

Meeting Minutes of
“The Internet of Things: an opportunity
for European Economy and Industry”

Poznan, Poland
26 October 2011

1. OPENING SPEECHES

Mrs Cristina Martinez Gonzalez (Head of the FInES cluster, European Commission, DG Information Society and Media) welcomes all the participants to Poznan for the 5th Future Internet Week of the European Commission, organised under the auspices of the EU Polish Presidency. She explains that two themes will be discussed today: on the one hand, the “enterprise” dimension of the Internet of Things (IoT), in particular the new concept of the “Sensing Enterprise”; and on the other hand, the governance and architectural aspects of the Internet of Things. She welcomes Mrs Megan Richards, Director of the Converged Networks and Services Directorate of the European Commission, who takes the floor.

Megan Richards opens this 5th Internet of Things EU Presidency Conference (the previous editions took place in Berlin, Lisbon, Nice and Budapest). Having already reached its fifth incarnation shows the long-term importance the European Commission attaches to this subject. In addition, the Member States have given strong support to these activities.

The IoT is central in ensuring future growth and development of the EU economy, by providing consumers with new e-services and products at a lower price. The Future Internet Assembly has identified smart cities and IoT as the main themes for its next conference, which demonstrates the importance of the subject. Europe has taken a leading role in setting up very high standards for IoT-based applications and services that are competitive, secure and affordable and take into account privacy and data protection. In this debate, most important are the implications for people: what does it do for us; how does it impact on us; how can we make it grow for our citizens and our economies. At the IoT Budapest Conference in May 2011, Mrs Richards had suggested to address two main questions: how to take bright ideas and turn them into something powerful for Europe’s economy, and; how to capitalise on Europe’s current leadership and commitment in the IoT field to make innovation accommodate the needs and expectations of citizens. Four areas were identified as being of primary importance in that respect: industry and academia collaboration; on-going policy forum; research and innovation, and; participation from the public. She explains that, since the Budapest conference, we have already made strong progress in each of those four areas:

- Academia – Industry collaboration: the IoT European Research Cluster (IERC) ensures the collaboration between academia and industry and pursues policy objectives.
- On-going Policy Forum: the goal of this forum is to provide policy makers with information on the IoT and encourage their participation. Such a forum will soon be established through the IoT-i coordination action, which will serve to nurture a global debate on the IoT. The initiative will be launched in Berlin on 23-24 November (<http://www.iot-forum.eu/>). With regards to governance, Richards stresses the importance of global cooperation, which should be pursued by the IoT Expert Group established by the European Commission, in association with the Internet Governance Forum (IGF).
- Research and innovation: there is a need to broaden and prioritise research and innovation. Mrs Richards explains that we can all take further action in this area, especially within the framework of “Horizon 2020”, which is the next Framework Programme for EU research and innovation. A lot of collaboration has already begun, but more work still needs to be carried out to ensure a place for IoT activities, services and applications in the Horizon 2020. She emphasises that this program will integrate and combine research and innovation, moving away from pure research to more applied activities. This is also important in the area of standardisation, where we can start to test some ideas from research.

- Talking to the public: The European Commission pursues its efforts to ensure the debate and speed up the adoption and use of IoT applications.

In July 2011, Vice President Neelie Kroes (Commissioner for Digital Agenda) launched an initiative to establish a future Commission's Recommendation on the governance of the IoT, which Mrs Richards hopes to be available by mid-2013. This Recommendation has to address a number of issues: naming and addressing of objects; defining allocation policies for IPv6 numbers; ensuring fair competition; securing privacy and protection of personal data; standardisation and interoperability; ethical aspects; etc.

Mrs Richards concludes by saying that the conference is an important milestone. A public consultation on IoT Governance will be launched by the end of the year or beginning of 2012. She encourages everybody to send their contributions to this consultation (on the 'Your Voice in Europe' web portal).

Cristina Martinez Gonzalez thanks Mrs Megan Richards and invites the representative from the EU Polish Presidency to take the floor. Professor Krzysztof Jan Kurzydłowski, director of the National Centre for Research and Development, joins the meeting via teleconference.

Prof Kurzydłowski starts by saying that the Internet is one of the major means of communication in this century. It plays a crucial role in shaping our civilisation from both a social and economic development point of view. It also determines competitive advantage of countries in the global economy. The Future Internet and IoT will bring about great changes in our lives. In Poland, there is large interest in research that can accelerate development and implementation of internet applications. The National Centre for Research and Development is already funding a number of projects in this field. These projects will be beneficial to everybody and he hopes that they will stimulate the conference' discussions. He wishes all the participants an enjoyable stay in Poznan.

2. SESSION I – KEYNOTE: THE VALUE OF THE INTERNET OF THINGS FOR THE ENTERPRISE

Cristina Martinez Gonzalez introduces Mrs Elżbieta Hałas, Chair of GS1 Europe and CEO of GS1 Poland, and gives her the floor.

Mrs Elżbieta Hałas addresses the practical aspects of the IoT and shows how the global business community tries to put the IoT concept to practice. In a few years, the IoT will revolutionise our lives, as the Internet has already done. We will have access to comprehensive information on products from a variety of manufacturers. In the business community, developments are rarely discussed as being part of the IoT: instead, the preference is to focus on individual new functionalities and processes. Therefore, the presentation focuses on the concept of “visibility”, which is a highly important business concept and a concrete example of an IoT application. This concept is based on the well-known bar codes. They are used worldwide and can offer new functionalities. The IoT can give new perspectives to the bar codes.

Highlights of Mrs Hałas' presentation include:

- GS1 Organisation: Mrs Hałas briefly presents GS1, a not-for-profit organisation, which facilitates collaboration among trading partners to create more efficient, safer and sustainable value chains through global standards. Over 1.5 million companies across 150 countries apply GS1 standards.
- Global Visibility Framework: the concept of visibility is the ability to know where a given object is at any point in time, and why it is there, at any point along the supply chain. Visibility aims to answer the questions: what, when, where and why? Thanks to the IoT, these

questions will be answered automatically. GS1 has developed the Global Visibility Framework, which is a set of standards that allow putting the IoT concepts into practice. It has three levels. The first is to identify, i.e. to provide a unique way of identifying any kind of object. The second is to capture data about the objects using standardised RFID tags. The third is to share information: transactional data, but also event data through the Electronic Product Code (EPC) information service. The concept of visibility is very important for companies, as it gives them the power to see and understand processes they had hitherto been unable to.

- GS1 Electronic Product Code Information Service: the electronic product code information service is a standard interface that was developed together with companies (both users and IT companies), which allows users to obtain and share data about unique objects within and across enterprises. It does not replace existing enterprise systems, but supplements them. The service tracks the what, when, where, and why of objects. The EPCIS interface can be implemented in any company.
- Examples of implementation: Mrs Hałas explains that many companies have already implemented this system and gives two concrete examples. First, Gerry Weber is a German clothing company that has implemented the whole framework and concept. It allows them to monitor the level of inventory at all their warehouses around the world. Second, two wine retailers in Hong Kong which are working with vineyards in Italy have implemented this system to track shipments from Italy to the rest of the world: it provides them real-time monitoring of stock and process of delivery.
- Conclusions: the implemented framework is the first step. However, we must be sure that the virtual world is coming closer to the physical world. In the near future, we will find other practical IoT applications in businesses, but also in our private lives.

3. SESSION I – PANEL: THE RISE OF THE SENSING ENTERPRISE

Cristina Martinez Gonzalez explains the concept of the Sensing Enterprise. The Sensing Enterprise is a novel concept that was first mentioned in the FinES position paper published earlier this year as a set of recommendations for the Orientation paper of the European Commission for Horizon 2020: “a European Innovation Partnership for Catalysing the Competitiveness of European Enterprises” (<http://cordis.europa.eu/fp7/ict/enet/documents/fines-position-paper-fp8-orientations-final.pdf>). She summarises the main sections contained in the position paper:

- Context: this section is about virtual enterprises, which are information-based and knowledge-intensive, operating in multi-dimensional ecosystems and networks. These enterprises replicate themselves along different value chains, mobilise their resources in a myriad of novel ways, dip in and out of markets; they even create new market spaces and market logic. Such developments bring new means of working.
- Redefining the enterprise, i.e. what is the new quality of being of an enterprise: the “WhatYouSensesWhatYouGet” enterprise. Future enterprises will be context-aware, dynamically configurable, and multi-identity oriented virtual entities that manifest themselves in many different ways and re-invent themselves over and over again. To summarise, real-time applications and the IoT are just two examples of technologies and practices which may bring tremendous opportunities as well as new challenges to traditional enterprises and manufactories.
- Conclusions: the paper identifies the concept of the Sensing Enterprise as an important topic to be addressed in the forthcoming research program. The Sensing Enterprise “refers to an

enterprise anticipating future decisions by using multi-dimensional information captured through physical and virtual objects and providing added value information to enhance its global context awareness.”

Mrs Martinez then briefly introduces the two speakers of the first session. She explains that three questions will be asked of them:

- What benefits does the Internet of Things entail for businesses?
- Are EU enterprises in general, and manufacturing enterprises in particular, prepared for the expected massive deployment of the IoT?
- What needs to be done in order for EU businesses to adopt the new paradigm of Intelligent Sensing Virtuality in their business and organisational strategy?

She gives the floor to Dr Rikardo Bueno, Director for the Scientific Policy Fatronik-Tecnalia¹, co-chair of the Ad-hoc Industrial Advisory Group (AIAG) of the Factories of the Future Public-Private Partnership (FoF PPP), who will present the user’s point of view.

Dr Bueno explains that he comes from the manufacturing sector and argues that what he calls “Sensing Factories” have become necessary and are the future of manufacturing in Europe.

- Factories of the Future & Role of ICT: 'Factories of the Future' is a public-private partnership, dealing mainly with four Research & Development challenges: Sustainable Manufacturing, ICT-enabled intelligent manufacturing, high performance manufacturing and exploiting new materials through manufacturing. ICT contributes particularly to the second challenge. The ICT challenges are addressed through Digital Factories, Virtual Factories (Internet of Services) and Smart Factories (this is the core of the IoT). He explains the maturity curve between these three factories: when a new product is introduced, it is in the Digital Factory; the product then grows in the Virtual Factory and finally matures in the Smart Factory. ICT is an enabler to make production in Europe easier, thus and will give a clear future to manufacturing. ICT services support digital businesses (standards for service definition and design, Internet of Services, Cloud Computing, etc.) and optimise the quality of service.
- Examples of IoT in manufacturing: Intelligent machines are capable of adapting their goal-oriented behaviour by sensing and interpreting their environment, making decisions and plans, and then carrying out those plans using physical actions. They should have similar characteristics as human intelligence. More and more, we see that some of the knowledge can be directly integrated into the machines. For instance, smart machines provide proactive assistance to the operators according to their needs; adaptive machines improve the machining process; autonomous machines assure that the machine is able to detect failures, provide a diagnosis of the cause of failure, and take care of the failure by self-repairing. Ambient machines are machines that refer to electronic environments that are sensitive and responsive to the presence of people. Ambient machines are at the interface between two important visions: ubiquitous computing and social user interfaces. Dr Bueno gives examples of both of these machines and concludes by saying that ICT is present at all levels of manufacturing.

¹ Fatronik-Tecnalia is an investigation centre, specialised in the generation of intelligent devices that require the integration of different technologies: mechanics, control, electronics and information technologies, and a profound knowledge of manufacturing technologies.

- Outlook towards the future: it is necessary to think beyond the FoF PPP. The future enterprise will be sensing, community-oriented, green, cloud-oriented, innovative, glocal (local production by global customers), and cognizant (it will acquire information from the sensors that it will be able to analyse in order to predict what is going to happen to take decisions at the right moment). The manufacturing sector needs a lot of contributions from the ICT sector – reference architecture, standards, interoperability, security and safety aspects, etc. A roadmapping project called ActionPlanT is addressing Manufacturing 2.0 issues by (a) establishing a vision for the role of ICT in manufacturing of the future, and (b) developing and validating a concept for industrial learning, extensively piloted via Industrial Learning Pilot Events (ILPEs) and workshops amongst stakeholders in industry, academia, and the European technology platforms. Participants are invited to contribute to this project (www.actionplant-project.eu). Another roadmap on the “factories of the future beyond 2013” is in preparation.

Mrs Martinez thanks Dr Bueno for his presentation and opens the floor to questions. A question is asked on the integration between machines and the humans. It is stressed that the role of the worker is very important. There is a need to work on the interaction between the machines and the operators. In some cases, the machine will be able to teach, but in most cases, it will be the other way round.

Mrs Martinez introduces the second speaker, Mrs Man-Sze Li, co-chair of the Future Internet Enterprise Systems cluster, head of the FInES Business Task Force and FInES architectural design principles Task Force, who will talk about the Sensing Enterprise.

Highlights of Mrs Li's presentation include:

- Introduction: this is the first public presentation about the “Sensing Enterprise”. A lot of ideas are just raw ideas, so the purpose is to clarify this research area through discussion and debate. She stresses that the timeframe is very important, given the big debates that are going on in Europe about the debt crisis. The current crisis will have an impact on how enterprises work. It is also essential that new technologies are understood by the target audience. It is a challenge to make the Sensing Enterprise understandable. In 2009, when the FInES cluster tried to develop its first position paper, it faced considerable resistance. They were, however, able to show that the position paper speaks for tomorrow’s business. The work of FInES has produced research roadmaps, with technical systems and technologies at its core. However, the goal is to come up with new services and applications for future enterprises. Technologies are only the enablers.
- The Second Economy: 'the second economy' is a term used in a paper by economist and technology thinker Brian Arthur². He explains that “digitization is creating a second economy that’s vast, automatic, and invisible – thereby bringing the biggest change since the Industrial Revolution.” There are many machines and complex processes working in the background for us: in everything we do, a multitude of processes is initiated and an abundance of information shared, without us noticing anything. The users, however, are more interested in the results of these processes. This development takes place almost unnoticed and Arthur wonders whether this “sensing economy” might be the biggest change in the economy since the Industrial Revolution. He may be right.
- In terms of the core architecture, a lot of discussions are going on. What is clear is that there is a proliferation of devices: we have more than 50,000 billion objects on earth, all of which are potentially connectable. More and more objects start to have new properties: identifiable, connectable, can be located, searchable, traceable, embedded ability. They have

² [The Second Economy](#), W. Brian Arthur, McKinsey Quarterly, October 2011.

potential characteristics: participatory, intelligent, authoritative, transformative, triggered by and triggering actions. We are entering into a new paradigm. With these new intelligent devices, many questions are arising: what is going to happen to the network? What about the end-to-end principle? These considerations have to be introduced into the wider debate of architecture.

- Sensing Enterprise: the definition from the FinES position paper defines a sensing enterprise as “a complex smart entity capable of sensing and reacting to a wide ranging set of (business) stimuli”. Mrs Li describes the characteristics of the Sensing Enterprise and stresses some elements that need to be considered in this debate. An important distinction needs to be made between data, information and knowledge. We have to transform data into information and transform information into knowledge, so it gives real value and assets to enterprises and people.
- Conclusion: future enterprises will probably be borderless and enterprise systems will communicate between themselves. This has implications for businesses, as it will change the business is done. We are potentially talking about a change in enterprise systems and prioritisation of enterprises’ resources and activities. Mrs Li argues that it is not just about having a world of IoT. From the enterprises, we are talking about small components, which are intelligent, interoperable and interconnected. The architecture of the IoT is very important and a critical issue will be the governance of intelligent things for an intelligent civilisation to serve people.

Cristina Martinez Gonzalez opens the floor to questions.

A question is raised on whether enterprises will need help from academia and research organisations in order to become competitive Sensing Enterprises or if they will be able to find their way “naturally”. ICT plays a crucial role in this area. There is, however, a need for convergence, because businesses that will be more “intelligent” will become more competitive as well. So, research centres and academia will have a role to play. The issue of governance is fundamental, because we need to ensure fair access to any kind of business. The user’s perspective and needs have to be taken into account, reason why the discussions are already taking place.

4. SESSION II – PANEL: TOWARDS GOVERNANCE OF THE IOT AND THE INTERNET

Cristina Martinez Gonzalez welcomes everybody to the second session about the governance of the IoT and standardisation issues. She introduces Patrick Guillemin from the European Telecommunications Standards Institute (ETSI), who will moderate the session. Mr Guillemin represents Ovidiu Vermesan, head of the IoT European Research Cluster (IERC), who has apologised for not being able to be present.

A number of questions are discussed: what is the optimal IoT architecture? What identification schemes should be used to address objects in the Internet of Things? Who should assign identifiers to objects, and what principles should govern the assignment of IDs? How can the foundational requirements, such as resilience, robustness, and security in the IoT be guaranteed? Does a role exist for public authorities in this context? Patrick Guillemin introduces the speakers and the organisations they represent.

Then he gives the first presentation on IoT governance. Highlights of the presentation include:

- IERC definition of the IoT: “A dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical

and virtual “things” have identities, physical attributes, and virtual personalities, use intelligent interfaces, and are seamlessly integrated into the information network.”

- Presentation of the IERC: the cluster brings EU-funded projects together with the aim of defining a common vision and identifying challenges at the European level. It coordinates the ongoing work on the main issues of the IoT, in order to build a broad consensus on the ways to realise IoT in Europe. The IERC has already published two books on the IoT. He explains the link between the Future Internet Assembly (FIA) and the IERC. FIA has developed Future Internet Support Actions (FISA) and within this structure, the work on the IoT is carried out under the CASAGRAS2 project and in the IERC and the European Telecommunications Standards Institute (ETSI).
- CASAGRAS 2 (<http://www.iot-casagras.org/panel/welcome-casagras2>): Mr Guillemin explains that CASAGRAS2 is a project that gathers 16 partners worldwide, incl. 8 from Europe. Its work started in June 2010 and is due by June 2012. Among the main issues discussed are IoT governance and issues of security and privacy. They are developing recommendations on these topics. The European Commission created an IoT Expert Group that is responsible for developing recommendations on IoT governance and they are closely following the work of the cluster in this respect. He encourages the attendees to participate in these projects. CASAGRAS2 is a support action funded by the European Commission and facilitates cooperation between European and international research on the IoT. ETSI is also in this project to facilitate links between research and standardisation. He briefly presents the ETSI standards landscape and the projects (more than 30) that are being carried out under the IERC.
- Working Group of Internet Governance: A working group addressing internet governance was created. Although internet governance is different from IoT governance, their work could potentially be taken as a basis for work on IoT governance.

Mr Guillemin gives the floor to Mrs Chiara Giovannini, from the European Association for the Coordination of Consumer Representation in Standardisation (ANEC). She thanks the organisers for their invitation. Highlights of her presentation include:

- Presentation of ANEC: ANEC is an organisation co-funded by the European Commission and EFTA, which represents European consumers in standardisation. They are active in the development of standards (ANEC is a member of ETSI), the monitoring of the implementation of standards, and the development of legislation and policies linked to standards.
- The consumer's position: Mrs Chiara Giovannini stresses that consumers need confidence to fully embrace the IoT in order to enjoy its potential benefits. We have to build an Internet of Things for People (IoT4P). She explains that there is a huge difference in size between the consumers' position and the industry position and a difference in resources available. The discussions show that the IoT serves the interests of industry and the economy, but that consumers are left outside, which ANEC of course does not support.
- Web 3.0: the future Web will bring more privacy challenges, as it is likely that “open data” or “raw data” become “personal data”. One of the concerns is therefore that, in the cloud computing environment, the differentiation between data and personal data will become too complicated. As the IoT is likely to be based on Web 3.0 or 4.0, parallels with Internet Governance need to be drawn, although it will probably not be sufficient, given that security, privacy and interoperability are still hot issues, as well as automatic decision-making.
- IoT principles: the issue of who owns what, especially the identifiers, is extremely important: whether it is a private or public actor and where these actors are located. The IoT governance principles will have to reflect the future new international order. It is obviously not an option

to have one owning all. This problem has already arisen in internet governance and it is a threat to the IoT.

- Role of public authorities: The role of public authorities is a difficult issue. One of the challenges will be to manage the merger of activities that are independent today within the framework of the IoT: business, private life, citizenship, consumerism, leisure, etc. The concept of “soft institutions” will also be important, although we are not yet entirely clear on what it means. Finally, the authorities will be expected to take on the enforcement and whistle-blowing roles. But to have a referee, you need rules. This is why standards could play the role of providing good application design, user application interferences and tools for consumers to better protect themselves.
- Conclusions: in the IoT world, objects will be identified and will be able to act independently, and consumers will interact with those objects. Consumer protection must therefore be the building block of IoT governance.

Patrick Guillemin thanks Mrs Giovannini for her presentation and gives the floor to Michał Grabia, from the Institute for Logistics and Warehousing. He makes a presentation on the architecture of GS1 EPC Global Network. Highlights of the presentation include:

- Connection between IoT and FMCG (Fast-moving consumer goods): the idea to use the IoT approach comes from the fact that GS1 is already in place and gathering many companies. Therefore, if the system can be used and slightly adapted to make it possible to use this new technology (e.g. RFID), there is good potential.
- GS1 concept for unique identification of products: the GS1 approach uses bar codes and adds further information to them. When developing the Electronic Product Code (EPCGlobal), GS1's idea was to create a global unique object identifier that could support the many identifiers that already exist. Thus, if a company already uses bar codes, it does not need to change anything, because the bar codes can be transformed into an EPC. GS1 does not provide solutions, but rather standards on how to create those solutions. Therefore, different companies can provide different software that can communicate between them, if they are both created on the basis of these same standards.
- How the EPCGlobal works: Mr Grabia presents the anatomy of the EPC and explains how the network functions. Once the manufacturer has tagged the product and introduced the product information on the EPC Information system, the product information goes to the EPC discovery services, in the cloud. The product is then sent to the retailer, who records the product information in its EPC Information Services and through it to the EPC Discovery Services. The retailer can then put queries to the root ONS to ask information. He finally explains the security of the EPC network: it is an on-going debate, because new challenges and problems arise, which GS1 has to address. But the basic idea is to use the technologies available on the market.

4.1. Discussion

Patrick Guillemin thanks the speakers for their presentations and asks a few questions to the panelists:

- What is the difference between IoT Governance and Internet Governance?

The IoT is not limited to the Internet and therefore the discussion on the IoT Governance goes well beyond the Internet Governance. There are similar challenges (e.g. security, privacy and interoperability) and principles common to the IoT and Internet Governances, but the IoT brings along also new kinds of issues (e.g. automatic decisions).

It is stressed that this question is closely linked to the issue of the definition of the IoT, which is still not clear.

It is argued that the IoT is basically a way of using the Internet, so it is difficult to separate the two. This is an issue, because the governance of the Internet is not, at present, global, so it will not be easy to develop governance for the IoT.

- What are the most important aspects of the IoT Governance?

Privacy and security issues are recognised as important aspects. As a new world is being built with new relations among people, between people and machines, and among machines, there is a need to predict potential issues in order to avoid them.

Consumer protection is another aspect to take into account, as well as how the principle of competition is going to be applied to the business model of the IoT.

4.2. Questions from the audience

It is stressed that the first question to be answered is whether there is a need for governance. Also, the question of what is private has to be considered: is a thing owned by somebody considered as private? It is argued that the problem is that theory about consumer protection exists, but it is not delivered, reason why we need oversight.

A question is asked about the difference between consumers' protection and citizens' protection. Sometimes, the citizen is a consumer, but, in the IoT world, they can also act as a producer. It is explained that the difference between consumers and citizens is well known, although the boundaries are still a bit blurry. A consumer is an economic actor entering in transaction with businesses, whilst citizens have some obligations and rights. It is true that citizens are another part of the picture, but it is unlikely that this is going to be a big issue.

5. CLOSING SPEECH: IOT POLICY UNDER THE FORTHCOMING EU PRESIDENCY

Cristina Martinez draws conclusions from the discussions that have taken place so far. She explains that many issues and challenges have been identified. Technology will be used to support people and enterprises. Therefore, user-friendliness is a key requirement. The role of the authorities to enforce the standards has been stressed, as well as the role of the consumers and users in application design. Consumer protection should be a building block of IoT Governance.

The European Commission IoT Expert Group could widen its advisory role on governance. A paper and possibly a recommendation from the European Commission will be prepared. A public consultation on this work will take place in the coming months and everybody is encouraged to take part in it.

She concludes by saying that the conference was another milestone on a common European approach. She stresses the importance of the global aspect and argues that we have to strive for a better, more inclusive and participatory IoT for people and industry.

She thanks again all the speakers for their presentations and the audience for their contributions.