

# Strategic directions in computing research in the European ICT Programme

## European Computer Science Summit



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# Outline

- FET (Future & Emerging Technologies)
  - FP7 – ICT
  - FET Proactive Initiatives (2002-2006)
  - FET Proactive Initiatives (2007-2008)
  - Future Directions
  - Conclusion



# Future & Emerging Technologies – FET

A continuing well established successful IST scheme

An incubator and pathfinder for new ideas and themes for long-term research in the area of information and communication technologies

High risk research, offset by potential breakthrough with high technological and/or societal impact

Two complementary inter-linked schemes  
FET Proactive + FET Open

## FET Proactive

- Top-down approach
- Set of novel pre-defined themes
- Pathfinder for related communities & themes



## FET Open

- Bottom-up approach
- Open to any research idea
- Incubator for new communities & themes



# FET Proactive Mission statement

- **(What):** FET Proactive acts as a pathfinder for the ICT programme by fostering novel non-conventional approaches, foundational research and supporting initial developments on long-term research and technological innovation in selected themes.
- **(How):** FET Proactive addresses evolutionary and revolutionary approaches through multidisciplinary cooperation.



It investigates new future technology options in response to emerging societal and industrial needs and identifies new drivers for research, e.g. by exploring the co-evolution of societal and technological change.



# FET Proactive Expected impact



- Building-up of excellence in novel ICT research themes
- Maturing emerging research communities
- Influencing and defining future industrial R&D topics
- Impacting on European research and education through the development of new research communities and of new academic curricula
- Promoting uptake of the research agendas defined through FET initiatives, at national or regional level
- Developing strategic partnerships on international cooperation



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## Structure of 7th Framework Program (2007-2013)

### **“Cooperation” (61%): Evolves around research themes**

- Collaborative research: Teams form to achieve a goal
- International collaboration: **ICPC and SICA**

### **“Ideas” – Frontier research (16%): European Research Council - ERC**

- Based on excellence and research interests of PI
- Basic foundational research

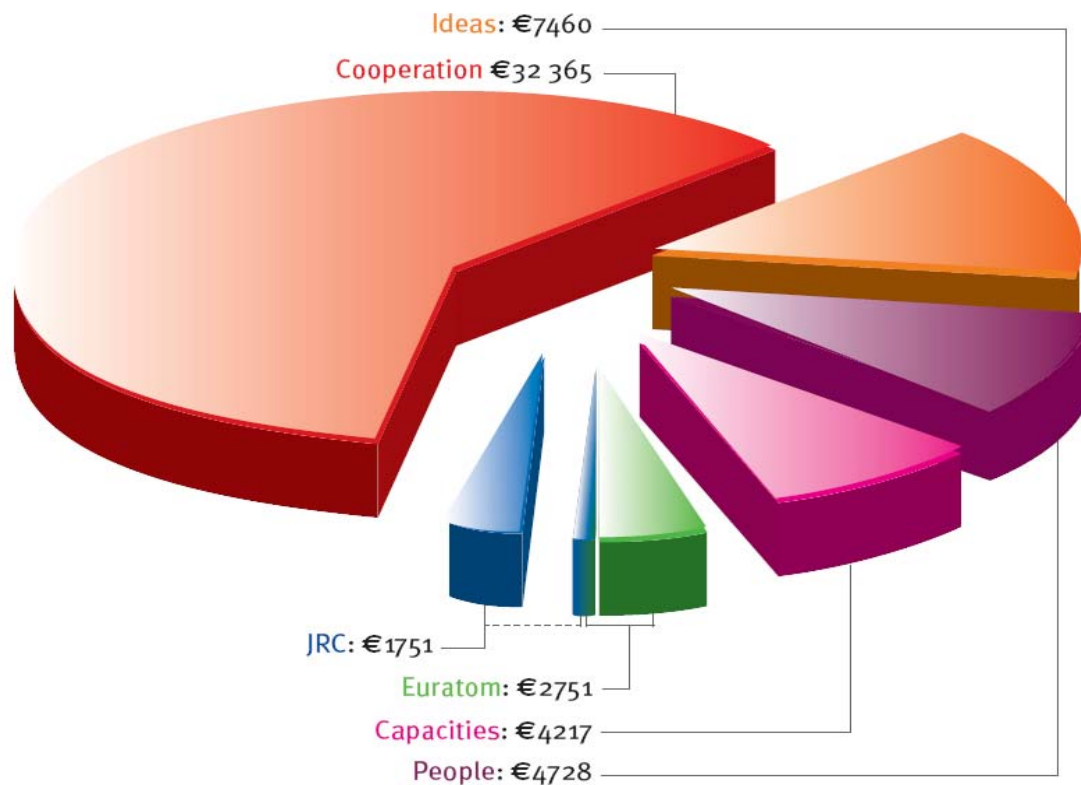
**“People” – Human potential (10%): Marie-Curie Fellowships...**  
Evolves around exchange of researchers including outside Europe,  
re-integration grants

**“Capacities” – Research capacity (10%): Research Infrastructures**  
International agreements (like GEANT), ICPC

Joint Research Center – (non-)nuclear (3%)

# FP7 budget distribution

The indicative breakdown (€ million) of FP7

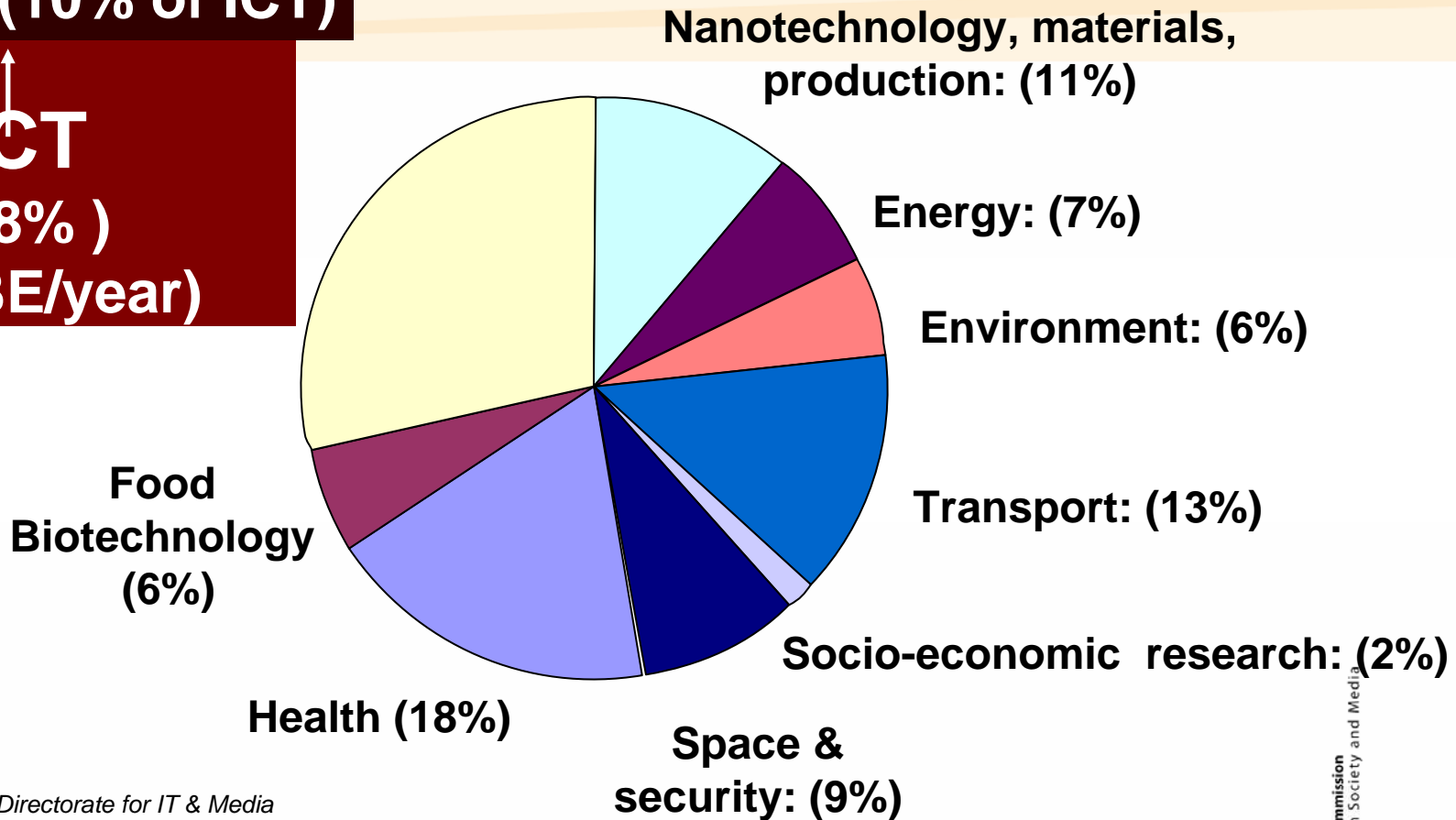




## Nine themes for cooperation programme

**FET (10% of ICT)**

**ICT**  
**(28%)**  
**(1.3 BE/year)**



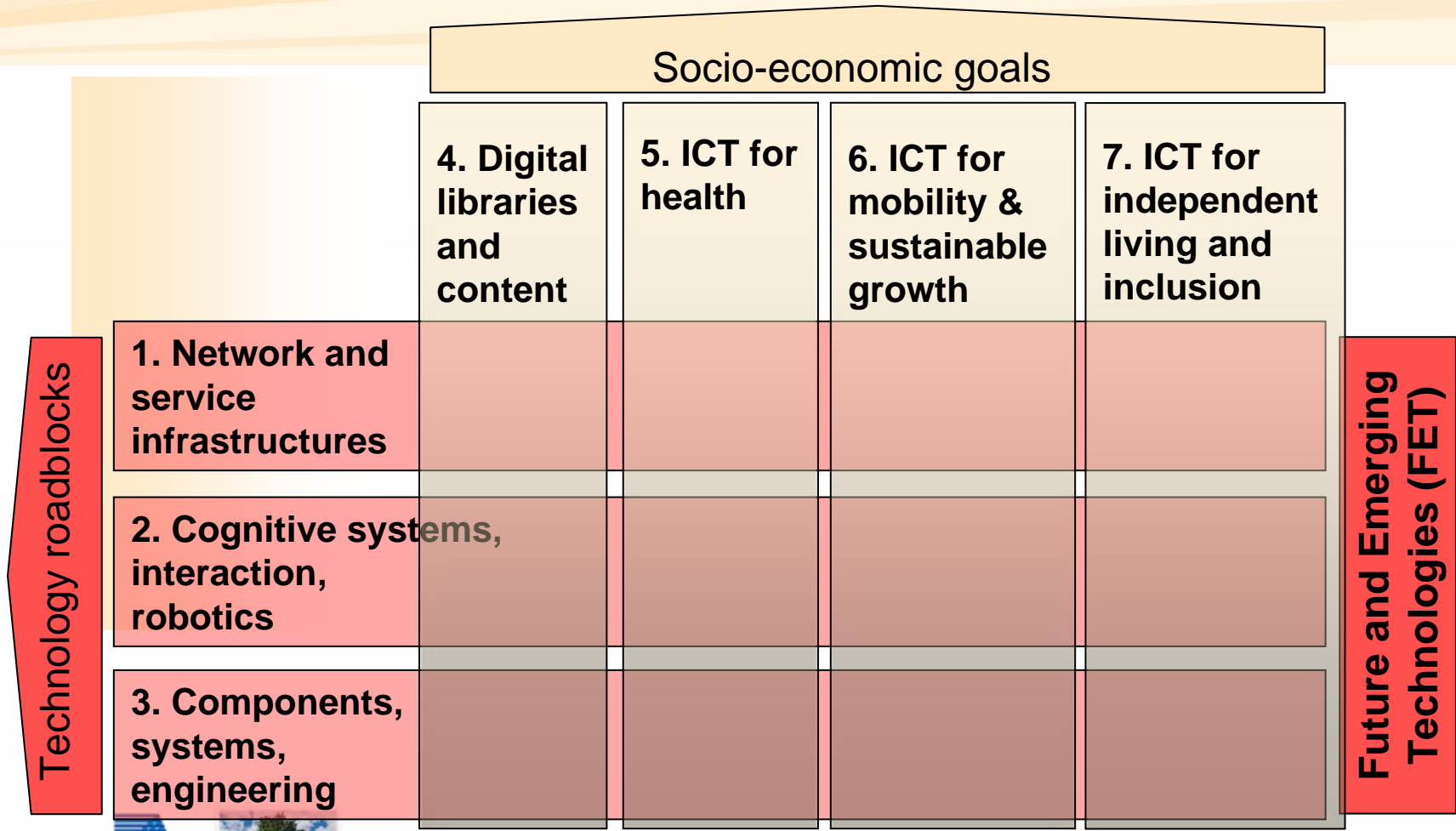
ICT is managed by Directorate for IT & Media  
All other themes are managed by Directorate for Research



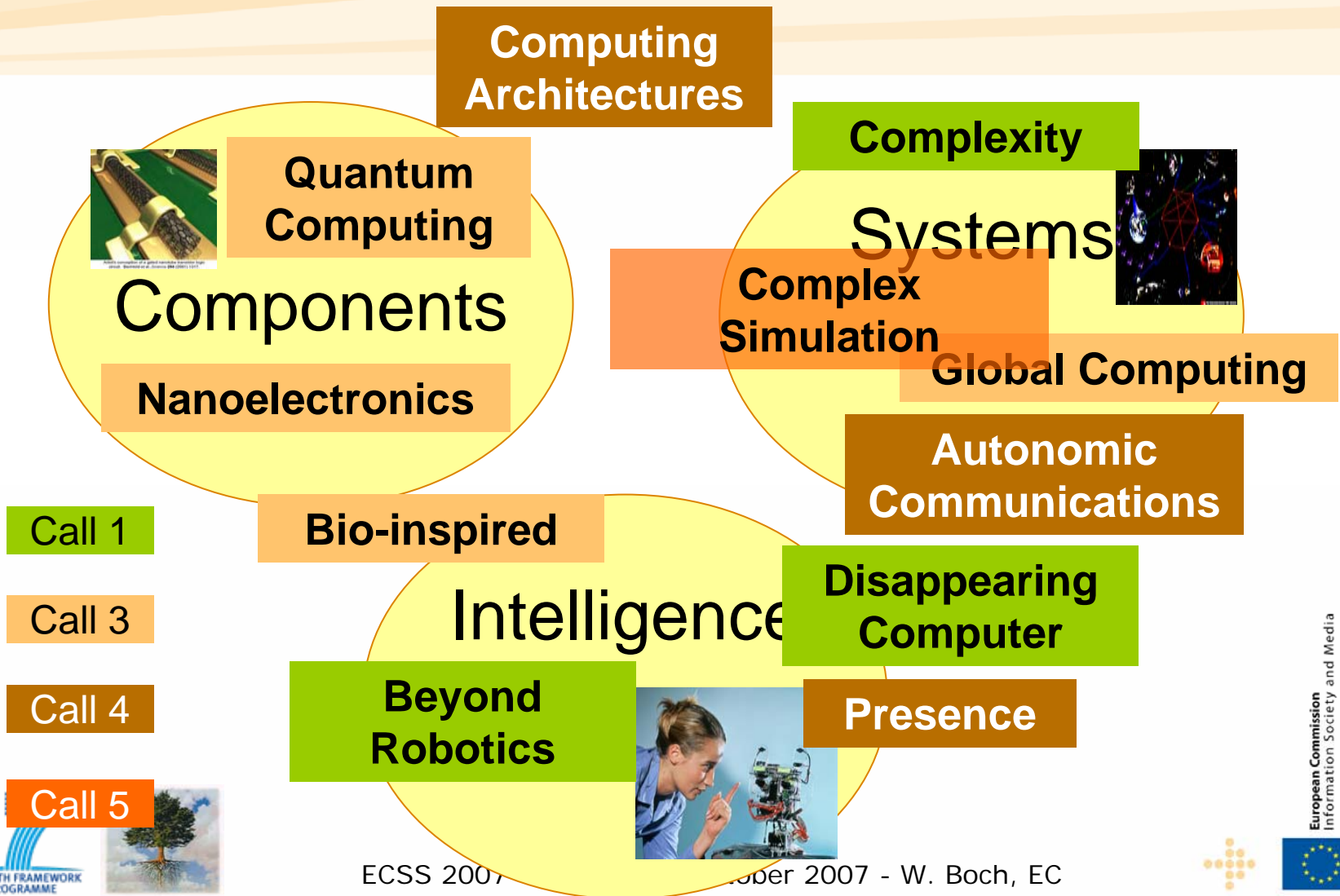
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# FP7 – challenges in ICT



# FET Proactive Initiatives launched during FP6



# European Technology Platforms

- Industry-led Framework to define
  - Priorities for R&D
  - Timeframes and action plans
  - Perspectives on non-R&D issues
- 34 Platforms launched, 9 related to ICT
  - NESSI – Software and Services
  - ARTEMIS – Embedded Systems
  - ENIAC, EPoSS, eMobility, NEM, Photonics21, EUROP, ISI
- Strategic Research Agendas



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# Future and Emerging Technologies: ICT pathfinder

- **Purpose-driven** Collaborative research
- Roadblocks in evolutionary R&D:  
explore **new options** where **no solutions known**
- Structured Foresight:  
Identify & nurture emerging ICT research themes,  
build critical mass in novel R&D areas
- Help new research communities emerge
- **Multidisciplinary**: ICT + other disciplines

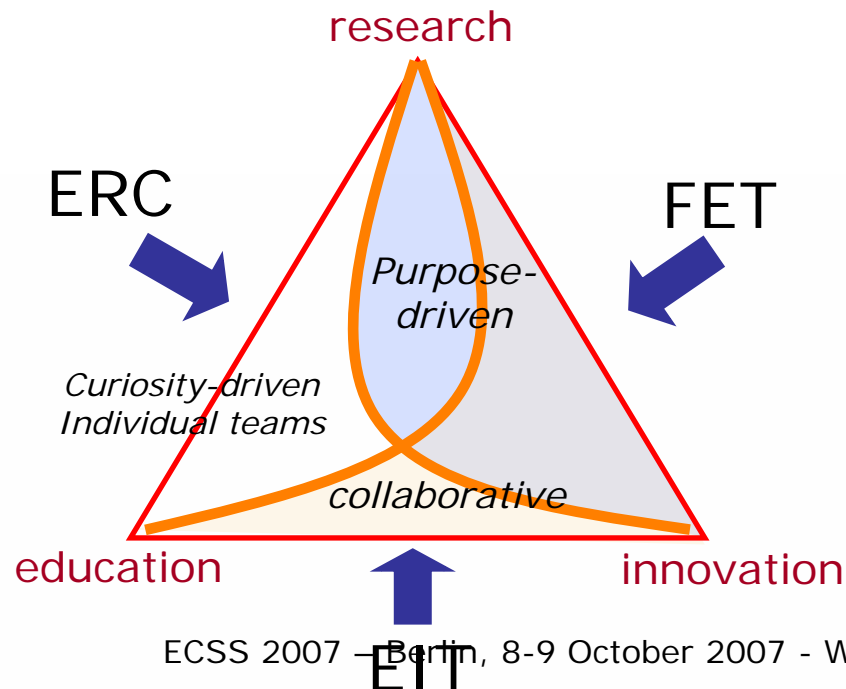


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# FET Proactive in the research landscape

- To be a genuinely competitive knowledge economy,
  - Europe must be better in producing knowledge through research
  - In diffusing it through education
  - In applying it through innovation



# FET Proactive Role in education

- Training of Researchers (in collaborative projects)
  - PhD students & Post-docs
  - Visits and short-term stays
  - Specific training activities (summerschools)
- Through Coordination Actions
  - Coordination of educational efforts of projects
  - Concertation of national education programmes
  - Creating graduate programmes, Master courses



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# Proactive initiatives in FP6

*Computing converges with communication and real world complexity*

Complex Systems

Novel design paradigms based on inspiration from real world systems or simulation and modeling of complex systems

Global Computing

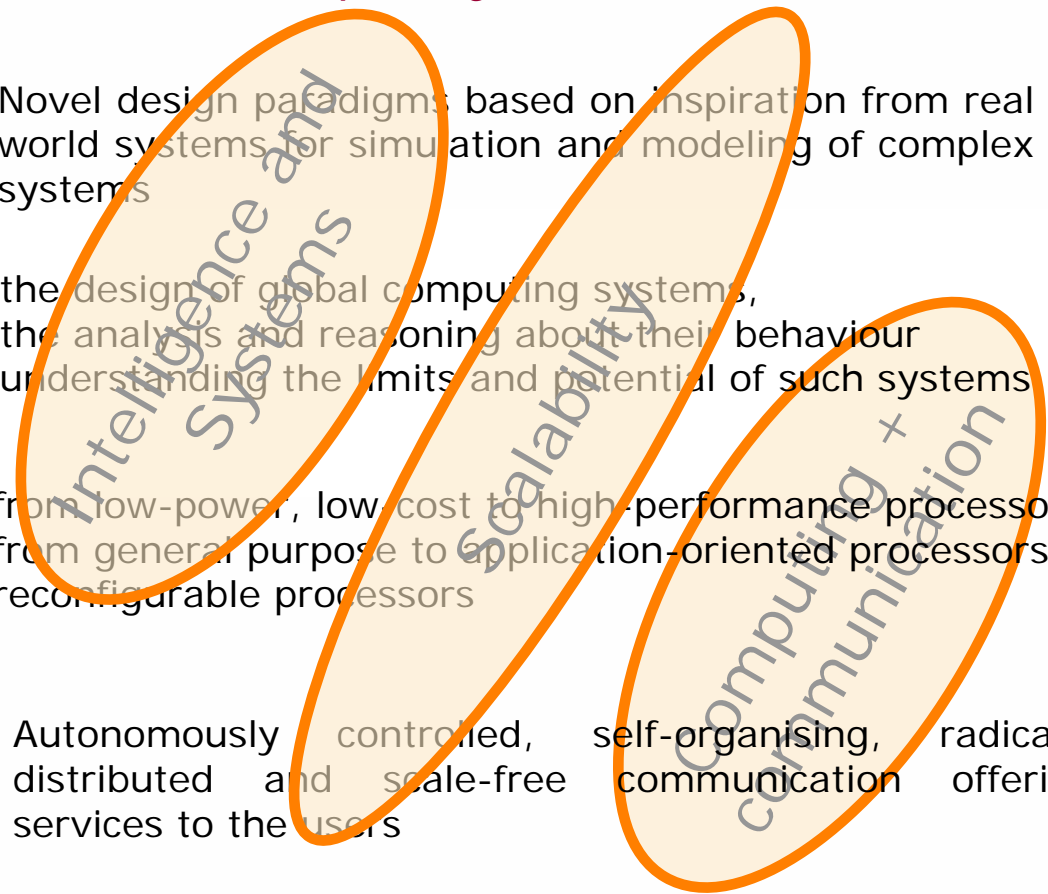
the design of global computing systems, the analysis and reasoning about their behaviour understanding the limits and potential of such systems

Advanced Computing Architectures

from low-power, low cost to high-performance processors from general purpose to application-oriented processors reconfigurable processors

Situated and Autonomic Communication

Autonomously controlled, self-organising, radically distributed and scale-free communication offering services to the users



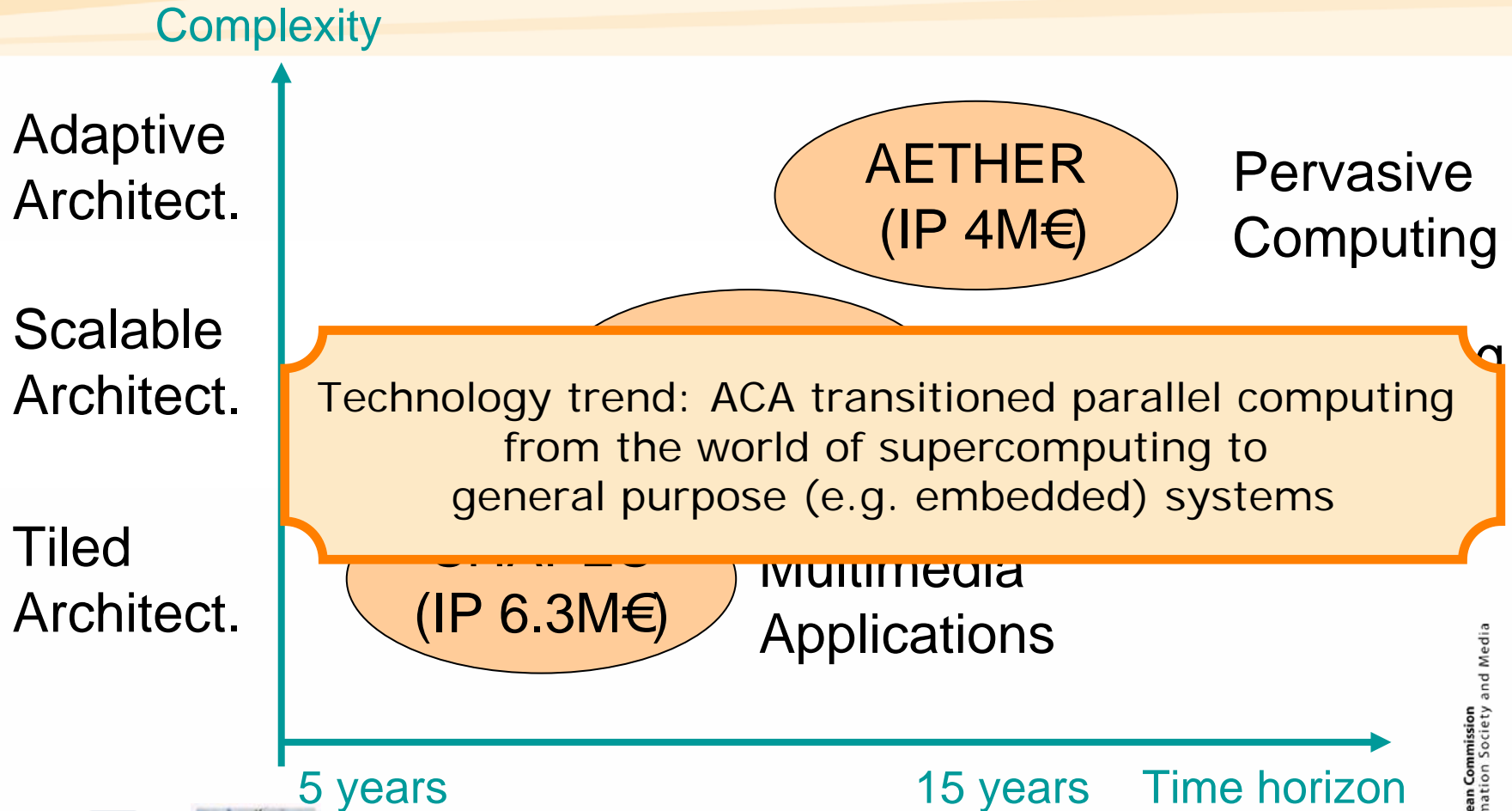
# Advanced Computing Architectures

- Novel advanced computing architectures, methods and tools
- Address the needs of applications in a 10+ years timeframe
- Aims:
  - Substantially increase the **performance** of computing engines (processors and scalable systems made of multiple processors)
  - Compiler and operating system technology to deliver high performance and efficient **code optimisation**, just-in-time **compilation**, **portability** across a wide range of systems.
  - Building blocks to be combined with each other and programmed easily and efficiently, even in heterogeneous processing platforms



# Advanced Computing Architectures

## Project Portfolio



# [ACA] AETHER

*(Self-Adaptive Embedded Technologies  
for Pervasive Computing Architectures)*

In the context of pervasive computing applications such as business, home and transportation, the main goals are to:

- increase the **performance** of embedded systems while reducing power consumption
- Reduce the **design** complexity of heterogeneous systems
- Provide the **flexibility** for **situation-aware computing**
- Mitigate the **complexity** of designing and managing large heterogeneous systems

Adaptation at all system levels

- It implements approaches such as
  - Applying **self-adaptive technology** at all levels
  - Exploiting dynamically **reconfigurable** architectures
- **Consortium:** CEA (coordinator), Amsterdam, Hertfordshire, Karlsruhe, CSI, Imperial, Barcelona, Prague, VTT, CNRS, INTRACOM, Thales, Atmel, ACIES



# Global Computing

Interconnection of existing networks

- Computational infrastructures able to provide uniform services
- Overlay computers
- *distribution: trust, reliability, ...*

- *security*
- *resource usage and management*
- *scalability*
- *distribution transparency*

Global computing refers to computation over "global computers", i.e., **computational infrastructures available globally and able to provide uniform services with variable guarantees for communication, co-operation and mobility, resource usage, security policies and mechanisms, etc., with particular regard to exploiting their universal scale and the programmability of their services.** As the scope and domain of applications of global computing continues to grow, it is expected to invest their potential benefits, and ultimately improve our quality of life, a vision needs to be realised which goes well beyond incremental and disconnected improvements of diverse (and often incompatible) implementations.

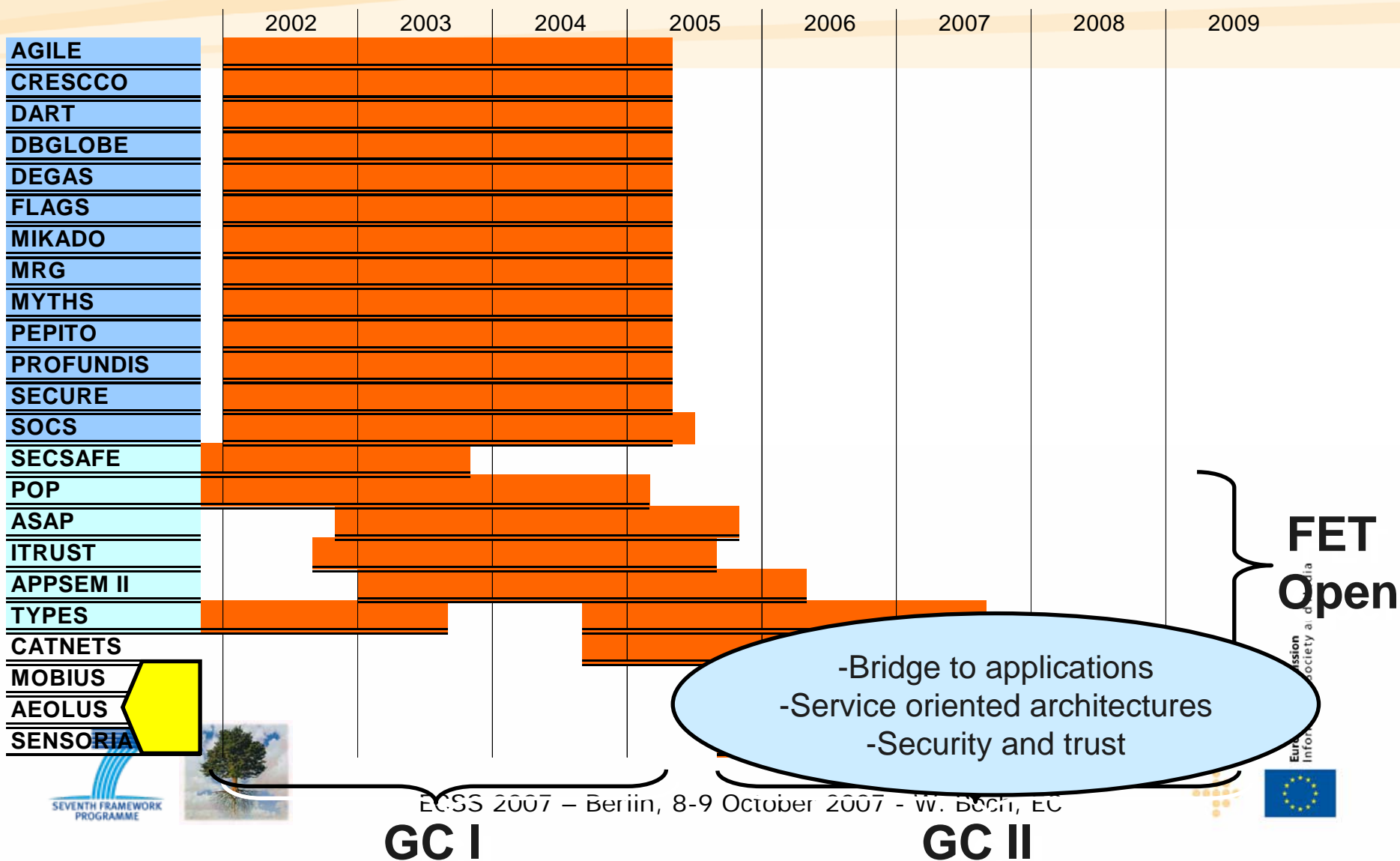
The key aim of this initiative is to promote improvements in computational paradigms, linguistic mechanisms and implementation techniques for the design, realisation and deployment of global computational environments and their application and management. The expected result in the long term is to achieve real, integrated global computing in a wide range of application scenarios by providing foundational advances on equally large issues as global computers together with the integration of methods and concepts necessary to advance global computing as a whole.

Through the abstractions of common characteristics representing global computers, referred to as "overlay computers", Global Computing tackles the four issues of security, resource usage and management, scalability and distribution transparency. There is growing overlap with the area of Grids, especially as the area of Grids has started to consider issues such as mobility, while researchers in the area of Global Computing have increasingly considered issues such as dependability and monitoring.

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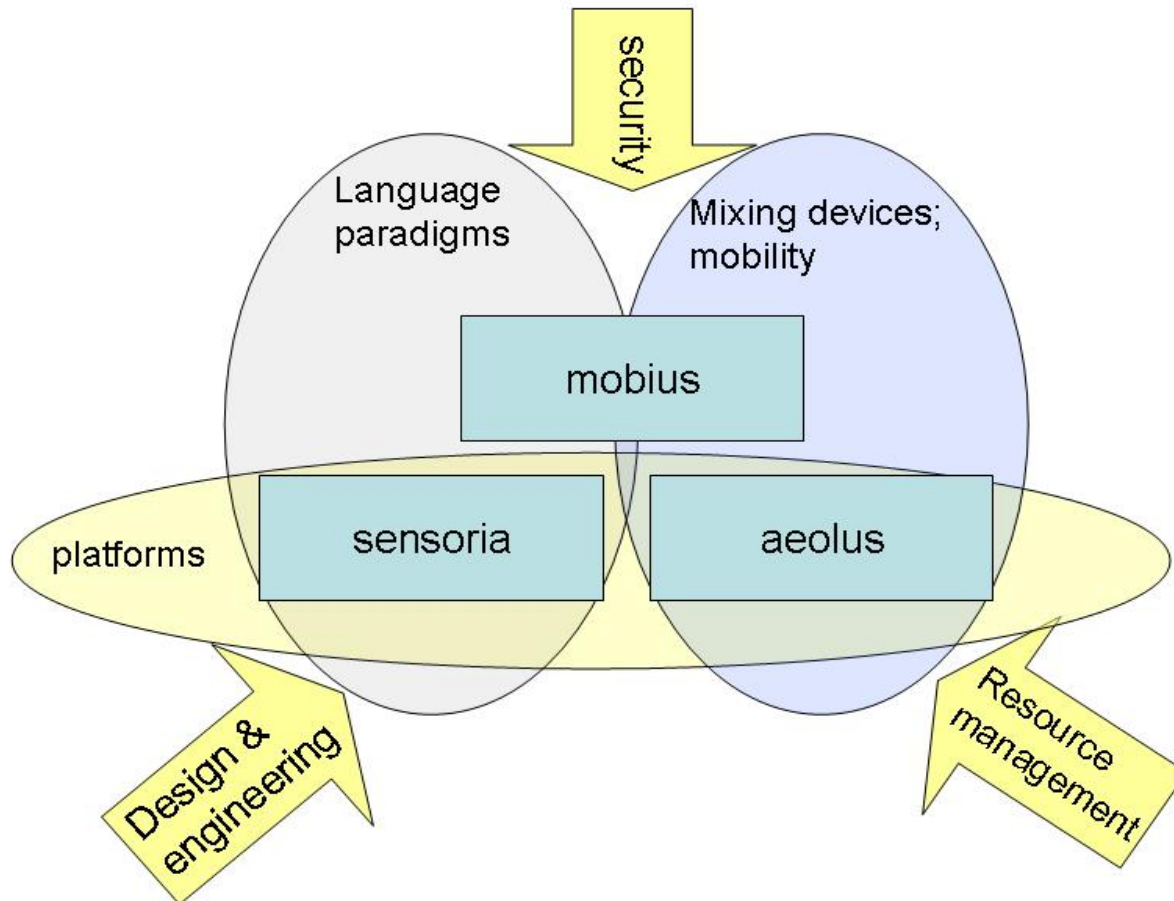


# Global Computing Timeline



# Global Computing II

## *simplified*



# Global Computing II projects



## Mobius

EC contribution: 6.25M€

MOBIUS will investigate trust and security for small devices which are functioning as a part of global computers. The main focus is on proof carrying code aimed at checking previously created proofs with modest computational resources.



## Sensoria

EC contribution: 8.15M€

Sensoria will develop a novel methodology for engineering service-oriented overlay computers and for building a framework for context-adaptive, personalisable global services

Technology trend: GC functioned as an incubator (i.e., feeding into the mainstream programme) and established new foundations for GRID, P2P systems, distributed systems, security, etc.

Aeolus aims at providing tools, trust management, secure distributed computation) to enable transparent and efficient access to an internet-based global computer, EC





# [GC II] SENSORIA

## (Software Engineering for Service-Oriented Overlay Computers)



- Engineering of service-oriented overlay computers
- Context-adaptive, personalized services
- Applied to e-business systems, telecommunication systems,

- International results
- Industry (Fast GmbH, ATX Software)
- Attracting world-renowned researchers
- Links to standards: World Wide Web Consortium; Object Management Group; Internet Engineering Task Force

Foundations of service-orientation



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# FP7 Proactive Initiatives

## FET Proactive (Call 1) – Closed 8 May 2007

- Nano-scale ICT devices and systems
- Pervasive Adaptation
- Bio-ICT Convergence

## FET Proactive (Call 3) – Closing March 2008

- Science of complex systems for socially intelligent ICT
- Embodied Intelligence
- ICT Forever Yours

## FET Proactive (Call 4, tentative) – Closing spring 2009 (tbc)

- Massive ICT Systems
- Human-Computer Confluence
- QIPC and other quantum technologies



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# FP7 Call 1: Pervasive Adaptation

*adaptation and evolve-ability in  
pervasive systems and networked societies*

- **Key features:**
  - Self-adapting software, hardware, protocols, architectures, ...
  - Massively scalable
  - Capable of adapting to highly dynamic contexts
  - Autonomous adaptation strategies (bio-inspired, stochastic, ...)
  - Multidisciplinary, human-centric research
- **Evolve-able pervasive systems**
  - From short term adaptation to long term evolution
- **Networked societies of artefacts**
  - From local autonomy to collaborative systems; ensembles of artefacts

## IMPACT:

Scalability under broad range of conditions  
Human-centric and adaptive services  
Reduced management and maintenance cost  
Higher security and trust



# Pervasive Adaptation – projects

## **SYMBRION**

Symbiotic Evolutionary Robot Organisms

## **REFLECT**

self-organised and adaptive collaboration between people and their specific environments.

## **Allow**

Enabling real-life objects based on concept adaptive pervasive flow.

## **SOCIALNETS**

social anthropology and social networks used to design trustable and adaptive networking protocols

## **ATRACO**

Ecologies comprising people, context-aware artefacts and digital commodities.

## **FRONTS**

foundation for adaptive networked societies of small or tiny heterogeneous artefacts

## **PANORAMA**

Coordination Action

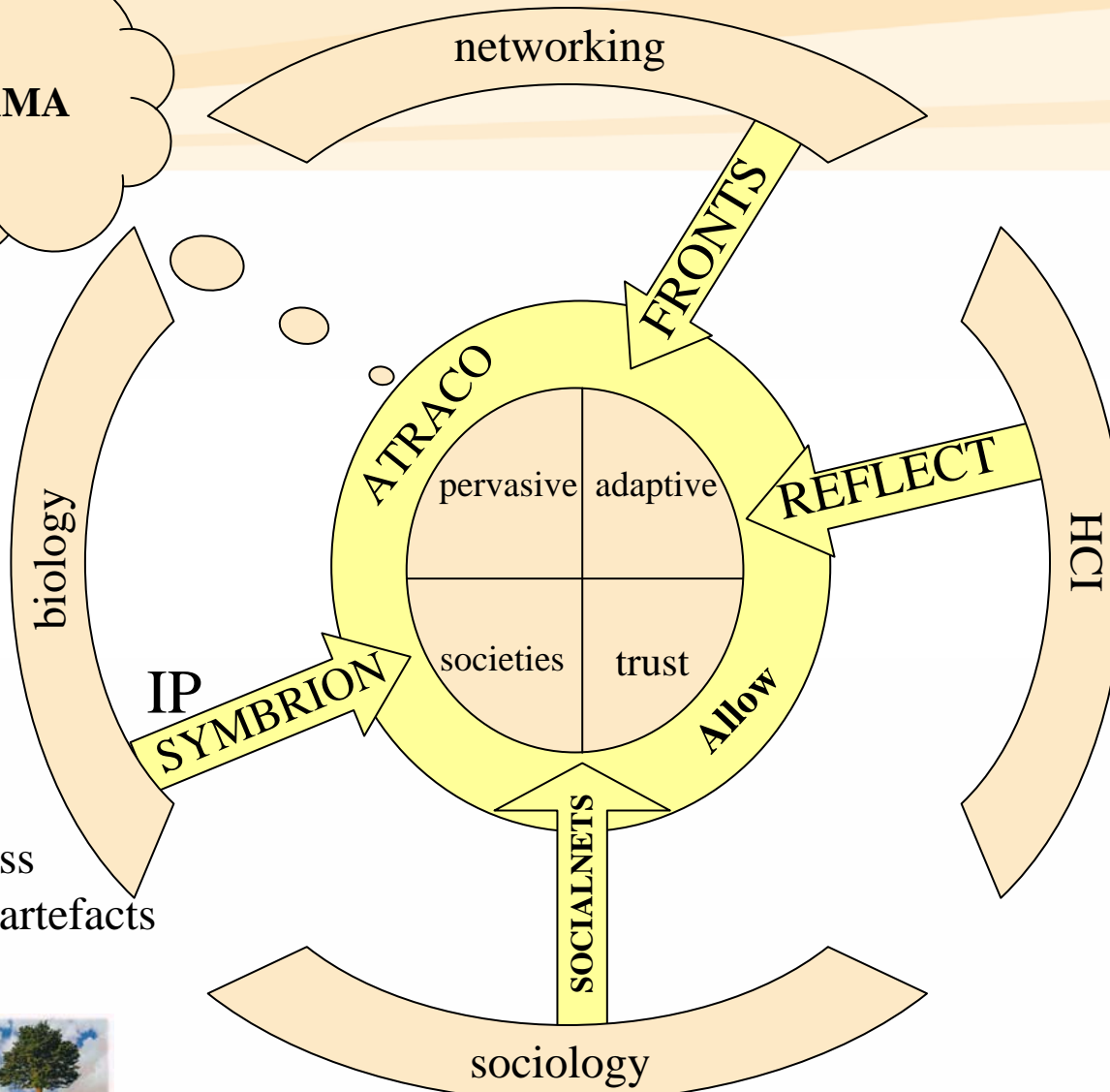


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# Pervasive Adaptation - overview

CA:  
PANORAMA



## Inspiration and grounding

- networking
- biology
- sociology
- HCI/cognition

## Coverage

- adaptation
- pervasiveness
- societies of artefacts
- trust



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# ICT Forever Yours

## The rationale and objectives

The mass diffusion of digital systems and their pervasiveness in our everyday lives increases our expectations on the dependability, security and longevity of these systems.

This requires new built-in mechanisms for

- enhancing confidence in their usage,
- preserving them from the threat of ageing,
- protecting them from malicious intents

in the context of highly decentralised and incremental development and deployment practices.

*designing for longevity, diversity and security*





# ICT Forever Yours Research Objectives

- **Key features:**
  - Longevity
  - Knowledge in context
  - Preservation
- **Eternal systems**
  - Self-sustaining, evolving, minimal intervention
  - Future proof
- **Knowledge, diversity and time**
  - Exploiting locally maintained knowledge
  - Building on external knowledge
- **Secure and dependable software**
  - Secure programming
  - Assessability in context



# ICT Forever Yours expected impact

The research should contribute to the design of highly distributed and heterogeneous software or of ambient systems:

- **adapting** to change in the environment with minimal intervention;
- **harnessing** dispersed and dynamic content by exchanging knowledge at a semantic level that is robust against diversity of origin and use;
- **preserving** or **adapting** original functionality and properties over time;
- **providing security** through verifiably secure programming models;
- **offering assessability** and proof of their trustworthiness in the context of their environment.



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# QIPC draft initiative for 2009

- Overcoming major challenges for quantum technology
- Deliver on promise to radically outperform classical counterpart
- Not only speed, capacity and communication security, but also solve practical problems that currently can't be solved

*Stengthen international collaboration on foundational research in an area where Europe has established itself firmly at the leading edge.*



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# Future and Emerging Technologies: Elaborating the Work Programme

- Beyond the Horizon
  - Pervasive Computing and Communications
  - Nanoelectronics and Nanotechnology
  - Security, Dependability and Trust
  - Bio-ICT Synergies
  - Intelligent and Cognitive Systems
  - Software Intensive Systems
- Further consultations
- ETP

WP0708

- Shaping the Future of FET
  - And follow-up events
- **NEW:** ICTAG
- Further consultations
- ETP

WP0910



# Developing the next Work Programme

## FET Proactive

Draft Call 4  
in WP 2007-08

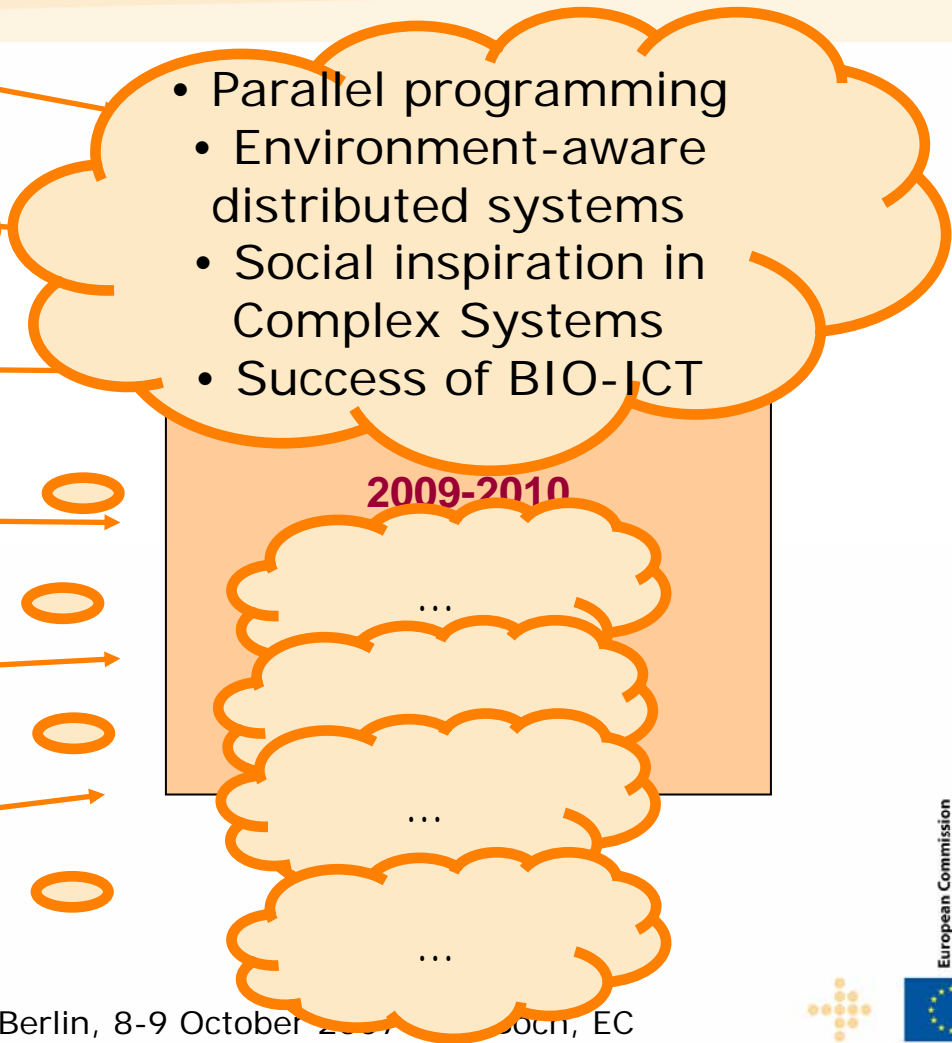
Shaping Future  
FET Proactive

Shaping Radically  
New Ideas

Topical Workshops

ICTAG Long-Term  
Working Group

Public Consultation



# FP7 Timescales

2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

**FP7 Call 1 PROJECTS**

**WP 2007-08**

**FP7 Call 3 PROJECTS**

**FP7 Call 4 PROJECTS**

**WP 2009-10**

**FP7 Call 6 PROJECTS**

**FP7 Call 7 PROJECTS**

**Beyond 2010**



# Work Programme Agenda

## FET Proactive

Sep. 07	Shaping FET Proactive
Nov. 07	Topical consultation meetings (3)
Nov. 07	Consultation on radically new ideas
Jan. 08	Topical consultation meetings (3)
Jan-Feb. 08	Public Consultation
Mar. 08	First Work Programme Draft
May 08	WP to Programme Committee
Oct. 08	WP adoption



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# Conclusions

## FET Proactive

- FET is a home for long term, foundational and high-risk research
- FET has supported the creation of new communities (e.g., Global Computing and QIPC)
- FET has attracted top-level scientists
- QIPC is a European success story
- FET is feeding the mainstream ICT program with fresh ideas
- FET offers ample opportunities for CS



# References - Documents

Beyond the Horizon documents:

<http://www.beyond-the-horizon.net/>

FET Proactive on CORDIS:

[http://cordis.europa.eu/fp7/ict/fet-proactive/home\\_en.html](http://cordis.europa.eu/fp7/ict/fet-proactive/home_en.html)

FET Call 3 Documentation:

[http://cordis.europa.eu/fp7/ict/fet-proactive/calls\\_en.html](http://cordis.europa.eu/fp7/ict/fet-proactive/calls_en.html)

Contacts:

[http://cordis.europa.eu/fp7/ict/fet-proactive/who\\_en.html](http://cordis.europa.eu/fp7/ict/fet-proactive/who_en.html)

