity to shape the future of the Internet.

I encourage you, the research projects, to work jointly in the setting up of the European Future Internet Assembly that I see as a vehicle to ensure a prominent role of Europe in the global debate.

Europe has all the assets to be a leader on the development of the Future Internet. Not only was the web invented in Europe, but many European companies are winning recognition as "best international internet start-ups". Europe is also home to the highest number of internet users worldwide. Europe is a tremendous pool of scientific talents and creativity.

We invite you to join us in ensuring that Europe fully benefits from the opportunities ahead of us.

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Introduction

The Internet world as we know it today has undergone far-reaching changes since its early days while becoming a critical communications infrastructure underpinning our economic performance and social welfare.

With more than 1 billion users world-wide today the Internet is poised to become a fully pervasive infrastructure providing anywhere, anytime connectivity. With the further deployment of wireless technologies, the number of users of the Internet is expected to jump to some 4 billion in a matter of few years.
As the Internet extends its reach and serves an ever growing population of users and intelligent devices, new innovative services are introduced, demanding an environment which supports innovation, creativity and economic growth.
In the i2010 policy framework the European Commission acknowledges and reaffirms its support to the openness, interoperability and end-to-end principles governing the Internet.
At the same time, it is anticipated that the current Internet may in the long term not be fully capable of supporting the ever larger set of usages, constraints and requirements that it will have to face as it further penetrates our immediate surroundings and environment. The issue of a "Future Internet" is hence attracting more and more attention and other regions in the world have already launched strategic exploratory initiatives in this field.

The ICT theme of the 7th Framework Programme for research and technological development provides a key opportunity to set in place a bold European effort regarding the "Future Internet" and in particular to investigate a number of technological domains, as well as associated policy domains, that have a bearing on the network and service infrastructure elements of the Internet of tomorrow.
This programme provides in particular a unique collaborative platform between academia, research institutes and industry that can be mobilised to address the multiple facets of a Future Internet, also taking advantage of the existence of key European Technology Platforms in the field, such as eMobility, NEM and NESSI.

Against this background, the projects referred to in this compendium are instrumental in the creation of the European Future Internet Assembly, which aims at identifying the long term societal and economic trends of future "on line societies", how they may impact the underlying network and service technologies, and how they subsequently drive research requirements.
As a consequence, opportunities for action at European level will be explored with the intention of further facilitating and mobilising the relevant research constituencies, also taking into account initiatives already launched in other regions of the world.
The European Future Internet Assembly will offer a vehicle for excellence and innovation that will create for the relevant European actors an opportunity to exchange and promote their views in the global "Future Internet" debate and building up on relevant initiatives emerging from the first call of the ICT programme, such as the "EIFFEL" initiative **(www.future-internet.eu).**

The open "Future Internet Assembly" main target is to provide a place where innovative approaches can be discussed and cross fertilised over the widest possible constituencies. The initiating projects will be invited to present themselves publicly during the first day of the Conference through a Poster Session.

This compendium summarise the relevant European project activities which contribute to setting the pace of the Future Internet developments in Europe.

Europe plays a key role in the Future Internet

Future Internet is vital to sustainable economic growth in Europe

In the future, even more users, objects and critical information infrastructures will be connected to the Future Internet and it will become a critical factor for supporting and improving the European economy.
It is therefore time to strengthen and focus European activities on the Future Internet to maintain Europe's competitiveness in the global marketplace.

Europe must address the technological challenges of the Future Internet

The Future Internet needs radically new concepts and technologies if it is to support our future society in an effective way.
Europe has committed €9.1 billion for funding ICT research in FP7 but we must ensure that enhanced and focussed attention is given to the design of the Future Internet.
It is a matter of strategic importance for Europe to fully engage in the conception, development and innovation of the Future Internet to ensure the long term growth of the ICT sector in Europe, support the multitude of applications and services relying on continued innovation in the Internet infrastructure.

The promise of the European research community on the Future Internet

We have to radically rethink the networking infrastructure and the networks of the Future with a view to having a new Internet that meets Europe's commercial and societal ambitions and we pledge to contribute to building the Internet of the Future.

The more than 70 EU research projects presented in this compendium represent a public and private partnership investment of around € 500 million that recognizes the need for innovative approaches to new network architectures and exciting service technologies to ensure the emergence of a new wave of applications that will serve the European society's future needs.

The European Future Internet Assembly aims to:

- Coordinate European efforts with a view to foster cross-disciplinary innovation and creativity
- Develop the European knowledge base underpinning the Future Internet
- Design and build the technologies and networking architecture for the Future Internet
- Encourage collaborative business models and social network applications
- Create the conditions for the development of innovation friendly service oriented architectures
- Ensure the robustness of the networks and create trust and security in the on-line world
- Foster experimental facilities and test-beds for the Future Internet technologies and services
- Develop the tools and approaches harnessing the potential of the Internet of Things
- Develop capabilities for the creation, sharing, search and delivery of new-media content
- Raise awareness of economic, policy and regulatory orientations identified by the UN Internet Governance Forum, the OECD and the European regulatory framework

AREA 1

"FUTURE NETWORKS"

Technological perspectives 2015 and beyond

The technical drivers to the future networked society are fairly well understood. Mobility is becoming an aspect that will heavily characterize both the terminals and the services and will have to be taken into consideration in future designs. The number of networked devices will increase dramatically. More people will be connected, more and diverse devices will be connected and more devices will be directly communicating.

More users will create more of its own content. They want to have the content accessible on the anyway, anywhere and at any time basically. At home there will also be major change, e.g. IPTV is regarded as one of our highest growth segments and this will create triple play in a different way, live broadcast, time-shifted broadcast and Video on Demand will all be available through their broadband lines. And also IPTV will be able in all kind of mobile devices.

It is not clear as which direction such important socio-economic and technical drivers will take the future Internet, but it is clear that they will drive an evolution of the current networked techno-economic landscape, even possibly cause a disruption of the next generation Internet by bringing new design goals.

The Future Internet must be accessible, trusted and secure, as well as able to robustly scale to meet the increasing reliance placed on it.

It is anticipated that Internet governance will remain a key topic for both the current and the future Internet, and this needs to address in a systematic manner, i.e. as an issue also of relevance from a technological perspective by addressing it early enough when considering possible novel architectural aspects and approaches. Other non research issues also deemed of significant importance relate to openness, standards and interoperability. These are actually major features that have ensured the success of Internet, which should be maintained in the future.

EU has clearly outlined its adherence to the openness, interoperability and end to end principles, governing the Internet of today. It is hence deemed necessary that any further redesign of the architecture of global networks will have to respect these basic principles and characteristics. The adherence to such basic principles is clearly an area for international cooperation at both technological (saying what is possible) and policy (saying the requirements) levels.

The change from a dominance of asymmetric application in terms of bandwidth to more symmetrical requirements of the capacities of the (access) networks is happening today, this e.g. due to digital pictures, peer-to-peer applications and interactive TV.

The Internet-based web and peer-to-peer applications (e.g : MSN Messenger, Gaming, Second Life., Google, Tencent, Myspace, BitTorrent, Skype, YouTube or Flickr) dominate the amount of the traffic in the networks. New internet-based infrastructures are re-shaping the economic models both on the network and the application sides.

The Internet applications are being complemented with really high-capacity and low-cost wireless access alternatives for finest possible access granularity and largest coverage for high speed access to the Internet. For example, next generation Mobile WiMAX network could transmit data at a speed of up to one gigabit per second when stationary and 100 megabits per second in a moving vehicle (as demonstrated by Samsung). Current cellular technologies like HSDPA have data speed of up to 5 megabits per second. (in the downlink) and its expected to increase dramatically from current capacities in 3G and HSDPA towards HSDPA++, 3G LTE, 4G and beyond.

The current and future physical network technologies in fixed (e.g. xDSL, CATV, fibre) and wireless (e.g. GSM, EDGE, 3G, HSDPA, 4G, mobile WLAN, mobile WiMAX, satellite) technologies need to cope with this in a myriad of protocols and transmission media.

The fixed transmission media of copper, power line, cable, fibre and air continue to be there, with even more focussing on the optical fibre and the air interface for the purpose of sustainable growth rates and for the important aspect of mobility. The deployment of fiber will continue to get closer to the Home/Office bringing higher capacities by integrating optical technologies into the access and home networks.

Deployment and Application Scenarios

In designing the future internet we need to anticipate the social acceptance by considering key human and social issues such as usefulness, social and psychological impact, privacy and ethical issues.
Integrating the physical with the digital world mainly addresses the socio-economic needs that arise through the increased demand for incorporating Information and Communications Technologies in different business, governmental and public sectors, for example health, sustainable environment, safety, transportation aiming to create a network and services that considers the needs of a human in a more efficient way – eventually leading to the Future Networked Society.

The growing importance of context-awareness, targeting enriched experience, intuitive communications services fitting mobile lifestyle and a mobilised workforce, will in the future lead it to be more and more included in intelligent services that are smart but invisible to users. The social and economic benefits of making ICT-based services in areas as diverse as health, sustainable environment, safety and transportation more intelligent and adaptive are recognised as a new driver for communications services.

Besides enhanced user experience for human to human or human to machine interactions, autonomous machine to machine communication has gained significant importance. More and more business transactions and processes will be automated and will take place based on autonomous decisions without any human intervention. These will be often based on or influenced by context information obtained from the physical world, without the requirement of human input to describe the situation. The emergence of the Web2.0 and associated technologies is just a starting point of this development and already the impact of those on the economic development is hugely beneficial.
Effectively, this enables an environment where real world physical phenomena are electronically sampled and influenced by heterogeneous sensors and sensor/actuator islands and are at the fingertips of applications and humans alike, thus linking the physical world with the Future Internet. Consequently our environment can be adjusted to our needs, or we can adjust our behaviour following environmental changes. And our economic and social interactions are enhanced with efficient information or intelligent and autonomous machine-to-machine (M2M) interactions, enabling feedback and control loops which are currently based on human input and which are cumbersome, slow and fault ridden.

Cross domain perspective

The original Internet was created sharing a consistent and simple vision: all players had a common purpose: creating an infrastructure to hook all computers together so that applications and services could be invented to run over it.

The Internet today is a series of ongoing tussles (locking competitions): different stakeholders have (often) divergent interests in competition which each other (tussle): they adapt their mechanisms to achieve their goals and push-back the competitors.

The Future Internet should have a common purpose: the backbone of Information Society. The Architecture should meet the requirements e.g. users' mobility, numbers of heterogeneous resources and devices, mass digitization of media, software as services, new models of service and interaction, improved security/privacy, etc..., but it should also accommodate the current tussle, which is causing stagnation.

Today, the Telco and Web2.0 models are still profoundly different. The former is based on traditional networking and service platforms, quasi-static services and business models (e.g. customers pay for services). The latter is mainly based on the concept of "web-as-a-platform", dynamic services (*prosumption,* long tail, perpetual beta, etc) and alternative business models (e.g. advertisers pay).

The vision is to create a reference model and architecture to hook together all "Telco and Future Internet resources" (with an innovative approach) so that applications and services could be executed over it.
Architecture is aimed at overcoming both medium-long term limitations of current Telco infrastructure and Internet and current tussles (locking innovation and creating market stagnation). Specifically, architecture (applicable for Telco infrastructure and Internet) is highly modularized, decentralized and distributed. Design is made by-variations making used of "standardized" components (already under definition and implementation).
Services (not only those for the end Users but also network services) are likely to be comprised of a variety of components, provided by a variety of Players (e.g. ASP, Prosumers…) and running over a decentralized hosting (low-cost) infrastructure (including end-user devices, PC, servers, storage, computing and networking/forwarding resources…). This vision is expected to pave the way for a deep integration of service and network frameworks for Telco-Web convergence thus allowing broad federations of Players (e.g. Network and Service Providers and Application Service Providers) according to new business models. Openness, broad federations of Players and do-it-yourself innovative services and knowledge management will allow people (already Prosumers as from web2.0) to be the true center of Information Society.

In summary, there is a strong need for richer and deeper dialogue across the network-applications layer boundaries!

Questions one might ask

- How will the developments in the content and media, security, sensors, and services impact the network architectures? What will be in the network and what in the service layer? How will virtualisation of storage, processing power and services impact on the network architecture? Will wireless (terrestrial and satellite based) limitations impose certain network design choices?

- Which are the implications on the network architecture arising out of developments and requirements in security, identity, trust, reputation? Where to focus attention on? Should the network identify particular types of traffic?

- What are the future implications of location and context aware services? How to design networks that are innovation friendly?

- What needs to be done at the level of the network and service provisioning to allow for a greater personalisation of media services? Which degrees of freedom as seen from user characterise certain architectures? What are the implications of 3D media (video) content on mobile network design?

- Is there scope for an open service framework for mobile media services? How fast will the mobile Internet evolve?

- How to best address standards issues pertaining to the next Internet infrastructure? How to handle the likely architectural differences between Telecoms, Media and IT service cultures?

- What are the implications of home network developments and which opportunities will be created for new players?

- How will the infrastructure be influenced by the developments on the Internet of Things? Which architectural issues for a future ONS? What are the likely developments beyond NFC and which critical operational and management solutions need to be considered to cope with sensor based edge networks?

- What are the requirements for federated large scale test beds and experimental facilities as seen from a networking perspective? Which are the key elements of such large scale European facilities?

PROJECTS IN THIS AREA

Integrated Projects

Specific targeted research projects

Networks of Excellence

Co-ordination and Support Actions

4WARD: Architecture and Design for the Future Internet

The need for structural changes in the Internet is becoming increasingly evident. 4WARD is combining a set of radical architectural approaches building on a strong mobile and wireless background to design inter-operable and complementary families of network architectures.

4WARD's answer to the Future Internet challenge

We have reached a critical point in the impressive development cycle of the Internet that now requires a major change.

Today's network architectures are stifling innovation, restricting it mostly to the application level, while the need for structural change is increasingly evident. The absence of adequate facilities to design, optimize and interoperate new networks currently imposes an architecture that is suboptimal for many applications, and that cannot support innovations within itself, the Internet.

4WARD overcomes this impasse through **a set of radical architectural approaches** built on our strong mobile and wireless background. We improve our ability to design inter-operable and complementary families of network architectures. We enable the **co-existence of multiple networks** on common platforms through carrier-grade virtualization of networking resources. We enhance the utility of networks by making them **self-managing.** We increase their **robustness and efficiency by leveraging diversity.** Finally we improve application support by a new **information-centric paradigm** in place of the old host-centric approach. These solutions will embrace the full range of technologies, from fibre backbones to wireless and sensor networks.

4WARD results will have technical and economic impacts

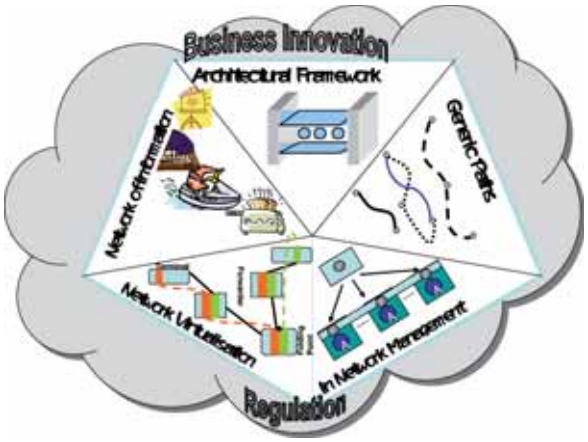
The 4WARD results will allow new markets to appear, redefining business roles, and creating new economic models. We will collaborate with related European and other region's projects, and establish the Future Internet Forum, enabling new markets and opening them for old and new players' alike, increasing opportunities for competition and cooperation, and creating new products and services.

To achieve these goals we have gathered **a strong, industry-led consortium** of the leading operators, vendors, SMEs, and research organisations, with the determination, skills, and critical mass to create cross-industry consensus and to drive standardisation.

The project is designed for multiple phases; the first one will establish the core concepts and technologies and last for two years. The project effort of about 2200 person months corresponds to the strategic importance of this endeavour.

4WARD's Strategic Objective

4WARD aims to increase the **competitiveness of the European networking industry** and to improve the **quality of life** for European citizens by creating a *family of dependable and interoperable networks providing direct and ubiquitous access to information.*
These future wireless and wireline networks will be designed to be readily adaptable to current and future needs, at acceptable cost. 4WARD's goal is to **make the development of networks and networked applications faster and easier, leading to both more advanced and more affordable communication services.**



Technical Approach

In our approach, we combine on one hand innovations needed to improve the operation of any single network architecture and on the other hand multiple different and specialised network architectures that are made to work together in an overall framework.
We will work
1. on innovations overcoming the shortcomings of current communication networks like the Internet
2. in a framework that allows the coexistence, inter-operability, and complementarity of several network architectures
3. in an integrated fashion, avoiding pitfalls like the current Internet's "patch on a patch" approach.

This work is structured into six work packages: three of them consider innovations for a single network architecture, i.e., Generic Path, In-Network Management and the Network of Information, one work package studies the use of Virtualisation to allow multiple networking architectures to co-exist on the same infrastructure, another work package

looks at the design and development of Interoperable Architectures, and finally one work package that ensures that all envisaged developments take proper account of essential Non-Technical Issues.

Key Issues

The Network of the Future must be based on a new set of architectural principles, formulated below as four programmatic tenets:

Tenet 1: Let 1000 Networks Bloom
We will explore a new approach to a multitude of networks: the best network for each task, each device, each customer, and each technology. We want to create a framework in which it will be easy for many networks to bloom as part of a family of interoperable networks that can co-exist and complement each other.

Tenet 2: Let Networks Manage Themselves
What we would like to have is a "default-on" management entity, which is an inseparable part of the network itself, generating extra value in terms of guaranteed performance in a cost effective way, and capable of adjusting itself to different network sizes, configurations, and external conditions.

Tenet 3: Let a Network Path Be an Active Unit
We want to consider a path as an active part of the network that controls itself and provides customized transport services. An active path can provide resilience and fail-over, offer mobility, simultaneously use multiple different sequences of links, secure and compress transmitted data, and optimize its performance all by itself.

Tenet 4: Let Networks Be Information-Centric
Users are primarily interested in using services and accessing information, not in accessing nodes that hosts information or provide services. Consequently, we want to build a network as a network of information and services where services and information are mobile and may be distributed.

Expected Impact

Our research work will have impact over a wide range of areas of the economy and society at large. The results of the 4WARD project will bring a new networking experience to end users integrating smoother, more flexible, and more dependable communication into daily life. For network and service providers, new business opportunities will be created that allow more competition and more customised services.

AT A GLANCE: 4WARD
Architecture and Design for the Future Internet

Project Coordinator:
Henrik Abramowicz
Ericsson
Tel: +46 8 4046608
Email:henrik.abramowicz@ericsson.com
Project website:www.4ward-project.eu

Partners:
•Ericsson,
•Nokia Siemens Networks,
•Siemens Program and System Engineering SRL Brasov - Punct de lucru Cluj,
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Universität Karlsruhe,
Universität Paderborn,
Waterford Institute of Technology,
Valtion Teknillinen Tutkimuskeskus,
Rutgers University (USA)

Duration:
Jan 2008 – Dec 2009

Total Cost:
23.245 M€

EC Contribution:
14.448 M€

Contract Number:
INFSO-ICT-216041

(E3) End-to-End Efficiency

E3 is aiming at integrating cognitive wireless systems in the Beyond 3G (B3G) world, evolving current and future heterogeneous wireless system infrastructures into an integrated, scalable and efficiently managed B3G cognitive system framework from a technical, regulatory, standardisation and business perspective.

Main Objectives

Introducing Cognitive Wireless Systems in the B3G World

The key objective of the E3 project is to design, develop, prototype and showcase solutions for optimised usage of existing and future radio access resources. In particular, more flexible use of frequency spectrum, terminals, base stations and networks is addressed. E3 will provide interoperability, flexibility and scalability between existing legacy and future wireless systems, manage the overall system complexity, and ensure convergence across access technologies, business domains, regulatory domains and geographical regions. E3 will converge both cognitive radios and cognitive networks from technical, business, regulatory and standardisation perspectives.

The goal of E3 is to strengthen Europe's leadership in the global effort of transforming current wireless system infrastructures into an integrated, scalable and efficiently managed Beyond-3rd-Generation (B3G) cognitive system framework. This objective will help to ensure seamless access to applications and services and to exploit the full diversity of corresponding heterogeneous systems. The approach favoured by E3 addresses this goal in a non-disruptive way by integrating existing and future wireless radio standards into a common framework and contributing to on-going/emerging standardisation bodies with a focus on key convergence enablers. In particular, IMT-Advanced related radio and cognitive system oriented standardisation bodies are targeted.

The E3 consortium will develop and showcase the B3G convergence beyond state-of-the-art and introduce cognition and self-x principles into the different parts of the communication systems. It will contribute to development, regulation and standardisation of the corresponding system following an end-to-end approach. Aspects ranging from self-x and multi-standard functions of the access and backbone network, over corresponding enablers such as a cognition supporting pilot channel, to the self-x functions on the terminal and network sides are studied from a technical and its complementary economic and regulatory viewpoints.

The E3 consortium brings together major key European players in the domain of cognitive radios and networks, self-organisation and end-to-end reconfigurability. E3 builds on several key achievements from the successful FP6 E2R programme, pursuing research into the most promising directions towards removing walls (current technical and regulatory limitations) and building bridges (technical) in order to facilitate the vision of true end-to-end connectivity being as efficient as possible.

Technical Approach

The E3 vision of the future framework, consisting of a multitude of heterogeneous standards, building on CR/CN principles is presented in the figure below where several operators are supposed to be present, each controlling multiple air interfaces, such as cellular (UMTS, HSDPA and LTE, a future 4G, etc.), metropolitan area (WiMAX, next generation WiMAX based on IEEE 802.16m, etc.), short-range (WiFi systems based on IEEE 802.11a/b/g/e/etc., next generation WiFi systems based on IEEE 802.11n, etc.). In this context, mobile terminals are expected to have the possibility of maintaining links to one or several of the air interfaces simultaneously.

To optimise the usage of existing and future radio access resources, the E3 consortium has set out four top level objectives:

(1) Design a cognitive radio system exploiting the capabilities of reconfigurable networks and self-adaptation to a dynamically changing environment,
(2) Enable a gradual, non-disruptive evolution of existing wireless networks in accordance to user requirements,
(3) Define means to increase the efficiency of wireless network operations, in particular by optimally exploiting the full diversity of the heterogeneous radio eco-space,
(4) Increase system management efficiency for network operation and (re)configuration by building on cognitive system and distributed self-organisation principles.

Key Issues

The key issues addressed by E3 cover:

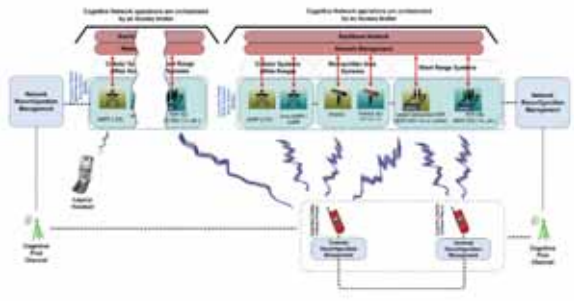
1) Validation and quantitative analysis of cognitive radio systems related business models including market assessment,

2) Extension of state-of-the-art towards a functional and implementation architecture enabling the exploitation of the full benefits of highly heterogeneous, cognitive radio systems,

3) Development of collaborative (network-terminal, network-edges) and autonomous distributed decision-making related algorithms targeting an efficient operation of the heterogeneous, cognitive system by self-organising principles in terms of fast reactivity to any context change, low parameterisation overhead and distribution of computational complexity,

4) Development of cognitive enablers with the objective to efficiently exchange context information and related optimisation constraints subject to which resource usage optimisation tasks are performed,

5) Development of a reference prototyping system based on cellular, metropolitan area and short-range systems in order



to implement and showcase the performance of cognitive decision-making algorithms in various scenarios.

Expected Impact

Based on the expected impact from the Objective ICT-2007.1.1 "The Network of the Future" (EC Work Programme), the E3 project is targeting specific contributions to:

- *Global standards for a new generation of ubiquitous and extremely high capacity network and service infrastructures (…):*
  - o E3 harmonisation of legacy and new standards for efficient, advanced and flexible access,
- *Reinforced European industrial leadership in wired and wireless networks; developing stronger synergies between various sector actors and contributing to new business models that take advantage of convergence and full interoperability:*
  - o E3 business modelling and regulatory evolution for emerging cognitive radios and cognitive networks,
- *New industrial/service opportunities in Europe, especially in the field of Internet technologies (…):*
  - o E3 promotes efficient, advanced and flexible end-user service provision thanks to multi-standard platforms and rapid customisation.

E3 is definitely engaged in a strategy for openness, economical efficiency and technological excellence thanks to strong standardisation and regulatory commitments.

AT A GLANCE: E3
End-to-End Efficiency

Project Coordinator
Dr. Didier Bourse
Motorola Labs, Paris
Tel: +33 1 6935 2558
Fax: +33 1 6935 4801
Email: Didier.Bourse@motorola.com
Project website: https://www.ict-e3.eu/

Partners:
•Motorola (FR),
•Alcatel-Lucent (GE),
•ANFR (FR),
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•Universitat Politecnica de Catalunya (SP),
•University of Piraeus (GR),
•Vrije Universiteit Brussel (BE)

Duration:
01/2008 – 12/2009

Total Cost:
€ 18.6m

EC Contribution:
€11.2m

Contract Number:
INFSO-ICT-216248

EFIPSANS - Exposing the Features in IP version Six protocols that can be exploited/extended for the purposes of designing/building Autonomic Networks and Services

The EFIPSANS project aims at exposing the features in IP version Six protocols that can be exploited or extended for the purposes of designing and building autonomic networks and services.

Main Objectives

One of the key prerequisites for the Evolution towards Network of the Future is the creation of Autonomic Network and Service Management !

The constantly increasing number of important applications and services running on dramatically increasing number of networked devices made the converging networks to a safety critical infrastructure. It is vital for the ever increasing part of the world's population living in the networked information society that the network of the future has high reliability and always operational. The convergence of different type of communication systems will result in an increasingly complex network in the future, which is becoming more and more difficult to manage. This already ongoing process is urging the need of more efficient, dynamic and autonomic network and service management mechanisms. EFIPSANS envisions that IPv6 and the extensibility of the IPv6 protocol framework are a viable evolutionary platform for engineering autononomicity (self-managing properties) in systems, services and networks.

Technical Approach

Study of the emerging research areas that target desirable user behaviours, terminal behaviours, service mobility, e-mobility, context-aware communications, selfware, autonomic communication/computing/networking. Out of these areas desirable autonomic (self-*) behaviours (ABs) in diverse networking environments e.g. end systems, access networks, wireless versus fixed network environments will be captured and specified. Appropriate IPv6 protocol and/or architectural extensions that enable the implementation of the captured desirable autonomic behaviours will be sought and specified.

A selected set of the specified autonomic behaviours will be implemented and demonstrated. Also, technical reports on the concrete IPv6 feature combination scenarios including any new extensions used to implement the selected set of autonomic behaviours will be presented.

The project's ambition is to start/initiate the standardisation process of the autonomic behaviour (ABs) to be specified in EFIPSANS, the identified exploitable IPv6 features and new "EFIPSANS-defined" protocol and network architectural extensions required to implement the "EFIPSANS-specified" autonomic behaviours.

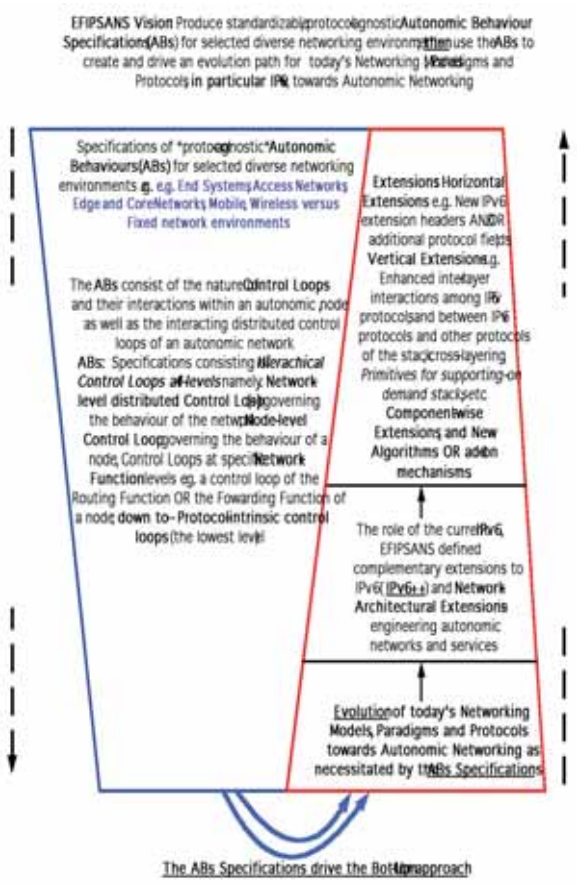
Key Issues

Produce standardisable, protocol-agnostic **Autonomic Behaviour Specifications (ABs)** for selected diverse networking environments
Use the **ABs** to create and drive an evolution path for today's Networking Models, Paradigms and Protocols, in **particular IPv6,** towards Autonomic Networking and Services.

Examples of Autonomic Behaviours

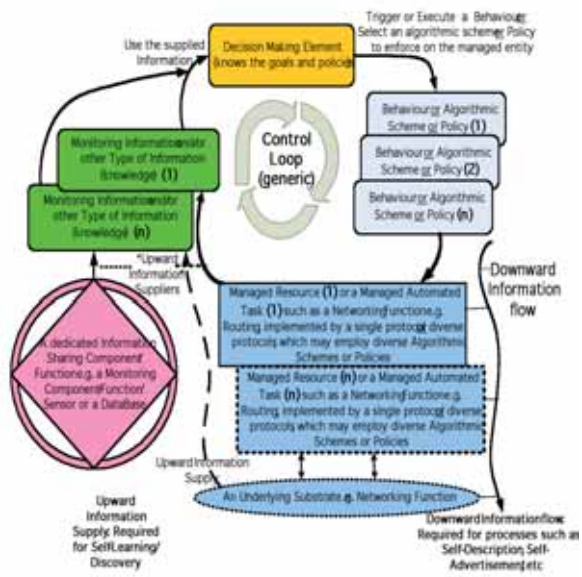
Self-adaptive routing in the core network, collaborative self-diagnosing network-wide behaviour, dynamic self-configuration, self-association in end systems, self-healing across protocol stacks and the network as a whole, etc.

EFIPSANS Vision



Autonomic Systems Engineering:

Concepts



Expected Impact

In general: more robust/reliable network infrastructure with adaptive service delivery capability and reduction of OPEX at the same time.

For **manufacturers** (Ericsson, Alcatel-Lucent, Fujitsu), the specifications of Autonomic Behaviours (ABs'), the identified exploitable IPv6 features, together with new "EFIPSANS-defined" protocol and network architectural extensions required to implement autonomic behaviours in networks and services, will give an opportunity to implement novel extensions to IPv6 protocols and networking components in order to offer extended features in their products.

For **network providers** (Telefónica, GRNET), **service providers** (Velti, Telcordia), **researchers** (Fraunhofer, UL, TSSG, ICCS, BUPT, WUT, TUB) and other potential users of IPv6, the ABs', the identified exploitable IPv6 features and the new complementary protocol and network architectural extensions will give a good picture on how to view IPv6 and the extended features as a platform for designing/building autonomic networks and services. This will also give them a chance to think and contribute innovative ideas on the use of IPv6/IPv6++ protocols. Essentially, this will also help in closing the gap between IPv6 and autonomic networking.

AT A GLANCE: EFIPSANS

Exposing the Features in IP version Six protocols that can be exploited/extended for the purposes of designing/ building Autonomic Networks and Services

Project Coordinator

András Tóth, Ericsson AB
Tel: +46 8 58530531
Fax: +46 8 4047020
Email: andras.toth@ericsson.com
Project website: www.efipsans.org

Partners:

- Ericsson AB (S),
- Fraunhofer Fokus (D),
- Luxembourg University (LU),
- Telcordia-Poland (PL),
- Waterford Institute of Technology (IR),
- Institute of Communication and Computer Systems (GR),
- Telefónica Móviles España S.A. (E),
- Beijing University of Posts and Telecommunications (China),
- Greek Research & Technology Network S.A. (GR),
- Warsaw University of Technology (PL),
- Velti S.A. (GR),
- Technical University of Berlin (DE),
- Fujitsu Labs of Europe (UK),
- Alcatel-Lucent France (F)

Duration:

01/2008 – 12/2010

Total Cost:

m€ 10

EC Contribution:

m€ 6.78

SENSEI - Integrating the Physical with the Digital World of the Network of the Future

SENSEI is an Integrated Project in the EU's Seventh Framework Programme, in the ICT Thematic Priority of Challenge 1: Pervasive and Trusted Network and Service Infrastructures: ICT-2007.1.1: The Network of the Future.

Main Objectives

In order to realise the vision of Ambient Intelligence in a future network and service environment, heterogeneous wireless sensor and actuator networks (WS&AN) have to be integrated into a common framework of global scale and made available to services and applications via universal service interfaces. SENSEI creates an open, business driven architecture that fundamentally addresses the scalability problems for a large number of globally distributed WS&A devices. It provides necessary network and information management services to enable reliable and accurate context information retrieval and interaction with the physical environment. By adding mechanisms for accounting, security, privacy and trust it enables an open and secure market space for context-awareness and real world interaction.

Tangible results of the SENSEI project are:

1) A **highly scalable architectural framework with corresponding protocol solutions** that enable easy plug and play integration of a large number of globally distributed WS&AN into a global system – providing support for network and information management, security, privacy, trust and accounting.
2) An **open service interface and corresponding semantic specifications** to unify the access to context information and actuation services offered by the system for services and applications.
3) **Efficient WS&AN island solutions** consisting of a set of cross-optimised and energy aware protocol stacks including an ultra-low power multi-mode transceiver architecture targeting 5nJ/bit.
4) A **pan-European test platform,** enabling large scale experimental evaluation of the SENSEI results and execution of field trials - providing a tool for long term evaluation of WS&AN integration into the Future Internet.

Technology developed by SENSEI will play an essential part in transforming the existing Internet, mobile networks and service infrastructures into a Network of the Future that is capable to deal with the challenging demands of a Future Networked Society.

SENSEI Rational

There are three fundamental motivations that have led to the proposal of the SENSEI concept:

1. The growing importance of context-awareness as an enabler for more intelligent, invisible and autonomous applications and services has highlighted the need for a greater integration of the physical with the digital world.

2. The lack of an open framework for WS&AN is leading to the emergence of closed vertically integrated WS&AN deployments that will prevent re-use of context information for new applications.

3. The observation that embedded sensors and actuators will make up the majority of connected devices in the Future Internet and their specific requirements will have a strong impact on its design of the Future Internet.

Key Issues

- Creating a vision for the use of the integrated physical world in the context of the Network of the Future, by exploring scenarios, requirements, acceptance and business models.

- Understanding the short comings of existing technologies and approaches in order to reflect those in the design of the technology used in the SENSEI system.

- Enable easy and seamless interaction with the physical world, by providing access to context information and actuation services in a unified manner over standardised service interfaces.

- Contributing to a scalable system architecture for the Future Internet and communication protocols and processing mechanisms to achieve scalability considering the special demands of sensor and actuators, that are expected to account for the majority of connected devices.

- Enable easy convergence and interoperability of heterogeneous WS&AN within the Network of the Future, by providing Plug&Play functionality.

- Design mechanisms and protocols able to deal with the consequences caused by mobility of WS&AN solutions and entities of interest.

- Design mechanisms and protocols which enable optimised control, management and flexibility of the future networking and service infrastructure.

- Design mechanisms and protocols ensuring that access to context information and actuation services is trustable, their

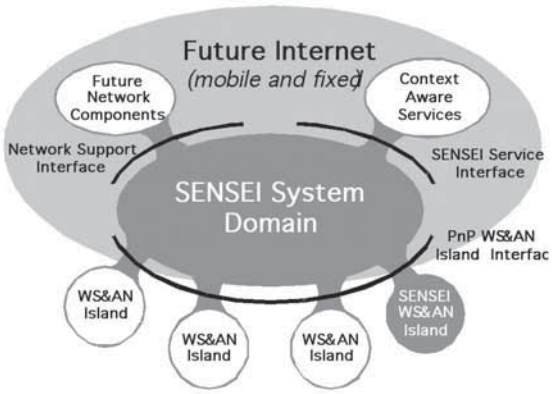
access secure, while the information privacy of individuals and corporations are not violated.

- Provide mechanisms for accountability and billing for access to context information and actuation services.

- Design mechanisms and protocols which ensure optimised processing of WS&AN related traffic from the nodes in the WS&AN, that interact with the physical world, to the services and applications, in an end-to-end fashion.

- Design mechanisms and protocols which ensure that context information is captured and actuations are performed in a highly energy and spectrum efficient manner.

- Creation of a Pan European test platform, enabling large scale experimental evaluation of the SENSEI results and execution of field trials - providing a tool for long term



evaluation of WS&AN integration into the Future Internet.

Expected Impact

SENSEI contributes directly to the creation of the Future Internet by developing the WS&ANs-based service and networking infrastructure that connects the physical world to the existing Internet and Future Internet (both, through evolutionary steps and revolutionary design). The deployment of sensors and actuators on bodies, buildings, vehicles, other objects and the environment adds a new dimension to the global information infrastructure, which enables the creation of new and enriched services in a variety of key economic sectors – energy management, logistics, healthcare, security as well as personal enhanced services. However, the large number of sensor/actuator devices presents unprecedented operational, capacity and scalability challenges to these networks and services. SENSEI addresses the challenges resulting from global deployment of such ambient systems in a holistic manner, from efficient communications aspects through to service enabling frameworks.
Europe has now a unique opportunity to take the initiative in order to shape the **Future Internet.** Standards need to be developed that are based on lessons learned from the past and insights obtained from novel research ideas and concepts that need to be further explored by projects such as SENSEI.

AT A GLANCE: SENSEI
Integrating the Physical with the Digital World of the Network of the Future

Project Coordinator
Laurent Herault, PhD
CEA-LETI - MINATEC
Tel: +33 4 38789515
Fax: +33 4 38785182
Email: laurent.herault@cea.fr

Project Technical Manager
Mirko Presser
The University of Surrey, CCSR
Email: m.presser@surrey.ac.uk
Project website: www.sensei-project.eu

Partners:
•CEA–LETI (FR),
•University of Surrey (GB),
•ALMA (FR),
•Arup (GB),
•Ericsson (SE),
•IBM (CH),
•NEC Europe Ltd. (GB),
•Nokia (FI),
•SAP (DE),
•Telefónica (ES),
•Thales (GB),
•Ambient Systems (NL),
•Sensinode (FI),
•Consorzio Ferrara Ricerche (IT),
•ETH Zuerich (CH),
•University Politehnica of Bucharest (RO),
•University of Oulu (FI),
•Université Pierre Mendès France (FR),
•University of Twente (NL),
•LM Ericsson (IE).

Duration:
January 2008 – Dec 2010

Total Cost:
€24m

EC Contribution:
€15m

Contract Number:
INFSO-ICT-215923

Trilogy - Re-Architecting the Internet

The aim of Trilogy is to develop new solutions for the control architecture of the Internet that remove the known and emerging technical deficiencies while avoiding prejudging commercial and social outcomes for the different players. The focus is the control functions of the Internet – the neck of the hourglass, but for control.

Main Objectives

Despite the phenomenal growth of the Internet over the last twenty years, we believe that the current Internet is reaching the fundamental limits of its capabilities. Performance and resilience demands are increasing at the same time that operational and business limitations imposed by the architecture are becoming more constricting.

"Our objective is bold: to re-architect the world's ICT infrastructure."

Future growth to meet these challenges will require not only new technologies from the leading edges of networking research, but also architectural changes which may be subtle but far reaching. The Trilogy project has a vision of a coherent, integrated and future-proof architecture that unifies the heterogeneous network, offering immediate deployment rewards coupled with long-term stability.

The Trilogy Concept: Architecture for Change

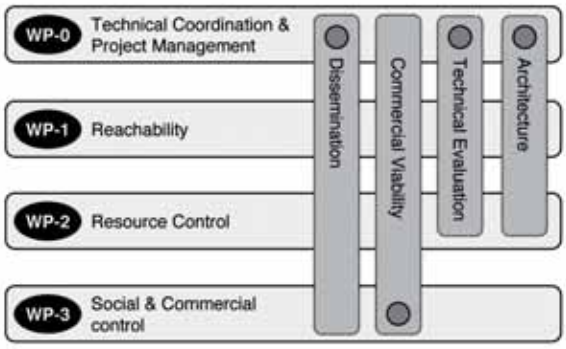
There are two key ideas behind the Trilogy Concept. The first key idea is technical; the traditional separation between congestion control, routing mechanisms, and business demands (as reflected in policy) is the direct cause of many of the problems which are leading to a proliferation of control mechanisms, fragmentation of the network into walled gardens, and growing scalability issues. Re-architecting these mechanisms into a more coherent whole is essential if these problems are to be tackled.

The second key idea is more abstract, but fundamental. It recognises that the success of the Internet derives not directly from its transparency and self-configuration, but from the fact that it is **architected for change.** The Internet seamlessly supports evolution in application use and adapts to configuration changes; deficiencies have arisen where it is unable to accommodate new types of business relationship. To make the Internet richer and more capable will require more sophistication in its control architecture, but without imposing a single organisational model. Therefore, our key principles are to retain the ubiquity enabled by the hourglass model, and take the self-configuration philosophy one level further: **we seek a control architecture for the new Internet that can adapt in a scalable, dynamic, autonomous and robust manner to local operational and business requirements.**

Technical Approach

At the core of the Trilogy workplan lies the realisation that internetworking functions can be broadly categorised into two classes. First, functions that establish and control a scalable, dynamic, autonomic and resilient internetwork ('reachability'). Second, functions which allow a diverse set of parties to use and share this internetwork to communicate according to their dissimilar needs ('resource control'). Consequently, Trilogy places the emphasis of its work around these two topic areas.

Trilogy explicitly addresses the contention between suppliers and users of internetworking functions through the introduction of a third key topic area. It investigates the socio-economic, commercial and strategic factors that influence the interplay between the technical internetworking functions in order to architect an integrated solution that is 'designed for tussle'. This activity will drive the design of the more technical work in the two main work areas in an ongoing manner, and is key for ensuring that the results of Trilogy will not only operate correctly at a technical level but also satisfy the broader goal of actively enabling changes.

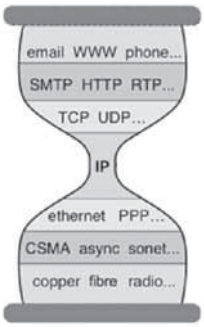


Key Issues

- Reachability: The main focus is the problem of inter-domain routing, including policy control but also integrating filtering at trust boundaries (e.g. firewalls, NATs). Key issues include multihoming, scalability and fast convergence.

- Resource control: The main focus is how to deliver effective and efficient control of sharing of resource. Key issues include how to share resources fairly and stop cheating, high-speed congestion control and load balancing (traffic engineering).

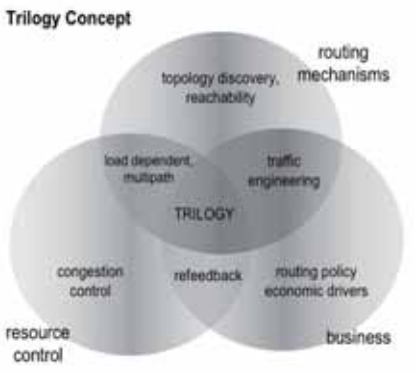
But further, all this must be under:



- Social and Commercial Control: the architecture will permit conflicting outcomes to coexist and evolve and will not embed assumptions that unreasonably favour certain types of industry player: "designed for tussle".

Expected Impact

Trilogy takes a holistic view of the fundamental design principles for a next generation Internet architecture, derives novel solutions for the dominant technical and economical challenges and disseminates the gained knowledge to the interested and affected parties. In particular, Trilogy will significantly enhance the reliability, robustness, manageability and functionality of the Internet, and will create new and varied business opportunities based around a common core architecture.



The key is to allow the Internet to be different things in different places without hindering interoperability. In enabling tussles to play out within the architectural framework (as opposed to working against the architecture, as often happens today), Trilogy will permit differentiation, allowing greatly increased robustness for customers who really need it and have the means to pay. In addition, the enhanced flexibility and improved manageability will simultaneously allow service providers to reduce costs and provide additional services; two aspects that are critical in a world of falling communications margins where service providers are wondering where the money to upgrade their networks will come from in ten years time.

Trilogy Concept: New Internet Control Architecture

Our objective is bold: to re-architect the world's ICT infrastructure. In order to be credible, we will have to deliver a coherent set of changes solving technical and commercial problems together: a unified control architecture for the Internet that can be adapted in a scalable, dynamic, autonomous and robust manner to local operational and business requirements.

AT A GLANCE: TRILOGY

Trilogy: Re-Architecting the Internet An hourglass control architecture for the Internet, supporting extremes of commercial, social and technical control.

Project Coordinator
Mat Ford BT Group plc
Tel: +44 (0)1875 341678
Fax: +44 (0)1908 860131
Email: matthew.ford@bt.com
Website: http://www.trilogy-project.eu/

Partners:
- BT (UK),
- Deutsche Telekom (DE),
- NEC Europe (UK),
- Nokia (FI),
- Roke Manor Research (UK),
- Athens University of Economics and Business (EL),
- Universidad Carlos III de Madrid (ES),
- University College London (UK),
- Université Catholique de Louvain (BE),
- EURESCOM (DE),
- Stanford University (USA)

Duration:
Jan 2008 – Dec 2010

Total Cost:
€9.2m

EC Contribution:
€5.9m

Contract Number:
INFSO-ICT-216372

AUTOI - Autonomic Internet

The network of the future will require greater degree of service-awareness, and an optimal use of network resources. As a consequence the complexity of networks will grow. As a solution, AutoI suggests a transition from a service agnostic Internet by virtualising network resources and Policy-Based Management techniques

Main Objectives

AutoI will implement the creation of a communication resource overlay with autonomic characteristics for the purposes of fast and guaranteed service delivery.

The current Internet has been founded on a basic architectural premise: a simple network service is used as a universal means to interconnect intelligent end systems. The end-to-end argument has served to maintain this simplicity by pushing complexity into the endpoints. The very success of the Internet is now creating obstacles to future innovation.

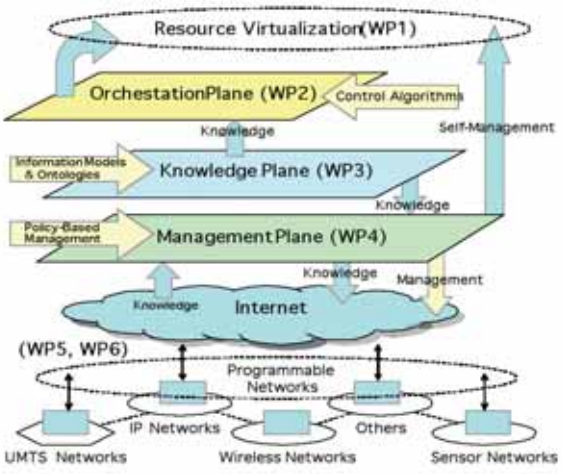
Autonomic Internet (AutoI) aspires to be a sustainable solution. It will design and develop a self-managing virtual resource overlay that can span across heterogeneous networks, support service mobility, quality of service and reliability. The overlay will self-manage based on the business-driven service goals changes (service context) and resource environment changes (resource context). *Ontology-based information and data models* are used to facilitate the Internet service deployment in terms of programmable networks facilities supporting NGN.

In other words, *AutoI* will design and develop, based on well-defined methodologies, an open software infrastructure and tools that enables the composition of better (fast and guaranteed) services in an efficient manner and the execution of these services in an adaptive (Autonomic form) way
The envisioned strategic impact of the AutoI project is to usher in an era where the European economy becomes a service-based economy, in which organisations deliver rich suites of services as utilities to their customers – other businesses and individuals – while assuring quality of service. Thus, with the AutoI virtual service infrastructure, consumers will benefit from higher service availability, quality and dependability across all areas of life – including business, science, leisure activities and government operations.

The AutoI consortium contains competent partners from all the specific areas needed to achieve the project objectives, and includes large industries, SMEs and key academic partners. In particular, the support of networking equipment and services industry and the direct SME involvement will reduce barriers for SMEs by establishing new channels to join the service economy.

Technical Approach

The General AutoI project structure is described in the figure below, where each work package (WP) activity is depicted. It is necessary to develop a knowledge plane containing a distributed knowledge base and an orchestration plane to manage knowledge generation and analysis environment. The orchestration plane is in charge of feeding the required knowledge to the management plane. The management plane is responsible for managing the data plane and more specifically, the virtual environment. The action of the knowledge plane is to feed the orchestration plane and more precisely the service and resource overlay algorithms with the best values for the different parameters. As a summary, the knowledge plane has to configure the orchestration plane which itself configures the Management plane. The Management plane has to provide the self-adaptation of the resources.



WP5 (Service Deployment) takes its lead from the Management WP and applies dynamic programming enablers to an executable service code that is injected/activated into the system's elements to create the new functionality at runtime. The basic idea is to enable trusted parties (users, operators, and service providers) to activate management-specific service and network components into a specific platform. WP6 serves to demonstrate the *AutoI* solution via the implementation of appropriate case studies. The case studies have been chosen directly from the requirements of our industrial partners as a tentative and realistic approximation to real necessities

Key Issues

The following key research challenges are identified as the basis of the *AutoI* design:

- Virtualisation of Network and Service Resources: Design & new Models
- Autonomically Enabled Service Delivery
- Assurable Resources

- Self-Management
- Context Awareness
- Orchestrations
- Network & Service enablers for programmability

Expected Impact

In the future service-oriented economy, every transaction or transmission of information will be based on a service that is available on demand, regardless of geographical or ICT boundaries. The AutoI project therefore will have a strong economical and societal impact and will reinforce the European competitiveness, by implementing a virtual service infrastructure that will allow consumers to benefit from higher service availability.

On a high level, AutoI aims to bring innovative service-oriented network infrastructure and solutions for deployment of complex services across different administrative domains, while assuring QoS and security guarantees closer to possible product development, push contributions to standardization bodies that serve the overall vision of AutoI, and share the pioneering findings with the global research community.

The results of the project will be targeted primarily towards the newly created international standard group "Autonomic Communications Forum" which has the aim of:

1. Unify current thinking in autonomics by creating a new set of Autonomic Standards, focusing on the management of systems and on computing and communications.
2. Define an autonomic reference framework as well as a set of baseline compliance statements to guarantee interoperability.
3. Create an organisational structure that will empower academia and industry to work together in developing and maintaining the above goal

AT A GLANCE: AUTOI
Autonomic Internet

Project Coordinator
Alessandro Bassi
Hitachi Europe SAS
Tel: +33 4 8987 4100
Fax: +33 4 8987 4199
Email: alessandro.bassi@hitachi-eu.com
Project website: www.ist-autoi.eu

Partners:
•Hitachi Europe SAS (FR),
•Waterford Institute of Technology (IE),
•University College of London (UK),
•Universitat Politecnica de Catalunya (ES),
•Institut National de Recherche en Informatique et en
•Automatique (FR),
•University of Passau (DE),
•Universite Pierre et Marie Curie – Lip6 (FR),
•Motorola (US),
•Ucopia Comminications (FR),
•University of Patras (GR),
•Gingko networks SA (FR)

Duration:
Jan 2008 – Dec 2009

Total Cost:
€ 3.639 K

EC Contribution:
€ 2.695 K

Contract Number:
INFSO-ICT 216404

CHIANTI - Challenged Internet Access Network Technology Infrastructure

The CHIANTI project is investigating network architectures, network protocols and business opportunities for nomadic and mobile scenarios with intermittent connectivity. The project will improve disconnection and disruption tolerance for mobile user communications relying on the unmodified core Internet architecture.

Main Objectives

"Improving disconnection and disruption tolerance for mobile user communications by deploying a new service-support infrastructure"

The CHIANTI project goes beyond existing mobility functions and "always best connected" solutions by explicitly addressing support functions for disruption tolerant networking. The focus is on **providing usable Internet access for mobile users.** CHIANTI will investigate both asynchronous (e.g., email messaging) and synchronous, interactive (e.g., interactive voice) communication. CHIANTI develops technologies that allow users to become productive immediately after reconnecting to a - possibly new - network. CHIANTI solutions specifically target users who access existing and new Internet-based services. Consequently, CHIANTI focuses on improving, extending and generalising existing Internet protocols, services and applications. The idea is to **enhance the existing Internet to better support intermittent connectivity.** CHIANTI is not designing a new internetworking architecture for challenged environments. Areas such as wireless sensor networks, ad hoc routing or link-layer mobility solutions are explicitly out of scope.

Expected Achievements

The CHIANTI project will improve disconnection and disruption tolerance for mobile user communications by deploying **a new service-support infrastructure – operated by a third-party as an overlay or closely integrated with an operator network** – that complements the core IP and mobility functionality to sustain operation and performance of business and consumer applications: Remote file access and email, interactive web access and even real-time media streaming maintain a satisfying user experience and full business productivity even under intermittent connectivity.

Most importantly, the CHIANTI project does not attempt to provide or emulate seamless connectivity. Instead, CHIANTI accepts disruptive connectivity as a given and provides **service enhancements that work in the presence of interruptions.** The CHIANTI project thus complements concurrent activities to improve global connectivity through 3G and beyond networks. The CHIANTI solution can **utilize whatever connectivity is available,** i.e., benefit from 3G and beyond activities and additionally operate across connectivity gaps, i.e., **improve service beyond what 3G and beyond networks already provide.**

Technical Approach

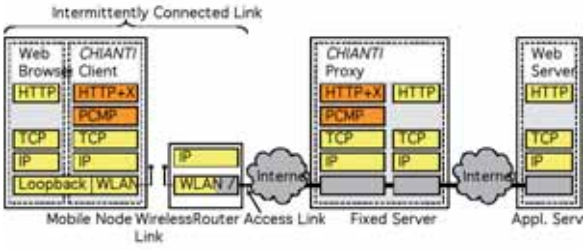
The CHIANTI project will follow both a user-driven and a technology-driven approach. Handling disconnected periods cannot be achieved at lower layers alone. Lower-layer mechanisms are necessary, but applications and eventually the users need will become involved, too. Therefore, CHIANTI **analyses typical applications** of nomadic mobile users in the context of the target application scenarios. This analysis includes examining application interactions, identifying and describing the elements involved in the communication processes (e.g., client-server or peer-to-peer, infrastructure components, intermediaries or networks) and classifying applications according to their interactions and communication patterns.

This user-driven input complements parallel research to **identify technological solutions** in the relevant areas. This research derives classes of solutions that can support the previously identified applications in disruptive environments. CHIANTI investigates all layers of the Internet architecture (i.e., link, network, transport, and application) as well as cross-layer interactions. Based on this research, the project **designs an** efficient and effective Internet-based internetworking **architecture** that enhances operation under intermittent connectivity, considering both end-to-end and infrastructure-based approaches. Besides improving the overall communications infrastructure, CHIANTI investtigates specific enhancements for key end user applications – in order to provide a complete and immediately deployable solution. A key focus of CHIANTI is the empirical **validation** of its research results through early prototype implementations and subsequent experimentation in realistic scenarios. Contributions to **standardisation,** supported by appropriate dissemination activities are an essential part of the CHIANTI strategy.

Key Issues

The CHIANTI project strives to improve the usefulness of temporarily disrupted connectivity. This implies a shift from the "always connected" paradigm to a paradigm where disruptions/ degradation of network access and connectivity are accepted as routine, meaning that connectivity should be used as well as possible whenever it does become available and that connectivity disruptions **should not cause application**

failures that are gratuitous from the point of view of the actual purpose of the application. The CHIANTI approach is based on the overriding objective of **deployability:** It would be meaningless to develop solutions that then cannot be deployed. An important element of this is to minimize the number of parties that are required to make a deployment effective. To this end, CHIANTI will make use of the existing Internet and existing end user applications.



Expected Impact

The CHIANTI approach is of **immediate commercial relevance,** as it can improve the user experience in existing and emerging wireless networks and can create new opportunities for manufacturers, operators and providers of endpoint devices and/or the corresponding software solutions. Deploying the CHIANTI solutions **will directly lead to an increase of efficiency and productivity for mobile users.**

AT A GLANCE: CHIANTI
Challenged Internet Access Network Technology Infrastructure

Project Coordinator
Dr.-Ing. Dirk Kutscher
Technologie-Zentrum Informatik
Tel: +49-421-21863904
Fax: +49-421-2189863904
Email: dku@tzi.org
Project website: www.chianti-ict.org

Partners:
•TZI (DE),
•Helsinki University of Technology (FI),
•Nomad Digital (UK),
•Lysatiq (DE)

Duration:
01, 2008 – 12, 2009

Total Cost:
€1,262,002

EC Contribution:
€968,262

Contract Number:
INFSO-ICT-216714

DICONET - Dynamic Impairment Constraint Networking for Transparent Mesh Optical Networks

The DICONET project proposes a novel approach to optical networking providing a disruptive solution for the utilization of the core network of the future. It is the vision and goal of DICONET consortium to provide high speed end-to-end connectivity with quality of service and high reliability, exploiting optimized protocols and lightpath routing algorithms.

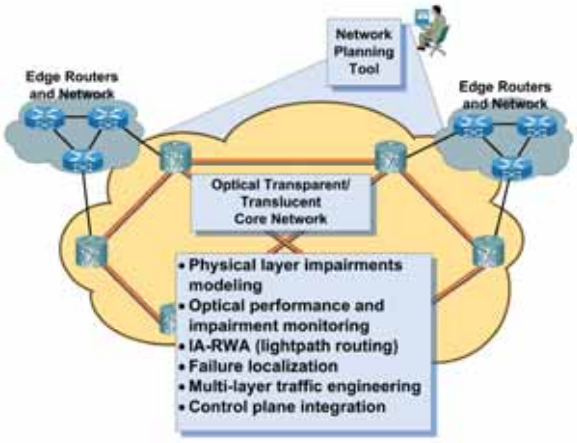
These routing strategies will complement a universal control and management plane offering flexibility for the future network infrastructure

Main Objectives

The key innovation of DICONET: "The development of a dynamic network planning tool residing in the core network nodes that incorporates real-time measurements of optical layer performance into IA-RWA algorithms and is integrated into a unified control plane",

The key innovation of DICONET: The development of a dynamic network planning and routing tool residing in the core network nodes, incorporating real-time measurements of optical layer performance into IA-RWA algorithms, and which is integrated into a unified control plane, is the key enabler for networks capable of automated, rapid network reconfiguration. This feature of fast dynamic reconfiguration upon user or network request is fundamentally different from slow, planned provisioning and reconfiguration used today. In addition our dynamic approach provides advanced network resiliency features not currently available in today's static networks. The DICONET consortium is committed to realize the following project objectives:

- Development of Impairment Aware RWA Algorithms
- Optimum equipment (regenerators & monitors) placement
- Study of failure localization algorithms to enable resiliency
- Study of OPM/OIM techniques
- Development of fast and accurate modeling tools
- Experimental verification of the models
- Realization of dynamic network planning tool
- Protocol extensions to enable an IA-control plane
- Verification of the DICONET tools, algorithms and protocols
- Techno-economic studies to support exploitation of results
- Dissemination of project results



Technical Approach

The work that needs to be performed during the life-time of the DICONET projects has been organized in several work-packages that perform stand alone research and development activities but they are also inter-related through an efficient integration of the project activities in order to ensure that the project objectives will be realized as planned. Besides the Project management, other work-packages are as follows:

- Network architecture and support studies: This work package aims at defining dynamic optical network architectures and analyzing these network architectures in order to support the activities in the other technical work packages.
- Development of a network planning tool for dynamic traffic/impairments: This activity will study efficient optical layer impairment monitoring and will design and develop a dynamic network planning tool based on advanced physical layer modeling and impairment dissemination techniques.
- Impairment aware lightpath routing: This work package will be devoted to the design, development and test of impairment aware routing and wavelength assignment algorithms (IA-RWA) for lowest cost routing while maintaining required quality of service.
- Network management and control protocol: This activity aims at the implementation of the most appropriate control protocols extensions which are going to be used by the DICONET test-bed.
- Integration and testing of the developed protocol extensions in a test-bed for validation and performance evaluation
- Exploitation & Dissemination: This activity aims at addressing the exploitation and dissemination of the developed modules.

Key Issues

The challenges associated with the realization of the DICONET approach are as follows:

- The physical layer information on individual impairments from optical performance monitors must be combined and evaluated in order to guarantee SLAs.
- Accurate modeling of the variety of physical impairments and their interplay.
- An integrated framework that connects and associates the physical impairments and the networking aspects (e.g. traffic blocking, utilization of resources, end-to-end delay, throughput).
- A mechanism that allows the impairment information to be exchanged between the network components. This can be performed through the use of appropriate signaling or/ and routing mechanisms and protocols.

Expected Impact

The DICONET project aims

- at providing new results in several areas supporting a new generation of high capacity networks:
  - o new optical networking concept,
  - o development of a dynamic network planning tool residing in the core network nodes
  - o advanced network resiliency features not available in current network implementations.
- at contributing in the definition of standards in the domain of high speed networking. Extensions to current standards (e.g. GMPLS),
- at realizing an ultra high capacity network capable of rapid reconfiguration,

The planning tool that will be developed, which does not exist commercially will include new design criteria leading to significant performance advantages, while reducing OPEX.

Besides the direct impact to the market leaders that are partners in our consortium, DICONET activities will open unique opportunities to develop new optical devices for impairment and performance monitoring, specialized software tools and related technological advancements. The potential impact of DICONET for creating new opportunities for SMEs is tremendous.

At A Glance: DICONET
Dynamic Impairment Constraint Networking for Transparent Mesh Optical Networks

Project Coordinator
Jean-Charles POINT
JCP-Consult SAS
Tel: +33 223 27 12 46
Fax: +33 299 27 77 82
Email: pointjc@jcp-consult.com
Project website: www.diconet.eu

Partners: JCP-Consult SAS (FR) / RESIT – Athens Information Technology (GR) / Center of REsearch And Telecommunication Experimentations for NETworked Communities (IT) /Institut TELECOM (FR) / Huawei Technologies Deutschland GmbH (DE) / Interdisciplinair Instituut voor Breedband Technologie, VZW (BE) / Research Academic Computer Technology Institute (GR) / University of Essex (UK) / Universitat Politècnica de Catalunya (SP) / ADVA AG Optical Networking (DE) / Deutsche Telekom AG (DE) / Alcatel-Lucent France(FR) / ECI Telecom (IL)

Duration: 01/2008 – 06/2010
Total Cost: € 4,854,712
EC Contribution: € 3,198,874

Contract Number: INFSO-ICT-216338

ETNA - Ethernet Transport Networks, Architectures of Networking

ETNA aims to design, analyze and validate future metro and core networks based on low cost and secured Ethernet technology that will serve as a basic transport layer of future communication networks. The consortium is comprised of six partners from Finland, UK, and Israel each with different technological expertise.

Main Objectives

"Low cost, scalable and efficient networks will make it possible to develop a wide range of innovative applications, and generate new opportunities for high value products and services."

Most of today's European communications transport networks are based on Legacy TDM (SDH) technology. A new generation of packet transport infrastructure based on the use of Ethernet technology is now emerging in many European countries, however there are still many challenges some of which will be addressed by ETNA.

The Carrier Ethernet equipment market is on the rise. The Metropolitan Networks market is expected to reach over €2.5 billion by 2010. The estimate is that until 2010, 5 billion subscribers will be connected in an "always-on" fashion to the network. A huge potential also exists for deployment of Carrier Ethernet Networks as national backbones.

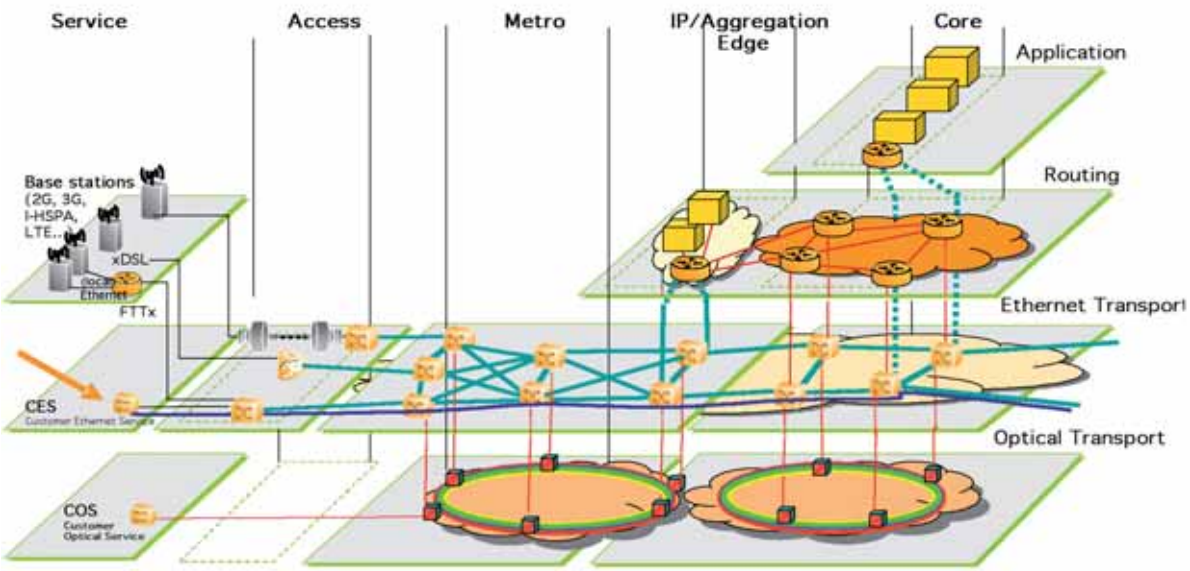
The objective of ETNA is to design, analyze and validate future metro and core networks based on Ethernet technology. The goal is to propose the architecture of a low cost pan-European Ethernet network capable of serving millions of subscribers, provide common, reliable and secure transport architecture for different current and future network services.

The successful development of such networks will shape future developments of information and communication technologies and deliver significant benefits for European citizens and business. Low cost, scalable and efficient Ethernet transport networks will enable the development of a wide range of innovative applications and will create new opportunities for high value products and services.

The ETNA consortium will perform analysis and identification of the requirements for new and innovative nation-wide Ethernet networks, research and develop architectures necessary to operate these networks in a cost-effective manner, design the network capabilities to deliver services to residential, business and mobile subscribers and investigate techno-economic models of such architectures.

Technical Approach

The ETNA project will run over a two year period. The project consists of 3 major parts – *i)* vision of the end-to-end network focusing on the role of the Ethernet, *ii)* network architecture which complements and extends existing approaches and *iii)* prototyping, field testing and standardization of the new architecture approach.
The ETNA work plan is parallelized. There are 7 Work Packages. After a definition phase (WP1) the requirements for the new network are sufficiently defined to start the basic development. Meanwhile the architectural work package (WP2) delivers the framework for the development of the various technological modules (WP3 and WP4). WP5 will combine two prototypes into one operational prototype. In the last phase of the project WP6 collects and guides the inputs from the technological work packages to include all



results in a field trial and to verify the feasibility of the next generation of Ethernet.
Dissemination and exploitation activities such as participation in internal and external workshops and submission of papers to conferences and journals and standardization activities

will be done throughout the duration of the project.

Key Issues

- ETNA will research and design new network architecture based on Ethernet technology capable of providing scalable, high-bandwidth services including mobility.

- ETNA will develop and demonstrate a prototype of the network nodes based on Ethernet technology, capable of providing scalable point to point and multipoint services and support mobility in Ethernet networks

- ETNA intends to create an economically efficient scalable pan-European Ethernet network. Quantitative evaluations based on accordingly developed cost models will be carried out.

Expected Impact

- ETNA will play a key role in influencing the direction and evolution of a new generation of network technologies in the area of Carrier Class Ethernet.
- ETNA will drive change in state-of-the-art technologies and will likely influence key standards in the area of Carrier grade Ethernet evolution.
- The collaboration among European leading companies with the help of leading universities in the area of networking make this consortium a strong task force to ensure an innovative yet simple and cost effective solution.

AT A GLANCE: ETNA
Ethernet Transport Networks, Architectures of Networking

Project Coordinator
Ilya Vershkov
Nokia-Siemens Networks Technologies Israel 1990 Ltd.
Tel: +972-9-7751237
Email: Ilya.Vershkov@nsn.com
Project website: www.ict-etna.eu

Partners:
•British Telecom (UK),
•Ethos Networks (IL),
•Ben Gurion University (IL),
•Helsinki University of Technology (FI),
•Ernst&Young (IL).

Duration:
01/01/08 – 31/12/09

Total Cost:
€3.480.638

EC Contribution:
€2.223.976

Contract Number:
ICT-215462

MOBITHIN - Intelligent distribution of demanding services and applications to mobile thin client devices

MobiThin – driven by a strong consortium focused on thin client computing - will develop an end-to-end solution, and address all important blockers for the wide adoption of wireless thin client computing paradigm.

Main Objectives

The **MobiThin** objective is to allow intelligent and flexible distribution of applications, services and content to mobile users in a wireless WAN setting, mirroring the successes achieved with wired thin client solutions.

The MobiThin project aims at designing, realizing and evaluating a networked infrastructure to offer the thin client service to mobile users in a wide range of wireless networking contexts. The project will address all important blockers for the wide adoption of the wireless thin client computing paradigm. These include technological (wireless medium optimization, dedicated video codec research to minimize client side (de)coding complexity, software/middleware oriented solutions), architectural and techno-economic (business roles, stakeholders and business models) issues. In addition to making substantial scientific and technological progress in these areas, the project will demonstrate an integrated solution for the wireless thin client scenario.

MobiThin: the challenges

To achieve this goal, **MobiThin** will address a set of scientific and technological challenges

- **Development of an adaptive thin client protocol,**
- **Development of an adaptive wireless protocol,**
- **Development of an adaptive image transmission protocol,**
- **Development of a service and resource management framework,**
- **Identification of suitable business models,**
- **Architecture validation,**
- **Standardization**

Technical Approach

WP1"Project management" ensures efficient project management, including interfacing to the European Commission.

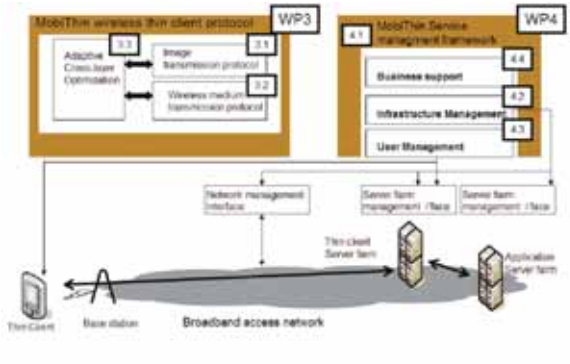
WP2 "System architecture and business modelling": Setting out the overall **MobiThin** architecture is the main objective of this WP, together with assessing the mutual impact of different architectures and business models.

WP3 "Technological component development": The main technological building blocks, targeted at a cross layer based optimization of the thin client protocol, are investigated, designed and realized in this work package. Building blocks include: wireless transmission protocol, thin client protocol, image transmission protocol. These protocols will interact with the applications through interface specifications set out in WP2.

WP4 "Service management framework" aims at translating the management related components of the system architecture developed in WP2 into a service management framework. Important building blocks here are proper (e.g. delay constrained, observing load balancing targets) server selection, interaction with the network infrastructure, application profiling, mobility support, resilience support.

WP5 "Experimental validation" is concerned with the validation of the overall **MobiThin** system (validation of individual parts will be done in the activities of the relevant workpackages). This validation will be done by both simulation and emulation, as well as through well-selected lab trials. To this end, a simulation framework will be built, allowing early feedback on the functionality, scalability and robustness of the **MobiThin** system. In order to allow validation of applications running on the **MobiThin** system, an emulation will be carried out, also serving as a show case for the project.

WP6 "Dissemination of results" will give the project results the proper visibility through dissemination actions (conferences, concertation meetings, standardization efforts,..).



Key Issues

MobiThin will address all important blockers for the wide adoption of wireless thin client computing paradigm including architecture and technology issues (wireless medium optimization, dedicated video codec and user pattern research, software/middleware, performance and energy saving oriented solutions), as well as economic ones (business roles and models).

Expected Impact

MobiThin project aims at one single technological breakthrough: thin client protocols on mobile networks. Removing this technological barrier can prove to be of immense impact in a connected mobile world.
This impact will reinforce European industrial leadership, and open up new business opportunities. More specifically, the project claims the following impacts:

- World leadership in a new generation of media technologies providing significantly higher performances in terms of intelligence, scalability, flexibility, speed, capacity, ease of use and cost.

- New and sustainable market opportunities based on converged business models between content, telecom, broadcast and consumer electronics industries. Reinforced European position vis-à-vis global interoperability and standardisation initiatives.

Europe has a solid basis in all necessary technological areas of expertise, and **MobiThin** will use this combined experience to develop the next generation mobile thin client infrastructure.

AT A GLANCE: MOBITHIN
Intelligent distribution of demanding services and applications to mobile thin client devices

Project Coordinator
Piet Demeester
Interdisciplinary Institute for BroadBand Technology vzw (IBBT)
Tel: +32-9-3314919
Fax: +32-9-3314899
Email: piet.demeester@intec.ugent.be
Project website: www.mobithin.eu

Partners:
- Interdisciplinary Institute for BroadBand Technology vzw (B),
- T-Systems Enterprise Services GmbH(G),
- Prologue Software (F),
- Interuniversitair Micro-Electronica Centrum vzw (B),
- NEC Technologies (UK) Ltd (UK),
- Institut TELECOM (F),
- JCP-Consult (F)

Duration:
01/2008 – 06/2010

Total Cost:
€ 5,053,646

EC Contribution:
€ 3, 253,150

Contract Number:
INFSO-ICT-216946

MOMENT - Monitoring and Measurement in the Next generation Technologies

The main objective of the MOMENT project is to design and implement a mediator architecture offering a unified interface for monitoring and measurement services, able to use all data and functionalities from the existing and future measurement infrastructures. The MOMENT project consortium has partners from Switzerland, Austria, Hungary, Sweden, Greece, Italy, Spain and Israel with different monitoring and measurement infrastructure.

Main Objectives

The MOMENT project **integrates existing measurement and monitoring infrastructures towards a common and open, pan-European platform.** The project will achieve **semantic representation and retrieval of measurement and monitoring information.** It also develops and demonstrate a set of tools and applications for the future Internet taking advantage of the integrated approach.

Measurement and Monitoring in the network is a grand challenge to be met.

In the Internet of today, really we have no idea what is on the network. MOMENT will make bold contributions about the things we know to make sure that network researchers will gain a better understanding of current networks as well as of The Network of the Future. By bringing together existing pan-European network monitoring infrastructures, MOMENT will mobilise the European key stakeholders who can make a difference and enhance our understanding of the network.

Evolution from FP6 to FP7

The MOMENT project will integrate major monitoring and measurement projects that have been funded under the FP6 umbrella. Such projects encompass DIMES, ETOMIC, LOBSTER and MOME.

The MOMENT platform will provide a middleware or mediation engine that serves not only to provide a common unified interface to monitoring applications, but also to provide taxonomy of such monitoring services, and semantic-based querying capabilities.

International co-operation

The MOMENT project has signed Memorandum of understanding with CAIDA, the unit of University of California, in San Diego (U.S.A) for developing unified interface and contribute towards international standards development. CAIDA is an international organisation having major activity in the Internet traffic monitoring and have also major interest in MOMENT activities.

Technical Approach

The core objective of the MOMENT project is to integrate existing monitoring infrastructures with a middleware layer, which allows for querying available monitoring results as well as forwarding specific measurement tasks to accessible measurement tools.
Based on a detailed requirements analysis, the system will be specified, designed, implemented and finally tested and validated. The overall work plan of MOMENT is structured into 5 technical work packages.

The project considers the following infrastructure available with the partners:

- **ETOMIC:** ETOMIC provides both a database infrastructure and tools for real-time measurements.
- **DIMES:** DIMES provides both a database infrastructure and a tool for real-time measurements.
- **LOBSTER:** LOBSTER provides a database infrastructure.
- **RIPE:** RIPE provides a database infrastructure.
- **BART:** BART is a tool for real-time measurements.

Figure 1: MOMENT mediator and interface

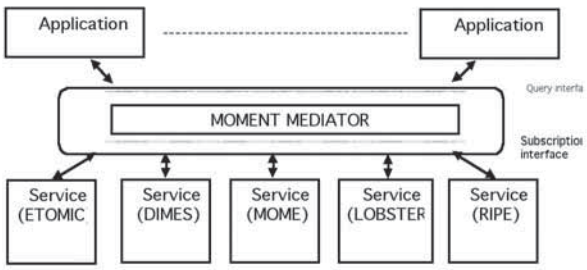
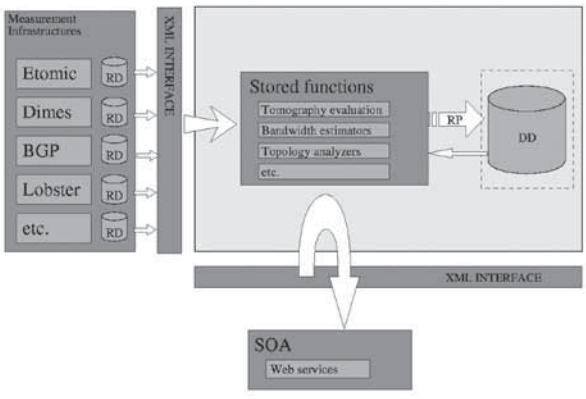


Figure 2: MOMENT System architecture



Key Issues

The key issues addressed by the project can be summarised as follows:

1. The protocol that serves for the applications to perform semantic queries to the mediation engine through the query interface using web services.
2. The monitoring services to suscribe through subscription interface
3. The interface or wrapper that the measurement infrastructures should use in order to register the offered service and data. For example, XML could be used to specify the data.
4. Configuration interface for communicating with management tasks

Expected Impact

To manage and optimise the control of the future Internet, necessary mechanisms should be embedded in the network to enable a good understanding of the operation. Monitoring the network is a grand challenge that has to be met in the future Internet design. By putting together key

European stakeholders from currently operating monitoring infrastructures/projects, such as DIMES, ETOMIC, LOBSTER and MOME, MOMENT will make high-impact contributions towards this grand challenge further advancing the state of the art in computer networking and paving the road to the Network of the Future.

The MOMENT platform will provide the means to assess and report the quality of the connectivity delivered by individual domains (e.g. indicators for network availability, reachability, QoS). This will have a beneficial effect onto the market competitiveness, driving the pan-European infrastructure towards higher technological standards and robustness. MOMENT will provide experimental facilities towards a single common infrastructure created that can lead to the emergence of an EU driven international standard for network monitoring to improve the interoperability and potential reuse of the various tools and components developed.

Dissemination and Exploitation

The project web-site (www.fp7-moment.eu) will be set up for on-line dissemination of activities of the Project, public deliverables and news related to monitoring and measurement activities. The project will participate in the concertation and cluster meetings to develop projects level liaison. The partners will participate in the conferences to disseminate the results and towards developing potential interest for the Internet traffic monitoring.

AT A GLANCE: MOMENT
Monitoring and Measurement in the Next generation Technologies

Project Coordinator
Dr. Sathya Rao
TELSCOM AG
Aarwilweg 20
3074 Muri
Switzerland
Tel: +41 31 3762033
Fax: +41 31 3762031
Email: Rao@Telscom.ch
Project website: www.fp7-moment.eu

Partners:
•Telscom (CH),
•Salzburg Research Forschungsgesellschaft (AT),
•Institute of Computer Science (GR),
•Universidad Autónoma de Madrid (ES),
•Universidad Pública de Navarra (ES),
•Collegium Budapest Association (HU),
•Ericsson (SE),
•SICS-Swedish Institute of Computer Science (SE),
•Tel Aviv University (IL),
•Consorzio Nazionale Interuniversitario per le
•Telecomunicazioni (IT),
•Telefonica Investigacion Y Desarrollo, S.A.Unipersonal (ES)

Duration:
January 2008 – June 2010

Total Cost:
€ 3.907,689 m

EC Contribution:
€2.800,363 m

Contract Number:
INFSO-ICT-215225

N-CRAVE - Network Coding for Robust Architectures in Volatile Environments

The novel paradigm of Network Coding (NC) is leveraged in architecting and controlling wireless networks in performance-challenged and resource-constrained environments. A consortium of research and industry leaders from 7 countries delivers a proof-of-concept for NC as the major enabler in volatile environments.

Main Objectives

NC has the potential of realizing multi-fold performance gains. It is thus is expected to change the way we perceive, architect, organize and control networks and foretells deep impact in a wide range of areas and tasks

The simple, yet disruptive idea of Network Coding (NC) is that nodes will no more only forward but also process and mix the incoming independent information flows. The revolutionary paradigm has the potential of realizing multi-fold performance gains. It is thus expected to change the way we *perceive, architect, organize and control networks* and foretells deep impact in a wide range of areas such as network topology formation, error resilience, resource sharing, flow control interactions, and tasks such as content delivery, network monitoring and security.

N-CRAVE project aims to exploit NC to enhance the capacity and the robustness of wireless networks. The scientific objectives of N-CRAVE are focused around the following key challenges:

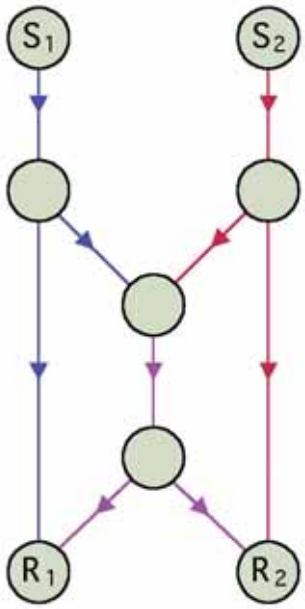
1. Deliver a proof-of-concept for NC as a major enabler in dynamic wireless network environments with multiple communicating peers, where robustness is a key challenge;
2. Exploit the inherent robustness of NC for the design of complexity-aware communication protocols capable of performing reliably under a wide range of medium access, network optimization and security constraints;
3. Develop peer-to-peer profiles and solutions under the network coding paradigm with particular emphasis on application-driven performance metrics, such as quality-of service, delay-sensitivity and fairness.

To this end, N-CRAVE is structured around (i) *utilizing and optimally exploiting the inherent benefits of network coding* such as robustness to variations, error resilience and ramifications in security to guide the design of a novel networked architecture, (ii) *building key components of the protocol stack* by introducing innovative optimized mechanisms for information transport, flow control and content distribution.

Technical Approach

N-CRAVE is organized in four RTD work packages:

1. **Foundational Aspects of NC:** After assessing the state of the art, theoretical bounds for performance (throughput, delay, energy) and complexity are developed for dynamically changing environments. Topology models will be analyzed toward constructing favourable topologies for optimal performance. Resiliency is studied in extremely volatile environments, in the presence not only of topology changes, but also under accidental disruptions and malevolent actions. Random codes will be leveraged to reliably disseminate information dissemination in networks in constant transience where typical network models fail.



2. **Novel key access, network, transport and cross-layer methodologies:** New communication protocols and cross-layer optimizations will be designed to exploit NC. In this context, we consider
- Autonomous techniques for optimally realizing advanced modes of information transport such as any-cast, group-to-group, multi-cast and any-cast;
- Random NC and lightweight back-pressure schemes in multiple unicast connections to maximize throughput;
- Novel MAC layer engineering jointly with network code resource allocation;
- Joint Routing and flow control;
- Tradeoffs in performance vs. computational complexity and signalling, minimizing control overhead;
- Adaptive NC that varies the volume of coded information to the environment volatility.

3. **Application plane aspects of NC:** Viable solutions for efficient content distribution and storage in isolated mobile networks on NC utilizing the broadcast nature of the wireless channel and multiple diverse paths for

delay minimization and throughput maximization are developed. Moreover, the intrinsic features of NC are used to quantify and fortify information secrecy and resilience of transported data.

4. **NC experimentation:** Provide proof-of-concept validation and understand NC requirements through an experimental wireless test-bed based on open source drivers. Various NC schemes and algorithms are implemented and evaluated in various applications most notable being video distribution.

Last, a **dissemination** work package will ensure spreading of the project and its findings to the key players and general public via an easily accessible website, organize conferences and key workshops, as well as enhance and pave the way of NC into evolving and new standards.

Key Issues

- Innovative fundamental methods and techniques for higher throughput over existing techniques.
- Resilient architectures (more robust over existing solutions in various volatile scenarios).
- Efficient transport mechanisms for advanced transport modes (higher throughput, lower delay and energy in multicast)
- Performance vs. complexity tradeoffs (capacity and delay vs. computation and signalling).
- Novel content distribution in volatile environments.
- Secure transport mechanisms – assessment of confidentiality & robustness to failures.
- Implementation of various coding schemes in 802.11 test-bed.

Expected Impact

N-CRAVE will greatly contribute towards the impacts listed in the work programme under objective 1.1 "The Network of the Future":

- The proposed methods and techniques will foster the development of novel applications and services with stringent requirements that rely on advanced modes of information transport and content distribution, not viable with today's network architectures.

- The randomized scalable schemes proposed, realizing multiplicative performance gains over current networks, are expected to shape and influence wireless standards.

- N-Crave's support by leaders in industry and research community will foster European industrial leadership in the ever-changing telecommunications' landscape.

AT A GLANCE: N-CRAVE
Network Coding for Robust Architec-tures in Volatile Environments

Project Coordinator
Leandros Tassiulas
CERTH/ITI
Tel: +302421074980
Fax: +30242174997
Email: leandros@uth.gr
Project website: http://www.ncrave.eu

Partners:
•CERTH/ITI (GR)
•EPFL (CH)
•IT/FCUP (PT)
•TELEFONICA (SP)
•THOMSON (FR)
•TUM (DE)
•CUHK (HK)

Duration:
01/2008 – 12/2010

Total Cost:
€ 3.318m

EC Contribution:
€ 2.196m

Contract Number:
INFSO-ICT-215252

PSIRP - Publish-Subscribe Internet Routing Paradigm

The project aims to develop, implement and validate an internetworking architecture based on the publish-subscribe paradigm, which appears to be one of the most promising approaches to solving many of the biggest challenges of the current Internet. The consortium consists of eight partners from six European countries: Bulgaria (IPP-BAS), Finland (TKK-HIIT, LMF, NSNF), Germany (RWTH Aachen), Greece (AUEB-RC), Hungary (ETH), and United Kingdom (BT).

Main Objectives

Despite its success, the Internet suffers from several major shortcomings, motivating a fundamental reform of its para¬digms and core technologies. A fundamental shortcoming in the design of the current Inter¬net is its imbalance of powers in the favour of the sender who is overly trusted.

The PSIRP project will design a new internetworking architecture based on the publish-subscribe paradigm.

This has led into increas¬ing problems with spam mail and distrib¬uted denial of service (DDoS) attacks, forcing compa¬nies and users to conceal their E-mail addresses and place their systems behind firewalls. The worst con¬sequence of this is that the Internet's full potential is not being realized.

For almost 30 years the Internet has been coping with ever increasing traffic and new types of applications, including voice and video, while retaining its original architecture, drafted almost 40 years ago. Finally experts all over the world are beginning to agree that a fundamental reform is needed to cope with the challenges of the new millennium.

In light of the ever increasing importance of ICT in all areas of society and the role of the Internet as the central compo¬nent of ICT, it is vital for Europe to be actively involved in creating the future Internet. This will give Europe an opportu¬nity to influence the design that will affect the lives of every person in the world. It will also give European companies a good starting position to offer products and services of the future.

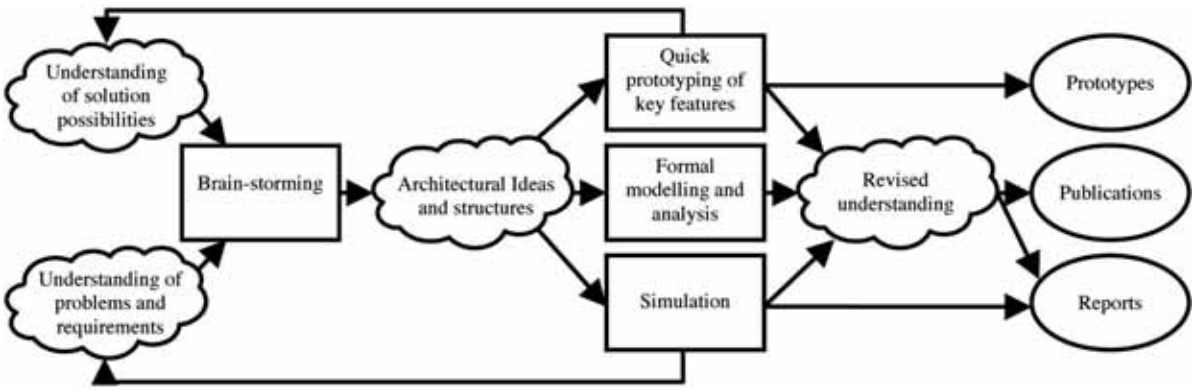
The PSIRP project will design a new internetworking archi¬tecture based on the publish-subscribe paradigm. Many of today's applications already are publish-subscribe by nature and the new architecture will support them efficiently.

The architecture will be implemented and validated. The validation includes testing the implementation with real applications as well as trying to break it, subjecting it to DoS and other types of attacks. Experiences gained are used to improve the design and implementation in an iterative way.
The implementation will be made available under a liberal open source license. This will enable the open source com¬munity to carry on the work and give SMEs the opportunity to use the results of the project as a basis for their product development. In the original spirit of the Internet ("rough consensus and working code"), the PSIRP project believes in good ideas implemented well.

Technical Approach

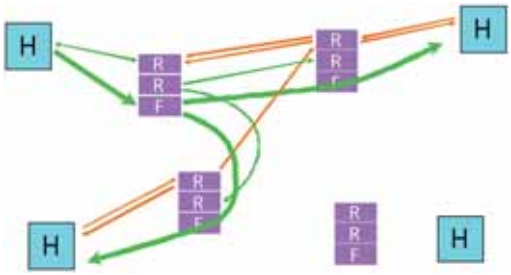
PSIRP bases its work on the publish-subscribe paradigm, which currently appears to be one of the most promising approaches to solving the main problems of the current Internet.

The work is divided into the following five work packages (WP leaders in parentheses):
WP1 Management (TKK-HIIT)
WP2 Architecture Design (TKK-HIIT)
WP3 Implementation, Prototyping and Testing (LMF)
WP4 Validation and Tools (BT)
WP5 Dissemination and Exploitation (NSNF)
The consortium includes two leading European telecom vendors, one of the largest telcos and several highly rated academic institutions.
The project also collaborates with the International Computer Science Institute (ICSI) at UCB, which gives it the necessary connection to related work being done in the United States.
Architecture design starts with a State-of-the-Art (SoA) survey, where current and proposed techn¬ologies and solutions are studied. This early phase produces the



termin¬ology used in the project, a taxonomy of proposed solutions, and an analysis of key scientific papers.

Every partner will participate in every work package and largely the same people will be involved in designing the architecture and implementing it. However, validation needs people that are not too deeply involved in design and implementation.
The diagram below illustrates the iterative method used in the project.



Key Issues

Among the issues that PSIRP will have to address are scalability and security.
Efficient distribution of mas¬sive amounts of information, including video, mandates the use of multicasting and caching. In the new architect¬ure, multicast is not the exception but the norm.
Security cannot be treated as a separate entity but as an integral part of the design and imple¬mentation. Among the most difficult security chal¬lenges are protection against unsolicited traffic (spam) and denial of service (DoS).
The figure below illustrates the three layers of the arch¬itecture (from top to bottom): rendezvous, routing and forward¬ing.
The project will produce two implementations: a clean-slate approach, where also the lower layers are redesigned, and an overlay design built on IP.
Some innovations may be patented but as much as possible, the results of the project will be published as scientific papers and source code under a liberal license (such as BSD).

Expected Impact

The project is expected to have the following impacts:

- Increase European understanding of the publish-subscribe architecture and its possibilities.
- Affect the standardization of the future Internet giving Europe a possibility to influence its direction.
- This will help bring better ICT-based services for education, business, care of the sick and elderly, and leisure for the European people.
- European telecom vendors and telcos will get a head-start in providing products and services for the future internet.
- The published results and open-source implementation will give SMEs a chance to enter the future Internet market.

AT A GLANCE: PSIRP
Publish-Subscribe Internet Routing Paradigm

Project Coordinator
Arto Karila
Helsinki University of Technology, HIIT
Tel: +358 50 384 1549
Fax: +358 9 694 9768
Email:arto.karila@hiit.fi
Project website: www.psirp.org

Partners:
•Helsinki University of Tech¬nology,
•Helsinki Institute for Information Science (FI),
•RWTH Aachen University (DE),
•British Telecommunications Plc (GB),
•Oy L M Ericsson Ab (FI),
•Nokia Siemens Networks Oy (FI),
•Institute for Parallel Processing of the Bulgarian
•Academy of Science (BG),
•Athens University of Economics and Business (GR),
•Ericsson Magyarorszag Kommuni¬kacios Rendszerek
•K.F.T. (HU)

Duration:
January 2008 – June 2010

Total Cost:
€4.1m

EC Contribution:
€2.5m

Contract Number:
INFSO-ICT-216173

SENDORA - Sensor Network for Dynamic and Cognitive Radio Access

SENDORA project develops a new approach of Cognitive Radio called Sensor Network aided Cognitive Radio in which a sensor network assists the cognitive radio actuation by monitoring the spectrum use. This project is led by Thales, Eurecom, NTNU, Telenor, KTH, TKK, Universities of Rome, Valencia and Linköping.

Main Objectives

Following current trends towards dynamic spectrum allocation and cognitive radio, SENDORA project develops a new approach to support the coexistence of licensed and unlicensed wireless users in a same area.

The key innovative concept developed in SENDORA is the Sensor Network aided Cognitive Radio.

The capability to detect spectrum holes, without interfering with the licensed network currently in use, is the major difficulty faced today by the cognitive radio, even more when fine granularity of allocation in time and frequency is targeted. The key innovative concept developed in SENDORA is the "Sensor Network aided Cognitive Radio" technology, which allows to solve this issue thanks to the introduction of sensor networks. This concept is a system approach that involves a set of advanced wireless communications techniques like spectrum sensing, interference management, cognitive radio reconfiguration management, cooperative communications, end-to-end protocol design and cross-layer optimisation. All these enabling techniques together form a compound system able to improve the spectrum use in a significant way.

SENDORA project targets three major objectives:

- the identification and analysis of the business scenarios of the Wireless Sensor Network (WSN) aided Cognitive Radio technology
- the definition and simulation of the WSN aided opportunistic access and dynamic resource allocation strategies for cognitive radios, which first requires a detailed work on the enabling techniques
- the design of a flexible and reconfigurable architecture, and a demonstration through a proof-of-concept of the WSN aided Cognitive Radio technology

As SENDORA covers a broad range of current topics of interest in wireless communications, a project at European level is required to achieve these objectives. A link with regulation authorities and standardization bodies is also necessary due to the expected changes in the way the spectrum will be managed in the future.

Beyond the limited current state-of-the-art on cognitive radio, the proposed concept will allow to address a very dynamic and competitive mixed radio access between cellular and broadband technologies.

Technical Approach

SENDORA is divided into 8 Work Packages (WP). **WP1** is dedicated to management activities. **WP2** details the targeted scenarios, thus providing requirements for the other WP. The enabling techniques are then addressed in WP3-WP6. As the project considers the Sensor Network aided Cognitive Radio as an integrated system, strong interactions between these WPs have been identified.

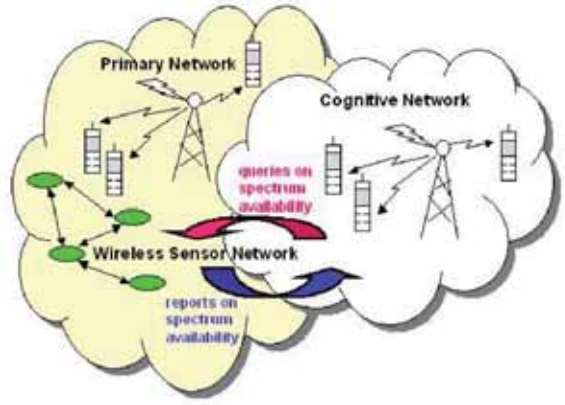
WP3 is dedicated to spectrum sensing, that is, the design of new robust spectrum sensing algorithms, whose detection power will be enhanced by processing data from several sources in order to perform distributed detection of the primary licensed users.

WP4 addresses the cognitive actuation. The objective is to achieve an improved understanding of the cognitive radio control actuation loop that will become a key module of the radio terminal.

WP5 is dedicated to the collaborative communications within the sensor network. Novel physical layer cooperative transmission techniques will be designed, by modifying various approaches like Virtual Beamforming, Amplify & Forward, Decode & Forward, Compress & Forward.

WP6 is dedicated to the design of the end-to-end protocol stack of the sensor network, to allow data gathering and spectrum monitoring. The design and evaluation of a complete, cross-layer optimised protocol stack for end-to-end query dissemination and data gathering in the wireless sensor network will be addressed.

WP7 will address the integration of these enabling techniques and the demonstration of the concept in a realistic environment. A radio demonstrator will be developed, based on two hardware platforms: one platform dedicated to digital signal processing, and one RF platform with frequency agility. The foreseen demonstration will use a WiFi primary network as test-bed environment. The traffic will be analyzed and the degradations caused by the cognitive network will



be measured. The improvements in the spectrum use will be also monitored.
WP8 is dedicated to dissemination activities.

Key Issues

Cognitive radio aims at improving the way the radio spectrum is utilized. Today's approach is based on dividing the spectrum into small pieces, each for a specific purpose. Since the applications use their spectrum to a limited extent, this leads to the unwanted situation of under-utilization of this scarce radio resource. While radio communications grow constantly, regulation authorities recognise that the current approach is reaching its limits. Consequently, cognitive radio and dynamic spectrum allocation are becoming key technologies and key research activities in the field of wireless communications.
SENDORA addresses this key issue and proposes a new approach and innovative techniques to support the coexistence of licensed and cognitive wireless users in a same area.

Expected Impact

The cognitive radio concept is expected to become the most important technique able to improve the efficiency of the radio spectrum use. It will represent a key technology on the way to future high-capacity wireless communications networks, and thus major impacts are expected.

In order to make the concept of cognitive radio applicable, the findings of SENDORA will provide inputs to standardization groups and regulation authorities. The project will thus contribute to the development of global standards for future networks.

An impact on the competitiveness of European telecommunications industry and academia is also expected. Indeed, the results of SENDORA will help them to take a strong position in the development of key technologies for future wireless broadband services. Hence, SENDORA will help reinforcing European industrial strengths in wireless networks and developing stronger synergies between the various actors of the sector.

New services and business opportunities are also expected to emerge from the cognitive radio concept. The scenarios and use cases considered in SENDORA will help to identify new industrial opportunities in Europe, for instance in the field of the Internet technologies.

AT A GLANCE: SENDORA
SEnsor Network for Dynamic and cOgnitive Radio Access

Project Coordinator
Bertrand Mercier
THALES Communications
Tel: + 33 1 46 13 32 27
Fax: + 33 1 46 13 22 55
Email: bertrand.mercierb@fr.thalesgroup.com
Project website: www.sendora.eu

Partners:
•Thales Communications (FR),
•Institut Eurecom (FR),
•Royal Institute of Technology - KTH (SE),
•Helsinki University of Technology - TKK (FI),
•Norwegian University of Science and Technology -
•NTNU (NO),
•Telenor ASA (NO), University of Valencia (ES),
•Università degli Studi di Roma "La Sapienza" (IT),
•Linköping University (SE)

Duration:
Jan,2008 – Dec,2010

Total Cost:
€5.63m

EC Contribution:
€3.84m

Contract Number:
INFSO-ICT-216076

SMOOTH IT - Simple Economic Management Approaches of Over-lay Traffic in Heterogeneous Internet Topologies

SmoothIT addresses innovatively the detailed economic and technical mechanisms for a flexible, secure, and scalable traffic management of overlay networks in tomorrow's ISPs and telecommunication operators networking infrastructure.

Main Objectives

The Internet traffic stemming from overlay-based applications, e.g., Peer-to-Peer applications, increases rapidly with the increase of available bandwidth of end-nodes. For today's Telecommunication Service Providers (telco) and Internet Service Providers (ISP) the issue arising is: how to **control and manage network traffic** stemming from **overlay-based applications.** As the structure of overlays determines the traffic flows in ISP networks, it is highly efficient for an ISP to **influence overlay configuration** based on information on their structure. Overlays have to be managed to maximize the benefit for multiple operators/ISPs involved, and to increase the capability to withstand faults, and balance the network load.

… an optimized incentive-driven signaling approach for defining (theory) and delivering (technology) economic signals across domain boundaries in support of co-operating and competing providers to manage overlay traffic…

Therefore, SmoothIT pursues the following major objectives:

1. SmoothIT will **structure overlays** in a way that is efficient or **optimal,** both for user communities and for ISPs. This is to be attained by means of incentive mechanisms.
2. SmoothIT will study and **define key requirements** for a commercial application of **Economic Traffic Management (ETM)** schemes for ISPs and telcos.
3. In order to advance traffic management beyond traditional limits, specialized **economic theory** will be applied for building in a **fully decentralized** way network efficient Internet-based overlay services in **multi-domain scenarios,** solving the information asymmetry problem.
4. SmoothIT will **design, prototype, and validate** the necessary networking infrastructure and their components for an **efficient** implementation of such economic traffic management mechanisms in an **IP test-bed and trial** network.
5. SmoothIT will develop an optimized **incentive-driven signaling approach** for defining (theory) and delivering (technology) economic signals across domain boundaries in support of **co-operating and competing providers** in an interconnected **heterogeneous network environment.**
6. SmoothIT will stress **operator-orientation** by verifying key results of the work through ISP and telco requirements as well as its supporting technology.

Technical Approach

The technical approach designed for the SmoothIT project consists of five work packages. WP1 investigates, specifies, and applies traffic analysis methods for overlay applications which are subject to ETM mechanisms. Detailed traffic requirements are determined and utilized to provide an objective basis for rating overlay traffic. WP2 specifies ETM mechanisms, develops the respective theory for incentive-based schemes, evaluates their performance through simulation, and provides applicable parameterizations for the test-bed and trial. WP3 specifies, develops, implements, and evaluates the flexible set of networking protocol and a systems architecture being able to perform measurements, accounting, and charging for overlay networks, forming the basis for the test-bed and trial. WP4 specifies and runs two trials in two interlinked phases. A first internal trial will be performed within the test-bed for parameter finding and tuning (at the middle of the project) and a second external trial one will be run (at the end of the project) to collect and assess practical-applicable results in a larger scale. WP5 is responsible for all project management, dissemination, standardization, and exploitation activities.
Based on those objectives defined above, the overall SmoothIT roles and relationships is envisioned as shown in Figure 1. The important interactions between telecommunication networks (representing operators), the overlay service (representing an application-driven support), and the group of users are outlined.

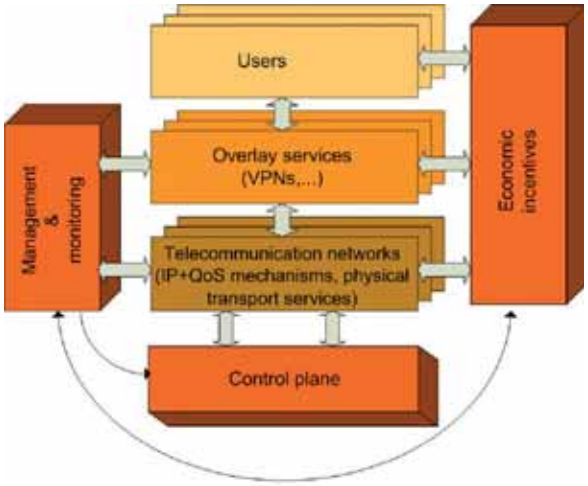


Figure 0: Interactions between Roles and Technical as well as Economic Mechanisms.

Key Issues

Key issues of SmoothIT cover the theroy and modelling of the new ETM mechanism to be designed as well as the technical aspects of its implementation and evaluation.

These are:

- The design of a **flexible, secure, and scalable** economic management mechanisms to enable ISPs to **reduce their service provisioning and maintenance costs,** thus, leading towards a highly competitive market advantage.
- The definition of appropriate **incentives schemes** to motivate collaboration among ISPs (which may also be competing ones at the same time) and between ISPs and overlay networks, thus solving the information asymmetry problem.
- The provision of **security, privacy and trust for economic management schemes** and their implementation in a fully **decentralized** and competitive **multi-provider** domain.
- The exploitation of network-related and management protocol, such as traffic measurement, AAA (Authentication, Authorization, and Accounting), QoS, and network management systems; based on the underlying infrastructure in order **to support the widest possible range of inter-domain and inter-provider solutions.**

Expected Impact

The SmoothIT project will have a considerable strategic impact regarding **theoretical concepts and results,** since it will focus on and promote the state-of-the-art of ETM. This approach involves decentralized decision-making guided by incentives and enabled by means of appropriate mechanisms, which are based on pricing and reciprocation. The project will also have significant strategic impact on the **players** involved, since it will provide (a) practical mechanisms, which will be prototyped and (b) theoretically justified ETM mechanisms promoting overall efficiency.

Three **envisioned measurable impacts** are:

1. **Cost saving for ISPs:** *lower operation costs,* due to ETM based traffic engineering, *lower interconnection costs,* as traffic can be kept inside an ISPs domain, and *lower capacity extension cost,* as capacity requirements can be forecasted with much higher accuracy.
2. **Lower prices for end users,** due to competitive pricing by ISP that are enabled by new ETM mechanisms.
3. **Better QoS** for overlay based applications across ISP domains, due to the usage of ETM based traffic engineering. This leads to an improved media consumption experience for the end users.

AT A GLANCE: SmoothIT
Simple Economic Management Ap-proaches of Overlay Traffic in Het-erogeneous Internet Topologies

Project Coordinator
Prof. Dr. Burkhard Stiller
University of Zurich
Tel: +41 (44) 635-6710
Fax: +41 (44) 635-6809
Email: stiller@ifi.uzh.ch
Project website: http://www.smoothit.org

Partners:
•University of Zurich (CH),
•Technische Universität Darmstadt (DE),
•DoCoMo Communications Laboratories Europe GmbH (DE),
•Athens University of Economics and Business (GR),
•Julius-Maximilians Universität Würzburg (DE),
•AGH University of Science and Technol-ogy (PL),
•PrimeTel Limited (CY),
•IN-TRACOM S.A. Telecom Solutions (GR),
•Telefónica Investigación y De-sarrollo (ES)

Duration:
Jan, 2008 – Dec, 2010

Total Cost:
€4.4m

EC Contribution:
€3.0m

Contract Number:
INFSO-ICT-216259

SOCRATES - Self-Optimisation and Self-Configuration in Wireless Networks

SOCRATES aims at the development, evaluation and demonstration of methods and algorithms for self-configuration, self-optimisation and self-healing, as a promising opportunity to automate radio network planning and optimisation. Key gains are a substantial OPEX reduction and an enhancement of network efficiency and QoS.

Main Objectives

SOCRATES aims at OPEX reduction and radio network optimisation

The general objective of SOCRATES is to develop self-organisation methods in order to optimise network capacity, coverage and service quality while achieving significant OPEX (and possibly CAPEX) reductions. Although the developed solutions are likely to be more broadly applicable (e.g. to WiMax networks), the project primarily concentrates on 3GPP's LTE radio interface (E-UTRAN). In more detail the objectives are as follows:

- The development of novel *concepts, methods* and *algorithms* for the efficient and effective self-optimi-sation, -configuration and -healing of wireless access networks, adapting the diverse radio (resource management) parameters to smooth or abrupt variations in e.g. system, traffic, mobility and propagation conditions. Concrete examples of the radio parameters that will be addressed include: *power settings, antenna parameters, neighbour cell lists, handover parameters, scheduling parameters* and *admission control parameters.*
- The specification of the required *measurement information,* its statistical accuracy and the methods of information retrieval including the needed protocol interfaces, in support of the newly developed self-organisation methods.
- The *validation* and *demonstration* of the developed concepts and methods for self-organisation through extensive simulation experiments. In particular, simulations will be performed in order to illustrate and assess the established capacity, coverage and quality enhancements, and estimating the attainable OPEX (/ CAPEX) reductions.
- An evaluation of the *implementation* and *operational impact* of the developed concepts and methods for self-organisation, with respect to the operations, administration and maintenance architecture, terminals, scalability and the radio network planning and capacity management processes.
- *Influence* on 3GPP standardisation and NGMN activities.

Technical Approach

WP1: Project Management. This work package takes care of the overall management of the project's operational and financial aspects and facilitates in- and external cooperation.

WP2: Use cases and framework for self-organisation. (Non-)technical requirements of the different components of self-organisation (self-optimisation, -configuration and -healing) will be derived from a list of use cases. These use cases define scenarios in which the application of self-organisation methods is envisioned in future access networks. In addition, assessment criteria for methods and algorithms for self-organisation are developed. Jointly, these aspects constitute the framework for the development of self-organisation methods in WP3 and WP4.

WP3: Self-optimisation. Development of new concepts, methods and algorithms for *self-optimisation* of wireless networks that adapt to gradual changes in the radio network. Simulation tools will be applied to assess their performance, using the criteria and methodologies developed in WP2, and to assist in the understanding and further enhancement of the algorithms. Further-more, the required measurements, interfaces and protocols are specified.

WP4: Self-configuration and self-healing. Development and validation of models and algorithms for *self-configuration* of newly deployed sites or technological features, and self-healing of incidental soft/hardware failures by means of local adaptation of radio parameters. In addition, newly required measurements and changes in interfaces to support the developed self-configuration and *self-healing* algorithms are specified.

WP5: Integration, demonstration and dissemination. WP5 aims at: *(i)* the *integration* and attuning of the developed self-organisation methods (WP3-4) in line with the framework constituted in WP2; *(ii)* a *demonstration* of the benefits from the self-organisation methods; *(iii)* an assessment of the *implications* of the project results on radio network planning and operations, standardisation, technical/business opportunities, regulation and society; *(iv)* the creation of an *exploitation roadmap* for the project results by identifying obstacles and enablers and determining a deployment roadmap for the use of self-organisation; and *(v)* the dissemination of project results, including contributions to standardisation (3GPP) and industrial forums (e.g. NGMN), and the organisation of two dedicated workshops.

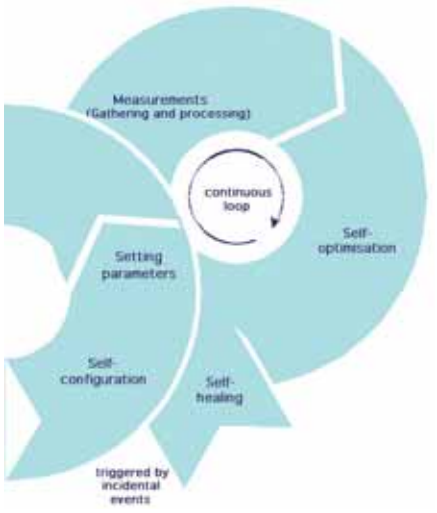
Key Issues

Future mobile radio networks are highly complex systems with a multitude of tuneable control mechanisms and parameters acting at time scales varying from milliseconds to days. Moreover, there are intricate interdependencies among these control mechanisms and parameters as well as limitations on measurements, signalling and processing. Understanding and mastering these complexities poses major challenges for the design of effective and dependable self-organisation functionalities.

Expected Impact

Bringing together a well suited, strong consortium of two of the world's largest equipment vendors (Ericsson, Nokia Siemens Networks), a leading mobile operator (Vodafone), an SME developing support tools for network planning and operations (Atesio) and three renowned research organisations (IBBT, TNO ICT, TU Braunschweig) with a proven record in successful cooperation with the mobile industry, the SOCRATES project has a great opportunity to achieve considerable impact.

- The SOCRATES project will *influence global standardisation,* by developing solutions for standardised measurements, new or adapted interfaces and new or modified protocols supporting self-organisation functionalities.



- SOCRATES will *reinforce European industrial leadership* by contributing to European dominance in the development of world-wide standards, by creating a 'head start' in the development of self-organising features for radio networks and support tools, and in providing high-level consultancy. In addition, the strong partnership will create stronger synergies between various sector actors and contribute to new business models.

- The findings from the consortium will *create new industrial and business opportunities* within the management and control area of existing and future networks, and will have several important spin-offs, e.g. towards the development of new services with a reduced time-to-market.

AT A GLANCE: SOCRATES
Self-Optimisation and Self-Configuration in Wireless networks

Project Coordinator
Prof. Dr. Hans van den Berg
TNO, Netherlands
Tel: +31 15 2857031
Fax: +31 15 2857349
Email:J.L.vandenBerg@tno.nl
Project website: www.fp7-socrates.org

Partners:
- TNO Information and Communication Technology (NL),
- Atesio (D),
- Ericsson AB (S),
- IBBT (B),
- Technische Universität Braunschweig (D),
- Vodafone (UK),
- Nokia Siemens Networks (D, PL)

Duration:
01/2008 – 12/2010

Total Cost:
€4.98m

EC Contribution:
€3.25m

Contract Number:
INFSO-ICT-216284

Euro-NF - Anticipating the Network of the Future - From Theory to Design

Euro-NF is a Network of Excellence on the Network of the Future, formed by 35 institutions (from the academia and industry) from 16 countries. Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future.

Main Objectives

Euro-NF will continue to develop a prominent European center of excellence in Future Networks design and engineering as well as on related socio-economic aspects, acting as a source of innovation and a "Collective Intelligence Think Tank"

Future networks became a central topic with a large debate whether moving towards the new networked society will be evolutionary or disruptive. In the future networked society the physical and the digital worlds will merge based on the massive usage of wireless sensor networks. Objects will be able to identify and locate themselves and to communicate through radio interfaces. Self-organized edge networks will become more and more common. Virtualization and programmability will allow for providing different networking environments over the same infrastructure. Autonomic networking will deal with the increasing complexity of I&C systems. End-users empowerment will increase with his capacity of providing services and content, as well as connectivity support.

This new environment forces the scientific community to develop new principles and methods to design/dimension/control/manage future multi-technology architectures. The new paradigms raise new challenging scientific and technological problems embedded in complex policy, governance, and worldwide standards issues. Dealing with the diversity of these scientific and socio-economic challenges requires the integration of a wide range of research capacities; a role that Euro-NF will fulfil.

Indeed, Euro-NF extends, in scope and duration, the successful Euro-NGI/FGI NoE that has integrated the required critical mass on the networks of the future and is now a major worldwide player in this area.
The consortium has evolved in order to have an optimal coverage of the new scope. Euro-NF will therefore cover the integration of a wide range of European research capacities, including researchers and research and dissemination activities. As such Euro-NF will continue to develop a prominent European center of excellence in Future networks design and engineering, acting as a "Collective Intelligence Think Tank", representing a major support for the European Society leading towards a European leadership in this area.

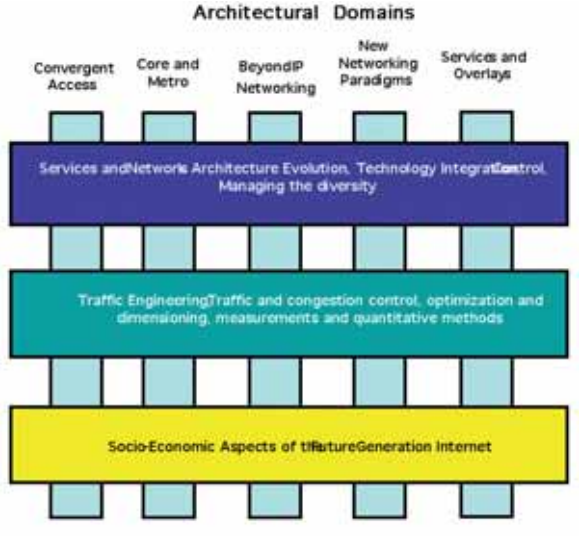
Technical Approach

The project is structured into three lines of activities: integration, joint research and dissemination activities. Each activity is composed of several workpackages.
Fifteen workpackages cover the various angles for integrating the researchers and their work. These workpackages offer a jointly developed and integrated knowledge roadmap, sharing and integration of software tools and platforms, internal workshops, a summer school, a PhD courses programme, tools for facilitating the mobility of researchers and information tools.
There are three joint research activities (JRAs), devoted respectively to the future network and services architectures, the network theory and fundamental quantitative methods, and the socio-economics aspects. The JRAs cover the whole networking domain in a comprehensive fashion with 18 related workpackages.
Fourteen workpackages are dedicated to the dissemination activities. This includes various external communication channels (e.g. a web site were most knowledge produced by the network will be available and activities and events will be announced), publication of special issues in journals, tutorials including a updated document of Euro-NF vision on the network of the future, organization of an international conference and several open international workshops including one devoted to the Future of the Internet, strong relationship with other European (including other European projects) and non-European initiatives, establishing synergies with industry, etc.
Three workpackages are dedicated to management related activities

Key Issues

The first research activity relates to future service and network architectures, requiring the integration of the large diversity of technologies and service and networking paradigms and therefore having the capacity of managing the diversity. The future architecture has to integrate natively a global mobility of users, services, terminals and networks, an explosion of connected devices, security and dependability, inter domain networking solutions, evolved services architectures, just to cite a few.
The second research activity is related with the quantitative issues of the networks of the future, such as new modelling, design, and dimensioning tools contributing to the development of a Network Theory. In future networks, the randomness of the quality of the radio links, of the mobility of users and devices as well as of the topology of the networks has to be considered. New quantitative methods raising complex scientific problems have therefore to be considered, in particular for the efficient processing of the traffic

Finally, giving the exponentially growing impact of the Internet, topics like governance, regulation policies, privacy, trust, security, standardization among others has to be considered together and not after the design of the network. These topics are covered in the third research activity.
The diagram summarizes the structure of the research activities..



Expected Impact

Euro-NF will be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future. The project will be at the heart of furthering networking understanding and design. Its activities cover the whole spectrum of networking.
Euro-NF will be a natural and strong interlocutor of major international initiatives in the domain and will join forces with them.
The integration of the research effort, as it has being carried out by the Euro-NF predecessors (Euro-NGI/Euro-FGI) and continued by Euro-NF is a main facilitator for maintaining a long term view and providing the exploratory research effort necessary to guarantee leadership in a scientific and technological domain that evolves extremely fast and which is under an extreme pressure of competition.
Synergies between experts in network and service architectures on the one hand and socio-economic experts, dealing in particular with cost and business models, on the other hand.
A workpachage is devoted to contribute to global standards for the future Internet.

AT A GLANCE: EURO-NF
Anticipating the Network of the Future - From Theory to Design

Project Coordinator
Daniel Kofman
Institut Telecom, Telecom Paristech
Tel: +33 1 45 81 80 98
Fax: +33 1 45 81 51 87
Email:Daniel.kofman@telecom-paristech.fr
Project website: www.euronf.org

Partners:

Duration:
January 2008 – December 2010

Total Cost:
€22,0m

EC Contribution:
€4,8m

Contract Number:
INFSO-ICT-216366

The EIFFEL Support Action: Laying the foundation for Future Networked Society

The objectives of EIFFEL are to create momentum, build cohesion and support the research, governance & policy communities by providing the European discussion forum and road mapping service that will give Europe leadership in the creation of the Future Networked Society.

Main Objectives

EIFFEL will set up a pan-European discussion forum and technical think-tank on enabling conflict-free, talented and scientific-oriented discussions around the future of the Internet

The widespread adoption of Internet technology has had one of the most profound effects on the nature of society ever witnessed. It has changed the way we do business, the way we obtain information, the ways in which we communicate, and many other facets of life. However effective it has been to date, the Internet was not designed for this purpose, and it is now time to consider how best to change it to support the Future Networked Society. The EIFFEL SA will mobilise European and international researchers to discuss, debate, and provide guidance on the changes needed in the Internet, and the R&D that must be undertaken to realise this vision of a truly networked society. To accomplish this, EIFFEL will set up a pan-European discussion forum and technical think-tank that aims to facilitate conflict-free, scientific discussion on the future of the Internet with input from expert, visionary, researchers as well as those concerned with governance and with delivery. This will be a non-competitive forum oriented towards technology and interest in building the trajectories for the future network society.

The EIFFEL SA has the following high-level objectives:

- **Creation of a pan European community of scientific/ technical experts** that will be able, in collaboration with other International initiatives (research, experimental, etc.), to investigate important areas for the Future Networked Society. It will study the fundamentals of the Internet architecture together with its underpinning design principles.
- **Creation of a European Dialogue** to ensure that the foundational scientific and exploratory investigation leads to cooperative exchanges with the engineering community, in order to ensure that the design principles are deployable within the 2020-2025 timeframe of the Future Networked Society.
- **Identification of the areas of investigation and research that are crucial for the transformation of the Internet into that supporting the Future Networked Society.** This will employ holistic and multi-disciplinary visions that reflect the broad technical contributions that underpin the systems that are changing nature of society. It will steer and support research activities in order to sustain open, broad, technical avenues of investigation.

Technical Approach

These goals will be implemented by the four work packages depicted in the figure above.

- **WP0** will be responsible for the overall management and coordination of the EIFFEL SA.
- **WP1** will be responsible for the overall management of the **EIFFEL office and secretariat,** running the operations, providing the web site and the communications infrastructure, planning the meeting budgets and ensuring an overall smooth progress of the operations.
- **WP2** will be responsible for two critical pieces of the envisioned framework: the establishment of the overall think-tank structure and the organization of the meetings themselves within this structure, largely taking place as bi-annual think tank meetings. The establishment of a mechanism for oversight will ensure that rapid bootstrapping and constant monitoring of the appropriateness of the outputs will happen. The important task of connecting to vital stakeholders will also be undertaken by this work package.
- **WP3** will ensure that proper interaction between both the exploratory and evolutionary approaches can be achieved through liaison with other communities. Those targeted include other relevant European activities (esp. NoEs and ETPs) as well as key non-European communities and organizations.
- **WP4** will implement one of the key objectives of the SSA: the dissemination of the SSA outcomes, i.e., the research manifestos and reports, to vital stakeholders and the overall research community. This will largely happen through funds of the SSA in the form of newsletters sent to the EC and other stakeholders but also through online publications, such as websites, RSS feeds, and mailing lists in order to foster and stimulate the overall research debate.

Key Issues

The following are the key issues that EIFFEL aims to tackle in its work programme:

- **There are many questions today on how the Internet will develop in the future.** What has been clearly identified is that the Internet must progress, and that the degree of progress must be to some extent revolutionary rather than evolutionary. Once we determine what sorts of transformations are needed, we can start working on

how to migrate from today's Internet to the forecasted Internet of the future.

- **Today's Internet was never designed to be a critical part of the worldwide economy's infrastructure** — but it has become exactly that. The future Internet must not be seen as a mere technical entity, but as an integral enabler of *the Future Networked Society.* This leads to the logical argument that new research paradigms need to be explored and that a more interdisciplinary research is required in this domain.
- **A key finding of the EIFFEL Initiative was the need for a balanced research agenda towards the Future Networked Society.** There is a clear need to support *evolutionary,* applied engineering research, based on present industry needs towards the future. But this is not enough to ensure that great opportunities are grasped by Europe. The evolutionary path must be supplemented by a portfolio of radical *exploratory* research activities that will push beyond the limits of existing systems and open the doors for new opportunities in the future.

Expected Impact

As its major output and impact EIFFEL will outline both the vision of the Future Networked Society in the 2025 timeframe and the technical enablers for the Future Networked Society. EIFFEL will also bridge between the different communities necessary to shape the Future Networked Society, as well as establishing the European voice in exploratory research towards it, eventually aiming at constituting the European arm in any international activity. EIFFEL will also support the coordinated exchange of information between the European Future Networked Society community and Research Programmes in other regions, thus contributing to the future harmonisation of viewpoints in technology, governance, privacy and societal aspects. Finally, EIFFEL aims to reduce the uncertainty about the requirements and research needs leading to increased return on investment from research and developmental activity.

AT A GLANCE: EIFFEL
Evolved Internet Future for European Leadership

Project Coordinator
Petri Mähönen
RWTH Aachen University
Tel: +49 2407 575 7032
Fax: +49 2407 575 7050
Email: pma@mobnets.rwth-aachen.de
Project website: http://www.fp7-eiffel.eu/

Partners:
- RWTH Aachen University (DE),
- Athens University of Economics and Business - Research Center (GR),
- British Telecommunication plc. (UK),
- Alcatel-Lucent Bell N.V. (BE),
- Jozef Stefan Institute (SI),
- University College London (UK),
- Groupe des Ecoles des Télécommunications (FR),
- EURESCOM – European Institute for Research and Strategic Studies in Telecommunications (DE)

Duration:
January, 2008 – June, 2010

Total Cost:
€ 2.0 m

EC Contribution:
€ 1.45 m

Contract Number:
INFSO-ICT- 216068

eMOBILITY - Creating roadmaps for the European telecommunications sector

The strategic objective of the eMobility CA project is to facilitate the emergence of a common understanding, between the European sector actors, leading to agreed road-maps and contributing to the global competitiveness of the European telecommunications sector on a number of key challenges.

Main Objectives

The eMobility CA project will facilitate the emergence of a common understanding, between the European sector actors, leading to agreed road-maps and contributing to the global competitiveness of the European telecommunications sector. The following key challenges will be addressed:

eMobility CA is based on the concept of supporting the wide range of projects and sector actors to achieve consensus on key challenges

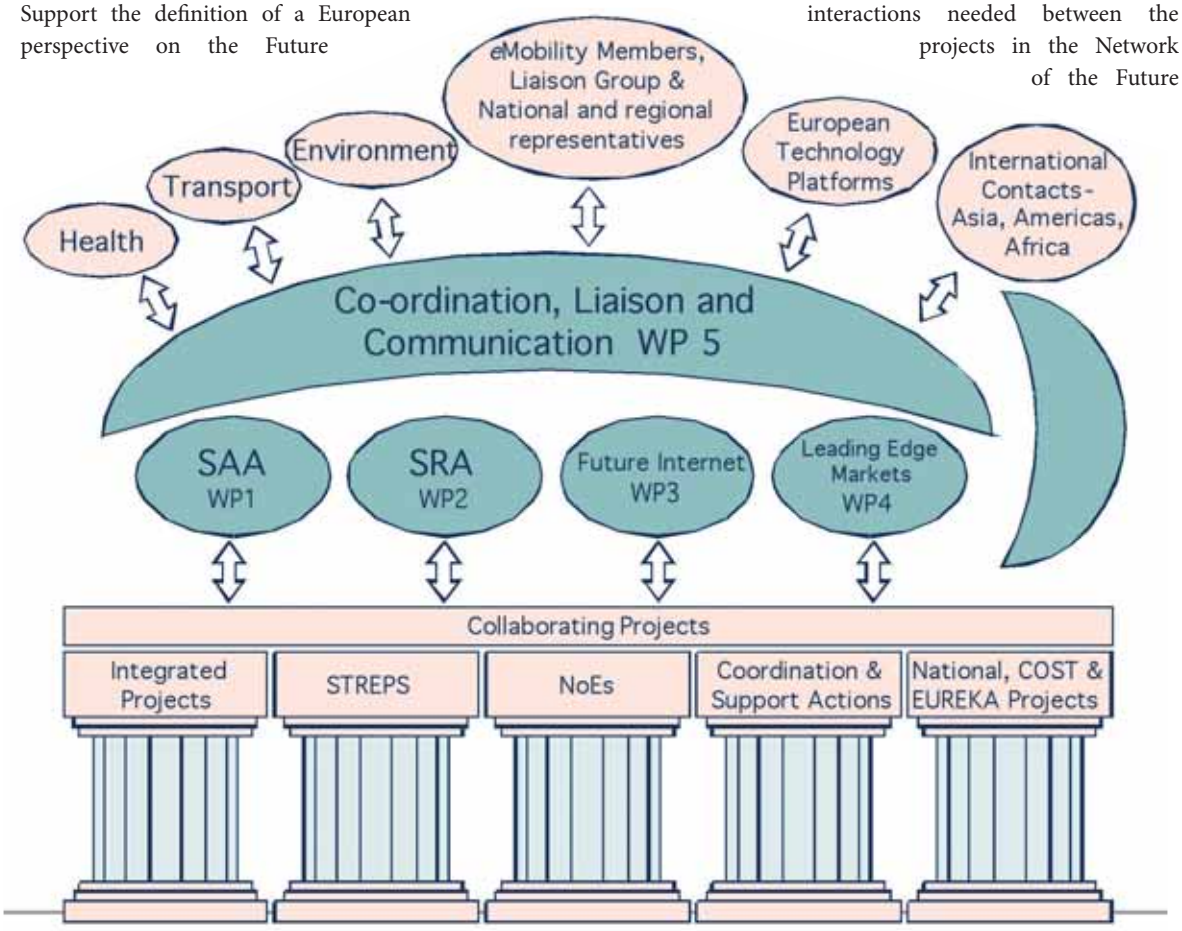
- Integrate the road-maps of the mobile and wireless sector with those of the health, transport and the environment sectors,
- Extend the eMobility Strategic Research Agenda to cover new technologies
- Support the definition of a European perspective on the Future Internet, positioning these views in the international context, and
- Build the opportunities to use Structural Funds to develop leading edge markets in Europe, promoting the take-up of the R&D output of collaborative projects.

Why this project is needed

The telecommunications industry is in the middle of a period of major change and sector actors are searching for new strategies and directions to enable them to capitalise on the changes to consolidate and increase their market presence. The market has become global, putting pressure on profit margins. Recent mergers in both the operator and manufacturer sectors in Europe aim to give critical mass in global markets. The eMobility Technology Platform is addressing these challenges. eMobility CA will support the platform by the strategy described below.

Overall strategy and approach

The role of this project is to facilitate the numerous interactions needed between the projects in the Network of the Future



area of Framework Programme 7 and the application sectors, technology platform members, international liaison partners to achieve the common goal of defining research priorities for Europe in the eMobility

Strategic Research Agenda (SRA), the eMobility Strategic Applications Agenda (SAA) and the Future Internet, and to explore opportunities for the implementation of results using combinations of instruments such as Structural Funds for innovation in Europe. The effort and resources of this project will be focussed on supporting co-ordination, while the technical work itself will be contributed by the participating projects and sector actors. Below figure illustrates the structure of the project and its interactions with projects in Framework Programme 7 and other programmes and with sector actors in Europe and internationally.

Expected Impact

The overall impact of the eMobility CA consists of:

- An increased and shared awareness of requirements and opportunities in the area of mobile and wireless technology, based on the involvement of the broad membership of the eMobility Technology Platform,
- Evolving the Strategic Research Agenda (Technology Push) and matching it with a Strategic Applications Agenda (Demand Pull) for some of the socio-economic challenges facing the EU,
- Providing a focus for the work on the Future Internet by the organisation of an "Open Future Internet Forum" ,
- Stimulating EU Regions to the development of advanced broadband infrastructures with special attention to the mobile and wireless part through an appropriate use of Structural Funds, national resources and private investment,
- Maintaining and strengthening the network of collaboration and sharing of visions developed under the eMobility SSA.

Building on the strength of the eMobility membership

The partners in the project are founders of the eMobility Technology Platform and are members of the eMobility Steering Board. The project will build on the strength of the eMobility membership (over 500 members), the well know eMobility SRA, the well established and successful eMobility working groups and the active liaisons with national and international programmes established.

AT A GLANCE: EMOBILITY CA
eMobility – Coordination Action

Project Coordinator
Dr. Fiona Williams
Ericsson GmbH Eurolabs
Tel: +49 2407-57 51 03
Fax: +49 2406-57 54 00
Email: fiona.williams@ericsson.com
Project website: www.emobility.eu.org

Partners:
•Ericsson GmbH (DE),
•Alcatel-Lucent Deutschland AG (DE),
•Eurescom (DE),
•France Télécom (FR),
•IST – Technical University of Lisbon (PT),
•Motorola (FR), Nokia (FI),
•Nokia Siemens Networks GmbH & Co. KG (DE),
•Mott MacDonald (UK),
•University of Surrey (UK)

Duration:
Jan. 2008 – Dec. 2009

Total Cost:
€ 1.952 m

EC Contribution:
€ 1.496 m

Contract Number:
INFSO-ICT-241089

Mobile Web 2.0

Accessing the Web from mobile devices is going to be an integrated part of each European citizen's' life. To make the mobile Web a reality for tomorrow, MobiWeb2.0 will develop standards, write guidelines for content authors, enhance validator tools and set up training programs.

Main Objectives

Mobile Web: huge potential but lacking use!

MobiWeb2.0 addresses the usability and interoperability issues that are holding back mobile Web access today. It will focus on mobile Web 2.0 applications based on technologies such as Ajax that can significantly increase the usability of mobile Web applications. MobiWeb2.0 builds on **3GWeb,** an FP6 project which focused on improving traditional browsing on mobile devices.

The project is led by the World Wide Web Consortium, an organization of currently more than 440 members from research and industry headed by **the Web's inventor, Tim Berners-Lee.** MobiWeb2.0 is integrated with **W3C's Mobile Web Initiative** (MWI) which has many European supporters, including Ericsson, France Telecom, Nokia, TIM Italia, Vodafone and Opera. To achieve the overall goal of improving the user experience of mobile Web access and thus tapping the huge potential for increasing mobile Web access, MobiWeb2.0 has the following 5 objectives:

1) **Increase awareness of W3C's Mobile Web Initiative in Europe**
   European actors in the mobile value chain (content providers, content production tool providers, operators, browser vendors, etc.) need to be informed about the goals and results of W3C's Mobile Web Initiative.
2) **Increase number of developers able to develop mobile Web 2.0 content**
   European Web developers need to be capable of creating Web content that works well on mobile devices.
3) **Provide more expensive test suites for Web standards**
   Today's European mobile Web systems contain a range of incompatibilities, often caused by lack of standards conformance. More extensive test suites that cover a higher percentage of Web standards will help increase the level of standards conformance.
4) **Improve the W3C mobileOK validator**
   The W3C mobileOK validator tool developed in 3GWeb needs to be extended to cover newer versions of W3C mobileOK.
5) **Increase number of available tools for creating mobileOK content**
   Content authors need to have access to content production tools that create mobile friendly content. This is particularly true for user generated content. The number of available tools needs to be increased. The approach taken by MobiWeb2.0 is to contribute code to open source content creation tools where needed.

Technical Approach

Each MobiWeb2.0 work package achieves one of the project's scientific and technical objectives. The work plan is structured into 5 work packages (WP):

- **WP1-Outreach** to disseminate the results of W3C's "Mobile Web Initiative" to a European audience of Web developers, software vendors and the press. A particular focus will be outreach to the IST community.
- **WP2-Training** to include the planning and establishment of new training courses that explain how to use currently available and future W3C technology to create Web content that works well on mobile devices.
- **WP3-Quality** Assurance to focus on the development of test cases for mobile software providers. These test suites can be used by implementers of mobile Web platforms to check the standards conformance of their implementations.
- **WP4-Tools** to create mobileOK content and to improve the W3C mobileOK validator tool. The quality of open source content production tools (blogging tools, content management systems, etc.) will be improved by contributions to relevant projects. Moreover, the well received mobileOK validator needs continued maintenance, as well as to evolve as the W3C Mobile Web Best Practices are revised to include these new technologies allowed by the evolution of the devices on the market.
- **WP5-Management** to track regular reporting mechanisms as well as the organization of project reviews and the contact with the Commission and the Project Officer.

Key Issues

There is an enormous potential for growth in mobile Web access in Europe: 1.7 billion mobile phone subscribers in the world own a phone capable of browsing the Web. However, only 200 million of those subscribers actually use their browser, and mobile Web access in Europe is lagging use in other world regions.

If the potential for increasing use of mobile Web access can be realized, it will have a significant impact on the success of European research on the Network of the Future by growing demand for high-speed mobile data traffic. Wired Web access was the key driver in widespread uptake of new network technologies (ISDN, ADSL). Mobile Web access can play the same role for new research results in wireless data networks.

The main remaining challenges that European mobile Web access is facing today are:

- **Lack of usability:** mobile phone users in Europe often find that their favourite Web sites are not as easy to use on their mobile phone as on their desktop device.
- **Lack of interoperability:** European content providers have difficulties providing mobile Web services that work well on all types and configurations of mobile phones.

Solving these issues requires a concerted effort of key players in the mobile production chain, which are all participating in the W3C:

- **Web content production tool vendors** need to support standards in a correct way so that content works independently of the particular handset or browser used by the mobile phone subscriber.
- **Content providers need to follow "best practices"** for mobile content that enable a user friendly mobile Web experience – the content should be conformant to the W3C mobileOK mark.
- **Handset manufacturers** need to ensure that descriptions of the capabilities of their devices such as the screen size are readily available so that content providers can use this information to adapt content to specific devices – information about devices should be available through a device description repository.
- **Browser vendors** need to implement Web standards correctly, so that mobile Web content is displayed consistently in different browsers – the browsers should pass MWI developed test suites.
- **Mobile phone operators** need to encourage use of standards when providing access to mobile content – the W3C mobileOK mark and the MWI test suites are tools for this.

Expected Impact

Contribute to the development of standards for a new generation of ubiquitous and extremely high capacity network and service infrastructures.

Reinforce European industrial leadership in wired and wireless networks, developing stronger synergies between various sector actors and contributing to new business models taking advantage of convergence and interoperability.

Create stronger synergies between various new industrial/ service opportunities in Europe, especially in the field of Internet technologies.

AT A GLANCE: MOBIWEB2.0

Project Coordinator
Dr. Philipp Hoschka
World Wide Web Consortium
Tel: +33 4 92 38 79 84
Fax: +33 4 92 38 78 22
Email: ph@w3.org
Project website: http://www.w3.org/2008/MobiWeb20

Partner:
W3C/ERCIM (FR)

Duration:
1 Jan. 2008 – 31 Dec. 2009

Total Cost:
798 378 €

EC Contribution:
543 928 €

Contract Number:
INFSO-ICT-212430

sISI - Support action to the Integral Satcom Initiative

sISI is a support action intended to stimulate the participation in future Community ICT research of a large number of interested actors through facilitating their involvement into the Integral Satcom Initiative (ISI), the European Technology Platform (ETP) for Satellite Communications

Main Objectives

The ISI present constituency (as of September 2007) is composed by 174 institutions from 27 different countries, comprising Member States (MS), New Member States (NMS), Associated Candidate Countries (ACC), and International Cooperation (INCO) countries. sISI will provide all necessary support to ISI to make it an efficient platform, able to provide plenty of opportunities for all of its participants. **The main objective of sISI is to support the successful revision, implementation and dissemination of the ISI Strategic Research Agenda.**

The objective of sISI is to support the successful implementation of the ISI SRA

The Strategic Research Agenda for ISI is built upon understanding future user needs and necessities and how these are going to be satisfied by satellite communication systems. The ISI SRA focuses on the three fundamental areas of satellite communication: broadband, broadcast, and mobile; for each of these areas within the SRA have been defined ISI key research themes which represent the objectives that the satcom European platform aims at carrying out in order to realize its mission.

More detailed objectives of sISI are as follows:

1. to stimulate the *active involvement of all potential actors and stakeholders into Satcoms related R&D research:*
2. to support the *actions that ISI will undertake with regard to European Union (EU), European Space Agency (ESA) and National Space policies:*
3. to support *ISI operations*
4. to support the actions that ISI will undertake with regards to *standardization* and other *regulatory matters:*
5. to support the actions that ISI will undertake with regards to the *End-Users* of *satellite communications technologies, with particular reference to institutional side but also dealing with the other User categories*
6. to support the actions that ISI will undertake with regards to *technological matters*

Technical Approach

sISI Work Package structure is as follows:
WP1: Support to ISI Policies
WP2: Support to ISI Operations
WP3: Support to ISI Promotion activities
WP4: Support to ISI End-User and Regulatory activities
WP5: Support to ISI Technical activities

Key Issues

Support to ISI European Technology Platform, in particular with regard to European Satellite Communications Strategic Research Agenda

Expected Impact

Satellite Communications are trans-national by nature. This is because the coverage of a satellite goes intrinsically beyond the borders of a single nature, and this requires a common approach to the market, to the regulation, to standardization, and to research. It is a field where European collaboration is more a necessity than simply an opportunity.

It can be said that the development of a common Strategic Research Agenda (SRA) by ISI has already had an initial impact in focusing the plans of a large number of European Players, (including all the large ones) and in prioritising Europe's Research Requirements in the Satcom field. But we cannot rest on these embryonic promising results, because the real concrete achievements are yet to come.

sISI will help ISI to consolidate European efforts, avoid duplication, strengthen European manufacturers, operators and service providers not just in Europe, but in world markets. Most European states undertake some space and Satcom-related research at national level. At the same time it has long been recognised that major projects – because of their cost and risk – can only be successfully implemented through international cooperation

Pictorial view of the scope of the sISI project and of the ISI European Technology Platform

ISI is one of the ETPs in the ICT Domain

European Technology Platforms (ETPs) are new action fora where all stakeholders, led by industry, come together to define research and development priorities on areas of strategic importance for Europe's growth, competitiveness and sustainability. Six ETPs addressing the key area of Information and Communications Technologies (ICT), namely **Artemis, eMobility, ENIAC, ISI, NEM, and NESSI,** are working closely together to address the technological challenges of the Lisbon Agenda, and to contribute jointly to the reflection on the factors which contribute to the successful transition from research to successful innovation.

AT A GLANCE: sISI
Support action to the Integral Satcom Initiative

Project Coordinator
Vincenzo Fogliati
Telespazio
Tel: +39-0640793740
Fax: +39-0640793500
Email: vincenzo.fogliati@telespazio.com
Project website: www.isi-initiative.eu.org

Partners:
•Telespazio (Italy),
•DLR (Germany),
•University of Bologna (Italy),
•Space Hellas (Greece),
•Rose Vision (Spain)

Duration:
36 months

Total Cost:
€ 1.415.359

EC Contribution:
€ 990.043

Contract Number:
INFSO-ICT- 215134

AREA 2

"SERVICE ARCHITECURES"

The Future Internet will be designed to overcome current limitations and to address emerging trends including: mobility, diffusion of heterogeneous nodes and devices, mass digitisation, new forms of user centered content provisioning, emergence of software as a service and of new models of service and interaction with improved security and privacy features.

Technological achievements by 2015

The Internet of Services will support and stimulate creativity, community and commerce. It will feature semantically-enriched services centred on the user. Services will enable the use of the Internet of Things. The Future Internet will lead to demand for innovative services characterised by on-the-move access, personalised cross-media streaming services, "software-as-a-service" and "resource-as-a-service" (RaaS). New revenue models will emerge enabling commercial usage and powerful personal and community spaces. Virtualisation will be used for increasing the efficiency of infrastructure use, extending the scalability of platforms and widespread creation of organizations. Services will increasingly bridge real-virtual life. Issues such as interoperability will be treated like services.

Deployment Scenarios

New alliances between traditional IT, telecom, mobile service providers, media companies, suppliers of consumer electronics, search engine companies and other powerful players will drive the deployment of the Future Internet. They will have to overcome a series of deployment barriers:

- Service platforms will have to enable service discovery, description, composition, negotiation; SLA management framework, QoS; access rights, customer charging; service aggregation platforms will be need to be capable of publishing 3rd party service provider services.
- Service engineering: Methods and tools will be needed to allow faster development and support evolution of better, more affordable services.
- Service Front Ends: High-level, functionality-aware, network-agnostic; exposure of user session state information (provision of session management API); service brokering functions will emerge to allow the seamless blending of services.
- Virtualised service delivery platforms: Virtualisation of service platforms will allow the same service to be developed once and executed on top of different platforms and will need to support service access and delivery environments.
- Service platforms will need to manage opportunities for real-time multimedia.
- SOA-Grid coupling will extend SOA for enterprise, embedded, pervasive and real-time systems and provide technology-independent standards for interoperability.
- End-to-end solutions for instant, context-aware and personalised service creation will be necessary.

Cross domain perspective

- **Scalability:** The increasing scale of the internet brings new challenges in a number of areas. Examples include: modelling, validation and verification of business processes composed on SOA; flexible evolution and execution of business processes; data, process and service mediation; reliable management of composed services; and brokering, aggregation and data management. Quality of software is an important factor in all of these and will become essential to the smooth working of the 'service universe'.
- **Trust:** Creating trusted environments for the new service world will require: i) mechanisms to monitor, display and analyse information flows between nodes participating in complex collaborations in order to detect and assess security risk; and ii) mechanisms to ensure trust and confidence in services created by end-users themselves, i.e. built-in safeguards and guarantees so that others trust the new services. In addition, it is necessary to bring about changes in perception. P2P services today are mainly associated with activities of doubtful legality, such as illegal trading of rights-protected content. Technical and legal mechanisms should be found to bring about changes in attitudes.
- **Interoperability:** This applies at many different levels: i) service interoperability to provide the ability to integrate largely stand-alone services with similar ones and with other services, for instance from the business domain; ii) semantic interoperability, so as to provide the (automated) understanding of the information exchanged and ensure quality of service[1] ; (iii) interoperability of the service layer with network and application layers from different providers.

1 Semantic interoperability is important from a quality of service perspective in order to facilitate composition and middleware support.

- **Alignment** of views, actions and strategy between Telco, media and IT worlds to ensure that European players, existing and emerging, acquire a leading competitive position in future global markets.

Questions one might ask

- What will be in the network and what in the service layer? How will content and media affect be addressed?
- How do we address the likely architectural differences between Telecoms, Media and IT service cultures?
- Is there scope for an open service framework? What are the security and trust implications? How to best address standards issues?
- How will we personalise and contextualise applications for individuals and empower them to compose their own services?
- Do we need to rethink current business processes in light of the upcoming Internet of Things? What are the implications from a service architecture perspective?
- Will this lead to a lowering of the barriers for service development and the repositioning of industrial players or opportunities for new players?

PROJECTS IN THIS AREA

Integrated Projects

Specific targeted research projects

Networks of Excellence

Co-ordination and Support Actions

IRMOS - Interactive Realtime Multimedia Applications Service Oriented Infrastructures

The overriding objective of IRMOS is to enable 'Real-time' interaction between people and applications over a Service Oriented Infrastructure, where processing, storage and networking needs to be combined and delivered with guaranteed levels of service.

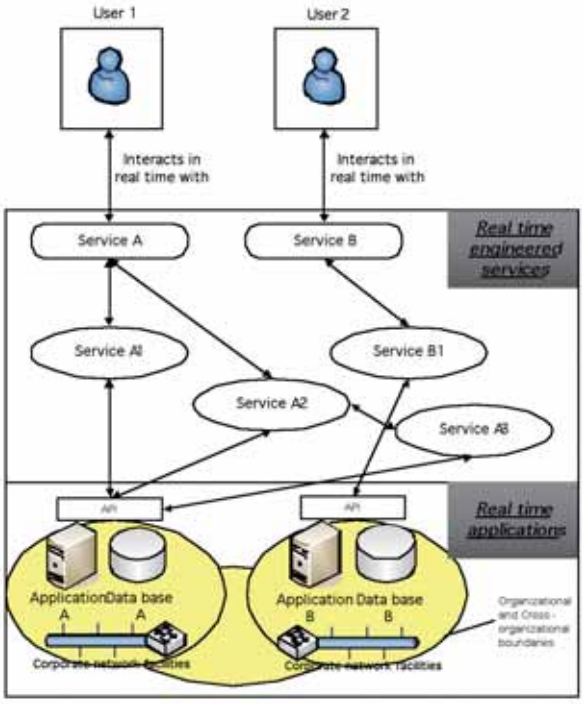
Why IRMOS?

Today's Service Oriented Infrastructures (SOIs) are inadequate for the rapid growth and provision of many interactive real-time applications. Soft real-time applications are traditionally developed without any real-time methodology or run-time support from the infrastructure on which they run. The result is that either expensive and dedicated hardware has to be purchased to ensure good interactivity levels and performance, or that general-purpose resources are used as a compromise (e.g. commodity operating systems and Internet networking) with no way to guarantee or control the behaviour of the application as a result. IRMOS aims to break this mould by enabling "soft real-time" applications to be delivered through value chains that span organisational boundaries by a service oriented infrastructure that enables the real time interaction of a distributed set of people and resources.

What makes IRMOS unique?

IRMOS is set apart from SOI through a set of key features. IRMOS will provide a **Real-time Framework** as a single infrastructure with real-time attributes at all levels (network, processing, storage, application, workflow and business) and provision of **Quality of Service Guarantees.** Furthermore, while this infrastructure is considered to be **Cross-Organisational,** allowing the distribution of interactive real-time applications, it provides at the same time **Inter-organisation Confidence** by giving all participants in inter-organisation value chains the confidence that interactive real-time applications will be delivered in a predictable, reliable and efficient way. The aforementioned framework also allows **Business Processes Automation** by providing services that enable the quick and efficient assembly of businesses without the need for protracted manual negotiations or service provisioning by using the IRMOS services.

The following figure depicts the abstraction of the application functions (mapped in the hardware layer resources, including computing, memory, networking, databases, and other resources), which is the basis for the provision of composite services through a SOA conceptual approach with real-time interactions.



Service oriented approach for real-time applications

Innovations

The following innovations will be contributed by the IRMOS project:

i. Network overlay enabling automated SLA negotiation and monitoring.
ii. An application platform that is QoS aware and able to participate in automated SLA negotiations.
iii. Software tools and associated modeling environments to enable real-time interactive applications to be written to target the IRMOS framework.
iv. An integrated optimisation approach at various levels from inter-organisation business processes and SLAs to intelligent networking and virtualisation techniques.
v. Specific services within SOIs that support applications with real-time attributes.
vi. An intelligent network infrastructure that provides efficiency through autonomous deployment of services.
vii. Specification languages that unify various parameters and characteristics used to describe real-time applications on SOIs, and allow value chain participants to collaborate in the design, deployment and execution of networks of services.

Expected Impact

The expected impact is envisaged to be significant in multiple sectors. More precisely IRMOS will:

i. Advance the business models of real-time applications with the benefits that come from SOAs.
ii. Increase competitiveness of involved players due to low cost implementation and broader market accessibility.
iii. Lower the entry level for SMEs to participate in Virtual Organisations (VOs) in the market of real-time interactive services (such as multimedia processing)
iv. Strengthen efficiency and productivity of organizations by advancing resilience of SOIs.
v. Work on standardization and extend the state of the art with the provision of open APIs to be used in the development of real-time interactive applications.
vi. Provide tools to write software with predictable performance, resilient to the changes of the environment in SOIs.

Demonstrators

Although IRMOS results will be independent from applications, they will be validated through three different application scenarios (demonstrators): *Digital Film Postproduction, Virtual and Augmented Reality and Interactive Real-time eLearning.*

Furthering European Technological Excellence

IRMOS is established by a European level highly motivated consortium with partners providing their area of excellence in the European dimension. This ensures that the project technical results will be of significant value and that the project will receive the maximum possible awareness in the European level.

At a Glance: IRMOS
IRMOS - Interactive Realtime Multimedia Applications on Service Oriented Infrastructures

Project Coordinator:
Eddie Townsend, Xyratex Ltd. (XY), Langstone Road, Havant, PO9 1SA, UK

Technical Coordinator:
Prof. Theodora Varvarigou, Institute of Communication & Computer Systems – National Technical University of Athens (ICCS/NTUA)

Partners from:
•Xyratex (UK),
•Institute of Communication & Computer Systems – National Technical University of Athens (GR),
•Universität Stuttgart (DE),
•Alcatel-Lucent Deutschland AG (DE),
•STIFTELSEN SINTEF (NO),
•Univsersity of Southampton (UK),
•Scuola Superiore Sant'Anna (IT),
•Telefonica I+D (ES),
•Giunti Labs (IT),
•Grass Valley Germany GmbH (DE),
•Deutsche Thomson OHG (DE)

Duration:
36 Months

Total cost:
€12.9M

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
Project website: http://www.irmosproject.eu

NEXOF-RA
Imagine a world...

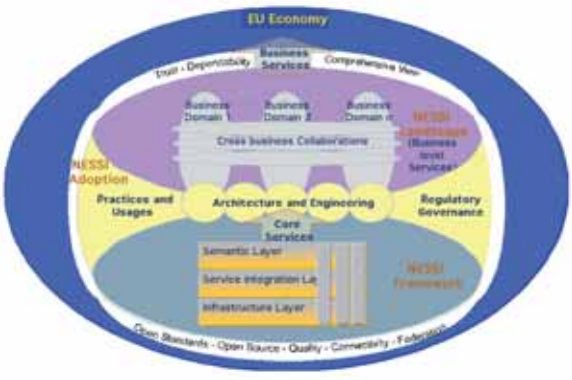
NEXOF-RA aims to build the Reference Architecture for the NESSI Open Service
Framework (NEXOF) leveraging research in the area of service-based systems, to and to consolidate and trigger innovation in service-oriented economies.

NESSI – a shared vision of Services

NESSI is the European Technology Platform launched in September 2005 by industry in support of strategic area of **software and services.** The NESSI community includes leading players from industries, SMEs, Academia and users **sharing the vision** of a common long term strategy of software and services to contribute to Europe's competitiveness, job sustainability and quality of life.
Overall activities of NESSI cover a wide range of areas that include **structuring research, defining and fostering the creation of NEXOF, the NESSI Open Service Framework.**

The Context

The context for NEXOF-RA is the NESSI Holistic Model and the NESSI Open Service Framework (NEXOF). In order to promote and make real the transformation of the European economy to fully employed service economy, NESSI is defined in the context of a holistic approach towards ecosystems in which all the parties involved coexist and which can develop into a new economic model. This holistic model embraces the whole service area and, as depicted in the following picture, puts the NESSI approach and technologies as key elements in the EU economy transformation.



In this context NEXOF is the technological environment that will make all of this happen, as NEXOF is intended to support the whole NESSI model being NEXOF an **integrated, consistent** and **coherent** set of technologies, methods and tools.

NESSI Strategic Projects

In order to implement NEXOF, NESSI launched several Strategic Projects (EzWEB, MASTER, RESERVOIR, SLA@SOI, SOA4ALL) designed to produce complementary results to be integrated in NEXOF. The role of NEXOF-RA is to capture such results and provide directions so that a Reference Architecture can be produced.

NESSI Strategic Impact

NEXOF-RA will than concentrate on the "value added" of building such a comprehensive integrated consistent and coherent Reference Architecture starting from the NESSI Strategic Projects but also incorporating as much as possible existing or emerging relevant results and solutions from other sources. To this end specific approaches, also in terms of project management, have been proposed and will be adopted to guarantee an adequate level of surveying and measuring of the state of the art and methodologies and policy for their integration in NEXOF-RA.
In line with our open approach, all the NEXOF-RA results will be made available to other research, experimental, or commercial initiatives as a reference from which to experiment with new ideas and identify new research gaps.
To assure its wide adoption, NEXOF in general, and the Reference Architecture in particular, will be domain, technology and business size independent. This independence will foster the adoption and usage of NEXOF by the large business as well as the dynamic world of SMEs.

NEXOF-RA Specific Objectives

The aim of the **NEXOF-RA Project** is to deliver:

- *the NEXOF Reference Architecture.*
- *a proof-of-concept;* this will be a set of software artefacts the project team will use to validate the key architectural choices made;
- *the NEXOF Roadmap;* this will define the roadmap for the implementation and adoption of the whole of NEXOF.

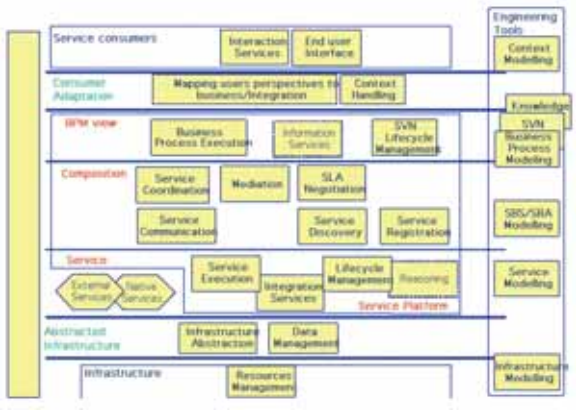
The overall scope of the Reference Architecture is to:

- provide the collection of specifications allowing the implementation of NEXOF;
- provide a common baseline and templates for the whole NESSI Community;
- be produced according to an Open Specification Process based on the concept of "Open Alliances".

The NEXOF Reference Architecture will not be a static specification as it will allow further evolutions as per research results or changes in the state of practice.

NEXOF-RA baseline

The baseline for the overall description of the Reference Architecture is that provided by the NESSI SRA Committee for its SRA Vol. 2 "Strategies to build NESSI". It provides a simple sketched layered functional architecture which, from the point of view of functional layers, can be considered a reference starting point.



NEXOF-RA Open Architecture Specification Process

The objectives of NEXOF-RA include a challenge which requires specific attention: the tension between openness, coordination, and predictability. As an open architecture initiative, NEXOF-RA proposes an open contribution mechanisms which is bound to generate an unpredictable number of contributions of an uneven quality; as a coordinating initiative, NEXOF-RA must work on the schedule and meet the needs of the coordinated work (in particular NESSI Strategic Projects) to deliver established results in a predictable and complete manner.

This process will be refined and amended as necessary during the initial phase of the project, and will be further tuned as necessary thereafter.

This process is not a design by committee process, as it is based on: combination of standards submitted by external parties, consolidated standards, specification proposals submitted by external parties, and proposals developed within the project. This not overriding the principles of coherence, consistence, and evolvability which remain paramount.

This process is open, which means it implements proper channels to consider all contributions which, in turn, should be open; i.e. they shall not include or imply the use of any proprietary components.

At a Glance: NEXOF-RA
NEXOF - Reference Architecture

Projects coordinator
Mr. Stefano De Panfilis
Engineering Ing. Inf. S.p.A
Email: stefano.depanfilis@eng.it

Partners from:
•Italy,
•France,
•Spain,
•UK,
•Israel,
•Ireland,
•Germany,
•The Netherlands

Duration:
March 2007 – February 2009

Total cost:
6,5 m €

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
IST: DG Information Society & Media Software Technologies unit
(cordis.europa.eu/ist/st)
NEXOF-RA: www.nexof-ra.eu
NESSI: www.nessi-europe.eu

RESERVOIR -Resources and Services Virtualization without Barriers

The goal of the RESERVOIR project is to increase the competitiveness of the EU economy by introducing a powerful ICT infrastructure for the reliable and effective delivery of services as utilities. This infrastructure will support the setup and deployment of services on demand, at competitive costs, across disparate administrative domains, while assuring quality of service.

Context

As today's ICT technologies move to Web 2.0, companies supplying Internet-based hosting typically need to over-provision their servers by as much as a 500 percent to handle peak loads. However, over-provisioning is expensive in terms of capital costs, as well as the cost of housing, cooling and supplying electricity to the mainly idle spare machines. Additionally the deployment of a service is an expensive and often very time consuming operation – machines need to be set up with an operating system, configured with network and storage capabilities, and software deployed.

As a result, entrance costs for a service provider are subsequently very steep, which not only serve as a barrier to small and medium sized enterprises, but also result in higher costs to citizens.

RESERVOIR research aims to harness the power of virtualization and grid technologies across administrative domains, to provide a foundation for a cost-competitive service-based online economy where resources and services are transparently and flexibly provisioned and managed like utilities. We are composed of outstanding researchers from both industry and academia across Europe who are supplying the expertise required in a wide range of technical areas to make the RESERVOIR vision a reality.

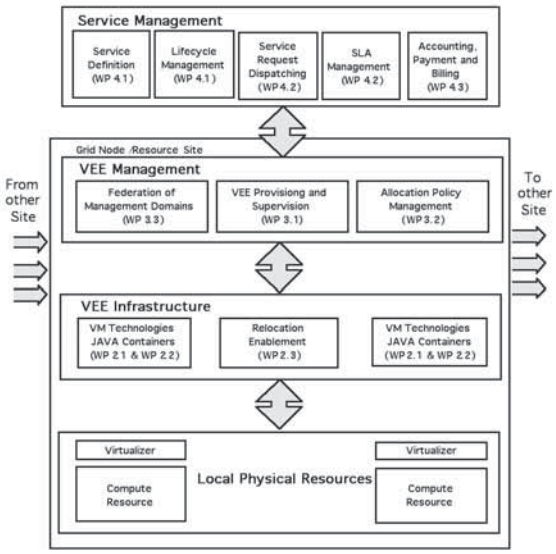
Expected benefits to the European Community

Today, the vision of hosting applications and data off the desktop and on the web, and is being enabled by the emerging "cloud computing" model. These clouds, however, tend to be hosted by large companies with vast resources, such as Amazon, Current technology does not exist to allow smaller service providers to cooperatively provide resources on-demand to compete with these giants, while still guaranteeing security and quality of service to their customers.

RESERVOIR, by merging virtualization, grid and business technologies, plans to provide the means to allow the migration of resources across geographies and administrative domains, maximizing resource exploitation, and minimizing costs to the European citizen.

Expected benefits to the partners

Four of the industrial partners will be analyzing the performance of actual use cases from their core business in the RESERVOIR environment. Not only will this supply feedback to RESERVOIR researchers, but will help guide all partners in the development of their next-generation applications.



The RESERVOIR Architecture

Achieving the RESERVOIR vision

The main goal of RESERVOIR is to supply an architecture and a reference implementation for a service-oriented infrastructure, which will be built on open standards and new technologies to provide a scalable, flexible and dependable framework for delivering services as utilities.

Using virtualization techniques, physical resources across the cloud will essentially be pooled. Users will be allotted a *virtual execution environment* (VEE) such as a virtual machine and storage, without needing to be aware where physical resources are physically located. Research will develop the infrastructure required to support and manipulate these VEEs, such as techniques for allowing relocation of a VEE across sub-network boundaries while retaining connectivity to underlying storage.

A VEE Management Layer will be developed to provide dynamic deployment and re-allocation of VEE's on underlying physical resources, based on quality of service requirements coming from a *Service Level Agreement* (SLA). The VEE Management Layer will provide mechanisms to federate management domains, allowing the management of VEEs across administrative domains, such as multiple service sites.

Finally, a Service Management Layer will provide the interface to requirements from the business world, including support for billing for services used, composition of the definition of the service required, and the monitoring of SLA compliance.

What our partners bring to the project

RESERVOIR partners were chosen based on their track record in virtualization, grid and Service Oriented Infrastructure (SOI) technologies. The following is a list of the major areas of involvement for RESERVOIR partners:

- Project Coordination: IBM
- Development of the Virtual Execution Environment infrastructure: IBM, USI, TID, Thales, CETIC, SAP, UCL, UniMe
- Management of Virtual Execution Environments: UCM, TID, IBM, Sun, SAP, CETIC, UniMe, Umeå, ED, Thales
- Service Management: TID, Umeå, Sun, USI, UCL, Thales, SAP
- Use Cases: SAP, Thales, Sun, TID
- Exploitation and Dissemination: CETIC, IBM, TID, Sun, Umeå, SAP, UCM, OGF, ED, UCL

At a Glance: RESERVOIR
Project Coordinator
Eliot Salant – IBM Haifa Research Lab
salant@il.ibm.com

Partners from:
•IBM Israel – Science and Technology LTD (IBM),
•Telefonica Investigacion y Desarrollo (TID),
•University College of London (UCL),
•Umeå University (Umeå),
•SAP AG (SAP),
•Thales Services SAS (Thales),
•Sun Microsystems CmbH (Sun),
•ElsagDatamat S.p.A (ED),
•Universidad Complutense de Madrid (UCM),
•CETIC asbl (CETIC),
•Universita Della Svizzera italiana (USI),
•Universita degli Studio di Messina (UniMe),
•The European Chapter of the Open Grid Forum (OFG. eeig).

Duration:
3 years

Total cost:
17,317,960 €

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
Web: http://www.reservoir-fp7.eu

SLA@SOI - Empowering the Service Economy with SLA-aware Infrastructures

SLA@SOI is an Integrated Project (IP) researching the systematic management of service-oriented infrastructures on basis of formally specified service level agreements (SLAs). SLA@SOI is a NESSI strategic project realizing one core pillar of the overall NESSI vision.

Motivation

The ongoing transformation of a product-oriented economy towards a service-oriented economy has come to a critical point. IT-supported service provisioning has become of major relevance in all industries and domains. However, the nature of these setups is typically quite static because it requires significant effort to create service offers, to negotiate provisioning details with customers and to manage and control provided services.

Project goal

The research project SLA@SOI will provide a major milestone for the further evolution towards a service-oriented economy, where IT-based services can be flexibly traded as economic good, i.e. under well defined and dependable conditions and with clearly associated costs. Eventually, this will allow for dynamic value networks that can be flexibly instantiated thus driving innovation and competitiveness.

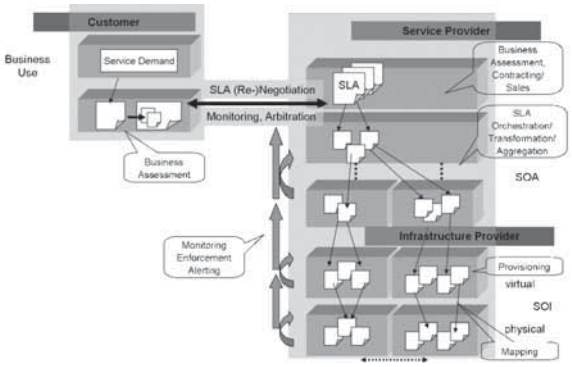
SLA@SOI will provide 3 major benefits to the provisioning of services:

- **Predictability & Dependability:** The quality characteristics of service can be predicted and enforced at run-time.
- **Transparent SLA management:** Service level agreements (SLAs) defining the exact conditions under which services are provided/consumed can be transparently managed across the whole business and IT stack.
- **Automation:** The whole process of negotiating SLAs and provisioning, delivery and monitoring of services will be automated allowing for highly dynamic and scalable service consumption.

Business benefits

Eventually, all the main stakeholders in a service-oriented economy will benefit from the project results:
Software providers will be empowered to produce components with dependable behaviour for arbitrary scenarios. Service providers can offer services (possibly stemming from different software providers) flexibly according to different customer needs but always balancing these with IT capabilities and business strategies. Service aggregators can offer composed services well managed according to IT and business needs. Infrastructure providers are empowered to allocate infrastructure elements exactly according to higher-level customer needs. And last but not least service customers are empowered to precisely specify and negotiation the actual service level according to which they buy a certain service.

The following figure gives a high-level overview of the anticipated SLA-driven process for service provisioning, detailing the SLA management activities across customers, providers and the various layers of a Business/IT stack



Expected results

SLA@SOI will provide its results in 3 complementing ways.
First, an open source based SLA management framework will allow for realizing the benefits of predictability, transparency and automation in an arbitrary service-oriented infrastructure.
Second, in-depth guidance for industrial stakeholders will be given explaining the best practise on how to transform their service business into an SLA-driven one.
Finally, SLA@SOI will provide an open reference case which allows for stakeholders to re-run, re-validate and even modify SLA experiments in the context of a concrete application.

Technical approach

The technical approach of SLA@SOI is to define a holistic view for the management of service level agreements (SLAs) and to implement an SLA management framework that can be easily integrated into a service-oriented infrastructure (SOI). The main innovative features of the project are (1) an automated e-contracting framework, (2) systematic grounding of SLAs from the business level down to the infrastructure, (3) exploitation of virtualization technologies at infrastructure level for SLA enforcement, and (4) advanced engineering methodologies for creation of predictable and manageable services.

Industrial relevance

The research topic of this project is highly relevant for many industry domains. Therefore, the project is based on various

highly relevant but also complementary industrial use cases. These use cases will drive the project in terms of requirements but will also serve for validating project results.
The industrial use cases include scenarios from hosted Enterprise Resource Planning systems, Enterprise IT management, service aggregation in telecommunication, eGovernment and Finance Industries.
Apart from use case specific evaluations the project will also derive an overall industrial assessment which then can be used in arbitrary domains for establishing an SLA-driven business.

Consortium

The consortium of SLA@SOI comprises world-class players in academia and industry representing all the relevant industrial and technical perspectives required for materializing the vision of this ambitious project.

NESSI contributions

The project seeks to contribute its results into the NESSI Open Framework. These include:

- an e-contracting platform between service consumers and providers
- a framework for mapping, planning and coordination within multiple levels in an organizational/IT structure
- access and provisioning layer for SLA-aware infrastructure

At a Glance: SLA@SOI
SLA@SOI is an Integrated Project (IP) researching the systematic management of service-oriented infrastructures on basis of formally specified service level agreements (SLAs).
SLA@SOI is a NESSI strategic project thus realizing one core pillar of the overall NESSI vision.

Projects coordinator:
SAP AG

Partners from:
•Austria,
•Ireland,
•Italy,
•Germany,
•Slovenia,
•Spain
•United Kingdom

Duration:
3 years

Total cost:
15.209.904 €

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
Project Web site: http://www.sla-at-soi.eu

NESSI (Networked European Software & Services Initiative): http://www.nessi-europe.com/

SOA4All - Service Oriented Architectures for All

Computer science is entering a new generation. The emerging generation starts by abstracting from software and sees all resources as services in a service-oriented architecture (SOA). SOA4All will help to realize a Web of billions of services, a world where billions of parties are exposing and consuming services via advanced Web technology.

Still far from a Service Web

In a world of services, it is the service that counts for a customer and not the software or hardware components which implement the service. Service-oriented architectures are rapidly becoming the dominant computing paradigm. However, current SOA solutions are still restricted in their application context to being in-house solutions of companies. A service Web will have billions of services. While service orientation is widely acknowledged for its potential to revolutionize the world of computing by abstracting from the underlying hardware and software layers, its success depends on resolving a number of fundamental challenges that SOA does not address today.

The SOA4All Ambitions

The outcome of the project will be a comprehensive framework and infrastructure that integrates four complimentary and revolutionary technical advances into a coherent and domain independent service delivery platform:

- **Web principles** and technology as the underlying infrastructure for the integration of services at a world wide scale.
- **Web 2.0** as a means to structure human-machine cooperation in an efficient and cost-effective manner.
- **Semantic Web** technology as a means to abstract from syntax to semantics as required for meaningful service discovery.
- **Context management** as a way to process in a machine understandable way user needs that facilitates the customization of existing services for the needs of users.

The cornerstones of SOA4All

Measuring the Impact

The impact of SOA4All will be substantial and broad ranging in terms of new frameworks, new platforms and new infrastructures transforming the Web into a Web of billions of services.

- **Dynamic services at Web scale** – through the application of *Web principles* SOA4All will transform the Web into a domain where billions of services are exposed and consumed in a dynamic, transparent fashion analogous to the document-centric Web today. Scalability is also supported through *semantics* which mechanises core tasks associated with creating service applications, namely, discovery, invocation, mediation and orchestration.

- **Service usability** – the exponential increase in mash-ups clearly indicates that Web 2.0 technologies are orders of magnitude easier to use than standard Web service platforms. By reusing Web 2.0 principles SOA4All will lower the entry barriers to the service world ensuring that the main activities associated with the consumption, production and personali¬zation of services are open to non-IT experts. A consequence of increasing usability is that we gain benefits in terms of productivity and efficiency.

- **Open standard service platform** – the Web, and its success, is founded upon a platform that is non-proprietary and based upon an open set of standards. Following the same approach, SOA4All will ensure a service platform that is truly open on top of existing and new Web standards.

- **Integration of service worlds** - the amalgamation of SOA with the Web utilising a Web 2.0 approach will bring services out from behind the enterprise walls into the mainstream. Additionally, we will integrate machine and human based services blurring their distinctions and enabling them to be used in an interchangeable fashion. This integration here will provide a significant benefit to the key players in the service market including SMEs, large corporations and end users (citizens).

- **Service adaptation to local contexts** – a main contribution of SOA4All will be that of providing mechanisms to support the adaptation of services to a local context. The impact on users will be that the services they use will be aware of the local setting such as the specific device used, the user's geographic location and personal preferences, to name a few.

From R&D to Real Business

In order to maximize the project impact, requirements will be gathered from real world use cases. The deployment of SOA4All within the use case sites will validate our technologies in terms of usability, re-usability, added value, interoperability, scalability and breadth of scope.

In particular, the usefulness of the SOA4All platform will be illustrated through collaboration with leading European enterprises such as British Telecom and SAP aligned with the emergent industry-adoption of IP-based service infrastructures as well as ongoing standardization efforts in the service arena.

At a Glance: SOA4All
Service Oriented Architectures for All (SOA4All), contract number 215219

Project coordinator
Mr. Santi Ristol, Services Area Manager
Atos Research & Innovation, ATOS ORIGIN SAE
santi.ristol@atosorigin.com

Partners from:
•Atos Origin (ES),
•British Telecommunications (UK),
•Open University (UK),
•SAP AG (DE),
•Leopold-Franzens Universitaet Innsbruck (AT),
•CEFRIEL (IT),
•EBM Websourcing SAS (FR),
•Hanival Internet Services (AT),
•IBM Ireland (IR), INRIA (FR),
•ISOCO (ES),
•Sirma (BG),
•TIE (NL),
•TXT (IT),
•Universitaet Karlsruhe (DE),
•University of Manchester (UK),
•Seekda (AT)

Duration:
36 months, starting 2008-03-01

Total cost:
13.648.488, 19 Euro

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
Project Website: http://www.soa4all.eu/

Software & Service Architectures and Infrastructures
European Commission – Information Society and Media DG
Office: BU25 3/134 B-1049 Brussels
Email: infso-st@ec.europa.eu
Tel: +32 2 298 93 02
Fax: +32 2 296 70 18
Webpage: http://cordis.europa.eu/fp7/ict/ssai/

mCIUDAD - A metropolis of ubiquitous services

User-friendly creation tools in the mobile, optimised execution environment, a model for knowledge warehouse, a proposed specific searching engine and a set of business models for users, for service providers and for third parties. This is m:Ciudad's scope.

Service creation on the move, with the mobile device, for mobile users.

Imagine what kind of applications become possible when our mobile devices do not only present data but provide valuable information to other users. Suppose that you are able to create instant services with information, contents and knowledge with your mobile device and in your mobile device. And suppose that this knowledge can be used remotely by other users in a simple way, with their mobile devices. And now, imagine the amount of available knowledge of those services. Millions or perhaps billions of potential sources with valuable information: constantly updated, relevant to our instant interests and still context aware.

m:Ciudad, a service infrastructure

So, what are the required tools to let each user to become a service provider with a mobile device? In which way should the mobile platform behave to make it simple to use and efficient? How to reach this type of distributed, volatile services and their associated knowledge or information? And how to exploit the business opportunities that this new scenario brings about?

m:Ciudad faces and answers these questions providing user-friendly creation tools in the mobile, an optimised execution environment, a model for knowledge warehouse, a proposed specific searching engine and a set of business models for users, for service providers and for third parties, mainly SMEs.
m:Ciudad is a service architecture, a set of mobile tools and a platform to allow users to create focused, knowledge-based mobile micro-services, which are called m:Ciudad U+ Services.

m:Ciudad micro-services, or "U+ services"

U+ services are small, sharply focused applications with their own graphical user interface, which allow users to obtain and provide information –like opinions, recommendation, location or speed– to fellow users. U+ services are fully running on the end-user mobile terminal and they are created and consumed by end users using only also their own mobile terminals, encouraging spontaneous and inspired on-the-go creation. U+ services are shareable and downloadable in order to allow every end user – with a potential for SMEs to act as such– to become a U+ service generator and provider. Therefore, flexible business models are implemented to reward U+ service generators and users who provide valuable information using U+ services.

User Generated Content and the Service Prosumer role of mobile users within m:Ciudad

What is the difference between services and contents? If we see content as a picture, a video or audio clip, a piece of information, we can clearly distinguish content from a U+ service. A U+ service is an application that displays and disseminates knowledge (in any format, including contents) under some rules. Therefore, a single picture is a piece of content; an application that prompts the user to take a picture and disseminates it amongst followers at a given interval is an example of a simple U+ service.

Then, what does the user create in m:Ciudad? The m:Ciudad environment allows users to define and create their own U+ services. This can be done from scratch or by modifying an existing U+ service. Of course, when a user runs a U+ service in his/her mobile terminal, he/she becomes a provider (and receiver) of knowledge (and contents) through that U+ service. In that way, a user also creates knowledge in the m:Ciudad framework.

Some sample U+ services are:

Traffic Jam Killer: users publish their location, time and speed at given intervals during their car trip.

CoolClub: users publish their location, time and a comment on the night club they are at.

My Big Brother: a user publishes personal details like location at a given time, status and some personal contents at rather regular intervals.

Collections and Personal Advertisement: users store collections of things on the move of particular interest.

Innovation vectors

While most of new successful Internet services offer User Generated Content, m:Ciudad proposes an advance beyond that, providing User Generated Knowledge exchange in a mobile environment. The main innovations are:

- A new flexible service description for mobile micro services.

- A new creation and editing method to create new U+ services from the mobile device, encouraging user-generated-services.
- A new point of view for knowledge provision and service creation based on the *prosumer* (producer+consumer) concept.
- A new embedded execution platform for mobile devices, to execute U+ services.
- An optimised searching environment to locate and access relevant services providing relevant knowledge.

At a Glance: m:Ciudad
The final goal of the project is to set up the basis for the engineering of a complete new service infrastructure, a metropolis of true ubiquitous services, with the mobile as a service platform, the "user adds value" paradigm and the "very Long Tail" business model as the three main pillars.

Project coordinator
ROBOTIKER-Tecnalia (E)

Partners from:
•TELEFÓNICA I+D (E),
•ALCATEL-LUCENT (F),
•UNIVERSITY OF SURREY (UK),
•VTT (FI),
•YDREAMS (PT),
•FTW. (A)
•DFKI-IWI (D)

Duration:
36 months (1/12/2007 – 30/11/2010)

Total cost:
4.009.412,00 €

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
www.mciudad-fp7.org
Ms. Maribel Narganes, ROBOTIKER-Tecnalia
+34946002266
info@mciudad-fp7.org

Software & Service Architectures and Infrastructures
European Commission - Information Society and Media DG
Office: BU25 3/134 B-1049 Brussels
Email: infso-st@ec.europa.eu
Tel: +32 2 298 93 02
Fax: +32 2 296 70 18
Webpage: http://cordis.europa.eu/fp7/ict/ssai/

OPEN - Open Pervasive Environments for migratory iNteractive Services

The objective of OPEN is to provide users with migratory interactive services, which enable users to change interaction platform and still continue their tasks through an interface adapted to the new context of use.

Motivations

One important aspect of ubiquitous environments is to provide users with the possibility to freely move about and continue the interaction with the available applications through a variety of interactive devices (including cell phones, PDAs, desktop computers, digital television sets, intelligent watches). Indeed, in such environments one big potential source of frustration is that people have to start their session over again from the beginning at each interaction device change. Migratory interactive services can overcome this limitation and support continuous task performance. This implies that interactive applications be able to follow users and adapt to the changing context of use while preserving their state.

Application Impact

The OPEN project will apply and analyse the middleware solutions developed in example applications from two different domains (business applications and gaming), to demonstrate the feasibility of the approach, the limited effort required of application developers, and its ability to enable new application services. There are many applications that can benefit from migratory interactive services. In general, applications whose tasks require time to carry out (such as games, business applications) or applications that have some rigid deadline and thus need to be completed wherever the user is (e.g.: online auctions). Other applications that can benefit from this flexible reconfiguration support are those that have to provide users with continuous support throughout the day by means of different devices (for example, in the assisted living domain).

Approach

The OPEN project provides integrated solutions able to address three aspects: device change, state persistence and content adaptation. This is obtained through a middleware able to consider and integrate various aspects: adapt and preserve the state of the software application parts dedicated to interacting with end users; support mechanisms for application logic reconfiguration; and identify suitably flexible mechanisms available in the underlying network layers. The resulting middleware is able to interoperate with existing technologies. Thus, OPEN aims to offer an intelligent infrastructure able to: deliver seamless and transparent support to users in carrying out their tasks when changing available devices, even in multi-user interactive applications; provide and coordinate reliable, dynamically changing/reconfiguring services; offer personalised user interaction by exploiting different interaction modalities and network technologies through an infrastructure able to provide the necessary context information (e.g. available devices, connectivity, users and related transformations for content adaptation).

Goals

The main objectives of this project are to:

- Offer seamless and transparent support to users in carrying out their tasks when changing devices as well as changing available services;
- Offer more natural and personalised interaction obtained by exploiting different interaction modalities supporting the mobile user;
- Exploit the wide availability of network technology to offer more reliable services in the context of migration with dynamically changing devices and services;
- Propose a novel infrastructure in order to increase possible services and application scenarios in several contexts (services for citizen, business, games, new interactive and collaborative method in work or educational applications, and so on).

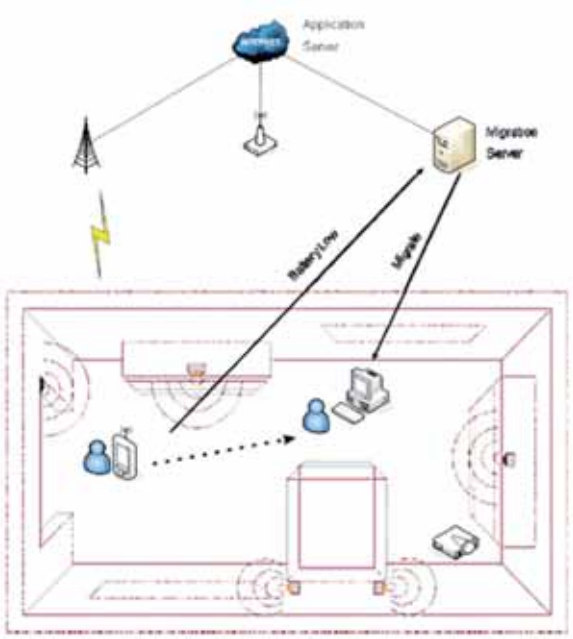


Figure 1 : Example of Migration Environment

At a Glance: OPEN
Open - Open Pervasive Environments for migratory iNteractive Services.

Projects coordinator:
Fabio Paternò
ISTI-CNR
Tel. : +39 0503153066
Email : fabio.paterno@isti.cnr.it

Partners:
•CNR-ISTI (Italy),
•Aalborg University (Denmark),
•Arcadia Design (Italy),
•NEC (United Kingdom),
•SAP AG(Germany),
•Vodafone Omnitel NV (Italy),
•Clausthal University of Technology (Germany).

Duration:
30 Months – February, 2008 – March, 2010

Total cost:
4.5 MEuro (with 2.8 MEuro EC Contribution)

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
Project website : www.ict-open.eu

Software & Service Architectures and Infrastructures
European Commission - Information Society and Media DG
Office: BU25 3/134 B-1049 Brussels
Email: infso-st@ec.europa.eu
Tel: +32 2 298 93 02
Fax: +32 2 296 70 18
Webpage: http://cordis.europa.eu/fp7/ict/ssai/

ICT PERSIST Personal Self-Improving SmarT spaces

The vision of PERSIST is of a Personal Smart Space, which is associated with the portable devices carried by the user and which moves around with him/her, providing context-aware pervasiveness to the user at all times and places. The Personal Smart Space will cater for the needs of users, adapting to their preferences and learning new ones as these arise.

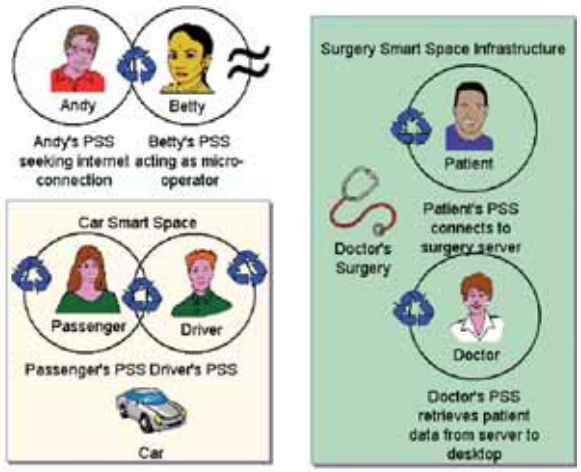
PERSIST Objectives:

The primary objective of PERSIST is to implement a user-centric smart space, the Personal Smart Space, that provides a minimum set of functionalities which can be extended and enhanced as the user encounters other smart spaces.

Personal Smart Spaces are:

Based on a personal area networks constructed from a variety of networked components which might range from mobile or wearable devices to smart dust. Personal Smart Spaces will be able to provide limited pervasiveness and context awareness at any time and anywhere. Their ability to inter-operate with other smart spaces will permit Personal Smart Spaces to automatically adapt environments to satisfy user preferences, to resolve conflicts and to facilitate a migration from smart places to smart regions.

Personal Smart Spaces can…



Share information and services in an ad-hoc fashion - The possibilities range from simple business card exchanges to accessing the context sources of others, such as GPS information, to disaster management scenarios.

Personalise the configuration of fixed smart spaces - The PSS of the driver of a rental car can be used to personalise the ergonomics of the car, pro-actively adjusting the seat and steering wheel, for instance. Personal preferences for climate control can also be made available to the car's smart space.

Link into pervasive infrastructures - A patient might have a PSS which incorporates sensors which capture his vital signs and logs them. Upon entering the doctor's surgery this data can be uploaded to the surgery infrastructure and appended to his medical record which can be accessed by the doctor's personalised PSS graphical interface.

Generate new business models - Consider a not uncommon situation at a bus stop. Andy approaches the bus stop and would like to connect to the Internet to discover when the next bus is due but he has no connectivity. Meanwhile, Betty, another passenger waiting for the bus, is accessing the Internet via her UMTS connection. Betty's PSS automatically offers to act as a broker between Andy and her Internet service provider. She becomes a micro-operator for Internet service provision.

Why PERSIST? - Key Innovations

Grouping and Sharing – When personal smart spaces overlap it will be necessary to reconcile the preferences of more than one user. Sharing of context information between users also becomes possible. Balancing the allocation of resources amongst multiple users is a further requirement, as well as adapting the behaviour of shared resources to maximise the overall utility perceived by the concurrent users.

User Intent – In order to properly personalise a pervasive environment it is necessary to know what a user is trying to achieve. User goals can be inferred from the past actions of themselves and those of other users.

Recommender Systems – When a user wishes to use a service of a particular type, recommender systems can suggest a particular service based on the previous choices of that user and other users.

Learning and Reasoning – Automatic learning of preferences by the system presents an opportunity to obtain accurate preference data without the user having to enter it manually. To fully exploit the benefits of context awareness we use the concepts of soft context and location estimation to infer higher level context and continuously precise location from low level context sources and sensors.

Pro-active Behaviour – It should be possible to respond automatically to situations that arise affecting the user in various ways. Pro-activity involves the system taking action on behalf of the user in situations where the user has given prior consent.

Why PERSIST? - Expected Impact

PERSIST will provide an open and extensible architecture to enable SMEs to use and augment smart spaces. PERSIST will explore the potential for new business models based on PSSs

whose scale is likely to prove attractive to SMEs. With the decreasing number of borders inside Europe, Smart Spaces will be used throughout Europe and other regions of the world. Interoperability is the key for worldwide usefulness of this technology.

PERSIST will impact on dynamic service creation by promoting standards around the PERSIST software stack. Adoption of these standards will facilitate the evolution of services through open and agreed interfaces. The creation of these standards can only happen through collaborative research and the FP7 programme is central to this objective.

PERSIST will also allow for the creation of new networked services profitable for SW providers, service/content providers, manufacturers and operators. In particular SMEs will benefit from the PERSIST approach as it would require minimal effort market the PERSIST middleware as an innovative SW product in the PerCom area.

PERSIST consortium

The PERSIST consortium has been selected for the diverse and complementary expertise and skills that the partners collectively bring into the project. The consortium has a strong balance between Research/Academic (5) and Industrial (5) partners, all of which have specific knowledge and experience relevant to the project's objectives. The consortium has significant experience in pervasive computing systems, machine learning and reasoning, and all areas specified in the Key Innovations section. The PERSIST industrial partners will exploit the project results to create new business opportunities in the area of pervasive computing, and will enrich their internal core skills in the area of smart spaces (offices, homes, etc).

At a Glance: ICT PERSIST
ICT PERSIST – PERsonal Self-Improving SmarT Spaces

Project coordinator:
Kevin Doolin (kdoolin@tssg.org)
Telecommunications Software and Systems Group, Waterford Institute of Technology (www.tssg.org)

Partners from:
- Telecommunications Software and Systems Group, Waterford Institute of Technology (Ireland)
- German Aerospace Center – DLR (Germany)
- Heriot-Watt University (United Kingdom)
- Security Technology Competence Centre (Slovenia)
- Institute of Communication and Computer Systems (Greece)
- LAKE Communications (Ireland)
- Soluta.net (Italy)
- Europäisches Microsoft Innovations Center GmbH (Germany)
- Telecom Italia (Italy)
- INTEL (Ireland)

Duration:
30 months

Total cost:
€5.6m (€3.6m funded)

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

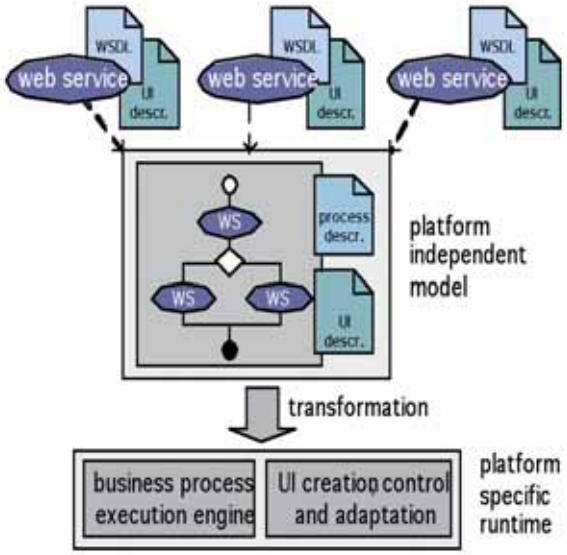
Further information:
www.ict-persist.eu

SERVFACE - Service Annotations for User Interface Composition

The project ServFace will extend service-oriented architecture concepts with an integrated approach of user interface description and development by introducing the notion of a correspondent user interface for services.

Motivation

Service-oriented Architectures are tailored and used for business applications across several enterprises. Services provide access to business data and allow managing business workflows. They flexibly integrate functionality across platforms and providers by using web service technology. However, services are not directly used by end users. User interfaces together with complex control logic must be developed as an additional layer on top of services. This development step is only insufficiently supported by methodologies and tools. Instead, user interfaces are designed



manually for service interfaces and business processes.

Relevance to the ICT Work programme 2007-2008

ServFace is targeted at extending service infrastructures to make services and business processes accessible to humans, extending the service-oriented concepts to business process with human interaction involvement and B2C scenarios. This will be a significant contribution to create an innovative service infrastructure enabling the development of services and corresponding user interfaces as autonomous, self-contained pieces of software. Especially SMEs can profit from this service infrastructure since it will be easy to create new value added services and offer them as pieces of business processes especially targeted to end users in a global environment.

Approach and Objectives

The project aims at creating a model-driven service engineering methodology for an integrated development process for service-based applications. ServFace will look at this process from two different perspectives: First, the development of services with corresponding user interface descriptions, and, second, the development of user interfaces for a composition of services. Thus, the development paradigm of service-orientation currently adopted to system functionality will be extended to user interfaces.

Objective 1 – Service Engineering Methodology
The objective of ServFace is to design a methodology enabling the development of interactive applications involving the creation of services and correspondent user interfaces, the composition of services to abstract business processes with consideration of user interface composition, and the mapping of abstract processes to concrete runtime platforms.
Objective 2 – Model-driven development approach
Platform-independent models are foreseen to describe services, the correspondent user interfaces or hints for their dynamic generation and business processes composed out of services together with composed user interfaces. Using appropriate transformations, abstract service definitions and compositions will be mapped to various technological platforms.

Objective 3 – Adaptive user interfaces and user interface composition
From the perspective of user interfaces ServFace will adopt concepts and technologies developed in the area of user interfaces design, generic user interface description languages, composition and model-driven development of user interfaces. In ServFace platform-independence, device-independence, context-ware creation, adaptation and multimodality will be key technologies to create usable user interfaces in service-oriented settings.

Objective 4 – Runtime platform and Web service technology standard extensions
The technological basis of ServFace will be web service standards which we see as the base for service-oriented approaches. Advances in web service technologies will be achieved regarding to the semantic description of service functionality, service operations and operation parameters, and the integration of user interface descriptions in existing standards. An appropriate runtime platform will be developed and implemented supporting the technological extensions for interactive and adaptive services.

Objective 5 – Integrated development environment
An integrated tool environment will be created to support all development phases of interactive service-oriented applications. This comprises authoring tools for service development and user interface definition. In the next step transformations will be supported to map abstract models to concrete runtime platforms.

Project Partners

- **SAP** coordinates the project and brings in strong experience with e-business solutions.
- **Technische Universität Dresden** brings in long term experiences in adaptive platforms, user interfaces and applications.
- **Lyria** brings in strong experience with software for rapid development of human-machine interfaces.
- **Consiglio Nazionale delle Ricerche** brings in long experience in methods and tools for model-based user interfaces design.
- **University of Manchester** brings in experience with formative user research and interaction design.

At a Glance: ServFace
The project ServFace will extend service-oriented architecture concepts with an integrated approach of user interface description and development by introducing the notion of a correspondent user interface for services.

Projects coordinator:
SAP AG, Germany

Partners from:
•Technische Universität Dresden, Germany
•Consiglio Nazionale delle Ricerche, Italy
•Lyria, France
•University of Manchester, UK

Duration:
30 month (02/2008 – 08/2010)

Total cost:
4.078.175 EUR

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
Project website: http://www.servface.org/

Software & Service Architectures and Infrastructures
European Commission - Information Society and Media DG
Office: BU25 3/134 B-1049 Brussels
Email: infso-st@ec.europa.eu
Tel: +32 2 298 93 02
Fax: +32 2 296 70 18
Webpage: http://cordis.europa.eu/fp7/ict/ssai/

SHAPE - Semantically-enabled Heterogeneous service Architecture and Platforms Engineering

The objective of the SHAPE project is to provide a powerful environment and standard for service modeling, to support the specification and realization of enterprise systems based on a Semantically-enabled Heterogeneous service Architecture (SHA). SHAPE will provide an open source implementation of the UPMS service modeling standard from OMG, with extensions for SHA.

Project objective

The main objective of SHAPE is to provide a powerful environment for service modelling. This includes a tool supported methodology for designing and implementing flexible business models and parameterised services on a Semantically-enabled Heterogeneous service Architecture (SHA). It will be based on a model-driven engineering (MDE) approach and the UPMS (UML Profile and Metamodel for Services) OMG standard.

SHA – Semantically-enabled Heterogeneous service Architecture

SHA extends SOA (Service-oriented Architecture) with semantics and support for heterogeneous architectural styles, including Web Services, Agents, SESA (Semantically-enabled Service Architectures), ERP services, P2P, Grid and Components, under a unified service-oriented approach, to form a new and better basis for meeting the business requirements of enterprise wide systems.

UPMS – UML Profile and Metamodel for Services

The SHAPE project is actively involved in the standardisation of UPMS in OMG (Object Management Group) and will provide an open source implementation of the UPMS standard made available through the Eclipse platform.

SHAPE AND UPMSHA

The SHAPE project will provide MDE tools and -platform for SHA systems, based on UPMS (UML Profile and Metamodel for Services) and the UPMSHA (UML Profile and Metamodel for Semantically-enabled Heterogeneous service Architectures) that will be extended from that.

REFERENCE MODELS FOR SOA AND SHA

The OASIS standard reference model for SOA will be extended with concepts to include the technologies included in SHA.

FLEXIBLE BUSINESS MODELS

SHAPE embraces the modelling of business aspects (processes, services etc) as a constituent part of the MDE approach, allowing for changing the models of the business and having SHAPE support development of a new or changed system to support the new business model.

SEMANTIC WEB SERVICES AND SESA

An initial focus on web services and JEE will be extended with support for semantic web services, based on WSMO (Web Services Modelling Ontology) and the concept of SESA –
(Semantically-enabled Service Architectures) – that also will be related to the other metamodels and technologies.

SERVICE VARIABILITY

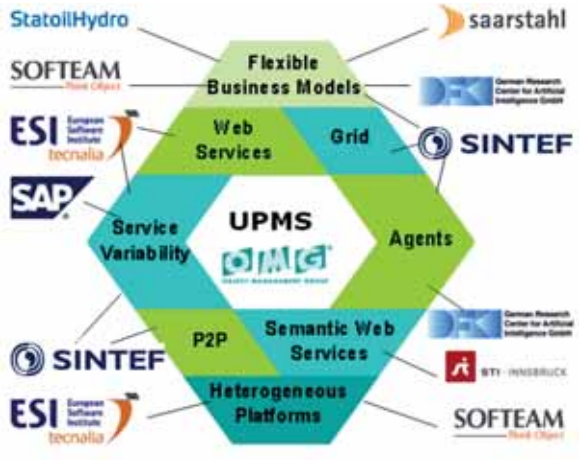
In SHAPE we aim to refine existing concepts and techniques for variability and extensibility to support the development of service-oriented architectures. In particular, we will investigate how existing concepts can be applied to services and service interfaces.

AGENT, P2P AND GRID TECHNOLOGIES

SHAPE will define metamodels for Agent, P2P Components, ERP services, and Grid technologies, and provide transformations from UPMS and UPMSHA to these realisations technologies.

METAMODELS AND METHODOLOGY FOR SOA AND SHA

The SHAPE project will provide open source models for the emerging UPMS standard for SOA service modelling, and extensions to this for SHA. The use of these will be supported with a methodology for SOA and SHA.



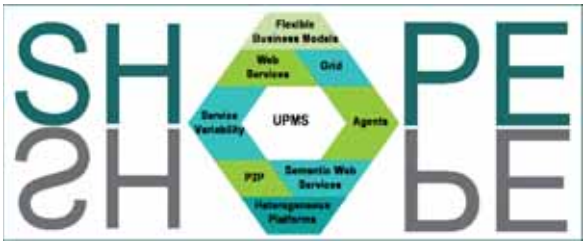
MDE TOOLSET FOR SOA AND SHA

The MDE (Model Driven Engineering) toolset will be based on the baseline from the MODELPLEX IST project and the Eclipse environment. It will include editors based on the metamodels and transformations from business models through UPMS to the various technologies.

TWO INDUSTRIAL PILOTS

The SHAPE project will derive user requirements and validate results on two industrial user pilots. One pilot is in the Oil&Gas sector by StatoilHydro and one pilot is in the Steelindustry sector by Saarstahl.

The SHAPE project will promote a new development paradigm with a higher degree of involvement of joint user and development communities through minimising the gap between business and system modelling, in particular by lifting the system specification models to a higher platform independent level.



At a Glance: SHAPE
SHAPE - Semantically-enabled Heterogeneous service Architecture and Platforms Engineering

Project coordinator:
Dr. Arne-Jørgen Berre
SINTEF
Forskningsveien 1, Blindern
0314 OSLO, NORWAY
e.mail: Arne.J.Berre@sintef.no
Phone : +47 22067452

Partners from:
- SINTEF, StatoilHydro
- SAP, DFKI, Saarstahl
- Softeam
- University of Innsbruck (STI Innsbruck)
- ESI-TECNALIA

Duration:
30 months from 1.12.07

Total cost:
5.7 M Euro

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
www.shape-project.eu

Software & Service Architectures and Infrastructures
European Commission - Information Society and Media DG
Office: BU25 3/134 B-1049 Brussels
Email: infso-st@ec.europa.eu
Tel: +32 2 298 93 02
Fax: +32 2 296 70 18
Webpage: http://cordis.europa.eu/fp7/ict/ssai/

S-CUBE - The Software Services and Systems Network

S-Cube, the Software Services and Systems Network, will establish an integrated, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, thereby helping shape the software-service based Internet which is the backbone of our future interactive society.

Motivation

An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address the following key problems:

- *Research fragmentation:* Current research activities are fragmented and each research community (e.g., grid computing or software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result the proposed solutions are not aligned with or influenced by activities in related research fields.

- *Future Challenges:* One challenge, as an example, is to build service-based systems in such a way that they can self-adapt while guaranteeing the expected level of service quality. Such an adaptation can be required due to changes in a system's environment or in response to predicted and unpredicted problems.

Expected Impact

S-Cube will pursue the following objectives which will have a long-lasting impact on European research:

- *Re-aligning, re-shaping and integrating research agendas of key European players from diverse research areas.* By synthesizing and integrating diversified knowledge, a long-lasting foundation for steering research and for achieving innovation at the highest level will be achieved.

- *Inaugurating a Europe-wide common program of education and training for researchers and industry.* This will create a common culture that will have a profound impact on the future of the field.

- *Establishing a pro-active mobility plan to enable cross-fertilisation,* which will foster the integration of research communities and the establishment of a common software services research culture.

- *Establishing trust relationships with industry.* Via European Technology Platforms (specifically NESSI) a catalytic effect in shaping European research, strengthening industrial competitiveness and addressing main societal challenges will be accomplished.

- *Defining a broader research vision and perspective.* This will shape the software-service based Internet of the future and will accelerate economic growth and improve the living conditions of European citizens.

Technical Approach

To reach the above objectives, S-Cube brings together over 70 researchers and over 50 Ph.D. students from 15 institutions, which jointly carry out the following three types of activities:

- *Integration Activities:* Integration activities tackle fragmentation and isolation of research by different means: First, a knowledge model will be developed that captures terminology and competences of S-Cube partners and their research. This will support eliminating the duplication of research efforts, better adjusting research activities of beneficiary institutions and restructuring already existing research agendas. Further, a Pan-European Distributed Service Laboratory will be established as a high-quality research infrastructure to provide access to state-of-the-art collaboration facilities. Finally, by providing a diverse and vigorous program of education, training and specialist courses for researchers as well as an intensive mobility plan within the network, a cross-fertilisation of knowledge and durable research integration will be achieved.

- *Joint Research Activities:* Work in S-Cube will be guided by the S-Cube research framework (see Figure 1), which clearly distinguishes between principles and methods for engineering and adapting service-based systems and the technology which is used to realize those systems while taking into account cross-cutting issues like Quality of Service (QoS) and SLA compliance.

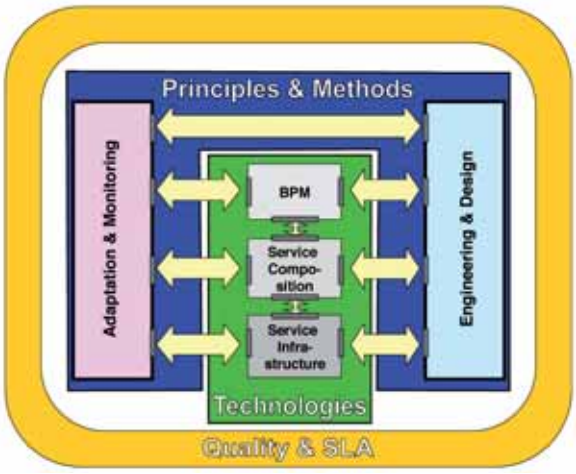


Fig. 1: S-Cube's Research Framework

- *Spreading of Excellence Activity:* This activity will ensure a broad dissemination of research results, stimulate industrial and commercial interest, and enhance the public visibility of the research conducted within the network. This includes – besides other means – the S-Cube Web Portal, the organisation of international conferences and specialised workshops and summer schools, as well as a European Ph.D. programme.

Openness

S-Cube invites organizations, research groups or researchers to join S-Cube as *associate partners* on the basis of the identified research gaps. Associate partners will be paid travel and subsistence. They will gain access to S-Cube internal information and may participate in S-Cube meetings. The admission process will be published on the S-Cube Web Portal.

At a Glance: S-Cube
Network of Excellence

Project coordination:
Prof. Dr. Klaus Pohl (Project Coordinator)
University of Duisburg-Essen, Germany

Prof. Dr. Mike Papazoglou (Scientific Director)
Tilburg University, The Netherlands

Partners:
•Univ. of Duisburg-Essen (DE),
•Tilburg Univ. (NL),
•City Univ. London (UK),
•CNR (IT),
•FBK (IT),
•INRIA (FR),
•Lero (IE),
•PJIIT (PL),
•Politecnico di Milano (IT),
•MTA SZTAKI (HU),
•Vienna Univ. of Technology (AT),
•Univ. Claude Bernard Lyon (FR),
•Univ. of Crete (GR),
•Univ. Politécnica de Madrid (ES),
•Univ. of Stuttgart (DE)

Duration:
01.03.2008 – 29.02.2012

Total cost:
€ 11 million

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
Email: contact@s-cube-network.eu
Tel: +49 201 183 4660
Fax: +49 201 183 4699
Webpage: http://www.s-cube-network.eu

NESSI-2010 - Networked European Software & Services Initiative 2010 support action

NESSI 2010 is a support action whose ambition is to sustain the momentum of the NESSI European Technology Platform dedicated to software and services, a community which, today, represents 300 members, a 1.7 Million strong workforce and 490 B€ annual revenues.

NESSI- a shared vision of Services

NESSI is the European Technology Platform, launched in September 2005 by industry in support of the strategic area of software and services. The NESSI community includes leading players from industries, SMEs, Academia and users **sharing the vision** of a common long term strategy on **software and services** to contribute to Europe's competitiveness, job sustainability and quality of life.
The overall activities of NESSI cover a wide range of areas, **structuring research, building links to coordinate to national and international programmes, defining and fostering the creation of NEXOF, the open service framework.**

NESSI's General Assembly 2007 – 290 attendees from 170 organisations

Since the launch of NESSI, these activities have been supported by the 22 NESSI partners, by two FP6 support actions NESSI-Soft and NESSI-Grid.

Collectively, this financial support from industry and the European Commission enabled **NESSI to achieve impressive results** over the first 2 years of its existence, establishing an **open model for participation** in NESSI, gathering membership from more than 150 organisations over 2006-2007 to reach **300 members,** defining its Strategic Research Agenda, creating a research structure to foster contributions by all, supporting the creation of 10 NESSI Working Groups which represent the heart of NESSI activities.

NEXOF –NESSI open service framework

The main output from NESSI is NEXOF, the **Open Service Framework.**
NEXOF's ambition is to deliver a **coherent and consistent** open service framework, ranging from the infrastructure up to the interfaces with the end users, leveraging research in the area of service-based systems to consolidate and trigger innovation in service-oriented economies for the benefit of the whole European Economy.

NESSI-2010 contributing to NESSI

To achieve its goals, NESSI has and will continue to be supported by all its partners and members, with direct financial support provided by the industrial partners and human resources provided by all.

In this context, NESSI-2010 contributes to NESSI focusing on five specific activities, operated by a subset of partners namely Atos Origin, Engineering, Thales and TIE to the benefit of all.

The five directions of support of NESSI-2010 include:

- **Supporting NESSI Strategy formulation and implementation,** in building a Global Strategic Plan which will encompass all NESSI objectives and ensuring its implementation in the areas of communication and dissemination, interlinking with national and international initiatives and liaising with SMEs

- **Supporting the SME Community effort,** in agreement with the SME Strategy paper that has been approved by NESSI in January 2007 and has led to the launch of the SME Working Group

- **Supporting the interlinking activities** specifically oriented towards **coordination** with national and international research programmes

- **Supporting the continued awareness** and participation building activity with the organisation of NESSI events, the support for participation to selected external events, the operation and evolution of the NESSI Web site, the provision of collaborative tools to facilitate NESSI working group activities

- **Supporting the labour resources of the NESSI Office,** in particular linked to membership management & support

and information and collaborative tools towards existing and new stakeholders

NESSI-2010 – Maximising the Impact

NESSI 2010 is a support action structured to have an impact in terms of:

- Scope: its activities are positioned to the benefit of all **stakeholders** who are or will be involved in a service oriented model reaching out far beyond the active NESSI members

- **Effectiveness:** NESSI 2010 is about supporting the **momentum of an existing and growing community,** through meetings and selected activities in an overall context that is wider, operating and ambitious, with identified goals of structuring research, supporting the delivery of the NESSI Open Service Framework, coordinating to national and international programmes, actively involving SMEs.

At a Glance: NESSI-2010
NESSI 2010 is a support action designed to contribute to the NESSI Software and Services Technology Platform by coordinating with national and international research programmes, supporting the activities of the NESSI SME Working Group and participating to the overall NESSI evolution through its governance bodies, the Board and Steering Committee.

Coordinator :
Nicolas Evain - Thales
nicolas.evain@thalesgroup.com

Partners from:
- Thales (France)
- Engineering Ingegneria Informatica (Italy)
- Atos Origin (Spain)
- TIE (Netherlands)

Duration:
24 Months: 04/2008 – 03/2010

Total cost:
986,000 €

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
- *Coordinator: nicolas.evain@thalesgroup.com*
- *NESSI Office: office@nessi-europe.eu*
- *www.nessi-europe.eu*

Software & Service Architectures and Infrastructures
European Commission -
Information Society and Media DG
Office: BU25 3/134 B-1049 Brussels
Email: infso-st@ec.europa.eu
Tel: +32 2 298 93 02
Fax: +32 2 296 70 18
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SERVICE Web 3.0

"After four decades of rapid advances in computing, we are embarking on the greatest leap forward in computing, one that includes revolutionary changes at all levels of computing from the hardware through the middleware and infrastructure to applications and, more importantly, in intelligence".

Towards a Service Web…

Even after four decades of rapid advances, computing is currently subject to revolutionary changes at all levels, including hardware, middleware, network infrastructure, but more importantly intelligent applications. Emerging technologies such as the Semantic Web or Web services transform the Internet from a network of information to a network of knowledge and services. The number of services which will be offered on the Internet is expected to rise dramatically in the next few years.

Paving the way…

It is the mission of Service Web 3.0 to address these emerging developments and contribute to the implementation of framework programs and their projects, and support the preparation of future community research and technological development. The focus of Service Web 3.0 will be to:

- Create, maintain, and publish roadmaps for scientific or business audiences as a means to plan and coordinate framework and community activities for a future service world.
- Support standardization activities for semantic service descriptions.
- Organize different types of events ranging from scientific conferences to industry-oriented tutorials on topics related to semantic computing.
- Provide information material such as white papers, feasibility studies, showcases and promotional movies to disseminate semantic technologies to the industry. This will introduce new business models and systematically facilitate Semantic Web services and Semantic Web technology adoption, in particular for SMEs.
- Set-up dedicated cross-project clusters focusing on Semantic Web services and Semantically-enabled Service-oriented Architectures, and exploit synergies.

Service Web 3.0 will pave the way to realize a world where billions of parties are exposing and consuming services via advanced Web technology and semantics.

© STI International

Scientific and technological objectives

The objectives of this support action are threefold:

- Installing roadmapping facilities in order to depict visions, future research, and its applicability. We will develop a public roadmap on semantic technologies as a result of a community-driven process.
- Transferring technology and know-how for dissemination of semantic technology. We will publish the results of our work and the associated coordinated efforts in the form of a roadmap book and will create further promotional materials such as a movie on the next generation of the Internet through the usage of semantic technologies.
- Building and supporting clusters and networks for increased visibility of the achievements in the domain. We will actively contribute to the Future of the Internet initiative and will install further cross-project working groups within STI International which will operate according to pre-defined procedures and will benefit from the technological communication infrastructure of the organization.

Thematically, activities within the project Service Web 3.0 are focused around the integration of three mainstream technologies: Web, Service-oriented Architectures and Web 2.0, and their extension into semantics as a means to achieve interoperability and scalability.

Realizing the objectives

The support action brings together three academic partners and the international organization STI International. The three academic partners are all founding members of STI International. STI International is a mature association of interested scientific, industrial and governmental parties sharing a common R&D objective: to establish semantics and semantic technologies as an integral part of modern

computer engineering. To do so, STI coordinates and actively contributes to major research and education activities in Europe and promotes greater awareness and faster take-up of semantic technology in full synergy with these activities. Service Web 3.0 will especially profit from the network that STI International brings in and the links to all relevant experts in the scientific and technology areas of the project.

Our activities at roadmapping, standardization and dissemination level will be aligned with the newly founded Future of the Internet initiative. Furthermore, we will play an active role in ensuring the sustainability of major scientific and industry-oriented series of events in the fields of semantic computing (E/A/ISWC, ESTC).

At a Glance: Service Web 3.0

Project:
Service Web 3.0
Contract number 216937

Projects coordinator:
University Innsbruck, Austria
Dr. Elena Simperl
elena.simperl@sti2.at

Partners from:
•Open University (OU), UK
•Akademia Ekonomiczna w Poznaniu (PUE), PL
•Semantic Technology Institute International (STI), AT

Duration:
24 months: January 2008 to December 2010

Total cost:
€ 721,273

Programme:
FP7 Objective ICT-2007.1.2: Service and Software Architectures, Infrastructures and Engineering

Further information:
www.serviceweb30.eu

Software & Service Architectures and Infrastructures
European Commission – Information Society and Media DG
Office: BU25 3/134 B-1049 Brussels
Email: infso-st@ec.europa.eu
Tel: +32 2 298 93 02
Fax: +32 2 296 70 18
Webpage: http://cordis.europa.eu/fp7/ict/ssai/

AREA 3
"NETWORKED MEDIA SYSTEMS"

Technological achievements by 2015

The Internet of 3D Media will not only radically change the entertainment industry but also is expected to stimulate and enhance creativity, professional productivity and community relations. User-generated/centric content as well as community networks and the use of peer-to-peer systems are expected to generate new business opportunities. In this context, the interaction with content combined with interactive search capabilities across distributed repositories and P2P (also mobile) networks and the dynamic adaptation to characteristics of multiple terminals are expected to contribute towards such a vision. Advances in 3D processing will give rise to innovative applications such as massive multiplayer mobile games and in virtual worlds placing new types of traffic demands and constraints on network architectures. These environments coupled with their usage rules hold the promise of a "3D Media Internet" forming the basis of future networked and collaborative platforms in the residential and professional domains (including creation, delivery and rendering), in virtual/gaming applications, and in digital and electronic cinema.

Deployment Scenarios

New alliances between traditional IT, telecom, mobile service providers, media companies, suppliers of consumer electronics, search engine companies and other powerful players will drive the deployment of the Future Internet. They will have to overcome a series of deployment barriers:

- 3D collaborative platforms create new requirements in terms of information representation, filtering, aggregation and networking.
- Increasing demand towards more sophisticated search tools, including tools for media professionals.
- Identity management, ownership and trading of virtual digital objects, right of use, and personalised advertisements.
- Media-to-network dynamic adaptation and use of network aware video coding techniques improving video quality beyond High Definition TV (HDTV) towards 3D and Ultra HDTV.
- New viewing methods and in general consumption of both professional and entertainment multimedia content depends on the availability of high quality content and ubiquitous network access.
- Real-time multi-party network sessions supporting virtual 3D worlds for professional as well as community and gaming applications
- Increasing demand for personalisation and aggregation of services supported by high throughput multimedia streams and sessions including data from smart objects.

Cross domain perspective

- **Network aware** video coding of 3D, Ultra-HDTV coding. **Multimedia aware** content processing in network nodes combined with high throughputs.
- Network architectures for multimedia delivery exploiting **cross layer interaction** of network elements.
- **Trust:** DRM, content sharing (identity management), ownership and trading of personal and professional virtual digital objects, right of use.
- **Involvement** of media industry in network and services design and architectures.
- The Internet of 3D Media will be characterised by an increasing demand for personalisation through the aggregation of services. It will need to be supported by multiple multimedia streams and sessions including data from smart objects (i.e. "Internet of Things").

Questions one might ask

- How will the developments in the content and media sphere impact the network and service architectures? What will be in the network and what in the service layer?
- What are the new security, privacy and trust evolutions to be expected as a result of the development of 3D-Media Internet? Where to focus attention on? Identity, privacy?
- What needs to be done at the level of the network and service provisioning to allow for a greater personalisation of media services? What to do to contextualise applications for individuals and empower them to compose their own services?
- Is there scope for an open service framework for media services?

- How to best address standards issues pertaining to content and media and ease the likely architectural differences between Telecoms, Media and IT service cultures?

- Do we need to rethink current business processes in light of the upcoming 3D Media Internet? What needs to be done to lower the barriers for service development? What are the implications for the repositioning of industrial players or which opportunities will be created for new players?

- How will the 3D media and content services be influenced by the developments on the Internet of Things? Which critical search and find solutions need to be developed?

- What are the requirements for large scale test beds and experimental facilities as seen from a content and media perspective? Which are the key elements of such large scale European facilities?

PROJECTS IN THIS AREA

Integrated Projects

Specific targeted research projects

Networks of Excellence

Co-ordination and Support Actions

20-20 3D Media: Spatial Sound and Vision

Film or cinema has been the driving force for the entertainment industry, setting the standards of quality, providing the most compelling experience, and feeding the distribution chains of other media (broadcast TV, cable and satellite channels, DVD, video, games et cetera). The creation of a complete '3-D capable' chain is expected to follow a similar path. The media industry knows that astonishing the public is still a route to large audiences and financial success.

2020 3D Media proposes to research, develop, and demonstrate novel forms of compelling entertainment experience based on technologies for the capture, production, networked distribution and display of sounds and images in three-dimensions. 2020 3D Media will add extra dimensions to Digital Cinema and create new forms of stereoscopic and immersive networked media for the home and public spaces. The goal is to research and develop technologies to support the acquisition, coding, editing, networked distribution, and display of stereoscopic and immersive audiovisual content to provide novel forms of compelling entertainment experience in the home or public spaces. The users of the resulting technologies will be media industry professionals across the current film, TV and 'new media' sectors to make programme material addressing the general public.
The key will be the creation of technologies for creating and presenting 'surround video' as a viable system, based on recognised standards. This will require innovations and knew knowledge in:

- Technologies and formats for 3D sound and image capture and coding, including novel high-resolutioncameras
- Technologies and methods for 3-D postproduction of sound and images
- Technologies for the distribution and display of spatial media
- The creative application of spatial media technologies

Participants

FUNDACIO BARCELONA MEDIA UNIVERSITAT POMPEU FABRA
Co-ordinator, SPAIN

JOANNEUM RESEARCH FORSCHUNGSGESELLSCHAFT MBH
AUSTRIA

UNIVERSITEIT HASSELT
BELGIUM

CREATIVE WORKERS
BELGIUM

HIGHLANDS TECHNOLOGIES SAS
FRANCE

FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.
GERMANY

DEUTSCHE THOMSON OHG
GERMANY

TECHNOS SRL
ITALY

GRASS VALLEY NEDERLAND B.V.
NETHERLANDS

MEDIAPRODUCCION SL
SPAIN

DATASAT COMMUNICATIONS LIMITED
UNITED KINGDOM

DIGITAL PROJECTION LIMITED
UNITED KINGDOM

DTS EUROPE LIMITED
UNITED KINGDOM

THE UNIVERSITY OF READING
UNITED KINGDOM

IDENTITY CARD
Funded by:
ICT
Total Cost:
€15.21m
EC Contribution:
€9.87m
Project Type:
Information and Communication Technologies
Call for proposals:
FP7 Call 1
Execution:
From: 01/03/2008 To: 29/02/2012

Coordinated by:
FUNDACIO BARCELONA MEDIA UNIVERSITAT POMPEU FABRA, SPAIN
Contact info:
FUENMAYOR Eugenia
PLAZA DE LA MERCE 10-12
08002 - BARCELONA
SPAIN
Tel. +34 93 5421100
Fax. -+34 93 5422896

P2P - Next Generation Peer-to-Peer Content Delivery Platform

P2P-Next develops an open source, efficient, trusted, personalized, user-centric, and participatory television and media delivery system with social and collaborative connotation using the emerging Peer-to-Peer (P2P) paradigm, which takes into account the existing EU legal framework. The P2P-Next integrated project will build a next generation Peer-to-Peer (P2P) content delivery platform, to be designed, developed, and applied jointly by a consortium consisting of high-profile academic and industrial players. The current infrastructure of the Internet is not suited to simultaneous transmission of live events to millions of people (i.e. broadcasting). With millions of potential users, this will easily congest the Internet. Also, the use of Audiovisual Media is moving from a collective and passive approach to personal active behavior. At the same time use patterns are moving away from the classic model of linear broadcast TV. The TV set no longer has the monopoly of delivery of audiovisual content; the PC and mobile devices are also becoming increasingly important. In such heterogeneous and demanding environments, P2P-based technology is considered an essential ingredient for future efficient and low-cost delivery of professional and user created content.
This development will have important consequences for the existing business models and institutions, as well as for content production, content distribution, and end user experience. In response to these challenges, the objective of P2P-Next is to move forward the technical enablers to facilitate new business scenarios for the complete value chain in the content domain, i.e. from a linear unidirectional push mode to a user centric, time and place independent platform paradigm. P2P-Next will develop a platform that takes open source development, open standards, and future proof iterative integration as key design principles.

Participants

VALTION TEKNILLINEN TUTKIMUSKESKUS
Co-ordinator, FINLAND

UNIVERSITAET KLAGENFURT
AUSTRIA

INSTITUT FUER RUNDFUNKTECHNIK GMBH
GERMANY

MARKENFILM GMBH & CO KG
GERMANY

FIRST OVERSI LTD
ISRAEL

UNIVERSITA DEGLI STUDI DI ROMA "LA SAPIENZA"
ITALY

STMICROELECTRONICS S.R.L.
ITALY

AG PROJECTS B.V.
NETHERLANDS

TECHNISCHE UNIVERSITEIT DELFT
NETHERLANDS

FABCHANNEL BV
NETHERLANDS

NORUT AS
NORWAY

UNIVERSITATEA POLITEHNICA DIN BUCURESTI
ROMANIA

JOZEF STEFAN INSTITUTE
SLOVENIA

RADIOTELEVIZIJA SLOVENIJA JAVNI ZAVVOD LJUBLJANA
SLOVENIA

DACC SYSTEMS AB
SWEDEN

KUNGLIGA TEKNISKA HOGSKOLAN
SWEDEN

EUROPEAN BROADCASTING UNION
SWITZERLAND

KENDRA FOUNDATION
UNITED KINGDOM

LANCASTER UNIVERSITY
UNITED KINGDOM

BRITISH BROADCASTING CORPORATION
UNITED KINGDOM

PIONEER DIGITAL DESIGN CENTRE LIMITED
UNITED KINGDOM

IDENTITY CARD
Funded by:
ICT
Total Cost:
€19.34m
EC Contribution:
€14.04m
Project Type:
Information and Communication Technologies
Call for proposals:
FP7 Call 1
Execution:
From: 01/01/2008 To: 31/12/2011

Coordinated by
VALTION TEKNILLINEN
TUTKIMUSKESKUS, FINLAND
Contact info
KOKKILA Katri
VUORIMIEHENTIE 3
02044 - ESPOO
FINLAND
Tel. +358 722 3303
Fax. +358 20 7223365
Project Website
http://www.p2p-next.eu

TA2 - "Together Anywhere, Together Anytime"

How can technology help to nurture family-to-family relationships? This is the question asked by the collaborative project "Together Anywhere, Together Anytime" (TA2).

For many people, families form the key social unit. Many of our enduring experiences, holidays, celebrations and moments of fun and laughter are framed as family events. This is something that current technology does not address well: modern media and communications serve individuals best, with phones, computers and electronic games devices tending to be individually owned and providing individual experiences. TA2 seeks to redress this imbalance, by exploring how technology can support group to group communication.

Family letters are often written from one family to another; family games are played between families. Memories in the form of videos and photographs are often shared within families. TA2 wants to enhance and support these processes; enabling people to share their stories, pass digital photos and videos around, add comments to them, and to pass them back. TA2 wants to build systems that allow people to play games with each other, seeing and hearing each other as they laugh with, and at, each other, as they struggle with games like Ludo, Labyrinth or Pictionary.

And TA2 also wants to find ways in which modern sensors and IT equipment can support the family to gain better awareness of each others activity, whilst mainaining each individual's right to privacy.

TA2 media and communication experiences will be characterised by their naturalness; clear relaxed voice communication and intelligently edited video. Through the TA2 system, stories are automatically generated from home-related content, the personal home video or from the antics of a lively game. TA2 will run for 4 years and finish in January 2012.

Participants

EURESCOM - EUROPEAN INSTITUTE FOR RESEARCH AND STRATEGIC STUDIES IN TELECOMMUNICATIONS GMBH,
Co-ordinator, GERMANY

JOANNEUM RESEARCH FORSCHUNGSGESELLSCHAFT MBH, AUSTRIA

ALCATEL-LUCENT BELL NV, BELGIUM

FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V., GERMANY

LIMBIC ENTERTAINMENT GMBH, GERMANY

RAVENSBURGER SPIELEVERLAG GMBH, GERMANY

THE INTERACTIVE INSTITUTE II AKTIEBOLAG, SWEDEN

IDIAP (FONDATION DE L'INSTITUT DALLE MOLLE D'INTELLIGENCE ARTIFICIELLE PERCEPTIVE), SWITZERLAND

PHILIPS CONSUMER ELECTRONICS BV, THE NETHERLANDS

STICHTING CENTRUM VOOR WISKUNDE EN INFORMATICA, THE NETHERLANDS

NETHERLANDS ORGANISATION FOR APPLIED SCIENTIFIC RESEARCH – TNO, THE NETHERLANDS

BRITISH TELECOMMUNICATIONS PLC, UNITED KINGDOM

GOLDSMITHS' COLLEGE, UNITED KINGDOM

Project Coordinator:

Mr. Peter Stollenmayer
Eurescom GmbH
Wieblinger Weg 19/4
D-69123 Heidelberg
Germany
Tel. +49 6221 989 153
Fax. +49 6221 989 209
mailto:stollenmayer@eurescom.eu
http://www.eurescom.eu

Technical Project Manager:

Dr. Douglas Williams
BT
Broadband Research Project Director
BT Group, Chief Technology office, pp1, Orion 3, Room 7
Adastral Park
Martlesham Heath
Ipswich
SUFFOLK IP5 3RE
United Kingdom
Tel: +44 1473 647264
e-mail: doug.williams@bt.com

Web site: http://www.ta2-project.eu

ADAMANTIUM - Adaptative management of media distribution based on satisfaction oriented user modelling

ADAMANTIUM proposes a Multimedia Content Management System (MCMS) focused on performing dynamic cross-layer adaptations for optimization of the user experience in terms of perceptual quality for IPTV and VoIP services. This multimodal management system will be applied in an integrated and coherent way along all the network layers and delivery-chain nodes based on a user/customer-centric approach rather than a typical engineering one.

The predominant candidate for current trend of multimedia services convergence with mobile/fixed networks and broadcast-interactive applications is the IP Multimedia Subsystem (IMS). IMS entails novel business opportunities for pioneering and emerging multimedia services, such as IPTV and VoIP video call applications. However, this strong commercial interest on this promising convergent IMS environment is balanced by the lack of efficient user/customer-centric network management mechanisms. ADAMANTIUM proposes an IMS-compatible Multimedia Content Management System (MCMS) focused on performing dynamic cross layer adaptations for optimization of the user experience in terms of perceptual quality for IPTV and VoIP services. This multimodal management system will be applied in an integrated and coherent way along all the network layers and delivery-chain nodes based on a user/customer-centric approach rather than a typical engineering one. Towards this, the proposed management system will make use of advanced IMS-compatible PQoS and NQoS monitoring and adaptation mechanisms across the network delivery-chain, enhancing in this way the current IMS management functions by providing perceptual awareness to them. ADAMANTIUM MCMS will be implemented and demonstrated on an actual IMS platform installed over a UMTS access network, where VoIP-based and IPTV applications over IMS services will be provided.

Participants

NATIONAL CENTRE FOR SCIENTIFIC RESEARCH DEMOKRITOS
Co-ordinator, GREECE

THOMSON GRASS VALLEY FRANCE SA
FRANCE

VIOTECH COMMUNICATIONS SARL
Beneficiary, FRANCE

ROHDE & SCHWARZ GMBH&CO KOMMANDITGESELLSCHAFT
GERMANY

VODAFONE - PANAFON ANONYMI ELLINIKI ETAIREIA TILEPIKOINONION
GREECE

ERICSSON ESPANA SA
SPAIN

UNIVERSIDAD DEL PAIS VASCO/EUSKAL HERRIKO UNIBERTSITATEA
SPAIN

UNIVERSITY OF PLYMOUTH
UNITED KINGDOM

IDENTITY CARD

Funded by:
ICT
Total Cost:
€4.30m
EC Contribution:
€2.61m
Project Type:
Information and Communication Technologies
Call for proposals:
FP7 Call 1
Execution:
From: 01/03/2008 To: 31/08/2010

Coordinated by:
NATIONAL CENTRE FOR SCIENTIFIC RESEARCH DEMOKRITOS, GREECE

Contact info:
MARTAKI Stella
PATRIARCHOU GREGORIOU STREET
15310 - AGHIA PARASKEVI ATTIKIS
GREECE
Tel. +30 2106503037
Fax. +30 2106522623
Project Website:
http://www.ict-adamantium.eu/

AGAVE - A liGhtweight Approach for Viable End-to-end IP-based QoS Services

Internet/telecommunications convergence and the fact that IP is becoming the ubiquitous multi-service delivery platform is leading to the separation of service and network concerns, with distinct roles of Service Provider (SP) and IP Network Provider (INP). SPs have started to deploy added-value services in addition to plain Internet access. Given the best-effort nature of the Internet and the current lack of inter-domain QoS, providing such demanding services over multiple administrative domains is difficult. This is of immediate concern to telcos who are in the process of migrating traditional telephony services to VoIP. AGAVE aims at solving the problem of end-to-end service provisioning over IP networks by studying, developing, and validating a new inter-domain architecture based on Network Planes that will allow multiple INPs to provide Parallel Internets tailored to service requirements. AGAVE will specify an open connectivity service provisioning interface to allow SPs to interact with underlying INP network resources for the provision of end-to-end IP-based added-value services. The project will investigate a range of Traffic Engineering techniques to realise Network Planes and Parallel Internets, depending on service requirements and the capabilities of transit domains. A lightweight QoS approach will be developed, based on the principles of differentiated routing with inherent load balancing and resilience, without requiring universal deployment of differentiated forwarding. The proposed solution will be deployable with small incremental additions to the existing best-effort Internet. The validity and performance of the proposed architecture will be evaluated through simulations and prototype implementations of the developed approaches and protocols. The project will actively contribute to standardisation activities in this area, most notably to the IETF and the IPsphere Forum.

IDENTITY CARD
Funded by:
IST
Total Cost:
€2.10m
EC Contribution:
€1.50m
Project Type:
Information Society Technologies
Call for proposals:
FP6-Call 4
Execution:
From: 01/12/2005 To: 31/05/2008

Coordinated by:
TELEFONICA INVESTIGACION Y DESARROLLO SA, SPAIN

Contact info:
ELIZONDO ARMENGOL Antonio Jose
Emilio Vargas, 6
ES28043 Madrid
SPAIN
Tel. +34 913374240
Fax. +34 915103308
E-mail: ajea@tid.es
Project Website:
http://www.ist-agave.org/

Participants

TELEFONICA INVESTIGACION Y DESARROLLO SA
Co-ordinator, SPAIN

UNIVERSITE CATHOLIQUE DE LOUVAIN
BELGIUM

FRANCE TELECOM SA
FRANCE

ALGONET S.A.
GREECE

UNIVERSITY COLLEGE LONDON
UNITED KINGDOM

THE UNIVERSITY OF SURREY
UNITED KINGDOM

CHORUS - Coordinated approach to the European effort on audiovisual Search engines

CHORUS is a Coordination Action for the search engine projects of Strategic objective 2.6.3 and beyond the IST initiative. The CHORUS workplan includes an information exchange platform (public documents, concertation meetings, newsletter, website) to enhance the interaction and invoke discussion among key players in the IST Cluster and thus to stimulate the creation of the European Research Area (ERA). An important task of the project consists of supporting the preparation of an analysis and a roadmap for the realisation of Audiovisual search engines in EU. That activity will need a multi-disciplinary (societal, economic, regulatory and technological) approach and will imply the participation of major Stakeholders of the domain through the creation of a Think-Tank. That structure, to which several representative organisations have already agreed to participate, will contribute to give an industrial relevance to the coordination action and its visions.Interaction and dissemination will be further ensured through the set-up of a perennial conference and dedicated workshops addressing a large community which complement the coordination instruments proposed by CHORUS.The consortium represents established and well-reputed research institutions and consultancies with a broad range of intellectual and technological expertise in the area, both as regards concrete actions and policy development and track records of national, Union-wide, and international cooperation and activity. Those actors have the experience and the network to achieve a wide audience for the efforts under discussion, and possess the experience and authority both as regards research and industrial weight to guarantee the attention and consideration of said audience. These two factors ensure timely dissemination and take-up of the most worthy ideas and results of the Coordination Action.

Participants

JCP-CONSULT
Co-ordinator, FRANCE

EUROPEAN COMMISSION - JOINT RESEARCH CENTRE
BELGIUM

EXALEAD
FRANCE

INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE
FRANCE

FRANCE TELECOM SA
FRANCE

CIRCOM REGIONAL
FRANCE

THOMSON R & D FRANCE SNC
FRANCE

INSTITUT FUER RUNDFUNKTECHNIK GMBH
GERMANY

FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.
GERMANY

CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS
GREECE

FAST SEARCH AND TRANSFER ASA
NORWAY

SICS, SWEDISH INSTITUTE OF COMPUTER SCIENCE AB
SWEDEN

PHILIPS ELECTRONICS NEDERLAND B.V.
THE NETHERLANDS

UNIVERSITEIT VAN AMSTERDAM
THE NETHERLANDS

IDENTITY CARD

Funded by:
IST
Total Cost:
€1.87m
EC Contribution:
€1.56m
Project Type:
IST Concerted Action
Call for proposals:
FP6-Call 6
Execution:
From: 01/11/2006 To: 30/04/2009

Coordinated by:
JCP-CONSULT , FRANCE

Contact info:
POINT Jean-Charles
80 AVENUE DES BUTTES DE COESMES, LE GALLIUM
35700 - RENNES
FRANCE
Tel. +33223271246
Fax. +33299277782
Project Website:
http://www.ist-chorus.eu

NAPAWINE - Network-Aware P2P-TV Application over Wise Networks

In the next few years we will assist to the explosion of the market of high quality video distribution over Internet (IPTV). The massive deployment of IPTV platforms will offer the opportunity to change the paradigm of current TV broadcasting, moving from the nowadays mass TV, toward personalized TV, thanks to the creation of a large number of thematic channels. IPTV services can be provided either exploiting IP multicast functionalities or relying on a pure end-to-end (P2P) approach. The first approach can be typically supplied only on a closed network infrastructure controlled by a single broadband operator. On the contrary, P2P approach has been successfully exploited to overcome these limits and potentially offer a scalable planetary infrastructure. On the other hand P2P-TV systems constitute also a fear for the current network carriers since the traffic they ingenerate may potentially grow without control, causing a strong degradation of quality of service perceived by Internet users or even the network collapse (and consequent failure of the P2P-TV service itself). Starting from these considerations this project is aimed: i) at providing a careful analysis of the impact that a large deployment of both general P2P-TV services may have on Internet, through an in deep characterization of traffic they generate; ii) at providing suggestions for P2P-TV developers regarding the design of systems that minimize the impact on the underlying transport network while optimizing the user perceived quality iii) at providing suggestions for Internet Providers by showing simple and minimum cost actions that can be taken to better exploit the network bandwidth in presence of P2P-TV traffic. A software library containing many of the algorithms studied within the project will be made available to the community of P2P developers wishing to use them.
At last network-aware P2P-TV application will be released, and its performance carefully evaluated.

Participants

POLITECNICO DI TORINO
Co-ordinator, ITALY

GROUPE DES ECOLES DES TELECOMMUNICATIONS
FRANCE

FRANCE TELECOM SA
FRANCE

MAGYAR TELEKOM TAVKOZLESI NYILVANOSAN MUKODO RESZVENYTARSASAG
HUNGARY

BUDAPESTI MUSZAKI ES GAZDASAGTUDOMANYI EGYETEM
HUNGARY

NETVISOR INFORMATIKAI ES KOMMUNIKACIOS SZOLGALTATO KORLATOLT FELELOSSEGU TARSASAG
HUNGARY

LIGHTCOMM S.R.L.
ITALY

UNIVERSITA DEGLI STUDI DI TRENTO
ITALY

POLITECHNIKA WARSZAWSKA
POLAND

TELEKOMUNIKACJA POLSKA S.A.
POLAND

NEC EUROPE LTD
UNITED KINGDOM

IDENTITY CARD
Funded by:
ICT
Total Cost:
€5.57m
EC Contribution:
€3.71m
Project Type:
Information and Communication Technologies
Call for proposals:
FP7 Call 1
Execution:
From: 01/02/2008 To: 31/01/2011

Coordinated by
POLITECNICO DI TORINO, ITALY

Contact info
SCHIAVONE Maria
CORSO DUCA DEGLI ABRUZZI 24
10129 - TORINO
ITALY
Tel. +39-011-0906312
Fax. +39-011-0905912
Project Website
http://www.napa-wine.eu

SAPIR - Search on Audio-visual content using Peer-to-peer Information Retrieval

Web search is dominated today by search giants like Google, Yahoo or MSN that deploy a centralized approach to indexing and utilize text only indexes enriched by page rank algorithms. Consequently, while it is possible to search for audio-visual content, it is limited to associated text and metadata annotations. Supporting real content-based audio-visual search requires media specific understanding and extremely high CPU utilization which would not scale in today's centralized solutions. SAPIR aims at breaking this technological barrier by developing a large-scale distributed P2P architecture that will make it possible to search in audio-visual content using the query by example paradigm. "A picture is worth a thousand words" so using an image taken by a cell phone to find information about e.g. a monument we bump into or singing a melody as a search hint for a full song, combined with optional metadata annotations and user and social networking context will provide the next level of search capabilities and precision of retrieved results.

Our vision is to conduct innovative research that will lead to a technology where end-users are peers that can produce audiovisual content from their mobile devices. This content will be indexed by super-peers across a scalable P2P network to enable content search in real-time while respecting IPR and protecting against spam. To this end, SAPIR brings experts in audio-visual content analysis together with strong partners in Information Retrieval and in P2P technologies. To further improve audio-visual retrieval and navigation SAPIR's consortium combines experts in Mobile devices technology with experts in Social networking nd in IPR to enable a secure and trusted environment. Having such a technology can provide significant advantage to the European community over existing centralized text only search engines and can be applied in various fields of applications such as tourism, government services, healthcare and more.

Participants

IBM ISRAEL - SCIENCE AND TECHNOLOGY LTD
Co-ordinator, ISRAEL

MASARYKOVA UNIVERZITA V BRNE
CZECH REPUBLIC

XEROX
FRANCE

MAX-PLANCK GESELLSCHAFT ZUR FOERDERUNG DER WISSENSCHAFTEN E.V.
GERMANY

EURIX S.R.L.
ITALY

CONSIGLIO NAZIONALE DELLE RICERCHE
ITALY

UNIVERSITA DEGLI STUDI DI PADOVA
ITALY

TELENOR ASA
NORWAY

TELEFONICA INVESTIGACION Y DESARROLLO SA UNIPERSONAL
SPAIN

IDENTITY CARD

Funded by:
IST
Total Cost:
€4.58m
EC Contribution:
€2.77m
Project Type:
Information SocietyTechnologies
Call for proposals:
FP6-Call 6
Execution:
From: 01/01/2007 To: 30/06/2009

Coordinated by:
IBM ISRAEL - SCIENCE AND TECHNOLOGY LTD, ISRAEL

Contact info:
MASS Yosi
94 DERECH EM-HAMOSHAVOT
49527 - PETACH TIKVA
ISRAEL
Tel. +972-3-7689427
Fax. +972-3-768-9545
Project Website:
http://www.sapir.eu

SEA - SEAmless Content Delivery

SEA (SEAmless Content Delivery) aims to offer a new experience of seamless video delivery, maintaining the integrity and, wherever applicable, adapting and enriching the quality of the media across the whole distribution chain.

In the forthcoming age, where everyone may be content producer, mediator and consumer, SEA aims to offer a new experience of personalised, seamless content delivery, maintaining the integrity and wherever applicable, enriching the perceived QoS (PQoS) of the media across the whole distribution chain. SEA is a project focused on seamless, personalised, trusted and PQoS-optimised multimedia content delivery, across broadband networks, varying from broadcasting to P2P topologies. SEA motivation is to implement a context-aware networking delivery platform, by focusing on four key principles: - Multi-layered/-viewed content coding, considering the evolving H.264 SVC/MVC and their emerging successors, as the major foreseen delivery technologies over heterogeneous networks/terminals and large audiences. - Multi-source/-network content streaming offering on-the fly content adaptation, increased scalability and enriched PQoS by dynamically combining content layers or representations of the same resource, transmitted from multiple sources and/or received over multiple networks.

- Cross-network/-layer optimisation. The network/terminal heterogeneity, also engaging P2P overlays and serving different quality and views will require cross-layer optimization, traffic adaptation and optimal use of the available network/terminal resources.

- Content Protection. A hybrid solution for personalised content protection by means of a combination of streaming encryption, content protection and rights management for new media, covering not only the legacy content creation chain, but also the private multimedia content. SEA will test/validate the developed technologies over three interconnected tedbeds: a) a real-time emulated lab, b) a world-wide extended P2P testbed (PlanetLab) and c) a real 2G+/3G/4G/WLAN mobile trial. SEA will eventually provide citizens with the means to offer personalized A/V user-centric services, improving their quality of life, entertainment and safety.

Participants

STMICROELECTRONICS S.R.L.
Co-ordinator, ITALY

THOMSON GRASS VALLEY FRANCE SA
FRANCE

NOMOR RESEARCH GMBH
GERMANY

FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V.
GERMANY

SYNELIXIS LYSEIS PLIROFORIKIS AUTOMATISMOU & TILEPIKOINONION MONOPROSOPI EPE
GREECE

VODAFONE - PANAFON ANONYMI ELLINIKI ETAIREIA TILEPIKOINONION
GREECE

POLITECNICO DI TORINO
ITALY

PHILIPS CONSUMER ELECTRONICS BV
NETHERLANDS

UNIVERSIDAD POLITECNICA DE MADRID
SPAIN

UNIVERSITY OF CALIFORNIA, LOS ANGELES
UNITED STATES

IDENTITY CARD
Funded by:
ICT
Total Cost:
€3.26m
EC Contribution:
€2.11m
Project Type:
Information and Communication Technologies
Call for proposals:
FP7 Call 1
Execution:
From: 01/01/2008 To: 31/12/2009

Coordinated by
STMICROELECTRONICS S.R.L., ITALY

Contact info
MUSCA COSIMO
VIA OLIVETTI 2
20041 - AGRATE BRIANZA
ITALY
Tel. +39-039-6037491
Fax. +39-039-6036154
Project Website
http://www.ist-sea.eu/

VICTORY - Audio-Visual Content search and retrieval in a distributed P2P repository

In light of three dimensional object retrieval evolving from text annotation to content-based and from standalone applications to web-based search engines, the creation of a search engine for 3D and multimedia distributed content into P2P and mobile P2P networks, is proposed. Driven by the very successful concept of Wikipedia, the first goal of the proposed project is to create the first distributed Visual Object Repository in which any peer can contribute to. The main differences between VICTORY and any known knowledge repository, is that, firstly, any visual information will be described as MultiPedia object (3D object along with its accompanied information - 2D views, text, audio, video), and secondly, the distributed nature of the repository. VICTORY's main objective is to create a MultiPedia search engine based on the 3D objects. The user will be able to use as input any Multipedia object or a combination of them. The retrieved content will contain 3D objects and their accompanied mixed-media and it will be accessible from both mobile devices and standard PCs. The search engine will be based on a combination of novel algorithms able to extract 3D low- level geometric features and high-level semantic features using relevance feedback and annotation techniques which are expected to improve significantly the retrieved results. Furthermore, the search engine will be enriched by multimodal personalized interfaces so as to take into account the users' interests and to offer capabilities of matching between 2D/3D objects, sketches and text. In conclusion, the VICTORY project aims at developing: Distributed 3D content and context-based search engine, P2P and Mobile P2P collaborative network, Unified distributed access, Community neighbourhood identification, 3D visualization on handheld devices, Multimodal interfaces (text, 2D images, sketches, 3D), Copyright protection.

POLITECNICO DI TORINO
ITALY

UNIVERZA V LJUBLJANI
SLOVENIA

IDENTITY CARD

Funded by:
IST
Total Cost:
€3.87m
EC Contribution:
€2.20m
Project Type:
Information Society Technologies
Call for proposals:
Call 6
Execution:
From: 01/01/2007 To: 30/06/2009

Coordinated by:
CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS, GREECE

Contact info:
TZOVARAS DIMITRIOS
6TH KM CHARILAOU-THERMI ROAD
57001 - THERMI-THESSALONIKI
GREECE
Tel. +302310487515
Fax. +302310464164
Project Website:
http://www.victory-eu.org/

Participants

CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS
Co-ordinator, GREECE

EMPOLIS GMBH
GERMANY

TWT GMBH INFORMATION & ENGINEERING TECHNOLOGIES
Beneficiary, GERMANY

ALCATEL-LUCENT DEUTSCHLAND AG
GERMANY

LIVINGSOLIDS GMBH
GERMANY

TELETEL TECHNOLOGIA TILEPIKOINONIONKAI PLIROFORIKIS ANONYMI EMPORIKIVIOMICHANIKI ETAIREIA
GREECE

HYPERTECH ANONYMOS VIOMICHANIKI EMPORIKI ETAREIA PLIROFORIKIS KAI NEON TECHNOLOGION
GREECE

Content Networks and Services for Home Users

The CONTENT Network of Excellence targets Content Delivery Networks for Home Users, as an integral part of Networked Audio-Visual Systems and Home Platforms. CONTENT aims to build the European Research Area in this important communication topic by integrating a group of experts with the purpose of taking forward the state of the art and increasing European leadership in Content Networks.

The overall goal of the CONTENT Network-of-Excellence is to integrate the research efforts of the members to address the technical challenges at the different system levels to enable easy-to-install and easy-to-use AV services in and between homes. In particular, the main technical objective will be to boost the potential of European Community Networking by improving Content Distribution infrastructures for the delivery of live (streaming) content and interactive stored content, and by integrating, in an open way, tools and mechanisms that would enable the curation of multimedia assets and their subsequent access for the benefit of the communities of users, producing a set of appropriate services for them, both in the context of the "long tail" or applied to (re-purposed) assets created by traditional broadcasters.

The joint programme of activities aims at the creation of a self-standing virtual centre of excellence that should result in developing the necessary means for achieving a durable integration of the research capacities. CONTENT will continue the idea initiated in E-NEXT of investing in the education of young researchers through the European Doctoral School of Advanced Topics In Networking (SATIN) to prepare the next generation of researchers for the European Research Area. CONTENT members draw considerable experience from the current FP-6 NoE E-NEXT, and will achieve these objectives through its focused Joint Research workpackage, network coordination, integration, spreading excellence and dissemination workpackages, and with guidance from an Industry Advisory Board.

Participants

UNIVERSITE PIERRE ET MARIE CURIE - PARIS 6
FRANCE

TECHNISCHE UNIVERSITAET DARMSTADT
GERMANY

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS
GREECE

CONSORZIO INTERUNIVERSITARIO NAZIONALE PER L'INFORMATICA C.I.N.I.
ITALY

TECHNISCHE UNIVERSITEIT DELFT
NETHERLANDS

UNIVERSITETET I OSLO
NORWAY

AKADEMIA GORNICZO-HUTNICZA IM. STANISLAWA STASZICA W KRAKOWIE
POLAND

FACULDADE CIENCIAS E TECNOLOGIA DA UNIVERSIDADE DE COIMBRA
PORTUGAL

UNIVERSITAT POLITECNICA DE CATALUNYA
SPAIN

LANCASTER UNIVERSITY
UNITED KINGDOM

IDENTITY CARD

Funded by:
IST
EC Contribution:
€2.65m
Project Type:
Information Society Technologies
Call for proposals:
FP6-Call 4.1
Execution:
From: 01/07/2006 To: 30/06/2009

Coordinated by:
UNIVERSITE PIERRE ET MARIE CURIE - PARIS 6, FRANCE

Contact info:
PLACE JUSSIEU 4
75252 - PARIS CEDEX 05
FRANCE
Project Website:
http://www.ist-content.eu

PETAMEDIA - Peer-to-peer TAgged MEDIA

In the Netherlands, Switzerland, UK, and Germany, national networks exist of collaborating excellent research groups in the areas of multimedia content analysis (MCA) and social and peer-to-peer (SP2P) networks. The Network of Excellence PetaMedia brings these four strong national networks together, at first to form a European network of national networks, and eventually to establish a sustainable European virtual centre of excellence to which research groups throughout Europe can connect. The four core partners of the project represent and coordinate the respective national networks; they are responsible for linking up EU national partners to the NoE. The purpose of joining four national networks is to achieve larger momentum, to integrate available resources, and to further develop complementary expertise necessary for pushing new paradigms in enabling efficient and effective access to multimedia content in emerging network structures. The collective research effort that thus comes available will be directed towards integration of existing MCA and SP2P technologies, and towards identification and exploration of potentials and limitations of MCA/SP2P combinations. A particular scientific challenge that binds the partners is the synergetic combination of user-based collaborative tagging, peer-to-peer networks and multimedia content analysis. Solutions and collaborative research field trials will be built on the coordinating partner's open source P2P software Tribler. The NoE will foster the linking up of researchers in the area of MCA and SP2P, resulting in a closer and harmonized collaboration at both European and national level. It is the ambition of the NoE to become an internationally renowned research centre with impact on national and European research funds in the MCA/SP2P area. The centre also takes up the challenge to create international research proposals based on complementary expertise of partners in national research networks (www.petamedia.org).

Participants

TECHNISCHE UNIVERSITEIT DELFT
Co-ordinator NETHERLANDS

TECHNISCHE UNIVERSITAET BERLIN
GERMANY

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE
SWITZERLAND

QUEEN MARY AND WESTFIELD COLLEGE, UNIVERSITY OF LONDON
UNITED KINGDOM

IDENTITY CARD

Funded by:
ICT
Total Cost:
€4.49m
EC Contribution:
€3.64m
Project Type:
Information and Communication Technologies
Call for proposals:
FP7 Call 1
Execution:
From: 01/03/2008 To: 31/08/2011

Coordinated by:
TECHNISCHE UNIVERSITEIT DELFT,
NETHERLANDS

Contact info:
HANJALIC Alan
STEVINWEG 1
2628 CN - DELFT
NETHERLANDS
Tel. +31 15 278 3084
Fax. +31 15 278 1843
Project Website:
http://www.petamedia.eu/

4NEM - Support Action for the NEM European Technology Platform

In 2004, the Networked and Electronic Media (NEM) industrial sector launched the NEM European Technology Platform.
Three years later, the NEM community has grown to more than 500 members. In the early time of FP7, the NEM platform intends to help to the birth of the NEM industry sector, develop its influence on the European organisations, and improve its presence on the international scene. The 4NEM SSA aims at giving the NEM platform the means to realise its ambitions. It includes the support to the following activities: • NEM secretariat : covering all necessary functions to ensure the normal operation of the NEM Initiative, including the coordination of activities, logistics assistance, website, informatics, communications, • Strategy Development, with the extension of the NEM Vision to a period beyond 2015, and related development of NEM Strategic Research Agenda, but also the production of positioning documents to provide answers to European and national bodies on strategic questions, • European collaboration, in particular, with the European Commission and Parliament, other European Technology Platforms and European Initiatives, such as Eureka-Celtic, and relevant national initiatives, • Liaison ensuring that NEM is influential
on the international scene. This includes professional publication and dissemination of achievements made by NEM
community and briefing standards and regulatory bodies, • Organisation of an annual conference, "NEM Summit", expected to attract 400 to 500 delegates from the NEM community and from the worldwide community of the organisations involved in the NEM sector, • Strategic analysis of how running projects are covering the FP7 networked media objectives and NEM Strategic research Agenda, including a wide consultation within and outside the NEM community, launching an open forum. The 4NEM consortium consists of Steering Board members of the NEM platform and reflects the operational organization of the platform.

Participants

THOMSON R & D FRANCE SNC
Co-ordinator, FRANCE

ALCATEL-LUCENT BELL NV
BELGIUM

STMICROELECTRONICS BELGIUM N.V.
Beneficiary, BELGIUM

INTEL CORPORATION S.A.
BELGIUM

NOKIA OYJ
FINLAND

SIGMA CONSULTANTS
FRANCE

JCP-CONSULT
FRANCE

FRANCE TELECOM SA
FRANCE

INSTITUT FUER RUNDFUNKTECHNIK GMBH
GERMANY

G.A.M.E. BUNDESVERBAND DER ENTWICKLER VON COMPUTERSPIELEN E.V.
GERMANY

EURESCOM - EUROPEAN INSTITUTE FOR RESEARCH AND STRATEGIC STUDIES IN TELECOMMUNICATIONS GMBH
GERMANY

PHILIPS ELECTRONICS NEDERLAND B.V.
NETHERLANDS

TELEFONICA INVESTIGACION Y DESARROLLO SA UNIPERSONAL
SPAIN

ROSE VISION SL.
SPAIN

BRITISH BROADCASTING CORPORATION
UNITED KINGDOM

IDENTITY CARD

Funded by:
ICT
Total Cost:
€2.38m
EC Contribution:
€1.37m
Project Type:
Information and Communication Technologies
Call for proposals:
FP7 Call 1
Execution:
From: 01/10/2007 To: 30/09/2009

Coordinated by:
THOMSON R & D FRANCE SNC,
FRANCE

Contact info:
LE PANNERER Yves-Marie
QUAI ALPHONSE LE GALLO 46
92100 - BOULOGNE BILLANCOURT
FRANCE
Tel. +33299273050
Fax. +33299273001
Project Website:
http://www.nem-initiative.org/

AREA 4
"INTERNET OF THINGS"

The Future Internet will go beyond today's traditional boundaries of the virtual world by being linked to the real world, the world of physical objects. The link will be based on tags and sensors embedded in objects that will allow the network to have real-time information on the whereabouts of any object (location, temperature, etc), which makes in turn possible the full advent of context aware applications. The capability to merge information coming from both the physical world and the virtual world will hence open new classes of applications in a variety of business of residential environments.

Technological achievements by 2015

The Internet of Things - IoT, enabled by new services that will link the real life to virtual environments, will start gradual deployment through a few applications (e.g. RFID product tracing, NFC payment devices, e-domestic appliances). Progressively, as more real-life elements become connected, new services are emerging (mash-up applications), requiring appropriate levels of interface standardisation and interoperability, of dynamic configuration capability, and an increase level of trust and associated information security. New revenue models will be defined based on a deep granular customisation of those services to users and will see the emergence of new business actors, acting as aggregators of traditional activities. IoT applications will be bi-directional, allowing the real-world to be accessed through computers as well as virtual information to be accessible by real-life objects.

Deployment Scenarios

While traditional IT industries, like telecom, software and mobile service providers are expected to play an important role, new players will emerge, offering a new breed of services to citizens. They will have to overcome a series of deployment barriers:

- **Architecture and Governance of IoT systems.** The architecture of IoT applications will necessitate optimised service discovery strategies and architectures, that may in turn impact the overall governance of the IoT.
- **Event driven middleware.** With the huge classes of information to be made available from the edge of the network to the application, new classes of middleware appear in the network, with event filtering capability
- **Scale.** IoT applications, through the connection to the network of billions of tags and sensors will generate an unprecedented amount of transactions and require new levels of storage requirements. Current Internet protocols may not be fully adapted to the transport of sensor generated information, whilst access network symmetry requirement may be affected by massive number of access devices.
- **Spectrum.** IoT applications imply the use of large numbers of tags that have to cohabit on the frequency spectrum. Various techniques (e.g LBT or FHSS) may be called upon to solve the issue.
- **Resilience of systems.** As IoT becomes a reality, it will affect people's life in aspects that cannot fail. IoT application will have to be fail-proof and persistent through partial failure.
- **Sensor networks.** As applications grow in complexity, they will require an increasing number of sensing functionalities (temperature, pressure, humidity, light, noise…)
- **Sensor "Plug and play":** as researched in the field of dynamic service composition, new sensors inserted in networks will need to be capable to declare their capabilities and characteristics. A UPnP for sensor may need to be made available.
- **Ad-hoc networks.** As objects move in the real world, on-the-spot networks will be created without user-interaction and for short periods of time, requiring new levels of interoperability.
- **Human computer interaction.** With day-to-day objects becoming part of the network, the traditional user-interfaces becomes fully intuitive.
- **Everyone becomes a user.** With day-to-day objects becoming part of the network, all individuals, regardless of their computer-literacy will be in contact with IoT applications.

Cross domain perspective

- **Network infrastructure (scalability):** The development of IoT applications, through the massive increase of new entry points to the network, represent a challenge for the scalability of the network, its communication protocols and middleware. Network symmetry requirements may also need to be revisited
- **Software and services:** The development of the Internet of Things is expected to come along with a new range of user-centric services, based on the interaction of day-to-day products with the network. The delivery of those services will be frequently seamless for the user, requiring no interaction with him. The business model for the delivery of those services will require the interaction of several organisations. In particular, "event driven" middleware need to be read whilst sensor "dynamic service capability declaration" is probably required.
- **Content creation and distribution:** The data processed through IoT applications will require the development of a semantic-like approach to describe real-life objects on the network. The data required for IoT applications

to function properly will have to be available anywhere at anytime and will require the development of ad-hoc distribution systems.

- **Virtual and physical objects fusion:** applications may process data coming both from a 3D virtual world and from the real environment. New (merged) information processing management tools may be needed, for instance search engines capable to process data from the physical and virtual world to present an integrated result.
- **Security:** As individuals rely progressively more and more on Internet of Things applications, the will put a new level of trust in the system. The applications, regularly processing personal data, will have to be (and be perceived as) secure enough to prevent identity theft and disclosure of unwanted information. In particular, the exchange of secure information in between different systems will have to integrate new aspects of privacy control. Schemes for reputations may also be needed in the world of objects.
- **Experimental facilities and Test beds:** While many applications of the Internet of Things are already in the carton-boxes and deployable from a technical point of view, few have been tested and even fewer have been deployed. For IoT applications to become mainstream, significant additional experiments, in live situations, need to be conducted. The current massive experimental deployment of RFID/sensor technologies in the context of the ANTS project in Korea could be considered as an example to follow.

Questions one might ask

- What are the constraints that a massive deployment of objects/sensor at the network periphery put on network capabilities and architectures?
- What types of service platforms are required to deploy "event driven" applications and to make possible dynamic adaptation of service platforms or application to insertion of sensors with new classes of capabilities?
- How the service discovery platforms that will be needed to deploy sensor networks may impact the overall governance of the IoT?
- What new requirements emerge in terms of information processing/management to make physical and virtual world data fusion possible? Are there requirements for new classes of search engines?
- What applications will first become mainstream and under which business model will they operate? Will they appear first in a professional or private environment?
- How will IoT applications affect users control over their own privacy and how will they react? What security requirements emerge on the network infrastructure and on the service infrastructure? How can those systems integrate privacy and security features from the early design stages? How can active sensors embarking processing capabilities be made robust to network attacks?
- What are the reputation requirements of an Internet of objects?
- What should be public authorities' policy with regards to data access?
- How can the principle of *'right to silence'*, aka *'silence of the chips'*, that allows individuals to disconnect from any application, be integrated into those systems?
- How will the main business actors of those applications interact? (Telco, software, ISP, retail…)

PROJECTS IN THIS AREA

Integrated Projects

Specific targeted research projects

Co-ordination and Support Actions

ASPIRE - Open source middleware for the internet of things

ASPIRE (Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications) ambition is to facilitate the deployment of RFID solutions at the lowest possible cost. It does this by developing a light-weight, intelligent, scalable, open source and privacy friendly middleware that is compliant with the most important standards.

Description

ASPIRE will research and provide a radical change in the current RFID deployment paradigm through innovative, programmable, royalty-free, lighweight and privacy friendly middleware. This new middleware paradigm will be particular beneficial to European SME, which are nowadays experiencing significant cost-barriers to RFID deployment.

European networked enterprises in general and SME in particular are still reluctant to adopt RFID, since they perceive RFID as unprofitable or too risky. This is largely due to the fact that the adoption of RFID technology incurs a significant Total Cost of Ownership (TCO). ASPIRE will significantly lower SME entry costs for RFID technology, through developing and providing a lightweight, royalty-free, innovative, programmable, privacy friendly, middleware platform that will facilitate low-cost development and deployment of innovative RFID solutions. This platform will act as a main vehicle for realizing the proposed swift in the current RFID deployment paradigm. Portions (i.e. specific libraries) of the ASPIRE middleware will be hosted and run on low-cost RFIDenabled microlelectronic systems, in order to further lower the TCO in mobility scenarios (i.e. mobile warehouses, trucks). Hence, the ASPIRE middleware platform will be combined with innovative European developments in the area of ubiquitous RFID-based sensing (e.g., , physical quantities sensing (temperature, humidity, pressure, acceleration), mobile re, low-cost), towards enabling novel business cases that ensure improved business results. The ASPIRE RFID middleware paradigm, as well as the unique and novel characteristics of the ASPIRE middleware platform are thoroughly described in this proposal.

Keywords

Requirements Engineering
RFID Middleware Infrastructure
RFID Middleware Programmability
Privacy Protection and Privacy Friendliness
Ubiquitous Added-Value Sensing and Low-Cost Readers
Integration and Interoperability

At a Glance: ASPIRE

Project coordinator:
PRASAD Neeli Rashmi
FREDRIK BAJERS VEJ 5
9220 - AALBORG
DENMARK

Partners:
- Aalborg Universitet (DK)
- Union Europeenne De L'artisanat Et Des Petites Et Moyennes Entreprises (BE)
- Universite Joseph Fourier (FR)
- Institut National De Recherche En Informatique Et En Automatique (FR)
- Pole Tracabilite (FR)
- Research And Education Laboratory In Information Technologies (EL)
- Electronic Systems And Software Applications (EL)
- Instituto De Telecomunicacoes (PT)
- Melexis Technologies (CH)
- Open Source Innovation (UK)

Duration:
36 Months

Total cost:
6.07m€

Programme:
FP7 – ICT Call 1

Further information:
http://www.fp7-aspire.eu
http://cordis.europa.eu

COIN - Enterprise Collaboration & Interoperability

"By 2020 enterprise collaboration and interoperability services will become an invisible and pervasive knowledge and business utility at disposal of the European networked enterprises from any industrial sector and domain in order to efficiently set-up, manage and operate different forms of business collaborations, from traditional supply chains to advanced and dynamic business ecosystems."

COIN Mission

The mission of the COIN IP is to study, design anddevelop an open, self-adaptive, generic ICT integrated solution to support the above 2020 vision, starting from notable existing research results in the field of Enterprise Interoperability and Enterprise Collaboration.

COIN Service Platform

COIN business-pervasive open-source service platform will be able to expose, integrate, compose and mash-up in a secure and adaptive way existing and innovative to-be-developed Enterprise Interoperability and Enterprise Collaboration services, by applying intelligent maturity models, business rules and self-adaptive decision-support guidelines to guarantee the best combination of the needed services in dependence of the business context, as industrial sector and domain, size of the companies involved, openness and dynamics of collaboration.

The Information Technology vision of Software as a Service (SaaS) will find its implementation in the field of interoperability among collaborative enterprises, supporting the various collaborative business forms, from supply chains to business ecosystems, and becoming for them like a utility, a commodity, the so-called Interoperability Service Utility.

Background and Motivation

Enterprise Collaboration (EC) and Enterprise Interoperability (EI) have been the two major research catalysts for DG INFSO D4 "Networked Enterprise & Radio Frequency Identification (RFID), and aggregated tens of projects and hundreds of researchers in their projects clusters initiatives. COIN is rooted in the previous initiatives.

EC comes from a business perspective and identifies the process of enterprises – mainly SMEs - to set-up and manage cross-enterprise win-win business relations in response to business opportunities; EI originated by the ICT world and identifies a capability of enterprise software and applications to be integrated at the level of data, applications, processes and models. COIN promoters believe that EC and EI are different concepts which cannot be merged or confused but that they are so interdependent and simultaneously present in every networked enterprise, that they can be really considered as the *two sides of the same COIN.*

COIN Scientific Objectives

Service Platform

The first main objective of COIN is to design and develop a pervasive, adaptive service platform to host Baseline and Innovative COIN services for EI and EC and make them available under innovative on-demand, utility-oriented business models to European enterprises and SMEs in particular for running their business in a secure, reliable and efficient way. Such a service platform, including business and knowledge interoperability models and tools, represents the innovative glue to fully exploit pre-existing and new services in the overall COIN mission.

Baseline Services

COIN aims to consolidate and stabilize the ICT results of both EC and EI FP6 research into some Baseline Services (free or charged; open-source or proprietary) which constitute the service foundations for COIN in the form of a solid service-oriented Technology Platform for Enterprise Interoperability and Collaboration. Such a reference Platform would be enriched by new services developed in COIN and will tremendously improve its usability and accessibility (mostly by SMEs) in different business and knowledge contexts.

Innovative Collaboration and interoperability services

The Baseline Services are further enlarged, extended and improved by developing other more Innovative Services in the EC and EI fields, which could taking into account the most recent and promising technology challenges (in the field of Web 2.0, semantic web, space computing) and put them at service of EC and EI purposes.

In the field of EC, COIN believes essential for SMEs to have configurable and flexible services for collaborative product development, distributed and participative production planning, co-opetitive multi-project management and finally some standardized services for user interaction and co-operation.

In the field of EI COIN will develop services for semantic, web-enabled business documents interoperability; for Knowledge interoperability and for Business models and policies harmonization and combination.

Software as a Service

COIN explores the reference concept of Software as a Service Utility - SaaS-U - intended as a further specification and substantiation of the ISU Grand Challenge of the EI Research Roadmap, positioned especially in respect of delivery of IT functions as services.

Within COIN SaaS-U will be addressing new business strategies and models, in complement to the technical RTD of the COIN ICT service platforms and services as described under the previous objectives.

The overall result will be: new business models for EI, an integrated EI value proposition, and scenarios of Open Innovation for EI.

Industrial Business Scenarios

The trial industrial scenarios are offered by COIN 6 test cases in Aeronautics (Spain), Automotive (Slovenia), Aerospace (Italy), Pulp & Paper plants design and management (Finland), Healthcare (U.K.) and ICT (Hungary). The scenarios represent a wide spectrum of collaboration contexts varying from supply chains, to collaborative networks, and to the most dynamic form of enterprise business ecosystems.

At a Glance: COIN

Project coordinator
GUGLIELMINA Claudia
VIA FRIGIA 27
20126 – MILANO - ITALY

Partners:
- **Txt E-Solutions Spa (IT)**
- Universitaet Innsbruck (AT)
- Technische Universitaet Wien (AT)
- Siemens Aktiengesellschaft Oesterreich (AT)
- Poyry Forest Industry Oy (FI)
- Valtion Teknillinen Tutkimuskeskus (FI)
- Biba - Bremer Institut Fuer Produktion Und Logistik Gmbh (DE)
- Deutsches Forschungszentrum Fuer Kuenstliche Intelligenz Gmbh (DE)
- Interactive Net Design Kereskedelmi Es Szolgaltato Kft (HU)
- Consiglio Nazionale Delle Ricerche (IT)
- Societa Finanziaria Laziale Di Sviluppo (IT)
- Esoce Net (IT)
- Soluta.Net (IT)
- Stiftelsen Sintef (NO)
- Slovenski avtomobilski grozd (SI)
- Jozef Stefan Institute (SI)
- Atos Origin (SP)
- Ingenieria Y Soluciones Informaticas Del Sur (SP)
- Fundacion European Software Institute (SP)
- Ic Focus (UK)
- Ven Process (UK)

Duration:
48 Months

Total Cost:
14.38m€

Programme:
Fp7 – ICT Call 1

Further Information:
http:// www.coin-ip.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

CUTELOOP - Customer in the Loop

CuteLoop is exploring how Intelligent Networked Devices such as enhanced RFID-based systems and Global Navigation Satellite Systems, can be used to effectively "integrate customers within an Integrated Enterprise" so providing an important step towards a highly Integrated Real Time Enterprise

Intelligent Networked Devices

When aiming at supporting the networked enterprises to provide ICT enabled added-value services to their actors as well as to realise a new dimension of networked applications and services capable of interoperation across a wide variety of business domains and organisations of all sizes, a key enabler are Intelligent Networked Devices. Such "Networked Devices" are provi¬ding their own computing capability, becoming more advanced as well as less expensive and can be combined with an increasing number of other devices. Examples are mobile phones, PDAs, notebooks, wearables, digital pens, displays, or even passive/active RFID tags and many others. They are generally neither easily interconnec¬table nor interoperable, often lacking required ICT related environment and infrastructure. Key challenge is to facilitate an industrial uptake as well as to improve the required technology infrastructure and environment for development of business specific services and applications.

CuteLoop – Key Objectives

It is intended to realise a novel approach for promoting and facilitating the realisation of highly flexible and dynamic business interconnections for agile coordination in business networks, having customers as key drivers. Specifically, the project is aiming at research on distributed asynchronous inter¬action of actors and exchange of knowledge among Large Enterprises (LEs), Small and Medium Enterprises (SMEs) and customers.

Distributed Asynchronous Control of Business Processes

The CuteLoop project intends to explore how to radically improve the interaction of diverse actors in an integrated enterprise, based on an approach which will facilitate the inclusion of customers as an integral part of complex relationships in such business networks. A special emphasis will be put on the elaboration of a new approach for employing a "Networked Devices Enabled Intelligence" for distributed and asynchronous control of business processes. Key issues to be taken into account for such an approach are:

- decoupling of decentralised message routing from subsequent processing in complex busi¬ness networks,
- distributed asynchronous optimisation of tasks in workflows of loosely coupled actors,
- decentralised approach for creation of com¬munities of interest and trust in networks with unstable composition of actors and
- innovative interactions among actors (especially with customers) addressing a horizontal and vertical supply chain integration.

Technology vs. Application Potentials

Specifically customers and the public audience have a reluctant perception of potentials and threats of massively distributed networked devices, such as RFID (e.g. concerns w.r.t. security, privacy, radiation, health, environ¬ment) jeopardising establishment and acceptance of RFID supported supply chains, especially when bringing the RFID tags in the customer's home. Research is needed to find appropriate methodologies for modelling complex interaction patterns within distributed business networks, where enhanced RFID based systems for distributed networks are promising to deliver business benefits. Such methodologies need to comply to technical challenges as well as enabling end-users, representing non-experts in those technologies, to identify most appropriate implementations for a human and customer centred business improvement.

Infrastructure and Environment for using RFID and GNSS

From technology point of view, the CuteLoop consortium specifically addresses on how to better exploit the potentials of enhanced RFID-based systems and Global Navigation Satellite Systems (GNSS), starting from the assumption that a combination of these two technologies is a promising way to support the integration of customers in the Integrated Enterprise. Therefore, the research targets for a realisation of an infrastructure and environment which will directly facilitate the realisation of a new dimension of added-value services to support especially the decentralised and asynchronous interaction in complex networks of the integrated enterprise, supporting distributed networked devices, usable by any size of acting entity. In particular, the CuteLoop partners will elaborate a corresponding architecture, agent based software services and a security framework.
For requirements analysis as well as for integration, test and assessment of the envisaged project results, SME driven integrated enterprise scenarios are included (focusing specifically upon small and micro enterprises). The application scenarios involved in the CuteLoop project are from food and construction industry.

The Consortium

CuteLoop is carried out by a European consortium, covering expertise from RTD, ICT and industry. The partners are located in six different countries in the European Union: France, Germany, Luxembourg, the Nether¬lands, Portugal and the United Kingdom (with subsidiaries in additional 7 European countries - Austria, Belgium, Italy, Norway, Spain and the Czech Republic, as well as with offices world-wide).
Moreover, the CuteLoop partners CAPEB, ETSI, EuroTeleServ and TheOpenGroup are including over 1.000 member organisation, which are located all over Europe as well as in the other continents.

RTD Cluster and Experience Exchange

CuteLoop established already contacts with other research projects and is continuously searching for potential cooperation and experience exchange. A key initiative for such cooperation are clusters on the European Level, while CuteLoop already joined the Cluster of European RFID Projects (CERP).
Additional opportunities for cooperation of the CuteLoop team are also provided by the work of the European Telecommunications Standards Institute regularly organising events and maintaining diverse standards related working groups as well as in the scope of the frequently organised events of The Open Group providing excellent educational and networking opportunities.

At a Glance: CuteLoop

Project Coordinator:
SUNDMAEKER Harald
WIENER STRASSE 1
28359 – BREMEN - GERMANY

Partners:
- ATB - Institut für angewandte Systemtechnik Bremen (DE)
- CAPEB - Confederation De L'artisanat Et Des Petites Entreprises Du Batiment (FR)
- EuroTeleServ (LU)
- Euro Pool System International (NL)
- ETSI - Institut Europeen Des Normes De Telecommunication (FR)
- Rheinische Friedrich-Wilhelms-Universitaet Bonn (DE)
- The Open Group (UK)
- TraceTracker (DE)
- Uninova - Instituto De Desenvolvimento De Novas Tecnologias (PT)

Duration:
36 Months

Total cost:
3.61m€

Programme:
FP7 – ICT Call 1

Further information:
http://www.cuteloop.eu

iSURF - An Interoperability Framework for Collaborative Planning

iSURF Project will develop knowledge-oriented inter-enterprise collaboration tools for European SMEs to enable them to be more agile, self-sustainable and responsive to the changes in the supply chain. An open smart product infrastructure will be developed to collect supply chain visibility information and an interoperability service utility will be provided for seamless exchange of planning documents.

The Need for Open Collaboration Framework for SMEs

In order to guarantee the survival in today's competitive and demanding digital world of business, the European companies, especially SMEs, should be more agile, self-sustainable and responsive to the changes in the supply chain. Trading partners have different competencies based on their business strategies and varying sources of information. Competitiveness of European Companies is reduced when decision making is inconsistent due to incomplete understanding of the impact of decision on the supply chain as a whole. The distributed intelligence of multiple trading partners needs to be collaboratively exploited in the planning and fulfilment of customer demand in the supply chain in order to achieve "network is the business" vision.

As a response to this need, iSURF project will provide a knowledge-oriented inter-enterprise collaboration environment to SMEs to share information on the supply chain visibility, individual sales and order forecast of companies, current status of the products in the manufacturing and distribution process, and the exceptional events that may affect the forecasts in a secure and controlled way.

iSURF project will provide a Service Oriented Collaborative Supply Chain Planning Process Definition and Execution Platform based on "Collaborative Planning, Forecasting, and Replenishment (CPFR)" guidelines.

The Challenges to be addressed

Providing an inter-enterprise collaboration framework to European SMEs involves a number of challenges. iSURF project will address these challenges as follows:

INTEROPERABILITY ACROSS MULTIPLE DOMAINS

There are various standard initiatives addressing the exchange of supply chain planning information in different domains, such as OAGIS, CIDX, and GS1 eCOM. Hence when companies are involved in more than one supply chain and hence need to exchange planning information across multiple domains, there is an interoperability problem to be addressed.

iSURF project will provide a Semantic Interoperability Service Utility for achieving the semantic reconciliation of the planning and forecasting business documents exchanged between the companies according to different standards. This component will be based on UN/CEFACT Core Component Technical Specification.

INTEGRATION WITH LEGACY SYSTEMS

For effective use, the inter-enterprise collaboration process should be integrated with the underlying legacy applications handling the company planning activities such as ERPs. Rather than all-in-one integration, interoperability solutions should be accessible to SMEs since SMEs with their limited resources cannot afford integration costs with all of the partners.

iSURF project proposes to use a Service Oriented Architecture: semantically enriched Web services will be used to interact with the underlying business processes and to wrap the existing legacy applications to solve the interoperability problem.

GATHERING REAL TIME SUPPLY CHAIN VISIBILITY DATA

One of the fundamental requirements for optimizing supply chain performance is availability of the right data at the right place and the right time in the right format, i.e., visibility of related information in the supply chain.

iSURF project will provide an open source smart product infrastructure based on RFID technology using EPCGlobal standards. Through this infrastructure, necessary tools and processes will be provided to collect realtime product visibility events from massively distributed RFID devices; filter, correlate and aggregate them in order to put them into business context.

Expected Impact

Today an enterprise's competitiveness is to a large extent determined by its ability to seamlessly interoperate with others. The i2010 Strategy Framework has explicitly identified interoperability as a key bottleneck that should be tackled. The iSURF project will address this "grand

challenge" by providing the "iSURF Interoperability Service Utility" that will enable the companies to exchange planning data seamlessly although they may be using different the message exchange standards or proprietary formats of legacy applications. In this way the companies, even the SMEs will be able to collaborate with partners across a wide variety of business domains: this will promote their competitiveness, they will be more agile and will be able to more easily exploit possible business partnerships.

Early Results

iSURF project started its activities through the Kick-off meeting held on February 05, 2008. Two journal papers related with iSURF Interoperability Service Utility component are submitted for publication and currently under review:

- Kabak Y., Dogac A., A Survey and Analysis of Electronic Business Document Standards, submitted to ACM Computing Surveys.
- Yarimagan, Y., Dogac, A., "A Semantic based Solution for the Interoperability of UBL Schemas", submitted to IEEE Internet Computing Journal.

At a Glance: iSurf

Project coordinator:
DOGAC Asuman
COMPUTER ENGINEERING DEPARTMENT,
MIDDLE EAST TECHNICAL UNIVERSITY, CAMPUS
06531 – ANKARA – TURKEY

Partners:
- Middle East Technical University (TR)
- SRDC Yazilim Arastirma Ve Gelistirme Ve Danismanlik Ticaret Ltd. (TR)
- Intel Performance Learning Solutions (IE)
- Fraunhofer Gesellschaft Zur Foerderung Der Angewandten Forschung (DE)
- Txt E-Solutions (IT)
- Uninova - Instituto De Desenvolvimento De Novas Tecnologias (PT)
- Fratelli Piacenza (IT)

Duration:
30 Months

Total Cost:
3.13m€

Programme:
FP7 – ICT Call 1

Further Information:
http://www.isurfproject.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

CASAGRAS - Global RFID Co-operation

CASAGRAS Aim:
To provide an incisive framework of foundation studies that can assist the European Commission and EU member states in influencing and accommodating international issues and developments concerning radio frequency identification (RFID) and the emerging "Internet of Things".

CASAGRAS

Coordination and Support Action (CSA) for Global RFID-related Activities and Standardisation

CASAGRAS General Objectives:

To provide:

- A platform for international collaboration on all aspects of standards and regulations relating to RFID
- A framework and supporting documentation for incisive and analytical review of international RFID standards
- Recommendations with respect to international standardisation and regulatory developments for RFID
- Recommendations with respect to applications methodologies and positioning
- Recommendations for future research and development and international collaboration
- Recommendations to encourage participation of SMEs
- An on-going collaborative research platform for RFID

CASAGRAS Work Packages:

1. Standards and Procedures for International Standardisation in Relation to RFID, Including Applications and Conformance Standards
2. Regulatory Issues in Respect of RFID Standards
3. Global Coding Systems in Relation to RFID Standards
4. RFID In Relation to Ubiquitous Computing and Networks
5. Functional, Including Sensory, Developments in RFID and Associated Standards
6. Areas of Application, Existing and Future, and Associated Standards
7. Socio-Economic Components of RFID Usage

Emphasis on work packages 3-6

CASAGRAS Approach:

1. Holistic (parts better definable by reference to the whole), independent, framework
2. Non-interfering, but supportive and contributory to the standardisation and regulatory processes
3. Mapping and gap analysis to identify international roadmap for harmonised global solutions to RFID open systems
4. Ability to embrace new developments in technology, principles, concepts and prospects for new standards

CASAGRAS and the Internet of Things*:

The Internet of Things viewed as a network for communicating devices and based upon four degrees of sophistication, involving:

- *Purely passive devices (RFID) that yield fixed data output when queried*
- *Devices with moderate processing power to format carrier messages, with the capability to vary content with respect to time and place*
- *Sensing devices that are capable of generating and communicating information about environment or item status when queried*
- *Devices with enhanced processing capability that facilitate decisions to communicate between devices without human intervention – introducing a degree of intelligence into networked systems*

*** European Commission (2007) From RFID to the Internet of Things – Pervasive networked systems**

CASAGRAS Framework:

The framework studies will draw particular attention to Objective ICT-2007-1.3: ICT in support of the networked enterprise and the call within that objective for a Support Action (SA) for global RFID-related standardisation activities involving in particular organisations from China, Japan, Korea and the USA.

At a Glance: CASAGRAS

Project coordinator:
SMITH Ian
AIM UK Ltd
The Elsie Whiteley Innovation Centre
Hopwood Lane
Halifax
HX1 5ER
UK

Partners:
- **AIM UK (UK)**
- YRP Ubiquitous Networking Laboratory
- (Japan)
- Hong Kong Science and Technology Parks Corporation (China)
- AIDC UK (UK)
- Electronics and Telecommunication Research Institute (Korea)
- FEIG Electronic (DE)
- ETSI (FR)
- QED Systems (USA)

Duration:
18 Months

Total cost:
533,703.43€

Programme:
FP7 – ICT Call 1

Further information:
http://www.rfidglobal.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

AREA 5

"SECURITY"

"Security, Privacy and Trust in the Future Internet"

Issues for discussion

I. INTRODUCTION AND GENERAL CONSIDERATIONS

The Information Society has become a reality with polymorphic fixed and wireless broadband networks deployed almost pervasively. Together with emerging service oriented architectures, they facilitate the composition and provision of interactive and personalised services and drive participative web technologies and web communities.

The inter-relationships and inter-dependencies between formerly stand-alone systems and networks are leading to complexities in the infrastructures of our society that have never been seen before. These complex systems and networks disseminate and process massive amounts of personal and business data, information and content in ways which are difficult to understand and control for users, in particular private citizens. In recent years we have witnessed a growing series of accidents and attacks on the Internet and on applications and databases. Through denial of service attacks, viruses, phishing, spyware and other malware, criminals disrupt service provisioning and steal personal or confidential business data for financial gain or other purposes. An increasingly organised and efficient though disruptive e-market is thus taking shape on an international scale.

Massive data gathering on individual behaviour for surveillance and service personalisation (though packaged as "enhanced functionality") may lead to the erosion of civil liberties through loss of privacy and personal freedom. These negative developments threaten to undermine the potential highly beneficial opportunities of the Future Internet.

II. TOWARDS THE FUTURE INTERNET

In the last few years, a key debate has started on the ability of the current Internet to cope with the above security and privacy challenges together with other major emerging trends, notably: dealing with generalised mobility and scalability in the number of users, devices and services; and reliably delivering ever more time-critical and high-bandwidth applications. Research initiatives have therefore been launched in Europe and other industrialised countries on the design and development principles of the ***Future Internet.*** This term encompasses, in fact, the emergence of future large heterogeneous and interconnected networked ICT infrastructures, as for example: the future evolution of the current Internet, the Internet of "Things", future wireless and mobile systems and sensor/actuator networks (post-IP, post 3G), mixed-mode environments consisting of diverse computing, communication and storage capacities, and service-centric, evolving and adaptive ambient environments[1]. It also encompasses the emergence of millions of different networked virtual constructs and entities. Examples here include enriched, dynamically evolving overlaid infrastructures (like virtual private or overlay networks, dynamic service software coalitions and interconnects, semantic P2P grids, etc.) and "virtual worlds" based on highly-distributed, virtualised communication, computing and storage resources.

III. RESEARCH CHALLENGES

In this paper we address research challenges for the Future Internet from the viewpoint of security, dependability, privacy and trust.

Two overarching challenges could be identified:

- The creation of a trustworthy and resilient Future Internet as a conglomerate of networks and systems, with built-in security, dependability, privacy and trust.
- Enabling users to understand security, privacy and trust in the Future Internet by providing usable and credible support protecting their data and privacy. Thus enabling them to make informed decisions on the trustworthiness of information, services, social contacts and services.

The cross-cutting nature of the area of Trust and Security leads to consider three perspectives:

III.1 Securing the Future Internet

Many early network protocols that are now part of the Internet were designed for performance and not with explicit consideration of security. For example, they lack inherent notions of "identity", "time", and "location" that could contribute to enhancing network security and user accountability and liability. The new security architectures,

1 *In other terms, the Future Internet is to be seen as an agglomerate of thousands of smaller interconnected systems and networks that are not necessarily interoperable, but open (i.e., with known interfaces) and possibly having their own proprietary protocols, as well as of trillions of heterogeneous networked computing, communication and storage devices.*

models and frameworks must address the vulnerabilities and threats emerging in the Future Internet. The security policies must be adequate for protecting infrastructures, composite applications and virtual entities which span across different countries and administrative domains and involve dozens of different stakeholders, each conforming to disparate legislation and/or having their own security policies.

Future Research challenges

New conceptual frameworks, technologies and tools are therefore needed for:

- Managing and protecting the "identity" of billions of networked persons, devices, "things", services and virtual entities connected in the Future Internet;
- Securing the interactions and interfaces between heterogeneous ICT systems and engineering scalable security policies across the Future Internet;
- Securing critical infrastructures that are interdependent and controlled through vulnerable networks;
- Designing scalable, dependable and resilient open systems and composite services;
- Assessing expected security, dependability and resilience properties at design stage or during dynamic evolution at runtime;
- Predicting, monitoring and managing dependable behaviour, evolution and adaptation to changing contexts, operating conditions, regulations or practices of use, while guaranteeing service level provision or best trade-off between conflicting factors based on business oriented risk analysis;
- Security of highly distributed virtual entities and trusted infrastructures based on virtualised communication, computing and storage resources;
- New crypto schemes both in the core networks, to cope with ever increasing data transfer rates (crypto at Gbits/sec or even Tbits/sec), and at network edges (crypto for tiny networked devices with scarce resources like tiny WSNs, PANs, or other networked "things"); cryptography in the quantum era.

The above challenges address either core dependability and security technologies needed to allow creation of a secure and trustworthy Future Internet, or technologies that need to be addressed in conjunction with those developed in other objectives of the FP7-ICT Challenge 1.

At the **Network level** we must address i.a.: new network architectures and communication protocols that incorporate security, user accountability and privacy-protection and that protect identities of "things", services, virtual entities; network security, supervision, management and control; virtualisation and secure management of resources.

At the **software and service level** we must work on secure and auditable service platforms and middleware; trustworthy end-to-end services; virtualisation and secure management of resources; taking account of application and domain specific needs.

Concerning **networked media** attention must be given to trustworthy content, security in mash-ups, or authentication and secure web browsing.

III.2 Protection against emerging threats and vulnerabilities

One of the major problems in the current Internet is the weak security at its end points, i.e., protecting the end-users, their interactions and transactions, and their devices, content and data against any malicious activity. This is mainly due to: the lack of proper user accountability mechanisms; vulnerabilities of end user devices; insufficient user security awareness; or lack of economic incentives for good security offerings.

In the Future Internet, we must stop the fast and unpredictable development of threats as we see it today. At the same time, we must provide solutions that will address new vulnerabilities emerging from increased user mobility and technology complexity, proliferation of mash-ups and user-created and shared content, new social networks and virtual "worlds" and other still unforeseen developments in the Future Internet. We must also enable the merging of the virtual (digital) world with that of real physical objects in a way that allows secure feeling and acting on reality.

Future Research Challenges

Further research efforts will be needed for:

- Continuous and real time assessing and managing the security level of systems, content and services;
- Early detecting, monitoring and countering attacks, intrusions, new forms of malicious code distribution or any other type of malicious behaviour; understanding and predicting the threat models and their evolutions and proactively developing new protection schemes;
- Protecting interconnected key infrastructures of modern life against intrusions, attacks and cascading effects;
- Cross-border, cross-organisational, scalable distributed collaborative security mechanisms, including mechanisms inspired from the bio-living world: collective as well as self-organising, self-healing and self-learning protection mechanisms.

The above challenges address mainly core security and dependability technologies needed to protect the Future Internet against emerging threats. The following issues are however strongly linked to and could benefit from technology

developments addressed in other objectives of the FP7-ICT Challenge 1:
At the **network level,** architectures enabling resilience and self-healing properties, together with network management and control tools for assessing such properties. At the **service level,** architectures and frameworks enabling event-driven management and service system resilience. At the **Internet of Things** level, autonomously adapting networked "objects" to vulnerabilities and threats.

III.3 Sustaining Privacy and Trust in the Future Internet Society

In their daily digital interactions and in emerging internet applications such as collaborative scenarios, virtual communities and environments, individuals are leaving a life-long trail of personal data. Technological advances facilitate extensive data collection, unlimited storage and data merging. Through user profiling, they enable more personalised service provision, while at the same time they create the conditions for tracking and tracing people and surveying their activities. In the Future Internet new tools and policies must be developed that will provide user-centric identity management (users control "what, where, when, and to whom") and that protect life-long privacy of users and their personal entities.
Companies and individuals will increasingly rely upon and exchange information and content they find on the Future Internet. We must develop capabilities and services that allow us to deal with the trustworthiness of data, information and knowledge, or the people we meet virtually and companies we deal with. This will include certifying data provenance and managing and negotiating trust relationships adaptable to the level of security and privacy required by users in a given situation and context.

Future Research Challenges
Hence, further research is needed for:

- Understanding and developing privacy-friendly identity management schemes;
- Rethinking privacy and trust in future ambient environments (incl. networked sensor environments and the Internet of Things): new privacy models and information control paradigms; privacy enhancing technologies;
- New frameworks and reference architectures integrating fragmented approaches for managing personal information and for data sharing and exchange under users' control;
- Understanding how trust emerges and evolves, and the related notions of reputation formation, monitoring, evolution and management;
- Developing novel trustworthy and usable means, including trust services, that take account of the situation and context and help users make informed decisions about which information, services and systems they can trust;

The cross challenge aspects in above research issues are clear and for example relate to:
Creation of trusted **Software and Service infrastructures** and trust in dynamic service coalitions. Personal data and privacy protection in **Networked Media** such as virtual worlds and the 3D Internet. Protection of the personal sphere and privacy in future **Internet of Things** and ambient environments.

IV. PROJECTS IN THIS AREA

Integrated Projects

Specific targeted research projects

Networks of Excellence Co-ordination Actions

MASTER - Managing Assurance, Security and Trust for Services

MASTER is an Integrated Project that aims at providing manageable assurance of the security and trust levels and regulatory compliance of highly dynamic Service Oriented Architectures that deal with business processes.

Why Research on Secure Service Oriented Architectures?

The business of the future will be characterized by highly dynamic service-oriented architectures (SOAs), where outsourcing and distributed management constitute the norm rather than the exception. Such SOAs will have to deal with an increasing complexity in security and trust requirements from regulations and business standards. Best-effort security will no longer be accepted and business entities will have to provide certified assurance services to customers and expect assured services from contractors in order to manage the associated business and technology risks.

Why MASTER?

MASTER aims at providing methodologies and infrastructures that facilitate the monitoring, enforcement and audit of quantifiable indicators on the security of a business process. MASTER will provide in fact manageable assurance of the security and trust levels as well as regulatory compliance of highly dynamic SOAs in three different business scenarios of increasing complexity: the centralized (single-domain), distributed (multi-domain), and outsourcing scenario.
To this extent, MASTER will identify new innovation components in terms of: key assurance indicators; key security indicators; protection and regulatory models; and, security model transformations coupled with the methodological and verification tools for the analysis and assessment of business processes.

MASTER helps translate business level challenges to high-level IT challenges in three domains:

1. Decision Support to transform and aggregate lower level and scattered security information on a complex web of services to a level that is amenable to board room action based on concrete information, based on key security indicators.
2. A trusted Monitoring Infrastructure of the business SOA and outsourced infrastructure to provide the real-time information on the actual security status of the system at different level of granularity
3. An Infrastructure for Enforcement of the security and trust decisions from the board level down to the real-time actions needed by preventive and reacting control.

It will thus define an overall infrastructure for the monitoring, enforcement, reaction, diagnosis and assessment of these indicators covering the above mentioned three different business scenarios. It will show a proof-of-concept implementation in the challenging realms of Banking/ Insurance and in the e-Health IT systems.

MASTER will deliver a strategic component of the security and trust pillar of the European Technology Platform NESSI which makes it a NESSI strategic project.

At a Glance: MASTER

Project coordinator:
Atos Origin (ES)
Partners:
SAP (FR), Universita di Trento (IT), Engineering Ingegneria Informatica S.p.A. (IT), British Telecom (UK), ETH (CH), University of Stuttgart (DE), LERO (IE), ANECT CZ), Deloitte (FR), IBM (CH), CESCE (ES), Fondazione San Raffaele (IT), Stiftelsen SINTEF (NO)
Duration: 36 months
Total cost: 15 034 874 €
EC Contribution: 9 300 000 €
Programme: FP7 ICT Work Programme 2007-08, Objective 1.4
Further information:
Mr. Pedro Soria-Rodriguez
CALLE DE ALBARRACIN 25
28037 MADRID - SPAIN
Atos Research & Innovation
E-mail: pedro.soria@atosresearch.eu
Phone: +34 914408800
Fax: +34 917543252
Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

PRIMELIFE - Bringing Life-Long Privacy to the Internet

More and more personal data is exchanged and stored on the Internet. Little assurance is given to the users that their privacy is sufficiently protected. PRIMELIFE is an Integrated Project that aims at bringing sustainable privacy and identity management to Future Networks and Services, with users retaining control of their own personal data.

Why is research needed on enhancing privacy in online interactions?

The Internet continues to be increasingly valuable to individuals, organisations and companies and web usage for everyday tasks is increasing. In the last two years, users have also embraced the Internet for social networking and substantial collaborative works have emerged.

Underlying all of these systems are distinct trust models and diverse trust relationships. Users and businesses increasingly rely upon information they find on the Internet – often without knowing anything about the originating sources. Thus, as a central part of their daily interactions, businesses as well as individuals need to manage not only their identity information but also trust information to assess their communication partners.

For the safe future of the digital society, the concepts of privacy-enhancing user-centric identity and trust management are central. These concepts distinguish themselves from other notions of identity and trust management by insisting that the users – and not some authority – maintains control over "what, where, when, and to whom" their personal information is released.

Part of this notion enforces user consent which requires that (a) the user's view of any transaction corresponds to the actual transaction and that (b) the user agrees to the execution of the transaction.

Within the limits set by law, privacy, trust, and identity management should support the users in deciding who can access which of their attributes in which situations. Users want to protect their autonomy and retain control over personal information, irrespective of their activities. Information technologies hardly consider those requirements, thereby putting the privacy of the citizen at risk. Today, the internet is changing from a client-server to a collaborative paradigm. Individuals will contribute throughout their life leaving a life-long trail of personal data. Moreover, technological advancements facilitate extensive data collection, unlimited storage, as well as reuse of these individual's digital interactions.

This raises substantial new privacy challenges: how to protect privacy in emerging internet applications such as collaborative scenarios and virtual communities; and how to maintain life-long privacy.

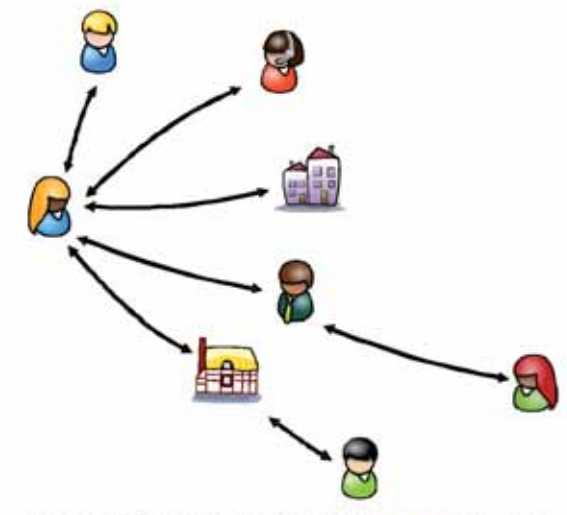
Why PRIMELIFE?

PrimeLife will address the core privacy and trust issues pertaining to the aforementioned challenges. Its long-term vision is to counter the trend to life-long personal data trails without compromising on functionality. It will build upon and expand the sound foundation of the FP6 project Prime that has shown how privacy technologies can enable citizens to execute their legal rights to control personal information in on-line transactions.

The main objective of the project is to bring sustainable privacy and identity management to future networks and services:

- Fundamentally understand privacy-enhancing identity management 'for life' (practical life, throughout life & beyond)
- Bring Privacy to the Web and its Applications
- Develop and make tools for privacy friendly identity management widely available – privacy live!

Resolving these issues requires substantial progress in many underlying technologies. PrimeLife will substantially advance the state of the art in the areas of human computer interfaces, configurable policy languages, web service federations, infrastructures and privacy-enhancing cryptography. It will also ensure that the community at large adopts the results of the project by working with the relevant Open Source communities, standardisation bodies and relevant partner's projects. It will further organise workshops to transfer technologies and concepts.



AT A GLANCE: PRIMELIFE

Project coordinator:
IBM Research GmbH (CH)

Partners:
Unabhängiges Landeszentrum für Datenschutz (DE), Technische Universität Dresden (DE), Karlstads Universitet (SE), Universita' degli Studi di Milano (IT), Johann Wolfgang Goethe - Universität Frankfurt am Main (DE), Stichting Katholieke Universiteit Brabant (NL), GEIE ERCIM (FR), Katholieke Universiteit Leuven (BE), Universita degli Studi di Bergamo (IT), Giesecke & Devrient GmbH (DE), Center for Usability Research & Engineering (AT), Europäisches Microsoft Innovations Center GmbH (GE), SAP AG (DE), Brown University (US)

Duration:
36 months

Total cost:
15 065 056 €

EC Contribution:
10 200 000 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Dr. Els Van Herreweghen
Saeumerstrasse 4,
Rueschlikon 8803, Switzerland
E-mail: evh@zurich.ibm.com
Phone: +41 44 724 8628
Fax: +41 44 724 8953

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

TAS3 - Securely Managing Personal Information Services

In today's ever-increasing computerized society, users are often required to make available their personal data at a third party (e.g. at a hospital) without being able to retain control of such data. TAS3 – Trusted Architecture for Securely Shared Services – is an Integrated Project that will develop a generic architecture with trusted services to manage personal information and will substantiate it into two concrete healthcare and employability platforms.

Why research in trusted services platforms?

A lot of personal information is generated over a human lifetime and is collected & stored at distributed locations and used in a multitude of business processes.

ICT systems that are currently in use or under development do not handle properly such personal information in the services they provide. This results into systems that do not naturally support cross-context solutions and that are intrinsically non interoperable. This makes the deployment of cross-context services very complex and fragile which does not contribute to increasing the trustworthiness of the resulting system.

Why TAS3?

TAS3 (Trusted Architecture for Securely Shared Services) is an Integrated Project that will develop and implement an architecture with trusted services to manage and process distributed personal information. This architecture will be dependable, robust, cost-effective and reliable. The personal information that will be processed and managed can consist of any type of information that is owned by or refers to people.

The proposed architecture will be generic and cross-domain applicable. TAS3 will focus on an instantiation of this architecture in the employability and e-health sectors. The project will allow users and service providers in these two sectors to manage the lifelong generated personal employability and e-health information of the individuals involved.

For example, in the employability sector (see figure below), personal information includes the professional interests, current and previous job activities, and future employment objectives of a worker. Service providers will then be able to use this information to propose career paths that are compatible with the worker's objectives. This process-view on lifelong employability of people perfectly fits in the decision number 1672/2006/EC of the European Parliament and of the Council of 24 October 2006 establishing a Community Programme for Employment and Social Solidarity.

The healthcare sector is another context in which the TAS3 architecture can be instantiated. In this case, the patient could be offered advanced services based on a number of personal health parameters (weight, body temperature, glucose level for diabetes patients, etc.) that are introduced by the patient himself. And again, like in the employability context, users will be able to retain control of the use of their personal information.

AT A GLANCE: TAS3

Project coordinator:
Katholieke Universiteit Leuven (BE)

Partners:
Synergetics (BE), University of Kent (UK), University of Karlsruhe (DE), Technical University of Eindhoven (NL), CNR/ISTI (IT), University of Koblenz-Landau (DE), Vrije Universiteit Brussel (BE), University of Zaragoza (ES), University of Nottingham (UK) SAP research (DE), Eifel (FR), Intalio (UK), Risaris (IR), Kenteq (BE), Oracle (UK), Custodix (BE), Medisoft (NL)

Duration:
48 months

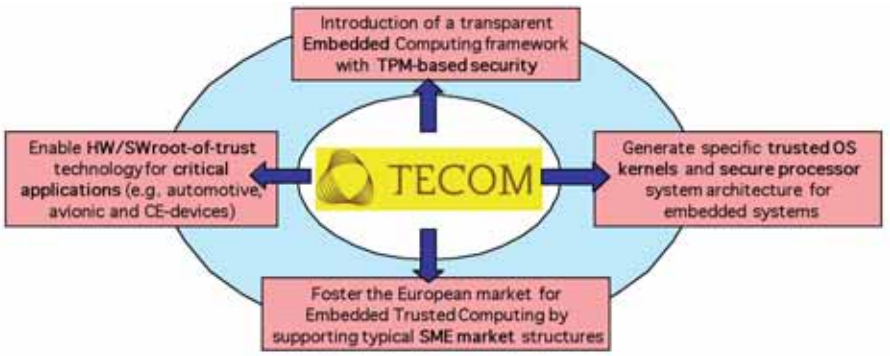
Total cost:
13 177 238 €

EC Contribution:
9 400 000 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Contact: Prof. Bart Preneel / Danny de Cock
Kasteelpark Arenberg 10 - Bus 2446
3001 Heverlee, Belgium
E-mail: Danny.DeCock@esat.kuleuven.be
Phone: +32 16 321073
Fax: +32 16 326515
Web site: http://tas3.eu

TECOM - Trusted Embedded Computing



As there are many more embedded computing platforms than PCs in the production and in the field, it has become necessary to adapt the current Trusted Computing security standard also to embedded computing platforms. This is the main goal of the Integrated Project TECOM.

Why Research on Trusted Computing in Embedded Computing Platforms?

Trusted Computing (TC) is an established technology for the verification and implementation of integrity and security in personal computers (PCs). PCs have large resources of available code space, specific bus interfaces and computing power. Embedded computing platforms, for which such resources are not available, nevertheless have similar trust and security problems as the PCs. The cause of this lies in the increasing complexity and therefore instability of platforms' operating systems and applications; furthermore, their connection to the Internet is exposing them to additional security threats and attacks.

As there are many more embedded computing platforms than PCs in the production and in the field, it has become necessary to adapt the current TC security standard also to embedded platforms.

Why TECOM?

The Integrated project TECOM will adopt a systematic approach to the development of trusted embedded systems, consisting of hardware platforms with integrated trust components. Special attention will be dedicated to the following issues (see figure):

- Trusted hardware, Trusted Platform Module as VHDL design for embedded platforms, which could be adapted to different host processor systems supporting the trust architecture.
- Trusted operating systems mainly based on the new virtualisation/hypervisor architecture which are already in use in the PC world. Adapting such architecture to the specific requirements of small platforms and trusted modules.
- Defining software interfaces for implementing easily accessible SW security modules and mechanisms into such trusted systems and working on example implementations.
- Trusted protocols: Elementary TC protocols like TSS (Host interface API) and TNC (trusted network connect, an advanced secure communication protocol) will be adapted to embedded platforms.
- Typical, specific application examples will give us feedback for the development methodology and interface requirements for the trust functionality and application friendliness.

The results and experience gained from the project will be used to influence the TC standardisation work. The project findings are expected to give impulses for the new trust based application scenarios and solutions concerning mobile phones, communications, e-commerce, automotive industry and similar.

At a Glance: TECOM
Project coordinator:
TECHNIKON Forschungs und Planungsgesellschaft mbH (AT)
Partners:
Infineon Technologies AG (DE), Amtec S.p.A. (IT), Trango Virtual Processors (FR), TU Dresden (DE), SYSGO AG (DE), Sirrix AG Security Technologies (DE), EADS (FR), Aonix (FR), Mixed Mode GmbH (DE), Trusted Logic (FR)
Duration: 36 months
Total cost: 9 007 964 €
EC Contribution: 6 139 998 €
Programme: FP7 ICT Work Programme 2007-08, Objective 1.4
Further information:
Klaus - Michael Koch
BURGPLATZ 3a
9500 VILLACH, Austria
E-mail: coordination@tecom-project.eu
Phone: +43 42 42 233 55 0
Fax: +43 42 42 23 3 55 77
Web site: www.tecom-project.eu
Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

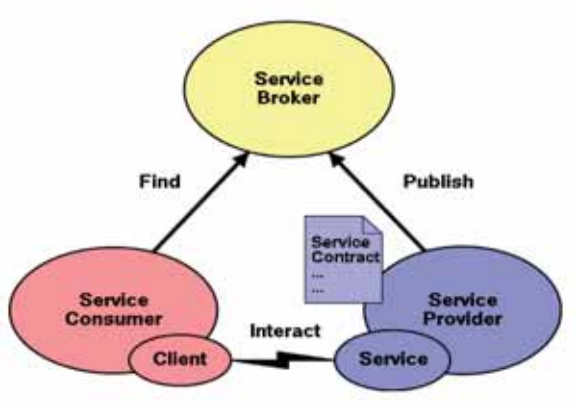
AVANTSSAR - Validating Security Properties of Software Services

The dynamic composition of software services in future network infrastructures entails a wide range of trust and security issues. AVANTSSAR will develop the first computer language for specifying trust and security properties of services and their dynamic composition into secure service architectures. The language will be integrated in a new software platform with algorithms and tools to validate those properties.

Why Research in Secure Service Composition?

Driven by rapidly changing requirements and business needs, IT systems and applications are undergoing a paradigm shift: components are replaced by services distributed over the network, and composed and reconfigured dynamically in a demand-driven way into service-oriented architectures.

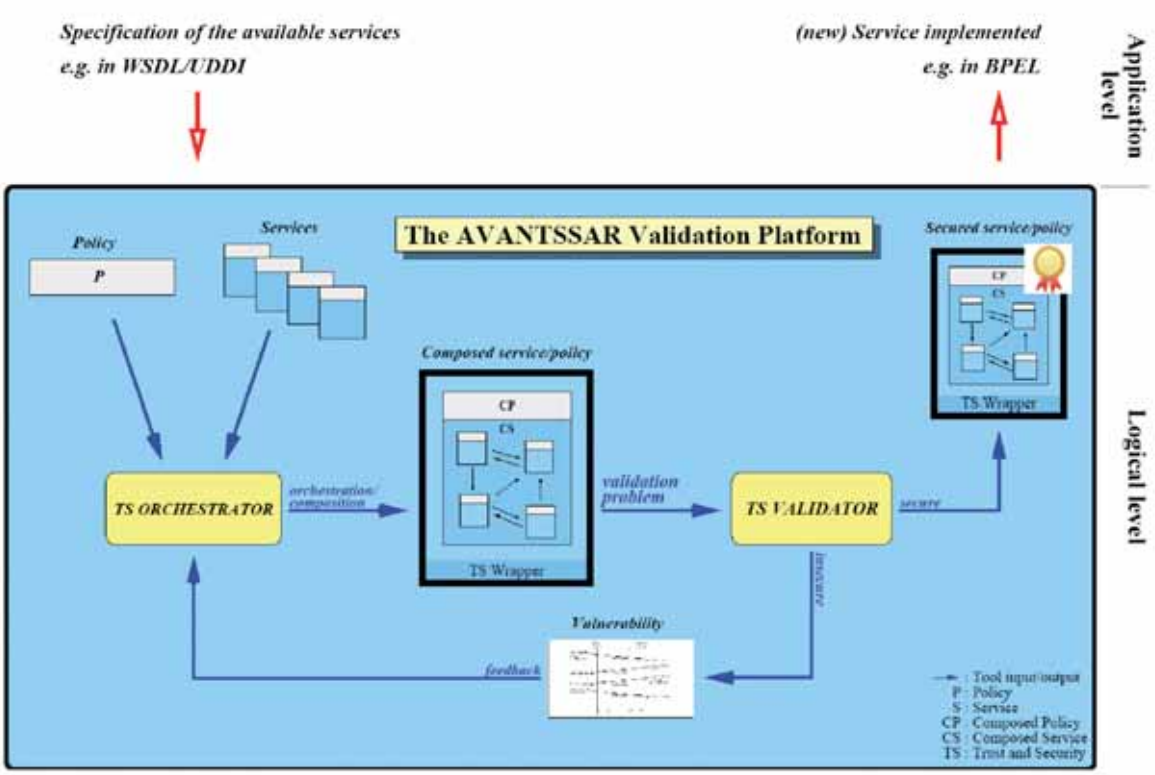
Deploying services in future network infrastructures entails a wide range of trust and security issues. Solving them is extremely hard since making the service components trustworthy is not sufficient: composing services leads to new subtle and dangerous vulnerabilities due to interference between component services and policies, the shared communication layer, and application functionality. Thus, one needs validation of both the service components and their composition into secure service architectures.



Why AVANTSSAR?

AVANTSSAR proposes a technology for the formal specification and Automated VAlidatioN of Trust and Security of Service-oriented ARchitectures. This technology will include an integrated toolset, the AVANTSSAR Validation Platform, tuned on relevant industrial case studies. The project will develop:

- ASLan, the first formal language for specifying trust and security properties of services, their associated policies, and their composition into service architectures.



The AVANTSSAR Validation Platform and its usage towards enterprise Service-Oriented Architectures

- Automated techniques to reason about services, their dynamic composition, and their associated security policies into secure service architectures.
- The AVANTSSAR Validation Platform, an automated toolset for validating trust and security aspects of service-oriented architectures.
- A library of validated composed services and service architectures, proving that the AVANTSSAR technology scales to envisaged applications.

Migrating project results to industry and disseminating them to standardisation organisations will speed up the development of new network and service infrastructures, enhance their security and robustness, and increase the public acceptance of emerging IT systems and applications based on them.

AT A GLANCE: AVANTSSAR

Project coordinator:
Università di Verona (IT)

Partners:
ETH Zurich (CH), Institut National de Recherche en Informatique et Automatique (FR), Institut de Recherche en Informatique de Toulouse (FR), Università di Genova (IT), IBM Research GmbH (CH), OpenTrust (FR), Institute e-Austria Timisoara (RO), SAP AG (DE), Siemens Aktiengesellschaft (DE)

Duration:
36 months

Total cost:
6 070 955 €

EC Contribution:
3 800 000 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Prof. Luca Viganò
Università di Verona
Strada Le Grazie 15
37134 Verona, Italy
E-mail: luca.vigano@univr.it
Phone: +39 3204251233
Fax: +39 0458027068

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

AWISSENET - Ad-hoc personal area network and WIreless Sensor SEcure NETwork

AWISSENET aims to implement and validate a scalable, secure, trusted networking protocol stack, able to offer self-configuration and secure roaming of data and services over multiple administrative domains and across insecure infrastructures of heterogeneous ad-hoc personal area networks and wireless tiny sensor networks.

Why Research in Secure Wireless Sensor Network Infrastructures?

Ad-hoc Personal Area Networks and Wireless Sensor Networks (AWSN) are expected to form an integral part of the foreseen ubiquity intelligent, future mobile network. They are envisaged to play a key role in the vision of offering mobile, personalised services, whenever and wherever needed, while supporting applications with broadband, wireless connectivity anytime and anywhere. However, security and resilience across AWSN, especially across insecure, heterogeneous and multi-administration domains face essential limitations. Characteristics like auto-configuration and self-organization, which are fundamental for the expected flexibility of an AWSN, introduce specific security concerns that are unknown or less severe in legacy wired and wireless/mobile networks.

Why AWISSENET?

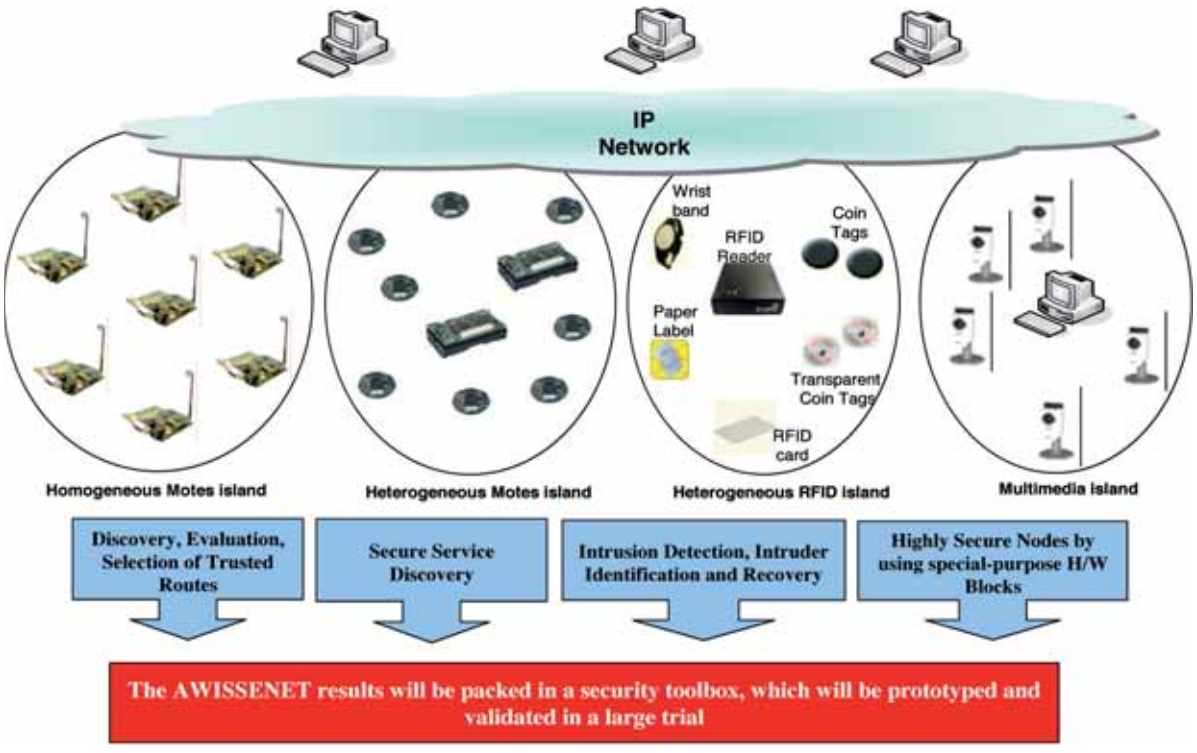
AWISSENET is a project focused on security and resilience across ad-hoc Personal Area Networks (PANs) and wireless sensor networks. AWISSENET motivation is to implement and validate a scalable, secure, trusted networking protocol stack, able to offer self-configuration and secure roaming of data and services over multiple administrative domains and across insecure infrastructures of heterogeneous ad-hoc and wireless tiny sensor networks. AWISSENET optimisations will be extended where applicable from networking up to the applications layer, focusing on three key principles:

- Discovery, evaluation and selection of trusted routes based on multiple security metrics and key pre-distribution methods. The overall scheme must support secure routing even with disappearing nodes, multiple levels of in-network processing and multiple layers of aggregation. Moreover, to protect the secure routing of information from traffic analysis attacks, the project will research utilisation of dynamic obfuscation of relationships.

- Secure Service Discovery, providing a network-level security framework, which will protect service discovery messages inside the AWISSENET, when crossing unknown domains or when interacting with public service providers.

- Intrusion detection, intruder identification and recovery based on distributed trust to provide security against malicious attacks.

The AWISSENET results will be packed in an AWISSENET security toolbox, which will enable easy configuration and



instant support of Ad-hoc PAN and WIreless Sensor SEcure NETworks (see figure below).

The proposed architecture and protocol toolbox will be prototyped and validated in a large trial of more than 100 sensor nodes. Over this trial, a number of PAN and sensor application scenarios will be validated e.g. disaster recovery and ambient intelligence in environments like industry, home, or roads.

At a Glance: AWISSENET

Project coordinator:
Hellenic Aerospace Industry S.A. (GR)

Partners:
- Alcatel-Lucent Deutschland (DE),
- Thales Communications France (FR),
- Northern Venture Ltd (CY),
- Telecommunication Systems Institute (GR),
- University of Helsinki (FI),
- Polytechnic University of Madrid (ES),
- Technological Educational Institution of Chalkida (GR)

Duration:
26 months

Total cost:
3 097 279 €

EC Contribution:
1 959 642 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Mr Evangelos Ladis
PO BOX 23
GR32009 Schimatari
Greece
E-mail: egladis@haicorp.com
Phone: +30 226 2052 511
Fax: +30 226 2052 910
Web site: www.awissenet.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

INTERSECTION - INfrastructure for heTErogeneous, Resilient, SEcure, Complex, Tightly Inter-Operating Networks

INTERSECTION (INfrastructure for heTErogeneous, Resilient, SEcure, Complex, Tightly Inter-Operating Networks) aims at enhancing the European potential in the field of security by assuring the protection of heterogeneous networks and infrastructures. The project will focus on vulnerabilities at the intersection points between different interoperating network providers.

Why research in vulnerabilities at the intersection points between network providers?

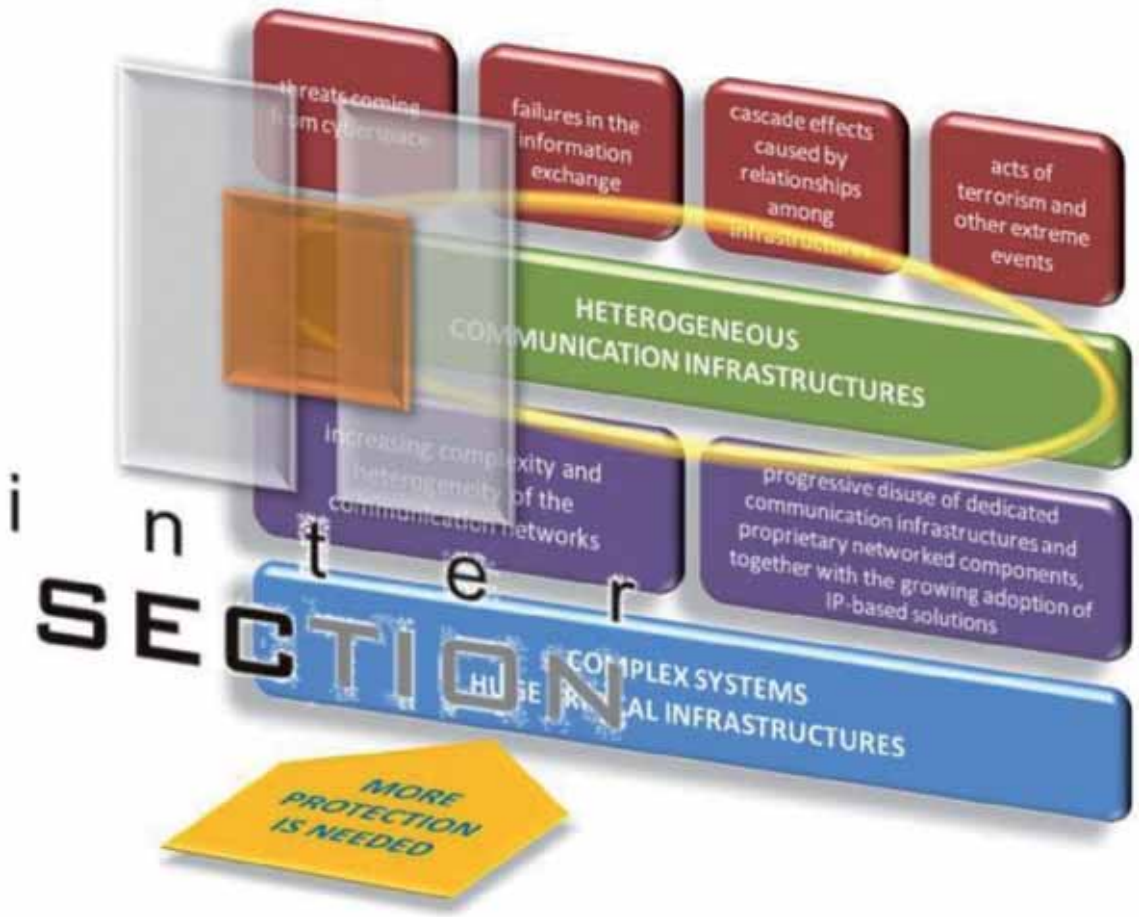
An emerging common feature of critical infrastructures (*e.g.* electricity production and distribution) is their reliance on the connections through heterogeneous networks. Unfortunately the increasing complexity and heterogeneity of the communication networks and systems increase their level of vulnerability. It becomes therefore important to strongly protect the network infrastructure from attacks and failures in order to ensure the secure end-to-end transmission of control information generated by critical systems. Examples of such vulnerabilities are:

- threats coming from cyberspace, (*e.g.* disruption of communication services, wide spectrum attacks to the equipment devoted to control the lifeline system);
- failures in the information exchange;
- delayed or erroneous information;
- cascade effects caused by relationships among infrastructures;
- acts of terrorism and other extreme events, such as technological disasters or natural catastrophes.

Why INTERSECTION?

The INTERSECTION project aims at designing and implementing an integrated framework for:

- Detecting anomalous events (**cooperative detection**);
- Reacting to well-known, as well as new forms of anomalies (**cooperative reaction**);
- Deploying truly distributed countermeasures against ongoing threats;
- Providing systems with mechanisms for intrusion tolerance, i.e. preventing intrusions from generating a system failure (**cooperative tolerance**).



INTERSECTION will design and implement an integrated security framework made of different subsystems and components providing network and infrastructure security. A working prototype will be implemented to be used as final demonstrator of specific scenarios. Involved end-users will share information on attacks and malfunctions, validate obtained results and host the demonstrator.

INTERSECTION will also contribute to standardisation in order to foster multi-operator interoperability and coordinated strategies for securing networked systems. Security metrics for assessment and certification of network infrastructures and systems will be defined.

In order to achieve its objectives, INTERSECTION has identified the following technical areas of work:

- Analysis and classification of vulnerabilities of heterogeneous networks
- Requirements analysis and design of an integrated framework comprising different security tools.
- Development of techniques and tools for increasing security and resilience of networked systems.
- Integration of the developed tools and their validation.
- Standardization and definition of security metrics.

A prototype of the security framework will be released during the project. It will be used to build a final demonstrator showing specific scenarios and will be validated by both the INTERSECTION project partners playing the role of end-users and the members of the Group of Experts supporting the project.

At a Glance: INTERSECTION

Project coordinator:
ELSAG DATAMAT S.P.A. (IT)

Partners:
Coronis Systems SA (FR), Fraunhofer Gesellschaft zur Förderung der angewandten Forschung E.V. (DE), Consorzio Interuniversitario Nazionale per l'Informatica C.I.N.I. (IT), Telespazio S.P.A. (IT), ITTI SP. Z.O.O. (PL), Polska Telefonia Cyfrowa SP. Z O.O. (PL), Telefonica Investigacion y Desarrollo SA (ES), Eidgenössische Technische Hochschule Zürich (CH), Thales Research & Technology (UK), Lancaster University (UK)

Duration:
24 months

Total cost:
4 624 845 €

EC Contribution:
2 900 000 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Mr Stefano Romani
Via Laurentina 760
IT00143 Roma
Italy
E-mail: stefano.romani@elsagdatamat.com
Phone: +39 06 50 27 42 18
Fax: +39 06 50 27 48 30
Web site: www.intersection-project.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

PICOS - Privacy and Identity Management for Community Services

PICOS will develop and build a state-of-the-art platform for providing the trust, privacy and identity management aspects of community services and applications on the Internet and in mobile communication networks.

Why is research needed on privacy and identity-management in online platforms supporting community services?

In recent years, we have seen the emergence of services for professional and private on-line collaboration via the Internet. Nowadays, many European citizens spend work and leisure time in on-line communities, such as social networks or other real world communities that utilise on-line services to support their activities.

Moreover, communities based on mobile communication allow users to participate in their community not only from places where fixed-line communication is available. Mobile communities also allow for a more intensive linking of services and therefore integration of people's virtual and real communities. Additionally, context information, such as location information, gets important, e.g. for spontaneous socialising and collaboration in the "real" world.

However, when users participate in such communities, they consciously leave private information traces they are unaware of.

The providers of community services need to handle trust and privacy in a manner that meets the participants' needs as well as complying with regulation. Moreover, in order to finance or co-finance respectively such community services, the infrastructure needs to be opened for marketing activities of sponsors/advertisers. And, as new community-supporting services offered by communication service providers will increasingly become interoperable, this would require that provisions for trust enablement and privacy-respecting identity management also be interoperable between such communication service providers.

A new approach to identity management in community services is needed, in order to meet the needs for:

- the enablement of trust, by members of the community, in other members and in the service-provision infrastructure,
- the privacy of community members' personal information,
- the control by members of the information they share, and
- the interoperability of community-supporting services between communication service providers

This approach must be developed in an open manner, and requires technical advances in order to meet the requirements.

Why PICOS?

PICOS will develop and build a state-of-the-art platform for providing the trust, privacy and identity management aspects of community services and applications on the Internet and in mobile communication networks. The PICOS approach to trustworthy on-line community collaboration addresses the following four questions:

- What are the Trust, Privacy and Identity issues in new context-rich mobile communication services, especially community-supporting services?
- How can information flows and privacy requirements be balanced in complex distributed service architectures (e.g., mash-ups)?
- How can these issues be solved in an acceptable, trustworthy, open, scalable, manner?
- Which supporting services and infrastructures do the stakeholders need?

PICOS will first review contemporary research in relevant disciplines. Work will then focus on platform design and prototype development in order to create interoperable, open, privacy-respecting identity and trust management tools that can be demonstrated to the public. These will be used to construct community application prototypes by leading industry partners in close cooperation with the targeted community. Finally the prototypes will be trialled and self-evaluated by PICOS concerning usability, ergonomics, legal issues, trust and privacy.

Expected Results

Expected PICOS results are:

- A set of interdisciplinary requirements for trustworthy, privacy-friendly community transactions, by setting policies for the disclosure of information to specific members of the community.

o A platform prototype that demonstrates the provision of state-of-the-art privacy and trust technology to leisure and business community applications, such as fishing or personal transportation services communities.

o User-centric trials that validate its applicability.

At a Glance: PICOS

Project coordinator:
Johann Wolfgang Goethe-Universität Frankfurt (DE)

Partners:
Hewlett-Packard Laboratories Bristol (UK), Hewlett-Packard Centre de Competence France (FR), Universidad de Málaga (ES), Center for Usability Research & Engineering (AT), Katholieke Universiteit Leuven - Interdisciplinary Centre for Law and ICT (BE), IT-Objects GmbH (DE), Atos Origin (ES), T-Mobile International AG (DE), Leibniz Institute of Marine Sciences (DE), Brno University (CZ)

Duration: 36 months

Total cost: 5 951 136 €

EC Contribution: 3 998 998 €

Programme: FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Prof. Dr. Kai Rannenberg
Gräfstr. 78
D-60054 Frankfurt am Main
Germany
E-mail: contact@picos-project.eu
Phone: + 49 69 79825301
Fax: + 49 69 798 25306
Web site: www.picos-project.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

PRISM - Privacy-aware Secure Monitoring

The goal of the project PRISM is to set a new de-facto standard for privacy-preserving traffic monitoring and deliver a tool that is guaranteed (and possibly certified) for legal compliance.

Why is research needed in privacy-preserving network traffic monitoring?

Traffic monitoring has always been recognised as a feature of paramount importance for all sorts of ICT networks, from very small access networks to world-wide operator domains. On the one hand, traffic monitoring is a fundamental method to acquire essential information for the operation and management of networks and for Service Level Agreement validation. On the other hand, traffic monitoring is needed to guarantee the security of the network infrastructure and its users and to detect frauds and attacks. For the latter, typically, raw packet-level traffic traces are collected using suitable traffic probe devices and fed to monitoring applications (Intrusion Detection Systems, antivirus, etc.) for analysis.

Traffic monitoring could become a threat to users' privacy by keeping individual communications under surveillance. Even when data capture is restricted to the header part of the transmitted packets, thus excluding the user payload data, a certain amount of personal information may still be gathered (e.g. who is connecting with whom or with which servers, which applications are used, etc.) and exploited to illegitimately profile individual users.

These privacy concerns contributed to prevent operators from sharing monitored traffic logs, let alone allowing third parties to access the collected data. However, such data would be very important for the research community in order to design and assess anomaly/intrusion detection mechanisms based on real traces taken from live infrastructures. It might be sufficient to anonymise the collected data traces right before making them available, or only publish suitably derived statistics of the raw collected data in order to render impossible any infringement of the privacy rights of the users. However, proper data anonymisation is not a trivial task and can lead to elimination of important information to a degree where the data become useless for certain purposes.

Why PRISM?

PRISM aims to show that it is technically possible to devise a privacy-preserving network monitoring system where carefully designed data protection mechanisms can coexist with suitably adapted monitoring applications.

The proposed approach is based on a two-tier system:

1. A first front-end tier of data protection mechanisms will be directly enforced at the traffic probe devices. The front-end cryptographic mechanisms will be controlled by a separate entity (privacy-preserving controller).
2. The collected (and already protected) data will be delivered to a second back-end tier, which is implemented as a privacy-enforcing middleware and provides an additional level of data protection to enable privacy-preserving access and/or sharing of the acquired data to external parties. By interacting with the privacy-preserving controller, the back-end provides the capability of selectively/partially removing data protection in specific cases (namely in the presence of attacks, abuses and in general when reaction is needed).

The system will exploit standard-based protocols for data exporting, in order to achieve interoperability. It will be designed from the beginning to comply with the privacy regulation set forth at EU and regional levels: the back-end will express privacy regulations into concrete rules in an ontology language. Ultimately, the goal of the project is to set a new de-facto standard for privacy-preserving traffic monitoring and deliver a tool that is guaranteed (and possibly certified) for legal compliance.

At a Glance: PRISM

Project coordinator:
Telscom AG (CH)

Partners:
Consorzio Nazionale Interuniversitario per le Telecomunicazioni (IT), Fraunhofer Institute for Open Communication Systems (DE),
Forschungszentrum Telekommunikation Wien (AT), Hitachi Europe (FR),
Institute of Communication and Computer Systems, National Technical University of Athens (GR), Nettare s.r.l. (IT), Salzburg Research Forschungsgesellschaft m.b.H (AT)

Duration: 27 months

Total cost: 3 160 587 €

EC Contribution: 2 300 000 €

Programme: FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Dr. Sathya Rao
Telscom A.G.
AARWILWEG 20
3074 MURI
SWITZERLAND
E-mail: rao@telscom.ch
Phone: +41 31 3762033
Fax: +41 31 3762031

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

SWIFT - Secure Widespread Identities for Federated Telecommunications

SWIFT aims to leverage identity technology as a key to integrate service and transport infrastructures for the benefit of users and the providers, thereby extending identity functions and federation to the network and addressing usability and privacy concerns. The project will develop a standards aligned model for user data linked to identities or personae with the user in control of the information exchanged.

Why Research in Identity Management?

Today, Identity Management (IdM) mainly covers applications and web services. Tomorrow, IdM will need to permeate the infrastructure, entering application platforms, network appliances, development tools, and client operating systems. Standards will be essential to make digital identities and entitlements portable and transferable.

Identity technology has the potential to be an integration technology to facilitate fixed mobile and broadcast (FMBC) convergence and to enable trusted network and the service infrastructures. Today, IdM has made great strides forward in the applications and service backend domain, but still lacks significant impact, in particular, on networks and network services. On the other hand, usability and privacy support across all layers are mandatory user requirements for digital identities, without which identity solutions would be unacceptable to the user.

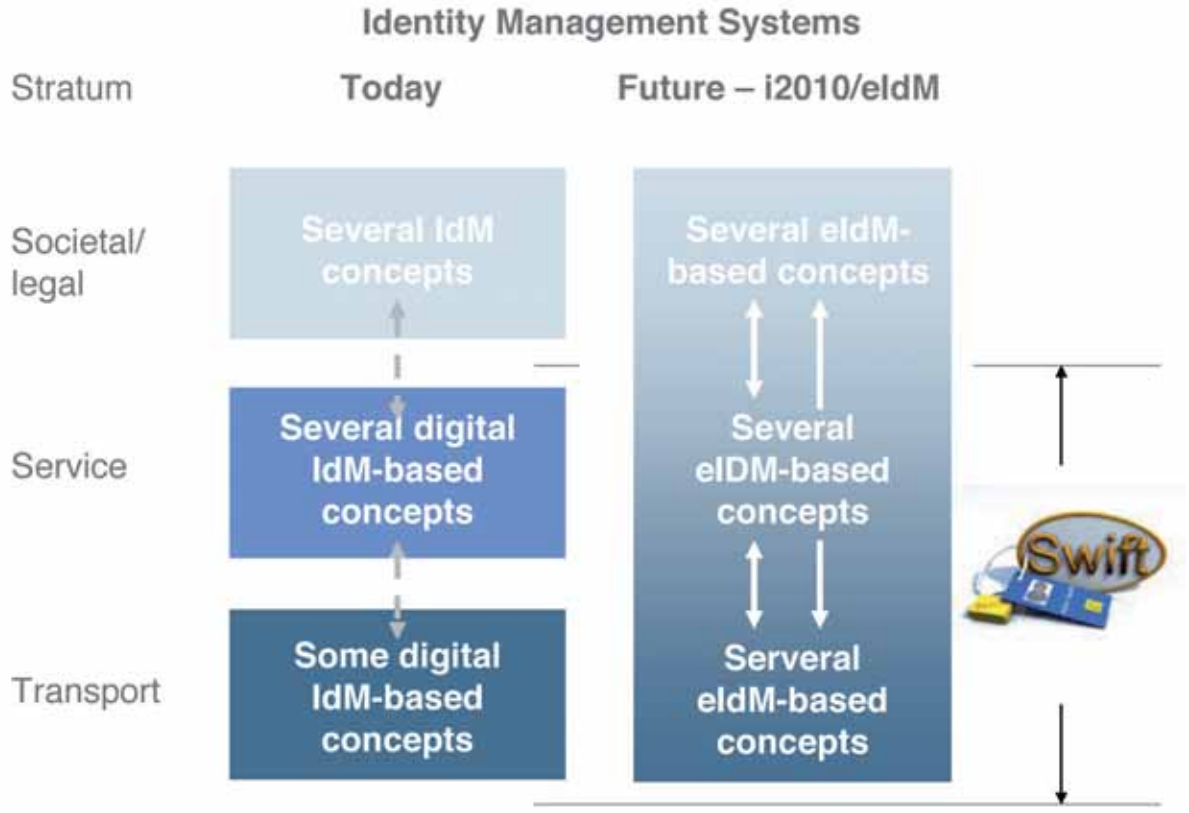
Identity Management (IdM) is considered key to private, legal and business transactions as in the European eIDM2010.

Why SWIFT?

IdM frameworks are currently confined to the web services domain. SWIFT extends IdM by including user centricity and network operators as additional interdependent domains with IdM at the core.

This new view of user centricity provides a novel perspective: Identity as central for legal, business and network development trends. To enable this vision, SWIFT aims to build a cross-layer identity framework with emphasis on networks and services using identity also as key enabler to convergence. For the user, it will provide multiple personae and identity-based privacy across layers and a data model for new and dynamic business. Cross-layer usability features will be included, such as ubiquitous connectivity, user-centred mobility and single sign-on based on vertical and horizontal federation principles.

SWIFT will develop a standards aligned model for user data linked to identities or personae with the user in control of the information exchanged. It will separate management from resolution of identities at all layers, i.e. from the service to link, considering both privacy and "need-to-know" concerns.



SWIFT's user-centric IdM approach addresses three views:

1) users have complete control over privacy and disclosed information dependent on the service accessed;

2) services can use a generic treatment of authentication, authorization and access control and are managed by a unique identity; and,

3) commercial players can leverage new business solutions for operators, service providers or third parties through their federation approach.

SWIFT aims to primarily impact technology research and related standardization in the manufacturing and telecom operator domains.

At a Glance: SWIFT

Project coordinator:
Fraunhofer (DE)

Partners:
•NEC Europe Ltd. (UK),
•Deutsche Telekom AG (DE),
•Dracotic (ES),
•University of Murcia (ES),
•IT Aveiro (PT),
•University Stuttgart (DE),
•Alcatel-Lucent (BE),
•Portugal Telecom Inovacao SA (PT)

Duration:
30 months

Total cost:
5 299 769 €

EC Contribution:
3 480 000 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Mr Mario Hoffmann
Rheinstrasse 75
64295 Darmstadt, Germany
E-mail: Mario.Hoffmann@sit.fraunhofer.de
Phone: +49 6151 869-60
Fax: +49 6151 869-22
Web site: www.ist-swift.org

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

WOMBAT - Worldwide Observatory of Malicious Behaviours and Attack Threats

The aim of WOMBAT is to provide new means to understand the existing and emerging threats that are targeting the Internet economy and the net citizens.

Why Research in Emerging Security Threats?

Today, combating cyber-crime becomes harder and harder. This is acknowledged by several recent articles from major anti-virus companies that confirm that cyber-crime scene is becoming increasingly more organized and more consolidated.

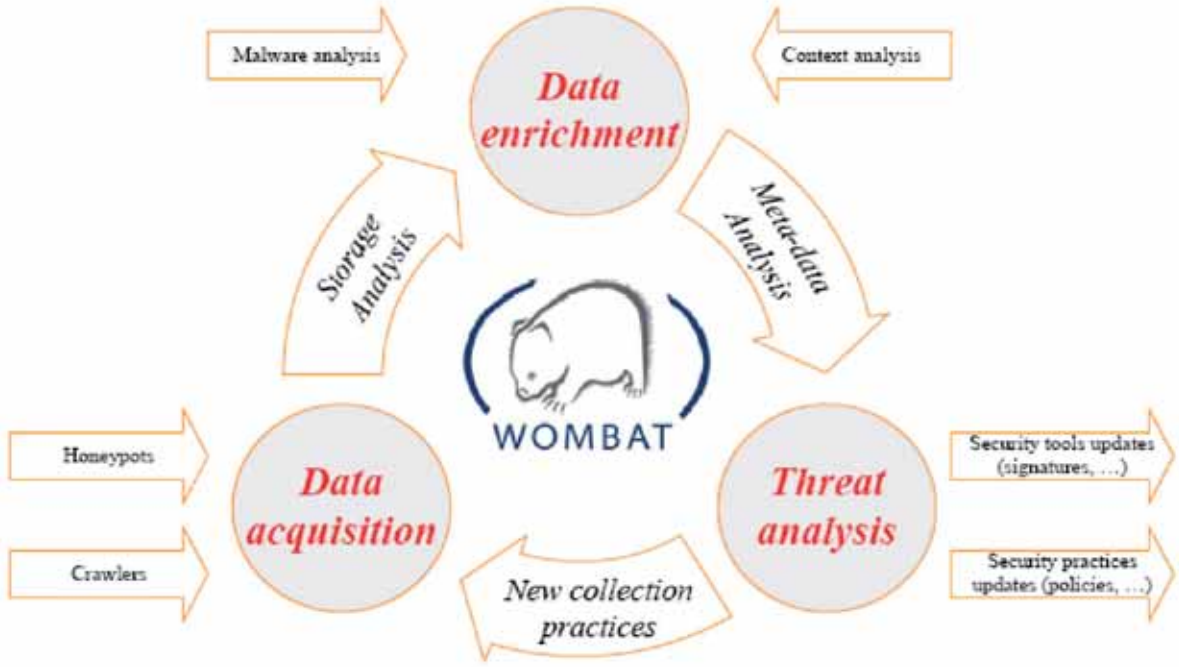
Several initiatives exist today that offer information and data that support this theory. However, the information they provide cannot be used by the research community to identify, understand and eventually defeat the cyber threats we are facing. The reasons are twofold:

- First, due to privacy or confidentiality issues, most of these sources are not allowed to share the detailed information they hold.
- Second, as a result of the lack of publicly available information, no framework exists to rigorously investigate emerging attacks using different data sources and viewpoints.

Why WOMBAT?

WOMBAT aims at providing new means to understand the existing and emerging threats that are targeting the Internet economy and the net citizens. To reach this goal, the project is structured around three main objectives (see figure):

1. **Real time gathering of a diverse set of security related raw data:** WOMBAT will take advantage of existing sources of information controlled by some of the partners, such as the Deepsight threat management system managed by Symantec, the worldwide distributed honeypot system operated by Eurecom, the nationwide early warning system in use by CERT Polska or the largest malware collection in the world accumulated by Hispasec. WOMBAT will also join efforts with other players in the field and explore how their dataset can be used, in order to obtain a global view of the observed phenomena. Also, some new types of sensors will be considered, especially in the domain of client-based honeypots. An important effort will be devoted to ensure interoperability among these various sources.
2. **Data enrichment by means of various analysis techniques:** As the sole observation of a phenomenon does not suffice to reveal its cause(s), other elements surrounding or characterizing it must be formalized and taken into account. WOMBAT will develop new techniques to characterize the observed attacks, the collected malware, etc. This will lead to the semi-



automatic generation of metadata associated with the raw data collected.

3. **Threats Analysis:** WOMBAT will build upon the recognized expertise of several of its partners in correlating the data and metadata related to various events in order to identify the root cause(s) of a group of intrusions. This will make it possible to generate models of harmless, yet malicious, activities. As a result, the project will not only be able to raise alerts more accurately when new situations emerge but, more importantly, it will offer support during the decision making process for countermeasures selection. These models will help security actors to derive sound rationales for their security investments.

At a Glance: WOMBAT

Project coordinator:
France Telecom R&D (FR)

Partners:
•Institut Eurecom (FR)
•Technical University Vienna (AT)
•Politecnico di Milano - Dip. Elettronica e Informazione (IT)
•Vrije Universiteit Amsterdam (NL)
•Foundation for Research and Technology (GR)
•Hispasec (ES)
•Research and Academic Computer Network (PO)
•Symantec Ltd. (IE)
•Institute for Infocomm Research (SG)

Duration:
36 months

Total cost:
4 422 746 €

EC Contribution:
2 890 796 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Dr Hervé Debar
Rue des Coutures, 42
14066 Caen
France
E-mail: herve.debar@orange-ftgroup.com
Phone: +33 231759261
Fax: +33 231378343

For further information:
Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

eCRYPT II - Fundamental enabler for secure, dependable and trusted infrastructures

The highly successful Network of Excellence ECRYPT on cryptology – the science that studies mathematical techniques in order to provide secrecy, authenticity and related properties for digital information - continues into FP7 as ECRYPT-II.

Why Cryptology Research .... ?

Cryptology is a fundamental enabler for security, privacy and dependability in the Information Society. Cryptographic techniques can be found at the core of computer and network security, of digital identification and digital signatures, digital rights management systems, content retrieval, tamper detection, etc. Their applications vary from e-business, m-business, e-voting and on-line payment systems to wireless protocols and ambient intelligence. Today we find cryptology in our GSM or 3G mobile phones, on our bank or credit cards, on our desktop (browser), on WLAN connections, and for some European citizens even in our electronic identity card.

.... in Europe?

Europe is playing a vital role in the area of cryptology. The International Association of Cryptologic Research (IACR, 1200 members) organizes 3 flagship conferences each year with high quality contributions (acceptance rate around 20%); one of these is held in Europe (Eurocrypt has more than 400 attendees). European researchers play a key role in the IACR. European successes in the area of cryptology include the Belgian algorithm Rijndael chosen by the US government for block ciphers as its Advanced Encryption Standard (AES), UMTS/3GPP, the smart card industry, and the NESSIE IST project.

Why ECRYPT II?

Firstly, because of the recognized success of ECRYPT in integrating cryptographic research in Europe. It has created new research communities and novel workshops (SHARCS and RFIDSec). Its open eSTREAM competition received 34 submissions and attracted more than 100 researchers from both industry and academia worldwide. This integrated approach has substantially advanced the state of the art in stream ciphers. The strength of ECRYPT has been in the combination of closer integration between its partners with its openness towards other researchers, who do not form part of the network, but who have participated in other ways, by attendance at workshops and schools, or as guests at research meetings. Secondly, because there remain …

.... Outstanding and on-Going Challenges for European Cryptology!

There is still a strong need for integrated research into the foundations of cryptology, and not only in applied cryptology. The cryptography problem has not been "solved", even if we do have cryptographic algorithms and protocols available that can be called as "black boxes" by security engineers. It would therefore be false for research efforts in security to be focused exclusively on building trust infrastructures, addressing application security issues and integrating security into applications, even if it is true that security systems usually fail for other reasons than cryptographic flaws (such as incorrect specifications or implementations, malicious software, incorrect configurations, social engineering attacks…).

Cryptology has matured as a scientific discipline but, at the same time, the world in which cryptosystems are deployed is changing. Threats to their security are increasing. A continuous monitoring of state-of-the art breaking methods in is called for in order to assess the security of systems deployed. Maintenance of their security is crucial for making our information infrastructures secure. On the other hand, future developments (e.g., ambient intelligence) present new challenging applications, which need to be addressed by different or better cryptologic methods than the ones we know today.

Where might ECRYPT II be expected to produce results?

Cryptology will help to deliver:

- Low-cost and low-power solutions: essential to get cryptography everywhere (ambient intelligence);
- Highly efficient solutions for applications such as bus encryption, encryption in Terabit networks: if cryptography presents too large an overhead/cost, it will not be deployed, or will be switched off.
- High security solutions in those application areas that require cryptographic algorithms and protocols that can offer a higher confidence and assurance level than the state of the art. E.g., for e-voting, we need secure and robust protocols that survive even if a subset of the players are faulty or corrupt; for e-health and national security we

need cryptographic algorithms which provide guaranteed protection for 50 years or more.

- Secure watermarking techniques based on a formal theoretical foundation, their integration into secure protocols for digital rights management, and perceptual hashing techniques for information retrieval and content identification as alternative DRM strategies.

At a Glance: ECRYPT-II

Project coordinator:
Katholieke Universiteit Leuven (BE)

Partners:
Ecole Normale Supérieure (FR), Ruhr-Universität Bochum (DE), Royal Holloway and Bedford New College (UK), Universita degli Studi di Salerno (IT), University of Bristol (UK), France Telecom (FR), IBM Research (CH), Technische Universiteit Eindhoven (NL), Graz University of Technology (AT), Ecole Polytechnique Fédérale de Lausanne (CH)

Duration:
48 months

Total cost:
3 717 604 €

EC Contribution:
3 000 000 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Prof. Bart Preneel
Kasteelpark Arenberg 10
3001 Leuven-Heverlee
Belgium
E-mail: bart.preneel@esat.kuleuven.be
Phone: +32-16-321148
Fax: +32-16-321969

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
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FORWARD - Managing Emerging Threats in ICT Infrastructures

FORWARD is a coordination action that aims at promoting collaboration and partnership between researchers from academia and industry involved in the protection of ICT infrastructures against cyber threats such as malicious code (viruses, botnets, spyware), spam and phishing.

Emerging Cyber-Threats

The Internet has become part of the life of millions of people who rely on it to communicate, obtain information, and perform business, on a daily basis. Unfortunately, the success of the Internet has also attracted shady characters who seek fast profit from criminal activities or fun from causing havoc and damage. As a result, the Internet has changed from an open and supportive environment into an often hostile and dangerous place. Interestingly, besides traditional attacks against servers and services, attackers are increasingly aiming at end-users. Novel threats have emerged in which the adversaries are not only interested in taking control of remote machines, but also in stealing sensitive information (such as credit card information) from their users.

In addition to the threats on the Internet for users, there is the increasing problem that attacks carried out over the network have an effect on operations, processes, and organizations in the real world, such as for example on the electric power grid, on hospitals or on airports.

Why Coordinating EU Research in emerging Cyber-Threats?

To protect the ICT infrastructures and their users, it is vital that research is carried out to identify and counter both existing attack venues and emerging threats. In addition, research is needed to understand the impact of ICT threats and attacks on domains that build upon a working infrastructure and to identify and mitigate cyber threats.

Such research is difficult to carry out in isolation, as the problems to deal with are complex and the threat landscape is constantly evolving.

Moreover, researchers need data coming from many different sources to be able to observe and analyse the complex effects and characteristics of real-world attacks. Such data are difficult to obtain though and often, different organizations have access to different sets of data. Thus, researchers and industry have to cooperate to share data that they collect as well as mechanisms (e.g., simulation or large test-beds) to verify their solutions.

Why FORWARD?

The aim of the coordination action FORWARD is to promote collaboration and partnership between researchers from academia and industry involved in the protection of ICT infrastructures against cyber-threats such as malicious code (viruses, botnets, and spyware), spam, and phishing. The goal is to identify, network, and coordinate the multiple research efforts that are underway in these areas and leverage these efforts with other activities to build secure and trusted ICT systems and infrastructures.

The Objectives of FORWARD

The main objectives of the project are to:

- Establish working groups to discuss best practices, progress and priorities, setting the research agendas to be pursued in Europe and identify possible new research areas and threats that need to be addressed.

- Set up an online platform for regularly assessing and reviewing the evolution of the threat landscape and the state of the art in threat detection and prevention techniques.

- Organize workshops with relevant groups of experts from industry and academia but also with policy makers for discussing and presenting the emerging threat landscape, the ongoing research in answer to these threats, and for providing recommendation on actions to be taken in partnership with industry and governments.

- Leverage the findings of individual working groups to describe scenarios in which adversaries use a combination of attacks to threaten the security and disrupt the lives of the people in the European Union.

At a Glance: FORWARD

forward

Project coordinator:
Technical University of Vienna (AT)

Partners:
•Institut Eurecom (FR)
•Vrije Universiteit Amsterdam (NL)
•Foundation for Research and Technology, Institute of
•Computer Science (GR)
•Institute for Parallel Processing (BG)
•Chalmers University (SE)

Duration: 24 months

Total cost: 889 950 €

EC Contribution: 889 950 €

Programme: FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Dr. Christopher Kruegel
Treitlstrasse 183-1
1040 Vienna
Austria
E-mail: chris@auto.tuwien.ac.at
Phone: + 43 1 58 80 11 83 25
Fax: + 43 1 58 80 11 83 91
Web site: www.ict-forward.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

THINK-TRUST - Think Tank for Converging Consumer Needs in ICT Trust, Security and Dependability

Think-Trust is a Coordination Action that will set up an ICT Security Research Advisory Board bringing together the opinions and requirements of a comprehensive range of stakeholders with regard to trust, security and dependability issues in emerging ICT environments.

Why research in security, trust and privacy for the future Networked Society?

The future networked society will depend on massive data collection for security surveillance, creation of Web communities and personalised services.

Data collectors are in an uphill battle to protect their data and ensure compliance with data protection regulation and increasing societal demands for privacy and trustworthiness. At the same time, hackers, organized crime and terrorists are quick to use new technology in an efficiently organised underground e-market.

Despite significant efforts of industry, networked infrastructures become ever more vulnerable. Current ICT developments lead to more complex large-scale polymorphic networks with massive distributed data storage and management capacity.

Research is needed for new and more effective security, trust and privacy, coherently addressing technological, societal and legal issues, in an effort to ensure a society based on freedom, creativity and innovation, whilst providing security for its citizens and critical infrastructures.

Why the Coordination Action Think-Trust?

As the Information Society continues to develop and to grow, there is a very strong need to develop "smart", i.e. intelligent and user-friendly, ICT security environments that take full account of the values of liberty, democracy and privacy in our societies, while providing necessary Trust, Security and Dependability.

Think-Trust will begin the process of mapping or modelling these new ICT environments with the goal to define new areas of work in ICT Security Research, further EU's strategic thinking and positioning in the field, and influence the subsequent ICT technology developments in the coming years. For this, Think-Trust will set up an ICT Security Research Advisory Board that will bring together the opinions and requirements of a comprehensive range of stakeholders with regard to trust, security and dependability issues in emerging ICT environments.

The project and its Advisory Board will be supported by targeted working groups from the stakeholder and research community that will address focussed issues and questions. It is envisaged that initially, the working groups will centre on three prominent and complementary aspects of ICT trust, security and dependability:

1. Technology, covering the conceptual and implementation provisioning for trust, security and dependability;

2. Governance, covering the non-technical needs and concerns, from the social and economic viewpoints, from the human and personal to the organisational and legal/ governmental;

3. Applications, covering areas of trustworthy services and applications, their composability and scalability, inter-relationships and infrastructures, and aggregate domain groupings such as finance, health, commerce, and the Internet itself.

At a Glance: Think-Trust

Project coordinator:
Waterford Institute of Technology (IE)

Partners:
•Technische Universität Darmstadt (DE),
•Ecole Nationale Supérieure des Télécommunications - ENST (FR),
•Telscom Consulting AG (CH)

Duration:
30 months

Total cost:
580 000 €

EC Contribution:
580 000 €

Programme:
FP7 ICT Work Programme 2007-08, Objective 1.4

Further information:
Mrs Zeta Dooly
Waterford Institute of Technology
Telecommunications Software & Systems Group (TSSG)
Cork Road, Waterford
Ireland
E-mail: zdooly@tssg.org
Phone: + 353 513 029 43
Fax: +353 51341100
(please mark on fax: F.A.O. Zeta Dooly)
Web site: www.think-trust.eu

Information Desk
European Commission - Information Society and Media DG
Office: BU31 01/18 B-1049 Brussels
Email: infso-desk@cec.eu.int
Tel: +32 2 299 93 99
Fax: +32 2 299 94 99
http://europa.eu/information_society

AREA 6

"EXPERIMENTAL TEST FACILITIES"

Today's communication infrastructure is more and more based on the Internet, resulting from a long evolution. The large legacy of deployed infrastructures, however, limits the Internet's capacity to absorb innovation and to cope with new requirements. Work under the area of experimentally-driven research and experimental facilities, which is also known under the acronym FIRE – "Future Internet Research and Experimentation", has two related dimensions, for which a total of 14 projects has been selected in ICT Call2:

1. Experimentally-driven research on new paradigms and advanced networking approaches for the future internet: many networking researchers around the world have identified emerging limitations of the current Internet architecture and agree that it is time for research to take a long term view and to reconsider the basic architecture of the Internet, to see if any improvement can be identified, even if it does not appear to be backward-compatible at a first glance. To be effective and to produce applicable results, this fundamental research in new paradigms has to be tested, at least as a proof-of-concept, in large scale environments, so as to assess the feasibility of the new concepts, verify their large scale effects (not only at technological level, but also as for their foreseeable implications on users, society and economy) and derive further requirements, orientations and inputs for the research. This kind of experimentally-driven approach avoids that the research efforts will remain at the level of paperwork and will hopefully allow exploring significant improvements over the current Internet.

2. Interconnected testbeds on networks and services: it is envisaged that the interconnected testbeds supported in this area will evolve from gradually federated testbeds towards becoming a sustainable, dynamic, and integrated large scale experimentation facility supporting academia, research centres and industry in their research on networks and services. As opposed to the functionality of individual testbeds, the federation of testbeds will allow testing at larger scale and at system-level. The interconnected testbed activities in this area are open to any relevant European projects within other Objectives of FP7, as well as national, regional or multinational initiatives. These projects will be able to use the facilities or to federate their testbeds within the facility.

FIRE experimentally-driven research vision

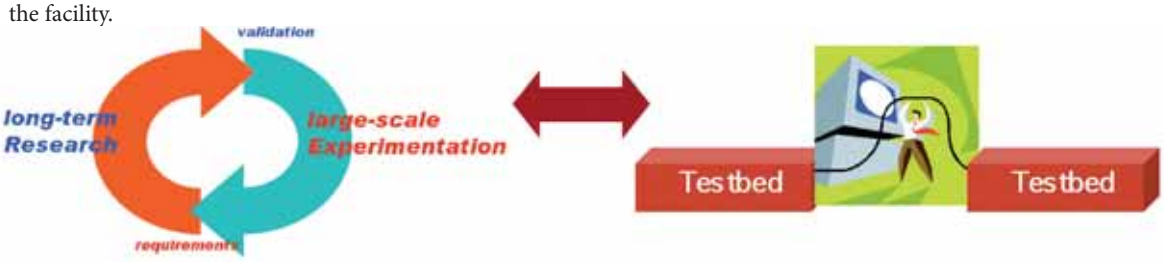
There is an increasing demand from academia and industry to bridge the gap between long-term research and large-scale experimentation, which can be done through experimentally-driven research consisting of iterative cycles of research, design and experimentation of new networking and service architectures and paradigms for the Future Internet addressing all levels. FIRE experimentally-driven long term research shall address broad system-level research which proofs and exploits the full value of the FIRE Facility:

- doing truly multidisciplinary experimental research:
- testing new internet architectures and paradigms including at service level;
- doing socio-economic impact assessments for future changes to the internet.

Long term cross domain perspective of the FIRE facility

The FIRE experimental facility is planned to be broadly scoped to support research on the Future Internet and its services:

- to include testbeds for different stages of the research and development cycle - from proof-of-concept type testbeds to pre-commercial testbeds.
- to support testing the impact of changes to the Internet not only in technical but also in socio-economic terms.
- to cover all levels from fast network connectivity to service architectures at different levels.
- to be available to academia, research centers and industry including the relevant ETPs.
- to allow experimentation with advanced architectures of the Future Internet taking a system view.
- to build on the design principle of "open federation of testbeds".
- to allow for access of broad user communities for experimenting on "user experience".
- to become a sustainable research infrastructure for the Future Internet serving both industry and academia in their Future Internet related research and to overcome limited availability of testbeds for the duration of the projects under which they are provided.



Important notice:

Important notice: because most proposals selected within this area are at this stage under negotiations between the European Commission and the consortia proposing the project, the following information is provided based on the proposal submitted and may evolve during the negotiations.

PROPOSALS SELECTED FOR NEGOTIATION IN THIS AREA

Integrated Projects

Specific targeted research projects

Co-ordination and Support Actions

OneLab2

Title/ Keywords

OneLab2 : An Open Federated Laboratory Supporting Network Research for the Future Internet

Future Internet, Test beds, PlanetLab, Monitoring, Wireless, CDNs, SAC, Benchmarking

Abstract

Experimentally driven research is key to success in today's Internet. Many test beds support research and development, and product prototyping in communication networks. However, they tend to specialise in particular access technologies or services, or explore near term product offerings, often with limited availability and openness. An open and sustainable large-scale shared experimental facility will allow European industry and academia to innovate today and to design the future Internet. The OneLab2 project will leverage the original OneLab project's PlanetLab Europe test bed and its international visibility to make this facility a reality.

OneLab2 is built on three complementary pillars. The Platform Pillar will operate PlanetLab Europe, extending PlanetLab service across Europe, and federating with other PlanetLab infrastructures worldwide. It will integrate new features into the system. The Tools Pillar will enhance the test-bed-native network monitoring service that supports experiments. And the Customers Pillar will meet the needs of the facility's customers by providing them with access to diverse facilities, achieved through federating different types of test bed. An experimental facility must know its customers. OneLab2 will do this by directly involving pilot customers who are testing novel ideas in networking research.

OneLab2's coalition assembles some of the most highly respected networking research teams from university and industry labs in Europe. Each team has an active research agenda in new network technologies, network monitoring, or test bed management. OneLab2's success would mean that PlanetLab Europe is established as a competitive and federated facility with international visibility and a broad set of customers, implementing OneLab2's vision and research contributions. PlanetLab Europe will continue to function beyond the end of the project period, providing ongoing services to the research community at large.

Partners

1 - UPMC - Université Pierre et Marie Curie - Paris 6

Other partners

2 - ALF - Alcatel-Lucent France
3 - ALI - Alcatel-Lucent Italia SpA
4 - BT - British Telecommunications Public Limited Company
5 - CB - Collegium Budapest Association
6 - CERTH - CENTRE FOR RESEARCH AND TECHNOLOGY HELLAS
7 - CINI - Consorzio Interuniversitario Nazionale per l'Informatica
8 - EDD - Ericsson GmbH
9 - ETH - Ericsson Telecommunications Hungary
10- ETH Zurich - Eidgenössisch Technische Hochschule Zürich
11 - Fraunhofer - Fraunhofer Gesellschaft zur Förderung der angewandten Forschung e.V.
12 - HUJI - The Hebrew University of Jerusalem
13 - IMDEA - IMDEA Mathematics
14 - INRIA - Institut National de Recherche en Informatique et Automatique
15 - IT - Instituto de Telecomunicacoes
16 - KTH - Kungliga Tekniska Högskolan
17 - NICTA - NICTA
18 - QNV - Quantavis s.r.l.
19 - TAU - Tel Aviv University
20 - THC - THALES Communications S.A.
21 - THL - THOMSON SA
22 - TP - Telekomunikacja Polska S.A.
23 - UniBasel - Universitaet Basel
24 - UNIPI - Universita` di Pisa
25 - UPB - Universitaet Paderborn
26 - WUT - Warsaw University of Technology/Politechnika Warszawska

Project Coordinator:

Mr Serge FDIDA
E-mail: serge.fdida@lip6.fr

PAN LAB II

Title/ Keywords

Pan-European Laboratory Infrastructure Implementation

Pan-European Laboratory, Test-bed federation, Large scale, end-to-end testing of next generation networks and services

Abstract

PII addresses the need for large-scale testing facilities in the communications area by implementing an infrastructure for federating testbeds. The central objective of PII is to create a testbed federation among regional innovation clusters in Europe. This will enable companies participating in these clusters to test new communication services and applications across Europe. The testbed federation includes four core innovation clusters and three satellite clusters.

PII will develop and deploy effective mechanisms and technologies to enable a functioning federation of existing testbeds. This will provide added value to users of existing local testbeds, and it will prove that federation is a model for the establishment of a long-term sustainable, large-scale and diverse testing infrastructure for (tele-)communications technologies, services and applications in Europe.

In particular PII will:
• Develop mechanisms and tools to describe, store, locate and orchestrate testing services as well as means to automatically provide composite testbeds across multiple administrative domains.
• Develop and elaborate mechanisms to combine and accommodate future clean-slate approaches and provide testing services in a network-agnostic manner.
• Define a common abstract control framework, which enables the interconnection of diverse testbeds.
• Establish trust across the federation by means of quality assurance processes and tools.
• Integrate the concept of User Driven Innovation.
• Execute a techno-socio-economic study to assess the long-term sustainability of the federation model.

PII's testbed federation infrastructure will build on the legal, operational, and technical framework developed by the Panlab SSA in FP6. 20 partners constitute a highly competent, well-balanced consortium of SMEs, associations, academic institutions as well as large manufacturers and network operators, to mobilise the critical mass at European level to achieve the project objectives.

Partners

1 - EUR - EURESCOM - European Institute for Research and Strategic Studies in Telecommunications GmbH
2 - DIMES - Digital Media Innovations Finland, Dimes ry
3 - OCTO - Oulu Innovation / Octopus
4 - NOKIA - Nokia Oyj
5 - EICT - European Center for Information and Communication Technologies
6 - DTAG - Deutsche Telekom AG
7 - Fraunhofer - Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
8 - MN - Association images & réseaux
9 - TMMF - THOMSON R&D France
10 - FT - France Télécom
11 - ISI - ATHENA / Industrial Systems Institute
12 - UoP - UNIVERSITY OF PATRAS
13 - COSMO - COSMOTE - MOBILE TELECOMMUNICATIONS SA
14 - BCT - BLUECHIP TECHNOLOGIES S.A.
15 - TSSG - Waterford Institute of Technology
16 - LTU - Luleå tekniska universitet
17 - TID - Telefónica Investigación y Desarrollo Sociedad Anónima Unipersonal
18 - ALU - Alcatel-Lucent France
19 - ITL - Italtel S.p.a.
20 - UNIPA - Università degli Studi di Palermo

Project Coordinator:

Mr Anastasius GAVRAS
E-mail: gavras@eurescom.eu

ANA

Title/ Keywords

Autonomic Network Architecture

Abstract

ANA aims at exploring novel ways of organizing and using networks beyond legacy Internet technology. The ultimate goal is to design and develop a novel network architecture that enables flexible, dynamic, and fully autonomic formation of network nodes as well as whole networks. It will allow dynamic adaptation and re-organisation of the network according to the working, economical and social needs of the users. This is expected to be especially challenging in a mobile context where new resources become available dynamically, administrative domains change frequently, and the economic models may vary.

The scientific objective of this proposal is to identify fundamental autonomic network principles. Moreover, this project will build, demonstrate, and test such an autonomic network architecture. The key attribute is that such a network scales in a functional way that is, the network can extend both horizontally (more functionality) as well as vertically (different ways of integrating abundant functionality). The challenge addressed in this project is to come up with a network architecture and to fill it with the functionality needed to demonstrate the feasibility of autonomic networking within its 4 years duration.

Partners

1 - Eidgenoessische Technische Hochschule Zurich
2 - University of Basel
3 - NEC EUROPE LTD.
4 - University of Lancaster
5 - Fraunhofer Gesellschaft zur Foerderung der angewandten Forschung
6 - Université de Liege
7 - Université Paris VI Pierre et Marie Curie
8 - National and Kapodistrian University of Athens
9 - Universitetet I Oslo
10-Telekom Austria
11- University of Waterloo

Project Coordinator:

Mr Martin MAY
E-mail: maym@tik.ee.ethz.ch

ECODE

Title/ Keywords

Experimental COgnitive Distributed Engine

Future Internet, Experimental

Abstract

The aim of the ECODE proposal is to develop, implement and validate experimentally a cognitive routing system. This system will use cognitive techniques to provide a routing system able to meet the future Internet challenges. The project gathers networking and machine learning experts to address these challenges efficiently. In architectural phase one, the cognitive routing system is designed and prototyped. In phase two, we consider three representative sets of use cases to evaluate the benefits of machine learning techniques to improve a) the Internet manageability and security, b) the availability of Internet paths, and c) the scalability and quality of the Internet routing system.

Concerning the manageability and security use case, the project will develop, implement and experiment new techniques that allow
1) to adaptively sample traffic on core links,
2) to efficiently monitor the path performance by combining passive and active measurements, and
3) to cooperatively detect traffic anomalies leading to performance or QoS decrease, and cooperatively detect intrusions and attacks.

Concerning the availability use case, the project will develop, implement and experiment new techniques to allow
1) efficient path ranking based on QoS and availability metrics,
2) routers to efficiently reroute paths to other links in case of failure, and
3) routers to correlate traffic flows to diagnose and predict deviation over time.

Concerning the routing scalability and quality use case, the project will develop, implement and experiment new techniques to detect events that are detrimental to the routing system dynamics and to efficiently react to such events. In phase three, we implement and experiment novel semi-supervised, on-line, and distributed machine learning techniques within the cognitive routing system. The experimentation and the validation of the techniques developed in the project will be carried on physical (iLAB) and virtual (e.g., OneLab) experimental facilities.

Partners

1 - ALB - Alcatel-Lucent Bell NV

Other partners

2 - UCL - Universite catholique de Louvain
3 - ULg - Université de Liège
4 - IBBT - INTERDISCIPLINAIR INSTITUUT VOOR BREEDBANDTECHNOLOGIE, VZW
5 - INRIA - Institut National de Recherche en Informatique et Automatique
6 - ULANC - Lancaster University
7 - CNRS - Centre National de la Recherche Scientifique

Project Coordinator:

Mr Dimitri PAPADIMITRIOU
E-mail: dimitri.papadimitriou@alcatel-lucent.be

FEDERICA - (Federated E-infrastructure Dedicated to European Researchers Innovating in Computing network Architectures)

Summary: The FEDERICA project will create a European wide "technology agnostic" infrastructure based upon Gigabit Ethernet circuits, transmission equipment and computing nodes capable of virtualization, to host experimental activities on new Internet architectures and protocols.

The FEDERICA network is based on the European Research & Education multi-gigabit networks footprint. Circuits are terminated in Points of Presence (PoPs) of NRENs and GÉANT2, which host FEDERICA nodes capable of virtualising hosts, e.g. open source routers and end nodes. Virtual slices of FEDERICA's infrastructure may be allocated to network researchers for testing even with disruptive experiments within a large production substrate. The researchers will have full control of the allocated virtual nodes and network slice and access network monitoring information.

Internal project research is focused on understanding and producing initial solutions for monitoring, management and control of parallel virtual networks in a multi-domain environment.

Objectives: The FEDERICA project supports research experiments on new Internet architectures and protocols by:

- Creating a versatile, scalable, European wide "technology agnostic" infrastructure, with the possibility to interconnect with Internet and other infrastructures. FEDERICA will create "slices" of its infrastructure to be used simultaneously by more than one research group. Each slice may be configured according to researchers' needs as a combination of Ethernet network circuits and nodes.

- Facilitating technical discussions amongst specialists, in particular arising from experimental results and disseminating knowledge and NREN experience of meeting users' requirements.

- Providing preliminary information and results for the next generation of the NREN networks, and linking with GÉANT2 and as a precursor experimental phase for GÉANT3.

- Contributing with real test cases and results to standardization bodies, e.g. IETF, ITU-T, OIF, IPsphere.

- Understanding and producing initial solutions on the management and control of distributed, parallel, virtual networks which may communicate between them and with the general Internet.

- Developing experience and proposing a model for managing and using virtual infrastructures as a combination of networks and systems. Currently, this type of management is in its infancy: pro-active tools are needed for monitoring and services.

- Enabling the graceful implementation of new inter-domain service layer.

The FEDERICA infrastructure is devoted to research on the Internet of the future and on virtual distributed systems. It is not intended to be used to provide raw computing power or permanent European connections.

Action plan: The FEDERICA infrastructure is based initially on Gigabit Ethernet circuits, network nodes and computer systems supporting virtual nodes from the participating NRENs and will be made operational in month 9 (September 2008).

The development of the infrastructure will be in three phases. In the first phase the users may request virtual networks with complete control up to the network layer, but with fixed Ethernet framing. In the following two phases, according to users' requests and infrastructure capabilities, the user control may extend down to lower layers.

The user can request a virtual network composed by (virtual) circuits and (virtual) nodes for experimentation. Each virtual network is a "slice" of the infrastructure and many slides can be active in parallel and independently.

Access to the infrastructure is normally free of charge and subject to compliance of an Acceptable User Policy. A User Policy Board is responsible for accepting and prioritizing users' requests. To each user group is assured testing privacy and results will not accessible by other users. The FEDERICA project requests explicit feedback from its users.

Networking activities: The network activities support the Project Management, training, standardization, liaison activities, and dissemi-nation - concertation vis-à-vis user communities. Emphasis will be placed on interacting with

re-searchers and similar activities in Europe and worldwide and in providing input to stand-ardization bodies.

Service activities: The Service Activities have to engineer, implement, manage and develop the FEDERICA infrastructure in a multi-domain environment. These tasks imply setting up a monitoring and control systems for the physical network and the virtual slices, based on the current results of the GÉANT2 project and NREN developments. The activities imply the development of a model for virtual network use, user control and related business models.

Joint Research activities: The Joint Research Activities are targeted towards prototyping and testing the virtualization – slicing tools and novel architectures not deemed sufficiently mature to be mapped to a service in the project. The results of the research will be fed into the Service Activities for rapid prototyping and implementation. As a starting point, the project will leverage from current R&D activities of the partners.

User communities: The target users of the infrastructure are the researchers and the activities engaged in research on networking, using networks not just as the tool, but primarily as the subject of their work. User groups will include primarily EC projects, research groups, equipment manufacturers and telecommunications research labs or even individuals (e.g. PhD students).

International aspects: The FEDERICA infrastructure will cover a significant fraction of Europe through the participating NRENs. The access to the infrastructure is not limited to the participating countries, but can be granted to any user with an Internet connection.
The FEDERICA infrastructure aims also at establishing a connection with other infrastructures for mutual enhancement, e.g. European NREN and GÉANT2 testbeds, vendor and TELCO experimental facilities; the PlanetLab overlay network and NSF GENI (Global Environment for Network Innovations) in the USA.

FEDERICA – RI

e-infrastructure

FEDERICA

Project acronym:
FEDERICA

Contract n°: RI-213107
Project type: I3
Start date: 01/01/2008
Duration: 30 months
Total budget: 5´179'645 €
Funding from the EC: 3'700'000 €
Total funded effort in person-month: 464

Web site: www.fp7-federica.eu

Contact person:
Mauro Campanella
email: Mauro.Campanella@garr.it
tel.: + 390649622000
fax.: +390649622044

Project participants:
•CESNET (CZ)
•DANTE (UK)
•DFN (DE)
•FCCN (PT)
•GARR (coord) (IT)
•GRNET (GR)
•HEAnet (IE)
•i2CAT (ES)
•ICCS (GR)
•Juniper
•Networks Inc. (IE)
•KTHSE
•Martel (CH)
•NIIF/Hunganet (HU)
•NORDUnet (DK)
•POLITO (IT)
•PSNC (PL)
•Red.es/RedIRIS (ES)
•SWITCH (CH)
•TERENA (NL)
•UPC (ES)

Keywords:
NREN, virtual networks and systems, infrastructure for new Internet

Collaboration with other EC funded projects:
GÉANT2
Phosphorus
Onelab2
OGF Europe

HAGGLE

Title/ Keywords

A Novel Communication Paradigm for Autonomic Opportunistic Communication

Abstract

Haggle is a new autonomic networking architecture designed to enable communication in the presence of intermittent network connectivity, which exploits autonomic opportunistic communications (ie. in particular in the absence of end-to-end communication infrastructure).
It departs from the existing TCP/IP protocol suite, completely eliminating layering above the data-link, and exploiting an application-driven message forwarding, instead of delegating this responsibility to the network layer. To this end, we go beyond already innovative cross-layer approaches, defining a system that uses real best-effort, context aware message forwarding between ubiquitous mobile devices, in order to provide services when connectivity is local and intermittent. We use only functions that are absolutely necessary and common to all services, but that are sufficient to support a large range of current and future applications, more oriented to the human way of communicating (and more in general, the way communities of any type of entities communicate), rather than related to the technological aspect of the communication.
The main components of Haggle are
1. A revolutionary paradigm for autonomic communication, based on advanced local forwarding and sensitive to realistic human mobility.
2. A simple and powerful architecture oriented to opportunistic message relaying, and based on privacy, authentication, trust, and advanced data handling.
3. An open environment for application and services easy proliferation, thanks to a top down approach that aims to reproduce communities' behaviour, which makes Haggle an ideal paradigm for supporting applications with high social and economic impact.

We completely specify this new communication model, implement it (including issues such as security, privacy, trustability, and information aging), evaluate it in a large scale trial (500 to 800 nodes), and interact with sociologists to study its impact on users.
We also demonstrate the validity of the Haggle paradigm in interdisciplinary contexts by experimenting it in a scenario of e-health.

Haggle enables a new family of applications with a high degree of spatial or logical locality. Haggle takes the aforementioned communities as both inspiring models and connectivity hypothesis to lay down new forms of networking, and provide explicit support for community formation and management within its context.

Partners

1 - Thomson S.A.
2 - Intel Research Cambridge **
3 - University of Cambridge
4 - Uppsala University
5 - Ecole Polytechnique Fédérale de Lausanne
6 - Scuola Universitaria Professionale Della Svizzera Italiana
Dipartimento Tecnologie Innovative
7 - Consiglio Nazionale delle Ricerche
8 - Institut Eurecom
9 - Martel GmbH

Project Coordinator:

Mr Christophe DIOT
E-mail: christophe.diot@thomson.net

NANO DATA CENTERS

Title/ Keywords

Edge Capacity Hosting OverlayS: the power of using "edge computing" as part of the network

Future Internet, Data Hosting and Delivery, Managed Peer-to-Peer (P2P), Broadband access, Tripleplay, Video-on-Demand (VoD), Distributed content management, Multi-player games

Abstract

The project proposes a radical solution to data hosting and delivery for the Internet of the future. The current data delivery architecture is "network centric", with content stored in data centers connected directly to Internet backbones. This approach has multiple drawbacks among which complexity of deploying data centers, power consumption, and lack of scalability are the most critical. The NANODATACENTERS project takes a totally innovative and orthogonal approach to traditional data centers, through what we call "nano" data centers, which are deployed in boxes at the edge of the network (i.e. in home gateways, set-top-boxes, etc.) and accessed using a new peer-to-peer communication infrastructure. This disruptive evolution solves most of the inconveniences of current data center based solutions, and allows for the deployment of next generation interactive applications. However, this creates a number of challenges as data has to be accessed and assembled dynamically "on-demand", in real-time. NANODATACENTERS will design and develop the nano-data center communication architecture with security and incentive mechanisms. We will demonstrate that NANODATACENTERS is a cheap and scalable alternative to the current data hosting and delivery model. The full NANODATACENTERS architecture will be implemented (i.e. an NANODATACENTERS box will be fully specified and implemented). Virtualization will be used to partition and manage box resources efficiently. Two interactive applications – multiplayer games and VoD – will be designed as a proof of concept. A large scale testbed will be deployed to evaluate the benefits and performance of NANODATACENTERS. We will contribute the ECHOS architecture to the relevant standardization bodies and to discussion groups on the design of the Internet of the Future. The project is in line with the Strategic Research Agenda (SRA) of the NEM initiative. The project is expected to lead to the commercialization of the NANODATACENTERS box. This will result in a competitive advantage for European industry and SMEs.

Partners

1 - Thomson - THOMSON SA

Other partners

2 - TID - TELEFONICA INVESTIGACIÓN Y DESARROLLO SOCIEDAD ANONIMA UNIPERSONAL
3 - SIT - Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
4 - Oversi - Oversi Networks Ltd.
5 - UPMC - UNIVERSITE PIERRE ET MARIE CURIE - PARIS 6
6- CERTH-ITI - CENTER FOR RESEARCH AND TECHNOLOGY HELLAS
7 - Martel - Martel GmbH
8 - Eurecom - INSTITUT EURECOM
9 - NICTA - National ICT Australia

Project Coordinator:

Mr Christophe DIOT
E-mail: christophe.diot@thomson.net

OPNEX

Title/ Keywords

Optimization driven Multi-hop Network Design and Experimentation

Wireless multi-hop networks, wireless ad-hoc networks, network optimization, optimal network control, decentralized operation, autonomous operation, optimization-driven protocol design, implementation

Abstract

OPNEX delivers a first principles approach to the design of architectures and protocols for multi-hop wireless networks. Systems and optimization theory is used as the foundation for algorithms that provably achieve full transport capacity of wireless systems. Subsequently a plan for converting the algorithms termed in abstract network models to protocols and architectures in practical wireless systems is given. Finally a validation methodology through experimental protocol evaluation in real network test-beds is proposed.

OPNEX will use recent advances in system theoretic network control, including the back-pressure principle, max-weight scheduling, utility optimization congestion control and primal-dual method for extracting network algorithms. These approaches exhibited already vast potential for achieving maximum capacity and full exploitation of resources in abstract network models and found their way to reality in high performance switching architectures and recent variants of TCP that embody the primal-dual optimization principle.

Wireless, the fastest growing component of internet today, is also the least understood for the designer due to mobility, rapidly changing topology, radio link unpredictability and volatile load distribution among others. Current approaches used in practice for multi-hop wireless, the basic communication infrastructure for sensor network extensions of the internet, are mostly empirical and heuristic. Our system optimization approach will provide a rigorous integrated system design framework from physical up to network and transport layer that renders itself to validation and comparison with the theoretically optimal performance in terms of throughput, spectrum and energy utilization. The adopted approach on decentralization, communication and computational complexity reduction as well as autonomous operation will lead to implementable algorithms and architectures to be validated eventually in the proposed test-beds.

Partners

1 - CERTH-ITI - Centre for Research and Technology Hellas

Other partners

2 - FUB - Freie Universität Berlin
3 - PUT - Poznan University of Technology
4 - INRIA - Institut National de Recherche en Informatique et Automatique
5 - Thomson - THOMSON SA
6 - MIT - Massachusetts Institute of Technology

Project Coordinator:

Mr Leandros TASSIULAS
E-mail: leandros@uth.gr

ResumeNet

Title/ Keywords

Resilience and Survivability for future networking: framework, mechanisms, and experimental evaluation

Resilience, Survivable networks, Security, Fault Tolerance, node misbehaviour, opportunistic networking, Service relocation, Virtualization, Network Monitoring, Remediation, Defence

Abstract

The main objective of the RESUMENET is to host original research work that will systematically embed resilience into future Internet. The project work has three main dimensions.

• At framework-level, work will elaborate on the D2R2+DR (Defend, Detect, Remediate, Restore; Diagnose, Refine) framework, and quantify the impact of different types of challenges and failures on normal network service operation. Metrics, classes of network resilience, policies and ways to negotiate them are at the epicenter of Work Package 1, whose outcome should ease the understanding of network engineers about of resilient network services.

• The project will then look into the mechanisms and algorithms to add to the network infrastructure so that the requirements identified at the framework level be met. The network infrastructure, both the end-to-end transport infrastructure and the service layer, including servers and data storage equipment, are the subject of work in WPs 2 and 3, respectively. The focus is on basic functions and technologies that constitute the building blocks of the D2R2+DR framework; nevertheless, the two WPs also consider some study cases (scenarios) of network service failure, to exemplify the synthesis of these blocks into a working system.

• Finally, experimentation is starring at the project, both in terms of resource consumption and significance to the project objectives. In Work Package 4, specific scenarios focusing on particular network service provision are composed out of failure types, and resilience mechanisms. The aim is to demonstrate the applicability of the systematic approach unfolding through WPs 1-3, and the benefits for several aspects of the network functionality. An equally important task from the WP4 experimentation activities will be to provide feedback to WPs 1-3 about the fine tuning of individual mechanisms in the network. The experimentation facilities will come from in-house test beds and facilities developed b

Partners

1 - ETH ZURICH - EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH

Other partners

2 - ULANC - Lancaster University
3 - UTU - Eberhard Karls Universität Tübingen
4 - FT - France Telecom
5 - NEC - NEC EUROPE LTD
6 - UP - UNIVERSITAET PASSAU
7 - TUDelft - Technical University Delft
8 - UU - Uppsala universitet
9 - ULg - Université de Liège

Project Coordinator:

Mr Bernhard PLATTNER
E-mail: plattner@tik.ee.ethz.cjh

VITAL++

Title/ Keywords

VITAL++

IMS; P2P; overlays; content distribution, user created content; content application services

Abstract

Emerging types of applications, rich in user-created or provider-created content, enabled by P2P technology, with high demands for network resources are rapidly changing the landscape of network requirements and operations creating new challenges in network and service management, configuration, deployment, protocols etc. P2P is primarily a technology that fosters self-deployment and self-organisation, thus, reducing operational costs, while it achieves optimised resource utilisation for the deployed applications and services. In contrast, IMS as a control plane technology primarily addresses issues of heterogeneity of access technologies, addressing schemes, AAA, security and mobility management.

VITAL++ major objective is to combine and experiment with the best of the two worlds, namely, IMS-like control plane functionality and P2P technology giving rise into a new communication paradigm that will bring a wide range of benefits. The key to achieving this objective, is to put this paradigm under strenuous experimentation, carried out under realistic network conditions using popular applications. To this end, VITAL++ is putting together a pan-European testbed comprised of existing geographically distributed test sites integrated by IMS technology. This will be thoroughly tested by reference content applications and services that use P2P technology as a means for their distribution and achieving satisfactory QoS levels through network resource optimisation algorithms rather than non-scalable QoS reservation operations.

Partners

1 - UoP - UNIVERSITY OF PATRAS
2 - TID - TELEFONICA INVESTIGACION Y DESARROLLO S.A. UNIPERSONAL
3 - Fraunhofer - Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
4 - RBB - Rundfunk Berlin-Brandenburg
5 - BCT - BLUECHIP TECHNOLOGIES SA
6 - CTRC - Centre for Technological Research of Crete
7 - WIT - Waterford Institute of Technology
8 - TA - Telekom Austria TA AG
9 - VoG - Voiceglobe Belgium Sprl.

Project Coordinator:

Mr Odysseas KOUFOPAVLOU
E-mail: odysseas@ece.upatras.ge

WISEBED

Title/ Keywords

Wireless Sensor Network Testbeds

Wireless Sensor Networks, Large-scale Simulation, Distributed Code Update, Joint Experiment Activities, Algorithm Engineering

Abstract

The aim of this project is to provide a multi-level infrastracture of interconnected testbeds of large-scale wireless sensor networks for research purposes, pursuing an interdisciplinary approach that integrates the aspects of hardware, software, algorithms, and data. This will demonstrate how heterogeneous small-scale devices and testbeds can be brought together to form well-organized, large-scale structures, rather than just some large network; it will allow research not only at a much larger scale, but also in different quality, due to heterogeneous structure and the ability to deal with dynamic scenarios, both in membership and location.

For the interdisciplinary area of wireless sensor networks, establishing the foundations of distributed, interconnected testbeds for an integrated approach to hardware, software, algorithms, and data will allow a new quality of practical and theoretical collaboration, possibly marking a turning point from individual, hand-tailored solutions to large-scale, integrated ones.

For this end, we will engage in implementing recent theoretical results on algorithms, mechanisms and protocols and transform them into software. We will apply the resulting code to the scrutiny of large-scale simulations and experiments, from which we expect to obtain valuable feedback and derive further requirements, orientations and inputs for the long-term research. We intend to make these distributed laboratories available to the European scientific community, so that other research groups will take advantage of the federated infrastructure. Overall, this means pushing the new paradigm of distributed, self-organizing structures to a different level.

Partners

1 - UZL - UNIVERSITAET ZU LUEBECK
2 - FUB - Freie Universität Berlin
3 - TUBS - Technische Universität Carolo-Wilhelmina zu Braunschweig
4 - RACTI - Research Academic Computer Technology Institute Research Academic Computer Technology Institute
5 - UPC - Universitat Politècnica de Catalunya
6 - UBERN - Universität Bern
7 - UNIGE - University of Geneva
8 - TUD - TECHNISCHE UNIVERSITEIT DELFT
9 - ULANC - Lancaster University

Project Coordinator:

Mr Stefan FISCHER
E-mail: fischer@itm.uni-luebeck.de

FIREworks

Title/ Keywords

Future Internet Research and Experimentation - Strategy Working Group

testbed, experimental facility, research network, testbed federation, future internet, next generation network

Abstract

The main goal of FIRE Works SA (Specific Support Action) project is to create a sustainable forum for testbed actors in Europe in the area of future networks. By the means of this project relevant parties are brought together in order to exchange ideas, experiences, specifications for future needs and information on test activity offerings in Europe and beyond. Through individuals involved in testbed activities, e.g. researchers, developers, managers of R&D units and ICT policy makers, it is formed a common understanding of what exists and what will be needed for future experimental facilities.

The FIRE (Future Internet Research and Experimentation) Initiative launched by the Commission within FP7 has two related dimensions: on one side, promoting experimentally-driven long term, visionary research on new paradigms and networking concepts and architectures for the future internet; on the other side, building a large scale experimentation facility to support both medium and long term research on networks and services by gradually federating existing and new testbeds for emerging or future internet technologies.

The FIRE Works SA is proposing to continue the work of the FIRE Expert Group work preceding the FIRE Initiative and to take further the two dimensions. It aims at clustering and concentrating activities in Europe in the area of testing new communications technologies and services, as support for numerous related Research and Development (R&D) projects running under European and national umbrellas. In particular, various available testbeds and experimental laboratories, including experimental communications networks, as well as so-called User-Driven Innovation platforms will be considered, in order to support creation of a federation of testbeds. The objective is to ensure both tighter collaboration of testbeds with the aim to improve overall testing features and provision of a higher number of testing services in Europe.

Partners

1 - DIMES - Digital Media Innovations Finland, Dimes ry

Other partners

2 - EURESCOM - EURESCOM - European Institute for Research and Strategic Studies in Telecommunications GmbH
3 - UPMC-LIP6 - UNIVERSITE PIERRE ET MARIE CURIE- PARIS 6

Project Coordinator:

Mrs Susanna AVÉSSTA
E-mail: susanna.avessta@dimes.fi

PARADISO

Title/ Keywords

Identifying strategic research directions on network and service infrastructures under the hypothesis of a disruptive PARADIgm concerning global SOcietal developments

Network service infrastructures - Paradigm - Societal models

Abstract

The PARADISO project aims at identifying strategic research directions on network and service infrastructures in the hypothesis of a disruptive paradigm concerning global societal developments.

This possible paradigm shift, which more and more analysts are evoking worldwide, is based on the vision that, in order to avoid major worldwide crises, all countries (developed, emerging, and developing ones) will need to agree, sooner or later, on an alternative way forward and make their societal development models converge. The EU is undoubtedly the world power the best placed to proactively promote this new concept of progress, based on revised social, environmental and economic objectives: a true sustainable development, a more sustainable economic growth, more equally shared resources, eventually the well-being of peoples around the world.

Which will be the ICT applications and services needed to support these new objectives? More precisely, which network and service infrastructures will have to be developed?

The PARADISO project will investigate this disruptive paradigm and identify the ICT research areas to be explored in this perspective.

The project construction is pragmatic, and aims at achieving results in the short term (project duration of 12 months). The paradigm will be explored (and the innovative research identified) through a study based to a large extent on the outputs of two events that the project will organise: a workshop and an open international conference. Important dissemination activities are planned to widely disseminate the initiative, and to contribute increasing its impact.

The PARADISO project will be run by two organisations offering complementary expertise and experience: Sigma and Club of Rome. Privileged links are ensured with the ETPs and the FP6-FP7 projects addressing Challenge 1. Moreover, a number of leading organisations, worldwide, are formally supporting the project and will be involved in planned activities.

Partners

1 - Sigma - Sigma Consultants
2 - Club of Rome - CLUB OF ROME PECCEI FOUNDATION

Project Coordinator:

Mr Roger TORRENTI
E-mail: roger.torrenti@orionis.com

REGISTER OF PROJECTS

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The Future of the Internet

A Compendium of European Projects on ICT Research Supported by the EU 7th Framework Programme for RTD

Catalogue number : KK-30-08-142-EN-C

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ICT Information Desk
European Commission

Information Society and Media Directorate-General
Office BU31 01/19
Belgium, 1049 Brussels
ict@ec.europa.eu
http://cordis.europa.eu/fp7/ict/contacts_en.html

ISBN 978-92-79-08008-1

European Commission
Information Society and Media