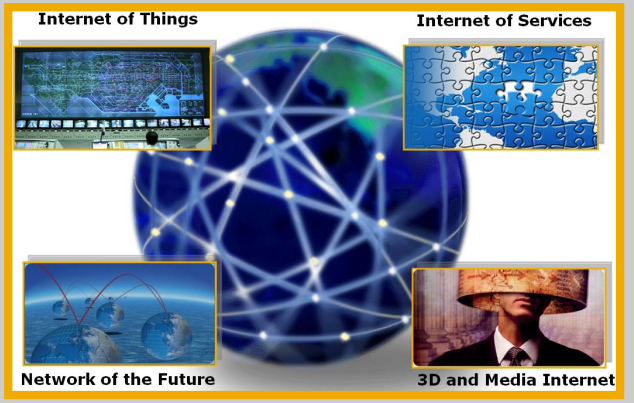
Global Future Internet Research

Origins, Visions and Initiatives



Thomas Michael Bohnert
SAP Research

ICIN 2010, Berlin
October 2010

Future Internet Research - Origins

„The Internet is broken.“

David D. Clark, MIT

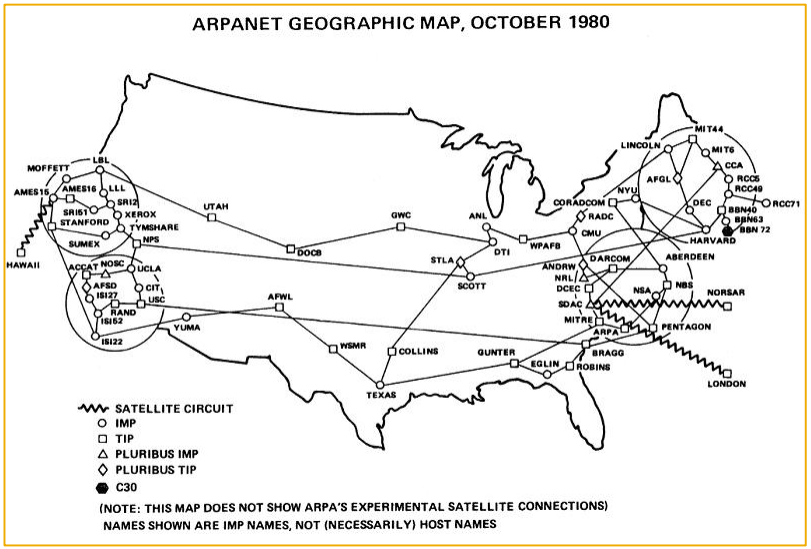
In an article in MIT Technology Review, 2005

But why, what has happened ?

Future Internet Research - Origins (cont'd)

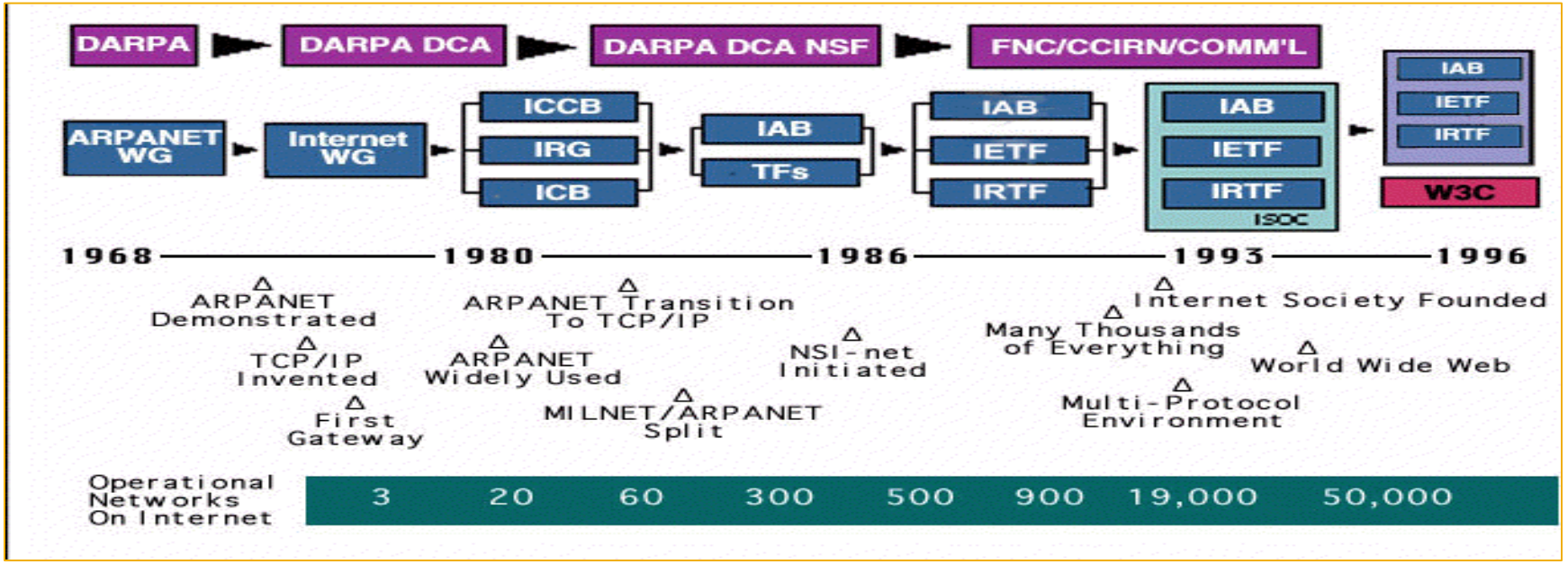
After 15 years research on Internet architecture, in 1988, the design goals for the Future Internet were (in the priority order top-down) [Clark88]

- 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

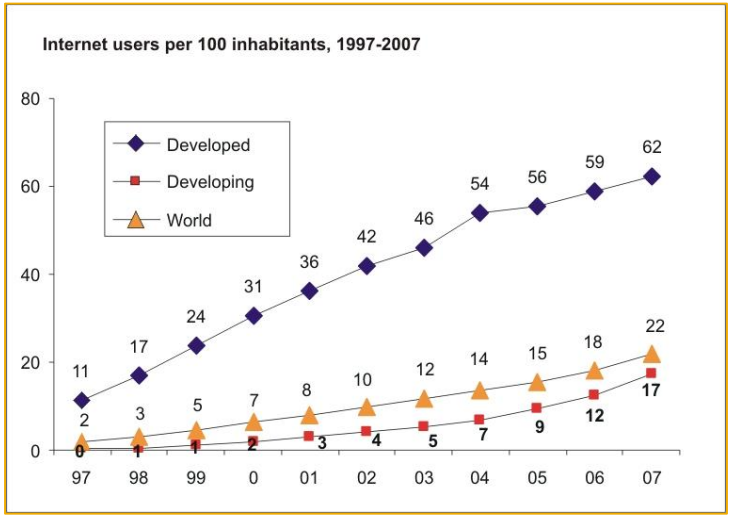


Original goal was to connect the original ARPANET with the ARPA packet radio network

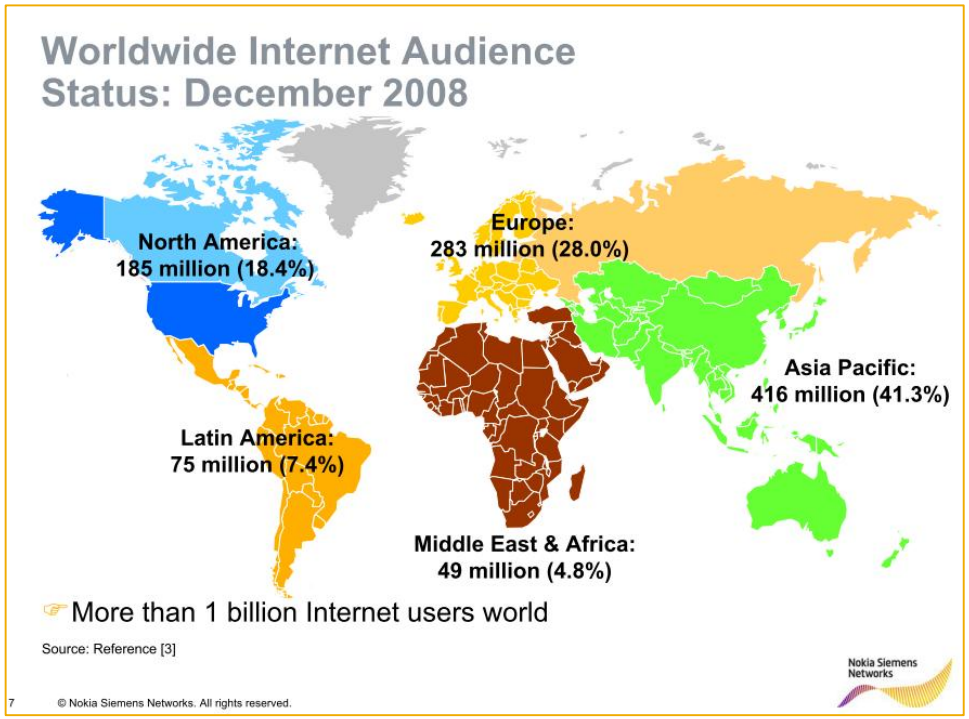
Future Internet Research
- Origins (cont'd)



Future Internet Research - Origins (cont'd)

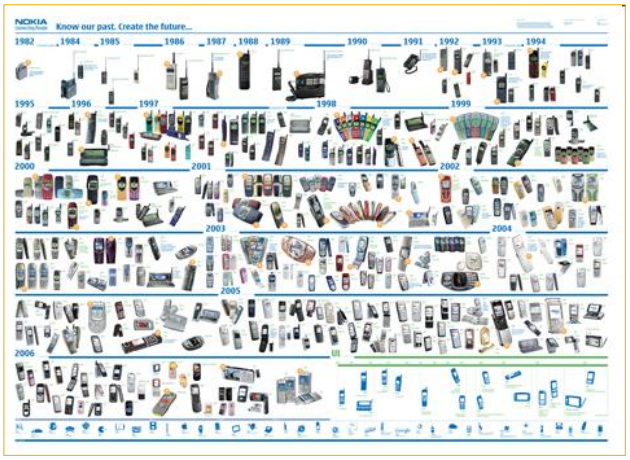


Source: ITU

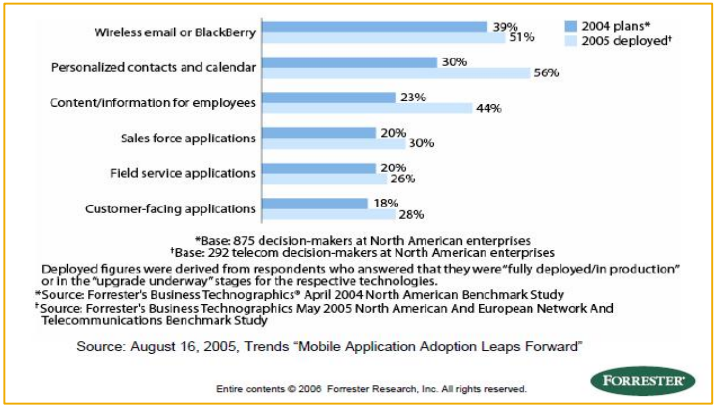


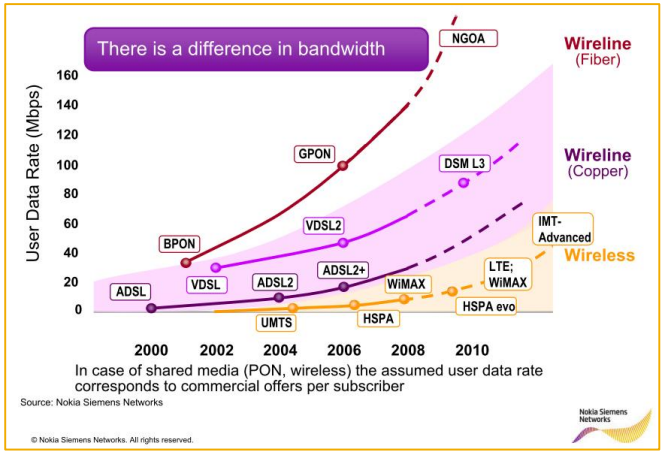
Source: W. Mohr, PIMRC 2009

Future Internet Research
- Drivers: Devices, Access, Apps



Source: Nokia





Future Internet Research
- Drivers: Cloud Computing

Definition from Consumer Perspective

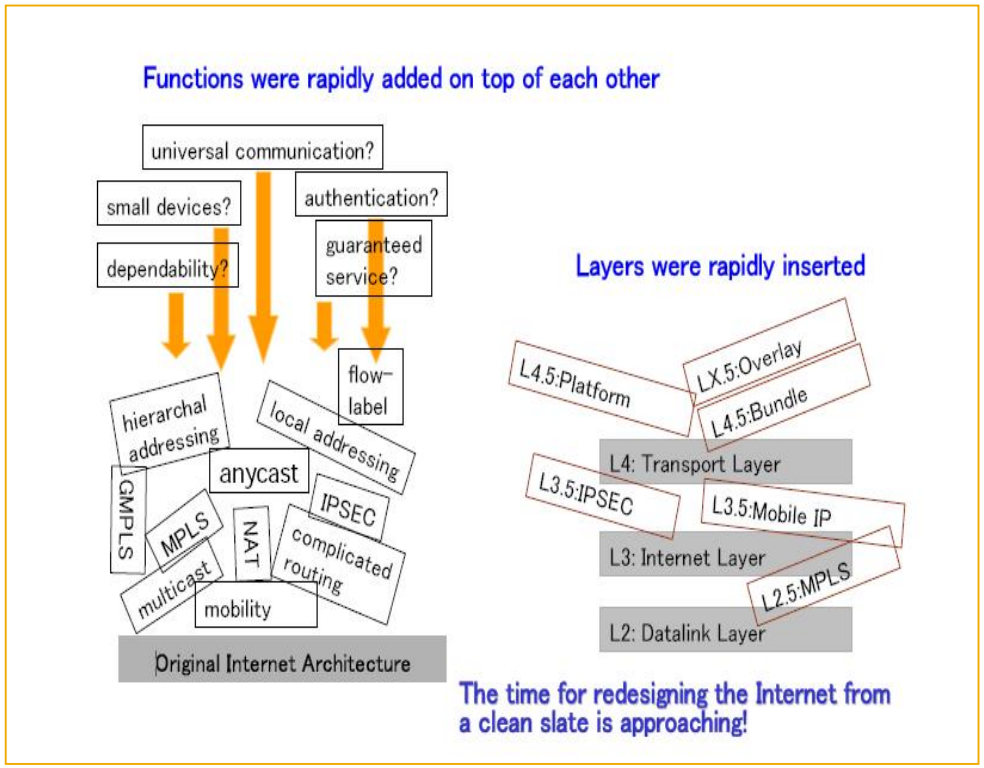
Cloud Computing allows **On Demand Software Provisioning** with **Zero-Installation & Zero-Configuration** at **low cost** and **immediate access** in **Ultra-Scalable Data Centers**.

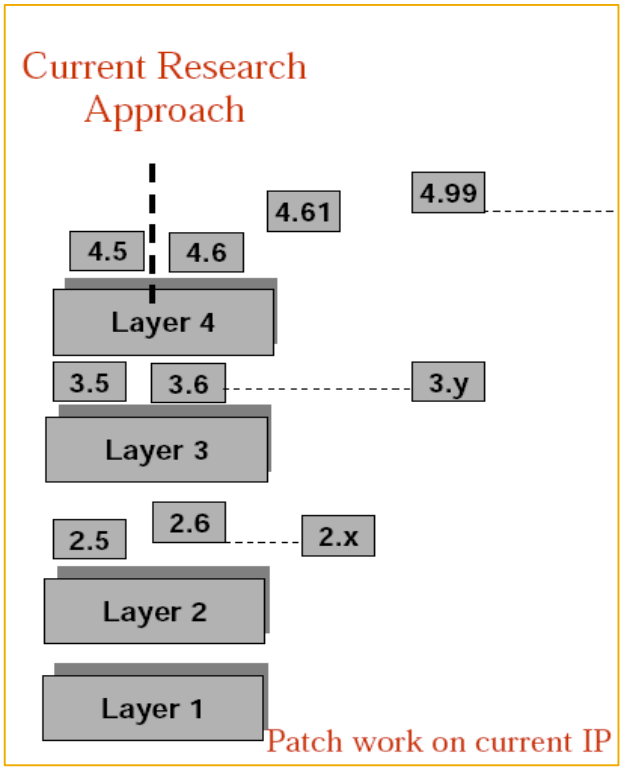
Application Providers	Platform Providers	Infrastruct Providers	Service Providers
salesforce	salesforce	amazon.com	accenture
Microsoft	Microsoft	BT at&t	IBM vmware
Google	Google	hp invent	EMC² where information lives
ORACLE	ORACLE	IBM OpSource	
SuccessFactors People Performance		T-Systems	

Selected Cloud Consumers & ISVs

bea ORACLE ON DEMAND XEROX amazon.com NBC UNIVERSAL The Washington Post RIGHTSCALE Autodesk Microsoft accenture The New York Times ON THE WEB P&G SanDisk rpath facebook

Future Internet Research - Consequence





Patching the Internet Architecture (Source eMobility)

Future Internet Research - Origins

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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)

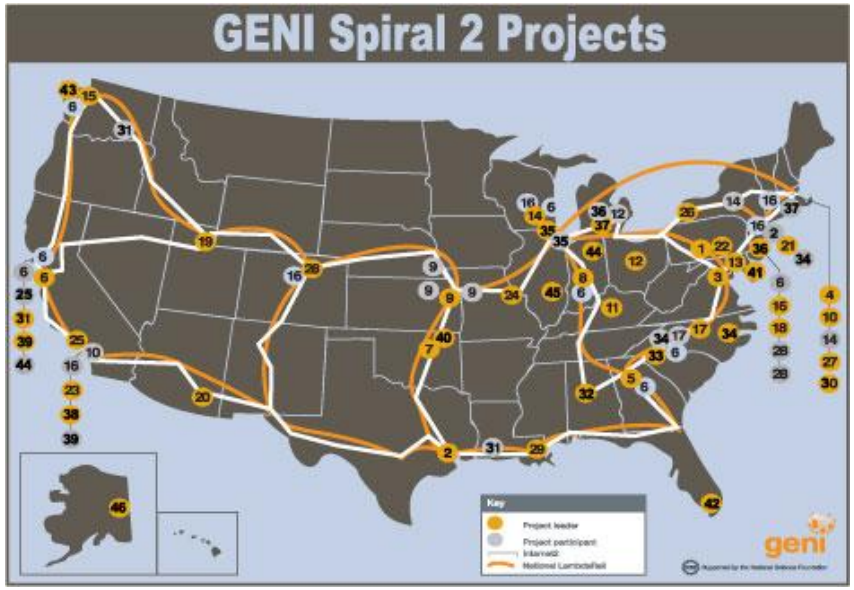
Future Internet Design (FIND)

- 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 Intenet from scratch

Future Internet Research - Nets, FIND, GENI

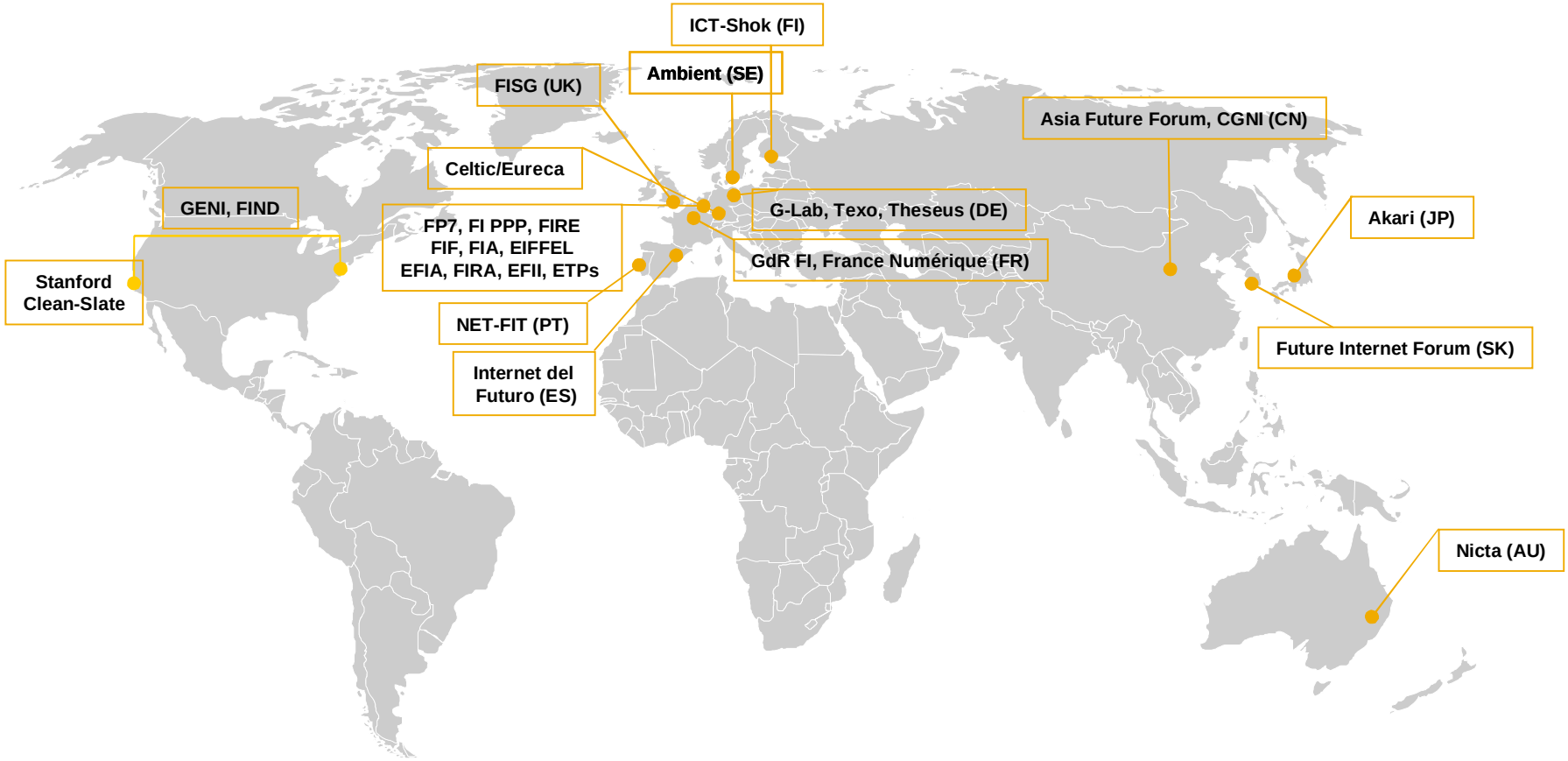
Global Environment for Network Innovations (GENI)

- 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

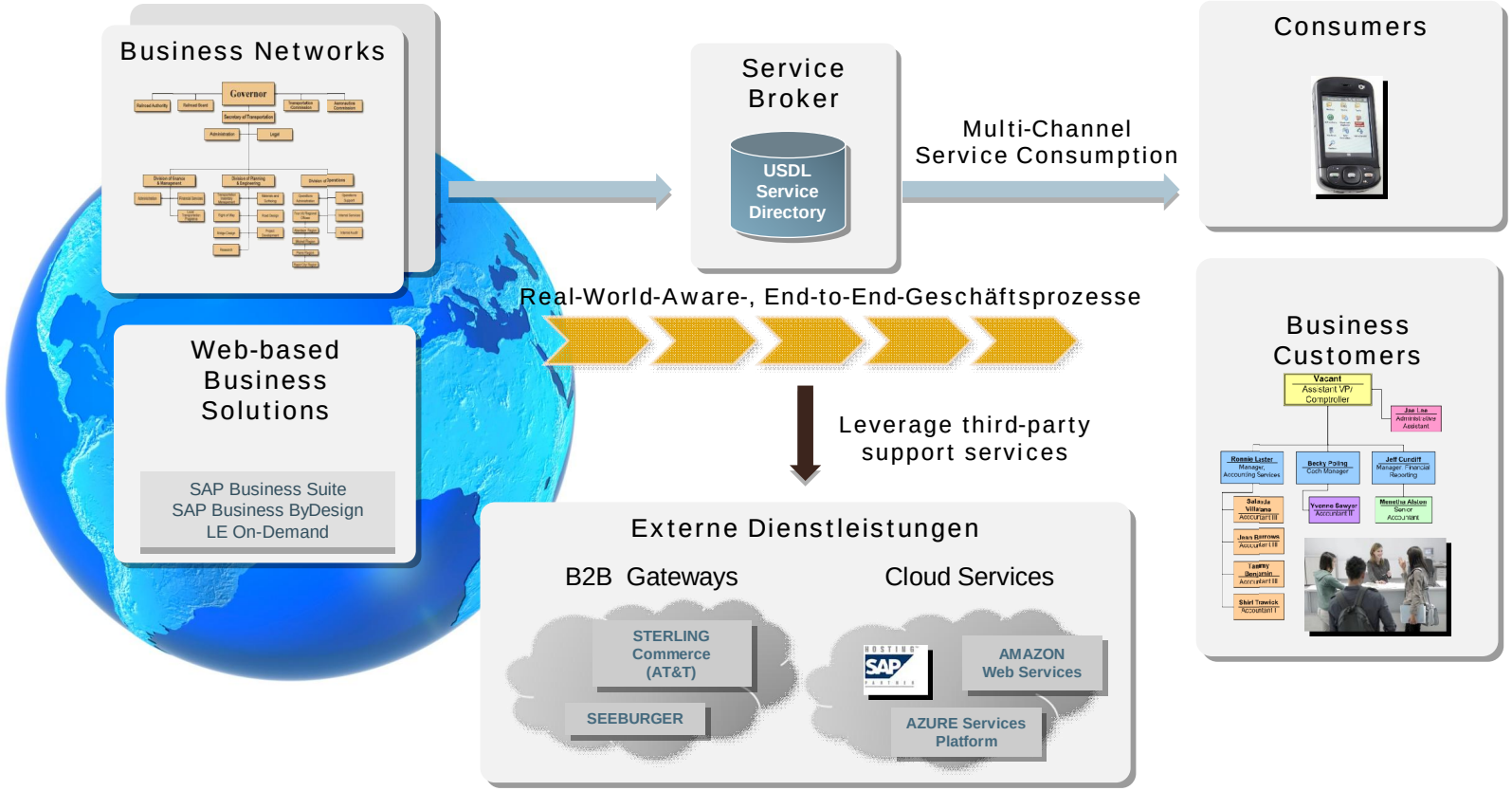
THESEUS (Greek mythology, succeeded in escaping from the Minotaur's labyrinth)

- 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

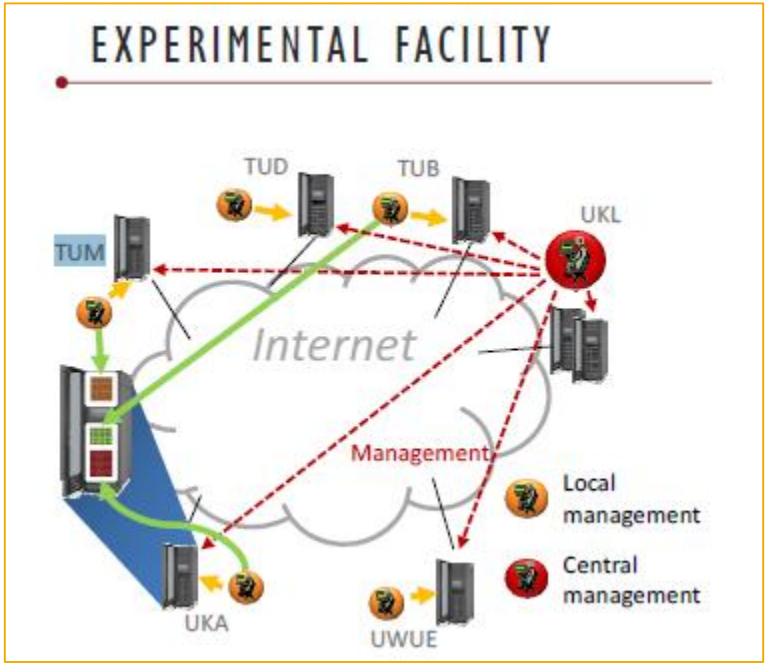
Theseus / Texo
- Paving Way for the Internet of Services



G-Lab
- Design & Experiment the Network of the Future

G-LAB (German-Lab)

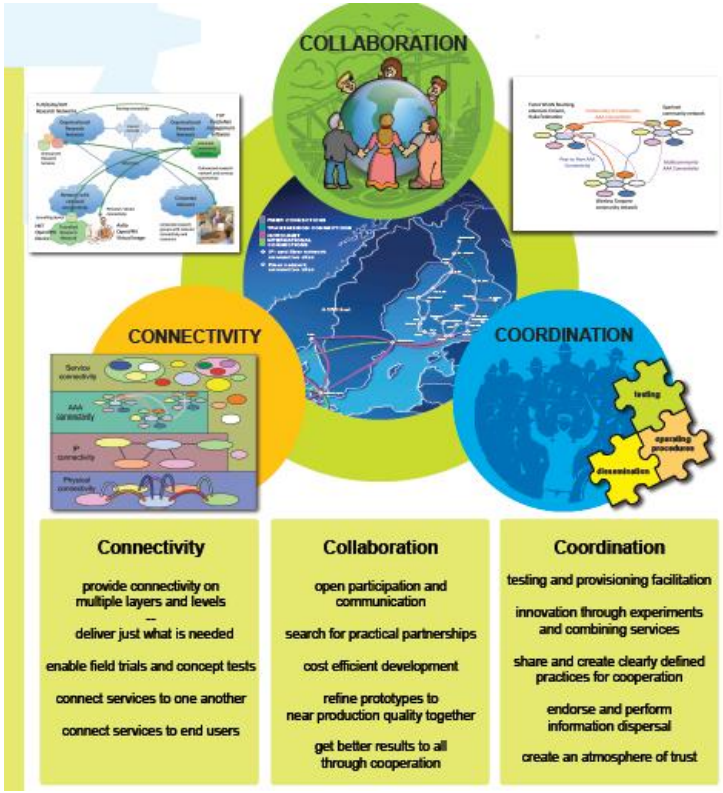
- National Platform for Future Internet Studies
- G-Lab consists of two major fields
  - Research studies of future Internet components
  - Design and setup of experimental facilities
- Future Internet Studies
  - Architectures, Routing, Mobility, Management, QoS/QoE, SoA
- Experimentation
  - G-Lab 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

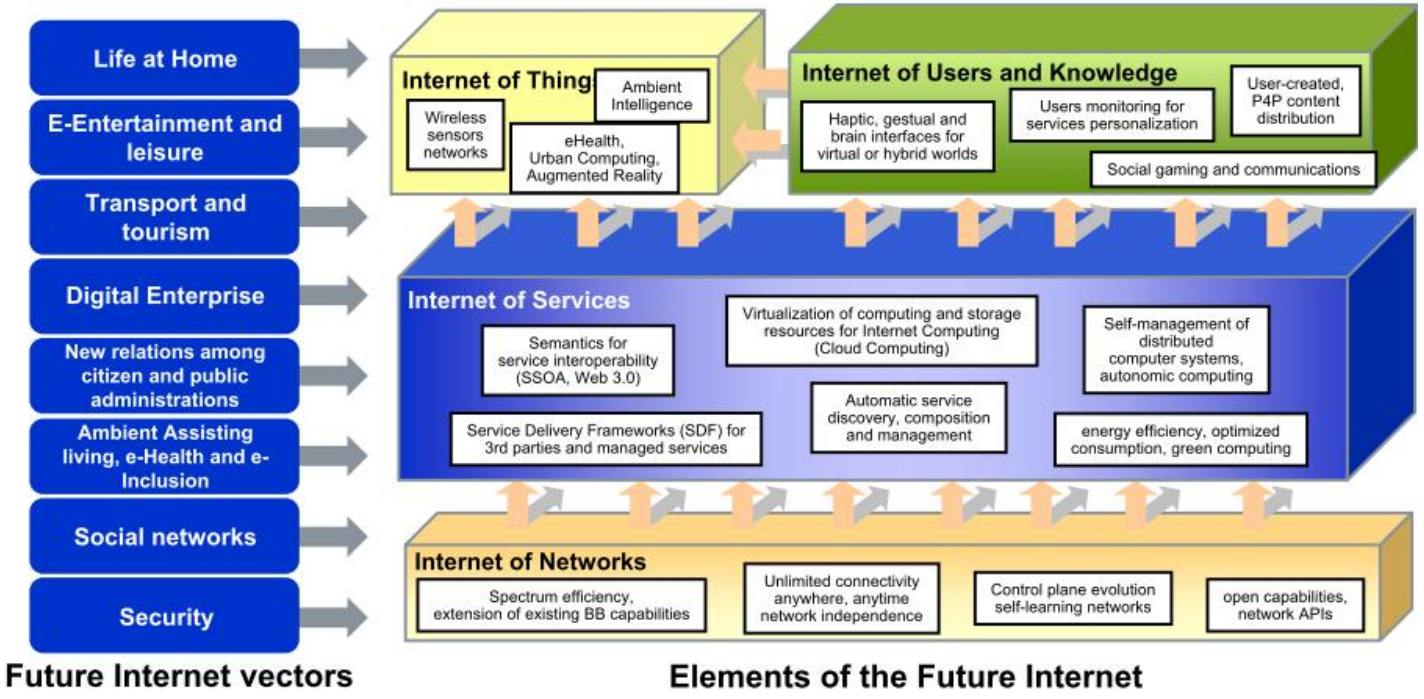
France – Plan Numérique 2012

- 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 schooles
  - 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

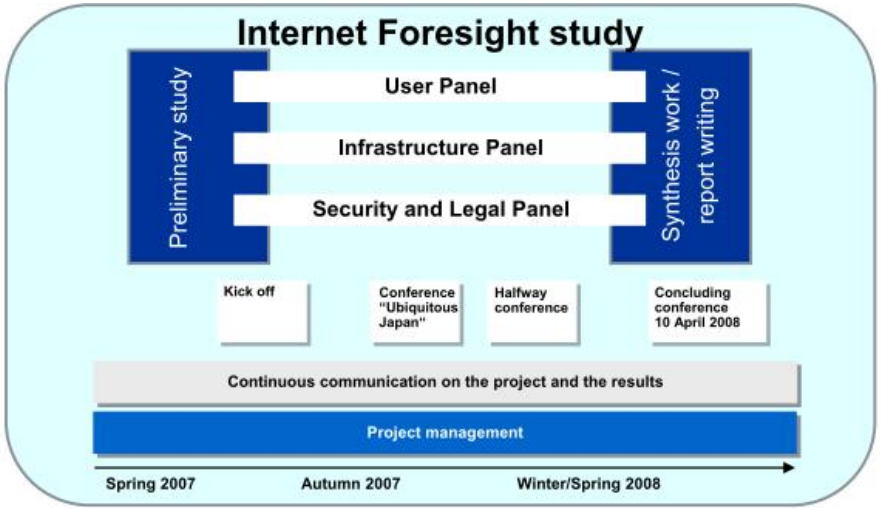
Internet del Futuro
- A Holistic Future Internet Approach

Spain – Internet del Futuro

es.INTERNET
Plataforma Tecnológica Española de Convergencia hacia Internet del Futuro

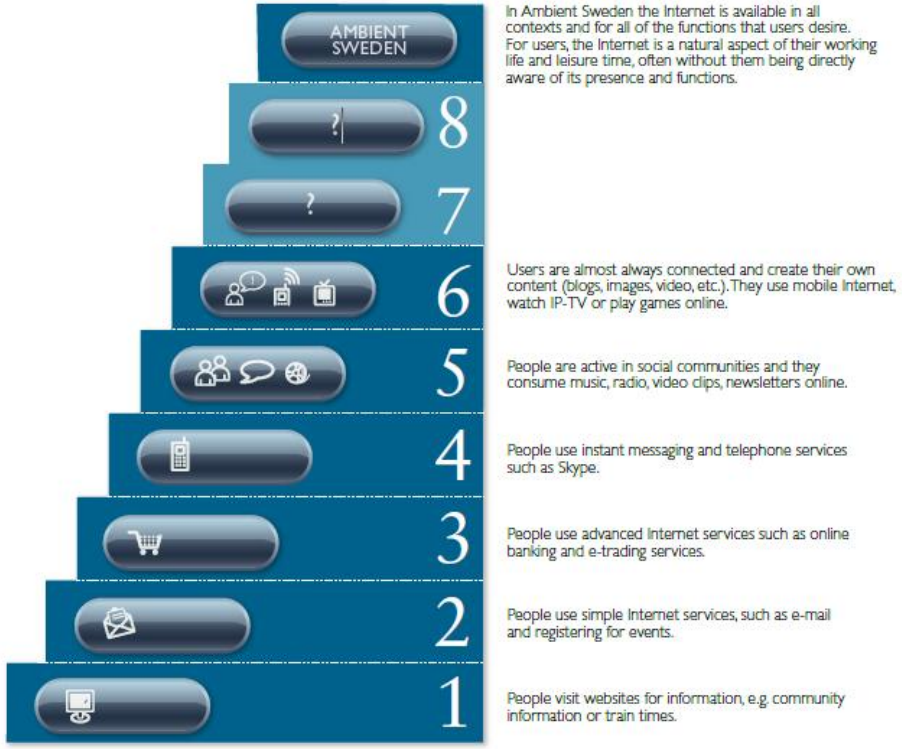


Ambient Sweden
- Sweden, a Leading Internet Nation in 2015



- 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

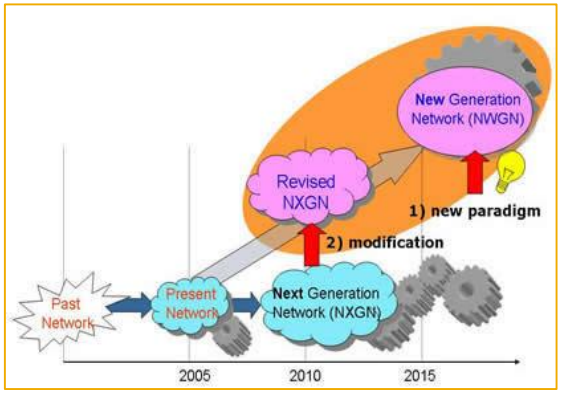
DIGITAL LADDER

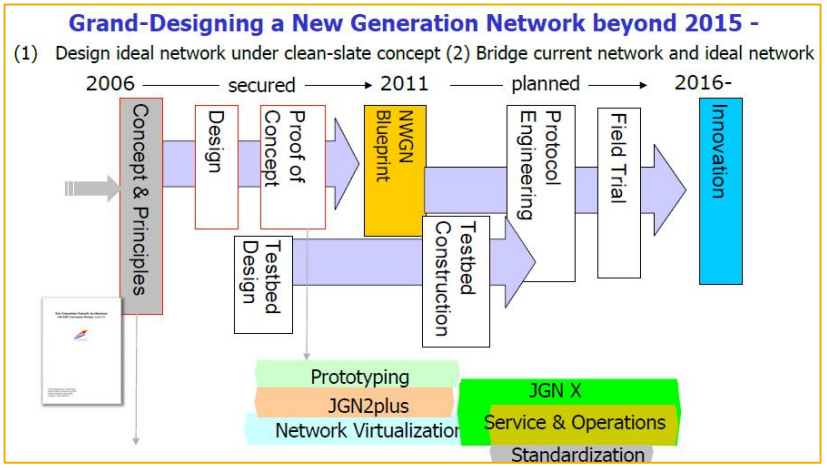


AKARI
- A Small Light in the Dark Pointing to the Future

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





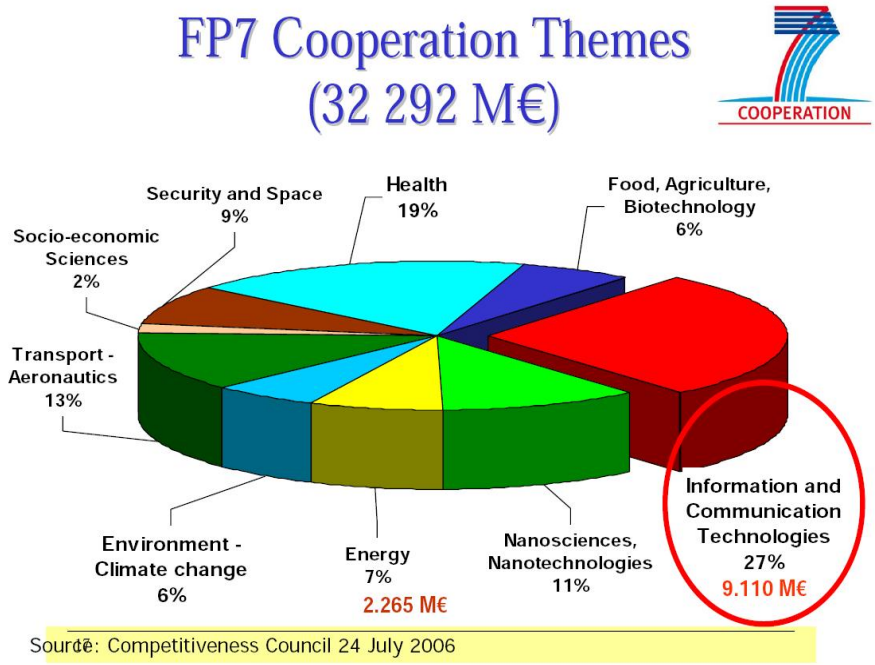
AsiaFI
- Asia Future Internet Forum

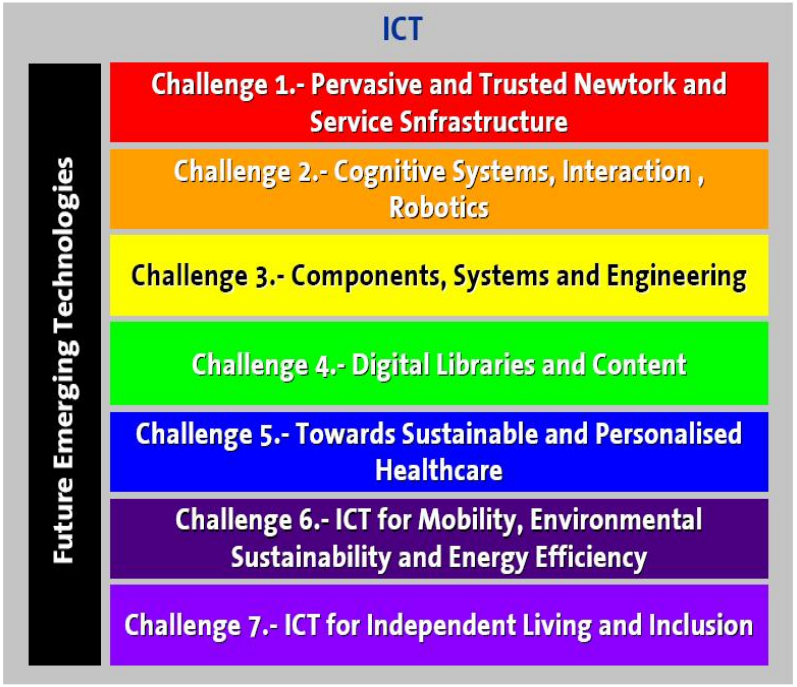
AsiaFI (Asia Future Internet Forum)

- 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 month
- 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

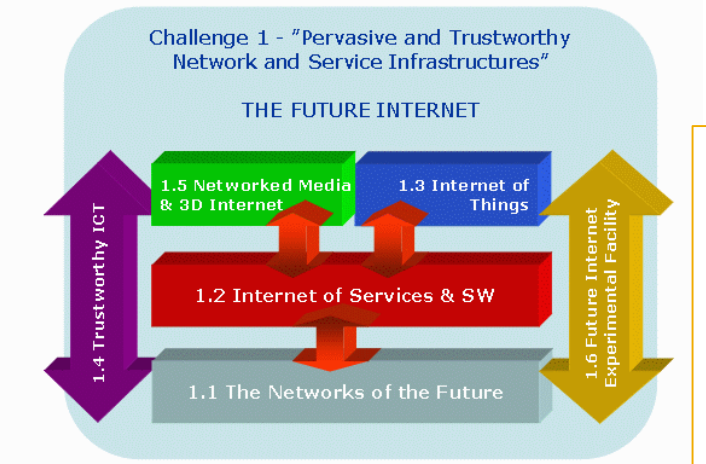
European Framework Program 7
- Research for European Competitivness

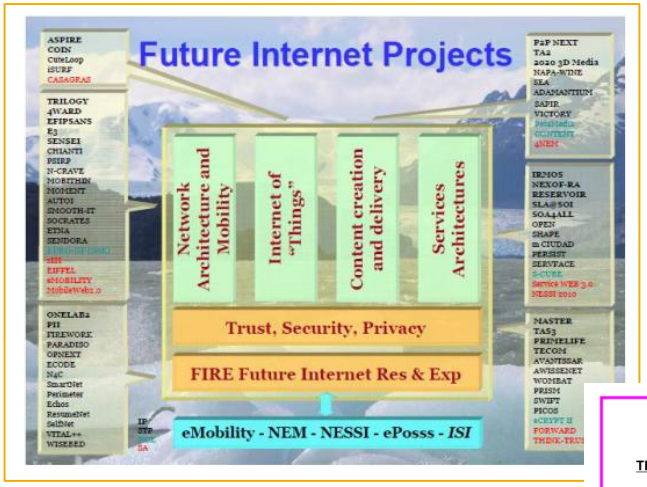
FP7 ICT: ~9 Billion Euro over 7 years

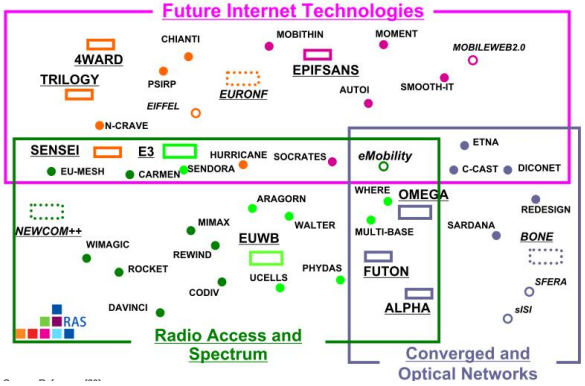




European Framework Program 7 - Challenge 1, The Future Internet







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


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

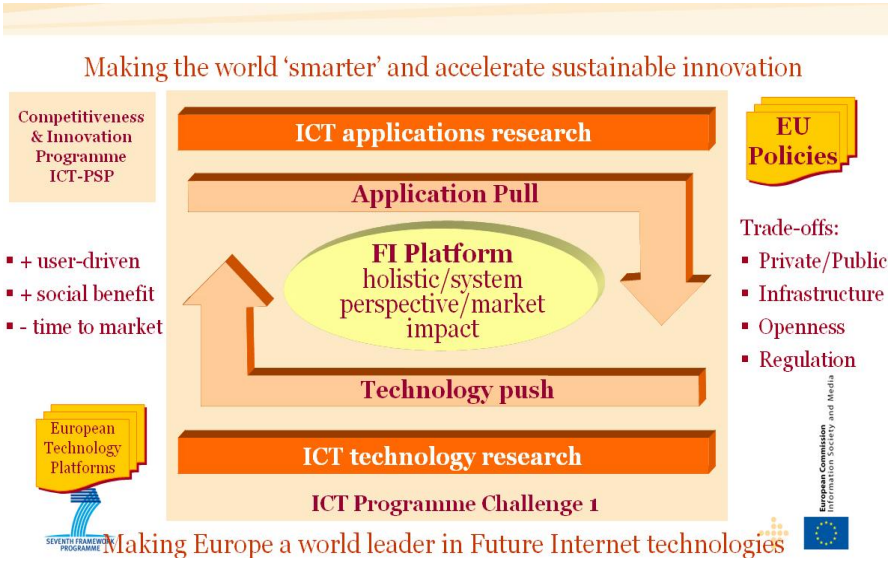
NEXOF

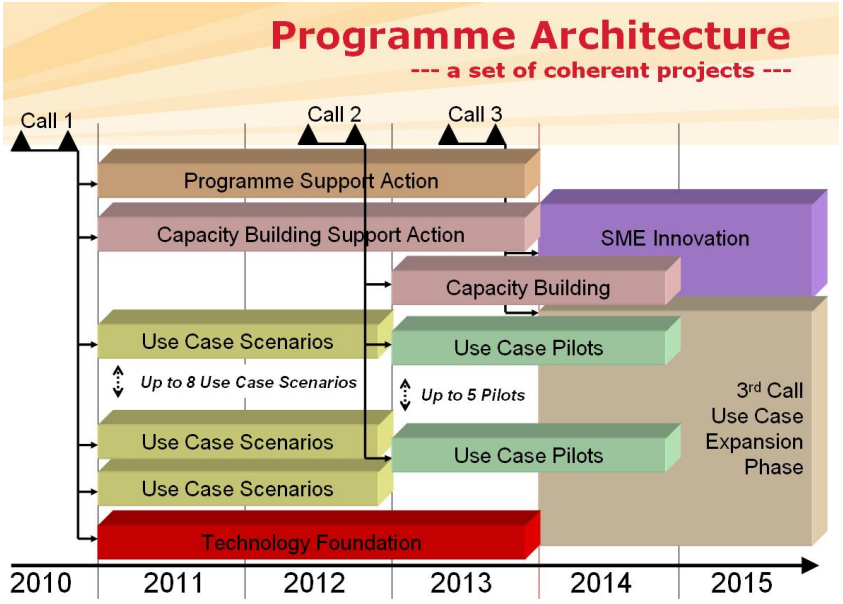
NESSI Open Service Framework

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



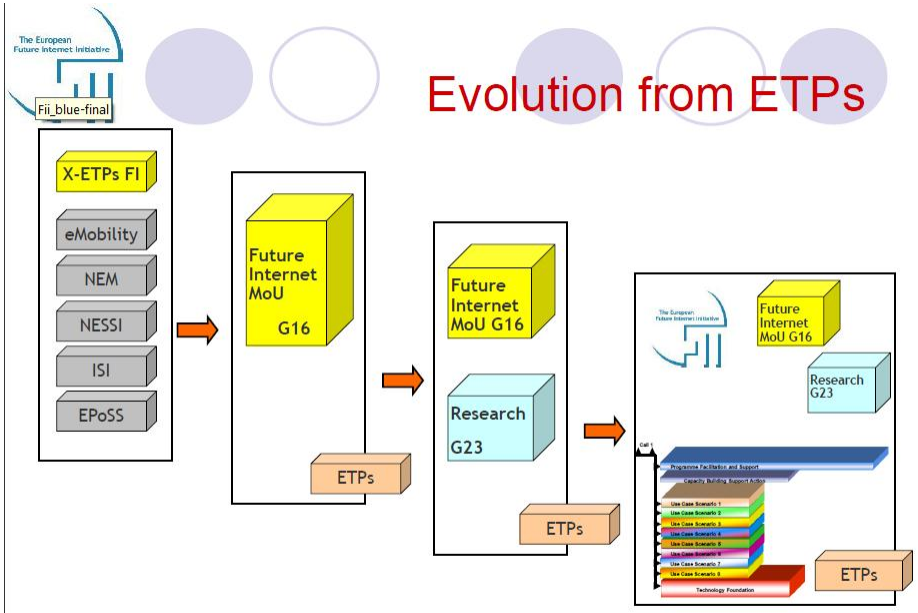


Source: European Commission

European Future Internet Initiative - A Vision for the FI PPP

European Future Internet Initiaitve

- 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



Source: D. Kennedy

Future Internet Research Alliance - Vision and Motivation

Transport, mobility & logistics

Automation

Content

Smart Energy Grid

eHealth

Utilities & Environment

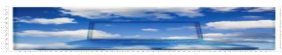
Vision

Holistic

Internet of Services

Internet of Things

Future Networks



Cloud Computing

Industry/Academic - SME/Incumbent - European/International

Enablement

Overarching

WPx-y

SEVENTH FRAMEWORK PROGRAMME

eit ict labs

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

Bundesministerium für Bildung und Forschung

Tekes

ANR

FCT

MINISTERIO DE CIENCIA E INNOVACIÓN

NWO

HIIT

European Initiatives

National Initiatives

Future Internet Research Alliance - Vision & Opportunities


Transport & Logistics


Automation


Content


Smart Energy

Biz & Tech Vision

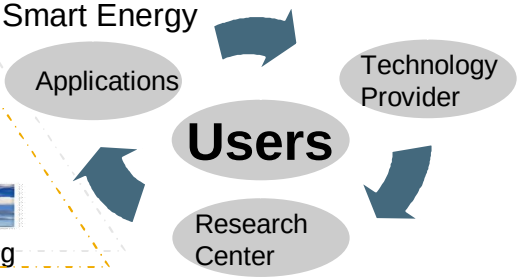
Generic Support for Future Biz


Internet of Services


Internet of Things


Future Networks


Cloud Computing



WPx-y

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

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 Demo

ict labs

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

European Future Internet Alliance
- Address Fragmentation and Join Forces

EFII : FIRA

EFIA

European Future Internet Alliance

A proposal by and to members of EFII & 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:

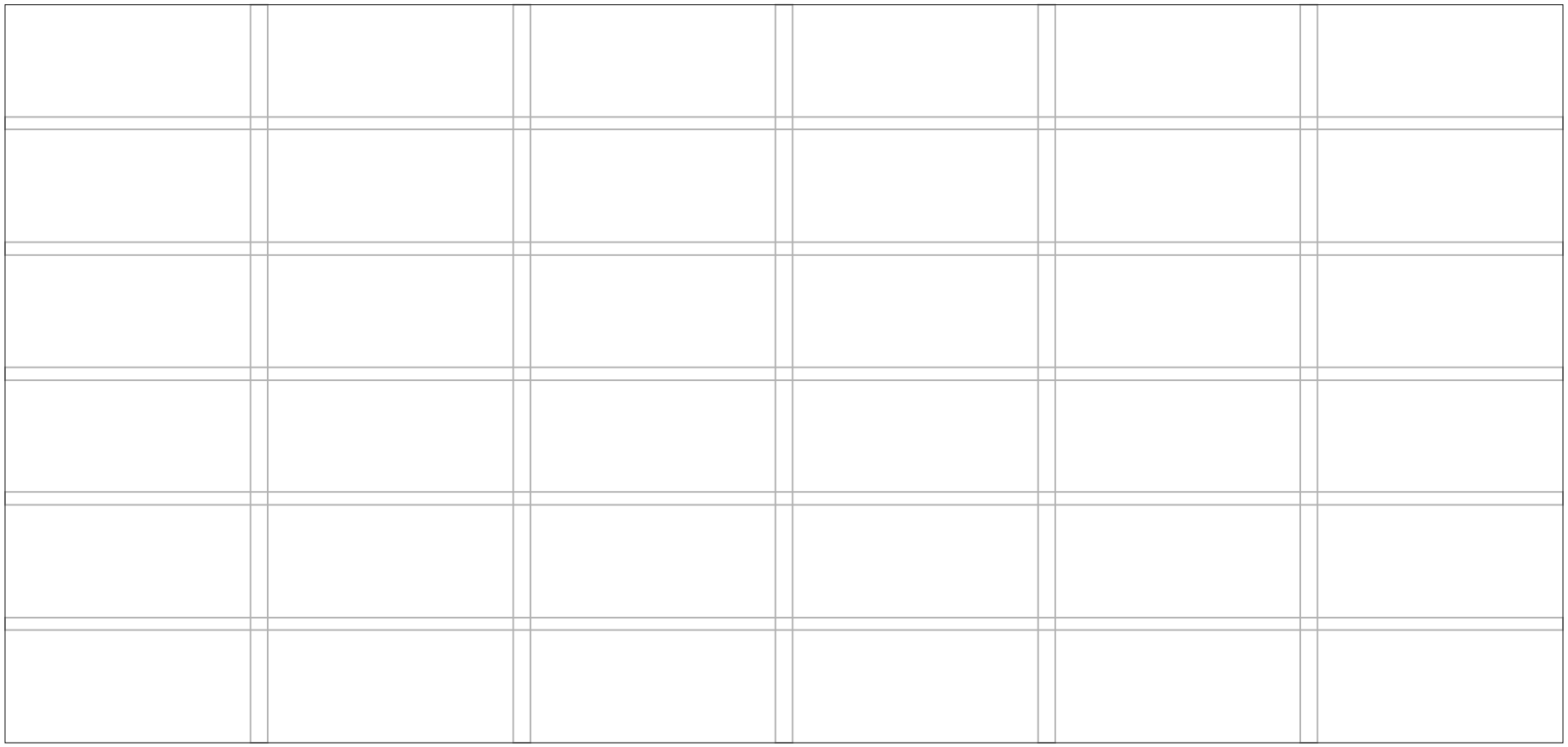
"to be the European industrial led alliance that facilitates the focused research, development and innovation towards the Future Internet while promoting the uptake of the advanced technologies and business models for the future internet in partnership with all stakeholders in the community"

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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