Wireless
Sensor Networks

In focus
European Space Agency

Project reports
Machine-to-machine communication

European issues
Beyond the Internet Protocol

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Dear readers,

Did you know that 98 percent of all processors are not in traditional desktop computer systems, but in mobile devices, household appliances, vehicles, and machines? Only a small percentage of these devices are networked. This gives you a rough idea of the vast scope for pervasive networking. One area in the networked world of the future, which offers particularly promising opportunities, is wireless sensor networks. Given the recent technological advances and the almost limitless application opportunities, we think that this is the right time to present wireless sensor networks as a cover theme.

In his opening article to the cover theme, Eurescom mess@ge editor Uwe Herzog provides an overview on technology and applications of wireless sensor networks. NEC's Dirk Westhoff presents the state of the art and insights from EU research project UbiSec&Sens. A specific application scenario from Siemens complements these articles. Finally, we interviewed Holger

Karl and Karl Aberer, two of the leading researchers in the area of wireless sensor networks.

Our "In focus" section this time features an article on the European Space Agency, written by Ninja Menning, ESA's Communication Officer at the European Space and Research Technology Centre (ESTEC) in Noordwijk, The Netherlands.

Our section "European issues" this time presents three articles that are related to EU research activities. In the first article, Eurescom director David Kennedy gives an outlook on the forthcoming EU Framework Programme 7, which will be of central importance for European research in the next 7 years. The second article by Hans Einsiedler from Deutsche Telekom provides an analysis of the future post IP networks. Finally, David Kennedy reports the main results from the recent General Assembly of the European Technology Platform or Networked and Electronic Media (NEM).

There are many more articles in this issue, which cover subjects as diverse as powerline communications and odour recording. We hope that you will find some of them interesting and relevant to your work.

We would appreciate your feedback on any of the articles in this issue. If you would like to suggest a topic or offer a contribution to Eurescom mess@ge, this is equally welcome. If you would like to provide feedback on Celtic News, the newsletter of Eureka Cluster Celtic, please send an e-mail to the Celtic Office at office@celtic-initiative.org

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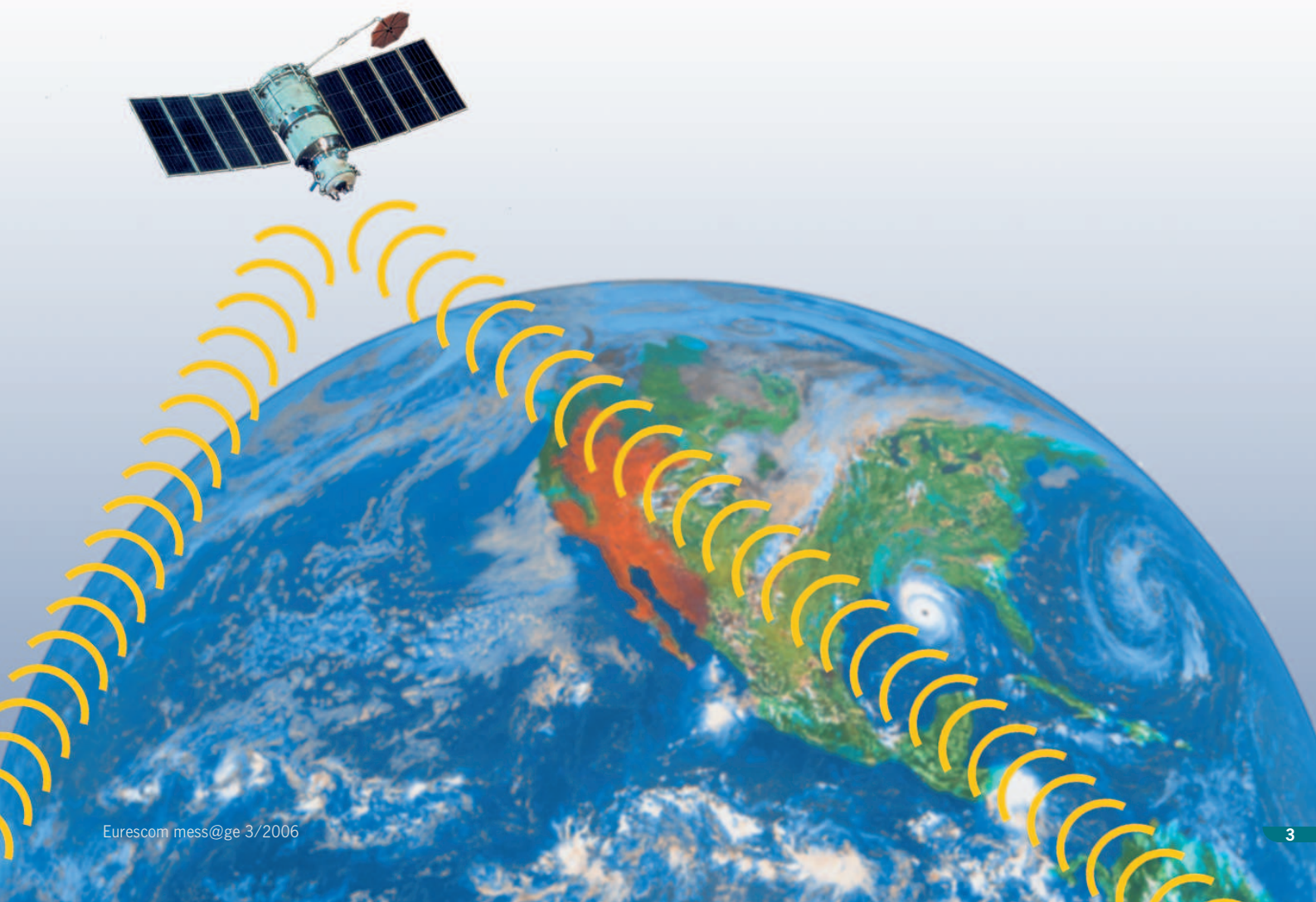
Events calendar

14 November 2006
2nd General Assembly of the eMobility Technology Platform
Heidelberg, Germany
http://www.emobility.eu.org

15 - 17 November 2006
Wireless World Research Forum Meeting 17 - Serving and managing users in a heterogeneous environment
Heidelberg, Germany
http://www.wireless-world-research.org

20 November 2006
3rd Concertation meeting on e-Infrastructure - Specific theme: FP6-funded test-beds
Helsinki, Finland
http://www.panlab.org/pages/events/concertation_Helsinki_2006.html

21 – 23 November 2006
IST 2006 - Strategies for Leadership
Helsinki, Finland
http://europa.eu.int/information_society/istevent/2006/index_en.htm

5 December 2006
Workshop on Digital Identity for NGN
Geneva, Switzerland
http://www.itu.int/ITU-T/worksem/ngn/200612

11 – 14 December 2006
BroadBand Europe 2006
Geneva, Switzerland
http://www.bbeurope.org

12 – 15 December 2006
2nd International Conference on Automated Production of Cross Media - AXMEDIS 2006
Leeds, United Kingdom
http://www.axmedis.org/axmedis2006

12 – 15 February 2007
3GSM World Congress
Barcelona, Spain
http://www.3gsmworldcongress.com

21 February 2007
Celtic Information Day on Call 5
Berlin, Germany
http://www.celtic-initiative.org/Events/InfoDay-07/celtic_information_day_07.asp

11 – 15 March 2007
WCNC 2007 - IEEE Wireless Communications and Networking Conference
Hong Kong
http://www.ieee-wcnc.org

Sn@pshot

Wi-Fi bunny

Rafi Haladjian, chairman of French company Violet, showing the company's latest product, a Wi-Fi bunny called "Nabaztag". The name means 'rabbit' in Armenian, the mother tongue of its creator.

The plastic bunny with ears like TV antennae can read out e-mails and mobile phone text messages, tell children to go to bed, alert one to a stock collapse and give traffic updates by receiving Internet feeds via a wireless Wi-Fi network.

The bunny stands 23 cm tall and has a white cone-like body that lights up when it speaks. It can also wiggle its ears and sing songs.

Further information is available at: *http://www.nabaztag.com*

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NM2 at IBC 2006 in Amsterdam
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Japanese odour recorder
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+++ News in brief +++ News in brief +++

IBM explores molecules as data storage

Researchers from IBM in Zurich have demonstrated how a single molecule can be switched between two distinct conductive states, which allows it to store data. The experiments show that certain types of molecules offer functionalities that
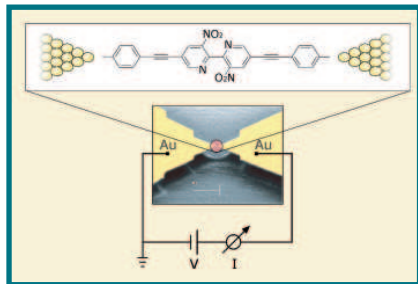
CMOS technology

are comparable to devices used in today's semiconductor technology.

With dimensions of a single molecule on the order of one nanometer (one millionth of a millimeter), molecular electronics redefines the ultimate limit of miniaturization far beyond that of today's silicon-based technology. The molecules investigated are specially designed organic molecules measuring only about 1.5 nanometers in length, approximately one hundredth of a state-of-the-art CMOS (Complementary Metal Oxide Semiconductor) element.

CMOS technology is expected to reach its ultimate limits in 10 to 15 years. As chip structures, which currently have dimensions of about 40 nm, continue to shrink below the 20 nm mark, ever more complex challenges arise and scaling appears not to be economically feasible any more. According to IBM, the chemical synthesis can produce completely identical molecules without variability. Below 10 nm, the fundamental physical limits of CMOS technology will be reached. Besides molecular storage, other technologies are explored, including carbon nanotubes, semiconducting nanowires, and spintronics.

Further information is available at
http://www.zurich.ibm.com

HP develops data stickers

Hewlett Packard has developed a tiny, self-contained storage device called Memory Spot, which can be stuck to documents and other objects.

The prototype Memory Spot has the size of a rice grain and can store up to 4 megabyte of information. The chip has

HP Memory Spot

an antenna which can transfer data at speeds up to 10 Mbps and does not require its own power source. Instead, the chip draws its power from a chip reader through a process called inductive coupling, which allows power to cross from one component to another over a shared electromagnetic field.

Data stored on Memory Spot chips could be accessed using a variety of devices, such as specially equipped cell phones or PDAs, making them suitable for a range of applications, such as stickers applied to a paper document or printed photo.

The idea behind the technology is to enhance real-world items, which can only story limited amounts of information, like menus, advertisements, brochures, printed photos, or DVD covers. The researchers at HP believe that paper will remain an important communication medium.

A Memory Spot on a document can hold exhibits or earlier versions. In addition, data on the devices can be erased and rewritten several times. That means hospital wristbands with a Memory Spot could contain complete patient records, as they can be updated.

According to HP, it will take a couple of years until Memory Spot chips are commercially available.

Nokia introduces new radio technology for small devices

On 3 October, Nokia announced a new radio technology called Wibree as an open industry initiative extending local connectivity to small devices. Wibree is meant to complement other local radio technologies. The new technology connects small, button-cell battery power devices such

as watches, wireless keyboards, toys and sports sensors, with mobile devices or PCs. Prospective application areas include sports, for instance for the transmission of pulse measuring data, and healthcare, for example, the transmission of blood pressure and other body data.

According to Nokia, Wibree is consuming only a fraction of the power, compared to other radio technologies, like, for instance, Bluetooth. However, compared to Bluetooth, which offers a bandwidth of up to 2.1 MB/sec, the maximum bandwidth of Wibree is limited to 1 MB/sec with a range of up to 10 meter. Like Bluetooth, Wibree works in the 2.4 GHz frequency range. Wibree can be implemented either as a stand-alone chip or as Bluetooth-Wibree dual-mode chip.

Nokia plans to have the first commercial version of the interoperability specification available during the second quarter of 2007. The current members of the group defining the specification are Broadcom Corporation, CSR, Epson and Nordic Semiconductor, who have licensed the Wibree technology for commercial chip implementation, as well as the sports device manufacturerer Suunto and the electronic equipment manufacturer Taiyo Yuden, who contribute to the interoperability specification in their respective areas of expertise.

Further information is available at
http://www.wibree.com

Wireless sensor networks
Perceive the world like never before

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Recent advances in microelectronics and wireless communications have technically enabled to build wireless sensor networks (WSN) on a larger scale. There are plenty of potential applications. However, a number of challenges are preventing an immediate and wide deployment of applications based on this technology.

Every year, many people die in avalanches, because it takes too long to find them. Severe forest fires destroy forests and threaten habitat areas as seen in Portugal recently. Floods have become a frequently occurring catastrophe in central Europe in the past few years. The ability to instantly detect such disasters would help to take immediate action for reducing the damage and for saving lives. These are just a few examples of applications that wireless sensor networks could be deployed for in the future.

Sensor nodes

A typical sensor network consists of a large number of sensor nodes which are densely deployed in the region of interest and which communicate in order to accomplish a given task. Sensor nodes are the key elements of a WSN. Progress in developing Microelectromechanical Systems (MEMS) has enabled new classes of sensors, e.g. for measuring gravitational forces or acceleration. There are also visual, acoustic, thermal, and magnetic types of sensors and combinations of it; others can detect fog, pressure, chemical concentrations, or seismic activities. However, there is more to a sensor node than only the sensing capability. A sensor node also contains a microprocessor, data storage, a data transceiver, and – maybe the biggest issue currently – an energy source.

Besides the sensor node, networking constitutes another key aspect of WSN. The following article in this cover theme gives a good overview on the various aspects and challenges that still have to be solved in WSN networking and the related security issues.

Resource constraints everywhere

If we look into the design of WSN, it quickly becomes obvious that the limited availability of resources is a key criterion which has to be considered for designing WSN. Sensor nodes must – for a dense deployment – be small in size, low cost, and yet multifunctional. They must operate for long periods of time under possibly harsh environmental conditions.

Energy is a scarce resource in a sensor node. Using small batteries is one way to provide power, although not a very environment–friendly one, as deployed sensors can often not be re-collected after the end of their operation. Harvesting energy, e.g. solar radio waves or vibrations, are alternative ways, though they seem still to be in an early stage. These constraints result in a limited processing speed, storage capacity, communication frequency and bandwidth in WSN. Communication is the most energy consuming operation. That is why WSN process data within the network wherever possible. Mastering these challenges is a prerequisite before mass deployment can be started.

Ample application areas

WSN enable that we can perceive what takes place in the outside world, in our environment, in a level of detail that was not possible before. The main capability that WSNs are offering is monitoring. The wide, dense, and relatively easy deployment of sensor nodes, for example by dropping from a plane or ship, or delivery by an artillery missile, makes it possible to deploy a WSN instantly on demand, to reach dangerous or other types of hardly or even inaccessible areas (natural reserves, underwater, mountain areas, battlefields, etc.), and to acquire information from the region of interest in a fine granularity. Some of the main application areas are:

- Monitoring objects, buildings, bridges, aircrafts etc. as part of their maintenance, e.g. for early discovering material fatigue
- Traffic/transportation: in-car sensors, asset tracking, traffic monitoring
- Precision agriculture: monitor livestock, plants, and soil
- Environmental and wildlife/habitat monitoring: detection of forest fires, floods, pollution, animal movement
- Manufacturing process control surveillance, alarm systems, disaster management
- Healthcare: medical diagnostics, tracking patients, telemonitoring
- Military and homeland security: attack detection, surveillance of battlefields or (potentially) hostile areas

Conclusion

I recently got aware of another application which has been described in a scientific paper: In a scenario called "Biosensor Network", animals (here: rats) are backpacked with a tiny sensor node. Based on recent research results, showing that animals can be guided remotely by stimulating regions of their brain, an animal WSN can be formed which could be applied for search and rescue operations. Though this scenario caused some ethic concern with me and also sounds slightly like fantasy, it gives a glimpse of the potential of this technology. I hope the readers of Eurescom mess@ge will find the articles of the cover theme in this issue informative, inspiring, and enjoyable.
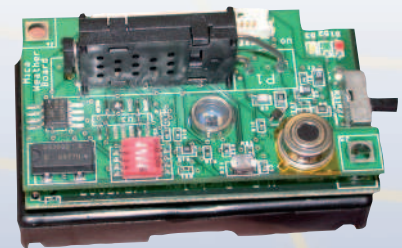
A **toolbox** for enhancing **security** in wireless sensor networks

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Implementing adequate security is a difficult task but crucial for wireless sensor networks (WSN) before they can be rolled out on the mass market. In this article we provide an overview on security and reliability challenges for WSNs. Furthermore, we give a short introduction to the European project UbiSec&Sens, "Ubiquitous Security and Sensing in the European Homeland", and present the areas in WSN security the project is working on. We conclude with an outlook on the real-life scenarios that UbiSec&Sens will implement in a prototype.

wireless sensor networks (WSNs) use tiny, inexpensive sensor nodes with several distinguishing characteristics: they have very low processing power and radio ranges, permit very low energy consumption and perform limited and specific monitoring and sensing functions. Several wireless sensors in a region self-organise and form a WSN. Information based on sensed data can be used, for example, in agriculture and livestock, assisted driving, or even in providing security at home and at public places. A key requirement from both the technological and commercial point of view is to provide adequate security capabilities. Realising privacy and security requirements in an appropriate architecture for WSNs offering pervasive services is essential for user acceptance.

Key research areas

UbiSec&Sens identified three key research areas for developing secure and reliable WSNs: "Security & Reliability", "Routing & Transport" and "In-network Processing" (figure 1).

Some major research topics from the areas illustrated in the figure are:

1. **Flexible routing and aggregator election** – The WSN must be flexible enough to cope with disappearing nodes. The overall scheme must support routing and multiple levels of in-network processing. Figure 2 illustrates the dominant traffic pattern for a WSN with a single aggregator node, which e.g. performs the aggregation function "average". In large WSNs multiple aggregator nodes and multiple levels of aggregation are used.
2. **Concealed data aggregation** – Enhanced mechanisms for end-to-end encryption from the sensors to the sink, also termed convergecast traffic, address the concern of reducing both the energy consumption at the sensor nodes and the effect of physical attacks on the nodes. Concealed Data Aggregation provides a good balance between energy-efficiency and security while still allowing data to be processed at the nodes.
3. **Secure distributed data storage** – In some applications, monitored data must be stored in a distributed way. Whenever it is undesirable or impossible to transmit volatile information to an authorised querying party in real-time, the WSN itself needs to store the monitored data. Since the WSN environment is volatile with nodes that disappear over time, security must be combined with replication.
4. **Enhanced key pre-distribution** – It is not possible for the manufacturer to configure all the sensitive information, such as keys, before the WSN is rolled out. Some sensitive information can only be determined and stored with knowledge of the final position of the nodes. Key pre-distribution schemes for different keying models, e.g. pair-wise, group-wise, and even region-wise, need to be in place.
5. **Pairwise/groupwise authentication** – In general, nodes need to build up security association without any preestablished secret or common security infrastructure. In this case, pairs of entities will establish pair-wise relationships. It is also conceivable that groups of entities are able to establish new relationships.
6. **WSN access control** – It is essential to provide an access control for end-users of WSN applications, which ensures access to the monitored data for authorized parties only, supports user-friendly data queries and is DoS resilient to save the sensors' battery capacity.

The UbiSec&Sens project

The European Specific Targeted Research Project (STREP) UbiSec&Sens aims at providing an architecture for medium and large scale WSNs with an adaptable level of security that will make them trusted and secure for the requirements of various applications. The project started in January 2006 and has a duration of 3 years. UbiSec&Sens aims at solving the research topics indicated above. UbiSec&Sens will design and implement a toolbox of security-aware components depicted in figure 3. This toolbox will be easy to configure to create security support for various WSN applications. The proposed architecture will be prototyped and validated in the representative wireless sensor application scenarios of agriculture, road services, and homeland security.

To give detailed examples, the project aims at obtaining results in the following security areas:

Authentication and re-recognition

One of the major threats in WSNs is the presence of an adversary that injects forged data in the network or pretends to be an aggregator. Current mechanisms for authentication are based on complex computations, which are not applicable in WSNs. In most scenarios an authority issuing shared secrets is not available as the sensors tend to

Key Area A: Security & Reliability

Authentication re-recognition

Key pre-distribution

WSN access control

Source routing

Concealed aggregation

Secure distributed data storage

Data plausibility

Flexible routing & aggregator election

Resilient data aggregation

Deviation query

Key Area B: Routing & Transport

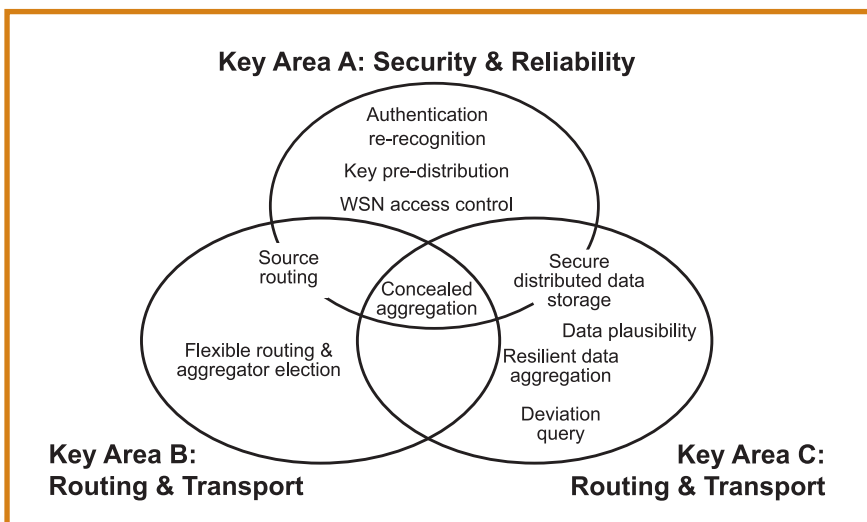**Key Area C: Routing & Transport**

Figure 1: WSN key research areas

communicate in a decentralized manner. With the zero common-knowledge (ZCK) protocol we provide an authentication protocol that establishes well-defined pair-wise

convergecast traffic between the monitoring (sensor) nodes and the sink node. CDA enables intermediate aggregator nodes to aggregate ciphers without the cost of
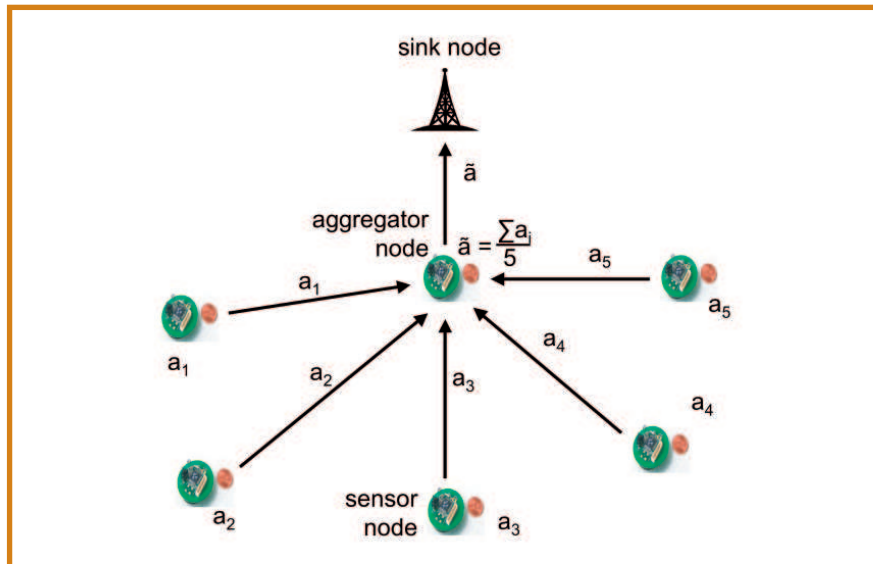

Figure 2: Convergecast traffic with in-network processing

security associations between entities in the absence of a common security infrastructure or pre-shared secrets.

Concealed data aggregation
The concealed data aggregation (CDA) approach uses symmetric additively homomorphic encryption transformations for end-to-end encryption of sensed data for

decrypting and re-encrypting these messages. We have implemented this scheme on sensor nodes.

Key pre-distribution
Key pre-distribution and its adaptation to convergecast traffic are addressed by introducing topology-aware group keying (TAGK). During the WSN's roll-out, all

available nodes discover in a fully self-organised and topology-aware manner their neighbours and specific roles. TAGK establishes mutually disjoint regions with randomly chosen group keys per epoch and region for convergecast traffic. It provides probabilistic security and the ability to use CDA, which is essential. We have simulated very large WSNs which confirm the feasibility and scalability of the approach. We have also implemented this scheme and will continue in this direction.

Secure distributed data storage
Sensor network applications might have only temporary connections to the sink node (i.e. not always-on). In these cases, nodes need to aggregate and store the monitored data of their surroundings over a certain period to be able to respond to query requests later. An adversary should not be able to obtain any sensitive data stored on the nodes. The Persistent Encrypted Data Storage (tinyPEDS) approach proposes an architecture for reliable and secure in-network storage of the monitored data by applying asymmetric additively homomorphic encryption transformation. TinyPEDS has been subjected to validation by simulation, and we are now in the process of implementing it in the sensor platform.

Outlook
In co-operation with FP6 project Daidalos II, a WSN vehicular prototype shall be developed, using CDA and TAGK. The WSN monitors road information via a service architecture and transmits the information to the on-board unit of a vehicle. For the agriculture use case a WSN of 50-100 nodes will be rolled out for one month within a vineyard. This roll-out shall validate the robustness and self-healing characteristics of a WSN developed by UbiSec&Sens under real-world conditions. Finally a WSN prototype shall be developed to evaluate the suitability of this technology and the developed algorithms for Homeland Security applications. It shall use the components of the UbiSec&Sens security toolbox. Sensorial equipment in the deployed WSN nodes shall consist of biochemical and temperature sensors. The WSN itself will be in the range of 15-25 nodes performing in-network processing. Security features range from CDA and tinyPEDS to the integration of authentication and re-recognition schemes to plausibility checks and secure routing approaches.
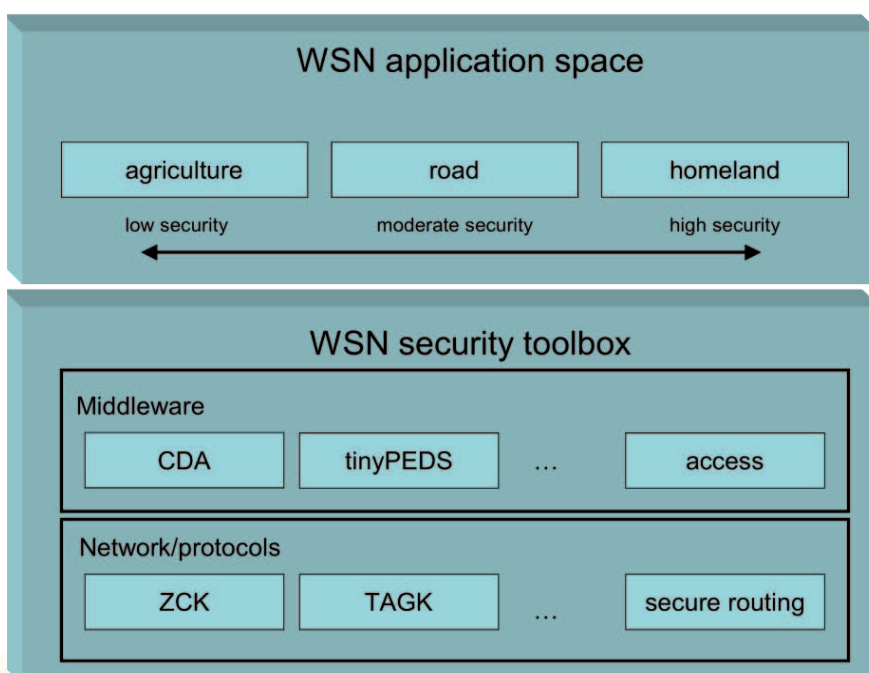
Further information is available at *http://www.ist-ubisecsens.org*

Figure 3: The UbiSec&Sens toolbox concept

Networked automotive scenarios

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In the catalogue of options of premium class cars you will find advanced systems aiding the car driver in various situations that occur almost every day. Parking aids, airbag pre-crash sensing, adaptive cruise control or stop-and-go functionality are just a few examples. These systems are made possible by recent technological advances in sensor devices that are available today. However, the future has more exciting applications to offer.

The previous examples are realised by sensors that do not communicate outside the car they are built in. The next generation of automotive sensors will communicate with their peers, the other cars' sensors, and share the data and interpretation of the environmental conditions they sense.

Enabling a wider range propagation of the sensed conditions by means of suitable ad hoc networks, means that drivers in cars several kilometres away can be informed or warned about road blocks, accidents, heavy traffic or icy roads in just a few seconds. Such information can be easily integrated in today's navigation systems, improving their accuracy and performance.

Furthermore, enabling the car to communicate with its environment, offers opportunities for information services and marketing. The benefits of such advanced driver assistance applications are obvious. For example, they will help to increase road safety by reducing the number of accidents as well as to lower the overall impact of unavoidable accidents. Distributing information about traffic flow will help in smoothing local traffic flow, thus contributing to increased highway throughput and energy efficiency. Finally, services can be built that offer increased comfort and business applications to drivers and passengers.

Additional information services are enabled if the sensors communicate with their environment, such as the entrance to the car park of a super market. Use your imagination to figure out the advertising possibilities for the super market. Another example is that a gas station could advertise its gasoline price to all cars in its vicinity – a valuable piece of infor-mation, considering the high gasoline prices.

Further information is available on the website of the Car2Car Communication Consortium at *http://www.car-to-car.org*
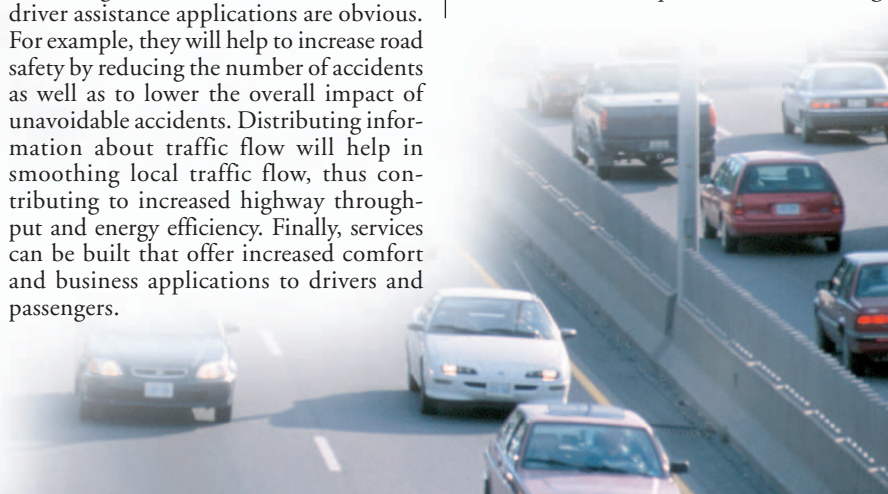
Sensor networks will change our life

Answers by Karl Aberer and Holger Karl on the challenges and opportunities of wireless sensor networks

Prof. Holger Karl   Prof. Karl Aberer

Wireless sensor networks are currently one of the most promising technologies in ICT. Their potential to change everyday life appears to be high. Eurescom mess@ge asked two leading European experts, Professor Dr. Karl Aberer and Professor Dr. Holger Karl, what the challenges and opportunities of wireless sensor networks (WSN) are.

Professor Aberer from the School for Computer and Communication Science at the Ecole Polytechnique Fédérale de Lausanne, Switzerland, is director of the Swiss National Centre for Mobile Information and Communication Systems. He is supervising the project Global Sensor Networks, which aims to develop a generic platform for deploying sensor networks.

Professor Karl from the department of computer science of the University of Paderborn, Germany, has co-authored a book on "Protocols and Architectures for Wireless Sensor Systems" and chairs the Wireless Worlds Research Forum's working group 3 on "Cooperating and ad-hoc networks".

How will sensor networks change our daily life?
Aberer: In short, wireless sensor networks will allow physical reality to directly interact with the Internet, extending it to a Sensor Internet, with many unpredictable consequences for our daily lives. Similarly, as at the initial stages of the Internet we could not foresee the impact of e-mail, Web, peer-to-peer technologies, and Wikis on our daily lives, it is hard to predict today the future impact of wireless sensor networks. There are obvious applications, like fine-grained observations of the environment, allowing us to improve water usage, provide faster warnings from disasters or perform more efficient agriculture, all with important economic implications. Similarly, applications in surveillance, healthcare or habitat and structural monitoring will help to increase our daily well-being. But all these applications are still quite evolutionary in comparison to what we can already do today. Where we may expect

quite disruptive and unpredictable developments is when we start to take advantage of the possibility to automatically control and coordinate sensors and actuators and also automate the subsequent information processing tasks. Also, from a more human perspective, the possibility to quite directly share physical experiences might lead to fairly exciting new community-related developments. But these are next to impossible to predict.

Karl: Sensor networks will change both private and professional life by enabling new types of IT applications. Popular examples are applications in home and office buildings, in production and automation, in logistics and ecology, where connected sensors can provide data previously not available. The degree of automation will increase, but so will efficiency and safety in many areas.

In which areas will wireless sensor networks be applied first on a larger scale?
Aberer: Car technology, logistics and healthcare appear to be among the most promising areas from the industrial perspective. In the research community, environmental monitoring is an area in which wireless sensor networks are being deployed at growing scales. For example, within the Swiss research centre for mobile information and communication systems, we are planning to deploy several thousands of sensors in a Swiss alpine region within a year as a testbed for a Swiss-wide data acquisition platform for environmental sciences.

Karl: Large-scale applications are currently appearing in environmental control applications of various kinds; for example,

avalanche or landslide prediction. But this is restricted to certain niche markets. On an even larger scale, automation applications – for example, for factory floors or preventive maintenance – seem to be a likely candidate as a pilot application area. But for this to happen, some reliability challenges still must be mastered.

What are the technical challenges in the development of wireless sensor networks?
Aberer: I would roughly classify the technical challenges into three categories. At a first stage developing techniques for addressing the resource constraints of wireless sensor nodes in terms of processing speed, storage capacity and communication bandwidth was considered as a key challenge. Substantial progress has been made there and will continue to be made. As the devices are now available and larger wireless sensor network deployments are becoming a reality, at a second stage, the deployment and maintenance of such networks are increasingly recognized as a major technical challenge. Controlling large-scale and often self-organizing systems is here the inherently hard task. At a third stage I expect with a growing number of deployments that the management, interpretation and analysis of the enormous data streams generated by large numbers of sensors and sensor networks will be a big challenge in the future.

Karl: Clearly, some traditional issues like energy supply and energy efficiency, dependability, but also easy programmability by non-experts or easy and reliable deployment have to be worked out. Other issues, like, for example, miniaturization, are only relevant for some areas but can then indeed be a show-stopper.

How rapidly will the cost of wireless sensor nodes decline in the next years?
Aberer: Several species of wireless sensor nodes have recently become commercially available at 50 to 100 dollar each. Through re-engineering, Moore's Law and volume production, wireless sensor nodes are expected to drop in price to less than 5 dollar each over the next five years.

Karl: This is very hard to predict. Since these nodes are not easily commoditized but have to be customized for different applications, the price trend will strongly depend on the dynamics in the different applications. It is a bit of a chicken-and-egg problem.

When do you expect wireless sensor networks to be a reality on the mass-market?
Aberer: More research and standardization are expected to be needed to solve all existing problems, at least for the next 3-5 years. Deployment in large quantities – millions and beyond – are not to be expected before 6-8 years. Given the large number of possible applications, the diversity of wireless sensor types is expected to be important.

Karl: Within five years, such networks will be deployed for specific applications. Within ten years, I would expect a WSN to be an entirely unexceptional technical means.

The interviews were conducted by Milon Gupta.

The European Space Agency (ESA)
Europe's gateway to space

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ESA is a collaboration of 17 European countries that have bundled their resources to realise pioneering space projects. The organisation was founded in 1975 and has extended gradually with the addition of new member states. Luxembourg and Greece joined in 2005. The European Space Agency (ESA) shapes the development of Europe's space capability and ensures that investment in space continues to deliver benefits to the citizens of Europe.

Ensuring competitiveness

On behalf of its member states ESA develops scientific satellites, earth observation/telecom and navigation satellites, elements for human spaceflight and launchers. The actual construction of satellites and launchers is entrusted to Europe's space industry under the direction of ESA. As a consequence, ESA is able to facilitate fascinating projects and provides for a European space industry that can compete worldwide.

ESA's budget and funding

ESA's budget for 2006 amounts to 2.9 billion euro. About 85% of the budget goes via ESA to the European space industry and research institutes where the actual construction of space hardware takes place. ESA ensures that each country receives roughly the same sum by way of orders as it contributes financially to the organisation.

The telecommunications department

European industry and European telecommunication operators are at the forefront of the huge international satcom market – thanks, in part, to the vision and the effort the European Space Agency and its member states.

ESA's telecommunications department is responsible for managing telecommunications projects, the technology activities related to telecommunications and monitoring the performance of the ESA telecommunications satellites in orbit. It is also supporting international efforts in the fields of interoperability, standardisation and frequency coordination. ESA's telecommunications programme covers the requirements of different actors in the telecommunications value chain: space segment suppliers, satellite operators, equipment suppliers, ground segment developers and integrators, service providers, application developers, and, last but not least, users.

Current ESA telecommunications activities

In the fast-moving world of telecommunications, the latest trends are all-important. ESA is keeping European business and industry right at the forefront in the 21st century.

ESA's telecom programme is organised into programme lines, which cover the main strategic areas of the telecom department. In addition to a broad variety of single small projects in the areas of new space and ground equipment, new satellite systems and services, ESA is pursuing the following major activities in the area of satellite telecommunications:

The ESA headquarters in Paris

ESA member states

ESA's 17 member states are Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Canada, Hungary, and the Czech Republic also participate in some projects under cooperation agreements.

As can be seen from this list, not all member countries of the European Union are members of ESA, and not all ESA member states are members of the EU. ESA is an entirely independent organisation, although it maintains close ties with the EU through an ESA/EC framework agreement. The two organisations share a joint European strategy for space and together are developing a European space policy.

European per capita investment in space is very little. On average, every citizen of an ESA Member State pays, in taxes for expenditure on space, about the same as the price of a cinema ticket. In the United States, investment in civilian space activities is almost four times as much.

Working for ESA

ESA employs about 1,900 international specialists, spread over establishments in The Netherlands (ESTEC), Germany (Space Operations Centre, ESOC, and the Astronaut Training Centre, EAC), France (Headquarters), Italy (Earth Observation Centre, ESRIN) and Spain (European Space Astronomy Centre). ESA's launch base is located in South America, in French Guyana, near the town of Kourou.

In addition, ESA has liaison offices in Belgium, the United States, and Russia as well as ground and tracking stations in various areas of the world.

Main control room of the European Space Operations Centre in Darmstadt, Germany, in the critical start phase of a mission.

CELTIC N·E·W·S
Telecommunication Solutions

CONTENT

EDITORIAL

Celtic in the advent of Framework Programme 7

Dear reader,

In this second issue of Celtic News, special attention shall be given to the upcoming challenges after the launch of EU Framework Programme 7, which will take place at the end of November. FP7 will considerably increases the available budget and will provide a lot more opportunities to place good projects on the various calls that will be launched. The European Technology Platforms that have been formed around particular technological areas have become important for discussing and steering the work programmes according to the needs of the ICT industry and other R&D players in the area of ICT.

Thus, our authors, who are all actively involved in this process, will discuss the challenges of FP7 for the ETPs as well as the important task of coordinating their work with the Eureka cluster Celtic in a complementary way.

As in the previous issue, Celtic News again highlights several successful Celtic projects, who present their achievements.

I hope you will find the articles in this issue interesting and would be glad to receive comments from you.

At this occasion I should mention that a new version of the Celtic brochure has just been released. In this brochure an update of Celtic's profile and achievements is provided.

Heinz Brüggemann
Director CELTIC Office

Celtic and the ETPs

European Technology Platforms are assisting in the definition of the 7th EU Framework programme. Celtic is expecting to play an important role in the short-term implementation of the Strategic Research Agendas.

Technology Platforms (ETP) are a new instrument of the European Commission to define and focus the activities of medium and long term research programmes not only on a European but also on a global scale. Celtic wants to play a significant role in the short term implementation of the research agendas and has established links with the major ETPs.

Difficulties of European research

It is widely accepted that Europe is getting closer to spend a comparable amount of money in innovation vis-à-vis the US and Asia. However, the innovative character of European companies still seems to be less significant than that of the US and Asian counterparts. One reason for this problem seems to be related to the lack of an effective commercialisation process (see figure 1). European universities and corporate research centres perform first class research, but unfortunately, they often lack the financial resources and commercial vision to turn those innovations into real products.

European Technology Platforms – The EC response

European Technology Platforms are considered as an important step forward to overcome these problems. European firms investing in R&D have commonly defined Strategic Research Agendas for the various research areas for the coming years to assure a better consistency and closer focus of the EC-financed research programme and a better way for the later commercialisation of the research results.

This idea has, originally, been initiated and promoted by the European Commission, and has found a lot of support from companies planning to participate in the coming 7th Framework Programme (FP7). It is also important that other European, international and national research programmes, including Eureka, have to be well coordinated to assure best use of publicly funded research. Various approaches have been defined focussing on this aspect.

Celtic's response

Since Celtic's objective is to promote applied research in telecommunications, we cannot remain outside this process. From the beginning, companies involved in the Celtic core group or in Celtic projects had taken part in the formation of the Mobile (eMobility) and Multimedia
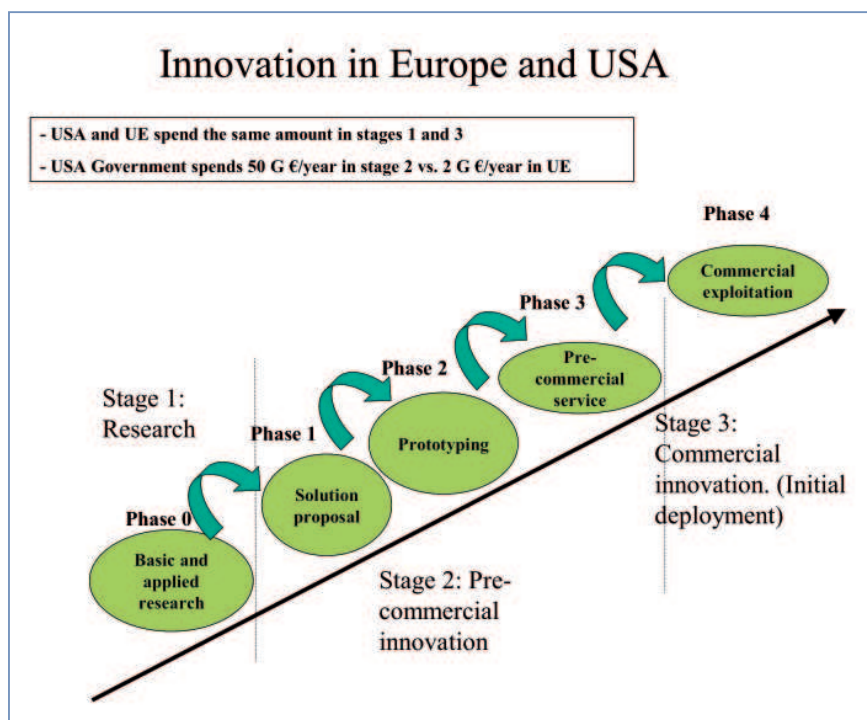

Figure 1: Innovation in Europe and the USA

(NEM) Technology Platforms. It became also apparent that a significant presence at the software technology platform (NESSI) and the satellite initiative (ISI) would be important. Figure 2 shows the relationship between the 4 ETPs and Celtic and the areas of work.

Outlook

The collaboration between ETP and Eureka Clusters is a first step towards more integrated research agendas in Europe. This should encompass not only the medium term objectives of EC financed research, but should be a key element in solving the R&D commercialisation problem that Europe is facing.

Celtic, as the main Eureka Cluster dealing with telecommunications, wants to play a double role: it should translate ETP objectives into short term objectives of the Celtic/ Eureka programme and, secondly, it should serve as the meeting point of the four ETP related to ICT (eMobility, NEM, NESSI and ISI). This should assure not only the coherence of the four ETP programmes but also the alignment of the Eureka goals in the telecom area with those of the EC.

Finally, it should be mentioned that the recently started Panlab project, a Specific Support Action underFP6, is considered as an important instrument

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to support the collaboration and European-wide testing of new services and networks among European projects, initiatives and organisations. Panlab had been originally initiated by Celtic. Further information on Panlab is available at *www.panlab.net.*
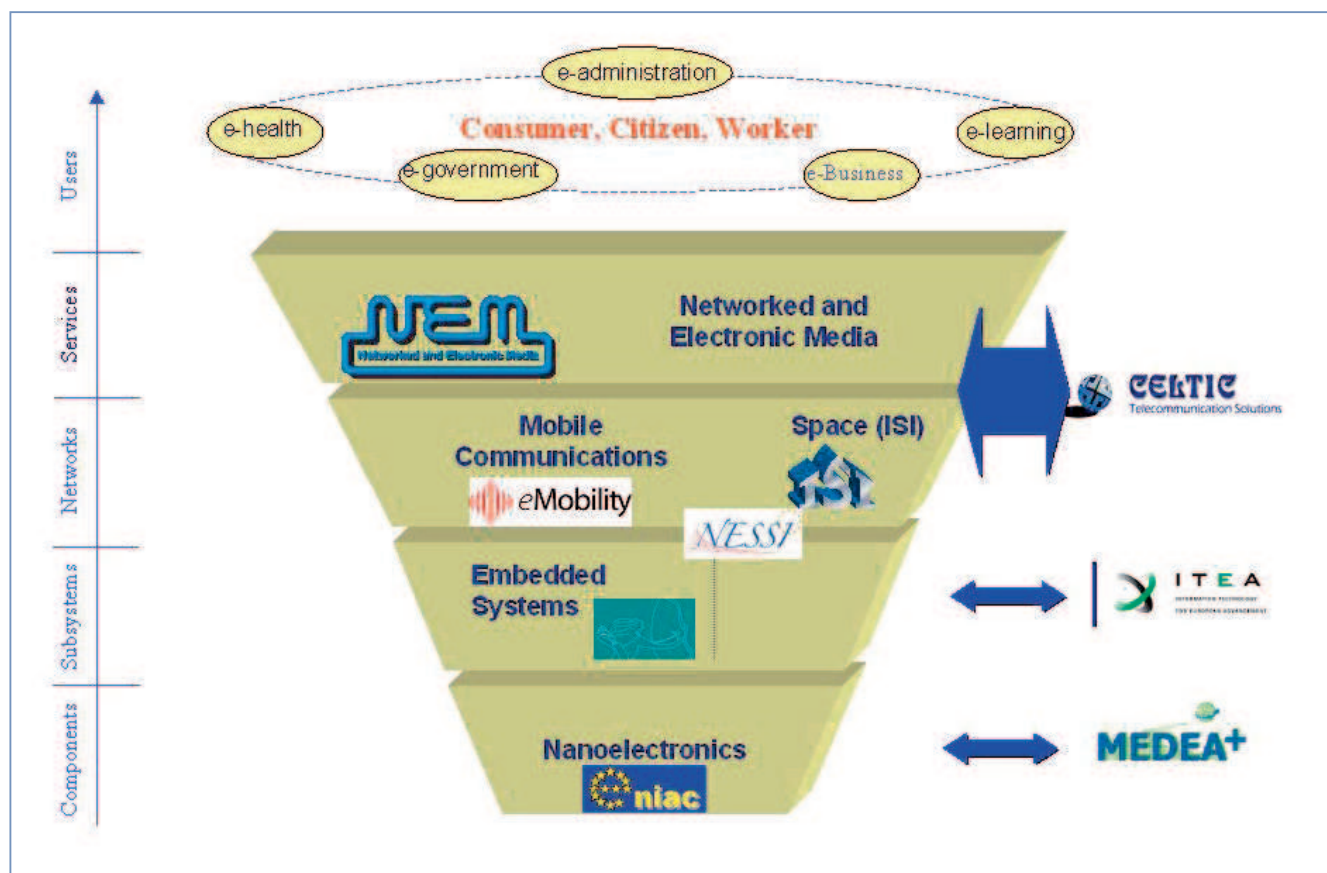

Figure 2: Eureka Clusters and ETPs in the area of R&D in ICT

Strategies of European Technology Platforms in ICT

In the following contributions, we present the four European Technology Plat-forms in the ICT sector: eMobility, NEM, NESSI, and ISI. The representatives of these Platforms explain their strategies and how they plan to implement them to achieve the goals they have set themselves. Celtic is closely coop-erating with these Platforms in order to coordinate the respective Eureka and EU research activities.

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Staying ahead with eMobility!

Now that the work plan for the first calls for FP7 is nearing a final draft stage, eMobility members can see that the efforts required to develop the eMobility SRA (Strategic Research Agenda), now in revision 5, were worth it and that they have made a strong contributed to the development of an innovative workplan for FP7 addressing the societal and economic challenges that are faced by Europe, particularly for wired and wireless communications technologies and their services and applications. eMobility has promoted simplicity, efficiency and trust (SET) as the most desired characteristics of future communications systems.

Membership is now at approximately 400 members and the preparation for the eMobility General Assembly in Heidelberg on 14th November are in full swing. Registrations for the meet-ing are flowing in at a steady pace so interested people should register early, rather than late, on the web site at www.eMobility.eu.org. The General Assembly is being held in co-location with the WWRF conference which takes place at the same location from 15th to 17th November, offering all an excel-lent opportunity to network with other organisations during the long coffee breaks and social event to solidify their plans for Call 1 activities… need I say more?

Three working groups are currently active in eMobility addressing the fol-lowing issues: a milestone roadmap for POST-IP research, the promotion of advanced Broadband in Europe using Structural Funds and other instruments, and the development of a Beyond 3G roadmap. See the web site for further information and contact points. Participation in working groups is open to members.

Cooperation with Celtic has been con-solidated during the year with an agree-ment that eMobility will promote the use of the test-bed facilities organised by Celtic to eMobility members, and that we will publicise each other's activ-ities in our meetings and member com-munications.
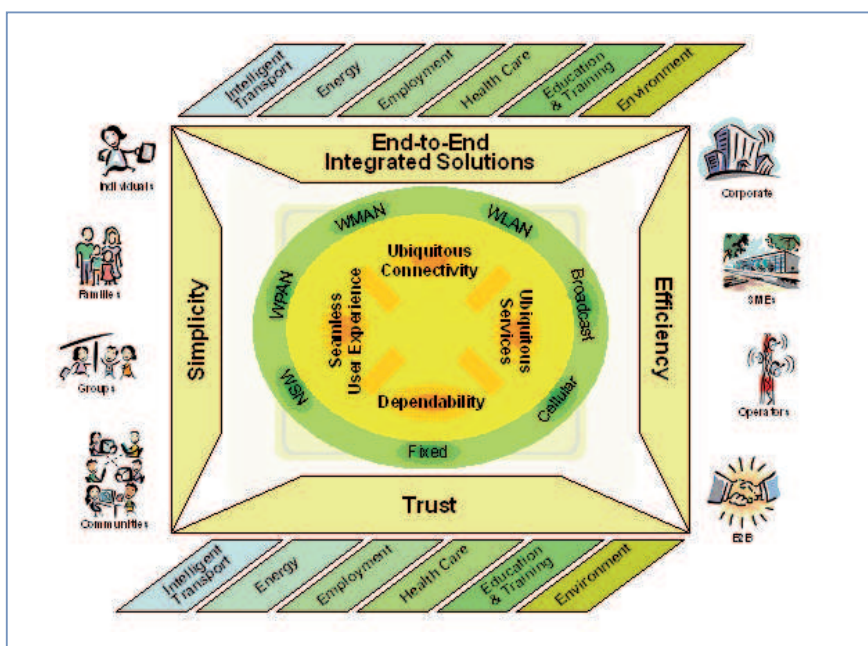
Summary of SRA version 5 of eMobility

NEM identifies key strategic challenges

The main objective of the Networked and Electronic Media Technology Platform (NEM) is to foster the development and introduction of novel audiovisual and multimedia broadband services and applications to benefit European citizens and enterprises.

The Networked and Electronic Media (NEM) Technology Platform focuses on an innovative mix of various media forms, delivered seamlessly over technologically transparent networks, to improve the quality, enjoyment and value of life. NEM represents the convergence of existing and new technologies, including broadband, mobile and new media across all ICT sectors, to create a new and exciting era of advanced personalised services.

NEM is the forum for industry and academia
- to share visions for future research and development and
- to develop a common Strategic Research Agenda.

The Networked and Electronic Media domain addresses all aspects of the media services lifecycle from content creation (by professionals and, increasingly, by individual citizens) to the delivery and utilization of innovative networked and electronic media services and applications. The NEM domain provides great opportunities for economic growth and the well-being of European

citizens. As the total ICT market currently already represents about 8% of European GDP, the commercial potential of the NEM sector is undeniably a key contributor to the economic development of Europe. The NEM sector contributes to crucial developments and improvements that benefit society at large: technological developments offer new services to enrich culture, education, health services and assisted living. The European media and related industries are significant economic players in their respective arenas.
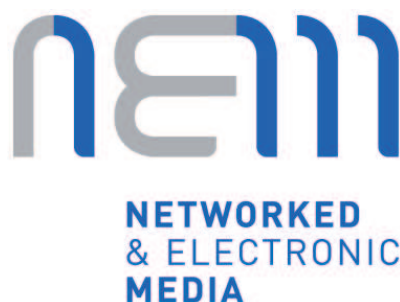
Over the next 15 years the converged NEM domain has the potential to become the largest economic influencer in Europe. NEM is one of the most important pillars of the Seventh Framework Programme. Its focused effort on producing concrete R&D results ensures commercial continuity, strengthening of the scientific and technological bases of the European Community, and empowerment of the European NEM industry to compete in the global marketplace. The ambitions

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of NEM have been defined in its vision statement for the 2015 horizon and beyond. The NEM Strategic Research Agenda (SRA) identifies the key technologies and research domains that need to be addressed to achieve this vision.

The SRA identifies five big challenges on which NEM should focus investments and commit R&D efforts in the coming years:
- to create interoperable network infrastructures that enable seamless multimedia networking
- to empower end-users by putting the user first
- to promote "Electronic content from all to all"
- to converge the various media and content formats
- to develop new middleware for media applications

Investment levels are estimated as 3.5 billion euro for the period 2007 – 2013.

Further information is available on the NEM website at *http://www.nem-initiative.org*

NESSI – building ICT for the age of services

The economy is shifting to services. It is key that all European ICT players unite to seize this opportunity. NESSI embodies this alliance.

Driving innovation is the priority in the software and IT services sector. For the first time in history, software and IT services can make an essential contribution to granting citizens, companies and public administrations of any size the flexibility they need to apply innovative business models including the provision of improved end user services.

The NESSI mission is to develop a visionary strategy for software and services driven by a common Research Agenda and to ensure that it implements the necessary steps for interoperable, secure and trusted service backbones.

NESSI's Strategic Research Agenda
NESSI has structured its Strategic Research Agenda (SRA) across three volumes. The first volume was delivered in March 2006 and scopes the entire space in which NESSI has operated and will operate.

It introduces the NESSI holistic model which recognises that services are embedded in a commercial and cultural context. Taking this context into account is a key differentiator used to ensure that technology is successful and acceptable to all. The challenge is not limited to enabling the delivery of services but on ensuring the complete uptake of adaptative, trusted, secure and reliable services.

The next SRA volumes will map the needs of the NESSI holistic model onto existing and future research and will detail the steps towards implementation.

NESSI – aiming to deliver
NESSI aims to deliver through industrial and research collaborations full implementations of the NESSI Framework, the service backbone defined in the NESSI

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holistic model. These implementations will be interoperable and open through the use of standards. In this context, NESSI will actively contribute to and when necessary create all the standards necessary to the existence of service backbones.

NESSI – providing a solution to known problems
NESSI has identified 8 problem areas to which NESSI's research will provide solutions. From single vendor-lock in to the burden of dealing with computational resources, from the need to better support business processes to improving responsiveness to user needs, NESSI recognises that solutions have to be fully validated in identified user contexts through the extensive use of pilots.

NESSI – open to all
Launched in September 2005 as the European Technology Platform on Software and Services, NESSI has established a governance model that fosters open and proactive collaboration.

At the heart of NESSI are the working groups. Open to all through a simple online membership application, the working groups contribute strongly to the update and continued elaboration of the Strategic Research Agenda and to the validation of user contexts.

More information can be found at: *www.nessi-europe.com*

Empowering citizens and businesses – NESSI, the Networked European Software and Services Initiative, is the European Technology Platform that focuses on moving the Internet beyond information and collaboration into the age of services.

Meeting the challenge – NESSI partners, representing 1.7 million strong workforce and 490 billion euro revenues are fully committed to delivering the NESSI Strategic Research Agenda involving private and public investments of 2.5 billion euro over the coming decade.

Bringing value to Europe – ICT (Information and Communication Technologies) has grown to around 8 % of EU GDP. It is one of the most innovative sectors, representing 18 % of overall EU spending in research and development. NESSI will enable new ways of living and new ways of working by providing new types of services that will contribute to a strong economic growth sector and allow the creation of jobs all over Europe.

ISI – The Integral Satcom Initiative

The worldwide telecommunications network is evolving fast, and historically separate sectors are converging into a single competition arena. Thus, there is an apparent need to coordinate efforts in the field of satellite communications, in order to maximize its chances for business consolidation and growth.

This is precisely the purpose of the Integral Satcom Initiative (ISI). It has been set up as a European Technology Platform in view of the upcoming EU Framework Programme 7 (FP7) and of the implementation of the European Space Policy.

Scope, rationale, and governance

ISI is an industry-led action forum addressing broadcasting, broadband, and mobile satellite communications, as well as their convergence and integration into the global telecommunication network infrastructure.

ISI includes all relevant and interested private and public stakeholders. ISI is designed as an open platform, intended to collaborate with the European Commission, the European Space Agency, the EU and ESA Member States and Associated States, the National Space Agencies, International Organizations, User fora, and other TPs. See Fig. 1 for a pictorial view of the scope of ISI.

ISI is determined to contribute significantly to several EU and ESA policies, in order to promote European industrial competitiveness, growth and employment in a sustainable way, in synergy with national priorities. Representative EU sectors of interest include ICT, space, security, transport, development, and environment. Specific policy initiatives of interest include i2010, the European Space Policy, and, in general, all those initiatives which can benefit from the existence of an efficient satellite communications infrastructure, or which are aimed at the development of innovative satellite services and technologies.

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The rationale of ISI is based on the fact that satellite communications constitute a strategic sector for Europe, with significant economic impact and high societal relevance. Satcoms are instrumental for European and international broadcasting, mobile communications, broadband access, bridging the digital divide, safety, crisis management, disaster relief, and dual use applications.

In fact, satellites provide both a direct access to and the backbone of European and worldwide digital information broadcast networks. In addition, satellites provide interactive and subscription TV services, mobile services to ships, aircrafts and land-based users, and data distribution within business networks. Satellites are also a key element in the Internet backbone and enable both broadband and narrowband Internet access services in remote and rural locations. Satellite services provide an essential component of disaster relief activities worldwide, offering reliability, instant and long-term availability for very wide areas. In addition to civil applications, the unique coverage advantages of satellite systems position them as key factors for risk and crisis management for institutional, government and defense applications.

ISI works towards the convergence and integration of satellite and terrestrial networks, both fixed and mobile, considering all interworking and inter-operability aspects. ISI supports the development of applications and services according to a user-centric approach, to enable all citizens to become full members of the knowledge-based society. ISI addresses the integration of satellite communications with navigation, Earth observation, and air traffic management systems. Specific attention is devoted to Galileo and GMES (Global Monitoring for Environment and Security). Data relay systems and the use of Unmanned Aerial Vehicles are in the scope of ISI as well.

One of the main priorities of ISI is to contribute to the harmonization of the European and International regulatory framework for satellite communications, helping in the removal of barriers. ISI works for the allocation of sufficient spectrum for all satellite communication applications and services. ISI favors the consideration of a regulatory framework for complementary ground components (CGC).

ISI promotes open standards and international standardization approaches. Indeed, ISI fosters the wide adoption of common standards to enlarge markets, reduce costs and tariffs, facilitate interoperability and roaming, and ensure fair competition for the benefit of citizens, user communities and governments.
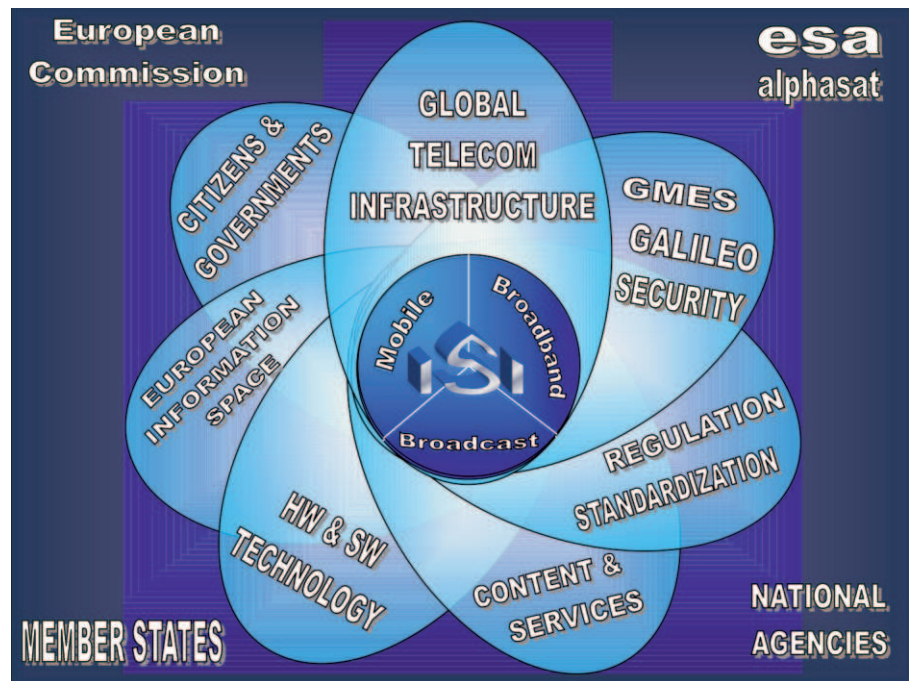
Figure 1: Scope and inter-relationships of ISI

High media interest in Bugyo

Celtic project Bugyo organised a press dinner at the mid-term review meeting in Luxembourg on 30 June. It took place at the Henry Tudor Public Research Centre and attracted high media interest. The journalists interviewed project partners, representatives from the Luxinnovation, who representing the Public Authorities of Luxembourg, and from the Celtic

Office. The media interest focused on the security monitoring system, which is currently developed by the Bugyo project. In addition, journalists were interested

in Celtic projects and international ICT research in general. The resonance of the press from Luxembourg was remarkable: six articles were published in French, German and in English. These articles can be viewed on the Celtic web site at *http://www.celtic-initiative. org/Publications/press-media.asp.*

Digital Rights Management of the future – D R M S O L U T I O N N G

DRMSolutionNG will develop a Digital Rights Management solution that will enable new business models in a fixed/mobile convergence environment. It will allow users of mobile environment secure acquisition of value-added digital contents from any device, and exchange and consumption withother devices, making possible interoperation between different devices with different DRM technologies.

This solution will be based on the SIM card for mobile devices, oriented to convergent networks through IMS services and supporting different DRM technologies. It is an evolution of a first DRMSolution project where an OMA DRM 2.0 compliant platform, linked to user identity, was implemented.

Protecting content in a convergent environment

Due to the huge growth of the digital-content industry and the convergence process in which fixed and mobile environments are involved, piracy has become decisive. The same value added copyrighted content could be stolen and consumed in the different devices.

To prevent this situation, several DRM technologies have emerged and most of them are incompatible, creating an entry barrier for final users and forcing them to pay for the same functionality for each DRM technology of its various devices. DRMSolutionNG will deal with this situation.

DRMSolutionNG is an evolution of a previous CELTIC project in which an OMA DRM 2.0 compliant platform,

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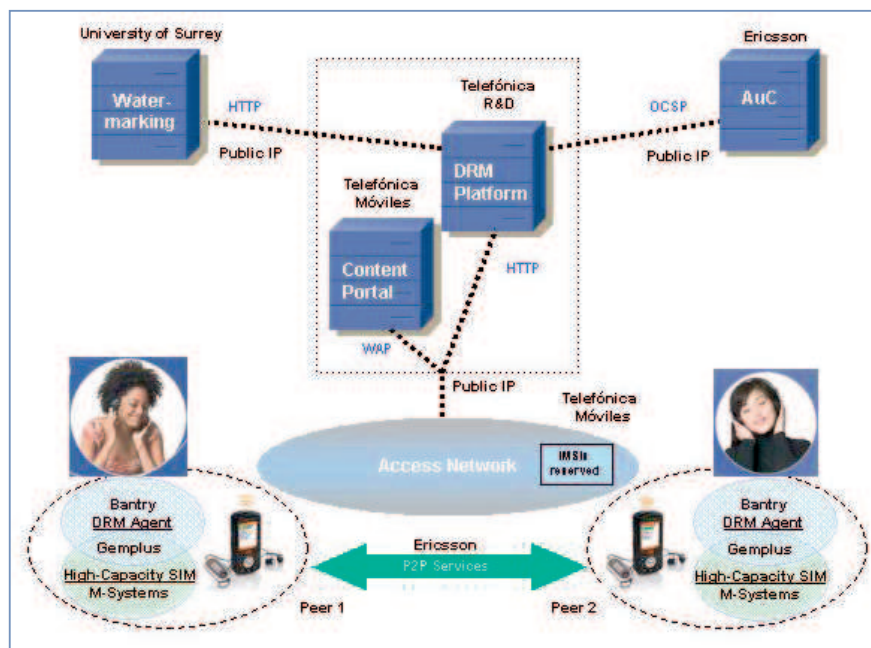
linked to User identity, was implemented. Moreover, higher capacity and security by using high-capacity SIM cards was achieved and some services with P2P used for legal distribution of DRM-protected contents demonstrated the possibilities of these technologies. Figure 1 shows the prototype.

Figure 1: DRM Solution prototype

Business cases

The solution will enable new convergent and interoperable use cases focused on advanced functionalities of OMA DRM v2.0 and Windows Media DRM technologies, protected streaming distribution, integrated P2P services and content and rights portability between devices.

This new proposal leverages on the generic DRM business cases: promotions, subscriptions, digital gift, preview, interoperable content and rights sharing, peer-to-peer distribution or super-distribution.

The new business cases, illustrated in figure 2, will be realized in a convergent next generation network environment based on the IMS standard, which will allow for innovative content-based services crossing the boundaries between mobile and fixed networks.

Main goals of the DRMSolution NG project

Based on the results of DRMSolution, the main goals of DRMSolution NG will be:

- DRM interoperability and convergence: Interoperability between OMA DRM v2.0 and Microsoft Windows Media DRM technology will be analyzed, and services will be deployed over convergent IMS architecture, allowing users full access to the digital content market.
- Trust environment and content security: The DRM system ensures the trust environment through a Public Key Infrastructure (PKI) that allows to authenticate all members in the multimedia content value chain.
- Audio and video streaming protection: The DRM platform will allow and improve the PDCF (Packetized DRM Content Format) profile in order to protect Continuous Media (audio & video).
- Advanced value added services and new business models built on top of OMA DRM v2.0 and IMS.

Outlook

The area of solutions related to Digital Rights Management, which is the target of these projects, is one of the cornerstones of the service architecture of the operator. By fostering innovative services and business models, preventing piracy and making possible interoperability and convergence there will be benefits for all members of the value chain, creating new market opportunities.
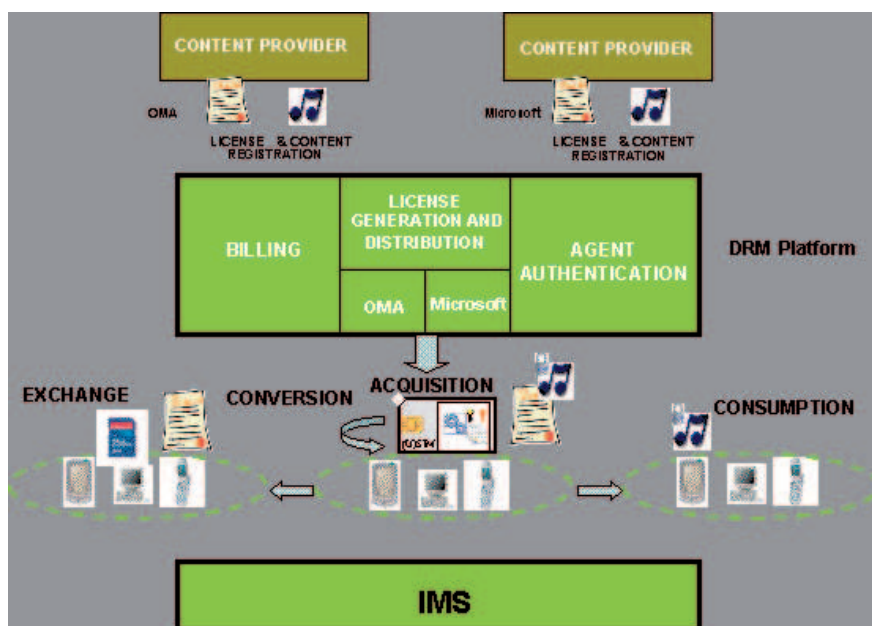
Further information is available at *http://www.celtic-initiative.org/ Projects/DRMSolutionNG/abstract.asp*

Figure 2: DRMSolutionNG business cases

FIDELITY: Federated Identity Management based on LIBERTY

The Fidelity project is building and making interoperable 4 Circles of Trusts in order to test the technical viability of the Liberty Alliance approach for Identity Management in a pan-European context through 7 close-to-market use cases.

User identification and authentication are key enablers for Internet business. However, nowadays users' identities are numerous, independent and fragmented, preventing users to benefit from authentications already achieved at other places on the Internet. To solve this problem, the Liberty Alliance Project (LAP) has defined a Federated Identity Management system, defining a Circle of Trust (CoT) with an identity provider (IDP), responsible for user authentication, with service providers (SP) and attribute providers (AP) offering services to end users and sharing the users' personal attributes. These specifications can even extend the scope of authentication beyond the border of a CoT, through establishing a pervasive trust framework.

Fidelity is building a network focusing on solving the problems that can be found in an international environment and that can be subject to regulation addressing the user data confidentiality. The layout of the network is shown in figure 1.

The project consortium consists of 4 telcos (France Telecom, TeliaSonera, Telenor and Amena), each one implementing a CoT, 3 industrial partners (Ericsson, Axalto and Italtel) providing software and hardware for the CoTs, three SME's (Moviquity, TB-Security and Linus) and the university of Oslo providing specific knowledge, such as development and integration.

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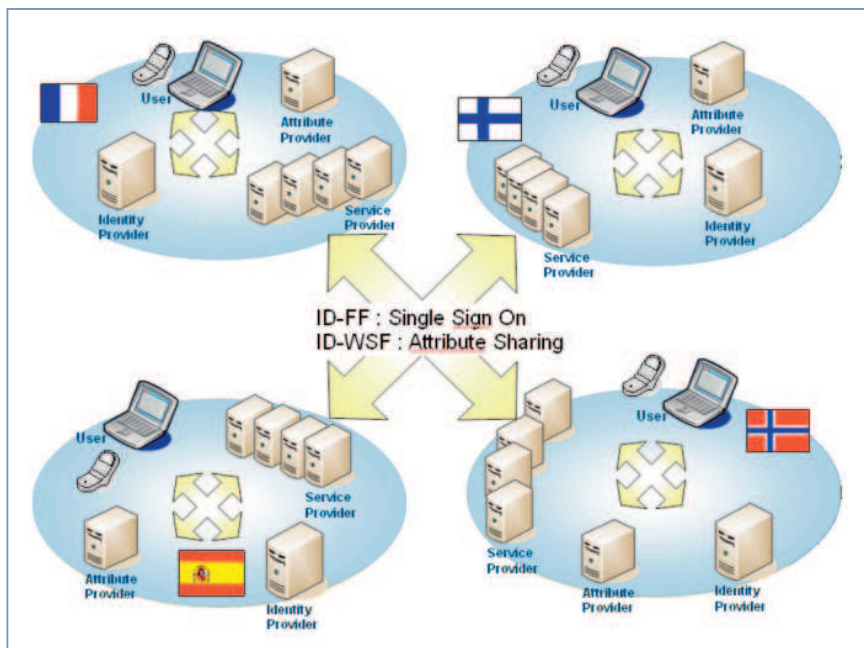
Figure 1: Fidelity InterCoT Architecture

The project has three main objectives:
- To show the technical feasibility of a large scale multivendor implementation based on the Liberty Alliance specifications.
- To show that seamless authentication with defined security levels and attribute sharing across CoT boundaries is possible.
- To produce best-practice recommendations regarding security to end users, legal issues in a pan-European context, and business-related issues.

User benefits

- Simple authentication: Single Sign-On allows the user to browse each protected service provider belonging to his Circle of Trust (CoT) or a related CoT using a single credential as a master key.
- Secure authentication: Single Sign-On allows the user to authenticate only once a session. The security level of this authentication, defined by Fidelity and shared by each CoT, is queried by the service provider and processed by the identity provider.
- Ease of attribute management: Attribute sharing provides the user with a means to designate, where each of his personal attributes is stored, anywhere within his CoT or on his smart card. The service provider can access these attributes in accordance with user-defined policies.
- Reinforce authentication methods: Fidelity provides and fosters the use of a set of moderate and strong authentication methods using smart cards.

Service benefits

- Attract users: Service providers will dramatically increase their amount of prospective clients with the identity provider's database of all users, and users from other CoTs, as demonstrated by Fidelity.
- Simplify local user management: A service provider using One Time Identifier management method can get rid of its user database and authentication mechanisms.
- Use Strong authentication: The service provider has access to strong authentication methods offered by the identity provider.
- Rely on user attributes: The ease of attributes management (creation, modification) increases their reliability.

Identity provider benefits

- Greater trust: IDPs will tighten their trust relationship with the user, providing him strong authentication.
- Broad adoption: IDPs will attract new user thanks to strong and trusted SPs.
- Better authentication schemes: IDPs will offer (sell) strong and complex authentication methods to SP.

Conclusion

Fidelity use case scenarios are currently being implemented, and the first test results show that interoperability between the various CoT's can be achieved, although many challenges are still ahead. Benefits for users and service providers make the identity provider the "trust guarantor" of a win-win system.

We are able to provide authentication and exchange of personal attributes across CoT boundaries in a transparent way for the user.

For more information you can visit http://www.celtic-fidelity.org.

About Celtic

Celtic is a Eureka cluster programme, which initiates and runs privately and publicly funded R&D projects in the field of telecommunications. The cluster, which runs until 2011, is supported by most of the major European players in communication technologies. Celtic projects are focusing at telecoms networks, applications, and services looking at a complete system approach. The size of the Celtic budget is in the range of 1 billion euro. Celtic is open to any kind of project participants from all Eureka countries.

Alphabus

The new Alphabus platform, which is under development, will be able to accommodate up to 200 transponders, which will allow Europe to compete in the world market of high-power telecommunication satellites. Alphabus will facilitate a wide range of commercial missions from TV Broadcast to multimedia applications, Internet access, mobile or fixed services in the wider range.

Alphabus will offer Europe reliable solutions matching world demand for very high-power satellites and will be commercialised jointly by Astrium and Alcatel Alenia Space.
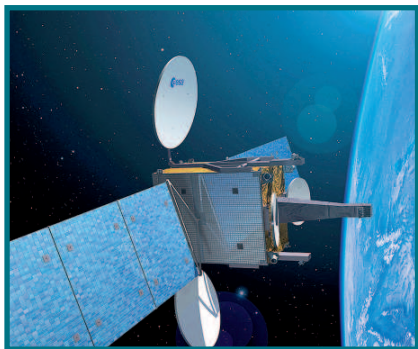
Artist impression of the future Small Geostationary Platform

The large platform mission (Alphasat programme) is a key element to the successful introduction of the new Alphabus product line on the global commercial markets. It will allow a thorough validation in orbit of the first Alphabus platform.

Small Geostationary Satellite initiative

The Small Geostationary Satellite initiative is aimed at the development of a general purpose small geostationary satellite platform which will enable European players to compete effectively in the commercial telecom market for small platforms.

HYLAS

HYLAS is a hybrid Ka Band/Ku Band satellite with European coverage. The satellite will be used mainly to provide broadband Internet access and to distribute/broadcast HDTV. The launch of HYLAS is currently planned for late 2008 on the orbital position of 33.5 degrees West with an expected lifetime of 15 years.

The Applications

The Applications is the part of the telecom programme devoted to promote the development and piloting phase of innovative concepts directly involving the utilisation of satcom by end user communities. Civil Protection Services, telemedicine via satellite, broadband access on trains, and many other areas of daily life are improved by advanced satellite applications developed under ESA contracts.

Working with ESA Telecom

There are two ways to work with ESA Telecom. Either by participating in one of the Invitations to Tender (ITT), or by submitting an unsolicited proposal to the ESA industry partnership programme, which is continuously open. Both are issued on different budget lines called ARTES elements. Each budget line is governed by different rules and funding levels.

Participation in ESA Telecom is open to all firms residing within the member states participating in the ARTES element concerned.

ESA will fully fund (100%) projects in the early stages of innovative technologies development where there is a perceived high commercial and/or technical risk.

ESA will partly fund (up to 50%) projects related to the integration and demonstration of activities based on existing technologies that are tailored to pre-operational products, systems and applications with identified market opportunities.

Medical care from space: telemedicine

Start-up Project Initiative

In addition to the ITTs in the different programme lines, ESA Telecom offers an exciting opportunity for start-up projects in order to promote business innovation. This new initiative aims at supporting a number of small and medium-sized enterprises (SMEs) through the early development stages of researching and refining a business proposition.

Call for ideas

Once a year, The European Space Agency (ESA) is inviting industry and experts from European member states and Canada to come up with ideas and suggestions for future research and development activities in the area of satellite communication.

Get in contact

Interested in knowing more about ESA or the satellite telecommunications activities of the Agency? The ESA portal website *www.esa.int* and the ESA Telecom website *www.telecom.esa.int* provide in-depth information. From Current Invitations to Tender, to free online satcom courses and an extensive documentation, they are your major source of knowledge.

Change or perish
Content providers need a new approach to digital rights

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The battle over digital rights is raging on. The music and the film industry are increasingly under economic pressure from copycats and file-sharing platforms. Content providers will have to change their business models quickly and radically, or the will find themselves out of business soon. Suing copycats is definitely not enough.

Recently, after a US circuit court has decided against it, eDonkey has given up. On the other hand, LimeWire, another peer-to-peer file-sharing software developer, has turned the tables and countersued the biggest record companies, accusing them of operating an illegal cartel to control the

online distribution of music. LimeWire also charges the record companies with trying to extend their monopoly by forcing music distributors to work only with their affiliated filtering system supplier. LimeWire says it developed a filtering application to prevent illegal downloading and encourage legal content purchasing. But the record companies refused to give the developer access to the metadata that uniquely identify each song in order for

the filtering system to work, LimeWire claims.

At the same time, Google continues to push its Google Books Library Project to digitize books and provide access to their contents through its search engine, sparking dissent from major publishers.

The Association of American Publishers has filed a lawsuit to block the Google project on the basis of copyright infringement.

These recent news illustrate the confusion surrounding intellectual property and copyright. This confusion underlines the need to revisit intellectual property and copyright in the light of new technologies and their capabilities.

The reach and availability of the Internet, the evolution of some associated technologies, in particular peer-to-peer technologies, and innovative thinking are challenging established business models of the music, movie and publishing industries. In particular, the enforcement of intellectual property rights and copyrights has become more difficult. Obviously, the established businesses fight to protect their proven business models to the very end using legal and technical means. Protection through technical means opens a competition spiral between encryption, watermarks and other methods to trace and control use, and methods to avoid these protection measures.

At the beginning the above industries showed very little affinity to the new tech-

nology and to the Internet and were slow to embrace it, but lately they seem to catch up and come out with interesting propositions. One could probably argue that because of their very nature incumbents in other sectors and industries (re-)act also slowly and adopt new business models only when absolutely necessary. This is perfectly un-derstandable and how it should be, from their shareholders' point of view, to maximise profit.

However, one interesting characteristic of the business of the above industries was lately, before the Internet came about that they tried to reduce the life-cycle of their products, their content. Their marketing machine was operating at an ever increasing speed, and the message was that only the latest is hip and tried to accelerate consumers' consumption.

In a way this has backfired, since this strategy suggested that there are no long term cultural values, which is clearly not the case. Consumers also got tired of it, and especially became reluctant to pay not insubstantial amount of money for content that is going out of fashion at an ever increasing speed. The Internet offered an alternative to gain free, but not legal access to the very same content. The former value proposition by the content owners and "factories" contributed to the erosion of the consumer moral.

There is a particularly interesting initiative, the Digital Citizen Project at the Illinois State University that tries to answer many aspects of the new challenges surrounding digital right management. A very important element of this initiative, besides the monitoring and enforcement, is education and making digital content easily accessible in a legal way.

Conclusions

The concept of intellectual property rights need to be re-evaluated in light of recent technical development, in particular the ubiquitous Internet and new peer-to-peer file sharing applications. Old and proven business models might need to be radically changed, and the content industry might need to embrace eventually such radical new ideas as flat fee access to content, because educating the user, implementing control and policing could prove prohibitively complex and costly.

The author firmly believes that we are only at the beginning of a major transformation of the content industry.

Shape-shifted TV —
NM2 at IBC 2006 in Amsterdam

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The collaborative research project NM2 successfully demonstrated its first results at IBC 2006 in Amsterdam. NM2, which stands for "New Media for a New Millennium", is a project co-funded by the 6th EU Research Framework Programme. The project will provide tools and technology for building interactive media forms that can be delivered over broadband to a TV screen.

IBC is one of the largest events for everyone involved in the creation, management and delivery of content for the entertainment industry. This year, IBC took place from 7 to 12 September at the Amsterdam RAI conference centre. About 45,000 attendees from more than 120 countries participated in the exhibition and conference. NM2 contributed with a conference paper and a stand on the exhibition floor. Both the paper and the stand created substantial interest amongst visitors.

An attractive new form of media

Visitors were very interested in the new media form becoming possible with the NM2 tools. "The new media genre will allow stories to be adapted, on the fly, for an individual viewer. We think this will be immensely attractive for viewers and for advertisers" explained Dr. Doug Williams from BT, NM2's technical project manager. Dr. Williams calls this new media form "Shape-shifted TV" to stress that the user decides interactively what he or she wants to see, and how the related clip, delivered through an individual broadband channel, looks like.

The NM2 stand at IBC 2006

Working tools and a prototype production

Both a demonstrator of the NM2 production tools, and a real media production, demonstrating how the NM2 production tools will work, were presented at the NM2 stand. "Gods in the Sky Choice" is one of eight interactive production pilots by NM2. Visitors could see, explore, and understand how this repurposed Channel 4 mini-series on the mythology and science of ancient cultures was structured. Viewers could select "Sit-back Entertainment", "Education", or "Information" mode, and choose topic and length of programme as well as level of educational suitability. Every viewing was unique. The economy of process and cost as well as the flexible format created keen interest. Ludvig Lohse of the Digital Studio, University of Cambridge, the producer of this interactive documentary, stated after the conference that "we were overwhelmed by the positive response to our demonstration in this production of how to successfully incorporate coherent stories into truly reconfigurable frameworks."

Visitors were not only interested in the productions, but also in technical details of the NM2 production tools, which allow producers and editors to prepare the new shape-shifted media.

Conclusion

The large interest, which the NM2 presentation evoked at IBC, showed clearly that it is high time for new digital media genres, which are better suitable for broadband than the current forms of television.

You can find more information on NM2 at *http://www.ist-nm2.org* and on IBC at *http://www.ibc.org*

Machine-to-machine communication
Opportunities in new service paradigms

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Machine-to-machine communication (M2M) has received increasing attention in recent years. Progress in short range networking, growth of mobile networks, and advances in user devices have allowed strong progress in this area. While services as, for example, fleet management, supply chain management, and remote metering are becoming common, M2M is still in its starting phase. In Europe and elsewhere, industry, research and standards organisations join forces to realize "The Internet of things". This concept seeks to combine applications and objects in our day-to-day environment to improve business processes and simplify our personal lives.

The Eurescom study P1653 "M2M – Opportunities in new service paradigms" looks into recent developments of M2M technology and services, assessing the impact of concepts like ubiquity and service pervasiveness. It investigates how operators can meet with these challenges in order to maintain a leading role in these new service paradigms. The study is carried out by experts from Bezeq (Israel), Portugal Telecom, and Telenor (Norway).

Services

The M2M communications market in 2006 is focused on vehicular, security and also telemetry applications. Figure 1 shows how data are gathered by a reading device in a local area (e.g. a car, house, neighbourhood). The data are conveyed through a wide area network, typically a mobile network, to a mediation or application platform where they are read, and from where a response may be sent. Typical applications include automatic meter reading (AMR), management of vending machines, fleet management, Pay As You Drive (PAYD) vehicle insurance, road toll, and health surveillance. Mobile payment and ticketing by means of barcodes is also becoming popular since mobile phones support such applications without much additional configuration, as figure 2 illustrates.

Operator roles

Due to their commercial and technical positioning, operators have a natural role in M2M communication. This is, among others, due to operators' proximity to end
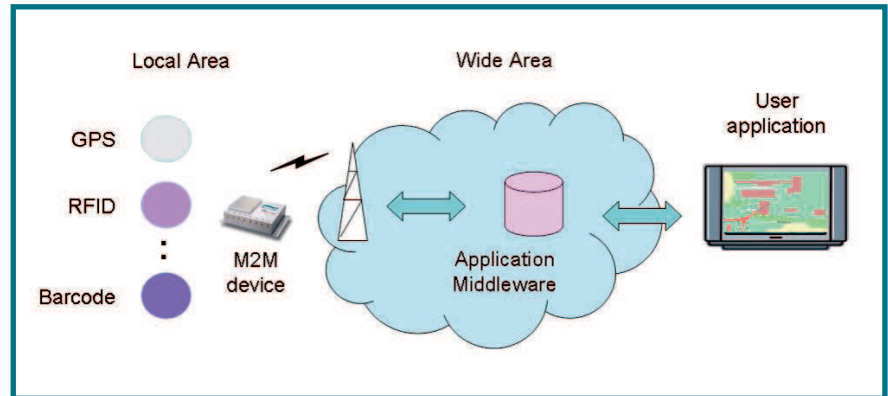

Figure 1: M2M network structure

users and direct control and ownership of backbone infrastructures. The next five years will be crucial to the positioning of operators. Orange, BT, and Telenor are already competing on the M2M market. Orange is offering third party service development using its M2M platform 'Connect'. Orange also offers complete services, such as fleet management, which is priced at around 1 euro per day and vehicle in France. BT Redcare is structured in three units, offering services on Alarm and Telemetry, Supply Chain Management, and Vehicle Tracking. Finally, in the Nordic Region, where remote reading of power meters is becoming mandatory, Telenor's Cinclus is dedicated to large scale AMR deployments (around 8 million by 2010), and simultaneously envisaging alarm and control applications that may complement the service.

The Internet of things

Large scale deployments in the metering and vehicular areas, sometimes as a result of regulations and initiatives such as the EU's eCall, will foster the creation of a widespread M2M infrastructure that can accommodate additional applications. This will contribute to ubiquitous and context aware services and implementation of the "Internet of things". The network will sense where you are and know what you need from your environment as long as you allow it to do so. This may include finding your way around the traffic, paying your bills or simply diverting a session to the device that happens to be closer to you.

Conclusion

The M2M market will continue to grow in the next years. Interworking of machines will have strong implications on the way we communicate and live. Service paradigms will shift towards computing ubiquity, service pervasiveness, and networking of sensors and objects. Business implications of this evolution are still to be fully understood and require close attention from operators.

You can find more information on study P1653 at:
http://www.eurescom.eu/ Public/Projects/P1600-series/P1653/

Figure 2: Mobile cinema tickets using 2D barcodes

Broadband powerline communications

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PowerLine Communications (PLC) is the usage of electrical power supply networks for communications purposes. In this case, electrical distribution grids are additionally used as a transmission medium for the transfer of various telecommunications services. The main idea behind PLC is the reduction of cost and expenditure in the realization of new telecommunications networks.

High- or middle-voltage power supply networks could be used to bridge a longer distance to avoid building an extra communications network. Low-voltage supply networks are available worldwide in a very large number of households and can be used for the realization of PLC access networks to overcome the so-called "last mile". Powerline communications can also be applied within buildings or houses, where an internal electrical installation is used for the realization of in-home PLC networks.

The application of electrical supply networks in telecommunications has been known since the beginning of the twentieth century. The first Carrier Frequency Systems (CFS) had been operated in high-voltage electrical networks that were able to span distances over 500 km [1]. Such systems have been used for internal communications of electrical utilities and realization of remote measuring and control tasks. Also, the communications over medium- and low-voltage electrical networks has been realized.

The communications over the electrical power supply networks, specified in a CENELEC norm, makes possible data rates of up to several thousand bits per second, which are sufficient only for some metering functions, data transmission with very low bit rates and realization of few numbers of voice connections. However, for application in modern telecommunications networks, PLC systems have to provide much higher data rates (beyond 2Mbps). Only in this case, so-called broadband PLC networks are able to compete with other communications technologies, especially in the access area.
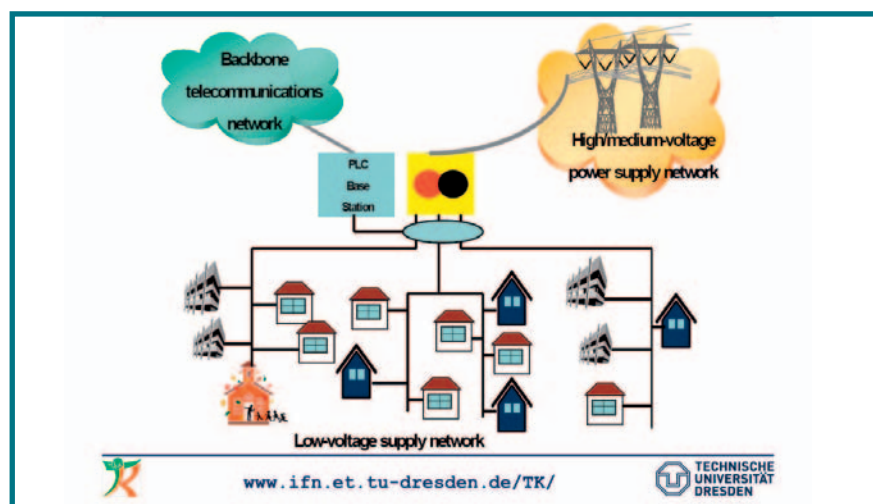
PLC access networks

Access networks are very important for network providers because of their high costs and the possibility of the realization of a direct access to the end users/subscribers. After the deregulation of the telecommunications market in a large number of countries, new network providers have built up their transport networks (WAN), but they still have to use the access infrastructure owned by an incumbent provider. Because of this, new network providers try to find a solution to offer their own access network to the subscribers. On the other hand, a rapid development of new telecommunications services increases the demand for more transmission capacity in the transport networks as well as in the access area. Therefore, there is a permanent need for an extension of the access infrastructure. There are two possibilities for the expansion of the access networks:

- Building of new networks or
- Usage of the existing infrastructure.

Building of new access networks is the best way to implement the newest communications technology, which allows realization of very attractive services. On the other hand, building new access networks is expensive. Thus, the usage of the existing infrastructure

Powerline access network

for realising access networks is a more attractive solution for network providers because of lower costs. The following networks can be used for this purpose:

- Classical telephone networks, by application of xDSL technologies
- Usage of TV cable networks (CATV) for classical telecommunications services
- Electrical power supply networks, by application of PLC

The low-voltage supply networks, used as transmission medium for PLC access systems, consist of a transformer unit and a number of power supply cables linking the end users, which are connected to the network over meter units. The low-voltage supply networks are connected to medium- and high-voltage networks via a transformer unit (see figure). The PLC access networks are connected to the backbone communications networks via a base/master station (BS) usually placed within the transformer unit [2]. The communications signal from the backbone has to be converted into a form that makes possible its transmission over a low-voltage power supply network. The conversion takes place in the base station. The PLC subscribers are connected to the network via a PLC modem, which converts the signal received from the PLC network into a standard form that can be processed by conventional communications systems, placed in the electrical power meter unit (M) or connected to any socket in the internal electrical network. In the first case, the subscribers within a house or a building are connected to the PLC modem using another communications technology (e.g. DSL, WLAN). In the second case, the internal electrical installation is used as a transmission medium that leads to a so-called in-home PLC solution. An in-home PLC network can also exist as an independent network covering only a house or a building.

Performance problems and solutions

Electrical supply networks are not designed for communications and, therefore, they do not represent a favourable transmission medium. The PLC transmission channel is characterized by a large, frequency-dependent attenuation, changing impedance and fading as well as a strong influence of noise. On the other hand, to achieve higher data rates, broadband PLC networks have to operate in a frequency spectrum up to 30 MHz, which is used by various radio services too. Therefore, the regulatory bodies specify very strong limits regarding the electromagnetic emission from PLC networks to the environment. As a consequence, PLC networks have to operate with a limited signal power, which reduces network distances and data rates, and also increases sensitivity to disturbances.

To reduce the negative impact of the powerline transmission medium, PLC systems apply efficient modulation techniques, such as spread spectrum and

OFDM. The problem of disturbances can be solved by well-known error-handling mechanisms (e.g. FEC, ARQ). However, their application consumes a certain portion of the PLC network capacity due to overhead and retransmission. The PLC bandwidth is shared by the subscribers and, therefore, any reduction of capacity due to protocol overhead should be minimized. At the same time, PLC systems have to compete with other access technologies and offer a big palette of telecommunication services with a satisfactory QoS. Both, good network utilization and provision of QoS guarantees, can be achieved by an efficient PLC MAC layer.

Current developments and perspectives

Recently, broadband PLC systems that can be found on the market achieve 8 to 45 Mbps in the access area and up to 14 Mbps in the in-home area, which can be considered as sufficient data rates to provide broadband telecommunications services, such as

telephony and Internet access. Furthermore, existing field trials and commercial networks show that PLC systems operate stable and robust. However, broadband PLC still has a low penetration in the communications world, particularly in the case of the access networks. The main reason for that is the absence of standards for broadband PLC, which does not encourage potential PLC network providers to invest in this area.

Current regulation on EMC (Electromagnetic Compatibility) allows usage of the frequency spectrum for PLC in some countries only if other communications services in the spectrum are not disturbed. Otherwise, PLC providers have to either solve the coexistence problem or to switch off their networks in the affected area. Also, recently offered PLC access systems differ, and different products are usually not compatible. Thus, multiple equipment sources are not available, and PLC network providers remain strongly dependent on particular manufacturers.

This situation is slightly different in the case of in-home PLC where a "de facto" standard is provided by HomePlug Powerline Alliance [3]. Therefore, penetration of the in-home PLC is significantly higher than in the case of PLC in the access area. Nowadays, the largest activity on PLC for access networks is carried out in the OPERA project, supported by the IST programme of the EU [4]. The main objective of OPERA is to provide the technological basis for the creation of a European standard for broadband PLC.

References:
[1] K. Dostert, Powerline Communications, Prentice Hall, 2001
[2] H. Hrasnica, A. Haidine, R. Lehnert, Broadband Powerline Communications: Network Design, John Wiley & Sons Inc., June 2004
[3] http://www.homeplug.org
[4] http://www.ist-opera.org

The Eurescom Study Programme

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One of the strengths of the Eurescom community is its commitment to engage in short and focused collaborative studies. The Eurescom study programme is the framework that enables an efficient setup of such studies and is financed through upfront payments of its members subscribing to the programme.

The Eurescom study programme continues to demonstrate its flexibility in bringing together leading experts from its members to address topics of common interest. Eurescom studies develop conclusions on specific topics and pave the way for larger collaborative initiatives.

The fundamental working principle within the Eurescom study programme is collaboration. Any network operator or service provider may become a subscriber of the study programme and participate in it, if he shares the interest of having the substantial issues facing the telecoms

industry addressed in a collaborative way. The results of the studies are exclusively available to the members of the programme, so that the study subscriber organisations benefit from a direct competitive advantage from collaborative work.

Following the second call for proposals in 2006, the Study management group recommended four additional studies in 2006. The issues addressed concern specific genres of mobile services, the acknowledgement that IMS standardisation has ignored the client side to date, as well as a forward looking study on the view of the network operator industry with respect to the future of the Internet.

The study on "Mobile Advertisement – Spam, threat or new opportunity?" will analyse the risks and opportunities of using the mobile phone as an interactive channel for advertisement. A main objective is to document how the challenges might be overcome by actively introducing context and personalisation data, to address the risk of customer trust erosion caused by privacy intrusion.

The study on "Mobile online gaming - from Tetris towards ubiquity?" will contribute to the understanding of the future trends of various flavours of online gaming involving large number of users interacting in virtual and mixed reality gaming worlds. Clearly the online gaming market is growing very fast and is rapidly moving

into mobility and thus ubiquity, representing a significant business opportunity for network operators. The study will develop recommendations for network operators in terms of technological considerations, viable business models, and possible alliances.

The purpose of the study on "Definition of an open and extendible IMS Client Framework" is to identify and define an agreed set of network operator requirements to an extendible, maintainable and hardware platform independent IMS client framework, acknowledging the fact that ETSI TISPAN / 3GPP IMS standardization has focused, to date, mainly on the platform and backend specific protocols and components.

The study on "Future Internet – the operators' vision" is aiming at consolidating the various opinions about how the future Internet should be, and forming a network operators' common vision. It does so by recognising the fact that the Internet has become a critical infrastructure for the society worldwide.

For more information on the study programme, or if you are interested to subscribe to the study programme, please visit the Eurescom website at *http://www.eurescom.eu*

FP7: The Research Agenda
for European competitiveness

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This year the European Union will decide on investing more than 50,000 million euro for the period 2007–2013 to support research in Europe. If you consider that European industry will match much of this investment, FP7 represents the motivation of at least 100,000 million euro into researching new and innovative developments in all areas of European industry.

This investment will be spread over the following high-level themes proposed for EU action: health, food, agriculture and biotechnology, Information and communication technologies (IST), nanosciences, nanotechnologies, materials and new production technologies, energy, environment (including climate change), transport (including aeronautics), socio-economic sciences and the humanities, security and space.

The most interesting area for us is the IST area addressing the information and communication technologies. In the amended proposal for a decision of the European Parliament and the Council concerning the 7th Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013) the provisional budget planned for IST projects is 9,110 million euro [1].

European industry has responded to the scale of this research initiative by establishing a number of European Technology Platforms (ETPs). In the ICT area the key ETPs are the NEM Initiative (www.nem-initiative.org), eMobility (www.emobility.eu.org), NESSI (www.nessi-europe.com) and ISI (www.isi-initiative.eu.org).

Each of these platforms have produced their own Strategic Research Agenda, and together they represent the interests and commitment of the wider Industrial and academic interests for future research in Europe. These SRA documents were submitted to the European Commission, and their contents have been reflected in the draft work programme leading to the first few calls for projects under the 7th Framework Programme.

In fact the discussion in the different technology platforms is now focused on the creation of consortia who will propose projects to address the challenges stated in the SRAs of the ETPs.

At the start of February 2007 the European Commission will host a major event in Cologne in Germany, where they plan to formally launch FP7 to an audience of over 5,000 people. The dates for call one and two of the 7th Framework Programme will be formalised and race will be on to submit the best proposals and win the funding for your projects.

Technical highlights
The European Commission, with the help of the European Technology Platforms in the ICT area, have identified three ICT technology challenges that offer high potential for giving European industry a significant competitive advantage [2]:

- The converged communication and service infrastructure that will gradually replace the current Internet, mobile, fixed and audiovisual networks.
- The engineering of more robust, context-aware and easy-to-use ICT systems that self-improve and self-adapt within their respective environments.
- The increasingly smaller, cheaper and more reliable electronic components and systems that constitute the basis for innovation in all major products and service.

Success in these areas will enable completely new services to be delivered rapidly with a much greater understanding and consideration for the User interests and behaviour. In fact in many of the innovative services it is expected that the users will play a much greater role in the creation and dissemination of exciting content. We are entering into a new social era of communications where it is possible for any individual to get the attention of the world by just being interesting enough!

You snooze, you lose
I cannot advise anybody to wait for the February FP7 launch event as there is enough information in circulation now to start effective project planning. If you are serious about making a strategic research commitment you should be represented in the ETP that best matches your interests and already start finding the partners that share these ideas. You could also meet companies with new ideas that complement yours.

Different communities are already actively evolving into working groups which should lead to high-quality proposals, and the ETPs will serve as facilitators to locate the right competences and to identify overlaps. The best advice to any aspiring project leaders and participants now is: get active in your community as quickly as possible.

It is possible to get key roles in proposals by putting in the effort now, but, as time goes on, consortia will have been formed, the SRA coverage will be high, and only niche roles will be available. This is a clear situation where the early participants can define the projects in their best interests.

References
[1] http://ec.europa.eu/research/fp7/pdf/amended-28_06_06-en.pdf
[2] ICT Work Programme 2007-08, Draft version 2

Beyond the Internet Protocol
Revolution or evolution?

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The Internet architecture and its protocols are currently the targeted technology for future operator business. In such an environment mobility, Quality of Service, security, privacy, routing, federation, and in principle the possibility for access are fundamental operator services. The current Internet plane environment is complex and not capable to provide such services in an easy way. Therefore, fundamental new techniques have to be invented to decrease the complexity.

The Internet philosophy

Rapid technological and social changes, together with the bewildering emergence of numerous new services and the increasing number and complexity of access technologies have created a complex environment for network operators and a confusing situation for end-users. The enhancement of existing technologies and the development of new systems, such as the IP Multimedia Subsystem (IMS) or systems beyond the Third Generation mobile communication, will even further increase this complexity. A major challenge for future networks is therefore the provisioning of ubiquitous access to an unlimited set of end-user-based services at reduced costs for both users and operators. The use of IP is rather limited, and extensions and workarounds had and have to be made. Example projects, which perform or have performed efforts in these areas, are the EU-funded projects Daidalos, Ambient Network, and Moby Dick.

Challenges for "beyond IP"

In a redesign of the current communication environment, a number of requirements have to be taken into account to have an excellently running and easy to manage system:

- Security (end-user satisfaction through hidden transmission, safeness of the communication equipment)
- Support of full mobility (inter-technology, intra-technology, inter-operator domain, and intra-operator domain)
- Reliability (protection from network interrupts)
- Network management – self configuration (automatic provisioning of services and dynamic adaptations of resource requests)
- Self-healing (automatic identification of sources of failures and reconfiguration of the network)
- Scalability (management of millions of end users, network devices, sensors and their networks)
- Quality of Service (e.g. delay, jitter, bandwidth) and Quality of Experience (end-to-end QoS)

Most of these parameters were not considered in the beginning, when the Internet was designed, because there was no need. The Internet was a closed and trusted wired network.

Solutions

Two ways exist to solve the problems: an incremental and evolutionary path or a complete redesign, which means a revolutionary approach. The incremental way leads to short term solutions. The already mentioned projects are candidate projects, which follow the incremental path. The redesign approach – also known as Clean Slate Design approach – focuses on a complete break and challenges all currently known Internet communication mechanisms and paradigms.

The new approach has to fulfil a number of important expectations, especially for a business communication environment. The three important ones are the convergence of the IT world with the communication world and its reduction of complexity, manageability of a huge number of different and heterogeneous access networks and applications, and last but not least the mobility of the society.

However, the development of such an environment is not possible without having a huge effort on research and development and the provisioning of a test bed. Simulations will not provide the realistic results of human and network node behaviour.

Current activities and outlook

Currently, a number of researchers tax their brains to get an initial point for creating the future Internet. In the USA, the FIND (Future Internet Network Design) initiative calls for proposals, and GENI (Global Environment for Network Innovations) sets up a testbed infrastructure.

In Europe, early steps in this direction were done by the Autonomic Communication Forum (ACF) within Framework Programme 6 in the context of the Future and Emerging Technology (FET) initiative. Currently, the Framework Programme 7 is in preparation. One focus – at least in the eMobility European Technology Platform (ETP) – will be the "Future Internet" or "Post-IP" research and development.

With the knowledge of the technical and socio-economical challenges, the experiences from former research and development activities, and the unique selling point of bringing the business and network management together, the European research community will be in a good position to contribute actively to a new communication infrastructure design. However, it is not yet clear, if it will be a revolutionary or a combination of an evolutionary and a revolutionary approach.
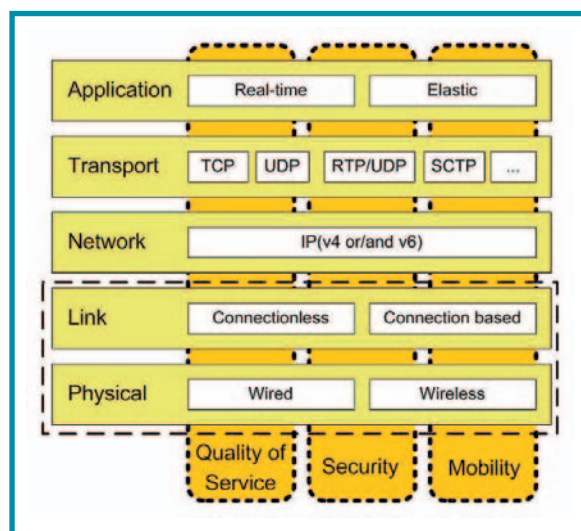
Internet stack challenges

Further information:
Daidalos project: *http://www.ist-aidalos.org*
Moby Dick project: *http://www.ist-moby-dick.org*
Ambient Network Project: *http://www.ambient-networks.org*
GENI Project: *http://www.geni.net*
FIND Project: *http://find.isi.edu*
ACF: *http://www.autonomic-communicationforum.org*
FET: *http://cordis.europa.eu/ist/fet*
eMobility: *http://www.emobility.eu.org*

NEM general assembly
in Brussels

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At the general assembly of the Networked and Electronic Media initiative (NEM) in Brussels on 10 and 11 October, a significant evolution happened. After two years of discussion about the Strategic Research Agenda and the priorities that the community need to address, we moved on to the first discussion on the work we should do to realise the NEM objectives.

Elections

The first major item at the meeting was the election of some new steering board members. We had about 25 candidates for 14 positions so there was some hot competition for the posts. All the candidates made short presentations highlighting their company capabilities and what they could bring to the NEM Initiative, and then the assembled representatives cast their votes in a secret ballot (see box for election results).

Talking technical

The entire second day of the general assembly was devoted to assisting the emergence of projects that will implement the Strategic Research Agenda. First, Luis Rodriguez-Rosello, Head of Unit, Networked Audio-visual Systems, EC Directorate General Information Society and Media, gave an update on the status of FP7 and what we should consider there. Then we quickly went into discussion on project ideas.

Over two fast moving sessions around 50 organisations presented their expressions of interest and ideas for projects and we had some discussion on how to proceed. What was probably more important is that the participants had the time and information to identify potential partners with similar interests so that already discussion groups are forming with a view to preparing proposals.

We had some discussion then on how to proceed and some clear actions emerged. First the expressions of interest from the meeting will be posted on the NEM website to allow follow up and further discussion to occur. Second, an additional web space will be made available on the NEM website to post new ideas and look for partners. Then we discussed how to keep the conversations going; the NEM office is offering to provide e-mail exploders and discussion groups but in the meeting the exact structure of such discussion groups was not finalised. For the moment we will allow it to grow organically, and NEM members may request such support if they have a group emerging.

Conclusion

The main point now is that 2007 will be the year of the project proposals. The NEM community is now working towards proposals for FP7, call1 and call 2, and call 5 of Eureka cluster CELTIC. The next NEM general assembly is going to be held early next spring, and there we will have a discussion on how the NEM proposals fit together and what milestones a pro-posal should include to be part of the NEM community.

NEM Steering Board

The following companies have been elected for the NEM Steering Board:

Category: Industry and content
- Hewlett-Packard, represented by Nick Wainwright
- Ericsson, represented by Martin Körling
- STMicroelectronic, represented by Eric Schutz

Category: Academia and research
- Waterford Institute of Technology - TSSG, represented by Willie Donnelly
- Queen Mary University of London, represented by Ebroul Izquierdo
- University of Amsterdam, represented by Arnold Smeulders

Category: User view and/or SME
- Homega Research, represented by Roger Torrenti
- Aido, represented by Elena Boronat
- Game, represented by Malte Behrmann
- GWT-TUD, represented by Sven Zeisberg
- Rose Vision, represented by Julian Sesena
- Swissmedia, represented by Roland Grunder

Category: Network Operator/Broadcaster Views (elected by acclamation)
- Abertis telecom, represented by Joan Manel Espejo
- Eurescom, represented by David Kennedy

In addition, the Pôle de compétitivité "Images & Réseaux" from France, represented by Christiane Schwartz, was invited to become an observer member of the NEM Steering Board.

Rose scent on the Internet
Japanese device records and reproduces odours

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Multimedia is entering a new dimension. Our eyes and ears are already exposed to digital text, photos, sounds, and videos. Now digital media are about to grab our noses as well. Recording and playing the scent of roses from your garden and of buns from your local bakery may soon become as easy as taking and showing digital photos.

Scientists at the Tokyo Institute of Technology have developed a new device, which records odours and later reproduces them. Just point the device to a rose, for example, and it will record the emanating odour. The device analyzes smells through 15 sensors, records the odour's composition in digital

Autosampler · Measurement Chamber · Computer

Whole system of odor recorder

format, and then reproduces the scent by mixing 96 non-toxic chemicals and vaporizing the result.

Applications of the odour recorder

Takamichi Nakamoto, the creator of the technology, imagines applications of the odour recorder in the food and flavour industry as well as in cosmetics and the perfume industry, but also in e-commerce, home electronics, and gaming.

Replicating odours could enhance the marketing of consumer goods, giving customers the chance to smell packaged goods before they buy them. Scent marketing could go beyond the point of sale into the world-wide web, allowing smells to be recorded in

one place and transmitted to interested noses anywhere in the world. Thus, online shoppers could, for instance, check out perfumes or flowers before they buy.

The device could also be used to add an extra dimension to virtual reality environments and even to assist military doctors treating soldiers remotely by recreating the odours of bile, blood or urine, which might facilitate a diagnosis.

So far, the Japanese odour recorder has been successfully tested on a more limited scope of smells. It recreated a range of fruit smells, including oranges, apples, bananas and lemons. However, it could be reprogrammed to produce almost any odour, from old fish to gasoline, said Dr. Nakamoto.

Nakamoto's vision

His vision is that any smell can be captured and sent via a mobile device. Beyond food and perfume, Dr. Nakamoto also thinks of touristic use: travellers could capture typical smells from an exotic place and send them as a souvenir together with photos and videos to relatives and friends at home.

However, at the moment, this vision is still far from reality. The current prototype measures 100 x 70 centimetres, which is too big to be portable. The unit's large size is due to the space required for the 96 odour-forming chemicals, which are contained in separate glass bottles. As humans have 347 olfactory sensors, this number of chemicals is required to synthesize any odour.

In order to replay a smell, drops from the relevant vials are mixed, heated and vaporised. A more compact version of the device, which includes only the sensors, can record smells, but must be hooked up to the blender to regenerate them.

However, Dr. Nakamoto is already working on new solutions: "Recently we have developed the laptop PC-size odour blender with 32 odour components. It will be demonstrated at several exhibitions in Japan this autumn."

Besides making the device smaller, Dr. Nakamoto also wants to extend the range of smells. "Then we can think about commercializing the system," he said. According to him, an odour recorder with limited

Dr. Takamichi Nakamoto

functions will appear in two or three years, but the odour recorder with the complete function will appear only in ten years at the earliest.

Dr. Nakamoto has been working on the fragrance recorder since 1999. He claims that it is the most advanced of its kind in the world. Nakamoto's team of 12 scientists has been collaborating with a Japanese perfume company that produces the raw ingredients for fragrances and with electronics companies interested in the sensor chip technology.

According to Dr. Nakamoto, making the 15 sensor chips, which pick up aromas and convert them to a digital formula, was the hardest part.
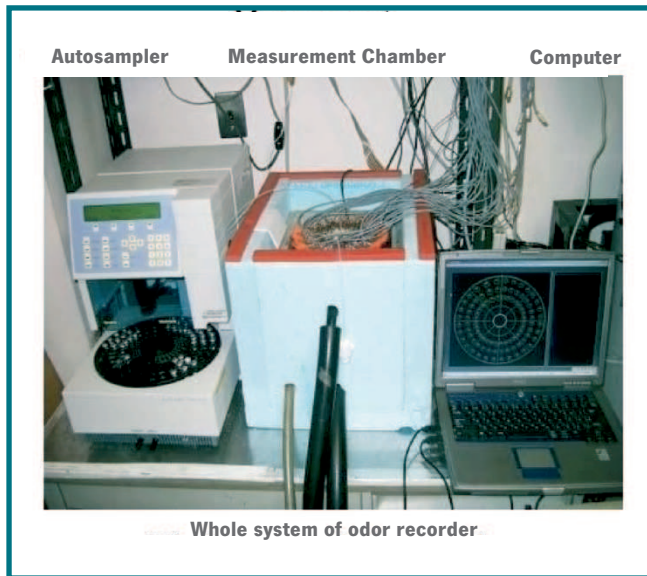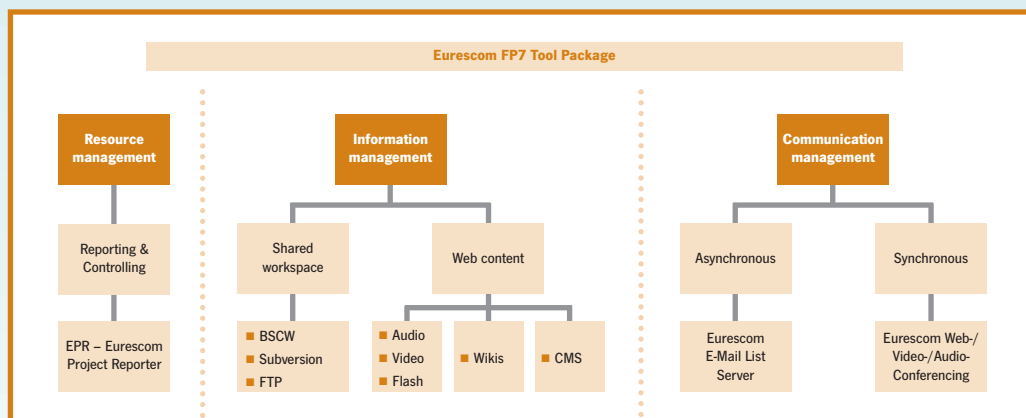
Smell-o-Vision

While development of the odour recorder is still ongoing, another odorous project from Japan has already hit the noses of customers. In April, NTT Communications had launched the Smell-o-Vision project that synchronized smells to movie scenes. During the historical adventure movie "The New World", seven fragrances wafted from machines under back row seats.

The concept of Smell-o-Vision is not new. It was already created in 1960 by Mike Todd Jr. who delivered scents throughout his film "Scent of Mystery". 30 different smells were injected into a movie theatre's seats when triggered by the soundtrack. Problems propagating the scents in sync with the film and flushing the scents out between each showing led to Smell-o-Vision's early demise.

In 2000, France Télécom R&D started a project on the diffusion of fragrances through telecom networks, which, however, has not led to a commercial telecoms service so far.

It remains to be seen, if the Japanese fragrance recorder will be more successful, or if consumers prefer to keep their noses free.

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