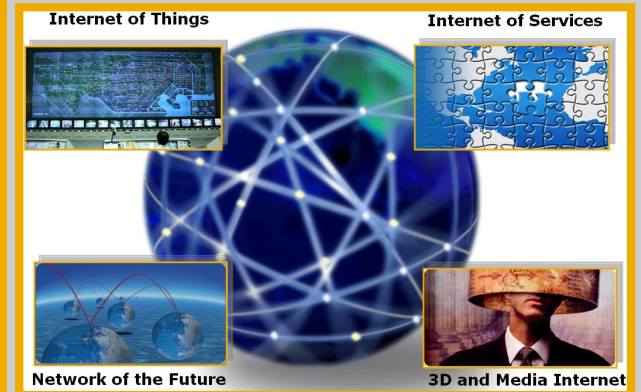


# Global Future Internet Research

## Origins, Visions and Initiatives



**Thomas Michael Bohnert**  
**SAP Research**

**ICIN 2010, Berlin**  
**October 2010**

THE BEST-RUN BUSINESSES RUN SAP™



*„The Internet is broken.“*

**David D. Clark, MIT**

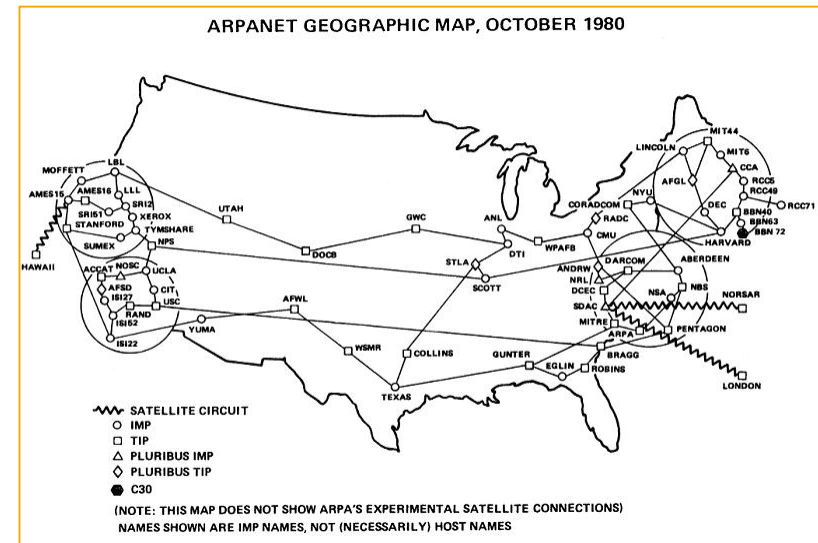
*In an article in MIT Technology  
Review, 2005*

*But why, what has happened ?*

# Future Internet Research - Origins (cont'd)

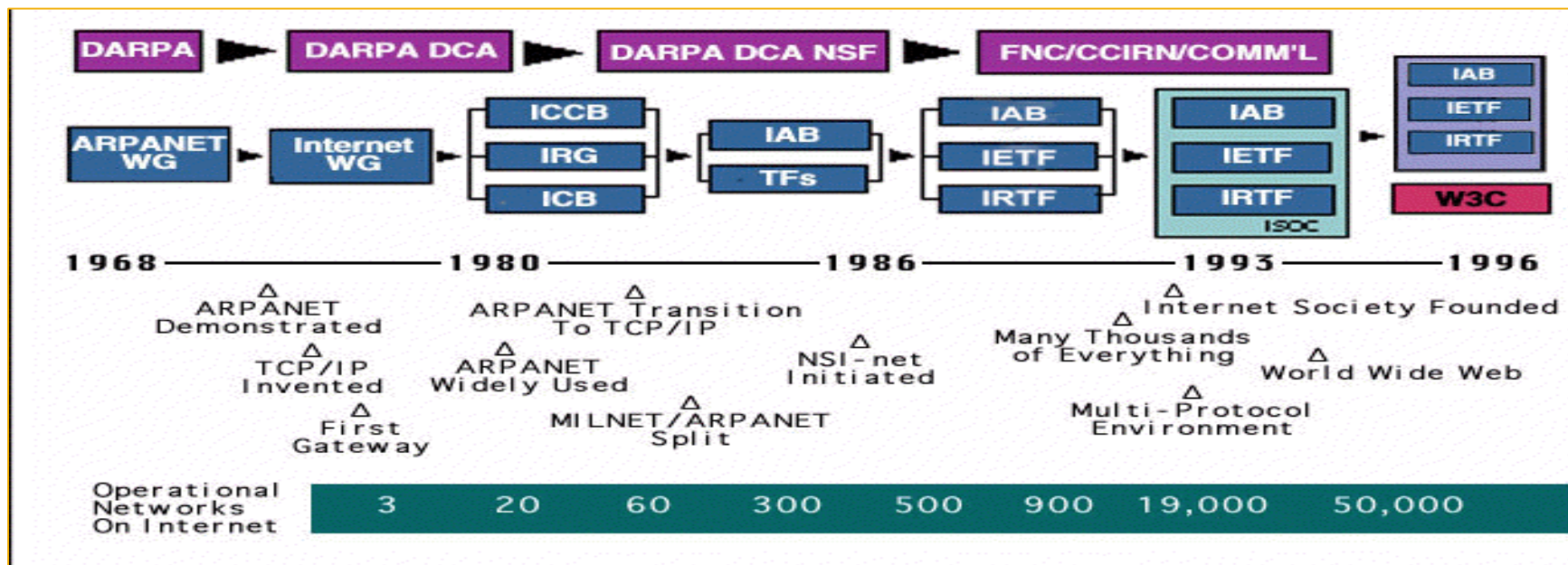
After 15 years research on Internet architecture, in 1988, the **design goals** for the Future Internet were (in the priority order top-down) [Clark88]

- Global connectivity
- Communication (service) survivability
- Multi-service support
- Support variety of physical networks
- Distributed management
- Cost efficiency
- Host attachment with low of effort and costs
- Resource accountability

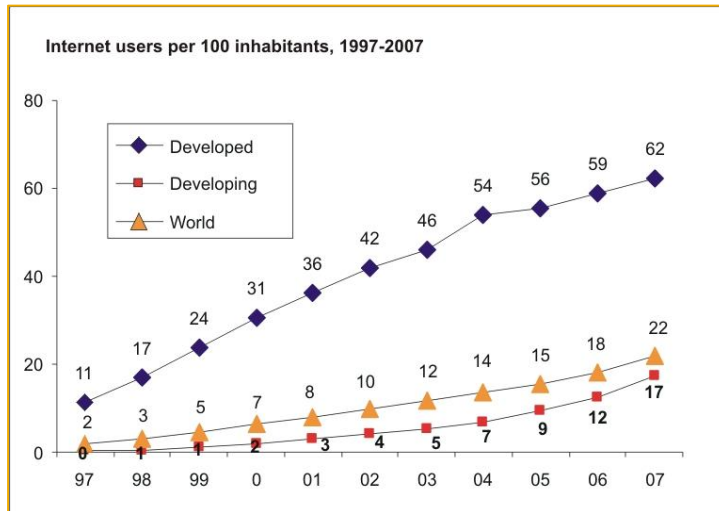


Original goal was to connect the original ARPANET with the ARPA packet radio network

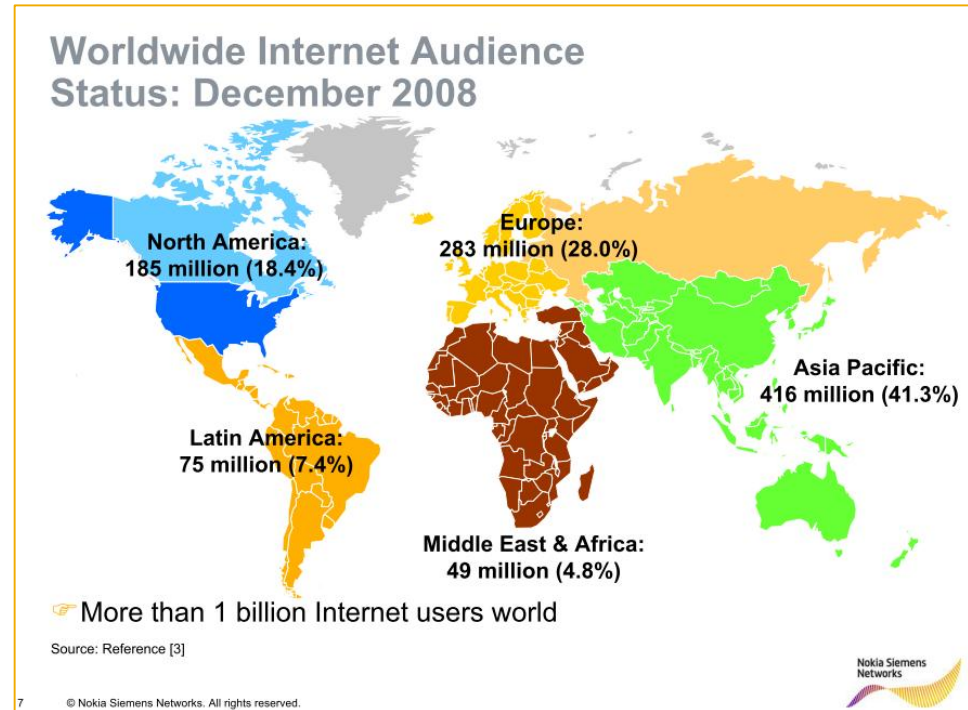
# Future Internet Research - Origins (cont'd)



# Future Internet Research - Origins (cont'd)



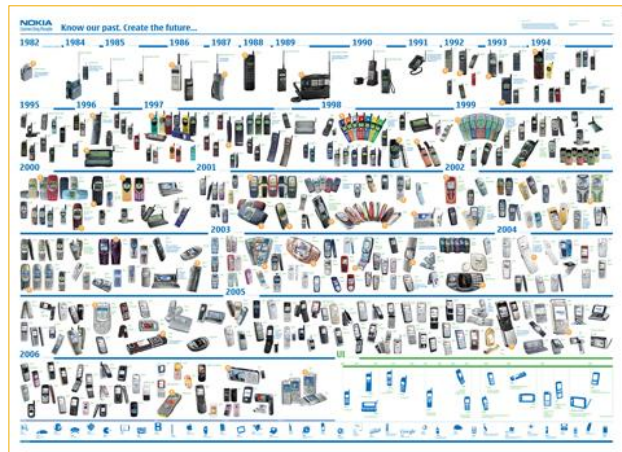
Source: ITU



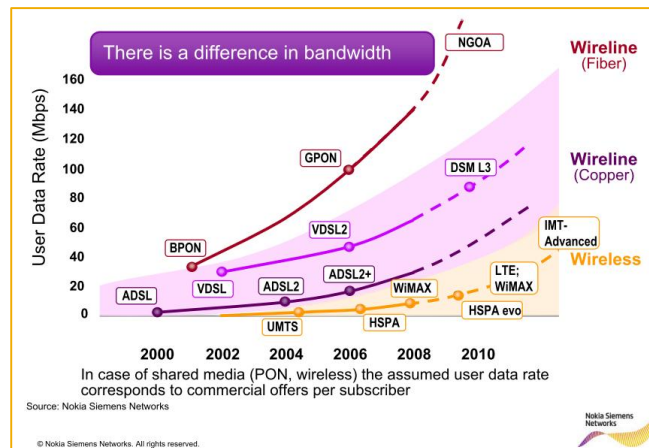
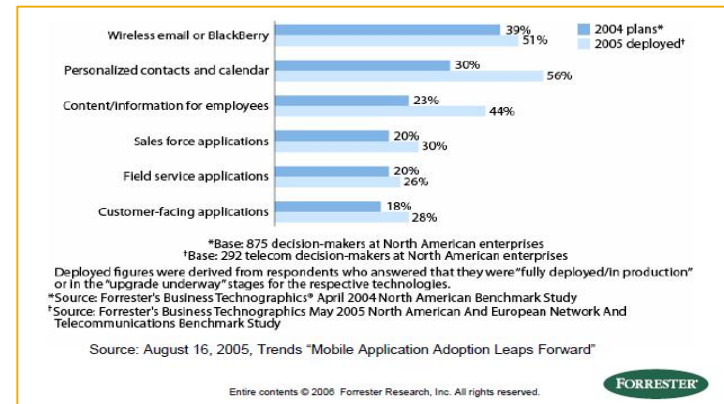
Source: W. Mohr, PIMRC 2009

# Future Internet Research

## - Drivers: Devices, Access, Apps



Source: Nokia





# Future Internet Research

## - Drivers: Cloud Computing



### Definition from Consumer Perspective

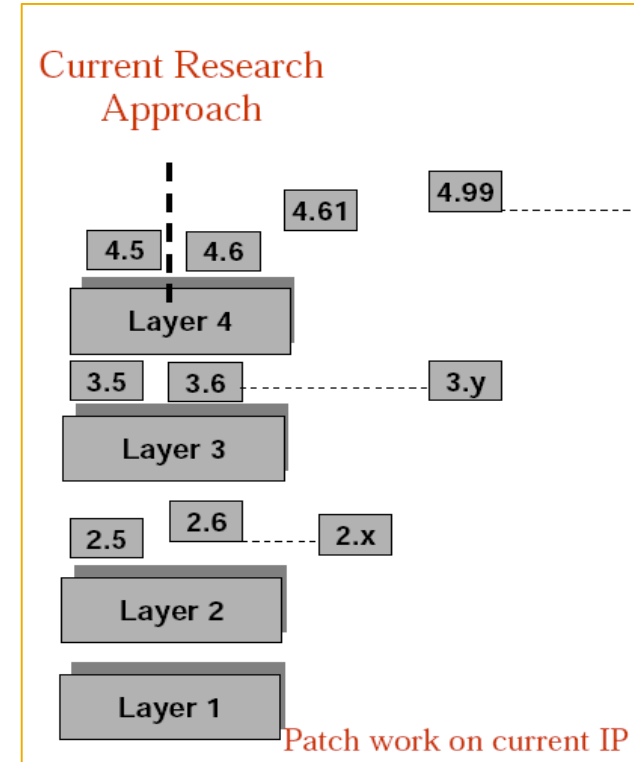
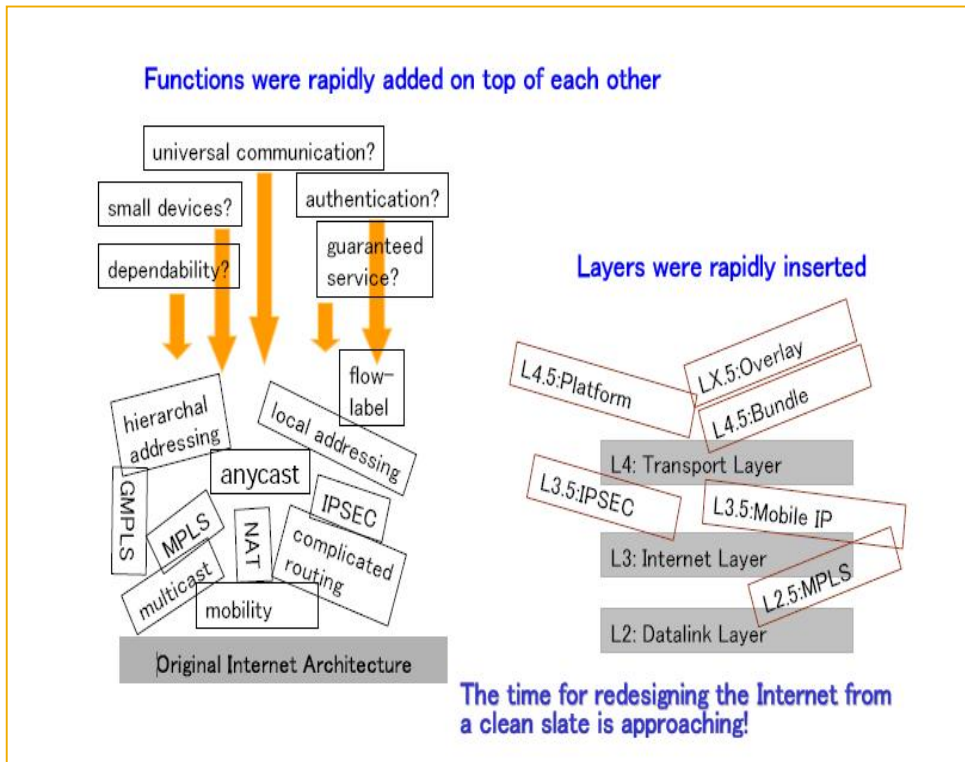
**Cloud Computing** allows **On Demand Software Provisioning** with **Zero-Installation & Zero-Configuration** at **low cost** and **immediate access** in **Ultra-Scalable Data Centers**.

Application Providers	Platform Providers	Infrastruct Providers	Service Providers

### Selected Cloud Consumers & ISVs



# Future Internet Research - Consequence



Patching the Internet Architecture (Source eMobility)



## Future Internet Research - Origins



*„The Internet is broken.“*

**David D. Clark, MIT**

*In an article in MIT Technology  
Review, 2005*



# Future Internet Research

## - Nets, FIND, GENI



### Networking Technology and Systems (NeTS)

- Program in National Science Foundation (NSF)
- Research on information networks
  - Network architecture, protocols, algorithms,
  - Proof of concept implementation of hardware and software
- Funding: ~\$40 million per year
- Focus in networking domain
  - Future Internet Design (FIND)
  - Wireless Networks (WN)
  - Networks of Sensor Systems (NOSS)
  - Networking Broadly Defined (NBD)

### Future Internet Design (FIND)

- Long-term initiative of NSF NeTS research program
- Created in 2006
- Funded project seeking to design a next-generation Internet called the 'Future Internet'
- Research goal
  - FI Network architecture & design
  - Community effort and engagement
  - How to build a network without the constraints of the current Internet - design the Future Internet from scratch



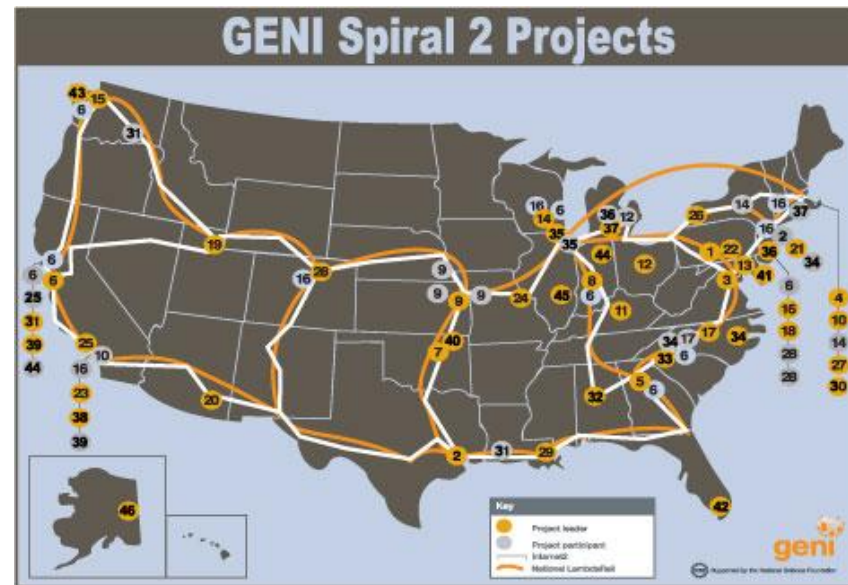
# Future Internet Research

## - Nets, FIND, GENI



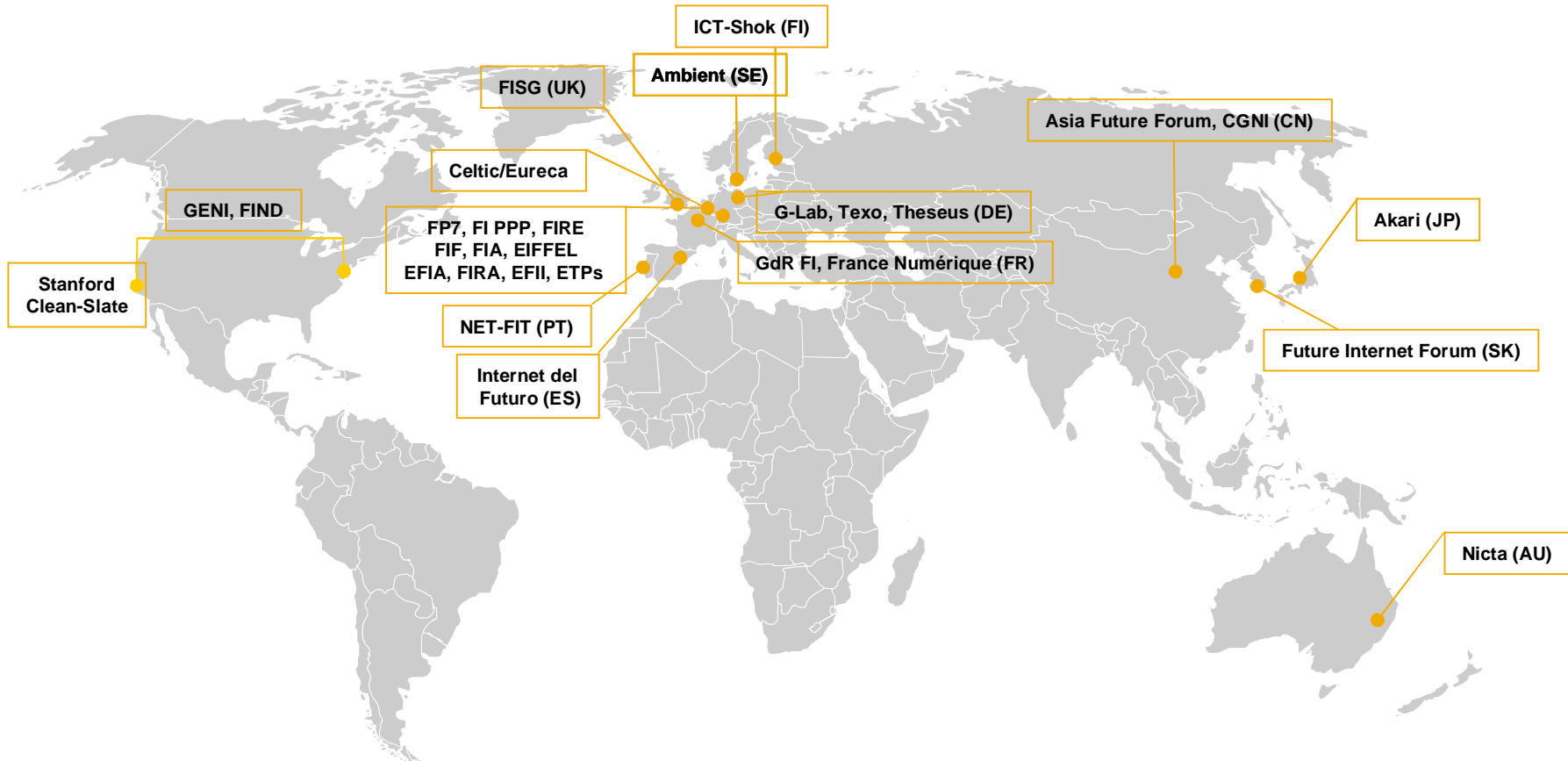
### Global Environment for Network Innovations (GENI)

- GENI is a unique virtual laboratory for at-scale networking experimentation
- Transformative research at the frontiers of network science and engineering
- Supports at-scale experimentation on shared, heterogeneous, highly instrumented infrastructure
- Enables deep programmability throughout the network, promoting innovations in network science, security, technologies, services and applications
- Provide collaborative and exploratory environments for academia, industry and the public to catalyze groundbreaking innovation



- Oct '09, NSF awards supports for additional 33 academic/industrial prototyping teams,
- A second award supports 3 collaboration sets of academic/industrial teams to integrate, operate, and host experiments on GENI infrastructure (40GBps)

# Future Internet Research - A Global Initiative



# Theseus / Texo

## - Future Information Internet



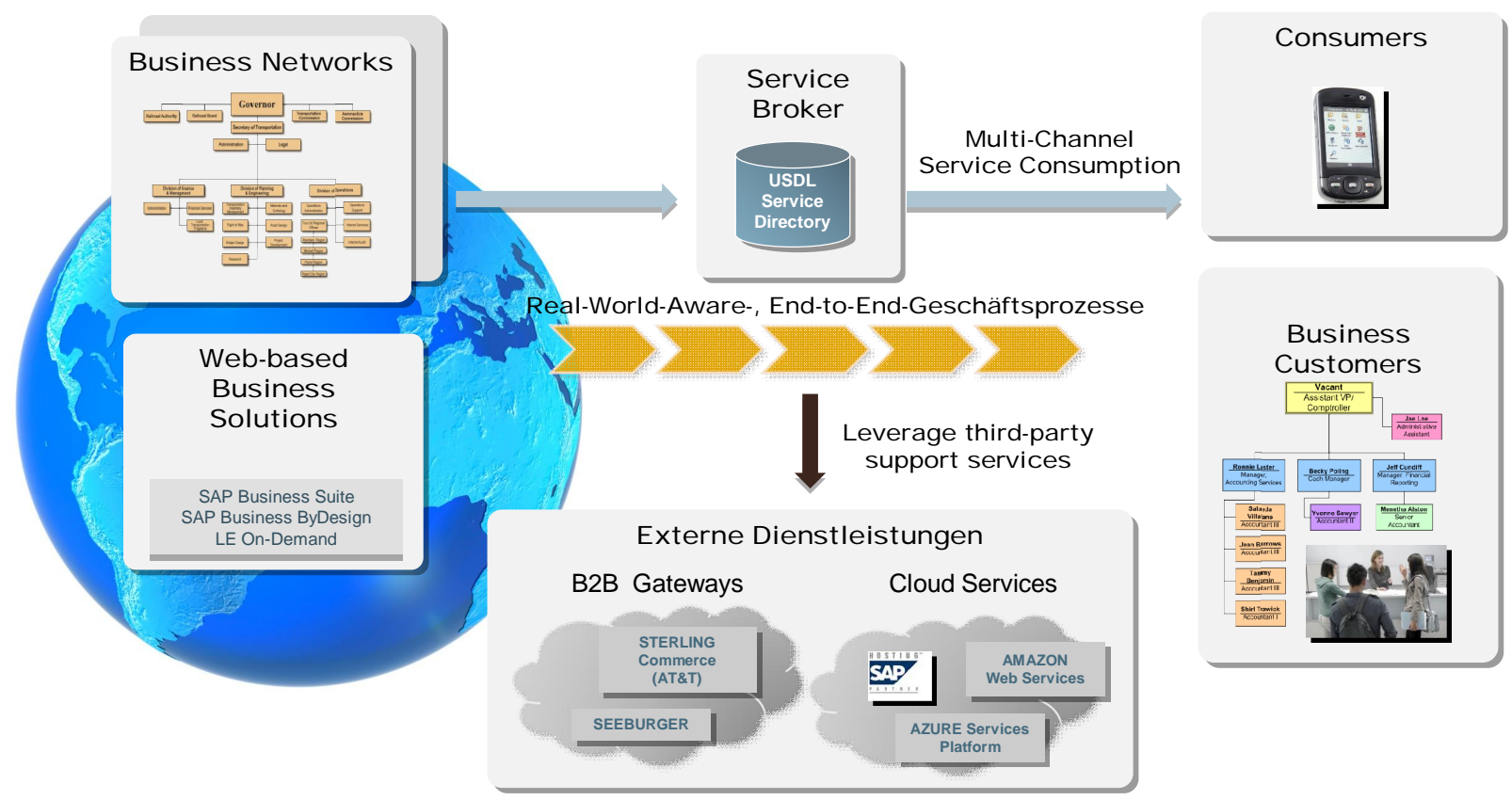
**THESEUS** (Greek mythology, succeeded in escaping from the Minotaur's labyrinth)

- Research program to develop ways to navigate through the increasing quantities of data found on the Internet.
- Launched at the end of 2007 for a term of five years.
- €100 million in funding from the German Federal Ministry of Economics and Technology
- €100 million by partners from industry and research
- Total of 60 research partners from academia and the business world
- Focus on new technologies and applications
- Facilitate access to information, combine data, form new kinds of knowledge
- Lay the groundwork for the Internet of Services

**TEXO** (Greek mythology, succeeded in escaping from the Minotaur's labyrinth)

- TEXO is a research project, within the THESEUS
- Contributes to future service economies by creating infrastructure components for Business Webs in the Internet of Services
- Goal of TEXO is to provide a platform which makes services
  - tradable on the internet
  - composable into value-added services
  - integratable into the environment of service consumers

# Theseus / Texo - Paving Way for the Internet of Services





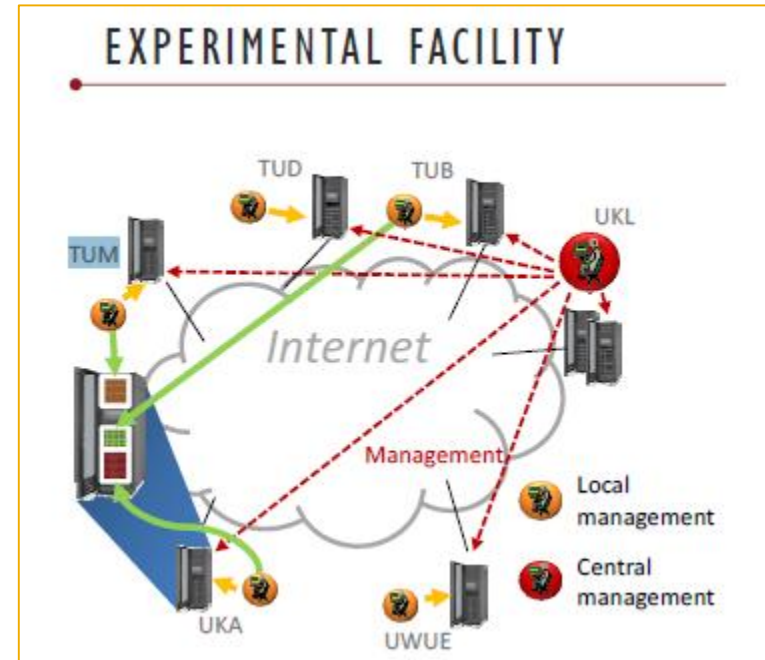
# G-Lab

## - Design & Experiment the Network of the Future



### G-LAB (German-Lab)

- National Platform for Future Internet Studies
- G-Lab consists of two major fields
  - Research studies of future Internet components
  - Design and setup of experimental facilities
- Future Internet Studies
  - Architectures, Routing, Mobility, Management, QoS/QoE, SoA
- Experimentation
  - G-Lab Central with 59 network nodes in Kaiserslautern
  - More than 170 network nodes in total
  - At least 25 nodes at each site
  - Additional sites with sensor networks
  - Currently based on PlanetLab software

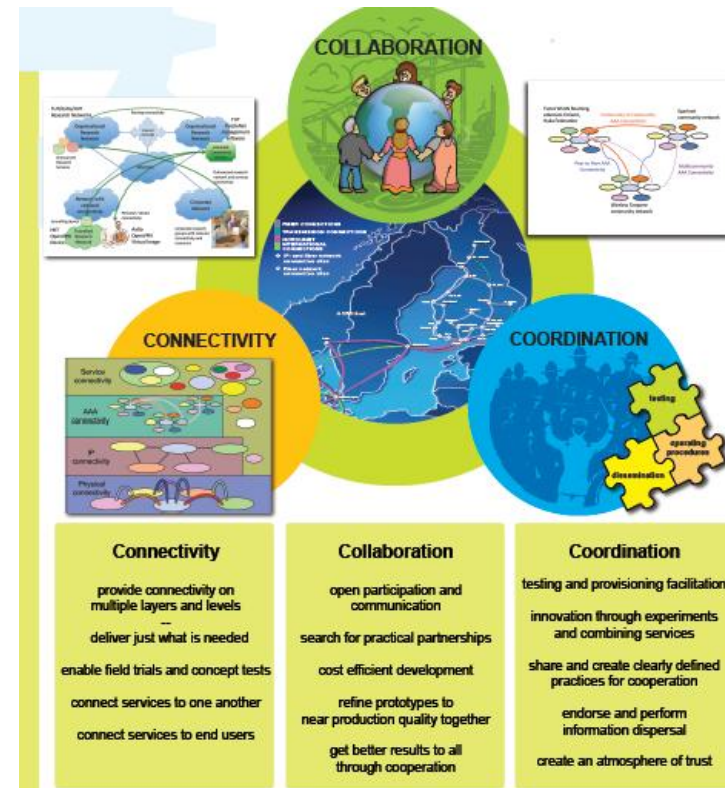


# ICT-Shok - Future Internet Networking



ICT Shok (Finnish Strategic Centres for Science, Technology and Innovation)

- Enhance the Internet technology and ecology as a platform for innovation
- Providing strong governance over the use of network resources
- Govern information in such a way that especially mobile use of the network and its services will be natively supported
- Present problems & challenges
  - Unwanted traffic, Scalable routing, Mobility & Multihoming, Resources & compensation, Privacy & attribution, Trust & reputation
  - Information networking, Usage patterns, Socio-economics, Autonomy & resilience, Energy consumption, Shifting bottlenecks



**Balanced research strategy between “clean slate” and “evolutionary” approach**

## France – Plan Numérique 2012 - Enterprise Digitization



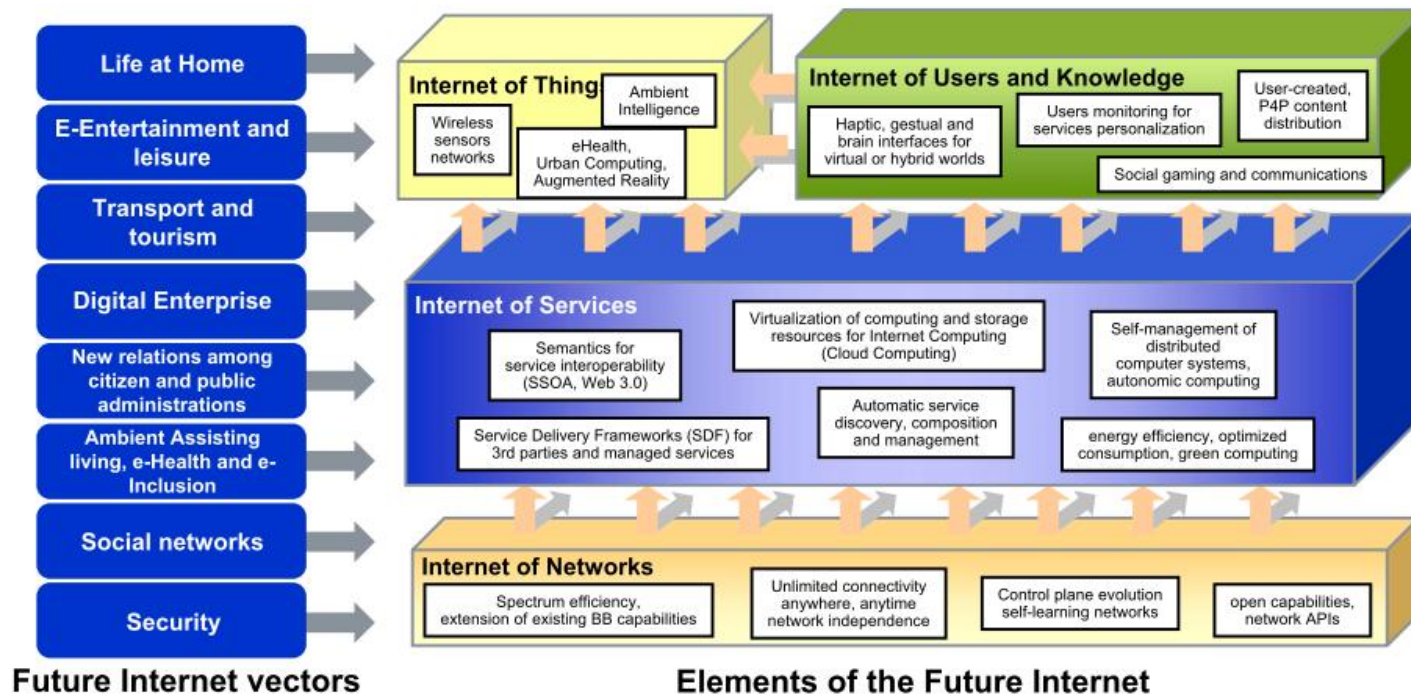
### France – Plan Numérique 2012

- Accelerate the improvement of competitiveness and growth of enterprises by digitization of the country by means of
  - Education
  - Research and development
- Further objectives
  - Increase of digital applications in schools
  - Establishment of a "digital University"
  - Adaptation of professional education according to the needs of the
  - Digital economy
  - Development of production and offer of digital content
  - Dynamization of research and development in the area of information and communication technologies

# Internet del Futuro - A Holistic Future Internet Approach

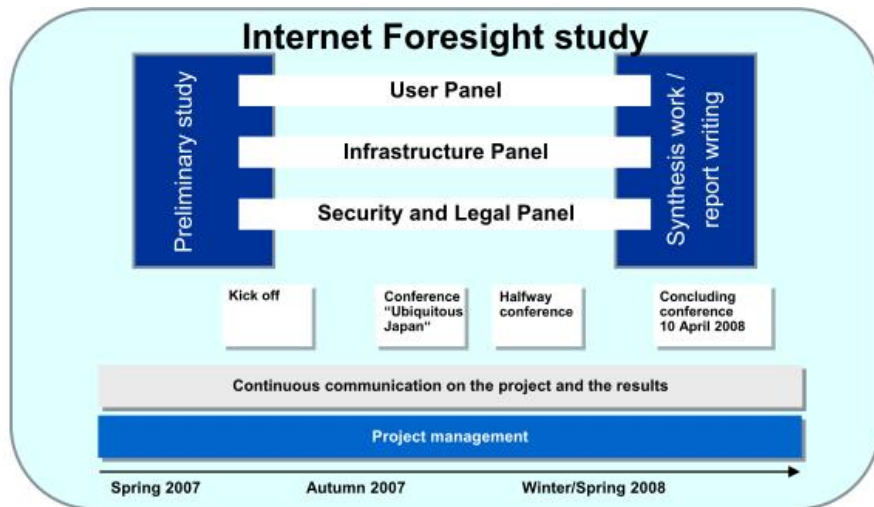


## Spain – Internet del Futuro



# Ambient Sweden

## - Sweden, a Leading Internet Nation in 2015



- In Ambient Sweden the Internet is available in all contexts and for all of the functions that users desire.
- For users, the Internet is a natural aspect of working and leisure time, often without them being directly aware of its presence

DIGITAL ORDER



In Ambient Sweden the Internet is available in all contexts and for all of the functions that users desire. For users, the Internet is a natural aspect of their working life and leisure time, often without them being directly aware of its presence and functions.

**8**

**7**

**6** Users are almost always connected and create their own content (blogs, images, video, etc.). They use mobile Internet, watch IP-TV or play games online.

**5** People are active in social communities and they consume music, radio, video clips, newsletters online.

**4** People use instant messaging and telephone services such as Skype.

**3** People use advanced Internet services such as online banking and e-trading services.

**2** People use simple Internet services, such as e-mail and registering for events.

**1** People visit websites for information, e.g. community information or train times.



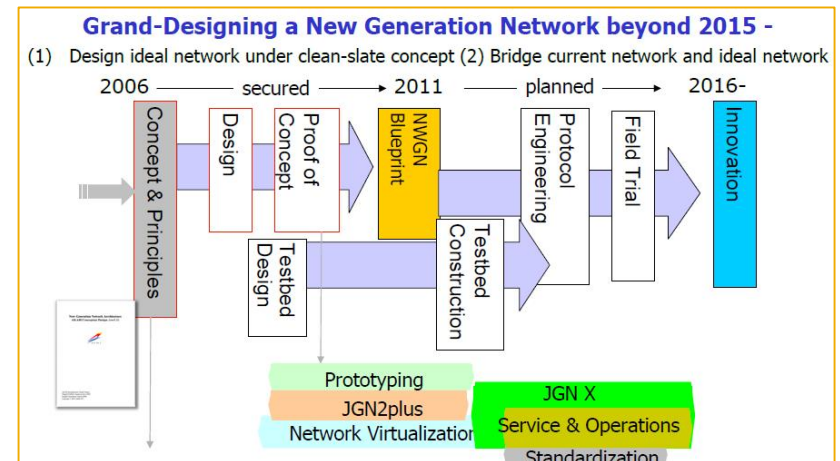
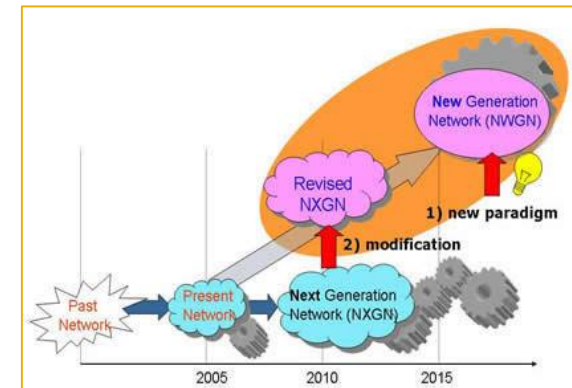
# AKARI

## - A Small Light in the Dark Pointing to the Future



AKARI (“akari” = “a small light” in Japanese )

- The AKARI Architecture Design Project aims to implement the basic technology of a new generation network by 2015
- Philosophy is to pursue an ideal solution by researching new network architectures from a clean slate without being impeded by existing constraints
- The issue of migration from today's conditions can be considered using specific design principles during design time
- Goal is to create an overarching design of what the entire future network should be.
- This vision of a future network is embedded as part of societal infrastructure





# AsiaFI

## - Asia Future Internet Forum



### Asia Future Internet Forum

AsiaFI

#### AsiaFI (Asia Future Internet Forum)

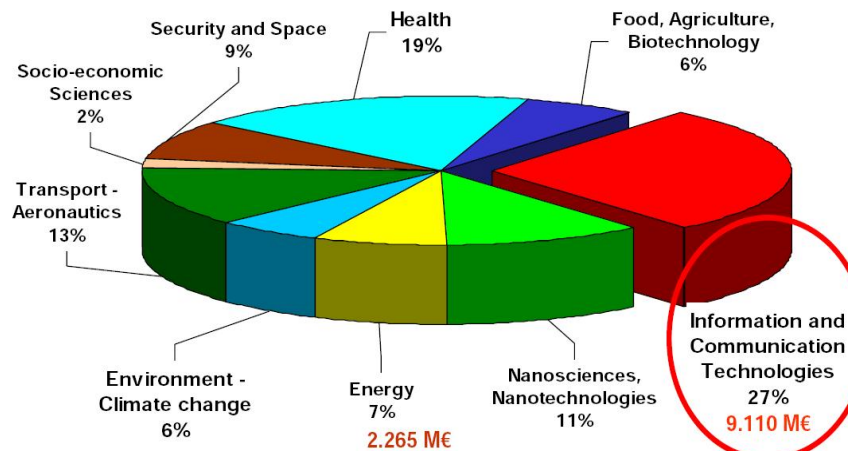
- Founded to coordinate research and development on Future Internet among countries in Asia as well as with other continents
- AsiaFI was formed in December 2007 after preparation of six months
- Objectives
  - long-term open research by international collaboration
  - loose federation for tight collaboration
  - work around political/financial difficulties
  - encourage tight collaboration
  - current focus on education and foster young researchers for future Internet research
- **Working Groups**
  - Architecture & Building Blocks Working Groups
  - Mobile & Wireless Working Group
  - Testbed
- Education
  - Semester-long FI Courses, Ph.D thesis, Short-term scientific exchange

# European Framework Program 7 - Research for European Competitiveness

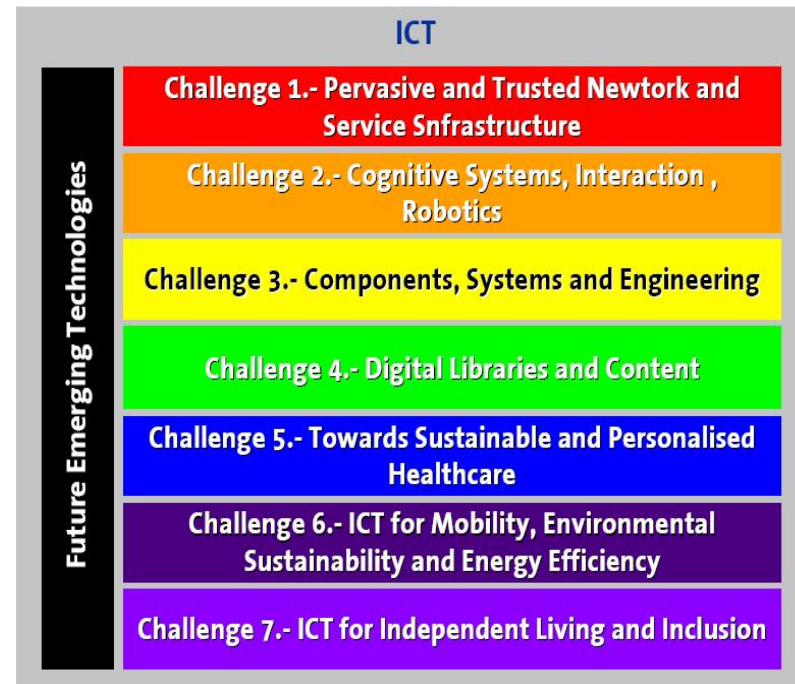


**FP7 ICT: ~9 Billion Euro over 7 years**

## FP7 Cooperation Themes (32 292 M€)



Source: Competitiveness Council 24 July 2006

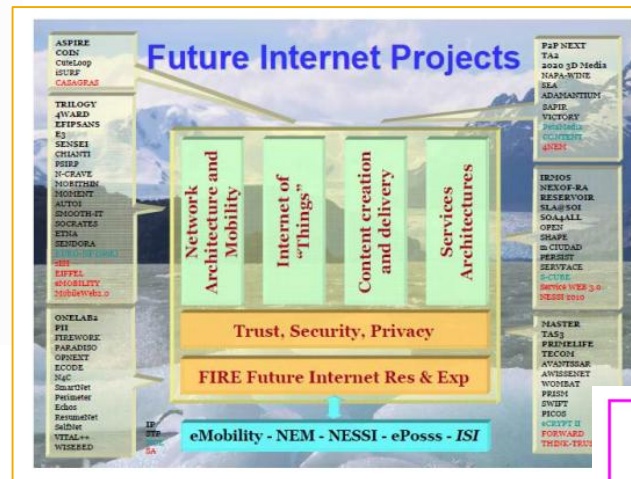
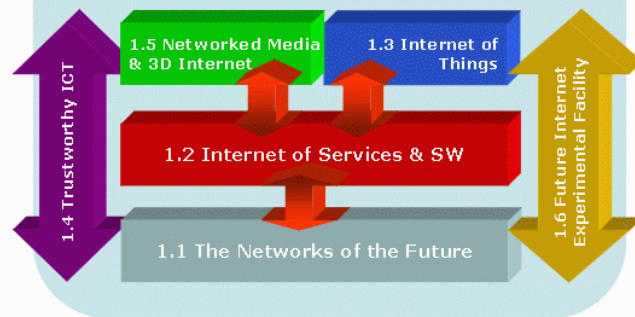


# European Framework Program 7 - Challenge 1, The Future Internet

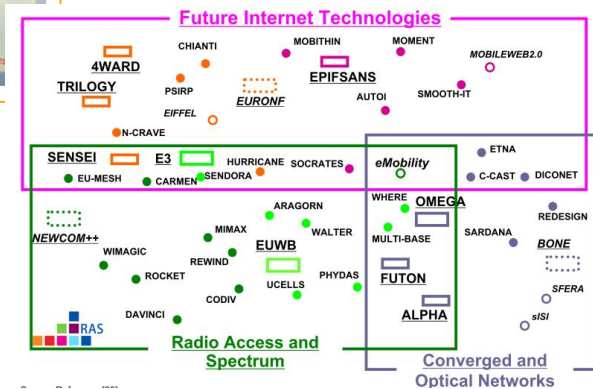


Challenge 1 - "Pervasive and Trustworthy Network and Service Infrastructures"

THE FUTURE INTERNET



- 1. Greater Coordination through the Future Internet Assembly**
- ☐ Today already 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:
    - ☐ Stockholm, 23-24 November 2009
    - ☐ Valencia, 14-16 April 2010



# European Technology Platforms - Sector Research Agenda



**EPoSS**  
European Technology Platform  
on Smart Systems Integration

European Technology Platforms related to the Future Internet

## Mission

- Strategic Research Agendas (SRA) for Future Internet in different technology fields
- Technology and Application Visions
- X-ETP - joint vision document on the Future Internet

## Impact

- EU Commission and EU Member States consider SRAs when defining national and European research programs and policy actions

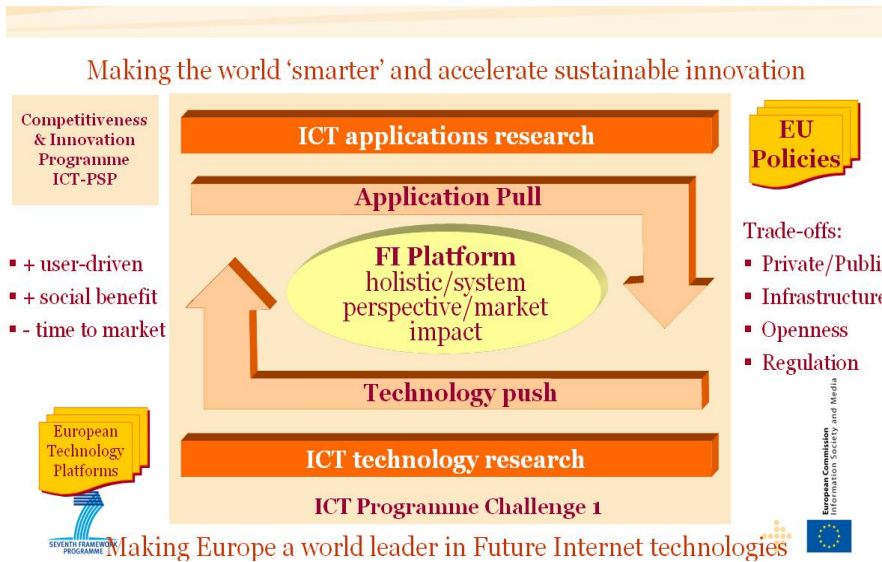


NESSI Open Service Framework

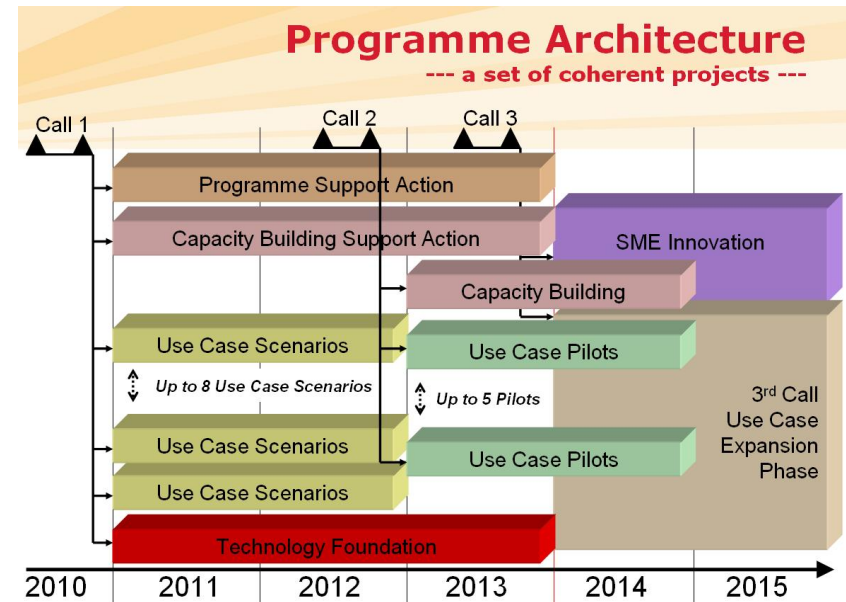
### The three core elements of NEXOF

- **NESSI Open Reference Model**
- **NESSI Open Reference Architecture**
- **NESSI Open Reference Implementation**

# The Future Internet Public-Private Partnership - Making the Future Internet a Reality



Making Europe a world leader in Future Internet technologies



Source: European Commission



# European Future Internet Initiative - A Vision for the FI PPP



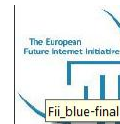
## European Future Internet Initiative



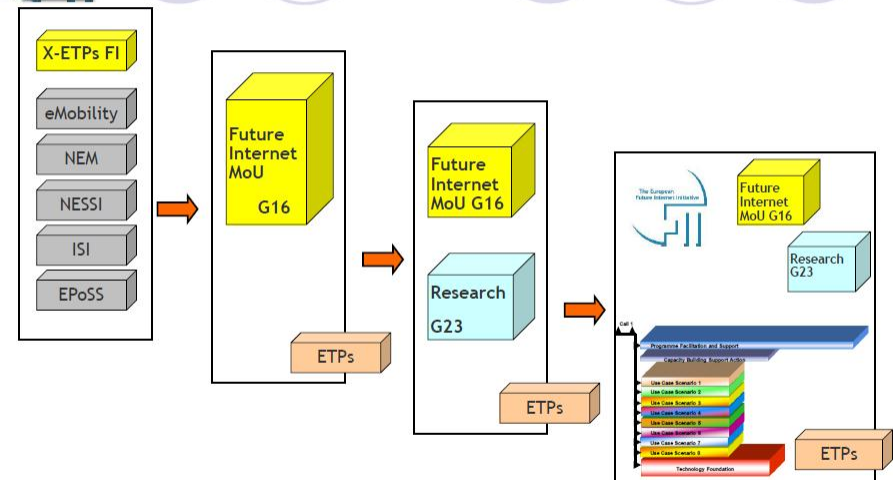
- Our immediate Goals:
  - Creating a community in 2010 with the application domains
  - To run workshops on applications, enablers, and infrastructures.
  - Determining the focus points, challenges, and optimal structures
  - Encouraging innovation in structures as well as projects
  - Publish Position papers
- [initiative.future-internet.eu](http://initiative.future-internet.eu)



Source: D. Kennedy

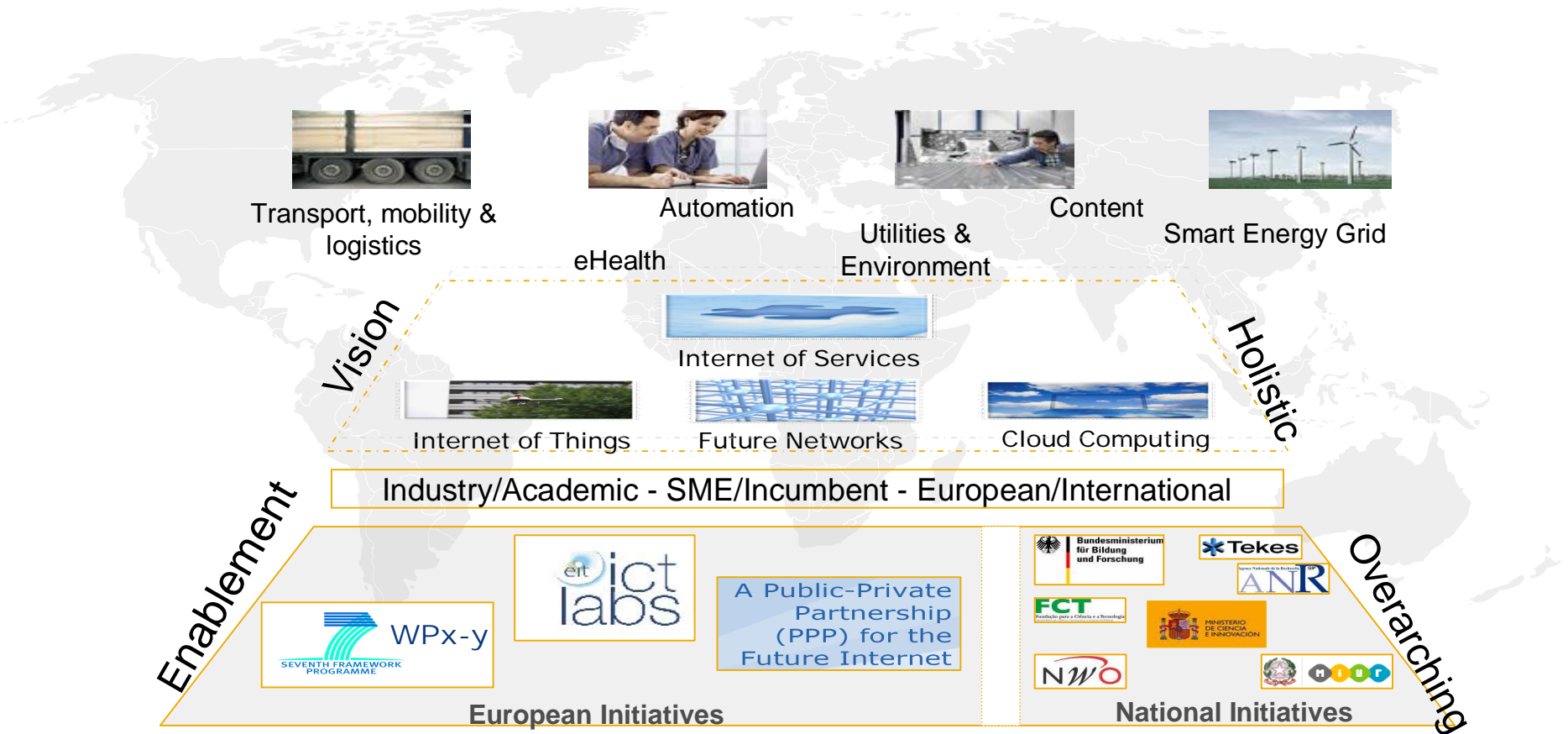


## Evolution from ETPs





# Future Internet Research Alliance - Vision and Motivation



# Future Internet Research Alliance - Vision & Opportunities



Transport & Logistics



Automation

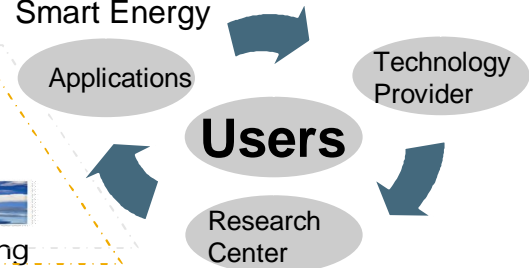
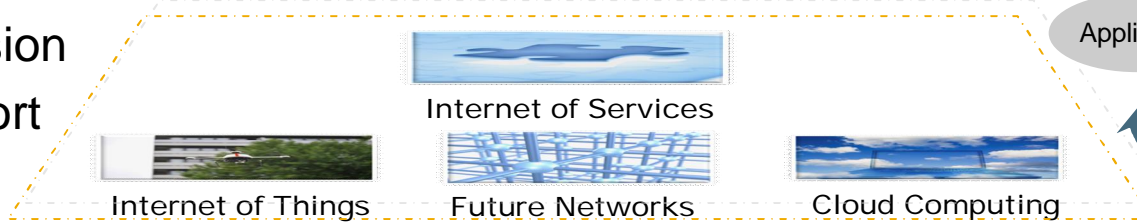


Content



Smart Energy

Biz & Tech Vision  
Generic Support  
for Future Biz



**WPx-y**  
SEVENTH FRAMEWORK PROGRAMME

- Focused
- Project Oriented
- Domain Innovation
- Proof-of-Concept

**Bundesministerium für Bildung und Forschung**  
Calls

- Focused
- Project Oriented
- Domain Innovation
- Proof-of-Concept

**A Public-Private Partnership (PPP) for the Future Internet**

- Program
- Industry focused
- Strategic Impact
- Consolidation
- Large-scale Demos

**ict labs**

- Instrument
- Multi-disciplinary
- RTD/INO/EDU
- Long-term Academic

# European Future Internet Alliance

- Address Fragmentation and Join Forces



Efi : FIRA

# EFIA

European Future Internet Alliance

A proposal by and to members of Efi & FIRA

# EFIA Mission and Vision

## EFIA's Vision:

“to advance the Internet significantly by 2020 using European technologies and services to the benefit of European Society and Industry”

## EFIA's Mission:

“to be the European industrial led alliance that facilitates the focused research, development and innovation towards the Future Internet while promoting the uptake of the advanced technologies and business models for the future internet in partnership with all stakeholders in the community”

## EFIA's Strategy:

“is to promote its vision through European, International and National Research Programmes to achieve a high synergy in the Future Internet activities across Europe and to significantly contribute to the realisation of a coherent viable and successful Future Internet in the shortest possible time”

Thank you!

# Grid






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