

Future Internet Research and Experimentation

fire

**experimentally-driven long-term research
on Future Internet concepts**

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<http://cordis.europa.eu/fp7/ict/fire>

Background: the Internet... and its **limits** (architecture, IP protocol)

■ Scalability

- Devices (users AND nodes, mostly wireless) will outnumber humans by several orders of magnitude
- Not only numbering: Service-centric networks in contrast to the source-destination approach of the Internet (semantic processing, space-aware mobility)
- Need to overcome the intrinsic limitations of a centralized management, self-organizing and interdisciplinary approaches to cope with complexity (e.g. bio-inspired)
- Multiple types of attachments to the infrastructure
- Routing

patches

patches

■ Suitability for ad-hoc/mesh networking

- disconnected operation (opportunistic, trust and privacy, ...)

patches

■ Mobility

- Mobile IP (or MIPv6) not effective, overhead

■ Transparency

- S???
- st?

patches

■ Security

- How to cope with heterogeneous networks

patches

patches

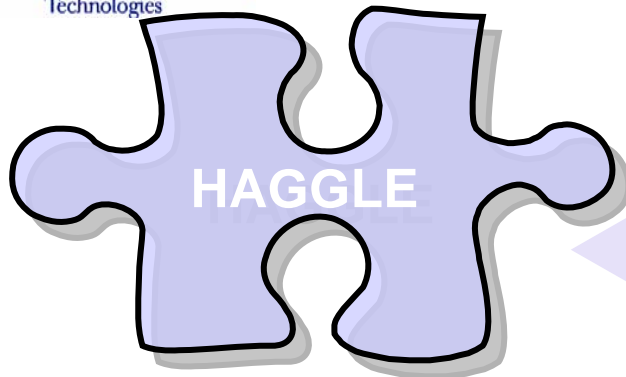
■ Machine-to-machine communication

Future and Emerging Technologies: SAC (Situated and Autonomic Communications)

- July 2003: First brainstorming meeting
- March 2004: Consultation Meeting on "Communication Paradigms for 2020"
 - Participants from university, industry, telecom operators and research centers
 - Outcome: background document on Situated and Autonomic Communications
- October 2004: Coordination Action on Autonomic Communication (ACCA) start
- December 2004: Call launch (20 Meuro) - Autonomic Communication Forum launch
- August 2005: negotiation of 4 selected proposals (out of 12 submitted)
 - Joint negotiation meeting, will have joint events and reviews
- January 2006: start of the 4 selected Integrated Projects



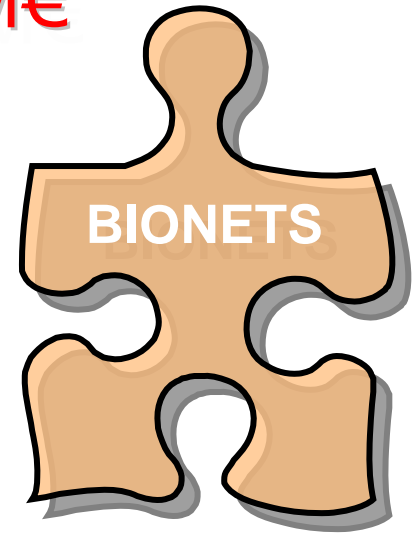
FIRE Baseline: SAC projects in FP6-FET 2006 – 2009, ~ 30 M€



HAGGLE

Opportunistic
networking
(cross-layer)

Autonomic
service
evolution

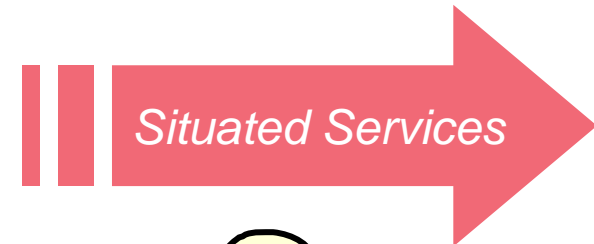


BIONETS

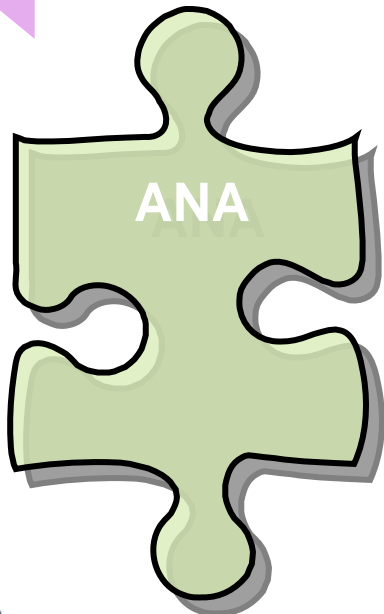


New Architectures

Common research issues:
*Security, resilience,
self-^{*} (organisation,
evolution, healing, ...)
interaction of new
paradigms with society*



Situated Services



ANA

Beyond
IP
self-org.

Autonomic
communication
elements



CASCADAS



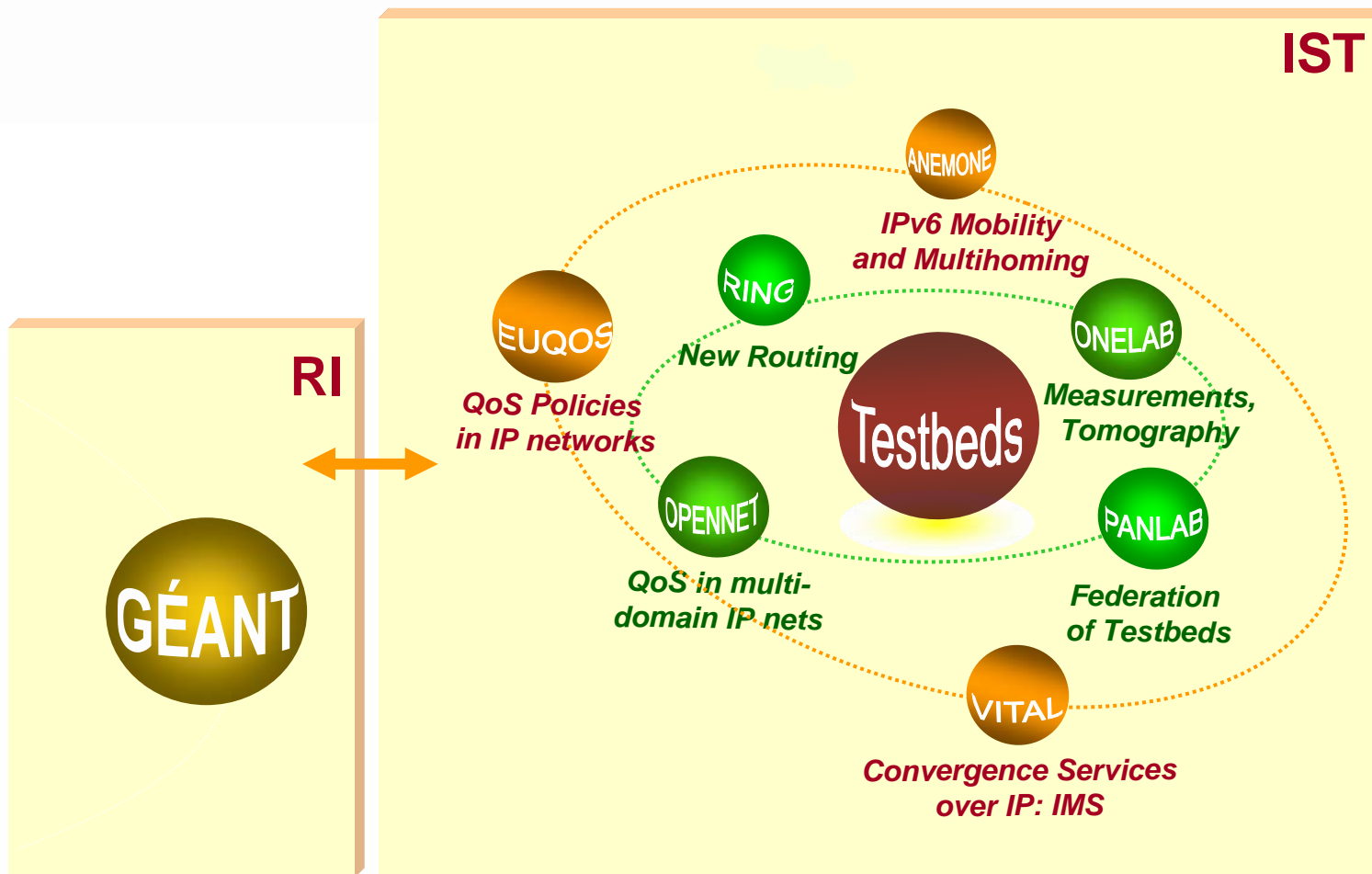
“Adopted” SAC projects (from FET)

- **EVERGROW**
 - Internet measurement technologies and their effects on distributed applications
- **NET-REFOUND**
 - Network research foundations and trends
- **COOPCOM**
 - Cooperative and Opportunistic Communications in Wireless Networks
- **CATNETS**
 - Evaluation of a decentralized economic self-organization mechanism for resource allocation in dynamic application layer networks

SAC Project Partners

- **Universities:** Waterloo, Basel, Athens, Lancaster, Oslo, Pierre et Marie Curie, Liege, London (Imperial College, LSE), Budapest, Berlin, Basel, Aachen, Ulster, Kassel, Trento, Bruxelles (ULB), Modena e Reggio Emilia, Uppsala, Cambridge, SUPSI, EPFL
- **Research Centers:** ETH, VTT, Fraunhofer, Create-NET, Hamburger ITC, Eurecom, CNR
- **Industries:** Nokia, NEC Europe, ex-Intel Research Cambridge, Sun Microsystems Iberica, Thomson Research
- **Telecom Operators:** Telecom Italia, Telekom Austria, British Telecom

FIRE Baseline: Testbeds in FP6 (2006 – 2009, ~ 30M€)



Objective ICT-2007.1.6

New Paradigms and Experimental Facilities

- *Experimentally-driven long-term research related to the Future Internet*
 - *“Advanced networking approaches to architectures and protocols: to cope with the increased scale, resilience, complexity, mobility, security and transparency of the Future Internet, coupled with their validation in large scale testing environments based on a combination of physical and 'virtual' infrastructures”*
- *Interconnected testbeds to support large scale validation*
 - *“Interconnected testbeds addressing: novel distributed and reconfigurable protocol architectures; novel distributed network and service architectures, infrastructures and software platforms; advanced embedded or overlay security, trust and identity management architectures and technologies”*
- Part of Challenge 1 - complementary to “Technologies and systems architectures for the Future Internet”, part of Objective “The network of the Future” (Call 1, 200M)
- To bootstrap and prepare the **FIRE Initiative**
- **Call 2 - Budget: 40 M€**
IPs, STREPs, NoE, CA/SSA - planned opening June, deadline September 2007

Advanced networking
approaches

Interconnected
testbeds

FIRE

experimentally-driven long-term multidisciplinary research

- Building on the FET **SAC** initiative “Situated and Autonomic Communications”
 - Open to fresh bottom-up ideas, no backwards-compatibility constraints
- **Not just paperwork:** new internet paradigms need large scale validation and testing
 - Integrating and validating new concepts developed in multiple research disciplines
 - Considering at the same time technological, economic and social/policy aspects
- Creating a **European Lab** for testing potentially disruptive internet concepts, by **federating** existing and planned testbeds for emerging technologies
 - possibly building on ONELAB and in line with the framework provided by PANLAB
 - No large infrastructure upfront, but **federation upfront**, showroom of EU research
 - **Open** to relevant testbeds from outside the Objective, e.g. EU, national, regional
- Building on **European strengths**
 - Fundamental research, multinational collaboration, wireless, GEANT ...
- Developing “disruptive” research **methodologies**
 - Sustainability, reproducible benchmarking, entrepreneurship...
- Collaboration with FIND/GENI (US) and related initiatives worldwide

FIRE meetings

- 14-15 Feb: The first FIRE expert group meetings, Brussels
- 18 February: launch of the web consultation
 - See <http://cordis.europa.eu/fp7/ict/fire>
- 6-7 March: FIRE workshop (co-located with the SAC review), Zurich
 - Focused on the experimentally-driven long-term research aspects of FIRE
 - enlarged to the wider research community in networking and communications
- 21-22 March PANLAB workshop in Rovaniemi, Finland
- 18-19 April: COST Meeting with NSF, Berlin
- 23-24 April: final FIRE expert meeting, to consolidate the report(s)
- May: Publication of the final report of the FIRE expert Groups

Thank You! Questions?

fire

(non-trivial logo sought)

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Different perspectives for the Future Internet

■ Industrial

- backward compatibility / standards
- security for supporting commercial services and applications

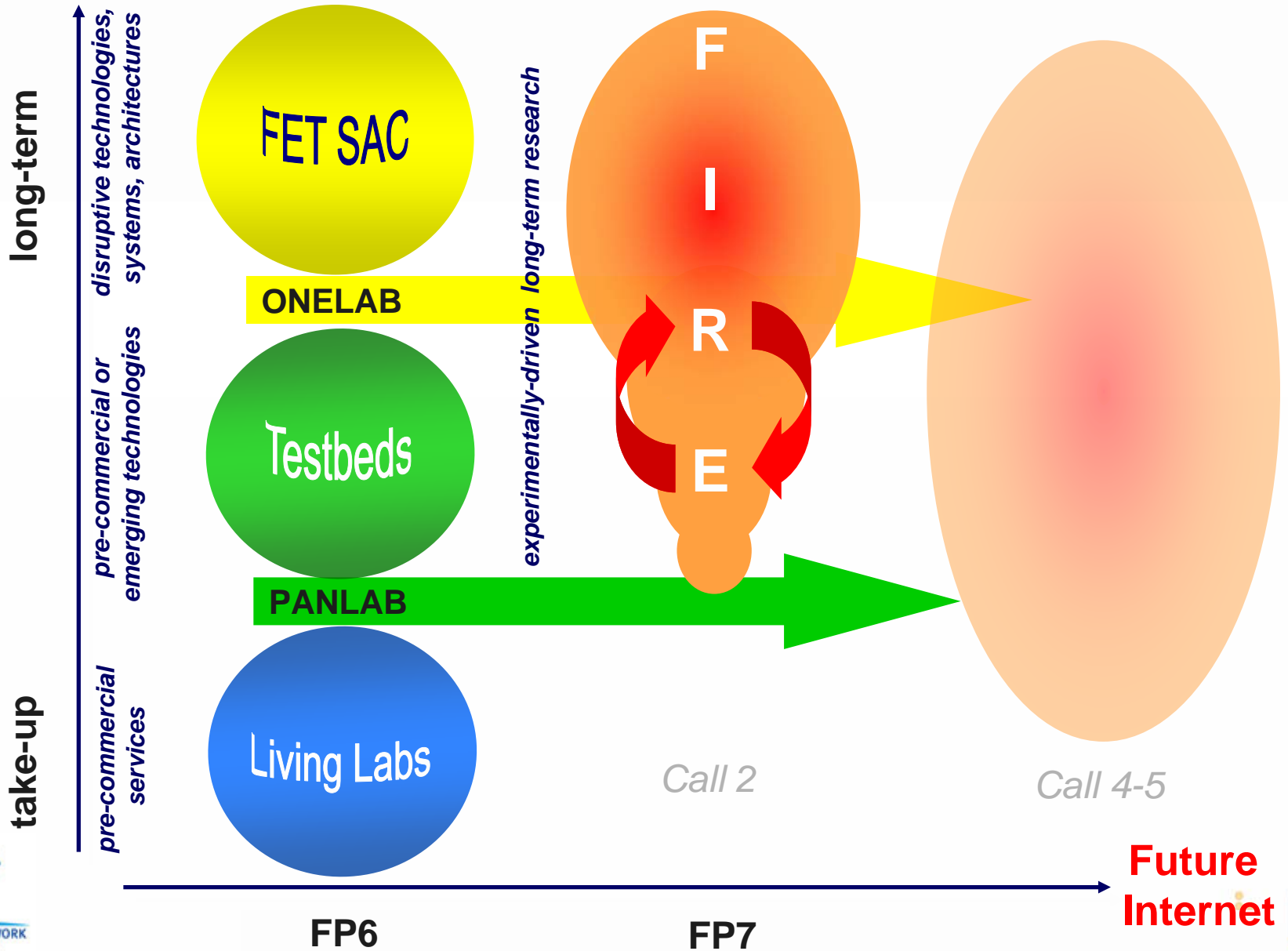
■ Academic/Technological

- aiming at clear improvements
- clean slate approach to overcome intrinsic limitations

■ Political

- European competitiveness on future internet
- redesigning the internet involves a huge social responsibility
 - cannot be based solely on technological or commercial constraints
- how to preserve openness, fairness, social role of the Internet
 - needs for security/accountability versus right to privacy
 - Intelligence to the core? QoS vs. innovation vs. network neutrality...
 - a network that knows what an attack is, is not net neutral
 - is internet open and democratic by design or by accident?
 - do not throw the baby out with the bath water!

FIRE strategy



Report from the workshop: possible topics for FIRE “experimentally driven long-term research”

- **Autonomic Communication** (**Joe Sventek**, Xiaoyuan Gu, Rolf Stadler, Scott Kirkpatrick, ...)
 - Network control, knowledge plane, self-monitoring
 - distributed data collection, storage and analysis
 - Also in relation to sensor networks
 - Trust and security?
 - role of ACF
- **New networking/communication ideas** (**Ioannis Stavrakakis**, **Peter Dussen**, Bela Berde, Arun, Klaus David, ...)
 - Layers? network, services, overlay
 - ethical/social consequences of bringing intelligence to the core
 - impact on network neutrality
 - how to ensure privacy as well as accountability
 - Interdisciplinary evaluation
 - Trusting the network
 - business models for the Future Internet?
 - Market mechanisms for grids, sensor networks, etc.
 - shift from business to home users
 - ?
- **Federation of testbeds** (**Martin May**, Serge Fdida, Christophe Diot, ...)
 - upfront commitment to federation, incentives to reuse testbeds
 - sustainability
 - examples of testbeds
 - benchmarking of different architectures, EU showroom
 - how to make testbeds for disruptive research