

# **FUTURE INTERNET ASSEMBLY**

**Madrid, Spain, 9<sup>th</sup> – 10<sup>th</sup> December 2008**

**MEETING REPORT**

**December 2008**

**DG Information Society and Media - Directorate for Converged Networks and Services**

*"The Internet People"*



**European Commission**  
Information Society and Media



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## EXECUTIVE SUMMARY

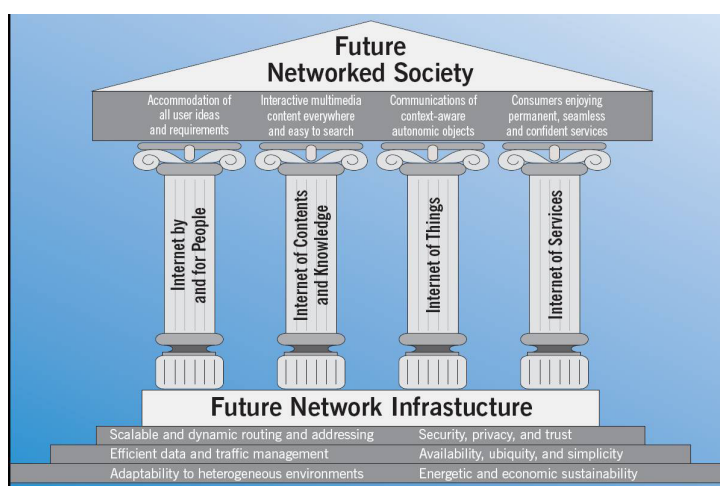
The Future Internet Assembly, held 9<sup>th</sup>-10<sup>th</sup> December in Madrid, Spain, brought together around 300 people to discuss Europe's efforts towards a future networked society<sup>1</sup>. Participants included representatives from academia, industry (including SMEs) and other interested organisations, many of them involved in current EU research projects in this area. Invited speakers from the United States and elsewhere also attended.

The meeting was a continuation of a process begun in Bled, Slovenia in March 2008 ([www.fi-bled.eu](http://www.fi-bled.eu)), which launched the Future Internet Assembly (FIA) as a forum for European industry and the research community to discuss and share ideas on Future Internet developments. Split into two plenaries and seven break-out sessions, the meeting reviewed the state-of-play and attempted to convert the momentum gained in the FIA process to date into a plan of action.

### Putting the Future Internet Centre Stage

The Future Internet will be at the heart of the future networked society. It will be *the* global communications network: ubiquitous, accessible, scalable, sustainable, adaptable and highly personalised. Rather than a simple evolution from the current internet, this Future Internet will arise from the convergence of new network concepts embracing technologies, services, media and content. It will offer flexibility and diversity, with scalable content and services accessible through a wide range of interfaces and devices.

The Future Internet, it is now widely accepted, will have five pillars. As well as an Internet of Networks, there will be an Internet of Services; an Internet of Things integrating common objects into our lives; an Internet of Contents & Knowledge; and an Internet of People. Usability, reliability, mobility, scalability, interoperability, user acceptability, and trust and confidence are just some of the challenges facing Future Internet development. Non-technical aspects, such internet governance, intellectual property, and education also need to be addressed.



<sup>1</sup> All of the reports and presentations from the meeting are available online: <http://www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008.html>

## Progress Since Bled

Europe has made steady progress in its FI efforts since the Bled meeting. A series of seven Working Groups has begun operation, supported by interested EU projects. These have elaborated discussion between researchers and others – through means such as wikis and workshops - on the relevant research agendas and other key issues. The results have been a series of position papers which provided the main basis for the Working Group Sessions at the FIA Madrid. In addition, each breakout session also included keynotes/invited talks, as well as extensive time for discussion and debate. The results of these Working Group sessions are summarised in the main body of this report, together with all of the presentations and are also available online ([www.fi-madrid.eu](http://www.fi-madrid.eu)).

In parallel, significant progress has been made in discussions within and between the European Technology Platforms (ETPs) in developing a dialogue on the Future Internet. These discussions have focused on the potential structure of research within the FI domain and have resulted in a Vision Document and Strategic Research Agenda, which are currently being finalised. The inter-ETP process has involved a combination of top-down and bottom-up approaches and will help to extend collaboration across the ETPs more generally. Much work has also gone into mapping how and where the ETPs and current projects could contribute. Elements missing at the moment are an industry association and market aspects expressed through standardisation.

At a political level, EU governments have recognised the importance of the Future Internet and at a recent Council meeting issued conclusions calling on the Commission to look at how to create a public-private partnership in this area under the next ICT Work Programme (2011-12). The Swedish Presidency hopes to bring forward a Council Regulation on a public-private partnership in the second half of 2009. Thus, a good European roadmap for the Future Internet could be in place by December 2009, in preparation for the WP 2011-12. In addition, the national ICT Directors meeting in Lyon, in November 2008, called for the Member States to create a forum on the Future Internet through which they could work together to align their strategies.

## National Initiatives for the Future Internet

The meeting heard about a number of national initiatives already underway:

- Germany has a number of contributory projects, focusing on areas such as: carrier-grade 100 gigabit Ethernet (100GET); experimental facilities for the Next Generation Internet (G-Lab); innovative radio transmission techniques for cellular networks (EASY-C); and the Internet of Services (THESEUS). Further activities will be launched under the €1.5bn *ICT 2020* programme.
- An enquiry by France's Groupe Recherche pour l'Internet Futur (GRIF) has resulted, among other initiatives, in the creation of three new 'laboratories of excellence' in Paris, Brittany and Sophia as a co-operation between INRIA, Institut Telecom and universities.
- Finland expects to spend around €9m per annum on Future Internet research, priority areas being: scalable routing; end-to-end connectivity; information networking; and testbeds. Testbed infrastructure, based on the Finnish national research and education network (FUNET), is a key element.
- Spain's national initiative, the ES.INTERNET programme, brings together government, industry and academia so as to avoid fragmentation of efforts, promote collaboration, and provide continuity in funding for long-term R&D investment and reduce the associated risks. As well as research, it aims to raise awareness of the importance of internet development; improve the regulatory framework; facilitate standardisation work; and promote internationalisation of Spanish industry through participation in international programmes.

## Destination Prague

In his closing remarks, Director João da Silva, of the European Commission, chartered the course ahead. *"The wealth of information, discussion and positions must be converted into strategies, actions and roadmaps"* he said. *"Prior to the Prague conference the European stakeholders must therefore be able to articulate where the Future Internet journey will take us."*

To facilitate this process, two consolidation actions will be undertaken:

1. During early 2009 the caretakers of the seven Working Groups will analyse the situation within their domains and across domains, in view of preparing reports ('White Papers') on possible scenarios of what the Future Internet will look like, together with recommended actions.
2. In parallel, a panel of senior European industry experts - so far not directly involved in the FIA - will also analyse the activities and reports in order to identify future scenarios and related actions.

The outcome of these two exercises will serve as key inputs for the follow-on Future Internet Assembly, to be held in Prague, 11<sup>th</sup>-13<sup>th</sup> May 2009. The Assembly will be opened by the European Commissioner for Information Society & Media, Viviane Reding, and Minister Ondřej Liška, Minister of Education of the Czech Republic, holder of the EU Presidency. A full agenda will be available at: [www.fi-prague.eu](http://www.fi-prague.eu).

## **OPENING PLENARY : Welcome Addresses**

### **Guillermo Cisneros, Director of the Telecommunications School (ETSIT), Universidad Politecnica de Madrid (UPM)**

Prof. Cisneros welcomed everyone to Madrid and to the second meeting of the Future Internet Assembly (FIA). ETSIT is Spain's largest academic centre for ICT with 2000 students and 600 researchers working on research & development projects. The centre enjoys a close relationship with industry and business is therefore an integral part of education at ETSIT.

The Future Internet will be the future telecommunications network: global, ubiquitous, accessible, scalable, sustainable, adaptable and highly personalised. It is not a simple evolution from the current internet but a convergence of new network concepts embracing services, media, content, etc. It offers flexibility and diversity, with scalable content and services accessible through a wide range of interfaces and devices. Everything must be built around the user at its centre – their behaviour, their reactions and their wishes.

Hence, the Future Internet will be all encompassing. It will support us in every area of our lives without any specific actions being necessary to access it, its contents or to connect to other people. We will be intrinsically part of the network; and, with the convergence of nano- and bio-technologies, we may eventually be part of its terminals too.

This Future Internet, it is now widely accepted, will have five pillars. As well as an Internet of Networks, there will be an Internet of Services; an Internet of Things integrating common objects into our lives; an Internet of Knowledge; and an Internet of People. The evolution and dimensions was not foreseen even ten years ago. Usability, reliability, mobility, scalability, interoperability, and user acceptability (which is closely related to trust and confidence) are just some of the challenges facing Future Internet development. Non-technical aspects, such internet governance, intellectual property, and education also need to be addressed.

The Madrid meeting provided an opportunity to address all of these issues and to develop them further. Standing between the meetings in Bled and Prague, it offered, potentially, a point of inflection, helping to shape relevant research programmes throughout Europe and those of the European Commission. Prof. Cisneros wished all participants well in their discussions.

### **Joao da Silva, Director, Directorate Converged Networks and Services, European Commission**

Dr. da Silva thanked UPM for hosting the event and the Spanish government for supporting it. He welcomed guests from across Europe, the United States and elsewhere.

The Future Internet is an important issue. Governments have recognised this and the recent Council meeting issued conclusions calling on the Commission to look at how to create a public-private partnership in this area under the next ICT Work Programme (2011-12). The Swedish Presidency hopes to bring forward a Council Regulation on a public-private partnership in the second half of 2009. If successful, by next December we should have a good roadmap for the Future Internet in preparation for the WP 2011-12.

In addition, the national ICT Directors meeting in Lyon called for the Member States to create a forum on the Future Internet through which they could work together to align their strategies. The

European Technology Platforms (ETPs) had also been looking at this issue and the meeting would hear further about this from David Kennedy of Eurescom.

The Commission's recent €100 billion package to tackle the economic crisis includes €1 billion for high-speed internet initiatives. Although not directly related to the FI, this should be seen as complementary and could be used to aid future development.

### **Francisco Ros, Vice-Minister for Telecommunications and Information Society, Spain**

Minister Ros welcomed participants to the meeting on behalf of the Secretary of State.

The information society is a virtual space linking citizens, businesses and governments. It is essential to the competitiveness of enterprises and improves citizens' quality of life. In 2006 Spain launched its National Plan for the Information Society, a strategic effort to develop leadership, co-operation and public-private partnerships. In the last three years, the Spanish government has invested €6bn towards achieving these goals. Broadband now covers 99% of the population, versus 8m before, and 51% of homes (=8m) have broadband connectivity.

But we also have to think about the future. The Internet Protocol, on which the internet is built, is 30 years old. At the same time, we are seeing whole new categories of smart devices and demand for new types of services. This is a revolutionary situation. The United States has led in the new application creation up to now. Europe must keep up in order to maintain its competitiveness and skills.

In Slovenia Europe's Future Internet community agreed to set up six working groups and Spain is strongly represented in each of these. Many of the priorities being identified by these groups also align with those under Spain's updated National Information Society Plan. Efforts here are focused on the *ES.INTERNET* initiative which will coordinate Spanish inputs to the ETPs and to national initiatives. It is already assessing capabilities. In total, in 2009 Spain will spend around €630m for research in digital content and services.

Europe clearly wants to lead in creating the Future Internet and this Madrid meeting would contribute to that process.

### **Javier Uceda, Rector - President of Universidad Politecnica de Madrid (UPM)**

Prof. Uceda reiterated the welcome on behalf of the Spanish hosts. UPM is involved in more than 50 European Framework Projects and 20 more are under negotiation. As well as the research content, these projects are important in UPM's aim to be a strategic partner for European industry. So the informal exchange of information through gatherings such as this is just as important.

Further information on UPM's own activities in relation to the Future Internet was available in a booklet prepared by UPM's EU Project Office, which was included in the conference packs.

## NATIONAL FUTURE INTERNET INITIATIVES

### Future Internet – Strategies and Research Activities in Germany

*Volkmar Dietz, BMBF, "G-Lab"*

Like other European countries, Germany has an objective to increase spending on research and development to 3% of GDP. The budget of the Federal Ministry of Education and Research (BMBF) has increased from €6 billion in 2006 to an estimated €10.2 bn in 2009. As part of these efforts, the High-Tech Strategy has a focus on 17 priority areas and emphasizes innovation alliances in 'lead markets', framework conditions for innovation, and the fast transfer of results to products. In particular, it characterises ICT as the "primary motor for innovation" and in March 2007 a new programme, *ICT 2020*, was announced with funding of €1.5 bn over five years.

Among the projects contributing in this area is 100GET, standing for 100 Gigabit Ethernet Transport Technologies. This Eureka project runs from 2007-2010, has a budget of €66m and involves partners from Finland, France, Germany, Spain and Sweden. It aims to develop carrier-grade 100 gigabit Ethernet for use within core transport networks.

Another project is "Germany-Lab" (G-Lab), funded by BMBF, which focuses on experimental facilities for the Next Generation Internet. G-Lab is architecture oriented and consists of two main activities: research projects and studies of future Internet components; and design and setup of Germany-wide experimental facilities.

Other strategic projects are: EASY-C, which operates testbeds to develop and test innovative radio transmission techniques for cellular networks beyond long-term evolution [LTE] (it has set-up two large-scale testbeds at sites in Dresden and Berlin); and THESEUS, which is looking at new technologies for the Internet of Services.

Looking to the future, there is increasing attention to topics of public (societal) interest. Germany supports the European Ambient Assisted Living (AAL) initiative to develop new technology for elderly people and BMBF issued its own call which closed in September 2008 (budget €35m). New application-oriented projects resulting from this will start in the second quarter of 2009. The Future Internet is relevant here by providing basic technology for AAL through the Internet of Services (applications such as emergency call systems, telemedicine, etc.). Other key topics are ICT security and, with a longer time horizon, quantum communication technology.

### Future Internet Initiative in France

*Francis Jutand, Scientific Director, Institute Telecom*

France is gradually mobilising towards the future of the internet. Two months ago the government launched a new digital initiative to promote take-up and digital inclusion. Amongst other things, this aims to stimulate the production of content, the diversification of services and to foster the digital ecosystem. France also has a strong set of ICT-related clusters which draw together large companies, SMEs and academic research.

At a policy level, the main activity has been the Groupe Recherche pour l'Internet Futur (GRIF), an expert group set up by the Ministry of Industry, which Dr Jutand co-chaired. This recommended to create excellence through research labs for the Future Internet and to back the efforts of SMEs. The result has been three new 'laboratories of excellence' in Paris, Brittany and Sophia as a co-operation between INRIA, Institut Telecom and universities.

Turning to the general situation, Dr. Jutand saw demanding trends both in terms of internet traffic and usage. There are three potential scenarios here for capturing value: a horizontal model, where users buy services from individual providers; a vertical model, where users pay for bundled services; and a hybrid or 'captive model', where users pay one actor who is able to dominate the value chain. This last scenario is arguably the situation today with the iPhone. Business and technology trends were also summarised.

Overall, European industry still holds strong positions but its strategic agenda seems to lag behind that of the US. The rate of innovation is still too low. Convergence will open the door to major disruptions in business and we need to combine all our resources and initiatives, coming from large companies, SMEs and academics. "We need a global long-term roadmap taking into account the potential of research, laws of economy, strategies of other global actors, and the vision of the digital society we want to build", was Dr. Jutand's recommendation.

Suggestions to establish European leadership in this area were:

- **Foster cooperations** between large companies, SMEs and research labs: consortium, bilateral, and open innovation;
- **Invest in laboratories of excellence:** create a scientific leadership in Europe as the ground for disruptive innovations;
- **Set up leading positions in new fields** such as smart networks & networked services, communicating objects and internet of things, digital health, and security and privacy.
- **Create experimental platforms** for usage of digital life and social networks; and
- **Fund high-level teaching programs** attractive for best European and international students.

## **Future Internet Initiative in Finland**

*Relja Paajanen, CEO of TIVIT*

TIVIT is one of the Finnish Strategic Centres for Science, Technology & Innovation ('SHOKs' in Finnish) and focuses on ICT. These are tri-partite initiatives involving government, universities and industry and aim to accelerate the creation of new businesses. Future Internet is one of four priorities for TIVIT, alongside flexible service ecosystems, cooperative ICT, and device and interoperability ecosystems.

The Future Internet has many dimensions – technological, economic, and societal/political. Current problems include managing unwanted traffic, scalable routing, mobility and multi-homing, resource management and compensation, privacy and attribution, and trust and reputation.

Finland's Future Internet Programme is a large-scale programme (50 person years/year) begun in April 2008. Expenditure in 2009 will be €9m (see [www.futureinternet.fi](http://www.futureinternet.fi)). Its mission is to enhance internet technology and ecology as a platform for innovation while providing strong governance over the use of the network resources and information. It has four main work packages focusing on: scalable routing; end-to-end connectivity; information networking; and testbeds. Testbed infrastructure, based on the Finnish national research and education network (FUNET), is a key element.

Looking at the wider scene, there are two approaches emerging towards the Future Internet: the 'clean slate' path adopted by research communities under programmes such as FIND, GENI and FP7; and 'evolutionary' approaches favoured by standards-making bodies. Most likely both will make important contributions towards the future networked society.

In summary, the Future Internet is a key element of an innovative national environment. Finland's approach is based on a long-lasting undertaking between industry and academia and aiming to contribute to the Future Internet standardization. "We expect that by becoming early developers and adopters of the Future Internet, Finnish companies and academia will gain immense benefits in new markets and scientific results", Mr Paajanen concluded.

## **Spain's Vision of the Future Internet**

*Fernando Fournón, Executive President of Telefonica I&D*

Future Internet is the next European challenge. We have seen the evolution from Web 1.0 – which was mainly text based – to Web 2.0, which adds video, graphics and user-generated context. Arguably the next step, so-called Web 3.0, will involve high-definition video, virtual 3D worlds and 3D navigation. It will offer immersive experiences and we already see early examples in the popularity of SecondLife and of gaming.

The Future Internet will be a hybrid world "in which neutrality is not very clear". Real and virtual worlds will be seamless and blurred. So, for example, we could have meetings in which people participate both in person and through highly realistic immersive VR. This will change our lives in very many ways: the way we work, how we live. We will talk about spaces rather than 'pages'.

The Future Internet is now widely seen to have four pillars: the Internet of Networks; the Internet of Services; the Internet of Things; and the Internet of Users and Knowledge. Each of these has demanding technological challenges.

To meet these challenges we will need open interfaces, characterised in terms of open applications, ubiquitous and ambient intelligence, and interoperability. 3D video will also demand much more bandwidth, which will require the deployment of fibre-to-the-street and –to-the-home – but who will pay? Search and security will also be key issues.

Spain's response has been the ES.INTERNET programme, a national initiative bringing together government, industry and academia. Its vision is that people can be connected "anytime, anywhere and with any device" which may contribute to enhance his/her quality of life in many aspects. The programme aims to: guarantee economies of scale and avoid fragmentation of efforts; promote collaboration between industry and academia; and provide continuity in funding for long-term R&D investment and reduce the associated risks. It will also raise awareness of the importance of the development of the internet; improve the regulatory framework; facilitate standardisation work; and promote internationalisation of Spanish industry through participation in international programmes.

Telefonía would like to see a specific Strategic Action within Spain's national Avanza R&D Programme to cater for small to medium-scale R&D projects, as well as a new action within the European FP7 Work Programme on the short-medium term perspective for the Future Internet.

## SESSION 1: FUTURE CONTENT NETWORKS

*Session Organisers: Jean-Dominique Meunier (Thomson), Theodore Zahariadis, (Synelixis Ltd.), Norbert Niebert (Ericsson)*

### Agenda

11:00-11:05	Session Introduction Jean-Dominique Meunier (Thomson)
11:05 – 11:25	Position paper. Setting the scene Theodore Zahariadis (Synelixis)
11:25-12:00	Invited Talk: Future Content Networks in USA Angelos Katsagellos (Northwestern University, USA)
12:00-12:20	Vision of Future Content Networks Norbert Niebert (Ericsson)
12:20-12:40	Future Content Aljoscha Smolic (Heinrich-Hertz-Institut Berlin, Fraunhofer)
12:40-13:00	Overlay Networking - P2P Streaming/Searching Johan Pouwelse (University of Delft)
14:00-15:45	Panel: Content-Aware Networks Vision Ebroul Izquierdo (Queen Mary, University of London) Content Aware Networks Vision Pierre Yves Danet (Orange/France Telecom) Home/Extended Home Content Network Fidel Liberal (University of the Basque Country) Quality of Experience / User perspective Petros Daras (CERTH/ITI) 3D content search Doug Williams (British Telecom) New forms of content Hiroshi Ando, Ph.D. (NICT)
15:45-16:00	Use cases experiments on FIRE
16:00-16:15	Follow up to Prague Jean-Dominique Meunier (Thomson); Theodore Zahariadis (Synelixis); Norbert Niebert (Ericsson)

### Objectives

It is impossible to conceive of an internet without content or without people. Therefore, to understand the Future Internet we have to gain a thorough understanding of the user.

The Future Content Networks (FCN) session focused on the Future Internet from these content and user perspectives. A key input was a Position Paper on Future Content Networks circulated before the meeting, which presented a vision of the Future Content Network, future media, and future internet architectural requirements.

### Discussion

The current Internet, though widely used for content and communication, must evolve to be more capable of dealing with emerging forms of content and of content consumption. We call this new internet the **Future Media Internet**. Changes in globalisation, demographics, lifestyles and economics, as well as new business models demanding educated consumers and media-literate 'prosumers', are

the major driving forces for this transition. In time, free view-point high definition (3D) video and immersive sound, augmented with visual sensors, haptics, olfactory and shared data devices will bring into the mainstream applications that now lie in the area of science fiction.

Five key characteristics of this Future Media Internet will be: being designed for ‘tussle’; offering accountability for resource usage; being more content- and context-aware; being increasingly symmetrical and with ever increasing throughputs; and offering secure, manageable and context-sensitive content services. To realise these characteristics both incremental and breakthrough innovations are required in a range of disciplines within both technical and business domains, and across the whole lifecycle of media production.

It is necessary to explore how we can achieve communication that is as powerful and realistic as that experienced when people meet face to face. We need to understand the impact on communication of synthetic gestures, gaze awareness, of increasing graphical realism, of spatialised sound. In addition, we should explore tangible multi-modal and multi-sensing interfaces, which may allow people to experience full-body interaction and to increase a sense of immersion through interaction with virtual objects. Naturally, the realisation of such “services” demands new network architectures that are generically content-aware rather than bit-stream aware, able to handle location and adaptation of content, new types of content, services, users and end-devices, and provide reliable quality of information, services, experiences, actuation, etc. In other words, the passage to the Future Internet heavily depends on the progress of **Future Content Networks**.

In considering the impact that future media may have on the **Future Internet architecture** requirements, the meeting foresaw four trends that are not mutually exclusive: increasing amounts of user-generated content which is better, both artistically and technically, than that available today; enhanced content representations through 3DTV, Ultra HD TV, holograms, etc.; new forms of interactive and collaborative storytelling, both professionally created and collaboratively developed by users; and framed communication experiences including serious, multi-player gaming.

## Conclusions

It is clear that the Future Internet must be designed to be robust, to offer accountability on a content level for resource usage, be more content- and context-aware, and be increasingly symmetrical and with ever-increasing throughputs. It must also offer secure, manageable and context-sensitive content services.

To realise these aims there need to be exchanges of information between the content service and the network to ensure the network knows what the content is and can handle it appropriately. This means the network must be capable of handling different content in different ways – all bits (packets) are not equal.

For the network to know how it has to deliver different packets implies a network management/control system that can make sure to deliver the content in the appropriate way. Furthermore, assuming the network does not have infinite capacity, then we must assume there is some form of resource management to support the delivery promises made. Also, if local routers have to make decisions about how to handle particular bits (for example a high-quality video stream) then we are making the case for intelligence in the router.

The combination of these points make it clear that the contents demand that we treat bits according to the need of the content. This is an fundamental architecture change and we then need to project when these developments might occur and consider how to improve the network in this timescale.

## Next Steps

The Future Content Networks Working Group is developing a White Paper.

Key future events for developing this will be the NEM General Assembly, Feb 3-4 (Brussels), the FCN session within the FIA meeting in Prague, May 11-13, and the NEM Summit, Sept 28-30 (St Malo).

### **Further Information**

FCN Session: [www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/fcn.html](http://www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/fcn.html)

FCN Position Paper: [http://synelixis.com/mailman/listinfo/futuremediainternet\\_synelixis.com](http://synelixis.com/mailman/listinfo/futuremediainternet_synelixis.com)

General Contacts: [futuremediainternet@synelixis.com](mailto:futuremediainternet@synelixis.com) and [info@nem-initiative.org](mailto:info@nem-initiative.org)

## SESSION 2: MANAGEMENT & SERVICE AWARE NETWORKING ARCHITECTURE

*Session Organisers: Alex Galis (University College London), Marcus Brunner (NEC Laboratories), Henrik Abramowicz (Ericsson Research)*

### Agenda

11.00 - 11.05	<i>I. Introduction &amp; Invited Talk</i>
	Introduction & Objectives of the MANA session Alex Galis (UCL, UK)
11.05 – 12.00	Invited Talk: “Future Internet of Networks and Services” Jeff Chase (Duke University, USA) & Suzanne Iacono (NSF, USA)
12.00-13.00	<i>II. Panel on Service-aware Networking Architectures</i> Panel Moderator: Henrik Abramowicz (Ericsson, Sweden) Krishan Sabnani (Alcatel-Lucent, USA) – for networking architectures Jens Zander (KTH, Sweden) - for wireless architectures George Pavlou (UCL, UK) – for evolutionary service-aware architectures Mark Wusthoff (SAP Research, Germany) for service clouds architectures Jeff Chase (Duke University, USA)–for clean slate architectures
14.00-15.00	<i>III. Panel on Self-management of Future Internet</i> Panel Moderator: Alex Galis (UCL, UK) Marcus Bunner (NEC Research, Germany) - for network management, Danny Raz (Google USA and Technion Univ., Israel) – for system management Olivier Festor (INRIA, France) - for network and service management Joe Butler (Intel, Ireland) - for service management
	<i>IV. Conclusions &amp; Proposals for research directions for Future Internet</i>
15.00-15.15	FIRE Use Cases
15.15-16.00	MANA position statement presentation and discussion

### Objectives

The Session comprised of invited talks on the “*Future Internet of Networks and Services*” by Jeff Chase (Duke University, USA) and Suzanne Iacono (NSF, USA); two panel discussions on Service-aware Networking Architectures and on Self-management of Future Internet; and discussion of the MANA position statement.

The Session was framed in terms of a series of questions which provided the backdrop for each of the panels and discussions. These were: What are the main bottlenecks in the current Internet? What are the first five challenges/problems to be fixed? What can we learn from the last 40 years of Internet evolution? How should we interwork Future Internet with the current internet, and how to deploy novel features?

At a more specific level it is necessary to consider: What levels of service-awareness will be required? How can we accommodate management as the driver in the design, deployment and growth of the Future Internet? What are the likely changes in management responsibilities, management technologies, accountability and responsibility, and relationships between management and governance, and management and costs? Finally, what does all this suggest for proposals for future research directions?

## Discussion and Conclusions

'Mana' has been used in many different contexts over the years. Historically, it is the name of a food which, according to the Bible, was eaten by the Israelites during their travels in the desert. In anthropology Mana has commonly been interpreted as "the stuff of which magic is formed" and as well as the substance on which souls are made. For scientists in the 21<sup>st</sup> Century, MANA is the core and the infrastructure on which the Future Internet will be built.

Whilst the need for accountability was known in the very early days of the internet, it was safely omitted from the initial deployment stages because each player knew the others, and all understood the limitation of the technical platform they were creating. Today the network is built from thousands of smaller networks, and they are supporting a much wider range of uses. This has led to tension and tussle between all the different players.

We aim at an "Accountable" Internet - where users are held accountable for any misbehaviour or congestion they cause - hence they are held accountable for their impact on others. As such we need an open delivery infrastructure that can accommodate innovation both at the network and service layer, including the aim to integrate both the technical and socio-economic aspects into a single solution.

## Next Steps

Some of the required functions are management-facing, some are resource-facing and others are consumer-facing. These aspects will be expanded further in a MANA System Functions and Requirements (SFR) Paper. This will identify the research orientation together with the priority challenges for MANA as part of the Future Internet. In addition, a workshop will be held in Q1 2009 to progress the SFR paper and the results of both exercises will be reported at the next FIA in Prague in May 2009.

## Further Information

MANA Session: [www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/mana.html](http://www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/mana.html)

MANA Position Paper: [www.future-internet.eu/fileadmin/documents/madrid\\_documents/sessions/MANA-Position\\_Paper-V5.0.pdf](http://www.future-internet.eu/fileadmin/documents/madrid_documents/sessions/MANA-Position_Paper-V5.0.pdf)

General Contact: [fia-mana@ee.ucl.ac.uk](mailto:fia-mana@ee.ucl.ac.uk)

## SESSION 3: TRUST AND IDENTITY IN FUTURE INTERNET

*Session Organisers: Jim Clarke, Zeta Dooly, Kevin Quinn (Waterford Institute of Technology), Volkmar Lotz (SAP), Nick Wainwright (HP), Michel Riguidel (ENST)*

### Agenda

11:00- 11:10	Introduction Overview of objectives & structure of session Jim Clarke (Waterford Institute of Technology)
11:10 -11:20	Opening of Trust session Chair - Michel Riguidel (ENST) Welcome, Jacques Bus, Head of Unit F.5. – ICT for Security, DG INFSO Presentation of position paper (Trust section)- Volkmar Lotz (SAP)
11:30 – 11:40	Keynote: Trust in the Future Internet Sachar Paulus (Paulus Consult)
11:40 – 12:30	Presentation by Chair of Trust issues from project contributions Chair - Michel Riguidel (ENST) <u>Panel Session</u> Trust – Sachar Paulus (RISEPTIS project) Future Internet Services – Syed Naqvi (RESERVOIR project) Future Content Networks - Theodore Zahariadis (SEA, AWISSENET projects) Real world internet - Mirko Presser (SENSEI project)
12:30 – 13:00	Open house discussion & Q & A Session
14:00 – 14:05	Opening of Identity & Privacy session Chair - Nick Wainwright (HP) Presentation of position paper (Identity & Privacy section) Volkmar Lotz, SAP
14:05 – 14:35	Keynote: An Example of a Strategic Privacy Technology and Implications for Policy Caspar Bowden (Microsoft)  Keynote: Privacy Challenges in the Future Internet Phil Janson (IBM)
14:35 – 15:00	Presentation by Chair of Identity issues from projects' contributions Chair - Nick Wainwright (HP) <u>Panel session</u> Future Internet Services - Kajetan Dolinar (PERSIST project) Real world internet – Neeli Prasad (ASPIRE project) Network - Joao Girao (DAIDALOS project) Identity - Caspar Bowden (Microsoft) Privacy – Phil Janson (IBM)
15:00 – 15:30	Open house discussion & Q&A Session
15:30 – 15:45	Contribution to Experimental Facilities – Martin Potts (Martel);
15: 45- 16:00	Follow-up activities in prep for Prague FIA & End of session Jim Clarke & session caretakers

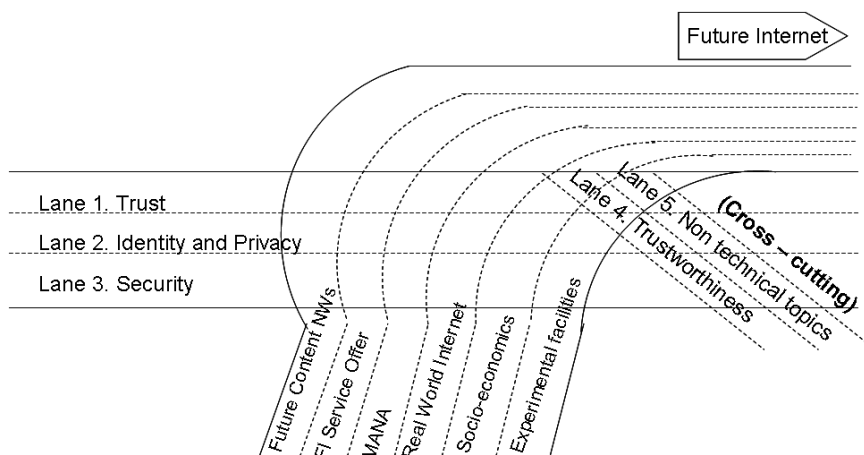
### Objectives

The objectives of this Session were to:

- Explore how the common themes in Trust (morning session) and Identity and Privacy (afternoon session) will impact representative projects from each of the different domains;
- Expose the ‘gaps’ in the programme as a whole, for example, in what the programme is covering, between expectations and reality, between theory and practice;
- Identify how experimental facilities could be used to test and illuminate how it all fits together in practice;
- Input to the research roadmap for trust and identity in the Future Internet.

In preparation for the meeting, a draft position paper and roadmap had been circulated which included contributions from relevant projects. These described some R&D priorities identified within the Trustworthy ICT communities and attempted to establish cross-domain support in order to ensure that a comprehensive view of Trust and Identity requirements are considered within the FIA environment. The session provided an opportunity to further refine this roadmap through participation of stakeholders from other domains.

The roadmap considers a number of related and cross-cutting concepts represented as five distinct ‘lanes’ (see Figure) and their interconnections with the other domains. Within the position paper, each lane attempts to address three levels, respectively: current state of the art (the “today” perspective), emerging trends (the mid-term perspective), and the future vision.



**Figure 1. Trustworthy ICT Roadmap for Future Internet**

Each session comprised two keynote addresses in the relevant topics, a panel session from across the domains, plus time for intensive discussions. The session also had a representative from FIRE Experimental facilities to present their offerings and generated useful discussions on how this offer could be taken up by the Trustworthy ICT and/or cross-domain communities.

### Discussion and Conclusions

Firstly in terms of trust, the challenge in the Future Internet will be to establish trusted relationships in real time. Historical data could be used as a basis here but would have implications for privacy. The field is compartmentalized with different means and technologies in place and multiple levels of responsibility. Trust is multi-lateral involving many different parties, layers and structures. The usability of trust mechanisms also has to be considered: trust cannot be outsourced but trust management can. It will also be important to regulate in the proper way and, arguably, we should start by adapting ideas from consumer protection law. Finally, we have to think about how trust is assessed and evaluated. Clear and visible measures will be important, but it will be impossible to provide complete transparency.

In the area of privacy, it is clear that the Future Internet amplifies current challenges significantly. The digital world does not forget and as more and more of our lives go online, people are going to leave lifelong traces on the internet. A key challenge is in reconciling privacy with accountability, and anonymity with traceability. Technologies that allow for privacy-preserving identity management are becoming available, such as minimal disclosure tokens, but need to be explored further. Another important factor is user awareness. For many people privacy is not yet a priority - privacy loss in and of itself is not yet a risk but rather a pre-condition to a risk (such as having one's bank account emptied).

A major effort is required in deployment and regulation. Technologies need to be harmonised through standardisation and interoperability. The legal landscape has become very cluttered and regulation lags way behind technology. Public procurement should take the lead.

### **Next Steps**

In addition to progressing the work in these first two lanes - Trust and Identity & Privacy - for FIA Prague there will be a renewed focus on refining the other lanes in the Trustworthy ICT roadmap, namely: Lane 3 – Security; Lane 4 - Trustworthiness; and Lane 5 - Non-technical aspects.

Work will also be undertaken to consolidate scenarios towards reference scenarios that could be used towards the implementation of the reference scenarios within other cross-domain areas, for example within service platforms, and/or through experimental facilities.

In view of the progress made, further collaboration will be sought with other domains to progress the roadmap and/or discuss project ideas, perhaps in smaller groups or online, etc. The caretakers will explore mechanisms for these kinds of activities in the run-up to FIA Prague in May 2009.

### **Further Information**

Trust & Identity Session: [www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/ti.html](http://www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/ti.html) and [www.think-trust.eu/events/events.html](http://www.think-trust.eu/events/events.html)

General contact: [fiacaretakers@think-trust.eu](mailto:fiacaretakers@think-trust.eu)

## SESSION 4: FUTURE INTERNET SERVICE OFFER

*Session Organisers: Stefano de Panfilis (Engineering) and John Domingue (Open University)*

### Agenda

9 December 2008	
16.30	Introduction Stefano de Panfilis (Engineering) and John Domingue (Open University)
16.45	Future Internet Service Offer Use Cases for FIRE: Alberto Sillitti (Free University of Bolzano)
17.00	Panel 1: Internet of Services and Internet of Things: Adapting to User, Task and Location in a Seamless Fashion. Patrick Hayden (TSSG Waterford), Alberto Leon (Telefonica), Joris Claessens (EMIC).
17.30	Panel 2: User-Generated Services and User-Generated Content: Similarities and Differences Juanjo Hierro (Telefonica), Andrew Oliphant (BBC), Pete Bramhall (HP)
18.00	Panel 3: Beyond Amazon - Using and Offering Services in a Cloud. Alex Galis (Uni. College London), Ignacio Llorente (Un. Complutense Madrid), Thierry Priol (Inria)
18.30	End of first part.
10 December 2008	
9.00	Introduction and recap of first day
9.15	Panel 4: Global Service Delivery Platform for the Future Internet: What is it and how to use it for innovation? Sergio Gusmeroli (TXT), Frederic Gittler (HP), Santi Ristol (Atos Origin)
10.00	A Vision for the Future Internet Service Offer: Stefano de Panfilis and John Domingue
10.30	Roadmap until Prague Stefano de Panfilis and John Domingue
11.00	End

### Objectives

The Session aimed to discuss and extend the Future Internet Service Offer (FISO) Position Paper which had been prepared and circulated before the meeting. What are the requirements and functionalities necessary for the Future Internet Service Offer? Do we need a new (comprehensive) architecture?

A series of panels were held, each of which focused on a set of desired functionalities/requirements of the FISO. Analysing these might give an answer to the question whether the current internet is still sufficient for FISO, or whether fundamental changes are needed.

### Discussion and Conclusions

#### *Future Internet Service Offer Use Cases for FIRE*

Alberto Sillitti introduced two use cases of Nexof-RA ([www.nexof-ra.eu](http://www.nexof-ra.eu)), one in the domain of assisted living and the second in traffic management during emergencies. He also mentioned that Nexof-RA has developed a methodology for collecting scenarios with specific templates. In discussion with the FIRE community it was noticed that the distance between these use cases and what they expect is still very big. They are interested in knowing the architecture and components that will run this use case and what kind of network support is needed for this.

***Panel 1: Adapting to User, Task and Location in a Seamless Fashion***

Patrick Hayden introduced the notion of Personal Smart Spaces of the project Persist ([www.ict-persist.eu](http://www.ict-persist.eu)), that will bridge the void between smart homes and smart offices. It is a combination of ad-hoc networking with devices and sensors available and services. In order to make this concept work, personalisation, learning and reasoning seem to be important functionalities.

Alberto Leon asked whether we are ready to scale-up to many more devices and more people connected to the internet. We also need new revenue models where there is a win-win situation for all actors involved.

Joris Claessens mentioned that adapting to user, task and location means that we need to establish trust mechanisms across different trust domains. Security researchers are already working on this problem, but further research is needed. It is also important to take into account that the internet will be very heterogeneous: everything will be connected to the internet, from small sensors to large-scale cloud computing facilities. Since adaptation to user, task and location involves service composition, it also means that the security needs to be composed from smaller security components to a secure service. Mechanisms for this 'hop' security still need to be researched.

The audience seemed to like the idea of the Personal Smart Spaces (PSS), but still saw many problems that need to be overcome before it can work on a large scale (how to do decentralised composition of services, how to deal with many sensors, how to have reasoning engines on PSS?). To pose strong requirements on the service lifecycle seems necessary. PSS seems only to capture a small part of the relationship between the Internet of Services and Internet of Things. How to deal with events for instance? Also, when the real world machines such as robots are interacting with human beings through seamless personalisation and adaptation, safety issues become critical as well.

***Panel 2: User-generated Services and User-generated Content: Similarities and Differences***

Juanjo Hierro made a presentation on behalf of the three panelists. The conclusion was that things developed for user-generated services might be very useful for user-generated content. This is also valid the other way around.

The resulting discussion centered around the question who is the user. Are all users able to generate their own services or content? For some participants it seemed clear that it is easier to upload content to the internet than it is to create a service. However, tested experience in the OPUCE ([www.opuce.eu](http://www.opuce.eu)) project has shown that users from all age groups were able to compose their own services, on the precondition that interfaces are very simple and some services are available on which to base variations. In general, there are many users that can all play a role. Some users might make raw content available that can be enhanced by professionals who in their turn deliver that to users again.

From the security perspective, it is important to understand that users can also do things wrong. Since services involve data processing it is necessary to think about security. Users should be protected against making mistakes, and their liabilities should be understood by them very clearly. A simulation environment seems necessary.

***Panel 3: Beyond Amazon - Using and Offering Services in a Cloud***

Ignacio Llorente explained that Amazon's cloud computing service, EC2, is a closed black box. Everybody can use it to host applications, but nobody knows how it works internally. The project Reservoir ([www.reservoir-fp7.eu](http://www.reservoir-fp7.eu)) is developing open source software through which every company could offer cloud computing facilities. A first release of Reservoir software is already available from <http://www.opennebula.org/doku.php>.

Thierry Priol explained the difference between grids and cloud computing. The main difference is that grids support virtual organisations and can work across different administrative domains. For cloud computing this is not the case. Grid research needs to continue, there will remain a need for grid computing, but lessons can be learned from cloud computing and vice versa.

Alex Galis mentioned that companies that offer cloud computing also need the possibility to outsource part of their cloud. So interworking between different clouds will be important.

During the discussion it was remarked that companies offering cloud computing facilities need to have instrumentation to monitor the workload generated by the applications running in the cloud. This means introspection in the applications, which might not be acceptable for the application owners.

***Panel 4: Global Service Delivery Platform (GSDP) for the Future Internet: What is it and how to use it for innovation?***

Frederic Gittler explained the NESSI view about a global service delivery platform. A service framework makes sense only if you also consider the wider context in which the platform plays a role. Also, a service framework needs to live in a society where use of the service framework is routine. One project on its own cannot develop a GSDP. In NEXOF-RA, which is a tool for implementing the NESSI vision, they are building on the results of a whole community of people and projects. NEXOF as the (technical) foundation for NESSI should be a long-living architecture that can grow over time. It is an integrated, coherent and consistent set of technologies and associated methods and tools. It is “open to the power n”: open source, open standards, open consultation process, open for evolution. Its main characteristics are: technology independent, federated, trusted and dependable.

Santi Ristol presented the high level architecture of SOA4ALL, which can also be considered as a GSDP. There are 27,000 publicly available web services today. The aim of SOA4ALL is to make billions of web services available, as many as there are static web pages in the internet. SOA4ALL is based on semantic technology and an important component will be a web crawler that will detect a new service automatically. It will add the necessary metadata so it can be discovered in the future. This model of service description and service discovery mimics the search model of Google for static web pages and could be an alternative for UDDI service registry. The SOA4ALL architecture comprises three levels: SOA4ALL Studio - which enables users to have a unified view of the whole lifecycle of services; SOA4ALL Cloud – semantic spaces and enterprise service bus; and SOA4ALL Infrastructure Services – basic services for the architecture. The use of ‘Micro WSMO’ or ‘WSMO Lite’ is being considered. The first prototype will be available in two or three months’ time.

Sergio Gusmeroli presented a viewpoint of the project COIN on a GSDP. Cooperation and interoperability are “two sides of the coin” (so to speak). The glue is a semantically-enabled service architecture. Enterprise collaboration environments are the starting point. These have involved different collaborative platforms in FP6 research, focusing on supply chains, collaborative networks and business digital ecosystems. Building on this, COIN is addressing collaborative platforms to access the Internet of Services; specifically GSDP will need to connect enterprise environments to the open internet. Sergio pointed out that enterprises will also be prosumers in the Future Internet. They will provide and consume high-level services which also have a manual part. The question is how to manage enterprise services in the Future Internet (e.g. outsourcing of services?); how to manage the distribution of enterprise applications between enterprise systems and facilities like service parks, data centers, clouds? Enterprises should not underestimate the usefulness of user-generated services. COIN will start with enabling employees to generate their own services. If that is desired, those can be made available to others such as business partners.

In discussion it was noted that AAA & billing are necessary components of a GSDP. The question as regards what is a unit of analysis for service constellation was raised. Another comment was that services spread through social links and business partners; understanding the different linkages and interactions is critical and socio-economics would help. Also, it is important to develop standards for such a GSDP and therefore projects should be clear about the standards they are targeting. However, standards development should be done only when research results are mature. Projects need to have a process to collect and coordinate research results to input to standards, and “scouting” of standardisation bodies is needed.

Regarding the global properties of GSDP, it was remarked that such a platform should be generic, that it could cope with different functionalities. There was a concern about the proliferation of platforms. A response to this concern was that while platforms should be transparent to the service consumers, service providers need to discuss the topology of the platforms, and what the purposes of the platforms are. Another response was that we need a connected world of federation of platforms. A further contribution (from the telco perspective) was that a GSDP should position itself vis-à-vis certain technical layers, not forgetting that the IMS (in telecommunications) is already tailored for vertical services. Overall, the term ‘platform’ had a different meaning for different people in the room, as did ‘service’. If a GSDP supports different types of services, it is necessary to develop technology that can glue these services together.

If a project develops a GSDP it should be tested on FIRE (with a large amount of users) to test for performance and scalability. Users should be taken into account from the beginning. The term ‘large scale’, as in large-scale testing facilities, needs to be clarified.

Telecom operators are currently opening up their walled gardens, since that is the only way to survive. They can play a role as GSDP provider – the opportunity for telcos to move to service discovery was described by a contributor as “a last opportunity for telcos”. But in principle a GSDP can be owned by anyone (even SME's for niche markets). There will be many GSDP's in the future that need to be able to interoperate. A GSDP is full of tensions that need to be reconciled. This is very difficult. A GSDP needs to be open for different models of service delivery, such as telco model and web services model as well as entirely new service delivery models. Also, with an enormous diversity of services, what is the glue that ultimately glues all these services together? Striking a balance between interoperability (of services and platforms) and innovation (doing something new) is said to be very tough. One suggestion in this respect is to include (end) users and SMEs in the development process. On the other hand, it was said that making users understand the process is difficult. It was asked: what is the role of a (Web 2.0-like) community in this? Can anyone offer services to each other? If any entity can be a service producer as well as a service consumer, how can we accommodate the dynamic behaviour of an entity?

Is a GSDP a public good? Should be rephrased to: “What are the smallest number of things that are needed for the public good?” and related to that governments have a role to encourage that small set of services to be developed. These could be addressed by pre-competitive standardization.

Finally a question was raised if anything needed to be changed to the current architecture of the internet. Perhaps the only thing was UDDI, that doesn't work and needs to be replaced. It is also important to understand that research on these issues only makes sense if industry in Europe is prepared to support one or more GSDPs.

### **Next Steps**

FISO requirements will be published for comments on the FISO wiki (see below) in Jan/Feb 2009. This will be followed by a call for projects to write position papers on requirements based on (early)

results. Contributions should target current internet limitations to aid definition of the Future Internet.

Progress will be presented at the next FIA in Prague.

### **Further Information**

FISO Session: [www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/fiso.html](http://www.future-internet.eu/home/future-internet-assembly/madrid-dec-2008/fiso.html)

FISO wiki: <http://services.future-internet.eu/>

FISO Position Paper: [http://services.future-internet.eu/images/e/e0/Future\\_Internet\\_Service\\_Offer\\_v4.pdf](http://services.future-internet.eu/images/e/e0/Future_Internet_Service_Offer_v4.pdf)

General Contact: [j.b.domingue@open.ac.uk](mailto:j.b.domingue@open.ac.uk)

## SESSION 5: REAL WORLD INTERNET

*Session Organisers: Manfred Hauswirth (DERI Galway), Srdjan Krco (Ericsson LMI), Neeli Prasad (Aalborg University), Mirko Presser (University of Surrey)*

### Agenda

9 <sup>th</sup> December 2008	
16.30	Session Introduction Mirko Presser (University of Surrey)
16.40	Invited Talk: Global Sensor Networks - Enabling Networked Knowledge Manfred Hauswirth (DERI)
17.10	Invited Talk: Security and Privacy/Anonymity in the RWI Claudia Diaz (Think Trust)
17.40	Short presentations from RWI projects: Approaches and lessons learnt
	RFID integration into the Future Internet - Neeli Prasad (ASPIRE)
	Context dissemination - Nigel Baker (C-CAST)
	Security and Trust in Wireless Sensor Networks - Theodore Zahariadis (AWISSENET)
	Federating sensor networks - the WISEBED approach - Stefan Fischer
18.40	RWI link to FIRE, use cases presentations and discussions Neeli Prasad (ASPIRE), Telma Mota (C-CAST), Srdjan Krco (SENSEI)
19.00-19.10	Day 1: Conclusions Mirko Presser and Neeli Prasad
10 <sup>th</sup> December 2008	
	Catching up from the first day:
	Services Virtualisation in the Future Internet - Syed Naqvi (RESERVOIR)
	RWI traffic considerations - Srdjan Krco (SENSEI)
0900-1000	Future of the Internet: Real World Internet Panel Chair: Neeli Prasad Panel: Manfred Hauswirth, Claudia Diaz, Srdjan Krco, Patrik Spiess, Martin Bauer
1000-1100	Conclusions, position paper discussion, white paper and future collaborations Chair: Mirko Presser

### Objectives

Technologies like RFID, short-range wireless communications, real-time localisation and sensor networks are now becoming increasingly common, bringing the Internet of Things (IoT) into commercial use. Connections are multiplying and creating an entirely new dynamic network of networks: the Real World Internet (RWI).

The RWI is neither science fiction nor industry hype, but is based on solid technological advances and visions of network ubiquity that are jealously being realised. It is important that all stakeholders exercise great care in addressing questions of governance, policy and regulation as the Internet evolves. Common agreement on terminology and concepts is necessary and a sound understanding of the Internet itself by all stakeholders cannot be assumed.

This poses a number of questions:

- Do we need RWI and why?

- How do we manage and scale RWI networks (e.g., heterogeneity of devices and users, large variety of context and networked knowledge)?
- How do we handle security, privacy and trust?
- How do we handle storage and querying of dynamic information?
- How do we integrate successfully the social aspects?

The Session set out to address these issues through invited talks and panel discussions.

### **Discussion and Conclusions**

In the first of two invited talks, Manfred Hauswirth noted that the wealth of information and services on today's information infrastructures has significantly changed everyday life, as well as the way in which business, public and private interactions are performed. The Web has enabled information creation and dissemination, but has also opened the information floodgates. This development will be aggravated by the enormous amounts of information coming from sensors in the near future. This "torrent" of data has made it increasingly difficult to find, access, present and maintain the information required. As a consequence, we are "drowning in information and starving for knowledge." Although knowledge is inherently strongly interconnected and related to people, this interconnectedness is not reflected or supported by current information infrastructures. The lack of interconnectedness hampers basic information management, problem-solving and collaboration capabilities, like finding, creating and deploying the right knowledge at the right time. Thus, the focus on "Enabling Networked Knowledge" is essential, where Networked Knowledge = Web + Sensors + Semantics. Knowledge is the fuel of our increasingly digital service economy: linking information is the basis of economic productivity.

In her talk, Claudia Diaz argued that the Real World Internet poses formidable security and privacy challenges. Securing devices with constrained resources will require highly efficient cryptographic algorithms and protocols, as well as secure implementations. Individuals will generate enormous amounts of data that will be identifiable and linkable unless protective measures are taken. And even if the confidentiality of the data is protected through encryption, communications' traffic patterns are often enough to reveal sensitive information. The current lack of awareness and transparency mechanisms implies that individuals have little if any control on which data is collected by whom and for what purpose, how it is composed into profiles, and how these profiles are then used to make decisions that affect them.

Challenges ahead include:

- A scalable semantic infrastructure.
- Advanced context functionalities for transparency and awareness.
- Security and privacy protection in the RWI. Privacy protection mechanisms are needed to counter the rise in surveillance technologies and bring about sufficient security. Transparency also needs to be ensured.
- Trust establishment in an ad-hoc manner (on-the-fly) : imposed by heterogeneity and the huge number of sensor nodes that need to be interconnected.
- Merge technological advances to business processes.

Also, it will be necessary to mediate interaction between applications or parts of an application through choice of an appropriate architecture. Given the trend towards ubiquitous computing, mobility and dynamic reconfigurability, are RWI solutions 'innovation-proof'? And how do we ensure consistent trade offs between autonomy and interdependence for the different subsystems, definition and implementation of resource management policies.

In all of these areas collaboration is key.

### **Next Steps**

A White Paper is being prepared which will be presented and discussed at the FIA in Prague.

### **Further Information**

RWI wiki: <http://rwi.future-internet.eu>

RWI Position Paper: [http://rwi.future-internet.eu/index.php/Position\\_Paper](http://rwi.future-internet.eu/index.php/Position_Paper)

General Contact: Mirko Presser, [m.presser@surrey.ac.uk](mailto:m.presser@surrey.ac.uk)

## SESSION 6: SOCIO-ECONOMICS

*Session Organisers: David Hausheer (University of Zurich), Pekka Nikander (Helsinki Institute for Information Technology and Ericsson Research), and Vincenzo Fogliati (Telespazio).*

### Agenda

16.30-16.40	Introduction David Hausheer, Pekka Nikander, Vincenzo Fogliati
16.40-17.15	Keynote: Socioeconomic Issues in the Internet of the Future Costas Courcoubetis (Athens University of Economics and Business)
17.15-17.45	Socio-Economics Panel Costas Courcoubetis (AUEB) Pekka Nikander (Helsinki Institute for Information Technology and Ericsson Research) Malte Behrmann (GAME) Vincenzo Fogliati (Telespazio) Klaus Wuenstel (Alcatel-Lucent) Mike Boniface (IT Innovation)
17.45-19.05	Socio-Economics Brainstorming Pekka Nikander, David Hausheer
19.05-19.20	Use Cases for FIRE Experimental Facilities Susanna Avéssta
19.20-19.30	Summary and Conclusions David Hausheer, Pekka Nikander, Vincenzo Fogliati

### Objectives

Following the successful panel held at the first Future Internet Conference in Bled in April 2008, the aim of this Future Internet Socio-Economics (FISE) session was to discuss the challenges related to socio-economic issues in the Future Internet in order to gain new insights and perspectives on how a possible research agenda and integration path towards the Future Internet could look like. In preparation for the session a position paper [1] was written, integrating the different viewpoints of all the contributors.

Socio-economics aims to understand the interplay between the society, economy, markets, institutions, self-interest, and moral commitments. It is a multi-disciplinary field using methods from economics, psychology, sociology, history, and even anthropology. Socio-economics of networks have been studied for over 30 years, but mostly in the context of social networks instead of the underlying communication networks.

The objective of the FISE session in Madrid was to tackle socio-economic questions related to networks, services, and content in the Future Internet. Topics of interest which were addressed in the session included pricing, value chains, and business models as well as network neutrality, bandwidth markets, regulation, and governance issues. Moreover, user identity and privacy, as well as trust and reputation questions were tackled. Furthermore, the session addressed topics like peer-to-peer content distribution models, customer usage behaviour and customisation, as well as creative commons. Finally, the vision of a universal internet service was discussed.

### Discussion and Conclusions

The FISE session programme included a keynote and a panel which was followed by a long discussion session. After the introduction by the session chairs, Costas Courcoubetis (AUEB) gave a keynote on

*Socioeconomic Issues in the Internet of the Future*, which raised an interesting discussion on the need for incentives in the Future Internet. Following the keynote, the socio-economics panel was moderated by David Hausheer and included short position statements from Pekka Nikander, Malte Behrmann (GAME), Vincenzo Fogliati, Klaus Wuenstel (Alcatel-Lucent), and Mike Boniface (IT Innovation).

Based on the experience in Bled, it was decided to allocate the rest and major part of the time for discussion. This part of the session was moderated by Pekka Nikander and started with a group brainstorming by Esa Saarinen and Kirsti Lonka. This brainstorming addressed the question what 'the dream research agenda' for Future Internet Socio-Economics should look like. It was organised in six steps, where participants had to share summaries of their findings in groups which doubled in size after every step. Finally, the results of all groups were presented to the plenary. Those answers can be found on the FISE Wiki [2] together with all other material of the session.

The group brainstorming was followed by a discussion which concluded the session.

### **Next Steps**

The discussion is likely going to continue on the FISE Wiki and will be followed-up at the next Future Internet Conference which is going to take place in May 2009 in Prague.

### **Further Information**

FISE Session: [www.smoothit.org/wiki/pmwiki.php/FISE/FIAMadrid2008](http://www.smoothit.org/wiki/pmwiki.php/FISE/FIAMadrid2008)

FISE Position Paper: [www.smoothit.org/wiki/uploads/FISE/FISE\\_position\\_paper\\_final.pdf](http://www.smoothit.org/wiki/uploads/FISE/FISE_position_paper_final.pdf)

FISE wiki: [www.smoothit.org/wiki/pmwiki.php/FISE](http://www.smoothit.org/wiki/pmwiki.php/FISE)

General Contact: David Hausheer, [hausheer@ifi.uzh.ch](mailto:hausheer@ifi.uzh.ch)

## SESSION 7: USAGE OF EXPERIMENTAL FACILITIES BASED ON USE CASES

Session Organisers: Anastasius Gavras (Eurescom)

### Agenda

9:00 – 9:10	Introduction to FIRE and Vision for Phase 2 – “At the Service of all FI Research” Anastasius Gavras
9:10 – 9:25	Test-Beds and Use-Cases: A Challenging Liaison Phuoc Tran-Ghia (G-Lab)
9:25 – 9:40	Next steps of FIRE-GENI Larry Landweber
	Short Q&A
9:45 – 10:15	Comparing offers and needs. Picks and reactions from other breakouts. Rapporteurs from the other breakout sessions
10:15 – 10:30	Introduction to Panel Discussion Anastasius Gavras <ul style="list-style-type: none"> <li>• Proposal to proceed by focusing on concrete projects’ collaborations</li> <li>• How to fill and prioritize the gaps between the offering and demand</li> <li>• Need to agree on terminology, e.g. how is reproducibility defined in a large-scale environment</li> </ul>
10:30 – 11:00	Panel discussion – “Reproducing an Experiment in a Large-scale Environment with High Enough Accuracy” Panel Moderator: Anastasius Gavras

### Objectives

Since the last Future Internet Assembly, held in Bled, Slovenia in March 2008, the area of Future Internet Research and Experimentation (FIRE) was active in several dimensions. One of the primary targets was to collect usage scenarios for the FIRE facilities from a user and customer point of view.

The resulting FIRE use scenarios have been discussed at a number of events, including:

- FIRE Launch event (FIREweek), Paris, 10-12 September 2008, [www.ict-fireworks.eu/events/fireweek-in-september.html](http://www.ict-fireworks.eu/events/fireweek-in-september.html)
- Manweek 2008 conference, during a panel at the IPOM workshop, Samos Island, 22-26 September 2008, [www.manweek.org/2008/ipom/programme.php](http://www.manweek.org/2008/ipom/programme.php)
- FEDERICA launch event, Lyon, 24 September 2008, [www.fp7-federica.eu/launch\\_event/](http://www.fp7-federica.eu/launch_event/)
- FOKUS IMS Workshop 2008, Open NGN Testbeds – Infrastructure as a Service, Berlin, 6 November 2008, [www.fokus.fraunhofer.de/en/fokus\\_events/ngni/ims\\_ws\\_08/program/abstracts/index.html](http://www.fokus.fraunhofer.de/en/fokus_events/ngni/ims_ws_08/program/abstracts/index.html)

- ICT Event, Networking session N.112, Lyon, 27 November 2008, [www.ict-fireworks.eu/events/ict2008-in-lyon.html](http://www.ict-fireworks.eu/events/ict2008-in-lyon.html)
- FIRE-GENI workshop, Madrid, 8 December, [www.ict-fireworks.eu/events/fire-geni-workshop/programme.html](http://www.ict-fireworks.eu/events/fire-geni-workshop/programme.html)

Before and during these meetings FIREworks representatives presented use scenarios, provided by project PII, from a FIRE facility-provider point of view. The main objective of this FIA Session was to further discuss and refine these through input from all Future Internet communities represented at the event.

### **Discussion and Conclusions**

FIREworks presented an analysis of the offerings and needs. The usage scenarios received from various projects were very useful, partly very detailed covering a wide area of needs, ranging from network platform, up to services and applications. Based on the scenarios received, requirements had been collected and analysed by the FIREworks support action.

The analysis suggests that several needs can be satisfied today by the offering. However there are also gaps, especially because in at least one case the needed experimentation environment cannot be provided in time for the customer project.

During the Session a number of areas were identified as the focus for further work in the coming months:

- Harmonise the presentation of the offerings;
- Create a service portfolio;
- Intensify the collaboration at the multi-lateral project level;
- Identify ways to include service layer offerings (e.g. cloud computing, grid computing). The current majority of the offerings and needs are at network level;
- Identify ways to introduce new components, such as Identity Management (IDM);
- Intensify the investigation for removing existing and avoiding future use barriers such as cost and heavy bureaucratic processes

Furthermore, the issue of terminology was briefly discussed, as it was apparent that different adjacent communities had differing interpretations and understanding of key terms. One example, from the FIRE-GENI workshop is the differentiation between “control” and “management”, which to a large extent are used to denote similar functions. Another example are the terms “testing” vs. “experimentation”, where in the latter observation turns out to be a key element. Further discussion on terminology was delegated to the FIRE Expert Group meeting to be held on 8-9 January 2009 in Brussels.

Finally, the Session agreed that FIRE must improve its communication towards the users and customers of the facilities in order to raise awareness about the offering and the collaboration opportunities.

### **Next Steps**

Work on all of these issues will continue in the run-up to the next FIA meeting in Prague.

## Further Information

Experimental Facilities Session: [www.future-internet.eu/fileadmin/documents/madrid\\_documents/sessions/FIRE\\_session\\_agenda\\_V1.0.pdf](http://www.future-internet.eu/fileadmin/documents/madrid_documents/sessions/FIRE_session_agenda_V1.0.pdf)

FIRE Position Paper: [www.future-internet.eu/fileadmin/documents/madrid\\_documents/sessions/FIRE\\_Issues\\_paper-Revision\\_0.2.pdf](http://www.future-internet.eu/fileadmin/documents/madrid_documents/sessions/FIRE_Issues_paper-Revision_0.2.pdf)

FIREworks action: [www.ict-fireworks.eu](http://www.ict-fireworks.eu)

General Contact: Anastasius Gavras, [gavras@eurescom.eu](mailto:gavras@eurescom.eu)

## CLOSING PLENARY

*Session chair: Prof. Guillermo Cisneros, Director ETSIT, UPM*

### Cross-ETP Vision

*David Kennedy on behalf of the ETPs*

Since the beginning of 2008 the European Technology Platforms (ETPs) have been developing a dialogue on the Future Internet, with at least 10 meetings being held. These discussions have focused on the potential structure of research within the Future Internet domain and have resulted in a Vision Document and Strategic Research Agenda, which are currently being finalised. These activities will help to extend collaboration across the ETPs more generally.

The inter-ETP process has involved a combination of top-down and bottom-up approaches. It has sought to map the FI Vision and SRA to FP7 calls and objectives and to map the calls and objectives to the ETP domains.

What do we mean by the Future Internet and what do we aim to achieve with it? The work to date has identified ten high-level Future Internet objectives:

Firstly, it will become the **common and global information exchange environment** of human knowledge. It must accommodate unanticipated **user expectations** together with continuous user empowerment. It should leverage and **evolve information and communication technologies**, capabilities and services to fulfil increased quantity and quality of internet use. It should be **ubiquitously accessible and open** (at physical, connectivity and information levels) and able to support open **cultural, scientific and technological exchanges** across all regions and cultures, as well as within single communities.

The future network will exhibit a number of new functions. It should be **secure, accountable and reliable** without impeding user privacy, dignity, and self-arbitration. It must be able to support **mobility**, have widespread ubiquitous **availability** and be capable of assisting society in emergency situations. It should support effective and efficient **performance management** features based on context, content, etc, as well as **innovative business models** that allow all entities equal access to the services and service provision markets. And given current concerns, it should be **energy efficient and environmentally sustainable**.

Ten key technological challenges are:

1. Routing and addressing scalability and dynamics
2. Resource (forwarding, processing, and storage) and data/traffic manageability and diagnosability
3. Security, privacy, trust, and accountability
4. Availability, ubiquity, and simplicity
5. Adaptability and evolvability to heterogeneous environments, content, context/situation, and application needs (vehicular, ambient/domestic, industrial, etc.)
6. Operating system, application and host mobility / nomadism
7. Energy conservation and economic sustainability
8. Managing conflicting interests and dissimilar utility
9. Searchability, localisation, selection, composition, and adaptation
10. Beyond just digital communication: semantic (intelligibility of things and content, language, etc.), haptic, emotion, etc.

Much work has also gone into mapping how and where the ETPs and current projects could contribute. Elements missing at the moment are an industry association and market aspects expressed through standardisation.

European industry needs support to gain a leadership position here. This requires focused initiatives. FP7 (and FP8) must continue to address this area. A JTI structure is being actively investigated and there is the possibility of a new Knowledge & Innovation Community through the EIT, while international (e.g. Eureka - CELTIC) and national programmes could also contribute. All this will require careful planning. Next steps based on the work done already include: refining the priorities; identifying the timings; getting started on the critical issues; and starting work on an implementation structure.

Industry is ready to invest, where the objectives and returns are understood. The Commission and national governments share understanding of the need for action. We need a coherent approach across Europe so as to: raise awareness of the potential; adopt strategies and plans at all levels; and identify actions beyond R&D. Now is the time to act on the Future Internet.

## **Summary of Breakout Sessions**

The session rapporteurs presented summaries of the workshop discussions, as reported in the main body of this report.

### **Forthcoming FIA Conference in Prague**

***Gabriela Krcmarova, CESNET***

Ms Krcmarova gave a preview of the next Future Internet Assembly meeting to be held in Prague, 11<sup>th</sup>-13<sup>th</sup> May 2009. The meeting will be organised by the Czech Education and Research Network, CESNET. The venue will be the Clarion Congress Centre, a large, modern conference hall with the latest audiovisual facilities 10 minutes from the city centre. The first day will include keynote speakers such as Commissioner Viviane Reding.

She looked forward to welcoming everyone to “the city of a hundred spires”.

### **Closing Message**

***Dr. João da Silva, Director, Directorate Converged Networks and Services, European Commission***

Closing the meeting, Dr. da Silva noted that much progress had been made since the first FIA gathering in Bled. “The silo walls are starting to come down – but not fast enough.” More should be done in this area before Prague to encourage dialogue across the different areas.

Each Working Group has identified issues which were being progressed through Position Papers and White Papers. In completing these, the caretakers should draft scenarios for the Future Internet and identify overlaps with other areas. Independently, the Commission would invite high-level representatives from industry so to do the same so as to provide two alternative – and hopefully complementary – views of Future Internet developments. These would help scope the Prague meeting and also provide input for planning for the next Work Programme 2011/12, which is not far away.

Business models run through all of the session reportbacks. It is important that network operators take the lead in this area and put business models centre-stage in future discussions.

Dr. da Silva acknowledged the creativity and commitment of all those involved in the Madrid meeting and the process leading up to it. This will help ensure that Europe's €800m investment in Future Internet will pay off. Times of crisis are the right time to spur research and the research community has to do more to get this message across.

Finally, Dr. da Silva thanked Prof. Cisneros and his colleagues for their organisation of the Madrid meeting.

Prof. Cisneros responded by thanking Dr. da Silva and his Commission colleagues for entrusting the FIA to UPM, and all caretakers, speakers and participants for attending. He looked forward to continuing the discussions in Prague and wished everyone a safe trip home.