European Commission
Directorate General Information Society and Media

The Footprint of European R&D Programmes on Future Internet Developments

Mobilware 2009

Berlin (DE), 28 April 2009

Franco Accordino
European Commission - DG INFSO
Assistant to the Director, Emerging Technologies and Infrastructures

Summary

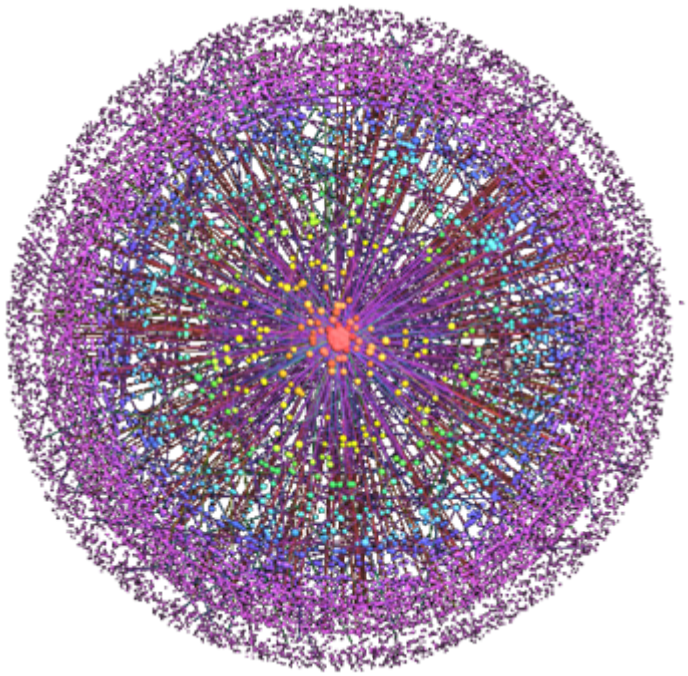
- Future Internet: background and motivation
- ICT work programme 2009-10
- European approach to Future Internet:

  ICT WP2011-13 and beyond FP7
- Conclusions

Future Internet research issues

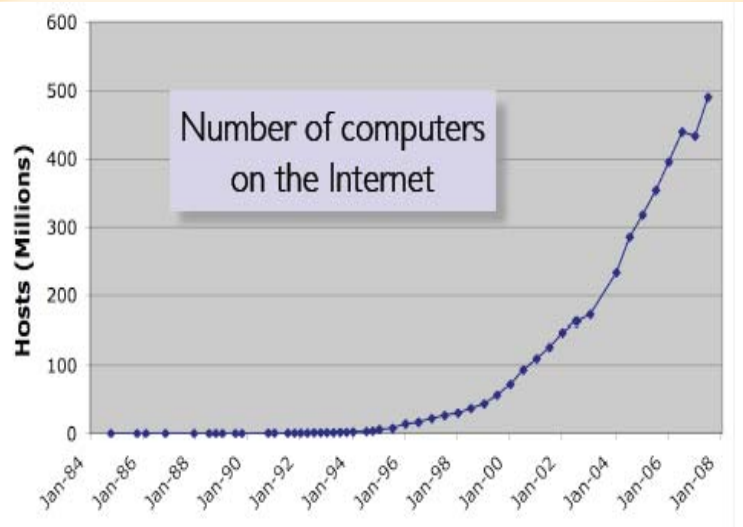
The original Internet design has successfully enabled multiple waves of innovation! But…

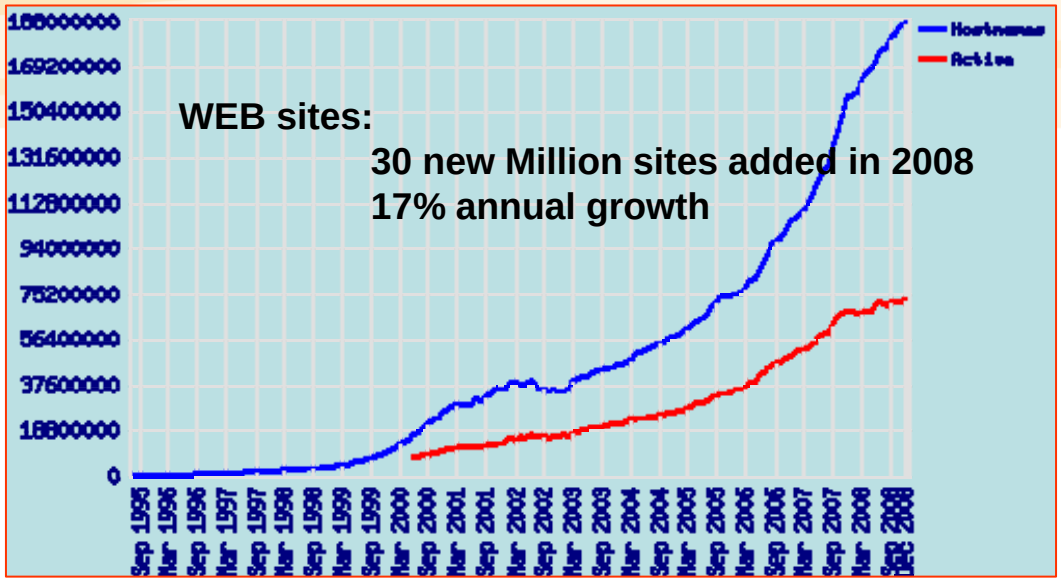
Novel societal and commercial usages are pushing the original Internet architecture to its limits…



- Mobility, pervasiveness, scalability
- Security, trust, dependability
- QoS for mobile and bb services (video, voice, …)
- Heterogeneity of devices (e.g. RFIDs, sensors)
- Complexity of network management
- …

The Internet: a scaling issue



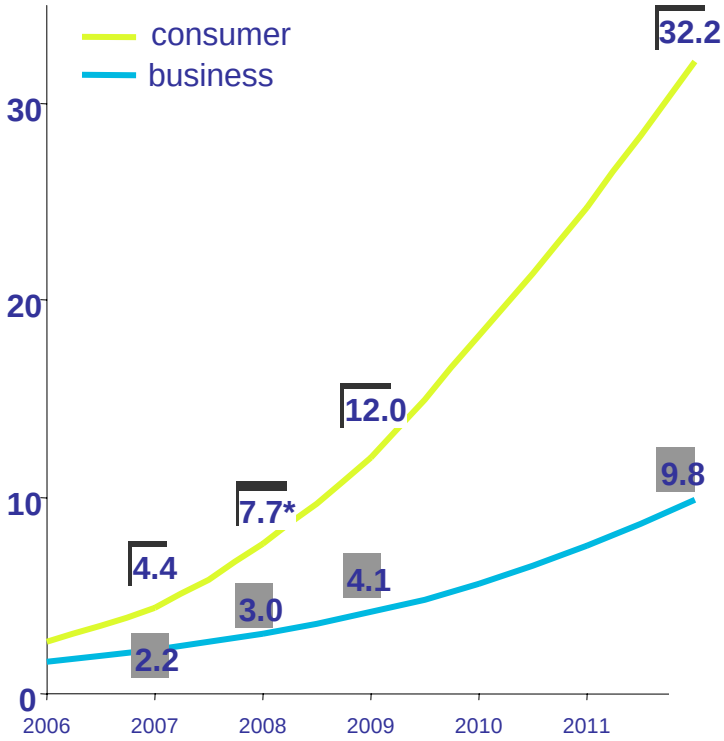


- Google indexed 26 Million pages in 1998 – today it **indexes 1 Trillion pages**
- There are currently **210 billion emails per day** (73% spam)
- In October 2008, 12.6 total billion searches (US alone) were made - as compared to **13.5 billion videos viewed**
- Facebook and MySpace each have over 100 million users (3 out of 4 teenagers).
- **1300 Billion SMS messages** in 2008
- 3.7 Million pictures uploaded every day in Flickr
- User generated content such as YouTube generate > than **73 billion streams in 2008**
- **Towards user-generated services**

Video makes traffic double every 2 years

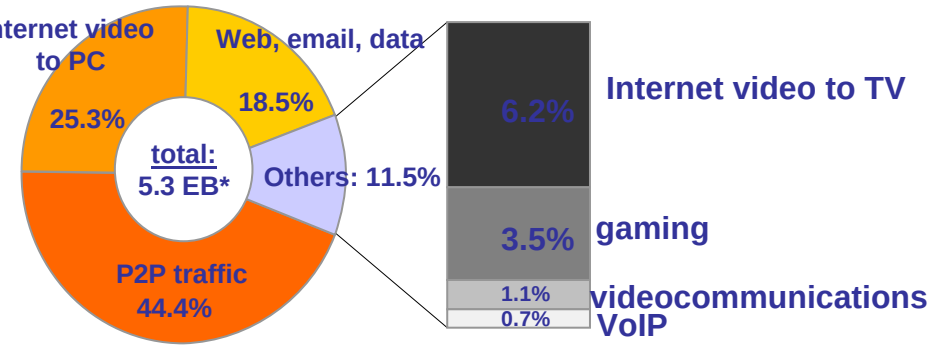
Change in IP traffic by category

2006-2012, in Exa Bytes** per month



Breakdown of consumer Internet IP traffic*

monthly traffic 2008, as a % of total traffic



Changes in consumer Internet IP traffic

- Equality or low decrease of P2P
- Strong growth of video streaming to TV

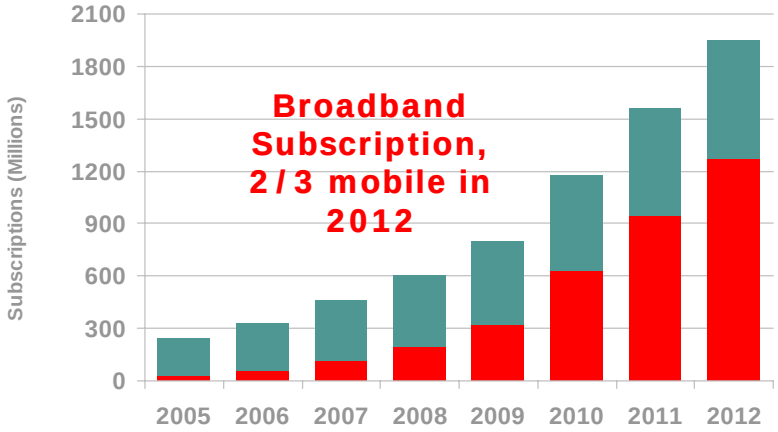
Source: Cisco Visual Networking Index, 2007–2012 (June 2008)
**: 2008 consumer IP traffic = Internet traffic (5.3 EB) + non-Interr traffic (2.4 EB), or 7.7 EB*
***: 1 EB = 10^{18} B*

- **You Tube grows 13 mn video per minute, 10 % of all Internet traffic (2008)**
- **Every 4 hours on Google refreshes more than entire library of congress (>20 TB)**
- **Network disruptions already happening (e.g i-player)**

Augmentation factor: Mobile & Things

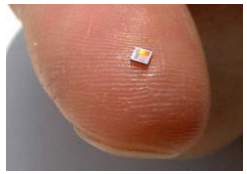
Mobile Internet taking up, combination of two factors: availability of Smart terminals, availability of true broadband mobile networks

2008, 50% increase. >1 Bn using Mobile as Internet gateway in 2012



- **Towards trillions of connected devices, M2M, Internet of objects, novel applications**
- **Geo-location as embedded capability**

➲ **Combining virtual world with the physical world**



Future Internet
...innovating the planet

- Sustainable transport
- Energy efficiency
- Climate change
- Health services
- Respectful security
- ...

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Dimensions of the Future Internet

Terabyte networks

Mobility

Internet of things

Complexity

Clean slate approaches

Support investments: backward compatibility

Need for (open) standards

Security for supporting commercial services and applications

European competitiveness on future Internet (act where market forces fail)

Consumer protection / empowerment

Social responsibility: preserve neutrality, openness, fairness, social role of the Internet

Balance the need for security/accountability and the right to privacy

What is at Stake?

The Future Internet: An opportunity for Europe

- Reopening the game in the ICT sector (Internet vs Telecom)
- Competitiveness in downstream sectors
- Novel applications and lower market entry barriers for high tech SME's
- Prospects of high societal value services with local value (relocation)
- Early mover advantage on novel Internet enabled disruptive markets

But it requires:

- "Complexity management" and open innovation
- Ecosystem of consumers and suppliers
- Need to combat fragmentation of efforts;
- Need to put industry and academia in the driving seat;
- Need to bridge the gap between technology and applications

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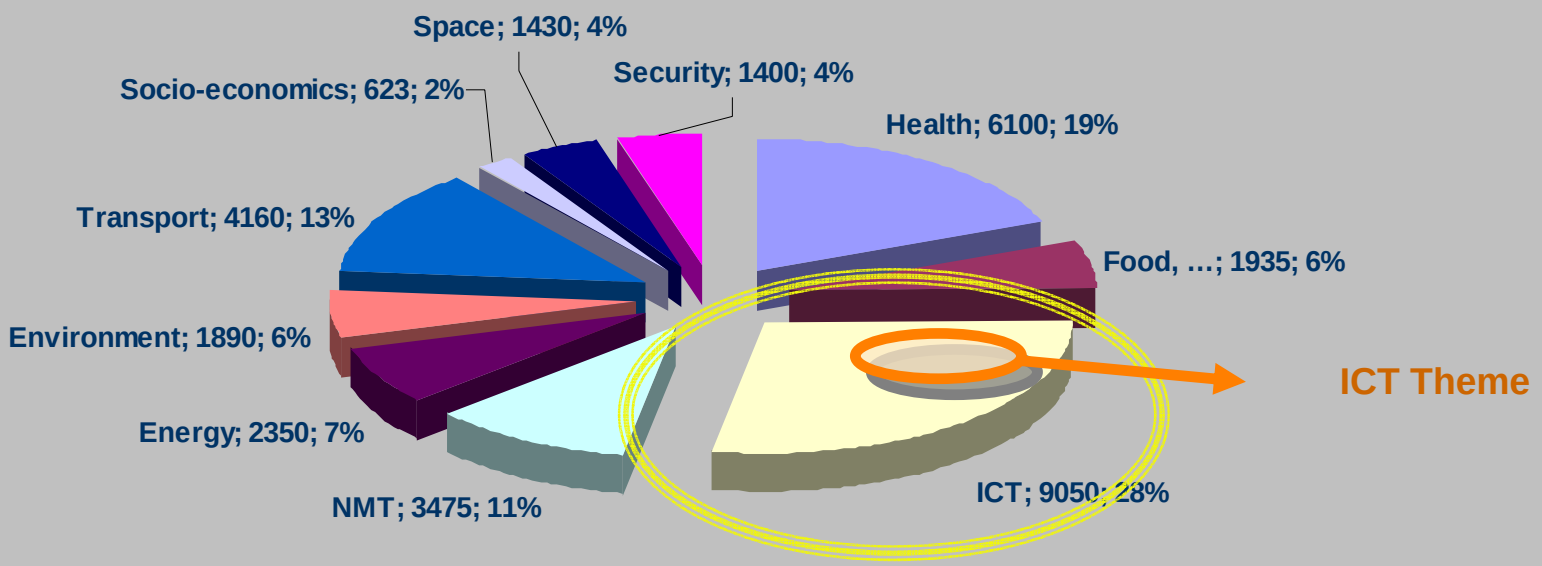
7th EU Research Framework Programme (FP7: 2007-2013)

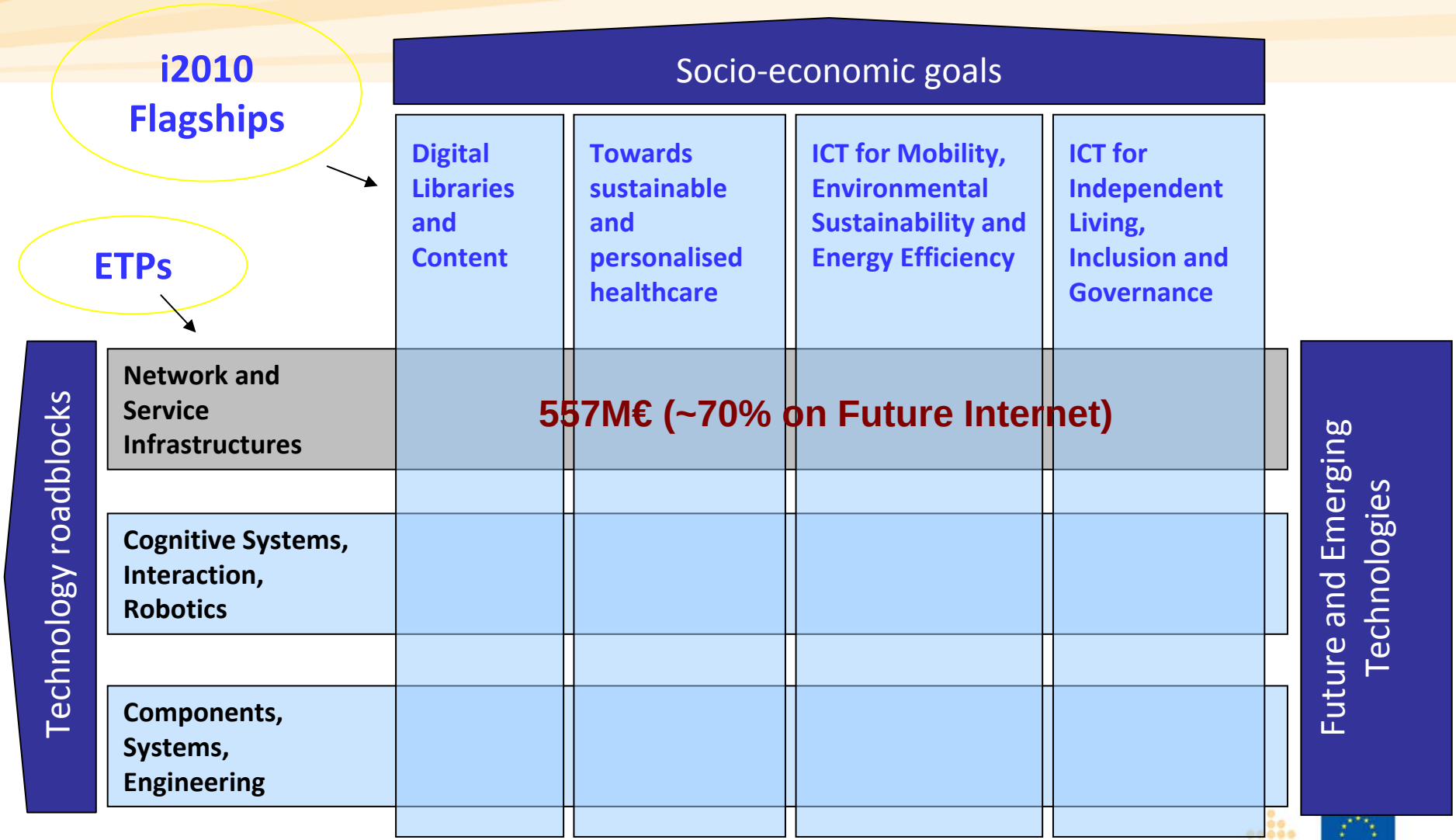
Total 50,521 M€

FP7 Cooperation Programme: 32,413 M€
The 10 Themes

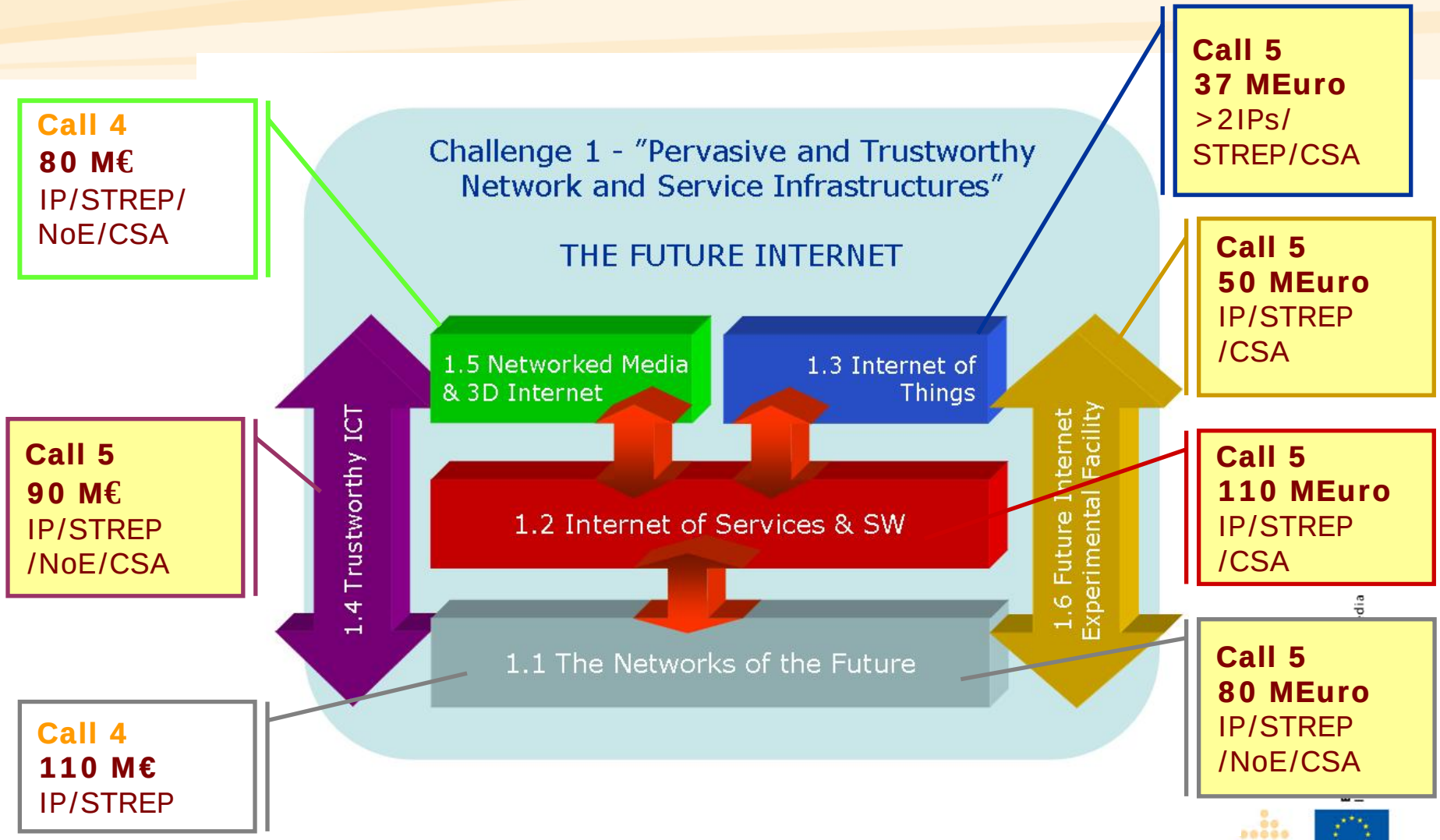


Strengthening Competitiveness through Co-operation

ICT Work Programme 2009-2010



Challenge 1: Pervasive and Trustworthy Network and Service Infrastructures



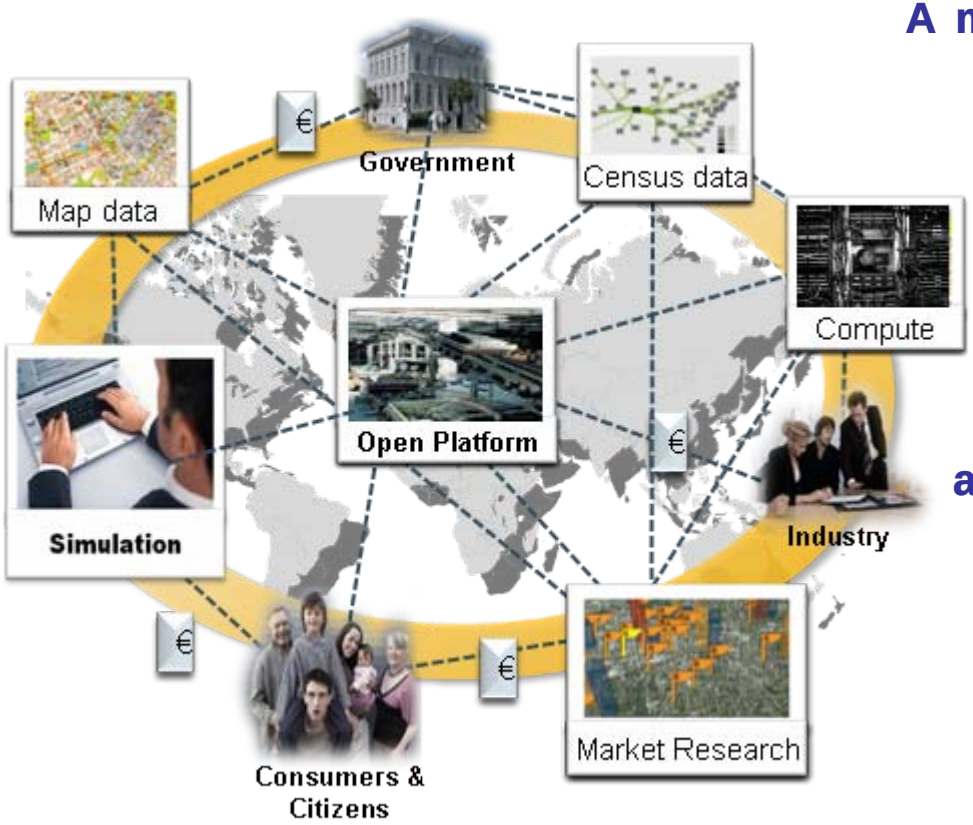
The Network of the Future

Future Internet Architectures and Network Technologies (IP/Strep)

- novel Internet architectures and technologies (support to: multiple user requirements, e2e quality m2m, wireless SN, BAN, …)
- flexible and cognitive network management (self healing, self management, fault tolerance, optimised resource allocation, …)

Coordination/ Support actions and Networks of Excellence (NoE, CSA)

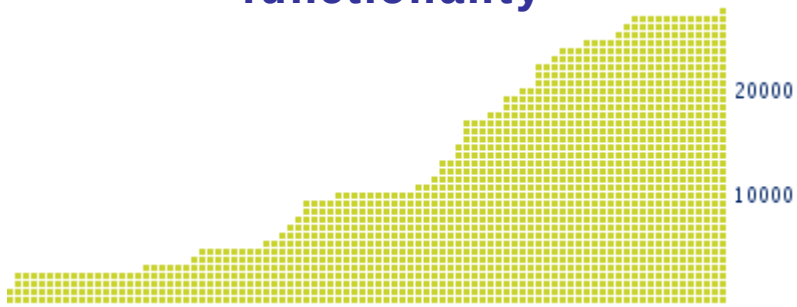
Internet of Services Vision



A multitude of connected IT services, which are offered, bought, sold, used, repurposed, and composed by a worldwide network of service providers, consumers, aggregators, and brokers

- resulting in -

a new way of offering, using, and organising IT supported functionality



Number of Web services found by SEEKDA crawler during the past 25 months

Adapted from SAP Research, 2008, and SEEKDA, 2008

Virtualised Infrastructures
e.g. Cloud Computing

- An emerging computing paradigm where data and services reside in massively scalable data centers and can be ubiquitously accessed from any connected device over the Internet[1]

	Traditional Computing	Cloud Computing
Acquisition Model	Buy assets and build technical architecture	Buy service (aka "rent")
Business Model	Pay for fixed assets and administrative overhead	Pay based on use
Access Model	Over internal network, to corporate desktop	Over the Internet, to any device
Technical Model	Single tenant, nonshared, static (often not shared)	Scalable, elastic, dynamic, multitenant

Source: Gartner (September 2008)

Merrill Lynch:
Cloud computing market opportunity by 2011 = $95bn in business and productivity apps + $65bn in online advertising = $160bn

(1) Source: IBM

Internet of Services, Software and Virtualisation

Service Architectures and Platforms for the Future Internet (IP/Strep)

- service front ends
- open, scalable, dependable service platforms
- virtualised infrastructures

Innovative Service / Software Engineering (IP/Strep)

- service / Software engineering methods and tools
- verification and validation

Coordination and support actions (CSA)

Internet of Things and Enterprise environments

Architectures and technologies for an Internet of Things (IP/Strep)

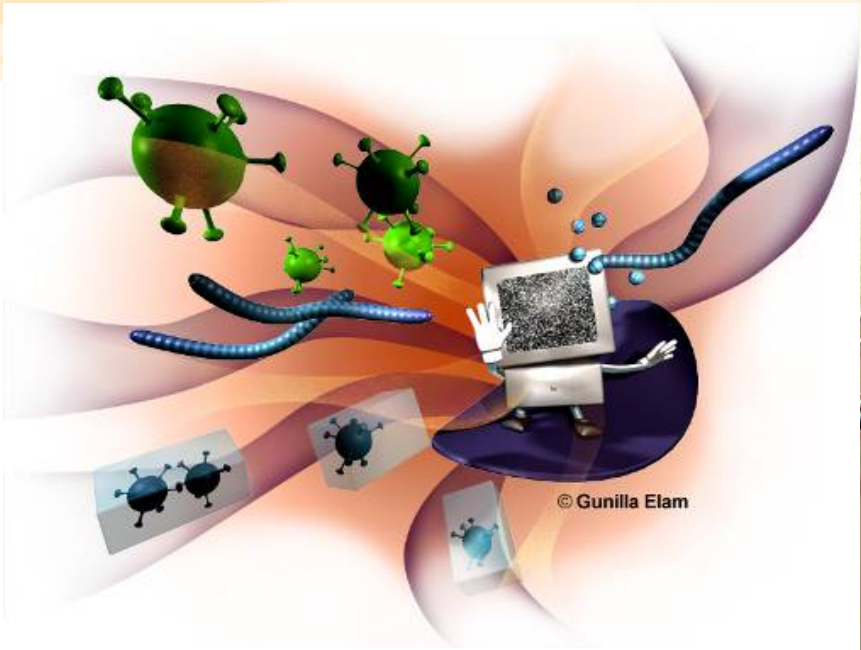
- architectures and technologies using open protocols, which enable novel Internet-based applications
- optimised technologies covering distribution of intelligence
- architectural models

Future-Internet based enterprise systems (IP/Strep)

- software platforms
- Interoperability
- dynamic ecosystems

International co-operation and co-ordination (CSA)

In the networked society…



technology is vulnerable!

user is vulnerable!

A new generation of trustworthy Internet technologies is needed to ensure prosperity while respecting fundamental ethical values

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Challenges for RTD for a Trustworthy Information Society

Technology

- Cyber-threats, cyber-crime
- Complex ICT Systems and Services underpinning Critical Infrastructures

Users

- Trust, accountability, transparency
- Identity, privacy and empowerment
- Creativity, Usability
- Human values and acceptance

Trustworthy ICT

Trustworthy Network Infrastructures (IP)

- novel architectures with built-in security / dependability / privacy
- trustworthy management of billions of networked devices

Trustworthy Service Infrastructures (IP)

- adaptability, interoperability, scalability and dynamic composition of services
- identity management for persons, tangible objects and virtual entities

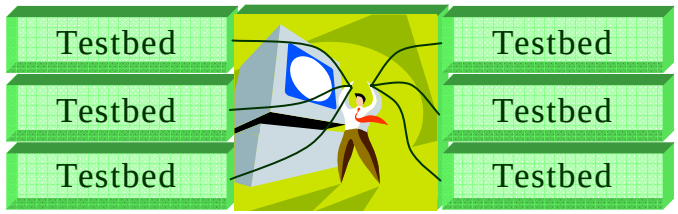
Technology and Tools for Trustworthy ICT (Strep)

- Understanding threat patterns for pro-active protection
- user-centric and privacy preserving identity management
- management and assurance of security, integrity and availability
- assurance and assessment of trustworthiness

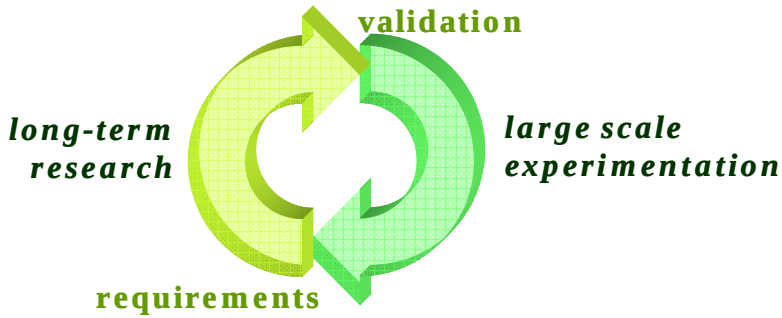
Networking, Coordination and Support (NoE, CSA)

Future Internet Research and Experimentation (FIRE)

- Allowing European researchers to test new paradigms at large scale, including interactions with end users and communities



- Internet as a complex system: need to promote strategic, long-term, multi-disciplinary research on new internet concepts



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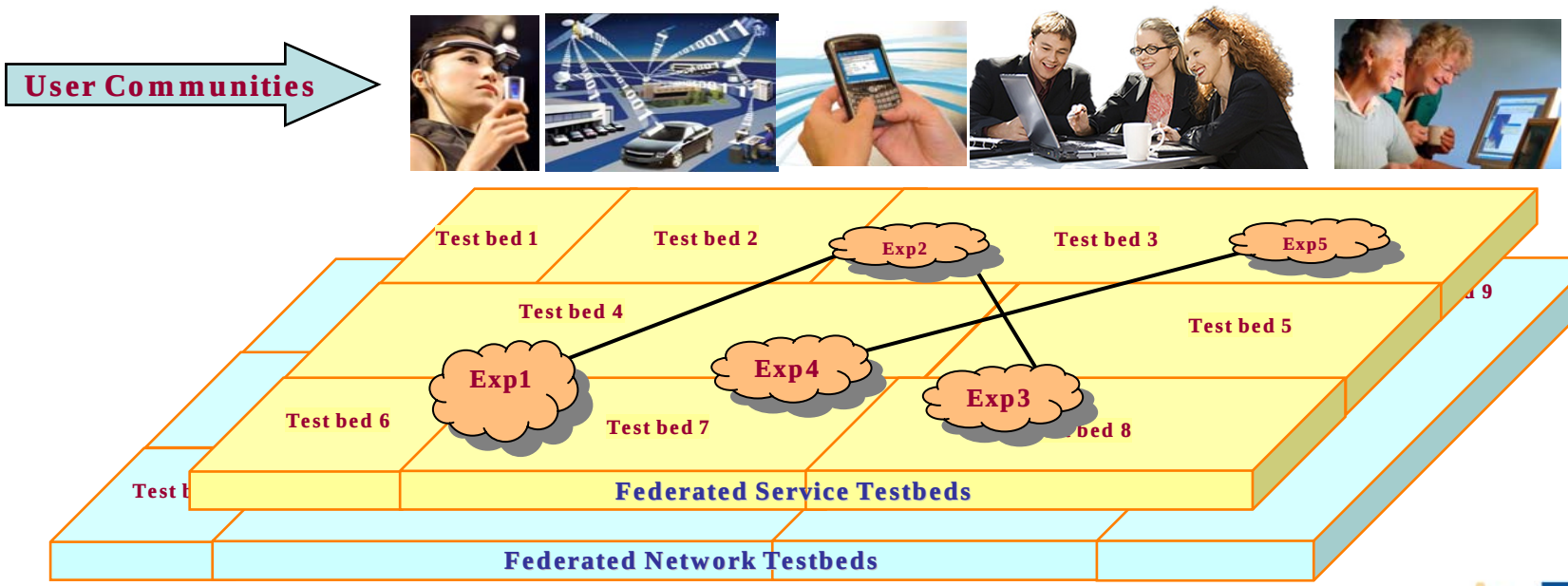
Future Internet Research and Experimentation (FIRE)

- Anticipating technology trends
- Assessing business models
- Evaluating societal impact
- User-centric development



FIRE Experimental Facility

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Objective ICT-2009.1.6

FI experimental facility and experimentally-driven research

Building the Experimental Facility (IP)

- prototype of the FIRE experimental facility
- open coordinated federation of testbeds
- large scale experimentation with full user involvement
- 1/ FIRE Components: operational prototype facility
- 2/ FIRE Users: open calls

Experimentally-driven Research (Strep)

- iterative cycles of research, design and large-scale experimentation
- Future Internet as a complex system (holistic vision)
- definition of relevant metrics
- taking into account energy, low cost, environmental or socio-economic aspects

Coordination Actions (CSA)

- International co-operation/ standardisation, co-ordination of experience research and user-driven open innovation

FET Proactive – Self-Awareness in Autonomic Systems (15M€, IPs/Streps)

a) Creating Awareness at the elvel of autonomic nodes

b) Dynamic Self-expression

Call 5: Launch 31 Jul 09, Deadline 3 Nov 09, ~557 M€

Challenge	Objectives
Challenge 1: Pervasive and Trusted Network and Service Infrastructures	ICT 2009.1.1 The Network of the Future (call 5) ICT 2009.1.2 Internet of Services, Software & virtualisation ICT 2009.1.3 Internet of Things and enterprise environments ICT 2009.1.4 Trustworthy ICT ICT 2009.1.6 Future Internet Experimental Facility and Experimentally-driven Research

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A three dimensional approach

1. *Provide greater focus and coordination of on-going FP7-ICT Work Programme activities*
   a. Look for greater impact and take-up of results
   b. Articulate activities with policy requirements

2. *Establishment a PPP complementing the FP7-ICT WP activities*
   a. Bridge the gap between the technologies and key application sectors (energy, health, transport, etc) with massively distributed features
   b. Look for new actors and innovation opportunities

3. *Establish a Future Internet Forum of Member States*
   a. Set the basis for a Europe wide strategy on FI
   b. Share best practices

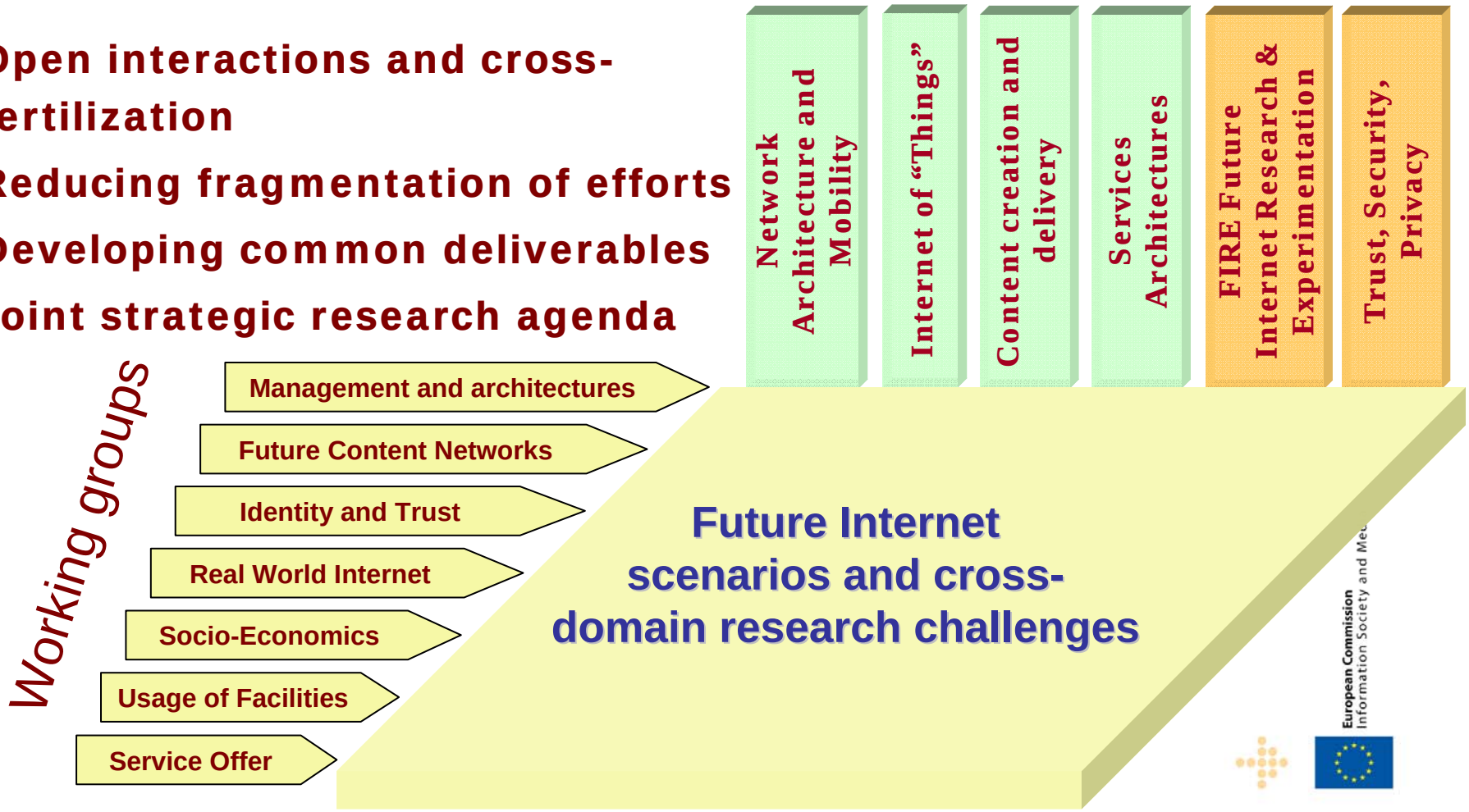
1. Greater Coordination through the Future Internet Assembly

- 94 EU-funded projects, 400 million euros, >500 participants
- R&D activities are no longer being seen from different technological silos
- FIA meets twice a year:
  - Bled, March 2008 ⇨ Bled Declaration
  - Madrid, December 2008
  - Prague, 11-13 May 2009 ⇨ Future Internet Forum
  - Stockholm, November 2009
  - … Valencia, April 2010

www.future-internet.eu

2. Organisation of the FIA

- **Open interactions and cross-fertilization**
- **Reducing fragmentation of efforts**
- **Developing common deliverables**
- **Joint strategic research agenda**



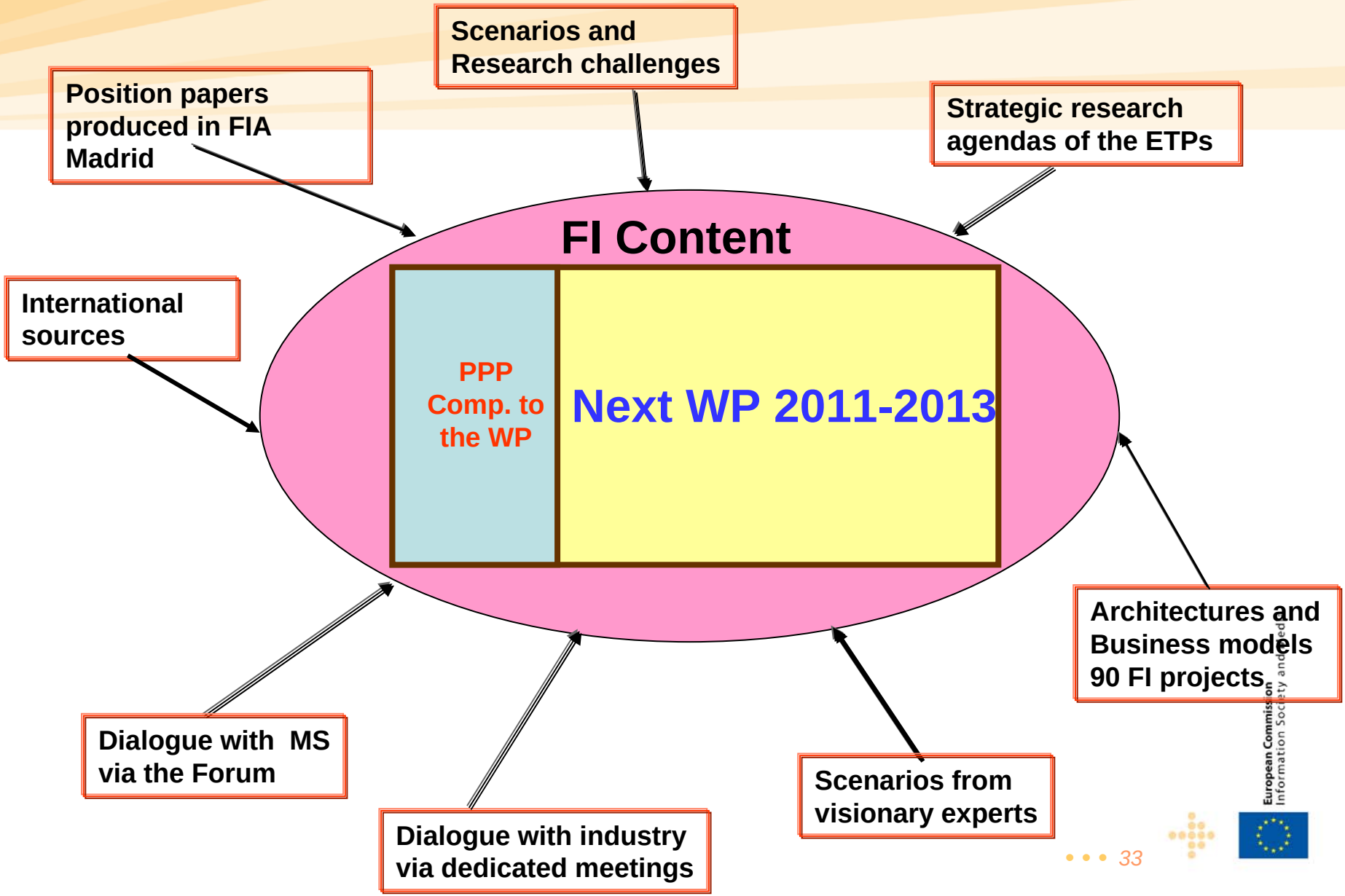
1. Internet Assembly - Next Steps

- A new wave of Future Internet related Projects will arise out of Calls 4 and 5
- Adding a potential 300 to 400 million euros of new funding to the Future Internet activities within the WP
- Coordination of R&D activities becomes ever more necessary
- Standards, regulations, governance need serious consideration

2. PPP on Future Internet

- Vision and SRA available
- Industrial commitment very high (core 16 members)
- Open to additional "critical" actors
- Having its focal theme in the short to medium term horizon (2015);
- Networking technological foundation but with a clear application focus (energy, transportation, health, etc)
  - Exploring the interrelationship of networks and applications
- Aiming at stimulating business innovation and new economic opportunities
- Implementation modalities under examination
- First public discussion in Prague (12 May 2009)

2. Partners in a dialogue



3. Forum of Member States FI Initiatives

- Promoted by National ICT Research Directors
- Future Internet Working Group launched under Slovenian Presidency to:
  - Take stock of national initiatives, towards joint programming and co-ordination of research in Europe
  - Fuel the ICT R&D and Innovation debate in view of the forthcoming changes in the policy landscape
  - Provide recommendations
- Two meetings (May and September 2009)

www.future-internet.eu/fileadmin/documents/reports/FI_Rep_final__281108_.pdf

3. Known Member States FI Initiatives

- Finland - ICT SHOK - www.futureinternet.fi
- Spain - Spanish Technology Platform convergent towards Future Internet" - www.idi.aetic.es/esInternet/
- Germany - G-Lab - www.german-lab.de
- France - Groupe de Reflexion Internet du Futur - GRIF
- Sweden - Ambient Sweden

www.vinnova.se/upload/EPiStorePDF/AmbientSweden.pdf

- Belgium - www.ibbt.be
- Luxembourg - www.ipv6council.lu
- Italy - TERIT - www.ict.cnr.it/documents.php?type=Actions
- The Netherlands - www.futureinternet.ez.nl
- Ireland - www.futureinternet.ie
- UK - www.internetcentre.imperial.ac.uk/about_us

Future Internet Event Prague

- 11 May 2009, High-level conference under the auspices of the CZ Presidency of the EU
  - Participation of minister-level speakers
  - Ribbon-cutting ceremony of the FI Forum of MS initiatives + Kick off meeting
  - Spotlight event on Trust in Digital Life
- 12-13: 3rd meeting of the FIA
- Several other side-events

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Conclusions

- Future Internet is recognised as a priority at European and international levels
- A comprehensive set of initiatives and tools are in place to pool resources
- Europe can and should take the lead in Future Internet developments
- The European mobile and wireless software and services community has strong potential to contribute to this collective endeavour

Thanks

More on Emerging Technologies and Infrastructures:

- **Future Internet**: http://cordis.europa.eu/fp7/ict/programme/challenge1_en.html
- **FET**: http://cordis.europa.eu/fp7/ict/programme/fet_en.html
- **e-Infrastructures**: http://cordis.europa.eu/fp7/ict/e-infrastructure/home_en.html