



FUTURE  
INTERNET  
ASSEMBLY

**Future Internet Conference &  
Future Internet Assembly**

**Budapest, Hungary**

**17 – 19 May 2011**

**<http://fi-budapest.eu>**

**[www.future-internet.eu](http://www.future-internet.eu)**

**Reporting by: European Service Network**

## Introduction – Advancing the cause: new perspectives on applications

*Since the 'Bled declaration' during the Slovenian EU Presidency in 2008, a large community of researchers and other stakeholders has worked tirelessly to drive forward the vision for Europe's internet-enabled future. "A significant change is required," the declaration stated, "and the European Internet scientific and economic actors, researchers, industrialists, SMEs, users, service and content providers, now assert the urgent necessity to redesign the Internet, taking a broad multidisciplinary approach, to meet Europe's societal and commercial ambitions."*

*The Future Internet Assembly (FIA) is where these actors come together. Twice a year a critical mass of thinkers and doers meet to hear about the latest challenges and breakthroughs in Europe's research effort to design, test and deploy new information and communication technologies (ICT) that address the internet issues of today and the anticipated challenges of tomorrow: privacy, new media dimensions, security and robustness, energy consumption, wireless/mobility, quality of service, connectivity, speed and throughput, and more.*

*In previous years the primary focus on FIA has been directed towards the development of technology architectures and infrastructure for the future internet. This work continues, of course, but the focus is perhaps beginning to shift. Since the Valencia FIA in April 2010 and the launch of the Future Internet Public-Private Partnership (FI-PPP), future internet stakeholders have been taking an increasing interest in the **applications** of the future internet. We must begin to plan **how** this future internet will be used, they argue. Only healthy dialogue between the architects, the planners, the developers and the users will ensure that the future internet meets the functional demands of the market.*

*In the warm spring sunshine of Budapest this dialogue was evident. The technical issues of the future internet were firmly placed within their political and societal context. Concerns and challenges were shared, ideas voiced, suggestions debated. Europe is still a hotbed for internet research and the FIA is the place to discover the cutting edge of this endeavour.*

### More information

Slides and presentations at FIA Budapest: <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011.html> and <http://fi-budapest.eu>

Photos and videos at FIA Budapest:  
[http://www.flickr.com/photos/peternagy\\_hte/sets/72157626740524060](http://www.flickr.com/photos/peternagy_hte/sets/72157626740524060)

Future Internet home site and next issue: [www.future-internet.eu](http://www.future-internet.eu) and <http://www.fia-poznan.eu>

For FIA history and EU background: [http://ec.europa.eu/information\\_society/activities/foi](http://ec.europa.eu/information_society/activities/foi)



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## Future Internet Conference – Tuesday, 17 May 2011

Ahead of the FIA, the Future Internet Conference was held to provide some political and social background to Europe's future internet research initiatives (FP7, FI-PPP and any post-FP7 framework programme). The day's programme of talks looked at where the future internet could support the EU 2020 growth strategy by fostering and supporting innovation and improving the competitiveness of EU business.

### Opening plenary session – Partnering for Innovation

**Gyula Sallai, President of HTE, Hungary**

- Research into the future internet is an important strategy to assure the realisation of Europe's vision for economic recovery and sustainable growth (EU 2020)
- R&D must take notice of what society demands from the future internet: global, mobile, secure, scalable, cheap and user-friendly technology for everyday applications

Before launching into any Future Internet event it is fitting to follow Gyula Sallai's example and see just how far today's internet has come and what it has achieved. "It is our great success story," he claimed, "and it is considered as the centre of our knowledge-based society." But it is

***"The internet is our great success story and it is considered as the centre of our knowledge society."***

**Gyula Sallai**

clear that society now demands more: an internet that is global, mobile, secure, scalable, cheap, user friendly and suitable for applications in everyday life.

The growing emphasis on applications was becoming evident, Sallai noted.

This was the seventh FIA meeting and over the years the scope of the conference has gone from the technical aspects of architecture to applications.

Indeed, the application of the future internet is at the heart of the EU's strategy for economic recovery and growth (EU 2020), Sallai stressed. Faced with the economic advances in the developing world and competition coming from the newly emerging economies of China, India and others, Europe especially was relying on the future internet to deliver competitiveness and sustainable growth.

**Balázs Botos, Deputy Minister of State for Foreign Economic Affairs, Ministry of National Economics, Hungary**

- The internet and its terminology are part of everyday life, business, healthcare, travel and more
- The internet has grown from a network of links to a superstructure, critical infrastructure

Picking up on the remarks of Gyula Sallai, Balázs Botos particularly enjoyed illustrating the importance of the internet in numbers. It now pervades so much of everyday life – Google, Wikipedia, Facebook are common household names – and is an essential part of business, leisure, entertainment, healthcare and travel to name just a few. According to Botos the internet now has 2 billion users; every day these users send nearly 300 billion emails and view some 2 billion YouTube videos.

“The internet has developed from a research network to a critical infrastructure,” he remarked. “It has gone from a small network with a handful of links to a new superstructure.”

Botos reminded the audience that the future internet holds a critical place in Europe’s political vision too. “The ICT sector in Europe provides the technology that is the core enabler of our competitiveness.”

“New efforts are underway to develop new markets for competitive networking,” he continued, introducing how the Hungarian EU Presidency has pushed forward policies in this area, for example spearheading the on-going drive to roll out high-speed broadband infrastructure and access across the EU.”

***“The ICT sector in Europe provides the technology that is the core enabler of our competitiveness.”***

**Balázs Botos**

For a roomful of future internet activists who use the internet – current or future – on a daily basis, the idea that many citizens and businesses may not have access to broadband connections may seem incredible. Yet the statistics speak for themselves. Even in Hungary, which is quite technologically advanced, the broadband penetration is still low. E-commerce is below the EU average and 70% of the ICT market comes from larger companies with over 100 employees.

Botos highlighted a number of EU initiatives which are designed to align future internet research with Europe’s policies for innovation, competition and economic growth. He explained how the Future Internet Public-Private Partnership (FI-PPP), pilots funded through the ICT Policy Support Programme (ICT PSP) of the Competitiveness and Innovation Programme (CIP) and the future research and innovation funding programmes currently being discussed and designed by the European Commission can create opportunities for researchers and business to develop and benefit from the future internet. The European Commission and the Hungarian Presidency

were also keen to encourage greater cooperation between the future internet programmes of Member States and more synergies with the European vision.

To illustrate this point, Botos described three Hungarian future internet initiatives. The Digital Renewal Action Programme (RAP), launched in December 2010, is Hungary's national implementation plan in line with EU 2020 and the Digital Agenda flagship. Its aim is to increase investment in ICT to 1.5% GDP. RAP focuses on four key areas: ensuring equal opportunities to citizens, increasing the competitiveness of businesses, making modern IT the norm in public administration and developing IT infrastructure. The plan is to provide broadband access to a million citizens who currently are unfamiliar with the technology.

The Hungarian government is also supporting the Future Internet National Technology Platform, which was launched in early May 2011. This platform will support the coordination of Hungarian universities, research institutes and industry in future internet research and help to develop a funding strategy for this area of research.

Finally, Hungary has established the Future Internet Centre, a joint activity of universities and research institutes. Its mission is to collaborate on state-of-the-art research, join other future internet projects and get involved in international collaborations. Research topics of particular interest include complex networks, internet measurement, test beds and the broad economic aspects of the future internet.



**Constantijn Van Oranje-Nassau, Senior Advisor in the Cabinet of European Commissioner Neelie Kroes**

- The future internet is the 21<sup>st</sup> century's gold rush; a great prize that offers sustainable growth, good jobs and great opportunities
- The public sector has a big role to play in promoting order, security, reliability and decency

From the local Hungarian view, Constantijn Van Oranje-Nassau presented the European perspective. Where is the place of the future internet and future internet research in the EU policy landscape?

Right at its very heart, Van Oranje-Nassau asserted, as the key enabler of Europe's Digital Agenda. "The future internet is an opportunity and the prize for the next decade," he said. "The explosion of creativity and competitiveness from the internet was unimaginable 15 years ago." Today the internet economy boasts a 12% annual growth rate and is creating more jobs with higher salaries than any other sector. It will grow by around €800 million by 2013 and is set to make a significant contribution to Europe's economy.

So it is hardly surprising that Europe wants to be a driving force in the internet of the future. "The challenge is how to use and manage the future data streams and 50 billion connect centres with accuracy. It is like the gold rush of the 19<sup>th</sup> century: chaotic, hazardous and unprepared. But there is land to grab."

***"We don't fund second-tier research and we don't want to be a provider of mere subsidies."***

**Constantijn Van Oranje-Nassau**

But rather than relying on the enterprise of individual prospectors, Van Oranje-Nassau stressed that the public sector has a crucial role to play in this modern day gold rush. "The public sector must play an active role. In the past we have played a role to protect the public, focusing on privacy, security and decency. But the challenge is how to

enforce these regulations whilst embedding these values in the internet technologies. The big challenge will be to combine the flexibility and 'adaptiveness' of emerging technologies with new government's role to ensure continuity and reliability of services and principles."

Still, the ultimate drivers of the future internet will be the market and consumers. And despite the financial pressures and fragmented markets across the EU there are some positive signs that Europe is on the right track and has strong assets to build on (not least because it has the largest ICT market in the world worth €600 billion). There is a huge wealth of innovative and creative people who run successful internet businesses. Europe also excels in many areas of ICT, including enterprise software and IT integration. Broadband coverage is ahead of the targets set in the Digital Agenda, although there is a growing gap as some countries are already rolling out superfast broadband services.

Europe has a strong entrepreneurial base, said Van Oranje-Nassau, who proudly cites a recent article in *Wired* magazine, "Watch out Silicon Valley", which argued that Europe is becoming a vibrant and entrepreneurial market.

European policy simply needs to build on these strengths, Van Oranje-Nassau argued. It has made a good start, mixing public and private investment in infrastructure and research, innovative financing mechanisms and the creation of the digital single market. The right supporting framework is in place although "we could do more and better in all these domains."

In the area of research and innovation, Europe is committed to turning knowledge into economic and societal returns. "More research will not solve our problems automatically," Van Oranje-Nassau insisted. Any increase in ICT R&D has to be accompanied by more returns. The Commission is therefore focusing on how to simplify the administration of funding programmes, increase the accessibility for SMEs, stimulate pre-competitive public procurement, connect user demand with technology supply, and aggregate the funding sources that are fragmented across Europe.

Actions to stimulate innovation will focus on ways to foster entrepreneurial environments and break down the barriers which prevent good technologies from being deployed. "The FI-PPP creates such an environment," stated Van Oranje-Nassau. "It is a pathfinder initiative that will help us better structure our future research and innovation endeavours. The PPP offers an opportunity for Europe to include a wide range of possible domains to contribute to future internet development." Other good examples include the European Innovation Partnerships.

But the research community must not be complacent about the degree of support and funding it currently receives. "You must think about how your projects will produce tangible outcomes. We will demand more commitment and better results. We don't fund second-tier research and we don't want to be a provider of mere subsidies." According to Van Oranje-Nassau, European funding was there to support excellence in complex projects using the best knowledge from across Europe.

He also touched on the role of the Commission in regulation. He acknowledged that Commissioner Kroes is not a big fan of regulation, believing that industry and users are better at finding flexible solutions to problems. However, business had to take the concerns of users about cybercrime, privacy, data abuse, traffic management, etc. seriously or customers would not embrace future technologies. "Rest assured that Mrs Kroes is very well prepared to act decisively where regulation is required in the absence of effective self- and co-regulation," Van Oranje-Nassau warned.

### **Willem Jonker, CEO of EIT ICT Labs**

- ICT Labs' model for driving innovation in the market involves creation, transition and acceleration
- There is not enough emphasis on developing patentable technologies with high potential customer impact

Willem Jonker's presentation gave the conference delegates a concrete example of how R&D and innovation can be melded together. The EIT ICTs try to bridge the gap between research and market-driven innovation, helping to get novel technologies and ideas out of the labs and universities and make a difference in business and society.

The strength of the EIT ICT Labs comes from the way it brings different worlds together –the digital world and the physical world. The labs are located in five nodes across Europe but internet technology means they function as one unit. Video conferencing links the nodes, making it possible to 'bump' into partners and collaborators from another node over coffee.

Still, the geographic location of the five sites – in major EU innovation hotspots – should not be underestimated. Co-localisation is a catalyst and a key part of how the Labs work.

The Labs also bring together the worlds of research and education. "Education is possibly our most important work," noted Jonker. "Education brings about culture change and breeds entrepreneurship and top talent. We also bring people together through mobility programmes and support world-class business through the translation of results." EIT ICT Labs runs a Master School for ICT in collaboration with local universities. Students are taught a standard curriculum through the universities, but EIT ICT

***"Europeans are not getting the prizes because their research is lacking in impact."***

**Willem Jonker**

Labs adds content related to technology transfer and innovation.

Jonker does not deny that Europe has a prestigious community of researchers. But he points out that we don't get our fair share of Nobel Prize winners. "Europeans are not getting the prizes because their research is lacking in impact." Laureates are awarded not just for their findings, but because their findings make a difference.

So where is Europe going wrong? "Everyone can open a shop," Jonker answers. "But the success of the shop is not the products for sale or how nice the inside of the shop is. Success only depends on customers. How much do researchers look at customers? The peer review process means researchers are judged against their peers, but they should also be judged on whether their work brings something to market." Jonker described the ICT Labs' model for driving innovation in the market: creation, transition, acceleration. Creation is all about breeding entrepreneurs and talented researchers. Transition is the process where knowledge is

transferred into market solutions (especially thanks to the co-localisation of R&D and the entrepreneurs). Finally acceleration is the process by which you drive R&D uptake through established companies or through entrepreneurship and the creation of new enterprises.

The role of EIT Labs is to facilitate this three-step process through a large number of different approaches and initiatives which it called the Catalyst Carrier Model. One example is its Patent Booster. “Unless you are a paper mill, it is very difficult to build a company on paper,” Jonker explained. “You need patents and products. Our Patent Booster tries to get patents out of research projects. We employed a patent engineer to go through the research output of partners and clients, identify patentable intellectual property and submit European patents.

EIT Labs is also developing innovative technology transfer mechanisms to match innovations to appropriate partners. “Sometimes good technology is developed, but there is no outlet for it, especially in big companies because of a change in strategy.” But the innovations should not simply go to waste. EIT Labs tries to find partners to implement ‘unwanted’ innovations. Jonker cites the case of a new technology developed for Nokia in Finland that ended up being deployed by a firm in Paris.

In conclusion, EIT Labs is about bringing together all the components to give the right mix to get ICT research and innovation into the marketplace: mix education, business support research, add the close proximity of innovation clusters and you could get a powerful driver for market-driven progress in the future internet.



## **John Day, Professor Boston University**

- We are looking at the future internet as craftsmen when it should be as scientists
- We need more seers and thinkers – people not afraid to ask deeper theoretical questions like ‘What don’t we understand?’

John Day shook things up a little with his clear message that we are tackling the future internet as craftsmen, not scientists, and this could be to our folly.

Drawing on the work of Lee Smolin in the book *The Trouble with Physics*, Day argued that the scientific community today, especially in the field of ICT, selects for master craftsmen – people with the skills and expertise to solve problems quickly. “If it works, it’s good,” is the adage of the day and this is leading to incremental improvements in the internet. “We don’t select people who ask *why*, so research is more about patching problems, which is a much easier approach thanks to Moore’s Law. This often leads to an answer, but we don’t really understand the answer.”

Craft trends tend to stagnate development in a field because knowledge is lost. Craftsmen mentality has led to the failure of future internet architectures.

Failure? “A decade of research has not yielded a single breakthrough,” Day asserted. What we need is more ‘seers’, Days suggested. These are people who are not just good at maths and science, but they can also ask (and are not afraid to ask) the deeper questions. The role of theory is unique and critical to science. The idea of proof and implication is unique to Western science. “If progress is an arrow then theory is its vector field,” Day asserted. “We need more thinkers.”

“We are trying to solve the wrong problems,” he continued, “so we need to ask deeper questions. Today we are asking ‘What do we build?’ when we should rather be asking ‘What don’t we understand?’”

### **So what are we to do?**

John Day explained that there is no need to panic yet. Engineering is common in the early days of a research field. You fly by the seat of your pants to get things started. But we now have two generations of researchers who have been educated this way, to solve by patch. “Good work must be disruptive,” Day announced, a term which continued to occur throughout the rest of the day.

Should we replace the craftsmen with theorists? No, but we do need more theorists, said Day, even though they tend to be an odd lot. Theorists tend to listen to the problem, not impose answers, he observed. “I’m worried, that’s why I’m talking about this,” Day stressed. “Research is stagnating, but this is a global problem and too much depends on us getting this right. We have got to break this trend.”

Day went on to describe how a theoretical approach to understanding networking can produce some fascinating insights. Starting from the premise that networking is inter-process

communication (IPC) and only IPC, Day and his colleagues have developed an entirely new networking model called RINA. “It incorporates 40 years of lessons learned about the good ways and bad ways to do things. We don’t propose that RINA overnight replace the internet as we know it, but rather that we begin a new age of protocol research and implementation. Let’s get back to being scientists,” Day concluded.”

*More details on the technical aspects of RINA:* [www.slideshare.net/an3tnet/an-introduction-to-rina](http://www.slideshare.net/an3tnet/an-introduction-to-rina)



## Plenary session – Future Internet Public-Private Partnership

The Future Internet Public-Private Partnership ([www.fi-ppp.eu](http://www.fi-ppp.eu)) was launched on 3 May 2011 at a high-level ceremony in Brussels. Speaking at the launch, Commissioner Kroes described the initiative as an important instrument to complement Europe's existing future internet activities. "It bridges the gap between private and public interests, between the technology development and its deployment and commercialisation," she remarked. "This is a programme that must provide the flexibility and adaptability to public service infrastructures and business processes to enable applications to interact seamlessly with the Cloud and sensors and to make better use of the richer data that will be collected."

The FI-PPP is an initiative led by industry and driven by users. In this plenary session Peter O'Donnell, associate editor of the *European Voice*, led a roundtable discussion to tease out what exactly this will mean in practice.

"The FI-PPP is a bit like unwrapping a present," said O'Donnell. "You know something good is inside, you're just not sure what. There are more than 150 organisations involved; it is like a Who's Who of the biggest and most advanced players in ICT technology along with many small and highly creative companies."

**Mario Campolargo**, Director for Emerging Technologies and Infrastructures at the European Commission's Directorate General for Information Society opened the session with a brief snapshot – the first glimpse of the gift underneath the paper – of the FI-PPP. It has launched with a number of projects in place: FI-WARE (the long-term effort to develop the underlying technology foundation and framework of the future internet) and eight 'use cases' to demonstrate and pilot innovative technologies and services in different market and social sectors.

But Campolargo wanted to throw out some questions for people to ponder. Are we using the right mechanisms? Can we develop business models that are user-centric? What is the role of the public sector in driving early deployment and commercialisation? Do we still need more research in this field?

"We have to catalyse the take up of new internet technologies and applications," Campolargo continued. "In the EU we believe that SMEs have a central role to play. We believe that with our support Europe can put the right technologies in place, but the development of successful applications needs users and SMEs to get involved in the earliest stages. SME and user involvement is the only way to ensure that FI PPP is strong."

Regarding business models, Campolargo admitted that the Silicon Valley model was compelling, but Europe still fell well short of this ideal. Innovative ecosystems tend to be fostered at a local or regional level. He hoped that FI-PPP could create a new ecosystem for innovation by drawing suppliers, users and developers together around large-scale innovative internet services.

So, do public administrations have any part to play in this? Here, Campolargo highlighted the

big difference between Europe and the US. “In the EU we have a strong public sector which supplies good services (health, transport, e-government, etc.); therefore Europe needed to keep up with, and be active in, innovation in these areas. But there needs to be more impetus to get public administrations involved in research, not just building infrastructure and rolling out broadband, but investing in state-of-the-art development and providing test beds for new technologies.

“We are by no means at the end of the road when it comes to future internet research,” Campolargo continued. “We face incredible challenges: an ageing population, the weak economy, climate change and regional imbalances. We need a fresh look at what we do; we still need to deal with the issues of trust, the billions of devices, virtual spaces and the problem of insufficient bandwidth.”

Ultimately, Campolargo concluded the market, consumers and citizens will judge the success of Europe’s future internet research effort. But the incentives are strong and the future internet promises riches and rewards.

When asked by O’Donnell whether the FI-PPP was to some extent a carnival parade that most people would just have to sit and watch, Campolargo reassured the conference that FI-PPP was only in its first phase. “In this phase we wanted to put supply and demand together, but this is not a game that is closed. Just because we have started pilots does not mean that we have finished. When we enter the second phase we will open up the FI-PPP to new partners. Really we are obliged to get new partners so we can respond to the demands of users.”

**Fernando Fournon González-Barcia** presented Telefonica’s perspective on participating in the FI-PPP. He pointed out that Telefonica has a strong R&D portfolio, spending €4.8 billion in technology innovation. It has a large network of innovation centres and partners across the globe. As a network operator Telefonica is involved in core platform development (FI-WARE), but also is participating in the use cases OUTSMART and FI-CONTENT.

Reiterating the same points as Mario Campolargo and Willem Jonker of EIT ICT Labs, González-Barcia tried to explain how innovation was quite different to R&D. With his commercial perspective, he made his position clear: “You have only got innovation when you have got customers and revenue.”

Telefonica sees its participation in FI-PPP as an important competitive move with commercial drivers. FI-PPP is creating the conditions for innovative companies and innovative ecosystems. The future internet will be a platform which will create new business models.

Peter O’Donnell asked González-Barcia to explain how participating in FI-PPP is different to other sorts of European initiatives. González-Barcia stressed that FI-PPP would be the main focus of Telefonica over the next few years. The main difference, he said, was the way in which FI-PPP works across so many different sectors.

Another delegate wanted to know how Telefonica defined ‘open’ *a propos* the development of an open platform and its support for open innovation. González-Barcia replied that the research effort meant that you had to communicate with all customers and use open protocols, but even

that was not enough. You also needed some data to be open and available to services, so you can build useful services on top of data.

**Jose Maria Cavanillas de San Segundo**, speaking for ATOS Origin which cooperates with Telefonica in the FI-WARE core platform project and also participates in four use case projects, reiterated the mantra that research is fun, but pointless unless there is business at the end of the road. You have to develop something that appeals, he pointed out.

ATOS Origin is the fifth largest IT consultancy in the EU and has vast experience of participating in EU ICT research. Within FI-PPP the company is working on highly innovative applications for the future internet including the 'Virtual Intermate'. The idea is that we could each have an online 'friend' that is capable of acting and interacting over the internet semi-autonomously on our behalf.

From blue skies thinking to concrete measures, ATOS is also aiming to be a 'zero email' company from 2014. Employee surveys found that people spent 5-20 hours a week on email, but could work more effectively using social media and other interactivity tools.

**Mischa Dohler**, CTO of Worldsensing, is interested in how sensor networks and the 'internet of things' (IoT) will transform society and make many everyday services smarter and more efficient.

A partner of the OUTSMART project, Worldsensing is playing its part to find solutions to the headaches we suffer as part of our daily routine. How can the future internet make life better when we get up, travel to work or spend time with family?

Along with ICT companies OUTSMART involves some unusual partners, specifically town halls, service providers and citizens. The work is clustered by theme and geography looking at water quality and sewage (Aarhus, Denmark), waste management (Berlin, Germany), transport and environment (Birmingham, UK), water and environment (Trento, Italy) and smart metering and street lighting (Santander, Spain).

The town halls are providing important input into new business models and working on the interoperation of large municipal IT and infrastructure platforms.

In Berlin, for example, sensors are being fitted to waste bins to detect and signal when they are full and need emptying. The city's environmental services department can use this information to optimise waste collection routes and schedules. In Santander the city council is working with partners to optimise street lighting, not just for cost savings, but also taking a more social perspective, looking at issues of security and safety.

The amazing selection of Hungarian cakes during the coffee break had already been the topic of conversation for many delegates, but **Adrie Beulens**, Professor at Wageningen University, wanted to talk about the whole supply chain, from farm to fork.

While local food has become a central feature of future internet events, you would not normally expect the farming to be featured so prominently. But Beulens' introduction to the

SMARTAGRIFOOD project perfectly demonstrates how FI-PPP places so much emphasis on future internet applications in the real world.

“We need twice the productivity with half the resources,” Beulens remarked; and this increasing pressure on food production is already having an effect on SME agribusinesses. This FI-PPP project will help Europe’s farming and food industries to make necessary changes.

This project is geared around prototypes. “When you are working with farmers, the public and businesses you have to have something to show them,” Beulens stressed. “They want something to test.” Beulens noted that farmers were quite open to technology. They understood that unless you were at the cutting edge of agricultural practice you would be out of business. Groups of young farmers are often very willing to try out new high-tech systems; SMARTAGRIFOOD has 20 innovative farming partners on-board.

SMARTAGRIFOOD is developing a range of technology solutions for smart farming, smart agri-logistics and smart food awareness. The future internet will be the enabling technology of all these applications, helping to track the quality and movement of goods, supporting the decision making of farmers and enabling food processors to develop more dynamic consumer profiles.

Finally, **Antonio Kung** spoke about Ambient Assisted Living Joint Programme (AAL JP), part-funded by the European Commission on the basis of Article 169 of the EC Treaty. Through open calls, the AAL JP seeks to develop sustainable systems and technologies that will help the growing elderly population to have a better quality of life and remain healthier and more active into old age.

But what has this Joint Programme got to do with FI-PPP? “We need to coordinate our work and ensure that our platforms are compatible,” Kung insisted. “There needs to be interoperability between platforms.”

Various initiatives have been established to bring the future internet community and AAL researchers together, for example the openURC Alliance which seeks to develop standards for intuitive and accessible user interfaces for devices and services.

Although Kung and other participants in the AAL JP could be considered outsiders in future internet research and the FI-PPP, he argued that this was not the issue. “What is most important is that our work is synchronised. We need interoperability between platforms and coordination of our work,” said Kung, appealing to the Commission to raise awareness of the issue.

Kung’s insistence on the importance of interoperability stimulated some heated discussion. Campolargo agreed that projects, such as FI-WARE working on core platform technologies, had to ensure that their solutions were flexible, scalable and able to adapt to the specific needs of different sectors and new partners. Kung remarked that the FP6 MonAMI project has prepared a declaration which calls on stakeholders to support the development of common platforms and consensus-building in interoperability. An AAL declaration will also be prepared for the AAL Forum in September 2011 and a dedicated AAL-FI workshop is planned for November 2011.

Following up Kung's presentation, González-Barcia said he agreed with Kung and added that FI-PPP was only in its first phase. Through open calls in later phases of the programme it may be possible that the AAL sector might be targeted as a use case.

Rounding off the presentations, O'Donnell asked panel members about how FI-PPP had so-called European value. They noted that:

- projects were taking place in a potential market of 100 million people;
- projects followed a typical European approach applying knowledge to benefit citizens and solve social problems;
- FI-PPP gets all stakeholders – especially businesses and users – talking to each other and thinking about compatible and interoperable systems;
- FI-PPP is part of a snowball – if the snowball is big enough it will roll;
- FI-PPP has high utility (similar US programmes are geared towards generating cash);
- FI-PPP provides critical mass for innovation and new business.

In conclusion O'Donnell suggested it was now down to the future internet community to prove the value of initiatives such as FI-PPP and to demonstrate that investment in this field was “more worthwhile than building more motorways.” Europe is not in this to get a bigger slice of the global pie, but to make the pie bigger for all, he remarked, but people had to be convinced that this was true.



## Plenary session – EU 2020: Future Internet Driven Innovation?

Some key messages were coming through loud and clear: future internet R&D is not just about finding technological solutions to existing problems or even solving the anticipated challenges of the future. Rather, it is a key enabler of Europe's innovation and competitive future.

As **Megan Richards**, Director Converged Networks and Services, European Commission DG INFSO, remarked, this is the big discussion: how do you integrate research and innovation? Innovation is not linear, so it involves much more than applying some standard procedure to the end of the research pipeline.

This session aimed to explore the multidisciplinary approaches being used across the EU to turn Europe's research excellence into innovations with concrete, commercial and competitive returns on investment.

### ***Graça Carvalho, Cisco***

In the context of various European 'megatrends' (ageing and decreasing labour force, population increase and greater urban densities, power shift to developing countries), Graça Carvalho introduced the conference to Cisco's idea of 'innovation communities'. The idea is to use networking technologies to make communities smart and connected and by doing this foster innovation within and among them.

Its Smart+Connected Communities programme has deployed solutions around the globe and has many case studies to demonstrate how networking can boost innovation, revitalise communities and stimulate new development and growth in physical communities. Examples include the Olympic Park and village for the 2012 Games in London and The Bridge which combines a science and industry park with 1500 new homes and facilities next to the QEII Bridge near Dartford, London.

The PlanIT Valley project in Portugal, meanwhile, is a new 1700 hectare development in Portugal which is being hailed as the next-generation intelligent city. Cisco is the master planner and expecting some 100 million sensors – the eyes, ears and fingers of the town – to be deployed in the development. The town will generate a vast wealth of data each day which will feed into the Urban Operating System (UOS) – the brain of the 'city' – which will coordinate and control events, for example altering the sequence of traffic lights or switching off lights in rooms when no-one is around.

Cisco has developed a unified delivery platform for Smart+Connected solutions which includes a 'storefront' so that external developers will be able to build their own services (including mobile services) and integrate them with other platforms. "We are finding that when you push for innovation, the community responds and produces developers," Carvalho observed.

In London they opened up a number of data sources and now there are apps that are making money – London SMEs are exploiting the connections to public data sources. In Barcelona city authorities have allowed developers access to traffic light sensors; there is now an app that will vibrate a blind person's mobile phone for the pedestrian phase.

Carvalho insisted that the Smart+Connected vision required more than the networking backbone, but a commitment from the public sector to open up its data. She has seen no harm come out of the pilot schemes already in place and the quantity of data makes it virtually impossible to track information to individuals. "People have no idea of the potential of the data they have," Carvalho added. For him, access to data is at the core of innovative applications.

### ***Sinisa Krajinovic, Ericsson Hungary***

These exciting examples of the latest applications for businesses and citizens certainly supported Sinisa Krajinovic's claim that we are now in the fifth technological revolution. It all started in the Stone Age when humans began using tools. Fast forward through the invention of the wheel, the Industrial Revolution and just 40 or so years ago we entered the Information Age. But the fifth revolution is already upon us: the Networked Society.

"Up to now we have been connecting places and people. Now we are connecting things," Krajinovic pronounced. "Everything that could benefit from a connection will be connected."

And with those connections will come many innovative applications, such as the automation of emergency service call outs or a vending machine ordering its own restocking from a supplier. The era of the internet fridge is almost upon us.

Three major forces have driven the development of the IoT: mobility, broadband and cloud computing. The statistics are staggering. For example it took 100 years to connect one billion phone lines but just 20 years to connect five billion mobile subscribers. In the area of broadband, it is estimated that for every 1000 new broadband subscribers 80 new jobs are created. And the impact of the cloud is only just becoming evident. These three drivers give us the networked society which will make it cheaper and easier to test and launch new business and try out new ideas. In short, innovation will be easier.

Ericsson's vision anticipates that by 2020 around 100 billion processors will benefit from network connectivity. By this time an average middle class citizen will have 10-12 connected devices, most vehicles will be networked and three billion utility meters will be hooked up in smart grids. "We are on the brink of tremendous and exciting change," Krajinovic remarked. We are building together the foundation, but it is down to the creativity of everyone to realise this vision."

Krajinovic briefly described Ericsson Hungary's current research collaborations in exploiting IPv6 for autonomic networks and services (EFIPSANS project), energy efficient networks (EARTH) and split architecture carrier grade networks (SPARC). "The only limit is our imagination," Krajinovic concluded (although a delegate pointed out many barriers, e.g. concerns about privacy and a mistrust of technology, which could easily prevent people from accepting the networked society model).

***Professor Guang-Zhong Yang, Hamlyn Centre for Robotic Surgery***

Finally, the conference got to see the power of the internet in action. The old internet, admittedly, but in a room full of computer scientists and future internet experts, it seems appropriate that at least one presentation should be made live via video link.

Speaking from Imperial College, UK, Yang gave his own perspective on the potential applications for a networked society in the area of health and ageing. Pervasive sensing offering tremendous opportunities to develop systems that could address many of the problems that Europe is likely to face as its population ages and becomes increasingly urbanised. At present in the EU about 6% of the population accounts for around 60% of healthcare budgets and this imbalance will only get worse. The way we deliver healthcare must change, Yang insisted.

Yang and his colleagues are working on developing ICT to prevent, diagnose and treat chronic conditions that are common among the elderly population. He also wants to use sensor networks to evaluate the health of people within their normal living and working environments, rather than having to see them face-to-face in the doctor's surgery or the hospital. "Current monitoring tools only provide a snapshot of a person's health at the moment they are measured. But so many symptoms come and go and the chances are that, by the time the doctor checks you over, everything will seem fine. Now we have the opportunity for long-term, continuous monitoring which you can combine with data monitoring and trend analysis to probe the long-term health of individual patients. We are beginning to see a shift in healthcare towards prevention."

Yang explained that sensing technologies have come a long way in recent years thanks to advances in MEMS which are smaller and more biocompatible and the development of ultra-low-power sensor designs (including using the body itself as a power source).

Yang went on to describe recent collaborative research which has developed the SAPHE architecture, designed to integrate networked systems with body and ambient sensors. SAPHE has been created to make it easier for the mobile network of sensors on a person's body to connect and disconnect with fixed networks, for example in the home or the healthcare setting. Yang described scenarios where the data from numerous wearable, implanted and fixed sensors could be combined to give a reliable picture of a person's normal routines and activity. For example you could detect that someone is still in bed at an unusual time and combine this with physiological data and their medical history to infer that something is wrong. By using surrogate health indicators (including behaviour patterns) doctors may pick up early signs of illness or take measures to prevent 'unhealthy' behaviours.

Yang concluded that the future internet and IoT can provide the foundation for innovations that would support 'life-long health'.

## **Plenary session – Future Internet Beyond FP7**

*“Just scan the general EU policy framework,” suggested Zoran Stančič, Deputy Director-General, European Commission DG INFSO, “and you quickly see that the future internet is high on the agenda. It’s on Europe’s Digital Agenda and its research agenda and is embedded in the EU 2020 strategy. But what is the future of the future internet?”*

*Certainly current future internet initiatives are running well. The sector continues to create jobs and pay higher salaries and is on track to account for 6% of EU GDP by 2015. The EU is supporting some 140 future internet research projects and FIRE is playing a central role in testing and experimenting. Now FI-PPP is bridging the gap between research and commercialisation and the Future Internet Forum provides a channel for Member States to express their position on the future internet to the Commission.*

*But it is always important to plan for the future and prepare for next steps to fulfil the future internet vision. Stančič has many questions: How should we structure research? How do we reach beyond traditional ICT communities? How do we maintain our academic links? How can we leverage the research taking place in Member States?*

*This final session of the Future Internet Conference helped to address some of these long-term and strategic questions.*

### **Steve Wright, Head of Strategic Review, BT**

You cannot improve public policy unless you know the strengths, weaknesses and impact of previous policy implementation. So the next framework programme, whatever its guise, must build on the lessons learned from FP7 and its predecessors.

Steve Wright was a panel member for the recently completed FP7 ICT Interim Evaluation report. This evaluation, which builds on the FP6 Aho report, was part of the overall FP7 evaluation which will guide the final few years of the programme and make an important contribution to the design of future funding schemes.

The ICT evaluation collected its evidence from the ICT annual work programmes, the FP7 self-assessment, surveys and interviews with project participants and the findings of other commissioned reports and studies.

On the whole, the evaluation panel concluded, the ICT programme is relevant and largely well implemented. But shockingly, FP7 has made but modest progress on the recommendations of the Aho report. Even more damning was its finding that simplification has gone backwards (“... not merely a matter of imperfect implementation... an existential challenge to the Programme itself.”). Wright observed that SMEs were particularly reluctant to participate in FP7 projects – “the very people you want to get involved won’t because it is too complicated,” he said. “Aho raised it before and here we are again.”

The interim evaluation makes three main recommendations:

- Strengthen European ICT research in a globalising world (by continuing to push ICT research in the next programme, finding synergies and coordination between EU and national programmes and ensuring a balance between consensus-based R&D and longer-term more speculative projects – “we are not so good at long-term, disruptive research,” Wright observed).
- Exploiting the pervasiveness of ICT via integrated policies (including more user involvement, supporting higher education to develop IT skills and creativity. “FI-PPP is a good start” was Wright’s comment on this recommendation).
- Improve risk sharing (a euphemism for simplification, said Wright, for example by introducing a lightweight form of subcontracting or associate partnership for SMEs and by reducing the wasted effort of proposal writing. “Financial regulations set the culture. FP7 is stifled by financial regulation and there needs to be a better trust base.”).

Wright then went on to discuss the Commission’s Green Paper on a Common Strategic Framework for EU Research (CSF). The paper recognised the need to break down the Commission’s silo structure and integrate research, development *and* innovation funding programmes. But Wright’s message was blunt: “simplify or die.” He also warned that planners should not ask “How do we get more SMEs in collaborative projects?” but address the fundamental question of “What interventions will best help SMEs?”

### ***Bridget Cosgrave, Director General, Digital Europe***

As the head of Digital Europe, an advocacy group for Europe’s IT, consumer electronics and telecommunications sectors, Bridget Cosgrave is perfectly placed to present industry’s perspective on the research needs for the future internet. “Most of the people in the room probably work for one of our member companies,” she pointed out.

And then came the shock. She named the elephant in the room. “China, China, China,” she declared. “We are operating in a global world. It is not just demographics and technology that is changing. There is a massive shift in economic and political power from west to east. We need research and innovation to lead to growth in Member States.” Later discussion among presenters pointed out that growth in China also provided many opportunities for cooperation, not just challenges.

Digital Europe has also submitted a response to the CSF Green Paper. “Our members are extremely positive about the support its R&D efforts receive. They like research based on excellence and designed to have an impact.”

Digital Europe has five recommendations for future internet research in FP7’s successor programme:

- Focus on global standards (international standards increase technology uptake and allow markets to grow).

- Use large-scale engineering test beds earlier in the R&D lifecycle.
- Build up trust and do not neglect the privacy issue (“a serious barrier to adoption,” according to Cosgrave).
- Make it possible to have *ad hoc* collaboration in projects to make them more flexible so that experts and interested parties can “hop in and out” for short periods of time as the work develops or tweaks their interest.
- Forums and dialogue between all stakeholders in the future internet value chain are extremely important especially in the early phases of its development.

Cosgrave reminded the audience that the EC’s budget for research was small compared with the budgets of Member States. She also called for national governments to use pre-commercial procurement as a way to maintain public investment in R&D despite shrinking economies.

But Cosgrave wanted to conclude by stirring things up a little, harking back to John Day’s talk much earlier in the conference. “Use cases with short- to medium-term impacts are great. But we also need research that contributes to disruptive developments. We really need ‘outside the box’, independent thought to take us to new paradigms.”

### ***Heikki Huomo, ISTAG***

Heikki Huomo’s recommendations for the post-FP7 research agenda were the synthesis of three ISTAG working groups which looked at instruments, impact and the mobility of goods, services and people.

He suggested that Europe is ready for a new innovation mix, incorporating more user- and policy-driven research as well as the traditional industry-driven and curiosity-driven projects.

ISTAG’s recommendations, based on the three working groups, call for:

- Greater participation from non-conventional actors (for example individuals and NGOs).
- An open fast-track scheme to identify noteworthy innovations with commercial potential and then accelerate their take up in the market.
- Extend the two-step proposal submission model which currently exists for FET project proposals.
- Disseminate project best practice and supporting ICT solutions which can be implemented in the public sector.

A delegate wondered whether it was contradictory to say that the future internet community wanted more focus on large-scale test beds but also likes to see more involvement from SMEs and smaller players. In response, presenters suggest that it was a question of balance and the future internet research agenda had to be split into a set of portfolios. Project proposals would compete within a portfolio. There would have to be consultation and discussion on the balance of portfolios (for example, how much curiosity-based research vs industry-driven projects).

## **Nick Wainwright, FIA and HP Labs**

It is never fun taking the podium after six o'clock in the evening following a packed conference agenda. But Nick Wainwright wanted to round off the day; not just dwelling on the successes of the past, nor gazing into the future, he wanted to show how we get from the here and now to the smart, networked and exciting society of the future.

Any such journey needs a map and that is exactly what Wainwright had to offer, a consensus FIA roadmap for future internet research, starting from FP7. But before saying more, he gave a caveat. "The context of this map is very different from when the FP7 started in 2007," he stressed. The implication? Roadmaps are dynamic and fit into their political, economic and social context. This was by no means a final blueprint (indeed, Wainwright called for comments, suggests and changes that could go into the next iteration).

The roadmap offers six broad themes for research:

- Beyond converged infrastructure
- Exploiting networked data
- Securing the future internet – infrastructures, applications, data, users
- Networked interaction – people, data, content, spaces
- Augmenting worlds – making the internet work for us
- Internet-style innovation – future and emerging applications and services

Behind these sweeping headings, Wainwright introduced a long list of areas for future research, but always with a focus on real-world applications. As he put it: "The internet of doing things."

The research programme, Wainwright argued, needs the four important components: a scientific approach (that's science in the John Day model, i.e. based on free thinking and theory), experimentation, the development of interoperable and scalable architectures and open innovation.

## **Links and info**

*Programme and presentations:* <http://fi-budapest.eu>

## Future Internet Assembly – Wednesday, 18 May 2011

*Many FIA delegates arrived at the opening of the FIA having spent the previous day listening to high-level presentations about the current landscape of European future internet research and its ambitions. Within this context, the research community settled down to two days catching up on the latest advances in the development of future internet architectures and their applications.*

*The master of ceremonies opened the proceedings with a little tale about how he spent the previous evening babysitting his young niece. “Can I switch on the internet on Daddy’s laptop?” she asked. Fearing that her little fingers might cause some catastrophic data loss on the laptop, he offered her his netbook instead. “Your internet is much better than Dad’s,” she observed. “I think he should buy one.”*

*“We may smile, but I wonder. Is she really wrong?” he asked. “Kid’s today have grown up with the internet as an everyday utility. They think differently. For them, devices are the internet. Maybe it is time us old researchers listened to the children and observed how they use the internet and what they want from it.”*



## Opening plenary session

### Welcome

#### ***Mário Campolargo and Megan Richards, European Commission***

Known to anyone with even a remote interest in European future internet research, Mário Campolargo formally opened the FIA and thanked all the participants for their forthcoming contributions in the plenary and parallel sessions. Megan Richards set the scene for the two days of presentations and discussion. She recognised that future internet research had come a long way from the early days of the Bled declaration, but the next steps were not all that clear. “Behind us are more than €4 billion of EU investment, over 1200 ICT projects involving almost 4000 organisations. We have seen research calls from Joint Technology Initiatives and from the EERP and the FI-PPP. But what lies ahead?”

The Seventh Framework Programme still has two years to run with nearly €3 billion still to allocate for ICT projects. The Joint Technology Initiatives and the Ambient Assisted Living Joint Programme (AAL) will also continue to issue calls as part of their annual work programmes.

Since FIA Ghent in December 2010, Richards says future internet research has reached cruising speed, particularly with the launch of FI-PPP which has added many new and quite different organisations (e.g. regional governments) to the future internet community. For Richards the FIA working groups, FP7 and FI-PPP projects are making a holistic contribution to this domain.

But there is no stagnation; already the European Commission is working toward what is currently called the Common Strategic Framework (CSF, soon to be renamed through a public vote). This future funding scheme will span the period 2014-2020 and will combine funding for research and innovation for society, for business and for science.

Following a consultation period (which closed on Friday 20 May), the Commission will analyse the responses to its CSF Green Paper and present its findings and recommendations at a high-level event in Brussels on 10 June 2011. The Commission expects to publish its CSF proposal by the end of 2011, with a decision by the European Council and legislation from the European Parliament made sometime in 2012-2013.

Richards also drew the attention of delegates to the big push by the Commission to save the EU from its innovation crisis: the Innovation Union. This initiative strives to act as a hub for all Europe’s innovation programmes and strategies to meet the EU 2020 objectives. The Innovation Union contains over 30 action points, including proposals for European Innovation Partnerships, the strategic use of public procurement budgets and greater use of risk-sharing financing.



***Zsolt Nyitrai, Minister of State for Infocommunications, Ministry of National Development, Hungary***

The FIA was honoured to welcome Hungary's Minister of State for Infocommunications and hear more about Hungary's perspective on the future internet as it approached the end of its EU presidential term. The strapline for the Hungarian presidency is 'Strong Europe' and for Zsolt Nyitrai collaboration is a keystone for building this strength. The benefits of collaboration are clearly demonstrated through Europe's science and research programmes.

Nyitrai went on to outline the role that the Hungarian Presidency has played in activating the Digital Agenda. For example, mobility is a key ingredient of European life, but the bandwidth for mobile devices and services is being squeezed. Hungary has spent much of its Presidency focusing on Europe's radio spectrum policy so that bandwidth may be freed. "Greater bandwidth can make a major contribution to economic recovery and growth," he suggested.

With broadband penetration below the European average, Hungary has also kept up pressure for Europe to meet its broadband targets. And it is also a goal of the national government. Nyitrai agrees that fast internet access is crucial for economic development. "Creating better and cheaper internet infrastructure is in line with the Digital Agenda and I am sure that this FIA will contribute to this effort," he noted.

Nyitrai also summarised the position of the Hungarian Presidency regarding the challenges facing the success of the Digital Agenda. He highlight the dangers (and growth) of cybercrime and the effect that this has on trust among users. He suggested that the future internet community should write security into everything it does. Even with the best technologies in the world, without trust, users will not use the advanced applications and services of the future internet. “The Hungarian Presidency has taken an ambitious course,” Nyitrai concluded, “and I hope the FIA will contribute to our work.”



## **Keynote address – Network Science: from the Internet to Human Communication**

***Albert-László Barabási, Northeastern University/Harvard Medical School, USA***

- Making predictions about human behaviour is notoriously hard, making them without adequate data is more like palm-reading
- The living cell and the internet are very different, but if you strip away the details they are virtually indistinguishable

“We can predict the trajectory of an electron in an atom, but not the economy. We know more about Jupiter than the person sitting next to us. How come we are so bad at studying humans?”

Quite simply this, commented Albert-László Barabási: the moon doesn't complain when you land on its face.

Science, he remarked, is the study of natural phenomena. And the job of the scientist is to describe, quantify then understand the phenomena he observes. From this knowledge he can make predictions and ultimately discover how to control it. Now replace 'natural phenomena' with 'humans', Barabási suggested. It just doesn't sit quite right. We know so little, our predictions about human behaviour are unreliable and we certainly don't like the idea of control.

But our lack of knowledge is not particularly because humans complain about being the subjects of research (although they do). Really, it just boils down to a lack of data. “Anyone making predictions without data is either a palm reader or a business consultant,” he quipped.

But the information is changing everything and for the first time ever we can study human behaviour in a quantitative manner, thanks to the mass of data now available. So much data is gathered about us that it is almost possible to piece together a person's entire life.

“So why would you listen to a physicist talking about human behaviour. Well, actually I don't really care about human behaviour. What I am interested in is complex systems. We can't know exactly what is going on in an individual's brain, but we can study human society. We are all nodes in networks. We can look at the structure of those networks and work out who are the people who play an essential role.”

Barabási described how networks have been studied using the Erdos-Renyi model. Nodes are connected by links, but the links are assigned to nodes at random. In such a random network each node has approximately the same number of links. If human society was random we would all have roughly the same number of friends.

But no network is random. There is structure in organisations, agglomerations of people with similar interests – friendship groups, churches, nation states, the EU. And then there is the worldwide web. It isn't a random network either.

If you imagine that webpages are the nodes and URLs are the links, do you find a nice Poisson

distribution for the number of links per page? No, you get a parallel distribution instead, with a few pages with many links and many pages with a few links. Barabási likened the network map of the worldwide web to airline routes with hubs.

“So why do hubs emerge,” Barabási asked. “What is missing from the network model that means networks do not form randomly?” You only have to look at what happens when you create a new webpage. You tend to link it to other pages that you know about; these tend to be the most connected nodes.

Amazingly, the hub networking model is found in biology (four million years of evolution suggests that the hub model is robust and well protected against the random failure of a node) and in human society too. Using mobile phone data, researchers have mapped the movement of people in Paris. Again, they tend to move between distinct geographical nodes, and it is possible to predict where they will go to.

At this point some delegates began to shift in their seats – and not just because they needed the coffee break. So Barabási tried to put them at ease. “Of course we make our own decisions, we still have free will.”

But he hadn’t finished. “We *can* change our behaviour, but we don’t exercise this freedom. In society and as a society we follow precise mathematical laws. It really is possible to quantify behaviour and make predictions. Of course you are free to go to the shops instead of to work if that is what you decide, but the point is that we choose to go to work.”

Barabási went on to describe a study where individuals in a data sample were assigned an entropy level. Individuals who behaved less predictably or in a disordered manner were given a high entropy rating. Those with more ordered lives had a low entropy rating. From these values it is then possible to assign a measure for predictability in a system. The results are scary: in a system of 100 000 individuals the predictability for the vast majority is around 0.9. No-one has a predictability rate below 0.8. “Even people who think they are unpredictable, spontaneous or disorganised are still incredibly predictable and restricted in what they do.”

In conclusion Barabási brought the subject back to the internet. “There are fundamental differences between networks but most have evolved similar architectures and follow similar laws. The living cell and the internet are very different, but if you strip away the details they are virtually indistinguishable.”

And what happened next? Everyone got up and enjoyed a coffee break. How predictable!

# Future Internet Assembly – Thursday, 19 May 2011

*The FIA may have only been running for three or so years, but already some good traditions have been established. The final plenary session of FIA in Budapest certainly followed the standard format including presentations of papers from the annual FIA Book and presentation of the Future Internet Award to a future internet project demonstrating innovation, problem-solving and some of the most exciting potential for internet applications.*

## FIA Book

### Introduction

***John Domingue, Open University, UK***

Children have been mentioned several times in FIA Budapest and John Domingue, editor of the FIA Book, had his own anecdote to tell. When his daughter is asked at school what he does, she tells them “Daddy’s inventing a new internet, but he’s not really sure what it will look like.”

The FIA Book tries to fill in some of the blanks, however. The 2011 edition tries to strike a balance between looking back at achievements so far in this domain and looking forward to the new technologies promised by researchers in this field.

The book covers some of the future internet ‘foundations’ – architecture, security, trust, experimentation and socio-economic issues. It also gives some insight into innovative research covering different areas of the future internet, including networks, content, services and applications.

“We have also followed the spirit of previous books and the FIA event itself; in other words it is cross domain,” said Domingue.

***Ioannis P. Chochliouros for “Challenges for Enhanced Network Self-Manageability in the Scope of Future Internet Development”***

Ioannis P. Chochliouros stressed that the internet is and will continue to be one of the most critical infrastructures of the 21<sup>st</sup> century. The number of users would continue to grow and the demand for wider bandwidth and faster speeds would be relentless. This daunting pressure on networks calls for better management at all levels of the infrastructure.

Currently network management takes place within client stations using protocols such as SNMP. But this approach has limitations in terms of scalability and still requires considerable human intervention. “Our vision,” says Chochliouros, “is a self-managing network, where nodes don’t just have a traditional management framework, but additional features including cognitive capabilities.”

This network management autonomy is the goal of the ‘Self’, which is designing and developing an innovative paradigm that uses cognitive elements in network management systems. This

self-management is achieved using a feedback control cycle: network monitoring gathers information about the state of the network; a decision is made to reconfigure or adapt; the task is executed and then monitoring activities will measure the impact of the decision and lead into another decision-making cycle.

“This is a kind of divide-and-conquer approach to network management that breaks down some of the complexity. It has benefits for network operators and users, for example by helping operators to reduce their operating expenditure while giving users a seamless experience in dynamic network selection.”

“The Self-NET approach offers resilience and flexibility in network management,” Chochliouros concluded.

### ***Pascal Vicat-Blanc for “Bringing Optical Networks to the Cloud: Architecture for a Sustainable Future Internet”***

If Software as a Service and (SaaS) was the big buzzword five or so years ago, the advent of the cloud is not creating a host of new ‘aaS’ acronyms. Pascal Vicat-Blanc described the work of the GEYSERS project which is trying to apply a cloud approach to networks leading to the notion of Infrastructure as a Service (IaaS).

GEYSERS makes it possible for virtual internet operators to provide virtual internet infrastructures to meet the specific demands of individual clients. GEYSERS introduces a logical infrastructure composition layer (LICL) which makes it possible to partition the physical infrastructure (network and IT resources) and to merge the resources coming from different physical infrastructure providers into a single virtual infrastructure.

The approach being developed by GEYSERS aims to overcome some of the many challenges facing today’s infrastructure. It aims to provide businesses (including applications providers) scalable ‘pay as you grow’ bandwidth, coordinate IT provision and networking, and deal with the problem of ‘burstiness’ in traffic flows. On top of these issues are those which are common across the internet such as security, reliability and energy consumption.

### ***Sergi Figuerola for “Renewable Energy Provisioning for ICT Services in a Future Internet”***

You don’t get much more politically correct than this: a water-powered internet. Well, perhaps that is the impossible ideal, but the work of Sergi Figuerola and his colleagues will certainly help the future internet to be powered by as much renewable energy as possible.

Figuerola is participating in a joint European and Canadian collaboration that seeks to optimise the use of data centres and network ‘hubs’ which are powered by renewable sources. “Climate change is not reversible,” said Figuerola, “so we need low-carbon internet solutions which focus on energy efficiencies and use renewable energy.” The GreenStar network solution uses a virtualised network (Network as a Service or NaaS) to maximise network activity in data centres with low greenhouse gas emissions and high renewable energy provision. You essentially follow the sun and the wind.

The solution combines the work of the Mantychore FP7 project (which allows European National Research and Education Networks to build their own layered virtual infrastructures including a base optical layer) and link up to the GreenStar Network of worldwide renewably-powered data centres. In a zero-carbon network a virtual machine is migrated from one renewably-powered node to another. A proposed energy-aware routing scheme uses Mantychore to find a virtual machine which is optimal in terms of greenhouse gas emissions.

*FIA ... Ageing like fine wine!*



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## **Plenary Session – Cloud Computing**

**Rainer Zimmermann, Head of Unit for Software and Service Architectures and Infrastructure, DG INFSO**

The surge in cloud computing over the past couple of years has forced everyone involved in future internet research funding to step back and rethink their strategies. “How will networks and the cloud work together,” the Commission’s Rainer Zimmermann asked. “Cloud computing has become a political topic. We need a cloud computing strategy.”

But policy-makers are not sure if they are approaching cloud computing the right way. “Bureaucrats don’t know problems,” Zimmermann continued, “they simply have processes – doing things right does not mean we are doing the right thing!”

On 16 May 2011 the Commission opened a public consultation about cloud computing which will remain open until 31 August. The responses to this consultation will feed into the Commission’s EU strategy on cloud computing which it expects to publish in early 2012.

Zimmermann outlined three areas which require more attention: regulation and related issues such as interoperability, data security and liability; the everyday use of cloud computing and the uptake of cloud services; and cloud computing R&D.

Zimmermann then introduced a panel of speakers and experts who would each give their own perspectives on the impact of cloud computing and research challenges that still need to be addressed.

**Juan A. Caceres** from Telefónica said that his firm has identified seven vertical markets where it intended to capture growth – the cloud was one of these. The company’s cloud portfolio includes infrastructure services (e.g. virtual PCs and data centres), Software as a Service, and ‘people services’ (covering personal productivity and leisure). “The cloud must be the enabler, a platform to give services that other actors want to provide. The cloud allows telcos to close the cycle and offer X as a service. Telcos will give people confidence in the cloud,” he said.

Through the FI-PPP project FI-WARE Telefónica is involved in various aspects of cloud architecture design. FI-WARE seeks to integrate the results from previous future internet architecture projects and create generic enablers. It will also issue open calls for research that will fill gaps in architectural knowledge and designs.

He presented a tag cloud of the main research challenges involved, of which 'trust', 'security' and 'privacy' were the most prominent words.

**Daniel Pays**, Director of Infrastructure Management Services at Thales called on engineers to build applications ready for the cloud. Thales is also a partner in the Future Internet PPP (in the core platform and several use cases). Their main role will be to develop usable security solutions.

He also described a newly-approved project for the French government called Andromède which works like a digital factory for creating new products and services.

Like so many other speakers during FIA, Pays could not over-emphasise the importance of security and building trust in the user community. The Andromède project would formalise the security requirements and develop the cloud infrastructure for secure business transactions.

One of the big advantages of the cloud is that security operations can be provided by a third-party security operator which can supply global security capabilities.

**Thierry Priol** of INRIA and EIT ICT Labs said that the growth of the cloud meant that the research community needed to look again at some internet basics such as adaptability and resilience. “Clouds tend to centralise the internet and that creates single points of failure,” he pointed out, echoing the previous day’s presentation on network science given by Albert-László Barbási. The importance of autonomous systems was becoming increasingly important.

He also said people were very concerned about privacy; they did not like the way they lost ownership of data when they uploaded to the cloud. He suggested that data should have some kind of self-destruct functionality to prevent its misuse.

Finally, Priol drew attention to the ICT Labs’ ‘Computing in the Cloud’ action line, in particular projects that are investigating new ways to route data in information-centric architectures.

**Jim Clarke** of TSSG Waterford, Ireland, quickly ran through some of the main topics covered by the FIA Ghent session ‘Can the cloud be trusted?’ He reiterated the comments of previous speakers, highlighting the flexibility of cloud services but accepting that trust is difficult to achieve. How, for example, can you be sure that the cloud services have implemented the right security measures? And once data is in the cloud, how do you guarantee to get it out again?

Clarke then proposed a comprehensive list of research challenges for trust and trustworthiness in cloud computing and discussed how to address them to make the cloud a trustworthy environment for cloud service users and operators. The challenges are available in the official [FIA Ghent report](#).

If the perennial fear of the surfing community is to be lost at sea, then the equivalent for the internet world is to be lost in the cloud. **Marcus Brunner** from NEC summarised the FIA Budapest session ‘The network lost in the Cloud’ (see also FIA Session III.1 later in this report).

“The main purpose of the cloud is resource sharing for elastic usage,” explained Brunner. “We have seen a lot of progress on cloud *computing* and dynamic IT resource management, but there has been a global trend to forget about the network – the connections between IT resources and data centres.”

Brunner believes that cloud computing is where business meets research today. Businesses want a one-stop shop, they just need their IT resources and online presence to work, covered with a single service level agreement. EU projects are looking at how to manage the different layers of the cloud and offer a single ‘front end’ to users.

Brunner also remarked that IT has to look closely at ‘consumerisation’. Businesses are increasingly using consumer-level devices and equipment to run enterprise applications and

services and this must be taken into account. Finally, Brunner noted a growing tendency to move cloud resource into the network; this improves the quality of experience for certain applications, but complicates how resources and virtual networks are defined and managed.

### **Round-up**

Picking up the different threads highlighted by the panellists, Zimmermann wondered how you transfer the new cloud technologies into everyday use. “What makes me really shiver is hearing about the stack,” he admitted. “With all these technologies I worry that the availability of each element is tolerable, but when you put them together, layer by layer, the availability is inadequate. The overall availability is not there. And when everything depends on something very small and apparently insignificant, that very small problem becomes a very big problem.”

Caceres agreed that each layer had to prove its reliability and be tested against infrastructure failure. Pays, however, suggested that we should not think in terms of ‘layers’ but functions. He said there are around 80 ‘functions’ in the cloud and each one must be secure. He insisted that the cloud is helping to accelerate research into business, but there could still be a major breakdown in trust which would jeopardise all progress made so far.

Taking the spirit of FIA, Zimmermann suggested that if there were problems with the cloud then we should go back and redesign the architecture.

From the floor, Stuart Clayman of the RESERVOIR project pointed out that the cloud was never standalone but a federation of physical and virtual resources. He noted that the cloud currently lacks the ability to find the best links between cloud resources.

Finally, Zimmermann asked the panels to say what they thought was the main motivation for moving to the cloud.

Pays said the cloud was a breakthrough and would affect IT products across the board – people were really asking for cloud solutions. Priol said that the cloud was a great playground for researchers and he was very excited about the next generation of cloud applications. Clarke thought the cloud marked the industrialisation of ICT, providing lots of opportunities for innovation, to develop new ideas, to implement them and run them. The largest challenge for researchers now, according to Clarke, is ‘roadmapping’ the required research activities in terms of ‘what’ and ‘when’ they needed to be done – in the FI-PPP, the remainder of FP7 and/or its successor. A perfect opportunity to contribute to this process is via the [FIA research roadmap](#) working group.

## **Closing Plenary Session**

### ***Future Internet Award***

*The Future Internet Award is presented each year to a future internet project that has produced outstanding results and achievements in Europe. This year the judging panel received 23 entries involving 10 Member States. The long list was narrowed down to three short-listed projects. However, the judges agreed that Smart Santander was the best project overall, citing its consortium "of extraordinary quality including citizens, scientists and government", its living labs methodology and its prototyping and testing of new technologies.*

### **Invitation to the next FIA in Poznan, Poland**

#### ***Jan Weglarz, Director of Poznan Supercomputing and Networking Centre***

Professor Jan Weglarz invited the FIA to Poznan for the next meeting (26-27 October 2011). Following a now established tradition, the FIA would be an integral part of a Future Internet Week which would include the Future Internet Conference, the Future Internet Forum, Future Internet Poland and the meeting of various clusters and committees.

The week is being organised by the Poznan Supercomputing and Network Centre (PSNC), a leading Polish ICT research institute and the pioneer of Poland's optical networking infrastructure.

### **Progress on parallel FIA actions**

#### ***Michael Boniface, University of Southampton***

Michael Boniface, speaking on behalf of the future internet coordination action FISA, quickly reviewed the year's progress in the future internet research community. He again highlighted the FIA Book and asked delegates for their ideas to include in next year's publication. He also reminded delegates about the work of the FP8 Roadmapping Working Group led by Nick Wainwright. The first draft version of the roadmap is currently available on the FISA website and contributions and comments are being gathered to inform V2 due to be published in September.

The International Cooperation Working Group has produced a consolidated list of upcoming events and is preparing recommendations to the European Commission on possible future international cooperation actions.

The Socio-economics Working Group was re-launched at FIA Budapest following a period of inactivity. This group is planning a workshop for FIA Poznan on the future internet business ecosystem.

FIArch (Architectures Working Group) is focusing on the design principles of the future internet

while the Open Linked Data Working Groups is seeking to reflect the requirements for the future internet in standards bodies.

In terms of pre-standardisation, My-FIRE is now an enlarged group and in direct discussions with ETSI, W3C and ITU. It is looking to create closer links with European Technology Platforms and FI-PPP.

Work is relentless in the Trust and Security Working Group which works closely with other FIA Work Groups as well as holding collaboration and cluster workshops.

The Real-World Internet Working Group has published its latest RWI architecture in the last FIA Book and is continuing to work with the Internet of Things community.

FIRESTATION successfully completed its first and second round of open calls (BonFIRE, TEFIS, OFELIA, Smart Santander and CREW). It continues to engage with relevant research (STREP) projects.

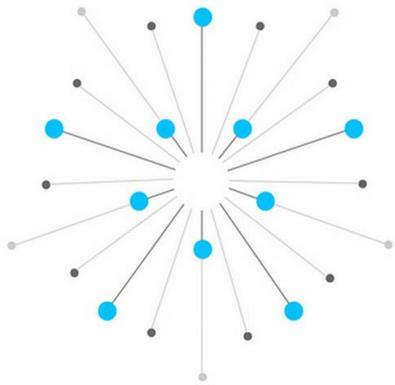
### **Closing comments**

Marió Campolargo thanked all the members of the FIA steering committee and session organisers for their work and contributions to a successful event.

He said that the meeting had demonstrated that the FIA was a vibrant community with lots of ideas and excellent interaction between different research fields. “New topics keep popping up and we already have a lot of new ideas for Poznan. I see a lot of energy here.”

Campolargo said that the launch of FI-PPP was a significant milestone in future internet research and it seemed to be smoothly integrating with FIA.

To conclude, Campolargo had this message: “FIA is switching on the minds of those making decisions about the future internet. There are very important dynamics going on here that can help to ensure that the future internet is driven by Europe. I would like to reiterate the commitment of the Commission. We are ready to listen to this community.”



# FUTURE INTERNET ASSEMBLY

PARALLEL SESSION  
REPORTS

## **Session I.1 – Information-centric Networking**

*Organisers: George Pavlou (University College London), Spiros Spirou (Intracom Telecom)*

### **Session summary**

The information-centric networking (ICN) session attracted about 100 people; four experts and six projects provided statements and contributed to the discussion with the audience. Each statement focused on content naming/identification, content delivery and business models. It seems that the session successfully brought together most projects working on ICN in Europe.

George Pavlou identified peer-to-peer (P2P) overlays and content delivery networks (CDNs) as the “first step in ICN” in his introductory speech. He further suggested that the key issues in ICN are content naming, name resolution and content routing.

Torsten Braun (University of Bern) made a point that in ICN “content should encompass services” and that ICN should facilitate “the composition of services”. Prof. Ebroul Izquierdo (Queen Mary, University of London) suggested that in ICN the network should be aware of content encoding – particularly, layered encoding – and should “help in content distribution by prioritising different layers”. Bruno Kauffmann (Orange, France Telecom) questioned whether “there are ICN incentives for players apart from network operators”. Finally, Börje Ohlman (Ericsson) proposed that in ICN business models “compensation for content and transport [services should be] totally independent”.

Project representatives gave their statements as part of the discussion moderated by Spiros Spirou. Evangelos Markakis (ALICANTE project) explained how content access and delivery can be through a proxy, namely the “Home-Box”. Francisco Javier Ramón Salguero (COMET) proposed a global content naming scheme based on a hierarchy of namespaces and emphasised stateless content routing for scalability purposes. Andrea Detti (CONVERGENCE) suggested two different content naming schemes optimised for the application and network levels respectively; he identified source routing as the mechanism for content delivery. Miguel Rio (ENVISION) noted that the application should be primarily responsible for content naming and content routing; the network provides information to assist in routing decisions. Arto Karila (PURSUIT) described the use of separate content identifiers at the application, control and data planes; he supported a disruptive data plane based on the publish/subscribe concept. Finally Victor Souza (SAIL) advocated a content naming scheme in a URI format, coupled with a name resolution system that also records the content location.

The session concluded that ICN should essentially make P2P and CDN mechanisms part of the network, but deployment should be incremental. Incentives for content service providers and network operators are adequate but it is not yet clear how end users will benefit from ICN. Finally, the main research challenges are still in content naming and content routing.

## Questions

- Why don't we just stay with existing P2P overlays and CDNs?
- What are the incentives for each stakeholder in ICN?
- Is in-network caching at the backbone necessary?
- Are content-based service policies compatible with net neutrality?
- Does the network really need to become something more than a bit-pipe?
- Can a content identifier refer to more than one content object?
- How do content naming schemes deal with dynamic content?
- Is cooperation between network operators, as suggested by ICN business models, possible?
- Are networked operators convinced that ICN deployment can be incremental?
- What is the benefit of ICN to the end user?

## Links and info

Session description: <http://www.fi-budapest.eu/download/SDI1.pdf>

Session presentations available: <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-i1-information-centric-networking-icn.html>

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## FIA Session I.2 – Linked Data

*Rapporteurs/Organisers: Manfred Hauswirth (DERI), Stefan Decker (DERI), Sören Auer (University of Leipzig)*

### Session summary

This session looked at how data could and should be linked within the future internet architecture, both at the level of the network and within the 'internet of things' (IoT).

#### *Linked data use and the internet of things*

Stephan Haller of SAP argued we need ways to make sense of the large amount of information the future internet will provide. We require, for example, approaches to ensure that data is of satisfactory quality and to track the source of the data (data provenance). Haller said that linked data could provide the foundation for an interoperable 'knowledge layer' of the IoT, although numerous challenges (e.g. metadata, constraint environments and data streaming) still needed to be solved.

#### *Linked data for telecom networks*

Ivan Bedini of Bell Labs described how linked data could solve the problems of data integration in telecom network management. Specifically, he said that performance figures from various

sources could be connected to network management functionality in the context of femtocells. Linked data could solve the problems, but in this specific domain people were still working out how to handle large spatio-temporal data and deal with data values.

#### *Interaction of the network layer and linked data*

Brendan Jennings of TSSG discussed linked data in the context of network management as a possible enabler for the knowledge plane/autonomic network management proposed by Clarke *et al.* In this context, the key challenges for linked data are how to handle the dynamic nature of the data and perform 'scalable reasoning' on possibly incorrect/incomplete data in real time.

#### *How to participate/contribute to the FIArch effort*

Dimitri Papadimitriou of Alcatel-Lucent Bell gave a quick overview of the work of the FIArch group and how the linked data group could get involved in the fundamental architecture work of the FIA.

Payam Barnaghi of the University of Surrey talked about the importance of linked data for the IoT and the establishment of semantic technologies and resource descriptions (IoT-A project).

#### **Next actions**

Since the future internet is a global effort and Europe is leading in the area of linked data, concrete steps have been undertaken to ensure consistent developments in the US and Europe. Specifically, a joint EU/US session has been proposed to the American Association for the Advancement of Science (AAAS) to take place during the next AAAS general meeting. The focus of the session will be *Future Internet with Cyberinfrastructure and Linked Data*.

#### **Links and info**

Session description: <http://www.fi-budapest.eu/download/SDI2.pdf>

Session presentations available: <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-i2-linked-data-in-the-future-internet.html>

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## **FIA Session I.3 – The Economics of Privacy**

*Rapporteurs/Organisers: Tuan Anh Trinh (Budapest University of Technology and Economics), Nicola Jentzsch (DIW Berlin), Estelle De Marco (Inthemis), Martin Waldburger (University of Zurich)*

*Other contributors: Aljosa Pasic (Atos Origin), Kai Rannenber (Goethe University Frankfurt), Eric Meyer, representing SESERV (Oxford Internet Institute), Roger Torrenti, representing PARADISO 2 (Sigma Consultants), Jim Clarke, representing BiC (Waterford Institute of Technology)*

## Session summary

The session identified privacy as a major socio-economic concern in the future internet and Tuan Anh Trinh noted that the economic aspect of privacy has not been thoroughly investigated. According to Trinh, the innovative business models of success stories like Google and Facebook are partly based on new uses of the personal information of users. Personal information is an economic asset, said Trinh, a position that was reiterated by others throughout the session.

In her keynote speech Nicola Jentzsch first reminded delegates that privacy is a human right analyzing privacy problems with economics would not change this basic fact. She introduced an economic definition of privacy: "A state of asymmetric distribution of personal information among market participants." She identified three pre-conditions for personal data markets to emerge: the specification of property rights to personal information; an infrastructure for the transfer of personal data; and incentives for firms to collect and trade personal data and for consumers to disclose information. Jentzsch spoke about competitive strategies of firms operating in personal data markets. Competition intensifies if consumers choose to remain anonymous and buy only standard products, as there is no additional product differentiation. Customer lock-in could increase when personalisation increases switching costs, she said. Finally, Jentzsch explained how research about consumer lock-in can be undertaken, referring to a research project conducted for ENISA.

Estelle De Marco shed light on the legal situation for privacy and personal information markets. She showed that personal data are elements of the private life, and are protected for this reason by several international and European legal instruments. EU legal requirements (e.g. imperative information, consent of the consumer) even apply to non-EU entities in many cases. Regarding users' perception of privacy and attitude towards personal data exploitation, she notably stressed that consumers are more open to disclosure when legal requirements are respected.

Aljosa Pasic and Kai Rannenberg looked at how personal information could be valued. The majority of attendees indicated they would be willing to share their political opinion for €20. So why do companies pay €20 for information that is often available for free, Pasic wondered. He commented that the legal situation and the 'proportionality principle' were inconsistent between states; it could be extremely costly and time consuming to test compliance to privacy regulation. For companies compliance was a balance between minimising cost and risk. A solid cost-benefit analysis of this complex system is needed, Pasic concluded.

Rannenberg introduced the idea of privacy-enhancing identity management (IdM). This valuation approach tries to overcome the shortcomings of common decision making processes. It should lead to a set of decision-relevant economic consequences of adopting, mediating or providing privacy-enhancing IdM services. Rannenberg proposed a process model that identifies stakeholders with their costs and benefits and assesses aggregated and clustered costs and benefits under different scenarios (e.g. with and without a trusted third party). Rannenberg concluded that minimisation and decentralisation of data is important, as well as user empowerment.

The session then heard position statements from a number of projects. Eric Meyer (SESERV Coordination Action) said privacy is a question of technological capacities, goals and attitudes. Meyer suggested that the idea of a trusted agent to hold and release personal information if required is not a new concept *per se*, but might address some privacy issues. Some solutions may exist, but we are not yet implementing them, he said. Meyer invited the audience to participate in the respective privacy-oriented discussions within SESERV (e.g. during the Oxford workshop in June 2011).

Roger Torrenti introduced PARADISO 2 as a project that explores the future of society. The project has called on the Commission to explore the limitations of the internet. Privacy (from no privacy up to full privacy) has been identified as such a limitation.

Jim Clarke (BiC Coordination Action) presented recent activities from around the globe (e.g. EU, US, Canada, Korea and Australia) on the economics of privacy. He said that BiC could facilitate contacts and links between these activities.

### **Questions and answers**

Q: Why are there no trusted entities emerging which keep personal information private as a gatekeeper for consumers?

A: Jentzsch explained that this was the case for recent start-up companies such as Allow, MyID.com and Bynamite. She explained that in some cases consumers would be paid for the sale of their data and could specify for what purposes and time period that could be sold.

Q: Are there models for the valuation of privacy and, if yes, have they been reliably tested thus far?

A1: Jentzsch explained that there is research on the quantification of privacy, however, much remains to be done in the area of testing theoretical models. While valuation of personal data by consumers could be assumed to be context-dependent, it is not completely arbitrary, but exhibits behavioural constants.

A2: Rannenber stated that no one really knows the value of privacy. One way to circumvent this issue is to bring users into the decision-making problem and to aggregate valuation after that.

Q: Is privacy a possible asset in public services, too?

A: Rannenber stated that the presented assessment model could be applied in the design of a public service as well.

Q: How to address a user's question: "Can I see all the data you are collecting about me?"

A1: Rannenber proposed a dashboard which may help users see the data being collected. But how do you organise the data in the dashboard in a meaningful way?

A2: De Marco emphasised that a right to access is granted in the European Directive, as well as a right to be informed. If, despite these rules, it remains difficult for a user to know who is collecting his data, we can note that within the framework of the revision of the Directive

95/46/EC, it is notably foreseen to increase transparency for data subjects and to strengthen users' rights. Regarding profiling, the informed consent of users is mandatory; information given in the general terms and conditions of a website is not sufficient when cookies are being used, under EU law as interpreted by the Article 29 Working Party.

Q: How could the cost of privacy compliance be determined?

A: Pasic pointed out that different levels of compliance have to be considered. For security, for instance, there is compliance with ISO standards (ISO certification).

## Conclusions and future work

Martin Waldburger wrapped up the session with some key messages and 'lessons learned':

- The economics of privacy implies a need for developing an understanding of the relevant stakeholders and their incentives in markets for personal information. From an economic and from a legal point of view, consumer perception and incentives for consumers and providers are of central importance.
- Stakeholders engage in tussles as they act according to the incentives.
- The identified preconditions for personal information markets are key (property rights, infrastructure, incentives have to be available).
- Appropriate consumer information must be available and consumer rights must be exercised, but the trade-off between differing interests has to be considered.
- Signalling the benefits of disclosure to consumers may increase consumer acceptance and loyalty, the costs of legal compliance for companies have to be reduced, and risks need to be known and reduced.
- Approaches to better risk assessment allowing for reliable cost-benefit analysis are needed.

## Links and info

Session description: <http://www.fi-budapest.eu/download/SDI3.pdf>

Session presentations available: <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-i3-the-economics-of-privacy.html>

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## FIA Session I.4 – Smart Cities and FIRE: Experimentation and Living Labs for the Future Internet

*Rapporteurs: Martin Potts (Martel GmbH), Roberto Santoro (ESoCE Net)*

*Organisers: Michael Nilsson (Luleå University of Technology), Anastasius Gavras (Eurescom), Roberto Santoro (ESoCE Net), Hans Schaffers (ESoCE Net), Timo Lahnalampi (Dimes)*

## Session summary

This session discussed practical experiences of user-driven innovation (UDI) – through ‘living labs’ in future internet experimentation projects. Presentations and discussions explored how testbeds and infrastructure for experimental research could also be used by users in cities and in regions; and how common resources and services provided by different facilities (e.g. living labs, experimental facilities, existing smart city platforms) can be made accessible and shared.

### **Learning from current projects in real-life experimentation and user involvement for FI**

*Moderator: Timo Lahnalampi, Dimes (FIRESTATION project)*

#### 1. Real-life experimentation experiences from the TEFIS project

Itziar Ormaetxea (Software Quality Systems, S.A) described how a service developer used the Botnia Living Lab to try out five ideas for new mobile services with real users. The most popular idea now will be tested using an IMS testbed from the FIRE project TEFIS. The service developer is also evaluating the business model of the idea which will provide important feedback on how the TEFIS platform could be developed further.

#### 2. Experimenting with the ‘internet of things’ (IoT) in the SmartSantander project

José M Hernández-Muñoz (Telefónica) said that the living labs model fills the gap between fundamental research and the market. He presented the plans of the SmartSantander project to experiment with IoT in the areas of mobility and traffic management, pollution and weather. Hernández-Muñoz identified the difficulties involved in simultaneously running research activities and providing actual services.

#### 3. Discussion

*Martin Dobler (FH Voralberg), Dimitri Papadimitriou (Alcatel-Lucent Bell), Roberto Santoro (EsoCE Net) and Anastasius Gavras (Eurescom)*

Martin Dobler is involved in the process of combining living labs and testbeds in the FIRE project PERIMETER. He is concerned that the results from the living labs should be made exploitable.

Dimitri Papadimitriou is the Technical Manager of the FIRE projects ECODE and EULER. He wants to collect ‘traffic traces’ from living lab experiments, to identify more realistic traffic data (patterns, traffic types, etc.) to improve current simulation and emulation.

Roberto Santoro’s ELIOTT project observes how the user affects the development of an IoT system. His recommendation was to measure and record user experiences using a standardised ‘knowledge-social-business’ or KSB experience model which integrates social, intellectual-cognitive, economic, legal and ethical aspects related to the use of IoT technologies. This knowledge could be used by testbeds and living labs.

Anastasius Gavras, coordinator of the FIRE project Panlab-PII, suggested that projects aiming to connect concepts with users should monitor actual experimentations and collect users’ feedback to answer three questions:

- How much UDI is realistic?
- How far along the UDI chain can we go with the tools we have today?
- What can we do in the short term (e.g. monitoring, user feedback)?

Taking the perspective of the living labs, Ormaetxea highlighted some further issues:

- What incentives can be provided to living lab end users to encourage them to take part and maintain their interest?
- Does the technology live up to users' expectations?
- Involvement of humans means that it is impossible to automate everything or get perfectly repeatable results.
- Participation of users in multiple sites (in different countries) adds complexity.

Ormaetxea recommended that users should be involved from the very beginning of a project or experiment, including the planning.

From the audience, Christer Ahlund (Luleå University of Technology), asked Hernández-Muñoz about the geographic scope of SmartSantander (multi-site?) and about the challenges and opportunities that have been identified.

Hernández-Muñoz replied that the effort so far has focused on the deployment of devices, mainly in the city of Santander. The next step is to interconnect the testbeds. He has already experienced problems with deployment and he expects that interconnecting the different cities will uncover new problems. It has been a challenge to deal with the various departments of the city council (traffic, health, safety, etc.) and incorporate the feedback from the advisory board (addressing the special needs of some citizens, for example). The involvement of real end users complicates an EC project, he remarked, adding that there are insufficient resources in the project to incorporate all the possible demonstrations that people would like to see implemented.

### **Bridging existing gaps in experimentation and user involvement methods and practices**

*Moderator: Michael Nilsson, Luleå University of Technology (FIREBALL project)*

#### 1. Living labs methodology for user involvement

Anna Ståhlbröst (Luleå University of Technology and Botnia Living Lab) presented the FORMIT methodology for user involvement. She stressed that only “interesting applications” will attract users.

#### 2. Experimentation and user involvement – future needs based on past experiences

Marija Zlata Boznar (MEIS Slovenia) described her work in the FIRE N4C project and the trials of delay and disruption tolerant networks (DTN) in remote areas with no existing infrastructures. She stressed the importance of e-inclusion outside smart cities and proposed the concept of “smart villages” to prevent the rise of future “second class e-citizens”.

### 3. Discussion

*Pieter Ballon (IBBT), Dave Carter (MDDA), Hans Schaffers (ESoCE Net).*

Pieter Ballon is part of the APOLLON project and he commented that SMEs are an essential actor for developing future internet technologies. The APOLLON project provides a dedicated platform for testing and accessing new markets through cross-border living lab pilots. He announced that the European Network of Living Labs now has 274 members.

Dave Carter is part of the EURO CITIES project and he said that within cities e-inclusion is a major problem. Smart cities are creating a network under the aegis of FIREBALL to define a concrete action plan for sharing future internet commons among cities.

Hans Schaffers is a member of the FIREBALL project and he identified the need to collect and analyse more empirical material from use cases. Although some promising practices are emerging from TEFIS (sequential) and ELLIOT (concurrent) there is still a need to consolidate an integrated model/methodology addressing the interactions between actors and access to common assets in a controlled environment.

#### **Panel discussion: closing the gap**

*Moderator: Hans Schaffers, ESoCE Net (FIREBALL project)*

Hans Schaffers offered three questions to the panellists and the audience:

Q: What can we learn from the presented initiatives about how to integrate users into future internet experimentation? What are the limitations and opportunities?

A: Colin Upstill (IT Innovation Centre, UK) noted that the challenges are different in dense cities and remote communities. There will not be a single solution and therefore a range of testbeds is needed.

Dave Carter (MDDA, UK) agreed, but believed that the focus on the large cities would have most impact, since many problems are more intense (e.g. pollution) and more people benefit from improvements. But adopting common approaches and strategies could make a big difference.

Peter Ballon (IBBT) observed that large-scale implementations will also be seen in the FI-PPP projects, not just in large cities, but, for example, also involving farmers.

Q: How can we methodologically and practically integrate living lab concepts into the future internet experimental process?

A: David Fuschi (University of Reading, UK) stressed the need to study the whole system, not just the components. He recommended re-using what had been done well elsewhere and concentrating effort on the aspects that are different.

Ballon offered some practical advice for smart city projects: engage the city officials in, for example, the IT and tourism departments, since their commitment will be essential for the sustainability of the project after the co-financing stops.

Schaffers added that there are examples of concrete forms of collaboration in the CIP programme (c.f. the "Smart City" portfolio).

Hernández-Muñoz said that it was important to designate a specific project representative for each city; councils need guidance, but it is not an easy job to liaise with them.

Q: What are the priorities for future work to integrate future internet testbeds and Living Labs methodologies?

A: Roberto Santoro, (ESoCE Net) said it was a problem having to identify all the partners at the proposal phase, whereas more suitable ones may be discovered after the project has started. A better strategy could be to divide the project into phases and re-assess the partners for each phase as the project develops. This more flexible approach would allow testbeds and living labs to match partners to the stakeholder priorities at the right time.

It was also mentioned that the technical ideas behind the proposals should originate from SMEs.

Anastasius Gavras (Eurescom) added that monitoring and benchmarking were being discussed by the FIRE facilities; these were probably also topics of interest for the living labs and smart city projects. However, the benchmarks would likely be less technical than those for the testbeds (e.g. Is the smart city beneficial to the region, in terms of the cost?).

Finally, from his experiences in the APOLLON and EPIC projects, Sebastien Levy advised projects to focus on what new city services can bring to the citizen. This approach will ensure that end users become involved which makes it easier to achieve the subsequent sustainability.

## Links and info

*Session description and presentations available:* <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-i4-smart-cities-and-fire.html>

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## FIA Session II.1 – Interactive Future Media Experience

*Rapporteurs/Organisers: E. Izquierdo (Queen Mary University of London), G. Fehér (Budapest University of Technology and Economics)*

*Other contributors: Nadia M. Thalmann (MIRALab, University of Geneva; NTU, Singapore), Peter Eisert (Heinrich Hertz Institute), Peter Kovacs (Holografika), Qianni Zhang (Queen Mary University of London)*

### Session summary

This session looked at the technologies that will enable the future internet to offer 3D immersive collaborative environments supporting realistic inter-personal communication and new content delivery architectures. This new generation of media experience will create new economic models for 3D media search and recommendation.

There were three keynote talks in this session: 'Towards truly user-centric convergence of multimedia' by Nadia M. Thalmann; '3D video processing' given by Peter Eisert; and 'Light-field 3DTV research' by Peter Kovacs.

Noel O'Connor (Dublin City University, Ireland) chaired the panel discussion which followed the talks. He was joined by the three previous speakers and Ebroul Izquierdo and Gabor Fehér.

The first round of discussions was about the autonomy of virtual agents. Panellists explained that many applications are being developed and reported on in the literature, but the main problem is the processing time required for real-time simulations. Autonomy in 3D virtual environment still needs a lot more work to achieve realistic interactions. Members of the audience observed that the construction of a virtual agent model would require a huge amount of data capture. Panellists commented that one solution could be to use 'philosophy based capturing'. Another delegate asked about the quality of 3D rendering in immersive environments. The panellists stressed that the quality of offline 3D rendering today can be extremely realistic and natural. The problem is really about generating real-time animation and modelling. The panellists concluded, however, that the most difficult but important challenge here is to simulate human emotions. Autonomy of a virtual human is a key research topic for the future.

The second round of discussion focused on the visualisation of 3D simulations. The use of 3D glasses for 3DTV has received a lot of negative feedback from family users, mainly due to parents' concerns that the glasses would trigger eyesight problems for their children. Eisert explained that using glasses to watch 3DTV is an intermediate solution. Display technologies already exist for 3DTV without glasses. The real difficulty is in content production. Therefore a lot of research is currently concentrating on ways to produce 3D content using fewer cameras and less expensive devices.

The last topic for discussion was the impact of the autonomous avatar. In general panellists commented that the ethical issues surrounding autonomous virtual humans are extremely tricky compared to conventional media. They agreed that different policies should be established depending on different application domains. However, they said that this problem could be slowly resolved as the technology matures.

Gabor Fehér summarised the panel discussion and highlighted the importance of exploring the ethics of virtual human clones, especially to prevent the fraudulent use of virtual reality.

### **Links and info**

*Session description and presentations available:* <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-ii1-interactive-future-media-experience.html>

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## **FIA session II.2 – ICT and Sustainability: Mutual Impacts and Gains**

*Rapporteurs/Organisers: Markus Fiedler and Roman Weidlich (Blekinge Institute of Technology, Sweden; Network of Excellence Euro-NF), Seppo Yrjölä (Nokia Siemens Networks)*

*Other contributors: Alice Valvodova (Global e-Sustainability Initiative), Jean-Marc Pierson (Paul Sabatier University; COST IC 0804 “Energy Efficiency in Large Scale Systems”), Anastasius Gavras (Eurescom GmbH)*

### **Session summary**

Markus Fiedler began with an introduction to the topic and a summary of the outcomes of the Fourth Future Internet Cluster Workshop on ICT and Sustainability, held on May 16, 2011.

The views of the panellists (see links section below) – some a little controversial – triggered some lively debate and the discussion was driven mainly by the audience.

It was pointed out that sustainability involves much more than just ‘being green’. Sustainability addresses the triangle of society, economy and environment. The roadmap and corresponding costs for the ICT sector to become sustainable are far from clear today. Such a transition requires investment and expenditure on the one hand, but promises marketing opportunities and future business on the other. It was recognised that it is still an open debate as to whether ICT users would accept the performance trade-offs that may come with a reduced carbon footprint; this is quite the opposite of the current expectation of ICT development in which performance still rules over energy consumption.

But which parameters should you use to measure your level of sustainability? The development of such parameters and calculations will help to turn the challenge of finding the best trade-off between performance and sustainability into a relatively straightforward optimisation problem. However, we realise that such complete and reliable calculations hardly exist. We also need parameters and measures related to hardware, software and services so energy usage can be made clearer to customers. ‘Green’ energy from renewable sources should be requested by ICT users. In North-American people see the ‘green movement’ as big business; in any case companies are trying to save energy irrespective of parameters and good cost-benefit models. In North-America it is considered win-win for all the stakeholders involved.

Patterns in energy consumption are a particular problem. Smart grids have to deal with highly volatile energy balances and there is therefore more risk that power supplies will be less stable. In addition, more ‘smartness’ introduces more computation, storage and transport of data – and, thus, higher energy consumption. Policies and regulation are therefore required to avoid any ‘rebound effect’ that may be created by the vast availability and trend towards wasteful use of ICT resources.

## Questions and answers

The discussion moderator closed by asking each panellist one final question: “If you had money to spend on research into ICT and sustainability, what would you do with it?” The panellists gave the following answers:

- find ways to raise awareness of sustainability issues and try to change the behaviour of ICT users;
- find ways to make business out of the ‘green vogue’;
- develop models that will give a more realistic view of the environmental impact of ICT;
- identify metrics and other factors that could make ICT ‘more green’;
- identify renewable power sources that deliver a positive energy balance over their full life cycle.

## Links and info

Session description and presentations available: <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-ii2-ict-and-sustainability.html>

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## FIA Session II.3 – Internet of Things (IoT) and the Future Internet

*Rapporteurs/Organisers: J. Clarke, R. Roman, N. Papanikolaou, N. Wainwright*

*Other contributors: A. Bassi, S. Haller, D. Uckelmann, T. Peirce, O. Garcia-Morchon, A. Skarmeta, A. Sarma, M. Riguidel, F. Carrez*

### Session summary

The main goals of this session were to highlight aspects of IoT architecture: how it should map to the future internet (Panel 1), and an analysis of security, privacy and trust challenges for the integration of the IoT into the future internet (Panel 2).

*Panel 1: IoT/future internet architecture and integration (A. Bassi, S. Haller, D. Uckelmann)*

The definitions and examples of the nature of the ‘things’ in the IoT were presented; the things are not the actual computational devices or components, but the physical entities (e.g. human beings, cars, trees). Devices enable the physical entities to belong to – and interact with – the IoT. The panel explored how the IoT:

- can be defined (i.e. ‘envisioned’);
- should make use of what we have (i.e. extended);
- requires solutions that bring the IoT to the real world (i.e. it needs enabling);

- needs new users (i.e. how can you bring users to the IoT and excite them);
- will create new business models (i.e. evaluation of the economics).

The challenges for the IoT in the future internet include those related to connectivity, services (infrastructures, protocols, deployment), interoperability (technical and semantic) and business models.

*Panel 2: IoT/future internet privacy, security and trust (T. Peirce, O. Garcia-Morchon, A. Skarmeta)*

Ongoing work in the IERC cluster seeks to define which technologies make up the IoT; it is making contributions to European policies and approaches. Some use cases and security requirements were presented, and the consequent challenge of making the IoT secure were discussed. The importance of diverse human roles and interactions in the IoT environment must be emphasised in the development of security solutions, the panelists agreed. Interoperability, applicability, and 'optimality' (against constraints) were seen as mandatory for security. The concept of trustworthiness had to be examined at every stage in a 'thing's' life cycles.

A large number of security challenges for the IoT were presented in the areas of architectures, standards, application security, privacy and trust, life cycle, bootstrapping, network security, mobility, integration, and trust and security models for things. It would also be important to find a balance between centralised and distributed solutions.

These issues are being explored in an IETF draft. It outlines and discusses a possible blueprint for a trust and security architecture, locating components within the IoT which would play a role in security.

*Integration and discussions panel (J. Clarke, A. Sarma, R. Roman, M. Riguidel, F. Carrez)*

Delegates asked some fundamental questions regarding the nature and definition of 'things'. The questions touched on the hierarchical categorisation of things and whether it would be possible to record access to the 'things' (and who can have access to such records). Delegates also asked how information created by different things could interact.

The idea of fault tolerance and resilience in the IoT was introduced ("If hackers today control part of the actual internet, what will happen when the IoT arrives?"). Questions were also asked about the creation of the security mechanisms ("Do we need to integrate, adapt, or create security mechanisms in the IoT?"). There was wide agreement that security measures must take special care when adapting to threats because they could potentially cause unexpected knock-on effects.

A stimulating (and controversial) assertion was made that the existence of an IoT with billions of elements – and much more intermittent connectivity through *ad hoc* networking – raises major concerns about governance. It was agreed that this was indeed a major problem, and that the IoT will generate other new problems yet to be discovered and analysed. It was important that the potential benefits outweighed these potential barriers.

Finally, the session heard that the first IoT International Forum will be held in Berlin on 22-23 November 2011 ([www.iot-i.eu](http://www.iot-i.eu)).

### **Questions and answers**

Q: In the definition of the IoT: Is the requirement that you want to be able to uniquely identify something really needed because if you look at sensor networks often it may not make sense to address individual sensors? For example, for temperature – you don't need to identify individual sensors but groups of sensors instead.

A: You may not need to identify the individual sensors, but from a management perspective, you may need to do so. We need to make a link to unique objects – only so that you can know what the data refers to (e.g. temperature). The 'thing' is the item that is being monitored.

Q: The definition is very restrictive in that it says that the things are available to everybody, and secondly assumes there will be one business model. For example, if we consider the 'accessed by anybody' (open internet of things vs. constrained extranet of things) part, we might limit the IoT to one single business model. Other companies might need something different.

A: A common definition should exist to differentiate the IoT from other fields of research. There is a need to have a common definition and there are discussions about 'intra-net of things' and 'extra-net of things'. But the internet should be more open – there's a bigger concept behind it. Somehow it has to pay, and the only thing you can charge for is the data.

Q: The business model does not convince me. We are not used to this kind of 'pay for one-off pieces of data' by the item in the internet (e.g. pay per article). The internet of things should provide means for application developers to get revenue, not necessarily just for the data from the thing, which might be a disincentive for the development of applications by developers.

A: We need a certain incentive for increasing the deployment of IoT technologies and development of new applications. Besides, the business model is based on the following question: 'Are we willing to pay for information provided by the IoT?' In fact, in the real world, we do pay, for example, through downloading apps, paying for the IT department by the slice, product sales and the selling of data.

Q: You propose an architecture of the various internet of things. In proposing this, it's important that the architecture provides access to any objects in an interoperable way. Do you think that all systems should be built this way, so that they can all interoperate?"

A: To a certain extent (e.g. at the discovery service level), we should follow the same approach. Of course, we will have heterogeneity, but we need some common standards enabling interlinking of the different approaches such as common discovery services, semantic approaches, and using information from different sources.

Q: There was mention in the presentation about the use of linked data for the IoT, and whether the source of such data could be deemed trustworthy and reliable. What do you mean with the problem of 'who provides the data'?

A: It is a challenge about data provenance and we need to know if the source of the data can be trusted.

Q: You argued for a layer of sensors and a layer of applications including billing – the world is indeed a complex place. There will be sensors everywhere and a multitude of sources of the IoT transactions (multiple initiators, etc.) and the notion of sensors we can always access is very good. But do we really require customer billing for this or to make this a main driver as discussed in the presentation on business models? At least, we should consider the existence of an accounting and management component, which might be just everything we need instead of individual billing systems that could frighten off users who aren't accustomed to this type system. It raises questions: Who do you bill? What about charging ISPs?

A: It is true that accounting and management is important. However, existing accounting solutions may not be able to deal with the huge amount of possible 'billable' interactions in IoT. [The ensuing discussion showed that this is still a contentious point, which requires further research.]

### **Session wrap-up**

Amardeo Sarma, NEC: "As we are in the phase of developing concepts and ideas for the IoT, the presentations raised [...] the question: 'What are the 'things' in the internet of things?'. In the talks, we have heard things referred to as many possibilities from the IERC survey (sensor networks, RFID, M2M, etc.), real-world objects (even trees and cows!) and identifiable end points. There are other issues related to the hierarchical nature of things, how to record access (and who can have access to such records), and how information created by different things could interact. This raises a need to identify things to different levels, for example in the room that we are in and then the loudspeaker in the room. Based on this, several questions were put to the panellists:

1. Where we have identifiable things, e.g. hotel, then things within things, like the room, loudspeaker, do we need a recursive composition of things and should it be part of the architecture?
2. From the discussions on billing and the nature of how people use and pay for things nowadays – almost for free – shouldn't we urgently address the business models?
3. Regarding naming and addressing for IoT, this raises issues such as how to get bootstrapping, deployment and discovery?

### *Responses from the panelists*

Yes, for the IoT, it is definitely necessary to have recursions – e.g. pallets with objects on them are recursive – and this has already been accomplished to a certain degree. There needs to be hierarchal identifiers with descriptions that are more complex (rather than single hierarchy) when dealing with devices in the IoT. A mechanism is needed to define the scope of recursion to allow different layers of aggregation for the IoT and FI with multiple models to fit the hierarchy of devices. Panellists also cautioned against mixing the address and identifiers. There is room for intelligent clustering – an example of a truck carrying special loads was given.

It is difficult to properly define the IoT, but the panellists agreed the primary focus should be on the IoT architecture (IoT-A) instead, thus defining the concepts within and below that. IoT-A results should be a step forward in this regard.

Rodrigo Roman of University of Malaga pointed out the importance of security and trust for the IoT to be successful which calls for a holistic 'cradle-to-grave' approach. He introduced the idea of fault tolerance in the IoT: "If hackers control part of the actual internet, what will happen when the IoT arrives?"

Roman also questioned the panellists about the creation of the security mechanisms: "Do we need to integrate, adapt, or create security mechanisms in the IoT?"

The consensus on this question was that all three approaches are necessary and this was also discussed at the IETF workshop in Prague. However, 'adapting' could cause unexpected knock-on effects elsewhere, the panellists felt. A solution proposed would be to leave the interfaces open. The notion of trust in the IoT is currently not clear and is a major challenge for the community. The observation was made that things evolve over their lifetime (they are not static!) and there is definitely a need for fault tolerance in the IoT and that it be resilient to attacks.

Finally, Michel Riguidel of Telecom Paris-Tech brought some welcomed controversy to the session by declaring that the existence of a single 'providential' internet of things with billions of elements raises some major issues for him on trust, security and especially governability. In essence, he disagrees with the concept that the IoT should be centrally governed/managed/administered since there are fundamental issues of personal freedom, online 'liberties', that we need to ensure are maintained, and he feels this cannot be accomplished by having a centralised IoT/FI governance model. Today, it is a closed world of billions of computers and the idea of having trillions of virtual, physical, static, nomadic objects raises thorny questions for Riguidel, such as: Who will govern this? Where is the directory of this world? Who is going to manage the secrets?

Riguidel raised the following questions:

- Do you want an IoT that is connected all the time to everyone or one where things are only connected from time to time?
- What about personal freedoms (especially not leading to a situation that is centrally controlled, monitored, watched)?
- The tracking services of parcel providers are not questioned today, although they could have potential security and privacy implications for individuals. Will people keep these attitudes or become more conscious of their privacy in future?
- Will devices really be uniquely identifiable? Perhaps this is not realistic.
- There is a need to be more precise when talking about the IoT terminology. For example, what do we mean when we speak of IPv6 in FI? Do we refer to the format or the protocol? Riguidel argues that discussions in the IoT/FI community so far seem to be

more about format than protocol, which can lead to a dangerous situation. This is a subtle point that deserves more attention especially at the edge of networks.

The panellists agreed that the IoT will generate new problems and the benefits must outweigh the possible problems. We must clearly differentiate between the 'internet of people' and 'internet of things' and there is also a differential between dumb things and intelligent things that must be made. Yes, today we are engaged in one internet and there are billions of devices associated with it, which on the outside look like one internet of things, but on the inside there needs to be differentiated, federated sets of services and devices.

Regarding governance, all panellists also agreed that it is an important problem that must be tackled following the conceptual and definitions phases to ensure security and trust in the IoT. In fact, in the current internet, this is only partially solved.

### **Links and info**

*Session description and speaker affiliations and presentations available:* <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-ii3-internet-of-things-and-the-future-internet.html>

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## **FIA Session II.4 – Standardisation**

*Rapporteurs/Organisers: Franck Le Gall (inno), Jean-Charles Point (JCP Consult)*

*Other contributors: Didier Bourse (Alcatel Lucent), Patrick Guillemin (ETSI), Alex Galis (University College of London), Daniel Field (Atos Origin), Dimitri Papadimitriou (Alcatel-Lucent), Tomas Piatrik (Queen Mary University of London), Henrik Abramowicz (Ericsson)*

### **Session summary**

The session addressed some significant questions related to future internet pre-standardisation: how to increase the contribution of research projects to the pre-standardisation process, what should be pre-standardised in the short term, where this work should be focused and over what timeframe?

Didier Bourse reminded the session of the FIA's historical activities in this area. He remarked that to be successful, a standard needed industry support and had to reflect the timing and needs of the market.

Dimitri Papadimitriou presented the work of FIArch on future internet architecture; he stressed that different future internet areas would need to collaborate if it were to be successful in defining a generic architecture.

Alex Galis presented an example of a completed standardisation activity involving the FP7 projects Autol, 4WARD, Reservoir, UniverSELF: ITU-T Recommendation Y.3001 'Future Networks Objectives and Design Goals'.

Henrik Abramowicz introduced the panel session with some general observations on what would make a standardisation process successful. During the panel, people asked about how the concept of 'future internet standardisation' was being defined, but there was no consensus. While the majority of panellists thought this would be a lengthy and inefficient process, Alex Galis defended the need to clearly differentiate the current internet from the future internet. He suggested that the future internet should be described in terms of target functionality and design objectives.

The panel said there was also a need to provide proofs of concept, technical validation and evaluation of 'testability' for developing standards. The test platforms, such as those provided to the majority of FP7 projects through the FIRE initiative and the upcoming FI-PPP, also needed to be evaluated. The panel observed that standards organisations were set up to welcome research work coming from initiatives such as ITU-T, IRTF, ETSI ISG or OGF; complementarities between future internet standardisation efforts and these other initiatives would be analysed and studied further. Finally the panel highlighted that policy and regulatory requirements are also important drivers for new standards.

### **Conclusions and future work**

The session underlined the need to agree on future internet definitions and raise awareness of pre-standardisation efforts. The current status of standardisation is being documented by the FIA Standardisation Working Group. This mapping exercise requires collaboration between projects, project clusters and European Technology Platform activities. It has been recognised that future internet standards are made from myriad inputs and that direct contribution from projects is essential to achieve all these goals, although this could not happen without projects also understanding the business environment.

### **Links and info**

*Session programme and presentations available:* <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-ii4-standardisation.html>

*Read more:* [http://fisa.future-internet.eu/index.php/FIA\\_Standardisation\\_Support](http://fisa.future-internet.eu/index.php/FIA_Standardisation_Support)

## **FIA Session III.1 – The Network Lost in the Cloud?**

*Rapporteurs/Organisers: Nicolas Le Sauze (Alcatel-Lucent Bell Labs), Marcus Brunner (NEC Europe)*

### **Session summary**

The session focused on the many issues related to infrastructures which support cloud services. The session provoked questions and discussions about the place of the network and the importance of service level agreements (SLAs) covering IT and network resources. It also looked at some virtualisation solutions which could join the two worlds.

Two presentations focused on how businesses are using the cloud. An SME is now able to offer cloud-based high performance computing (HPC) services; a large operator can offer its global cloud services to enterprises. The session discussed the requirements of these different users, for example:

- a single interface (one-stop shop) for customers – they do not care how the cloud works, just that it *does* work;
- end-to-end SLAs which today are well managed within a single network operator, but remain a major challenge between operators and across carriers;
- the need for IT to manage ‘consumerisation’ and support a heterogeneous world where applications have to be run on a host of different and devices.

Peter Glock highlighted that “the network is a vital part of delivering services to the end user”, positioning network operators as “trustable hubs” for cloud services.

Three FP7 projects (ETICS, SAIL and GEYERS) highlighted their specific contributions to this area proposing solutions to assure multi-carrier SLAs and to move cloud resources into the network. The goal of projects like these is to improve the quality of experience for certain applications (e.g. those which are delay sensitive).

Pascale Vicat-Blanc proposed that the domain needed a common definition language for IT and network resources.

### **Questions and answers**

Q: What are the requirements for high-performance computing?

A: Alban Schmutz replied that the issue of IT and network assurance is very important to that business due to the large volume of data for visualising the results of HPC (mainly based on large-scale simulations).

Q: How should telcos position themselves, given the need for inter-domain SLAs?

A: Peter Glock responded that businesses can see the benefits of world-wide network coverage and that having control over the network is a business advantage.

Q: There has been a lot of research on inter-domain quality of service (QoS)? How have things changed recently?

A: Earlier research tended to focus on pure technical solutions to the problems, Hakon Lonsethagen observed, and only a few studies looked at the associated business models, although both of these areas are important and tightly coupled. Moreover, the requirements and demands of smaller operators and service providers are intensifying as they push for a larger reach and higher revenues from the ever-increasing traffic.

Q: What is the difference between the SAIL project and other cloud-related projects like RESERVOIR?

A: Victor Souza explained that SAIL takes the network into account from the beginning (a member of the audience also mentioned that the RESERVOIR type of system does not open up the operator network for access from virtual machines and the cloud platform).

The separation between the operator network and 'cloud' per se was further discussed after Pascale Vicat-Blanc's presentation. A participant mentioned that mission-critical networks are built to be independent, so the need for reliability in virtual networks is lower at the moment, but this may change in the future. It is mainly an issue about trusting the network and it being operated correctly.

### Links and info

Session description and presentations available: <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-iii1-the-network-lost-in-the-cloud.html>

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## FIA Session III.2 – Future Social Computing

*Rapporteurs/Organisers: Nick Taylor (Heriot-Watt University), Kevin Doolin (TSSG, Waterford Institute of Technology), Fausto Giunchiglia (University of Trento)*

*Other contributors: Gabriel Yoran (aka-aki networks), Dorit Geifman (University of Haifa)*

### Session summary

Nick Taylor of the SOCIETIES project opened the session, explaining the motives for the project and its primary focus. He indicated that *social computing has some unique characteristics* which make it worthy of special treatment in the future internet, for instance:

- internet users need no encouragement to socialise and use social media;
- social media can provide an entry point for lay users to become actors;

- social computing is becoming more context aware and personalisable;
- social media facilitate mass participation and collaboration.

These characteristics were then addressed by the session's remaining speakers.

Gabriel Yoran of aka-aki networks gave an insider's perspective on the future of social networking. He believed that "relevance" was the key element which attracts users to social networking. He suggested that relevance was made on emotion, context, symbolic self-completion and trust. Yoran also emphasised that "federation" would be important to users in the future internet so they could access their social data and contacts irrespective of the network provider.

Dorit Geifman of the SocloS project looked at the challenge of providing future internet users with "economic incentives to supply content and information to others". She explained how the SocloS project was trying to tackle this problem. Social networks, she said, are thought to be the ideal future market place for consumer-to-consumer interactions; Geifman outlined the FlexiPrice system for negotiating bids and sales.

Kevin Doolin of the SOCIETIES project introduced the concept of a "pervasive community" in which "pervasive meets social", enabling future internet users to take advantage of pervasive services, sensors and actuators and share them with others. SOCIETIES is helping to develop some prototype communities.

Fausto Giunchiglia of The Social Computer presented the "social computation" paradigm. He cited the DARPA challenge: find eight balloons released at undisclosed locations across the USA. This task was completed in just seven hours using social computing. The moral of this fascinating study is that, despite advances in AI, we still need humans in the loop to solve many problems in a timely fashion.

The session concluded with a panel discussion chaired by Taylor. This raised questions about the possibility of, and need for, regulating the federation of social networks, possibly via directives on the use of personal data; setting limits on the scope of information which could be traded by users; and the kind of architecture that would be required for a hybrid human/machine computer.

### **Links and info**

*Session programme and presentations available:* <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-iii2-future-social-computing.html>

## **FIA Session III.3 – Dynamically Adaptive FI-Applications: Beyond Adaptive Services**

*Rapporteurs/Organisers: Andreas Metzger (Paluno, University of Duisburg-Essen), Clarissa Marquezan (Paluno, University of Duisburg-Essen), Katarzyna Wac (University of Geneva), David Hausheer (TU Darmstadt)*

*Other contributors: Nuria De-Lama Sanchez (Atos Origin), Yagil Engel (IBM Haifa Research Labs), Michael Boniface (IT Innovation), Heikki Huommo (Centre for Internet Excellence)*

### **Session summary**

The session opened with an introduction to some major characteristics of adaptive future internet applications: cross-layer, cross-area, human-in-the-loop, context-aware, proactive, distributed, autonomic and reactive adaptation. Three areas of application for adaptive solutions were then presented in the domains of e-health, transport and logistics, and media.

E-health involves the continuous provision of care, not just acute ‘cures’ provided at the hospital. The iHealth project, for example, is looking at how to make more use of the patient’s own resources, such as their online social networks. E-health scenarios are strongly user-centric, but this creates another set of issues which must be tackled including standardisation, semantic operability, interoperability, machine-to-machine, mobility, and infrastructure. The need for dynamic adaptation arises because there are many different interfaces (different equipment, different settings, etc.), many sources of information and multiple data sources of a variable quality. These must all be brought together to provide coherent and reliable decision-support systems and enable healthcare professionals to work out the best composition of services for each patient.

In the area of transport and logistics the diversity of ICT solutions is a major challenge for the future internet. In this field, cross-layer and cross-area adaptive characteristics are thought to be particularly important. Future internet applications and platforms will need to share information and decisions to deal with adaptive actions.

In the media, users want a high quality of experience (QoE). There will be the need for “community” QoE and not just individual QoE. It is necessary to use a “human-in-the-loop” approach to rationalise the actions executed by agents.

### **Questions and answers**

During the panel discussions, the iHealth project (a community-driven approach to personal health histories) was further explained, and some of the technical enablers for e-health applications were also identified (these could perhaps be furnished by the FI-PPP core platform). Further, the potential benefits and challenges of proactive adaptation were discussed. The session participants also contributed to a survey study; the results will be published and made available in due course.

## Links and info

FIA programme: <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-iii3-dynamically-adaptive-fi-applications.html>

Project acknowledgments, presentations, survey study, and more information at the S-Cube web-page: <http://www.s-cube-network.eu/fia>

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## FIA Session III.4 – Security and Usability

*Rapporteurs/Organisers:* Nick Papanikolaou (HP Labs), Fabio Massacci (University of Trento)

*Other contributors:* Jim Clarke (Waterford Institute of Technology)

### Session summary

This successful session highlighted several important issues and concerns that need to be addressed in order to balance the often conflicting needs for a usable and secure future internet.

Corrado Leita used many examples to discuss (and highlight the pitfalls of) two potential approaches that help users to be safe online. First, there was the idea of educating users to practice safe surfing and to use security tools (e.g. antivirus and firewall software), but Leita warned that social engineering attacks and dialogue boxes imitating genuine antivirus warnings work all too well in fooling even an ‘educated’ user. The second approach, of building disruptive security software, which presents a series of warnings to users, can also be unhelpful because warnings are all-too-easily ignored. Leita emphasised the challenge to find the right balance.

Angela Sasse discussed numerous attempts to design helpful authentication mechanisms for users, giving several examples of real systems and highlighting the problems that emerge in practice as user behaviour is often unexpected (e.g. users selecting pictures of faces arbitrarily or in a very biased way from a set of pictures intended for secure entry into a system). The speaker emphasised that user involvement was imperative for designing successful security systems. Security researchers are told to “get real” with regard to usability and that mechanisms requiring too much time or effort to use have either low compliance, or a high cost of enforcement.

Kai Rannenberg introduced the PICOS project, which developed user interfaces for mobile devices, enabling users to configure privacy settings. Frank Stajano presented a number of common tricks fraudsters use to deceive users, and how these apply in the online world. He identified seven key principles that are used (documented in a recent paper). Florian Mansmann discussed visual analytics, and showed how graphical representations can help people to understand security threats and the spread of attacks in diverse environments.

## Questions and answers

Q: The lack of transparency is a big issue – users cannot understand what is a good choice and bad choice. If they click on ‘no’ things don’t work. They can’t distinguish between browsing without protection on or off. Is there some way you can make this transparent to the users?

A: Rannenberg suggested visualisation techniques, using established culture and tradition to help users. For abstract concepts, there are metaphors that can be used. Metaphors are powerful but some people say they should be avoided to prevent misunderstandings. This was not found to be the case in the PICOS trials, however. A comment from a delegate suggested that the use (or not) of metaphors and abstractions was very context specific. Metaphors do not translate easily in computer science, someone commented.

A delegate from Symantec said it was unfair to say transparency for consumers has not improved. Some effort has been made to highlight security to users. For example, two years ago there was a small lock icon saying it was locked. Now they have green bars to say you are safe. The speakers conceded that if you try to stop a user from doing something, they will just try something else as a work-around (e.g. if they are trying to download a bit torrent file, the user will just try to circumvent any blocks).

Another comment pointed out that there is a lot of knowledge about design but people are ignoring usability design. The interface has a direct link and influence on a user’s action – if you have two buttons that look the same, the user won’t be able to tell the difference. From an engineering viewpoint, if you build a model which only makes sense to the people who made it, obviously users will not be able to use it correctly.

To draw this discussion to a close, it was commented that technology design is largely at fault – a lot of security services are not adopted because users do not understand them. A study has been carried out to look at the awareness of users about privacy; awareness is improving but it is still a long way from where it should be. Angela Sasse said you need to go right back to the beginning and look at the functional requirements for security products. Some time ago experts from IBM claimed that typically only about 20% of a device’s functionality is actually used. Has any study been done on usability, how it has been developed and what users are accepting, expecting or developing themselves?

Q: Watching children now – using fictitious accounts for Skype etc. – we see distrust of the internet is already building. Are we designing a future internet for our generation or next generations?

A: Rannenberg agreed with the experience described from the anglers’ perspective (‘anglers’ are a notional community of advisors/guides/protectors who safeguard your privacy and security online). There were younger anglers and older anglers and the young ones seemed to be more aware of privacy issues than most engineers. It was noted that ‘partial identity’ was part of the solution which would let us present a different face to each other.

Q: Is this one of these things that we cannot solve? Are there solutions out there? Is it going to improve over the next 10 years?

A: The panel thought security would probably get worse before it got better. The community has not developed what the user wants. Until the message from users is received and understood, it is going to get worse. It is nice to see people discussing it, the panel said, but it will be a while before it gets better. There is not a universal urge to spread the privacy message and until the issues percolate through, it will get worse.

Rannenbergh commented that there are a lot of activities which can be understood (e.g. credit card fraud). If someone asks for one technical solution, the overall situation won't necessarily get better, he remarked. We are on a journey and we will collect a number of possible tools then evaluate them. Prudent decisions can be made and we can avoid the big mistakes made in the past. Today, we tend to hear about much smaller disasters.

New generations are learning about the situation and security flaws, a panelist pointed out. And there is another problem that cannot really be solved: if you treat people like children, they will act like children. And if you don't involve them, they won't take any responsibility. But you also get people who do not want to know the details of how to manage their privacy.

A good approach is to start with the assumption that we will fail, a panelist suggested. Then you try to find ways to deal with these failures. You also need to make sure security is written into the development processes (Google Chrome is an example of software with security designed in from the outset) By trying to tolerate failure and adding mechanisms to deal with failure, we can have a robust security approach.

The panelists observed that engineers are good at pushing our systems to the limit, but we are not good at pushing users to the limit. There are many issues in the domain of psychology and usability that have not been fully addressed.

### **Links and info**

*Session programme and presentations available:* <http://www.future-internet.eu/home/future-internet-assembly/budapest-may-2011/session-iii4-security-and-usability-panel-discussion.html>