

*The Network of the Future
Towards a Green Internet*



MobiMedia10

Lisbon, 7 September 2010

Paulo de Sousa
Head of Sector 'Future Internet'
European Commission



European Commission
Information Society and Media

Outline

Europe 2020 and The Digital Agenda for Europe

Future Networks and Green Internet

FP7-ICT Work Programme 2011-2012

Challenge 1

Outlook to upcoming Calls



European Commission
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EU 2020: a new strategy to make the EU a smarter, greener social market

- **Economic Boost:**
Creating value by basing growth on **knowledge**
- **Inclusive Society:**
Empowering people in inclusive societies
- **Eco-Efficient economy:**
Creating a competitive, **connected** and **greener** economy
- **Governance** - making EU 2020 work

Europe 2020: 7 flagship initiatives underpin ambitious targets

Smart Growth	Sustainable Growth	Inclusive Growth
Innovation « Innovation Union »	Climate, energy and mobility « Resource efficient Europe »	Employment and skills « An agenda for new skills and jobs »
Education « Youth on the move »	Competitiveness « An industrial policy for the globalisation era »	Fighting poverty « European platform against poverty »
Digital society « A digital agenda for Europe »		

The European Digital Agenda



Broadband Europe

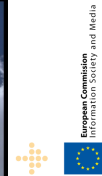
Digital Skills

Research & Innovation

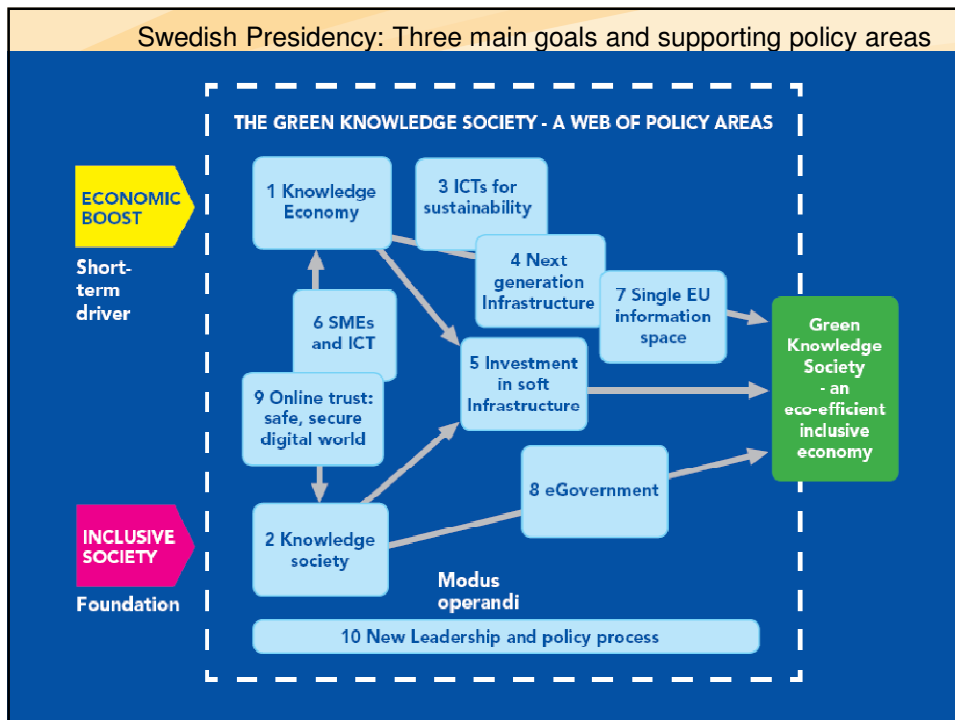


Borderless Services & Content Market

Sustainable – Green ICT



Swedish Presidency: Three main goals and supporting policy areas



Energy Efficiency of the ICT Sector: EC Actions

- > Launched the [ICT for Energy Efficiency Forum](#) where the ICT sector is working to establish a methodology to measure its own carbon emissions and once this has been agreed to commit to reduction targets.
Signed by Digital Europe, Japanese and American associations.
- > Developed a number of [Voluntary Codes of Conduct](#) to improve the energy efficiency of data centres, digital TV services, broadband equipment and external power supplies.
Signatory event at ICT2010.

What is a Code of Conduct

- a voluntary commitment of individual companies, to **reduce energy consumption of products and/or systems**, without hampering the fast technological developments and the service provided.
- Targets expressed in **maximum allowed power consumption**
- Energy consumption levels are complemented by **general commitments of power and energy management**.

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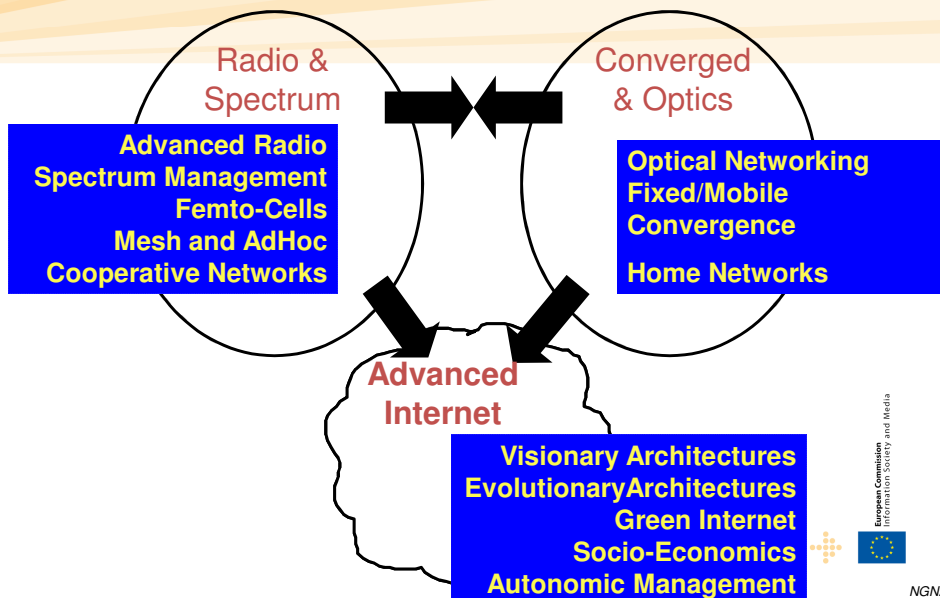
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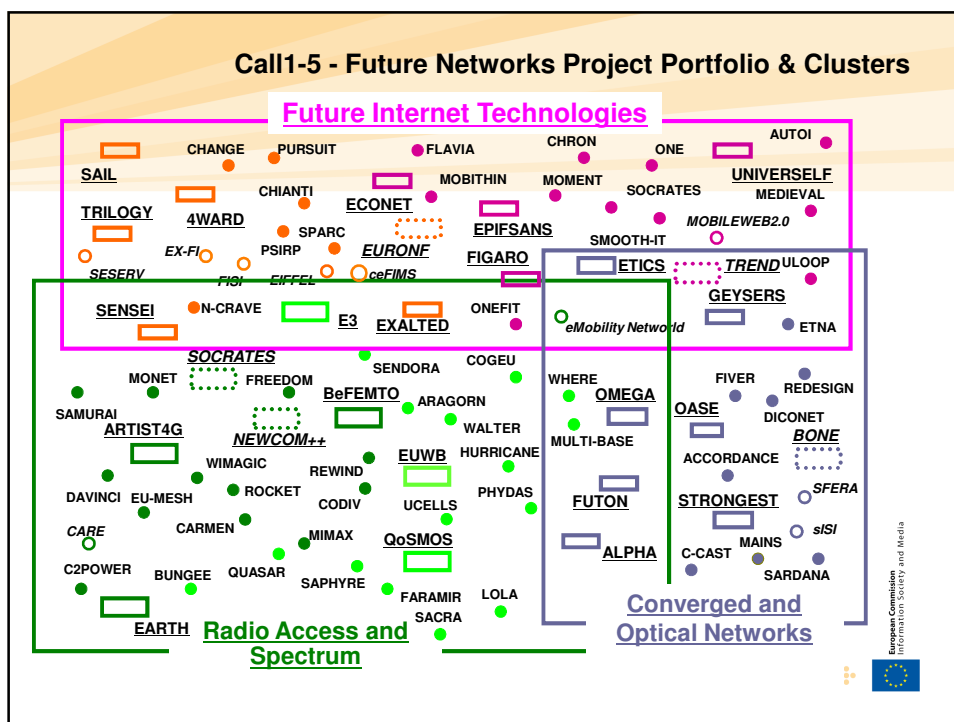
Outlook to upcoming Calls



Networks of the Future

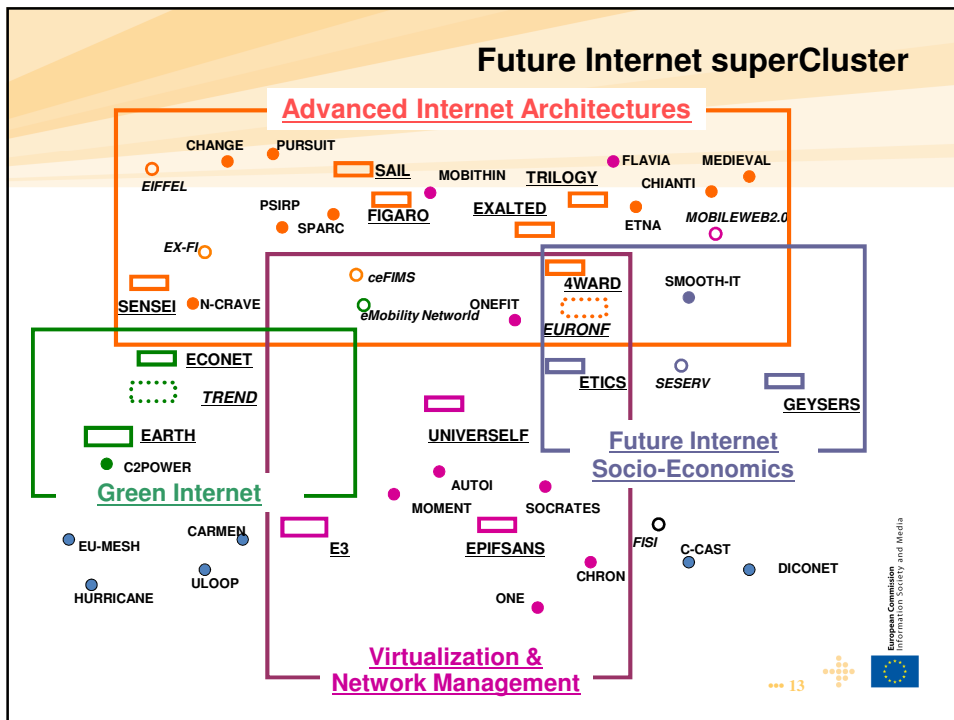


Call1-5 - Future Networks Project Portfolio & Clusters



Key topics of Research on Advanced Internet

- **Novel internet architectures and network management and operation frameworks**
 - Exploration of **network of information and other new paradigms**
 - Convergence **Internet & mobility**
 - **New routing paradigms to solve Scalability issues** related to explosion of traffic and endpoints
 - **Self or Distributed Management** approaches to handle the complexity



Green Internet : Motivation

- Today, ICT CO₂ contribution equals global air traffic contribution.
- Mobile Broadband traffic is “exploding” and continuing to grow.
- Current growth is not sustainable.

Two main tools to research:

- Use low power technology
- Manage power dynamically

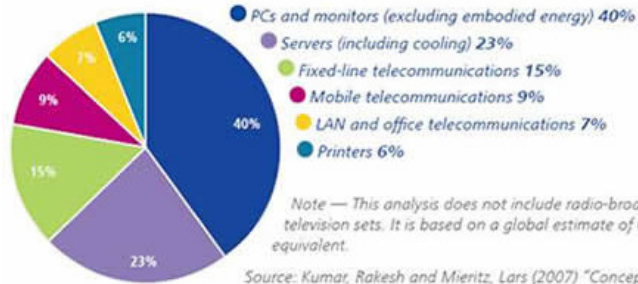
For all telecom components

and

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Estimated Distribution of Global CO₂ Emissions from ICTs



Note — This analysis does not include radio-broadcasting equipment or television sets. It is based on a global estimate of 0.9 Gigatonne of CO₂ equivalent.

Source: Kumar, Rakesh and Mientz, Lars (2007) "Conceptualizing "Green IT" and data centre power and cooling issues", Gartner Research Paper No. G00150322.

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Green Internet Projects

eearth
Energy Aware Radio and network technologies

ECO net

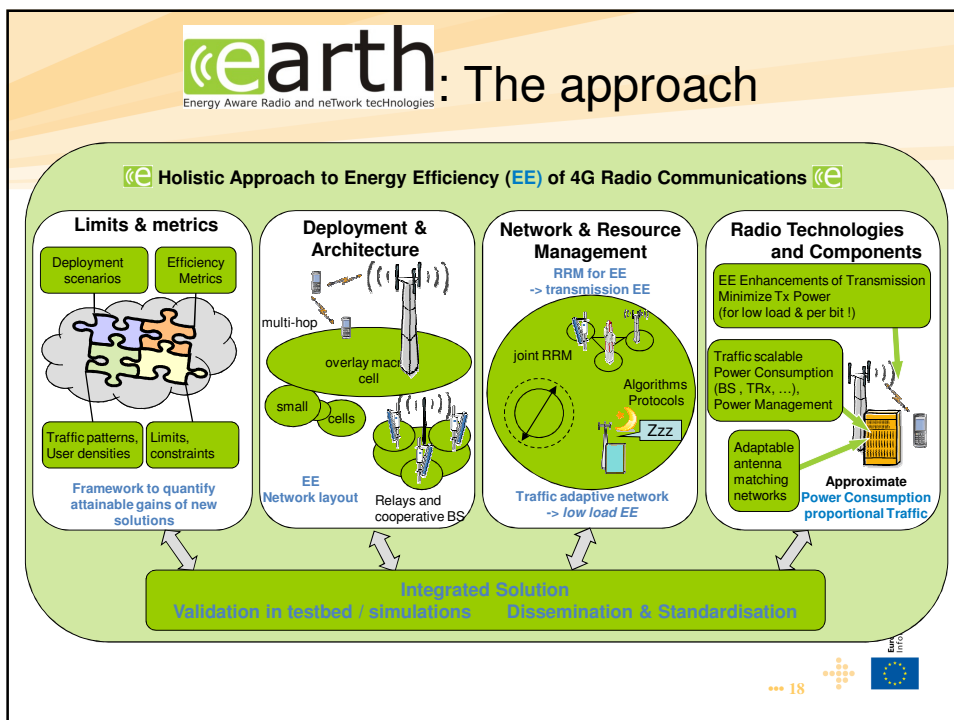
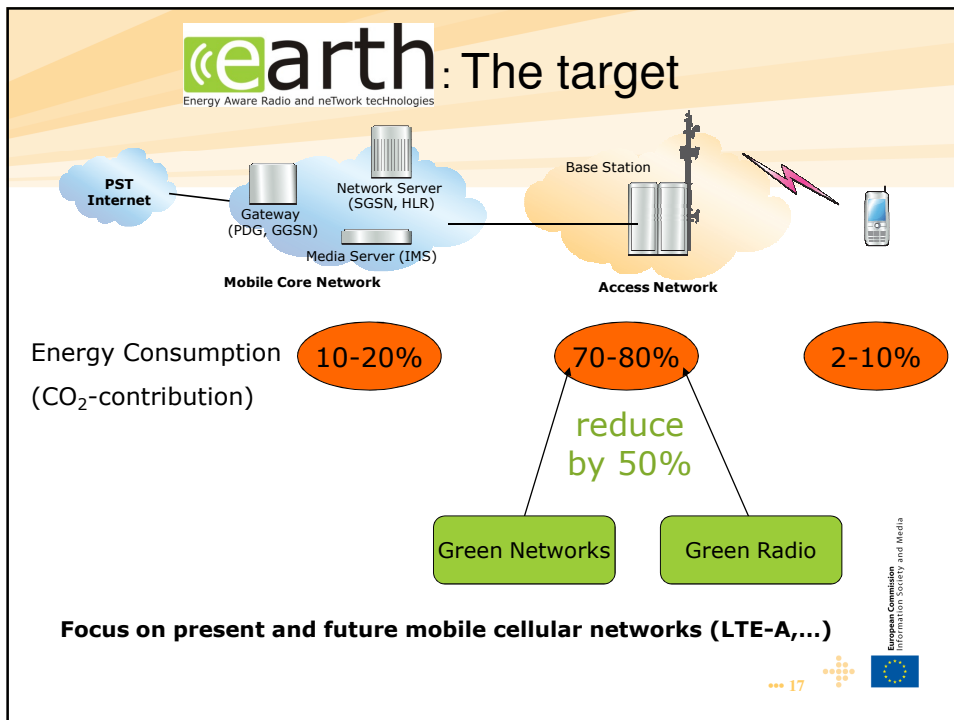


- **TREND:**
Towards Real Energy-Aware Network Design

9.5M+3.5M+6M+3M=22M€

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ECO net

- The ECONET project aims at studying and introducing **adaptive technologies (standby and performance scaling) that allow saving energy when a network device or part of it is not used.**
 - Access /home → standby when users are not “connected”; idle/performance scaling when users are “connected”
 - Core/metro → standby for redundant and unused HW; idle/performance scaling for active HW

**expected reduction in energy consumption
of 50-80%**

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TREND NoE: rationale and focus

- The European technical community can claim both a strong background in networking and a high level of environmental consciousness
- A NoE for promoting awareness and contributing to build a sound knowledge base in the scientific community
- Scope limited to networking; e.g., no direct attention to the estimation of the carbon footprint of the full lifetime of an electronic device, nor to power-related tradeoffs due to ICT technologies (e.g., the energy cost of telecommuting vs. the energy cost of physical commuting)

The aim of TREND is to establish the integration of the EU research community in green networking with a long term perspective to consolidate the European leadership in the field.

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TREND topics

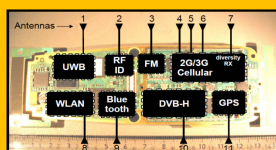
- Energy efficiency in network infrastructures:
 - Estimation of power consumption in ICT and collection of data
 - Assessment of the fundamental energy-saving potential of network technologies and protocols
 - Guidelines for policies and incentives to stimulate energy-efficiency in networks
 - Redesign the home equipment for energy efficient communications
 - Organizing the flying bits: saving energy on wireless access
 - Power on/off strategies for energy saving and transparent connectivity
 - Tools for power management and power management protocols
- Contribution to both “retrofit” of existing networks and “clean slate” design of new networks

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C2POWER Motivation

- 4G higher data rates and multi-mode functionality: As energy per bit decreases, in order to operate with acceptable signal-to-noise ratios, the transmitted power needs to be increased.



- 4G extra functionalities like advanced imaging features, camera, high-definition display, GPS, ... are power demanding.
- 4G ability to provide users with a continuous connection, or as it is typically referred to “always being connected”. From the battery standpoint, this can also be interpreted as “always being drained”.
- High power dissipation in terminals means that the temperature of the small handheld devices would rise to unpleasant values for the user, and make active cooling necessary
- Battery capacity has only increased by 80% within the last ten years, while the processor performance follows Moore’s law..

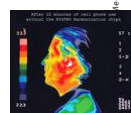
- □ 4G users will be left searching for power outlets rather than network access



- □ 4G devices will get hot !!!



- □ Increased human exposure to radiation

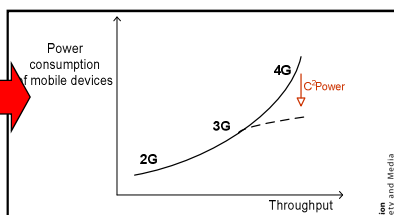
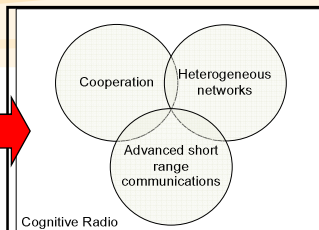


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C2POWER Objectives

- C2POWER** main objective is to research, develop and demonstrate energy saving technologies for wireless mobile devices, exploiting the combination of **cognitive radio** and **cooperative strategies** while still enabling the required performance in terms of data rate and QoS to support active applications.
- C2POWER** focus on the power that is consumed in the wireless transmission and reception process, i.e, the wireless subsystem of the **mobile devices** without considering any power issues at the other mobile phones functionalities (display, memory, camera,..)



aim is to **reduce the power consumption at the mobile device by up to 50%**



“Going Greener with telecommunications” Examples of Celtic Projects (1/2)

- OPERA-Net “Optimising Power Efficiency in mobile Radio Networks”** *Finalist for the “First Best ICT for Energy Award 2010 Project”*



Addresses the power and energy efficiency technology barrier to implement Next Generation Mobile Broadband Systems encompassing terminal, infrastructure and end to end systems –holistic approach considering a complete end-to-end system, identifying all relevant network elements and their interdependencies

- Major objectives**

 - Radical improvement in energy efficiency at system, infrastructure and terminal level to enable EU industry to take leadership in environmentally sustainable mobile networks
 - Develop metrics and Key Performance Indicators for mobile network efficiency to direct the development and stimulate competition for efficiency through easy system comparability
- www.celtic-initiative.org/Projects/OPERA-Net/;
www.opera-net.org



“Going Greener with telecommunications” Examples of Celtic Projects (2/2)

- **100GET “100 Gbit/s Carrier-Grade Ethernet Transport Technologies”**



Addresses new networking concepts and physical layer technologies for next generation Ethernet based transport networks (beyond 10GbE)

- One of the (many) outcomes of the project is **considerable lower energy requirements by a more efficient use of bandwidth over the fibers**
- <http://www.celtic-initiative.org/Projects/100GET/>
- New project ideas include also an *“ecological router”* (still TBC)



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ICT Work Programme 2011-12

Total available budget for next WP: ≈ 2.4 Bn€

Proposal includes 8 Challenges + FET

CH1 proposal major share ≈ 25%

Future Internet, 2 Strands under CH1:

Mainstream research on networks, trust & security, media, Sw & Services, Enterprise and IoT, FIRE: approach based on continuity.

→ A number of new issues under CH1 core objectives

FI-Public Private Partnership (PPP), closing the gap between research and innovation

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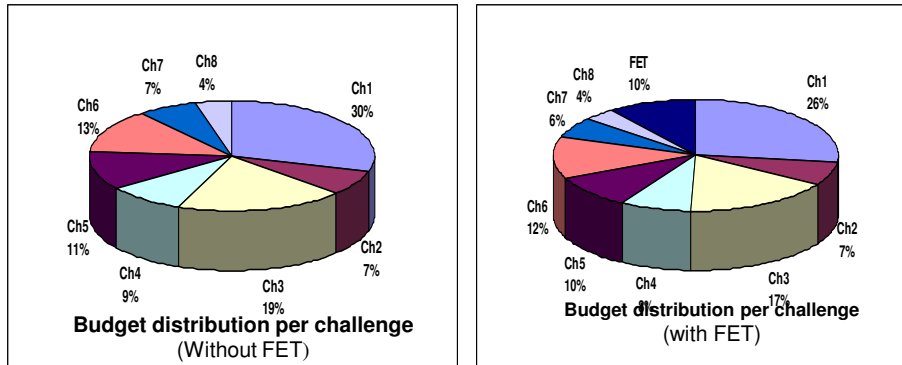
Budget available (M€)

	Available for ICT WP + JTIs/AAL	Eniac, Artemis, AAL	Other costs (COST, experts, studies ...)	Available for ICT WP Calls
2011	1255	111	50	1094
2012	1475	123	40	1312
2013	1692	122	38	1532
Total	4422	356	128	3938

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Overview of budget distribution



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Changes since 2007-08

Challenge	WP11-12	WP09-10	WP11-12 vs 09-10	WP07-08	WP11-12 vs 07-08
Ch1	625	540	15,74%	585	6,80%
Ch2	155	153	1,31%	167	-7,20%
Ch3	400	375	6,67%	434	-7,80%
Ch4	165	126	31%	203	18,7%
Ch5	256	234	9,40%	205	24,9%
Ch6	280	189	48,14%	159	76,10%
Ch7	140	52	169,23%	NA	NA
Ch8	100	88	13,6%	90	11,1%
FET	260	171	52%	185	40,50%
Total	2381	1928	23,5%	2028	17,40%

ICT4EE



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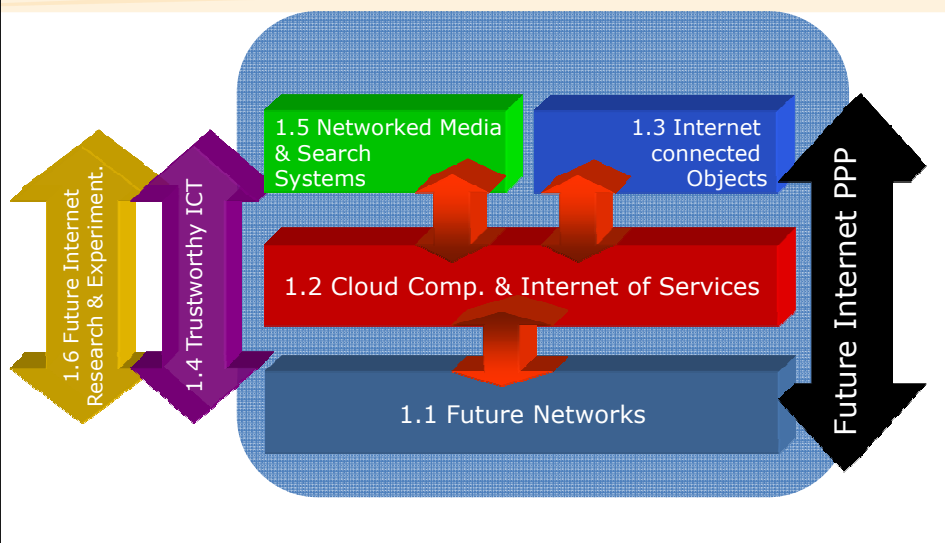
Challenge 1 (Future Internet)

Outlook to upcoming Calls

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Challenge 1 - "Pervasive and Trusted Network and Service Infrastructures"



Challenge 1 in ICT WP2011-12

Pervasive and Trusted Net. and Sces. Infrass.	625
1.1 Future Networks	160
1.2 Cloud Computing, Internet of Services and Advanced Software Engineering	70
1.3 Internet-connected Objects	30
1.4 Trustworthy ICT	80
1.5 Networked Media & Search Systems	70
1.6 Future Internet Research and Experimentation	45
1.7 PPP FI: Technology foundation – Future Internet Core Platform	41
1.8 PPP FI: Use Case scenarios and pilots	107.5
1.9 PPP FI: Capacity Building and Infrastructure Support	15.5
1.10 PPP FI: Programme Support	6

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Challenge 1

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Schedule of upcoming Calls

Six "Call packages" to be launched over two years:

- **20 July 2010** **4 PPPs** and FET-F with deadline 2 Dec 2010 + FET-Open + EU-Russia Call
- **28 Sep 2010** **Call 7** + EU-Brazil Call with deadline 18 Jan 2011
- 1 Feb 2011 SME initiative Call
- **26 July 2011** **Call 8** + 3 PPPs
- 18 Jan 2012 Call 9
- **18 May 2012** **FI PPP Call 2**

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Outlook to Call 7 (Challenge 1)

- Objective 1.3 Internet-connected objects
- Objective 1.5 Networked Media and Search Systems
- Objective 1.6 Future Internet Research and Experimentation (FIRE)

- Date of publication: 28 September 2010
- Deadline: 18 January 2011

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Call 7- Objective 1.5 Networked Media and Search Systems

- IPs and STREP's in the areas of:
 - Digital Media Delivery Platforms
 - End-to-end Immersive and Interactive Media Technologies
 - Multimedia Search
- CSA:
 - Coordination of related national and EU-wide R&D programmes/activities and cooperation between the relevant authorities
 - Dissemination of results and organization of scientific and/or policy events.
 - Research and technology development roadmaps and stakeholder coordination.
 - Analysis of international research agendas and roadmaps, pre-standardization initiatives and preparation of concrete initiatives/projects for international cooperation.
- Indicative budget per Instrument:
 - IP and STREP: 68M€ of which a min of 50% to IPs and 30% to STREPs
 - CSA: EUR 2M€

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Outlook to Call 8 (Challenge 1)

- Objective 1.1 Future Networks.
- Objective 1.2 Cloud Computing, Internet of Services and Advanced Software Engineering
- Objective 1.4 Trustworthy ICT
- Objective 1.6 Future Internet Research and Experimentation (FIRE)
- Date of publication: 26 July 2011
- Deadline: 17 January 2012

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Objective 1.1 Future Networks (160M€)

Target Outcome

- Development of energy-efficient future network infrastructures that support the convergence and interoperability of heterogeneous **mobile, wired and wireless** broadband network technologies



a) Wireless and mobile broadband Systems

- **LTE-Advanced and post-LTE Systems** (*targeting new radio transmission paradigms and system designs*)
- **Flexible spectrum usage** (*reference implementation for cognitive radio*)
- **Novel radio network topologies** (*autonomy, energy efficiency, low EMF...*)
- **Integration radio and fiber** (*integrated communication systems using e.g. femto-cells*)



b) High capacity end-to-end infrastructure technologies

- **Ubiquitous fast broadband access:**
convergence of heterogeneous broadband and mobile network technologies; (*heterogeneous networks with optimised traffic exchange*)
- **Ultra high capacity all-optical networks** (*WDM technologies enabling transportation of 160 wavelengths at 40Gb/s, in combination with TDM technologies with e.g. 100Gb/s per wavelength*)
- Functional split between circuit, flow and packet switching
- system perspective for photonic components and sub-systems undertaken in Objective 3.5



c) Novel Internet architectures and management and operation frameworks

- **Future Internet architectures**
(*designed for open access and heterogeneity of end-points with the need of a seamless and generalised handover*)
- **Visionary multi-disciplinary research on new architectures**
(*Cycles of research, design and large-scale experimentation of innovative architectures*)
- **Network management and operation frameworks**
(*Internet mobility, virtualization, and backward compatibility strategies*)
- **Self or distributed management approaches**
(*tighter integration between network functionalities and overlay service functionalities*)



d) Flexible, resilient, broadband satellite communication

- **Innovative system architectures and technologies**
(*ultra high capacity satellite communication systems with seamless integration capabilities, reconfiguration of satellite-terrestrial protocols*)
- **Novel technologies and architectures for resilient and flexible networks**
(Enabling institutional missions. Integration with navigation systems and sensor networks)



public-private partnerships

Factories of the Future

Energy Efficient Buildings

Green Cars

Future Internet



Future Internet: Innovations with 2 time scales

The PPP: medium term perspective

Open and shared platforms for future internet and web-based services

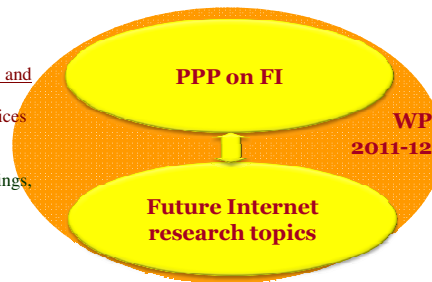
Exploiting a wider spread of information devices and systems, new access modes and service development tools

e.g. wireless and mobile, Internet of things, etc..

In the longer term, technology breakthroughs

-New network architectures, beyond IP networks, all optical, adaptive networks, LTE...

-Etc.



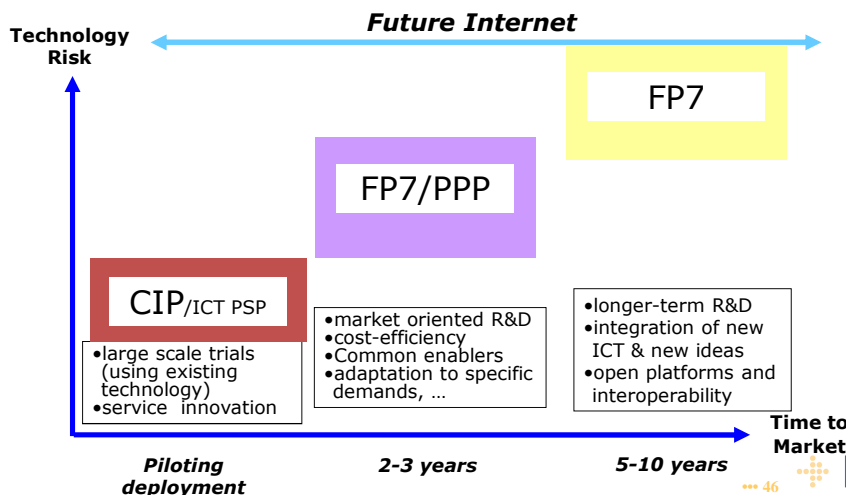
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Future Internet: A Comprehensive EU Approach



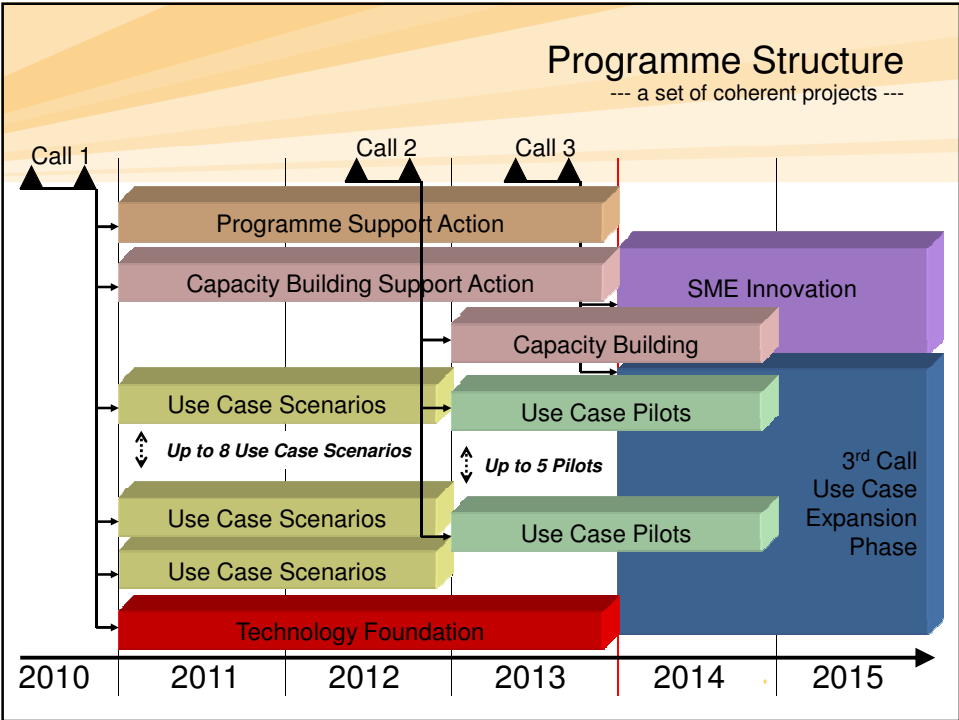
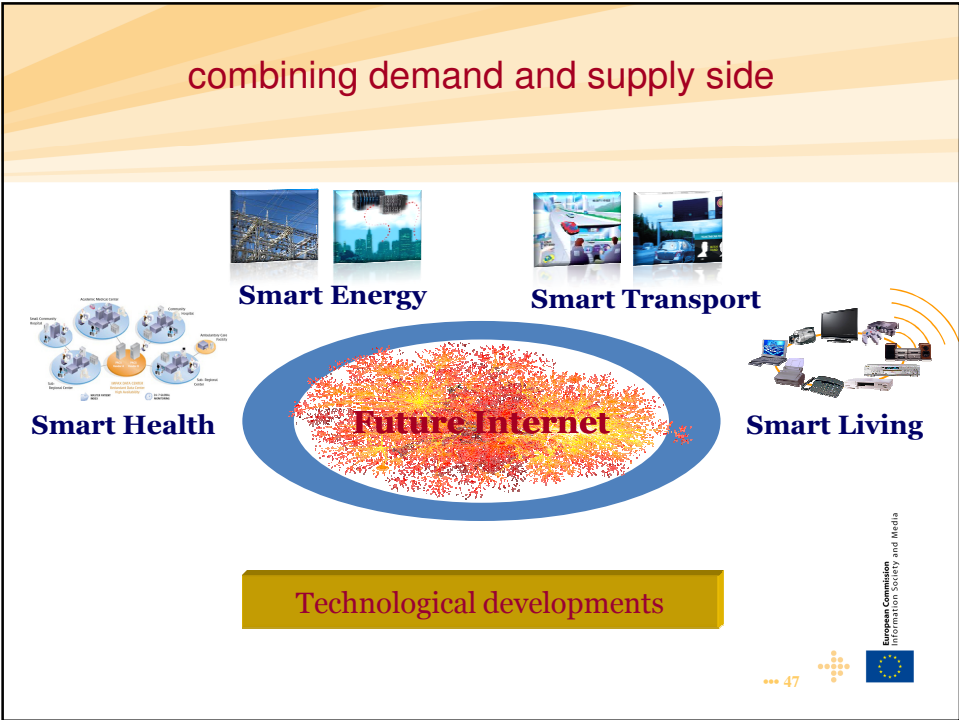
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towards Future Internet

Policy
Digital Agenda for Europe

Regulatory Framework
e.g. Spectrum policy and roaming



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Further Information

Sites to drill further:

- ec.europa.eu/foi – read about the many activities the EC undertakes on the subject Future Internet
- www.future-internet.eu – The European Future Internet Portal – the community site
- cordis.europa.eu/ict/ch1 – Ongoing European research and development activities

Events in 2010:

- 13-15 Sept – Barcelona, [NEM Summit](#)
- 21 Sept – Istanbul (ECOC), [Green Touch Workshop](#)
- 27-29 Sept – Brussels, [ICT Event](#)
- 30-1 Dec IoT2010 www.iot2010.org
- 16-17 Dec – Ghent, [FIA Conference](#)

Mail to: paulo.desousa@ec.europa.eu

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Future Internet PPP

Mega Trends & Opportunities

More INTELLIGENCE

How to take advantage of the wealth of information available real-time from a multitude of sources to make more intelligent choices?

Turning data into value

More FLEXIBILITY

How to make organization and systems just as dynamic as today's most innovative businesses?

Leveraging the value of "networked"

More EFFICIENCY

How can we face our collective responsibilities:
 - Traffic jams costs Europe 135 B€/yr
 - 40 to 70% of electricity is lost in inefficient grids
 -

Getting green and sustainable

Opportunity: making key societal infrastructures and business processes more intelligent and sustainable through tighter integration with the Internet.



Making use of multiple technologies

Multiple Future Internet Technologies not yet fully mature but whose application to smart systems/infrastructures is very promising → **virtuous tech/appli circle**

- **Devices**
 - Smart Phones
 - **Sensors/M2M**
- **True Mobile Broadband**
 - LTE,
- **Enabling Capabilities**
 - Real Time Context Based analytics
 - Real Time Social Networking communication and analytics
- **Pervasive 'cloud' services**
- **Secure and Trusted environments**



- Novel application capabilities
- New Business Models
- Empowering users, new Business Processes
- New social opportunities
- Multiple end user (consumer and enterprise) created personalized applications with an increasing focus on mobile

Use Cases

- Vertical application scenarios whose efficiency, sustainability and performances can be radically enhanced through a tighter integration with Internet based advanced capabilities.
 - Use cases, high social and economic impact, suggestion only
 - Each use case is expected to make use of technologies and functionalities leapfrogging current internet technologies, such as:
 - context awareness and sensor networks,
 - advanced real time information processing,
 - handling huge volume of data,
 - ad-hoc service composition and mash ups,
 - managed broadband connectivity and services,
 - embedded media support for interfaces easing the interpretation of contextual data.
 - Identification of generic vs. specific enablers
- ➔ **Pilots, CP functionalities validation, Phase 3 planning**

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Related Elements

- **Project line: Capacity Building and Infrastructure support**
 - Preparing for the infrastructure requirements for testbeds and validation phases
 - A key aspect of the “public” part of the PPP
- **Project line: Programme facilitation and support**
- **Openness: Standards, architectures, markets**
 - Another key aspect of public implications
 - Deployability, test and validations
- **SME dimension**
- **Open innovation model (Phase 3)**

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