3.
INTERNET OF THINGS

3. INTERNET OF THINGS

Imagine an Internet of Things, where everyday objects, rooms, and machines are connected to one another and to the larger digital world. Like we begin to see it today, mobile phones would pay for things like subway fare or cosmetics from a Web site, and Radio Frequency Identification (RFID) tags would be used to monitor access to VIP clubs and passes for ski lifts.

But also sensors, robotics and nanotechnologies would enable a balanced lifestyle and independent living by supporting seamless digital life recording, active stress prevention, well-being and fitness, and assisted living.

Sensors on expensive factory equipment would tell you when the machinery is about to fail; cargo shipping containers could search their contents for nuclear material or other hazards; every office could report its temperature and humidity and whether its lights are on or off; each foot of a geographical area's streets and highways could monitor traffic flow; and in the home environment, the fridge could talk to the microwave, the microwave to the nearby toaster, and the toaster to the stove.

Therefore, when we talk about an Internet of Things, it is not just putting Radio Frequency Identification tags on some dull thing so we *smart* people know where that dull thing is. It is about embedding intelligence so things become smarter and do more than they were proposed to do.

From the Internet of Machines to the Internet of Things

The move from today Internet of Machines to tomorrow Internet of Things reflects several visible shifts: from systems to software-based services, from passive RFID tags to wireless sensors, from Web 2.0 to the Semantic Web, from high-tech to trusted tech, from features and options to experienced sense and simplicity, from always-on to always-responsive, and from exposure to privacy.

The Internet of Things means the fusion of the physical and digital worlds: physical entities have digital counterpart; objects become context-aware – they can sense, communicate and interact; immediate responses can be given to physical phenomena; instant information can be collected about physical entities; intelligent real-time decision making becomes possible, thus opening up new opportunities to handle incidents, meet business requirements, create new services based on real-time physical world data, gain insights into complex processes and relationships, address environmental degradation (pollution, disaster, global warming), monitor human activities (work, criminal, health, military), improve infrastructure integrity (civil, energy, water, transport), and so on.

We can foresee that as the connected world weaves an ever-growing web of interconnections, anything that can be connected to the Internet will be connected. And with those things connected, our daily lives could change radically. The focus of the network will shift from human interaction to machine-machine connectivity. When machines can communicate directly with each other, people can focus on the major issues, not routine activities.

The Internet of Things will lead to increased use of technology and new levels of service and productivity.

Challenges

The challenges relating to the Internet of Things are tremendous:

- What are the constraints that a massive deployment of things and devices at the network periphery put on network capabilities and architectures?
- How to compress a massive amount of data into discrete pieces of information in a secure timely manner through the right medium and appropriate granularity?
- Which applications will first become typical and under which business models will they operate? Will they emerge first in a professional environment (e.g. real-time enterprise) or private environment (e.g. home, lifestyle)?
- How will Internet of Things applications affect users control over their own privacy and how will they react? Which security requirements will emerge on the network infrastructure and the service infrastructure? How can privacy and security features be integrated from the early stages of system design?
- How to address the issues of naming, addressing and querying of the physical world? More specifically, how the service discovery platforms that will be needed to deploy sensor networks may impact the overall governance of the Internet of Things?
- How can the principle of 'right to silence' or 'silence of the chips' that allows individuals to disconnect from any application be integrated into the Internet of Things systems?

It is also important to stress that when things are networked they become social actors. They are not of course human social actors, but they are things with social activity.

Therefore, the question is: "What sort of world will we inhabit with networked social actors that are things?"
This invites to include ethics into the reflection on the Internet of Things.

The European Commission has started reflections and discussions among stakeholders for reaching mutual understanding about the Internet of Things and its relationship to the Internet of the Future, foster multidisciplinary collaboration in science and technology, favour the discussion between existing EU-funded research projects, and encourage international dialogue towards the exchange of information and best practices.

The projects presented in this section are some of the trailblazers which embrace the variety and complexity of the challenges and opportunities relating to the Internet of Things.

Integrated Interoperable Services

Future businesses will be more competitive, innovative, agile, and value creating. Future enterprises will require new technologies, applications and services to enable them to work as networked knowledge-based businesses. Enterprise Interoperability, as a means for European Enterprises to work together, aims at fulfilling this vision.

To understand the major achievements so far in the domain of the interoperability of enterprise applications and software, it is worth recalling the recent events under which the relevant EU-funded research projects have carried on their mission. Under the Sixth Framework Programme (FP6), the unit "Networked Enterprise & Radio Frequency Identification" brought these projects together into an Enterprise Interoperability (EI) Cluster.

Enterprise Interoperability Cluster

The Cluster not only has reinforced collaboration and synergy between the projects, but has also become a European hub for stimulating and catalysing fresh ideas, concepts and solutions in the field by including external stakeholders. The unit managed over 8 projects in the EI domain, with a responsibility for approximately 36 million Euros. The portfolio included 3 large projects (ATHENA, INTEROP and TRUSTCOM), which gives an indication of the importance of the shift from small projects in FP5 (mainly technology take-up measures) to larger RTD projects with ambitious and clearly defined objectives for the domain. Additionally, the trend towards these larger Integrated Projects (IP) was confirmed by the mobilisation and cohesion of a community and hence, the potential structuring of the research area.

Among the cluster achievements lies the Enterprise Interoperability Research Roadmap, published by the European Commission in July 2006, updated this year and which will continue to evolve. The Roadmap targets breakthrough research for stimulating and catalysing business innovation. It is a major reference document in 2007 for European research in Enterprise Interoperability by establishing the domain as a capability for the purpose of business and not only as an ability of entities to work together.

The scope of Enterprise Interoperability was not anymore restricted to the 'integration' problem encountered by enterprises, but would significantly offer a new, radical approach to Enterprise Interoperability as a vehicle for innovation requiring new services, new approaches and new frameworks to be developed.

The strategic positioning of new projects along the Grand Challenges defined in the Enterprise Interoperability Research Roadmap clearly confirms their adherence to the vision defined in the document, with a specific focus on the first Grand Challenge called Interoperability Service Utility.

Another important work instigated in parallel to the establishment of the Seventh Framework Programme is the analysis of the Informal Study Group (ISG) on Enterprise Interoperability which resulted in a report called "Unleashing the potential of the knowledge economy".

It started with the identification of the lack of a business case for Enterprise Interoperability in the problem space of our Roadmap. It was recognised that various technologies and tools resulting from research needed follow-up beyond (further) research and that we lacked understanding where most value is created through EI research.

Innovation for Enterprises

Addressing the above considerations was perceived critical as

we stressed on the importance of value innovation for enterprises, and on the fact that the mechanism and the nature itself of innovation are changing.

The Roadmap positions future enterprises as nodes in innovation ecosystems, where interoperability spans all enterprises throughout and across entire innovation ecosystems. The "Value Proposition for Enterprise Interoperability" (VPEI) report further suggests that disruptive innovation at the enterprise level needs to be matched by disruptive innovation for enterprise systems of the future. So, in defining our priorities for future research in the EI domain we should aim at solutions that contribute to the EI field as a whole, rather than value-added EI solutions highly context-dependent (and making use of specific technologies).

Furthermore, a number of initiatives established to complement and support market-driven interoperability adoption need to be mentioned.

A major one is due to the INTEROP Network of Excellence which completed at the end of the project the establishment of a sustainable structure called the Interop-VLAB aiming at stimulating the scientific activity at the European level and beyond. The iVLAB acts today as a reference in the Enterprise Interoperability domain, and is consulted by international bodies like the "Laboratoire d'Intégration du Matériau au Système" (IMS) organisation or the "International Federation for Information Processing" (IFIP).

This initiative was complemented by the creation of the IEKR (Interoperability Explicit Knowledge Repository), welcoming the public deliverables of our past and future Enterprise Interoperability projects. Last but not least, a European Master Programme in Enterprise Interoperability was set-up by the INTEROP partners and continues to attract students from all over Europe.

Finally, it goes without saying that the domain constantly follows and integrates the relevant results obtained by neighbouring domains such as software and services architectures and infrastructures, content and knowledge, interaction and interfaces, etc, with which it maintains fruitful relationships.

Although the bulk of the new FP7 projects is still in progress, we can already conclude, based on the various developments described above, that the results recently obtained by the community constitute the foundation of the future European research in this area. To promote innovation, to support SMEs in adopting ICT, and to contribute to the competitive dimension of our enterprises, we need to target research priorities supporting novel concepts, approaches, techniques and tools for a new generation of interoperable enterprise systems required by the emerging "Semantic Economy". To adapt to this new context, no doubt that the Enterprise Interoperability domain will evolve (under the next FP7 calls), diversify (new paths will be taken) and specialise (along the Future Internet priorities).

COIN
Enterprise Collaboration & Interoperability

"L'iniziativa Future Internet rappresenta per il progetto COIN una preziosa opportunità per dare profondità alla visione del proprio modello di business".

—

"The Future Internet initiative represents for COIN a valuable opportunity to tune its proposed business and technical models".

Claudia Guglielmina
(COIN Coordinator)

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

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

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

Background and Motivation

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

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

Scientific Objectives

Service Platform

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

Baseline Services

COIN aims to consolidate and stabilise the ICT results of both Enterprise Collaboration and Enterprise Interoperability FP6 research into some Baseline Services (free or charged; open-source or proprietary) which constitute the service foundations for COIN in the

form of a solid service-oriented Technology Platform for Enterprise Interoperability and Collaboration. Such a reference Platform would be enriched by new services developed in COIN and will tremendously improve its usability and accessibility (mostly by SMEs) in different business and knowledge contexts.

Innovative Collaboration and Interoperability Services

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

In the field of Enterprise Collaboration, COIN believes essential for Small and Medium enterprises to have configurable and flexible services for collaborative product development, distributed and participative production planning, cooperative multi-project management and finally some standardised services for user interaction and co-operation.

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

Software as a Service

COIN explores the reference concept of Software as a Service Utility - SaaS-U - intended as a further specification and substantiation of the ISU Grand Challenge of the EI Research Roadmap, positioned especially in respect of delivery of IT functions as services.
Within COIN SaaS-U will be addressing new business strategies and models, in complement to the technical RTD of the COIN ICT service platforms and services as described under the previous objectives. The overall result will be: new business models for Enterprise Interoperability, an integrated EI value proposition, and scenarios of Open Innovation for EI.

The trial industrial scenarios represent a wide spectrum of collaboration contexts varying from supply chains, to collaborative networks, and to the most dynamic form of enterprise business ecosystems.

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SYNERGY

Knowledge Oriented, Adaptive Enterprise Collaboration

"SYNERGY addresses the need to help companies, especially SMEs, to build and manage collaborative networks rapidly to exploit product opportunities together by providing web-based services for knowledge management and sharing, and learning".

Keith Popplewell
(Synergy Coordinator)

The main objective of SYNERGY is to enhance support of the networked enterprise in successful, timely creation of and participation in collaborative Virtual Organisations by providing an infrastructure and services to discover, capture, deliver and apply knowledge relevant to collaboration creation and operation.

The next phase of enterprise interoperability is the sharing of knowledge within a Virtual Organisation (VO). Such knowledge will be a driver for new enhanced collaborative enterprise, able to achieve the global visions of enterprise interoperability.

The SYNERGY project envisages the delivery of Collaborative Knowledge services through trusted third parties offering web-based, pay on demand services, exploitable through Interoperability Service Utilities (ISUs)

Specifically SYNERGY aims to provide semantic ontology-based modelling of knowledge structures on collaborative working; develop the service-oriented self-adaptive SYNERGY holistic solutions for knowledge-based collaboration services; and facilitate the testing and evaluation of the efficiency and effectiveness of the SYNERGY solution in concrete case studies.

Motivation

The recent decades show clear trends in business - away from big, comprehensive trusts which can cover all stages of a value creation chain and also away from long standing, well established, supply chains that have been stable over many years.

Instead companies are increasingly focusing on their core business and core competencies and entering more into more agile and flexible alliances for value creation and production.

This growing demand for flexible interaction and efficiently integrated businesses and services already led to a huge amount of scientific and technological work in enterprise interoperability, in particular in the ICT area.

Although the work so far has achieved promising results and partially led to the first commercial products and service offerings, they remain at the level of process and *data* interoperability, and *information* exchange, they hardly reach the level of *knowledge* integration, and certainly fall short of knowledge-based collaboration.

Main target organisations are Small to Medium Enterprises (SMEs), though not exclusively as large organisations are involved in Virtual Organisations with SMEs. Given the importance of SMEs to the European economy (SMEs make up 99.7% of companies in Europe, accounting for approximately 50% of Europe's GDP) clearly the growth of the Small to Medium Enterprises sector and its greater adoption of ICT would make Europe progress significantly towards the Lisbon objectives.

Impact & Benefits

An expected impact is to improve the competitiveness of enterprises in Europe by fostering the creation of new networked applications and services capable of interoperation across a wide variety of business domains and organisations of all sizes.

By allowing easy access to, and flexible integration with, collaboration services through application or specialisation of tried and tested collaboration patterns, organisations of all sizes will have the ability to rapidly and successfully form and operate networks sharing knowledge and combining competencies to exploit product and service opportunities.

Moreover, SYNERGY will have an impact on international cooperation between EU member states and beyond. In the developing global economy, many, perhaps most, enterprise networks are EU and world-wide and enterprises will benefit from the application of SYNERGY results by enhancing their participation in international networks.

Consortium

The SYNERGY consortium is comprised of 8 partners in 6 European countries (4 EU Member States and 2 Associated Countries) each bringing a wealth of experiences and skills to the project which will ensure the achievement of the ambitious project objectives. It would be very difficult, if not impossible, to set up such a consortium and acquire the necessary critical mass at a national level.

The complementary expertise of the SYNERGY partners enables the transfer and internal exploitation of scientific, application and technical know-how developed in 6 European countries. Moreover, the European dimension of the consortium enables the exchange of experiences and knowledge amongst numerous end-user SMEs brought into the consortium by the partner networks of Douglas Connect and TANET, and also CIM's and EBM's customers and business partners.

In this way, different user perspectives from different European regions and industry branches will be integrated in the project approach, facilitating the wider adoption and acceptance of the project final results.

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Next generation RFID

The Objective "ICT in support of the Networked Enterprise" of Call 1 of the ICT part of the 7th RTD Framework Programme (2007-2013) has resulted in 10 new projects, of which 6 are dealing with some aspects of RFID and networked devices.

All these projects address, with a different focus, the architectures and platforms that are required to make available networked devices and systems for the integrated enterprise. An important goal here is to develop a European open source Radio Frequency Identification platform (ASPIRE). There is for the moment little coverage of Enterprise Resource Planning (ERP) integration; data management of massive amounts of real-world data and novel applications (CuteLoop has started work on this).

The standardisation efforts (CASAGRAS) focus almost exclusively on networks of Radio Frequency Identification (RFID) devices, while a broader perspective on real-world integration of all sorts of networked contact-less devices – an embryo of the future "Internet of Things" – will be needed for comprehensive progress in the field.

A lot of research work is carried out in the world on the next generation of RFID technologies, including hardware, software and networks.

Vision of an Internet of Things

The Internet of Things is going to be based on information about objects in the real world and their respective surroundings. This information will be provided by the things, as they obtain and reveal the information through RFID and a huge variety of sensors and wireless communication devices mounted in different environments, embedded in systems or worn by users.

The Internet of Things era reflects a gradual evolution from *ICT around us to ICT on us*. This vision of an Internet of Things powered by next generation RFID has many potential advantages. It presents new industrial opportunities to the ICT market, and creates unique opportunities for breakthrough improvement in process efficiency and product/service quality in many application sectors (logistics, retail, banking, transport). Moreover it increases the perceived and real usefulness of the Internet to the majority of EU citizens, who are interested not only in navigating and retrieving information, but also in getting physical support to their daily needs (for all citizens, and particularly for citizens with special needs, such as disabled and elderly).

Research challenges for next generation RFID and its applications

Regarding the future of RFID technologies, with a time horizon between medium-term (5-10 years) and long-term (10-20 years), it is obviously difficult to determine where vision supersedes realism. What seems clear is that we are witnessing a paradigm change from the "identification of objects at a distance" to the more challenging "communication between objects", which implies that besides the next generation of RFID technology there must be a scalable, efficient, reliable, secure and trustworthy infrastructure able to link all involved objects.

Technological issues relating to laws of physics must clearly be addressed. In particular, although radio waves can pass through most articles, the combination of materials, operating frequencies, associated power and environment can prove to be problematic. As tags and readers attempt two-way communication, there are multiple sources of potential interference and a proliferation of wireless devices may create electromagnetic interference with RFID systems.

Since RFID operates in bands that are shared with other users, this might become a serious problem deteriorating the accuracy of RFID systems. Future RFID applications will increasingly need to take electro-magnetic (or radio) interference from other devices into account.

The ensuing research targets include the hardware aspects (tags, readers, and embedded systems), the software/system aspects and the networking aspects.

Hardware

The RFID devices themselves need more capabilities to broaden the range of applications. They need to acquire larger memory, local intelligence, encryption and security features, extended functionalities such as integrated sensors, and much more. To support this functionality, new breakthroughs in battery technology are needed, in particular to enable more energy, less space (or printing on the tag), and more reliability than ever before.

Today almost all conventional RFID devices contain a silicon-based microchip. The potential in low cost RFID is split between chip-based technologies and "chip-less" tags. These chip-less tags can still be interrogated through a brick wall and hold data; although more primitive in performance than silicon-based chip tags, they hold the potential of much lower production costs and other advantages that will become clear as the technology matures.

Further miniaturisation of the tag antennae and more efficient and reliable antennae connecting technologies are seen as another priority before mass introduction is affordable.

Interoperability issues are also very important because RFID tags increasingly travel across a large number of different geographical and organisational environments, together with the object which they identify, thereby imposing new technical requirements such as multi-protocol, multi-frequency integrated circuits and appropriate antenna solutions for tags.

Software/Middleware

Research not only applies to the RFID tag and/or reader themselves, but also to the information systems which process the RFID events. Using RFID events within enterprise applications, such as Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM), requires new RFID middleware and reorientation of these business applications. Research on RFID software is needed to ensure data security, integrity and quality in large networks. It is also needed to provide solutions enabling a reduction of counterfeit.

Networks

For open or online systems, such as in a supply chain application, where multiple entities have the ability to access RFID tag related information that is shared across geographic or organisational boundaries, there are issues which need to be addressed through R&D and that are of a different kind than those addressed by the RFID hardware or middleware.

They include notably look-up services for efficient data retrieval; business models for data sharing among multiple partners (selective data retrieval, access rights); support for distributed decision-making further than just data sharing; networked RFID systems; interoperability requirements and standards; and network security (access authorization, data encryption, standards).

ASPIRE

Advanced Sensors and lightweight Programmable middleware for Innovative RFID Enterprise applications

"ASPIRE vil ændre den nuværende måde, hvorpå RFID bliver brugt ved at introducere royalty fri RFID software og ved at lave software i hjertet af RFID infrastrukturen med speciel henblik på Små og mellemstor virksomheder med lav pris hardware. Aspire vil udvikle og aflevere en, letvægt, royalty fri, programmerbar, sikker, og i henhold til standarder, intelligent software platform som vil sikre en billig og fuld automatisk RFID løsning".

Thomas Christiansen
(ASPIRE Administrative Manager)

European networked enterprises in general and Small and Medium Enterprise (SME) in particular are still reluctant to adopt Radio Frequency Identification (RFID), since they perceive it as unprofitable or too risky. This is largely due to the fact that the adoption of RFID technology incurs a significant Total Cost of Ownership (TCO).

ASPIRE will significantly lower SME entry costs for RFID technology, through developing and providing a lightweight, royalty-free, innovative, programmable, privacy friendly, middleware platform that will facilitate low-cost development and deployment of innovative RFID solutions. This platform will act as a main vehicle for realising the proposed swift in the current RFID deployment paradigm.

Portions (for example specific libraries) of the ASPIRE middleware will be hosted and run on low-cost RFID-enabled microelectronic systems, in order to further lower the TCO in mobility scenarios (for example mobile warehouses, trucks). Hence, the ASPIRE middleware platform will be combined with innovative European developments in the area of ubiquitous RFID-based sensing; towards enabling novel business cases that ensure improved business results. The ASPIRE RFID middleware paradigm, as well as the unique and novel characteristics of the ASPIRE middleware platform are thoroughly described in this proposal.

Privacy Protection and Privacy Friendliness

The ASPIRE middleware will by design to be "privacy-friendly". The principles of privacy protection and privacy-friendliness will be incorporated in the logic of the middleware. The specific principles are:

- Removing data unnecessary for the business (for example tags identities after the object has been sold).
- Separation of personal data and object data (for example different databases and/or different transactions).
- Establishment of certification programs to verify compliance for example through independent auditing of the RFID infrastructure and middleware.
- Establishment of guidelines for adopters, with special focus on SMEs. These guidelines will cover not only technical aspects associated with consumer privacy, but also recommended business procedures to maximize privacy-friendliness.
- Creation of a "seal" to provide adopters with a marketing tool to promote the advantages of their privacy-friendliness.
- In coordination and with the support of UEAPME, dissemination through specialised events and conferences aiming mostly at SMEs.

Ubiquitous Added-Value Sensing and Low-Cost Readers

A primary focus of the ASPIRE added-value sensing activities will be the new generation of battery-assisted RFID-tags that incorporate physical sensors, such as temperature, humidity, pressure and acceleration meters.

These sensors have been proven extremely beneficial in a variety of business cases, for example, where the position of tagged merchandise and its physical conditions are of extreme important. Nevertheless, these sensors are up-to-date voluminous and expensive to facilitate common business cases, involving large amounts of low-cost tagged items.

The ASPIRE deployment paradigm aims at leveraging the intelligence of the core middleware platform to enable lower-cost deployment of these added value sensors.

Applications and Scenarios

The ease of development and cost-effectiveness enabled by the platform will be manifested across different application domains, such as:

- Cold Chain Management for food and diary products.
- Asset Management for Pharmaceuticals.
- Product Packaging, Tracking and Traceability.
- Health care.
- Pharmaceutical.

The developments of the ASPIRE will be validated in the scope of Pilot Trials involving European SMEs. Innovative RFID scenarios showcase and pilots will be built around the following axes:

- Fully automated reading and processing functionality. Applications will run without human intervention.
- Mobility scenarios involving several mobile warehouses in the scope of the supply chain.
- Measurement of added-value parameters such as temperature, humidity or pressure.

ASPIRE Pilots

In relation to the overall objectives of the project, the objectives of the two pilots will in general be the following:

1. To verify that the developed middleware is programmable to be used by SMEs (e.g., health, food, industry...).
2. To verify ease of deployment of ASPIRE Middleware on SMEs IT infrastructure, on low-cost hardware (i.e. to validate the lightweight nature of the middleware).
3. To verify that the ASPIRE middleware is able to work with 500 RFID tag detections but also with 500 000 tag detections (Scalability).
4. To verify the ASPIRE middleware is easy to use (based on feed back from the SMEs regarding the programmability and the difficulties to use the middleware).
5. To verify that the use of RFID and ASPIRE middleware results in true really cost savings for SMEs.
6. To verify that the ASPIRE middleware can be effectively adapted for mobility RFID solutions with low-cost (significant lower than the cost required today).

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"ASPIRE will change the current RFID deployment paradigm, through introducing royalty-free RFID middleware, making the middleware at the heart of RFID infrastructures especially targeting the SMEs with low-cost hardware. To support this paradigm ASPIRE will develop and deliver a lightweight, royalty-free, programmable, privacy friendly, standards-compliant, scalable, integrated and intelligent middleware platform that will facilitate low-cost development and deployment of innovative fully automatic RFID solutions".

Thomas Christiansen
(ASPIRE Administrative Manager)

CUTELOOP

Customer in the Loop

"Das ‚Internet der Dinge' bietet nicht gekannte Potenziale, um unsere Kunden mit neuen Dienstleistungen und Produkten zu begeistern. Hierfür müssen wir uns trauen, die Entwicklung der neuen Technologien aus Kundensicht voran zu treiben".

—

"The Internet of Things offers unrecognised potentials to delight our customers with new products and services. Consequently, it is essential to advocate development of innovative technologies through the customer's perspective".

Harald Sundmaeker
(CuteLoop Coordinator)

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

Intelligent Networked Devices

When aiming at supporting the networked enterprises to provide ICT enabled added-value services to their actors as well as to realise a new dimension of networked applications and services capable of interoperation across a wide variety of business domains and organisations of all sizes, a key enabler are Intelligent Networked Devices.

Such "Networked Devices" are providing their own computing capability, becoming more advanced as well as less expensive and can be combined with an increasing number of other devices. Examples are mobile phones, PDAs, notebooks, digital pens, displays, or even passive/active Radio Frequency Identification (RFID) tags and many others. They are generally neither easily interconnectable nor interoperable; often lacking required ICT related environment and infrastructure. Key challenge is to facilitate an industrial uptake as well as to improve the required technology infrastructure and environment for development of business specific services and applications.

Key Objectives

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

The CuteLoop project intends to explore how to radically improve the interaction of diverse actors in an integrated enterprise, based on an approach which will facilitate the inclusion of customers as an integral part of complex relationships in such business networks.

A special emphasis will be put on the elaboration of a new approach for employing a "Networked Devices Enabled Intelligence" for distributed and asynchronous control of business processes.

Key issues to be taken into account for such an approach are: decoupling of decentralised message routing from subsequent processing in complex business networks; distributed asynchronous optimisation of tasks in workflows of loosely coupled actors; decentralised approach for creation of communities of interest and trust in networks with unstable composition of actors and innovative interactions among actors (especially with customers) addressing a horizontal and vertical supply chain integration.

Technology vs. Application Potentials

Specifically customers and the public audience have a reluctant perception of potentials and threats of massively distributed networked devices, such as Radio Frequency Identifications (e.g. concerns about security, privacy, radiation, health, environment) jeopardising establishment and acceptance of RFID supported supply chains, especially when bringing the RFID tags in the customer's home.

Research is needed to find appropriate methodologies for modelling

complex interaction patterns within distributed business networks, where enhanced RFID based systems for distributed networks are promising to deliver business benefits. Such methodologies need to comply with technical challenges as well as enabling end-users, representing non-experts in those technologies, to identify most appropriate implementations for a human and customer centred business improvement.

Infrastructure and Environment for using RFID and GNSS

From technology point of view, the CuteLoop consortium specifically addresses on how to better exploit the potentials of enhanced RFID-based systems and Global Navigation Satellite Systems (GNSS), starting from the assumption that a combination of these two technologies is a promising way to support the integration of customers in the Integrated Enterprise.

Therefore, the research targets for a realisation of an infrastructure and environment which will directly facilitate the realisation of a new dimension of added-value services to support especially the decentralised and asynchronous interaction in complex networks of the integrated enterprise, supporting distributed networked devices, usable by any size of acting entity.

In particular, the CuteLoop partners will elaborate a corresponding architecture, agent based software services and a security framework. The application scenarios involved in the CuteLoop project are from food and construction industry.

RTD Cluster and Experience Exchange

CuteLoop established already contacts with other research projects and is continuously searching for potential cooperation and experience exchange. A key initiative for such cooperation are clusters on the European Level, while CuteLoop already joined the Cluster of European RFID Projects (CERP).

Additional opportunities for cooperation of the CuteLoop team are also provided by the work of the European Telecommunications Standards Institute regularly organising events and maintaining diverse standards related working groups as well as in the scope of the frequently organised events of The Open Group providing excellent educational and networking opportunities.

Contact the Project

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Partners

Institut für angewandte Systemtechnik Bremen (DE), Confédération de l'artisanat et des Petites Entreprises du Bâtiment (FR), EuroTeleServ (LU), Euro Pool System International (NL), Institut Européen des Normes de Télécommunication (FR), Rheinische Friedrich-Wilhelms-Universitaet Bonn (DE), Open Company LTD (UK), TraceTracker (DE).

CASAGRAS

Coordination and Support Action for Global RFID related Activities and Standardisation

"The Internet of Things" is a concept that means many different things to many different people. CASAGRAS is an initiative to provide clarity and technology inclusion to this concept".

Ian Smith
(CASAGRAS Coordinator)

CASAGRAS aims to achieve several objectives such as to provide a platform for international collaboration on all the aspects of standards and regulations relating to Radio Frequency Identification tags.

Moreover it means to offer a framework and supporting documentation for incisive and analytical review of international RFID standards and recommendations with respect to applications methodologies and positioning.In terms of future research the project is aiming to bring up recommendations for future research and development and international collaboration, to encourage participation of Small and Medium Enterprises (SMEs).

Work Packages

1. Standards and Procedures for International Standardisation in Relation to RFID, Including Applications and Conformance Standards.
2. Regulatory Issues in Respect of RFID Standards.
3. Global Coding Systems in Relation to RFID Standards.
4. RFID In Relation to Ubiquitous Computing and Networks.
5. Functional, Including Sensory, Developments in RFID and Associated Standards.
6. Areas of Application, Existing and Future, and Associated Standards.
7. Socio-Economic Components of RFID Usage.

Approach

The following are the main characteristics of CASAGRAS approach :

1. Holistic (parts better definable by reference to the whole), independent, framework.
2. Non-interfering, but supportive and contributory to the standardisation and regulatory processes.
3. Mapping and gap analysis to identify international roadmap for harmonised global solutions to RFID open systems.
4. Ability to embrace new developments in technology, principles, concepts and prospects for new standards.

The Internet of Things viewed as a network for communicating devices and based upon four degrees of sophistication, involving:

- Purely passive devices (RFID) that yield fixed data output when queried.
- Devices with moderate processing power to format carrier messages, with the capability to vary content with respect to time and place.
- Sensing devices that are capable of generating and communicating information about environment or item status when queried.
- Devices with enhanced processing capability that facilitate decisions to communicate between devices without human intervention – introducing a degree of intelligence into networked systems.

The framework studies will draw particular attention to Objective ICT-2007-1.3: ICT in support of the networked enterprise and the call within that objective for a Support Action (SA) for global RFID-related standardisation activities involving in particular organisations from China, Japan, Korea and the USA.

CASAGRAS
an EU Framework 7 Project

Contact the project

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Partners

AIM UK (UK), YRP Ubiquitous Networking Laboratory (JP), Hong Kong Science and Technology Parks Corporation (CN), AIDC UK (UK), Electronics and Telecommunication Research Institute (KR), FEIG Electronic (DE), ETSI (FR), QED Systems (USA).

List of all the projects

ASPIRE - Advanced Sensors and lightweight Programmable middleware for Innovative RFID Enterprise applications.
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Project number: 215417

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Project number: 216803

COIN - COllaboration and INteroperability for networked enterprises.
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http://www.coin-ip.eu
Project number: 216256

Commius - Community-based Interoperability Utility for SMEs.
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http://www.commius.eu/
Project number: 213876

CuteLoop - Customer in the Loop.
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Project number: 216420

GRIFS - Global RFID Interoperability Forum for Standards.
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Project number: 215224

iSURF - An Interoperability Service Utility for Collaborative Supply Chain Planning across Multiple Domains Supported by RFID Devices.
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http://www.isurfproject.eu
Project number: 213031

K-NET - Services for Context Sensitive Enhancing of Knowledge in Networked Enterprises.
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Project number: 215584

SPIKE - Secure Process-oriented Integrative Service Infrastructure for Networked Enterprises.
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Project number: 217098

SYNERGY - Supporting Highly Adaptive Network Enterprise Collaboration Through semantically enabled knowledge services.
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Project number: 216089

Outlook

In the previous Work Programme (2007-2008), the Objective 1.3 "ICT in support of the Networked Enterprise" of Challenge 1 "Pervasive and Trusted Network and Service Infrastructures" marked a transition between the Electronic Business (e-business) research era (1995-2005), and the emerging era of the Hyper-Connected Enterprise (2005-2015 and beyond).

While the benefits of this are clear, the risks are also emerging. In particular, one of these risks is to secure the data and communication which are becoming more distributed and will become more dominant.

Collaborative R&D during FP5 (1998-2002) and FP6 (2002-2006) has contributed to the maturation of e-business activities of large companies. These companies, and also a growing segment of the small and medium-sized enterprise population (0-249 employees), have today powerful ICT systems for linking business processes, improving customer service, and competing more directly and effectively on the global market.

Therefore, e-business is no longer a priority for public sector support to research but instead it is a priority for policies that aim to accelerate the adoption of ICT and e-business practices among companies, including among small and medium enterprises.

Within the Objective 1.3 in the ICT-FP7 Work Programme 2007-2008, 10 new projects were funded and included in the project portfolio of the unit "Networked Enterprise and Radio Frequency Identification (RFID)". Together with the ongoing IST-FP6 projects, these new projects have been included in two Clusters, namely Networked Devices and Enterprise Interoperability & Collaboration.

Towards the Internet of Things

Indeed, new network and service infrastructures will emerge replacing the current Internet. This Future Internet will feature almost unlimited bandwidth capacity, magnitudes of higher computing performance, wireless access anywhere, trillions of devices interconnected, integrated security and trust for all parties, and adaptive and personalised services and tools.

These developments are driven by wider and different forms of use of the Internet and Web technologies some of which we see already emerging with Web 2.0 applications, the "Internet of Services" and "Internet of Things".

Expect outcome includes the development of architectures and technologies enabling novel Internet-based applications for business and the enterprise and integrated business solutions with emphasis on collaboration and interoperability. This work will reflect the clear need to re-appraise the state-of-the-art from the perspective of new enterprise systems required to support the changing nature of organisations and business-level innovation in the emerging Internet of Things.

Find More About

Our Directorate

DG – Information Society and Media
The Information Society and Media Directorate General supports the development and use of Information and Communication Technologies for the benefit of everyone.

For more information on INFSO activities visit:
http://ec.europa.eu/information_society

Directorate D "Converged Networks & Services"
Director: João da Silva
The directorate engages in research on converged networks and explores new possibility of development in Europe, considering economic and social impact.
http://cordis.europa.eu/ict/ch1/

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Unit D4 "Networked Enterprise & Radio Frequency Identification (RFID)"
Head of Unit: Gérald Santucci
The Unit "Networked Enterprise & Radio Frequency Identification (RFID)" promotes and manages research, development and innovation activities related to the application of ICT to support the networked enterprise model.
http://cordis.europa.eu/fp7/ict/enet/
http://ec.europa.information_society/policy/rfid/index_eu.html

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Further Information

CORDIS –
Community Research & Development Information Services
CORDIS is the portal of research and technological development of the European Commission.

To find out more on FP6 and FP7 visit:
http://cordis.europa.eu/

European Future Internet Portal
European Future Internet is the central discussion forum for European activities on the theme The Future of the Internet.

For more information visit:
http://www.future-internet.eu

ICT Event 2008
Lyon 25-27 November 2008

Find out about this and other events at:
http://ec.europa.eu/information_society/events/ict/2008/

Unit AGENDA
Nice, 6-7 October 2008
Internet of Things French EU Presidency Conference
The conference will include expert presentations and panel discussions on topics related to the development of the Internet of Things.

For more information visit:
http://www.internet2008.eu