On Future Internet, Cloud Computing, and Semantics – You name it

Arian Zwegers

European Commission

Information Society and Media Directorate General

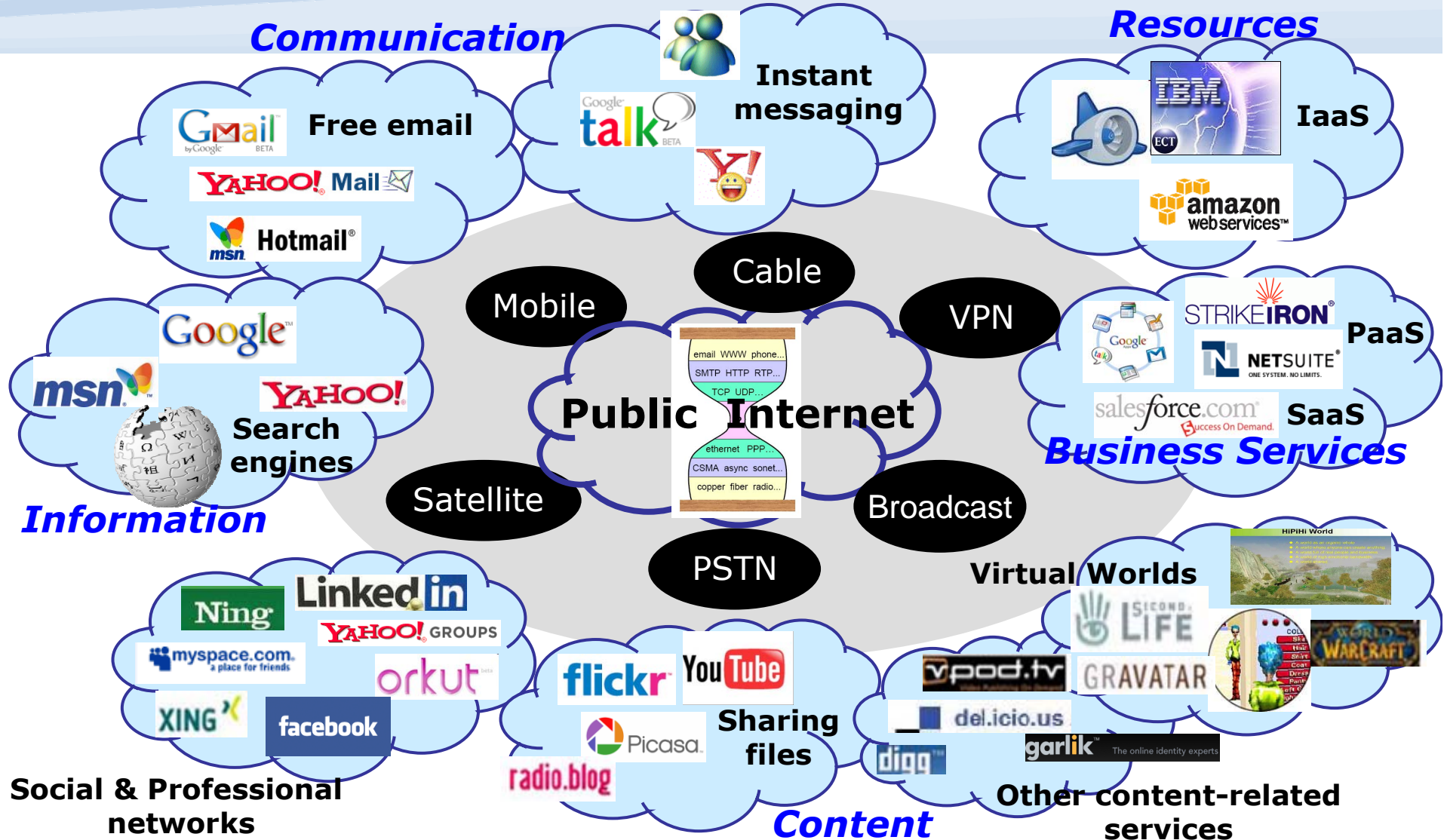Software & Service Architectures and Infrastructures Unit

Overview

- Future Internet
  - Today's Internet
  - Problems and opportunities
  - Different perspectives
  - What's next?
- Internet of Services
  - Vision
  - Cloud Computing – What is it?
  - Cloud Computing – Market values
  - Some issues for debate
  - What's next?
- Semantics Research in EU
- Business models
  - Some factors to consider
  - Business strategies
- WP2009-10
  - Objective 1.2

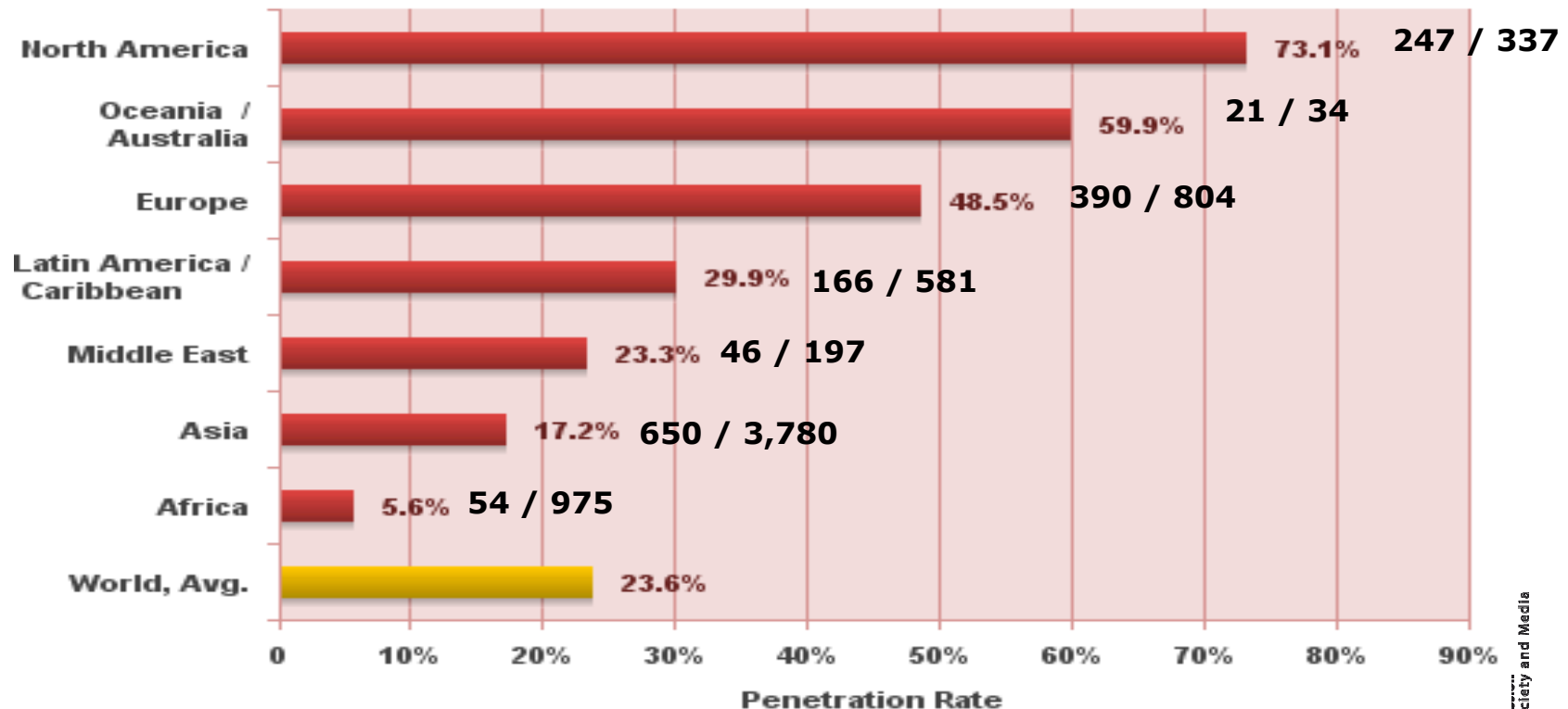SEVENTH FRAMEWORK PROGRAMME

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Future Internet
Today's Internet

Communication · Instant messaging · *Resources*

Free email — Gmail BETA, YAHOO! Mail, Hotmail MSN

IaaS — IBM ECT, amazon web services

Google talk BETA, YAHOO!

Google, msn, YAHOO!, Search engines — *Information*

Mobile · **Cable** · **VPN**

Public Internet — email WWW phone…, SMTP HTTP RTP…, TCP UDP…, ethernet PPP…, CSMA async sonet…, copper fiber radio…

PaaS — STRIKEIRON, NETSUITE ONE SYSTEM. NO LIMITS.

SaaS — salesforce.com Success On Demand — Google talk

Business Services

Satellite · **Broadcast**

PSTN

Virtual Worlds — HiPiHi World, SECOND LIFE, WORLD of WARCRAFT

Ning, Linked in, YAHOO! GROUPS, myspace.com a place for friends, orkut beta, XING, facebook

flickr, You Tube, Picasa, radio.blog — Sharing files

vpod.tv, GRAVATAR, del.icio.us, digg, garlik The online identity experts

Social & Professional networks

Content

Other content-related services

Adapted from Zwegers (2008) and Li (2009)

Future Internet
World Internet Penetration Rates
by Geographic Regions

Region	Penetration Rate	Users / Population
North America	73.1%	247 / 337
Oceania / Australia	59.9%	21 / 34
Europe	48.5%	390 / 804
Latin America / Caribbean	29.9%	166 / 581
Middle East	23.3%	46 / 197
Asia	17.2%	650 / 3,780
Africa	5.6%	54 / 975
World, Avg.	23.6%	

Penetration Rate

Source: Internet World Stats - www.internetworldststs.com/stats.htm
Penetration Rates are based on a world population of 6,710,029,070
for full year 2008 and 1,581,571,589 estimated Internet users.
Copyright © 2009, Miniwatts Marketing Group

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Future Internet
Current/emerging problems and opportunities

- Current Internet was never designed to be a critical part of an economy's infrastructure
- Net-delivered services are reshaping the world (search, media, games, social networking, etc.)
- Tripling of the number of people connected (1 → 3 B)
- Addition of billions—perhaps even hundreds of billions—of devices (sensors, tags, micro controllers)
- User generated content leads to a massive increase of creative flow of content and processes
- Balance the perceived need for control with the creativity that spawns innovation—and profit?
- Towards tethered appliances or generative technology?

http://www.youtube.com/watch?v=ZAsb4gtEpaw

http://iiea.com/zittrain/video.wmv

http://www.youtube.com/watch?v=KDgxGN6cqTA
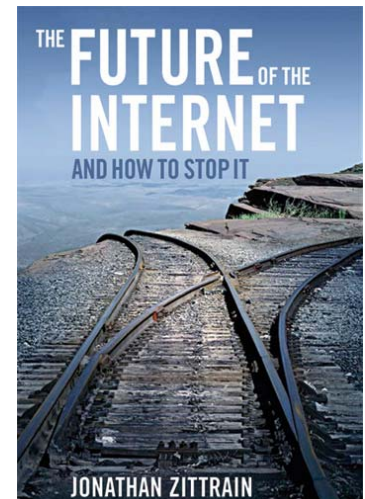
Future Internet
Different perspectives and their danger

Internet of Services, Service Web
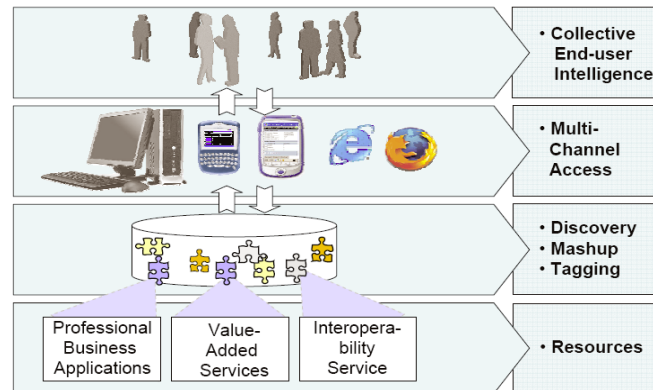
3D Internet

Trust

Security

Networks of the Future
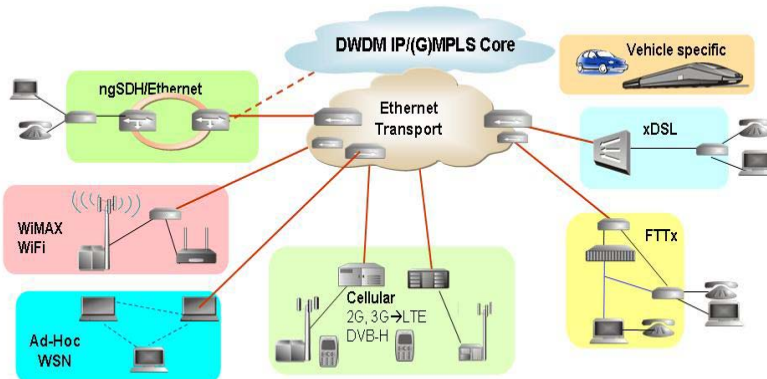
http://www.alexandria.unisg.ch/EXPORT/DL/38496.pdf
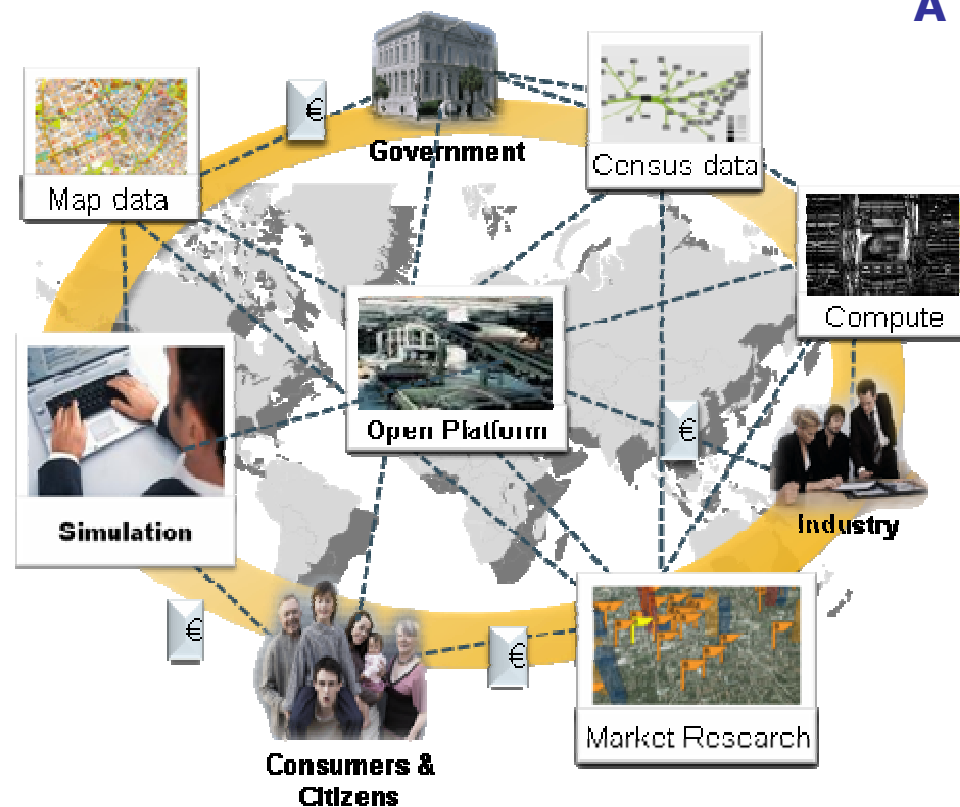http://www.itu.int/osg/spu/publications/internetofthings/
Second Life

Internet of Things

Internet of Services
Vision

A multitude of connected IT services, which are offered, bought, sold, used, repurposed, and composed by a worldwide network of service providers, consumers, aggregators, and brokers

- resulting in -

a new way of offering, using, and organising IT supported functionality

Number of Web services found by SEEKDA crawler during the past 26 months

Adapted from SAP Research, 2008, and SEEKDA, 2009

Internet of Services
Cloud Computing – Everything old is new again?

An Internet Critic Who Is Not Shy About Ruffling the Big Names in High Technology

By JOHN MARKOFF
Published: Monday, April 9, 2001

David Winer is a software designer who loves making trouble. And even if many in Silicon Valley consider him an irascible gadfly, he has a large, attentive audience.

☑ SIGN IN TO RECOMMEND

SIGN IN TO E-MAIL

For Microsoft, the idea behind .Net is software programs that do not reside on any one computer but instead exist in the "cloud" of computers that make up the Internet. The move from the desktop-based computing paradigm that Microsoft has controlled to an open-network approach would be a crucial one for all computer users and software programmers.

Mr. Winer began discussing cloud-computing ideas with several Microsoft developers in 1998, and together they quickly cobbled together a standard means for communicating XML data between computers, something he called XML-RPC. That standard has since been overtaken by Microsoft and I.B.M., which, with input from Mr. Winer, developed a separate standard called SOAP, or Simple Object Access Protocol.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction
(Source: NIST Cloud Computing Project)
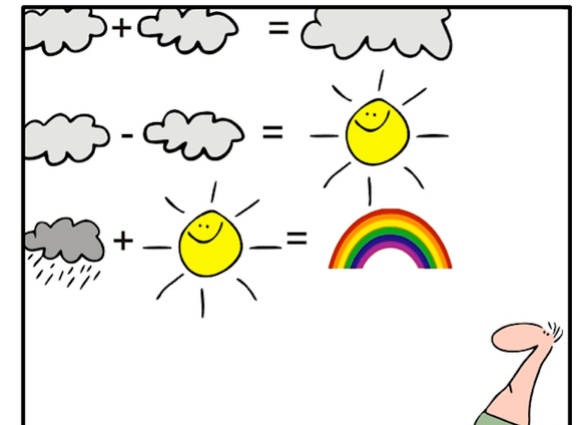
Internet of Services
Cloud Computing – Every cloud has a silver lining
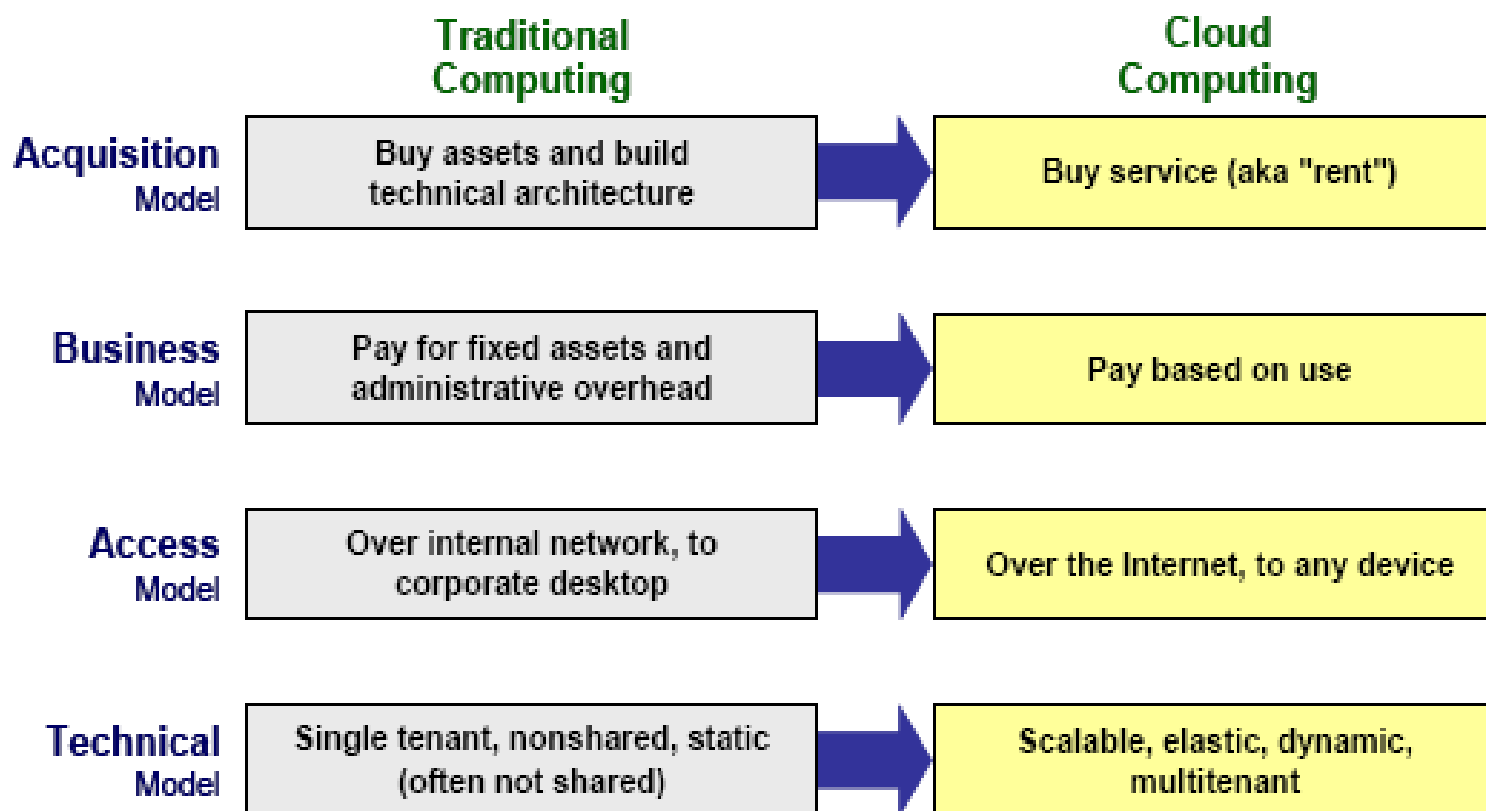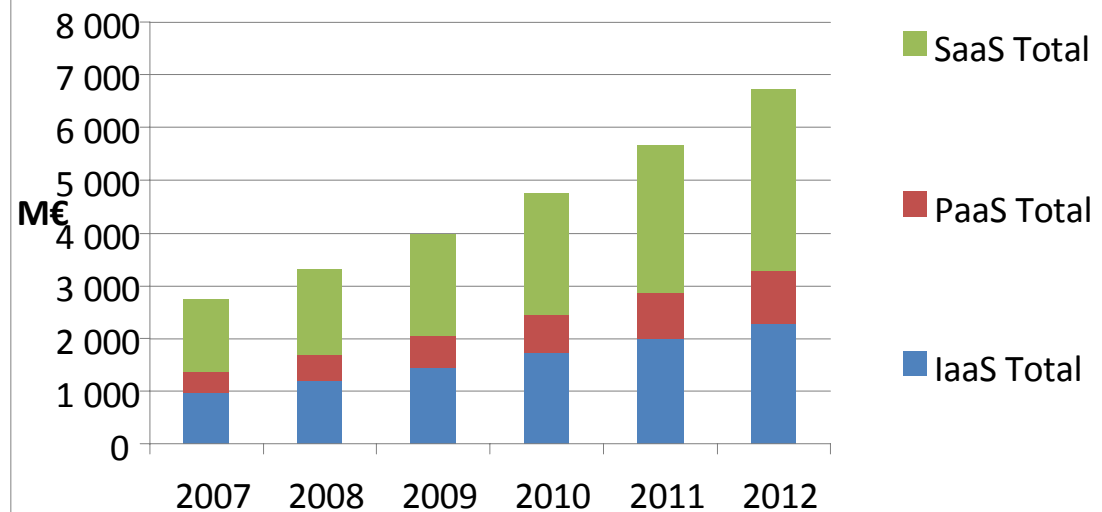
Worldwide by 2012
- SaaS: $21bn
  - 20% CAGR
- PaaS: $9bn
  - 160% CAGR
- IaaS: $4bn
  - 60% CAGR

Cloud Computing - EU27

Merrill Lynch:
Cloud computing market opportunity by 2011 =
$95bn in business and productivity apps +
$65bn in online advertising =
$160bn

Sources: AMR, Gartner, IDC, William Blair & Co., Merrill Lynch, PAC

Internet of Services
SaaS, a silver bullet?

Drivers

- Maintenance fees are the gravy train of enterprise software
- Costs savings (acquisition and maintenance)
- Predictability of software management costs
- Complexity reduction
- Increasing offerings available in the market, increasing customer choice
- Increasing provider accountability

Inhibitors

- "Tethered appliances" argument (Zittrain)
- From privacy policies to portability policies
- Switching costs
- Reliability software-on-demand products/services
- Perceived lack of functionality, security, customisation, and integration capabilities
- Putting critical information off-premise?
- Service provider viability

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Internet of Services
Billions of services vs service parks/ecosystems?

Billions of services

- Everybody is a potential service provider
- Everybody potentially uses services from everybody
- Requires work on service discovery, composition, semantics for heterogeneous services

Service Parks

- Trusted services from recognised brands
- Sets of services with rules for combining and modifying them
- Homogeneous semantics
- Guaranteed SLAs
- Like the old vision, but in a park only

Source: Charles Petrie, Christoph Bussler
"The Myth of Open Web Services –
The Rise of the Service Parks"
IEEE Internet Computing, May/June 2008, pp 93-95
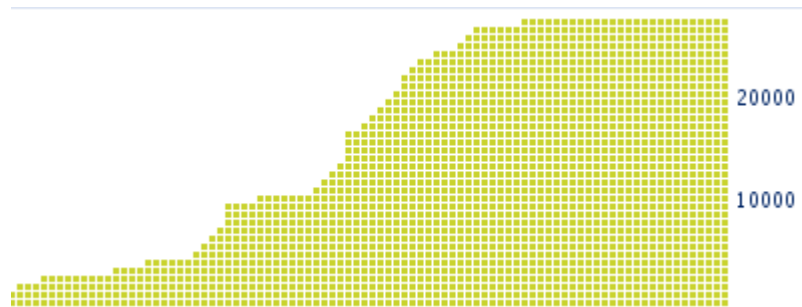
Number of Web services found by SEEKDA crawler during the past 26 months

Source: SEEKDA, 2009

Internet of Services
Shared vision vs independent thinking?

Semantics? What semantics?

SEARCHPOINT | semantics | Search via topics | Search via query to ontology | Search via hits to ontology |

(6) Formal semantics of programming languages - Wikipedia, the free ...
In theoretical computer science, formal semantics is the field concerned with ... The formal semantics of a language is given by a mathematical model that ...
http://en.wikipedia.org/wiki/Program_semantics

(2) semantics: Definition from Answers.com
semantics n. (used with a sing. or pl. verb) Linguistics. The study or science of meaning in language ... In formal studies, a semantics is provided for a ...
http://www.answers.com/topic/semantics

(71) HTML, the Foundation of the Web | Web Page Design for Designers ©
Web Page Design for Designers - HTML, the Foundation of the Web ... Semantics ... HTML is more than just semantics, it's also about structuring your document. ...
http://www.wpdfd.com/issues/86/html_the_foundation_of_the_web/

(9) semantics - definition of semantics by the Free Online Dictionary ...
Information about semantics in the free online English dictionary and ... semantics - the study of language meaning. linguistics - the scientific study of ...
http://www.thefreedictionary.com/semantics

(11) Semantics
Algebraic semantics describe the meaning of a program by defining an algebra. ...
Denotational semantics tell what is computed by giving a mathematical object ...

Library and Information
Linguistics
Knowledge Management
Reference
Social Sciences
Science
Top
Math
Society
Computers
Philosophy
Artificial Intelligence
Computer Science
Markup Languages
Data Formats

http://searchpoint.ijs.si

SOA4All
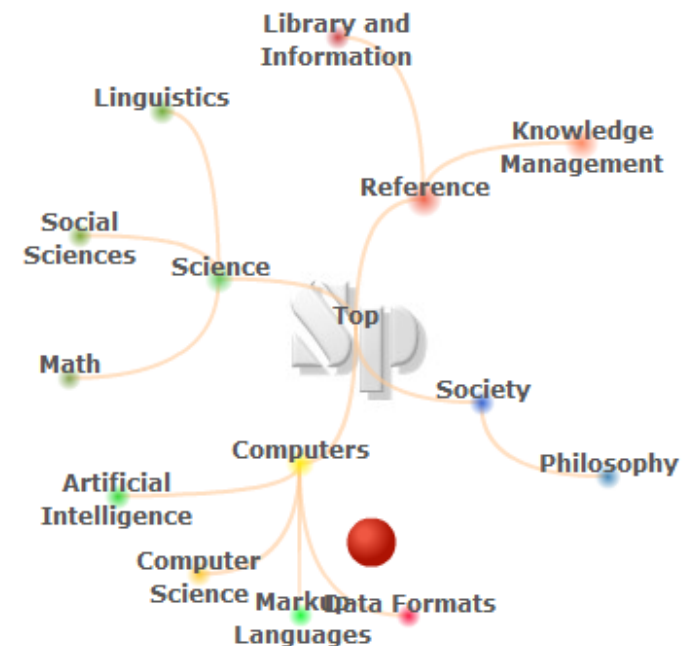
SOA
As the emerging dominant paradigm for application development which abstracts from software to the notion of a service

Web principles
To scale SOA to a world wide web communications infrastructure

Context
Adapting to meet local environment constraints, organizational policies and personal preferences

Web 2.0
As a means to structure human-machine cooperation in an efficient & cost-effective manner
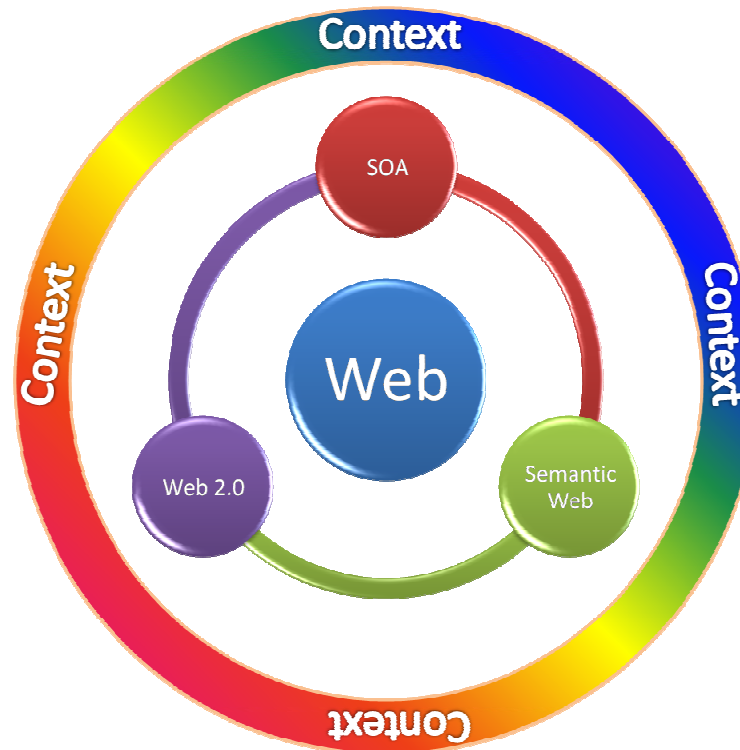
Semantic Web
To automate service discovery, mediation & composition

(See http://www.soa4all.eu)

SOA4All

SOA4All will integrate the service world of large enterprises, SMEs, and end-users enabling them to engage as peers within a network of equals
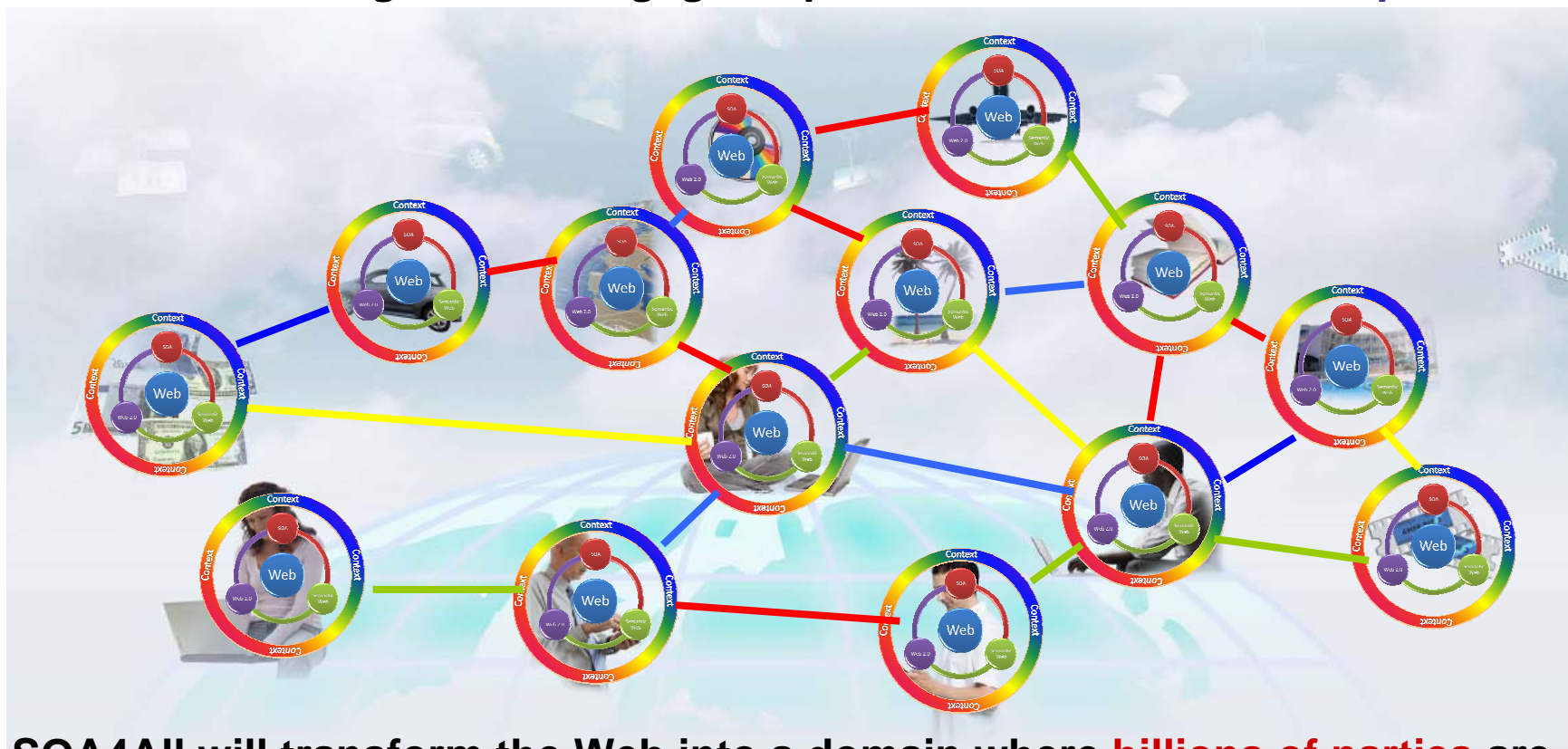
SOA4All will transform the Web into a domain where billions of parties are exposing and consuming services in a seamless transparent fashion

(See http://www.soa4all.eu)

Business Models
Some factors to consider (1/2)

- Generative technology vs Tethered Appliances
  - Generative technology
    - Configurable, processable
    - Development mediated through market model
  - Tethered appliances
    - Need for 'men in white coats'
    - Development mediated through company
  - E.g. Windows vs iPhone; or Internet vs CompuServe
- Ecosystems
  - Variety of applications based on platform, and/or
  - Business partnerships, and/or
  - Relationships with suppliers and consumers

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Adapted from Li, 2009

Business Models
Some factors to consider (2/2)

- ## Services
  - From shrink-wrapped, packaged products to Software as a Service
  - Focus from basic network services to "more valuable" software services

- ## Universality & Utility
  - Universal service: utility, affordability, accessibility, availability, quality
  - Utility: right to the service in question
  - Scarcity and market power

Business Models
Business Strategies (1/2)

- ## Protection of intellectual property
  - Patents and trade secrets
  - Right to exclude others vs right to exclusivity

- ## Bundling of technologies
  - "A superior offering"
  - Distribution advantages and network effects

Adapted from Li, 2009

Business Models
Business Strategies (2/2)

- # Standards
  - Openness, interoperability and market as arbiter
  - Defensive strategies and publishing APIs

- # Open source
  - Collective intelligence, added value, management of development process

- # Long tail
  - Market niches, smaller customers, customisation, choice

So?

- Where is Europe?
- "Web 3.0 = Google Inc?"
- Issues with Internet of Services and Cloud Computing
- What can Europe do?
  - ➔Framework Programmes
  - ➔(National programmes)
  - ➔(Software strategy)
  - ➔(Cloud Computing workshops)
  - ➔(Other?)
- Are we going to act (or not)?

WP2009-10
7th Framework Programme (2007-2013)

	COOPERATION	1. Health	2. Food, Agriculture Biotechnology	3. ICT	4. Nano, Materials, Production Techn.	5. Energy	6. Environment	7. Transport	8. Socio-economic Research	9. Space	10. Security
€ 32 B											

	IDEAS	European Research Council
€ 7.5 B		

	PEOPLE	Marie Curie Actions
€ 4.7 B		

	CAPACITIES	Research Infrastruc-tures	Research for the benefit of SMEs	Regions of Know-ledge	Research Potential	Science in Society	International Co-operation
€ 4.2 B							

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http://cordis.europa.eu/fp7/

WP2009-10
ICT WP2009-2010, ~2 B€ total

i2010 Flagships

ETPs

Socio-economic goals

	Digital Libraries and Content	Towards sustainable and personalised healthcare	ICT for Mobility, Environmental Sustainability and Energy Efficiency	ICT for Independent Living, Inclusion and Governance
Network and Service Infrastructures				
Cognitive Systems, Interaction, Robotics				
Components, Systems, Engineering				

Technology roadblocks

Future and Emerging Technologies

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ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/ict-wp-2009-10_en.pdf

WP2009-10
Challenge 1

The Future Internet

Call 4
80 MEuro

Call 5
37 MEuro

Call 5
90 MEuro

Call 5
110 MEuro

Call 5
50 MEuro

Call 4
110 MEuro

Call 5
80 MEuro

1.4 Trustworthy ICT

1.5 Networked Media and 3D Internet

1.3 Internet of Things and Enterprise environments
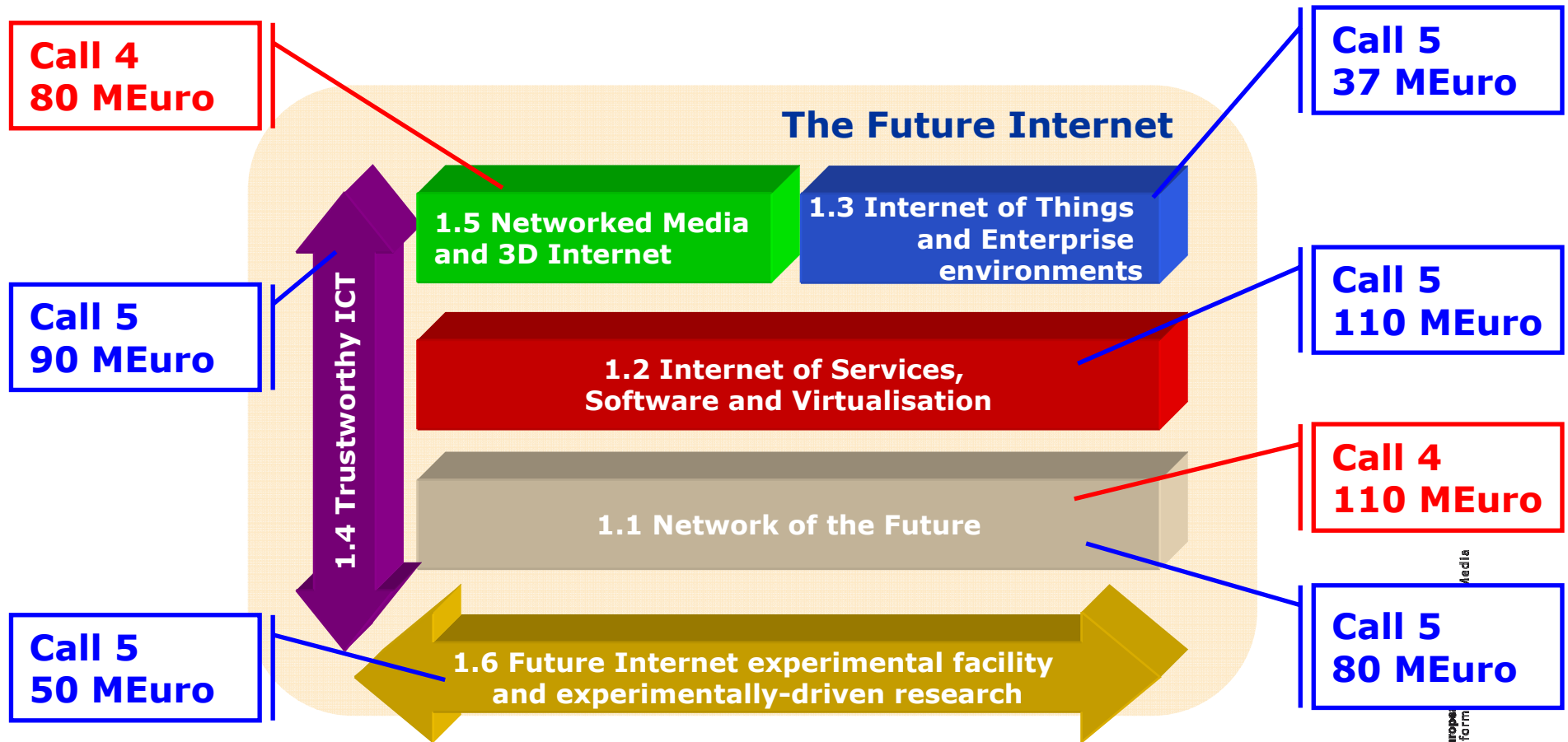
1.2 Internet of Services, Software and Virtualisation

1.1 Network of the Future

1.6 Future Internet experimental facility and experimentally-driven research

Target Outcomes

Services for the Future Internet

- Service Front Ends
- Architectures & components
- Virtualisation

&

Highly Innovative

- Service Engineering
- Verification
- Open Source Software
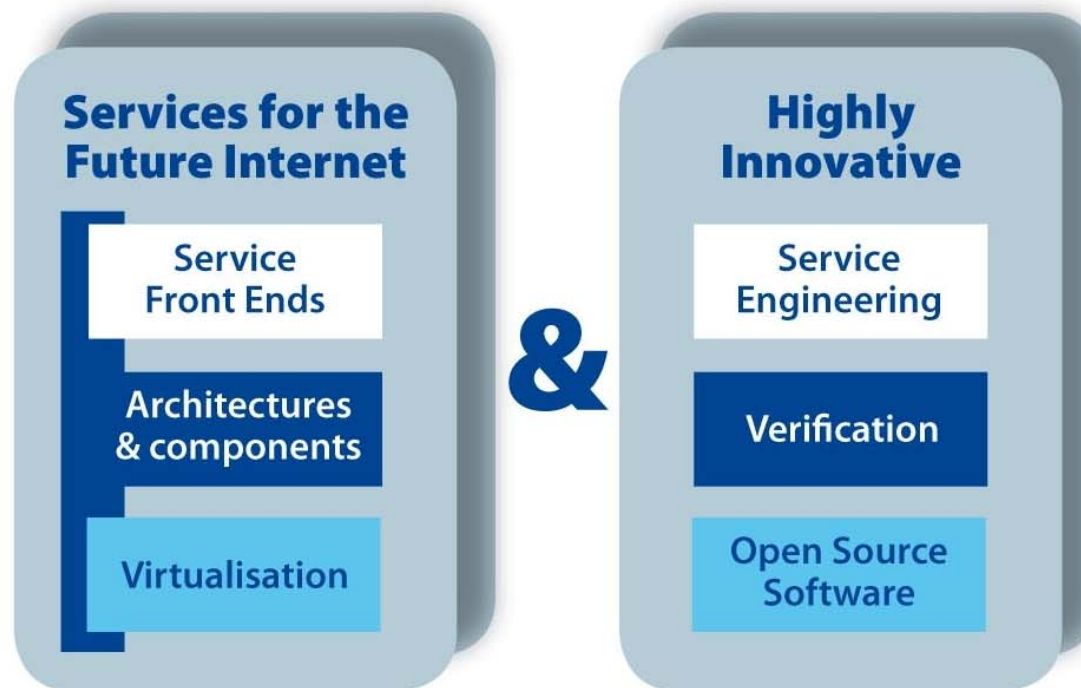
Expected Impact

- Contribution to Future Internet / Convergence
- Technological advances in software/service engineering
- More competitive environment for service providers, including SMEs
- Massive uptake of high-added value services. Service Front-ends, online communities
- Strengthened European software and services industry

SEVENTH FRAMEWORK PROGRAMME

WP2009-10
Objective 1.2, Problems and opportunities (1/2)

- Issues with service architectures and platforms
  - Existing web-based service front-ends are based on monolithic, inflexible, non-context-aware, non-customizable and unfriendly UIs
  - How to deal with many, many diverse services?
  - How to manage many, diverse underlying hardware and software resources?

➔ Service Architectures and Platforms for the Future Internet (CP)
  - Service front ends
  - Open, scalable, dependable service platforms, architectures, and specific platform components
  - Virtualised infrastructures

Text in black:	**issues, challenges, opportunities**
Text in blue:	**Work Programme target outcomes**

Remember: The Work Programme text is the official reference for the call

WP2009-10
Objective 1.2, Problems and opportunities (2/2)

- Issues with very large, dynamic, open service networks
  - From design time to run-time
  - Quality of open systems without fixed system boundaries
  - Opportunities with open source software and service engineering?
- ➔ Highly Innovative Service / Software Engineering (CP)
  - Service / Software engineering methods and tools
  - Verification and validation methods, tools and techniques
  - Methods, tools and approaches specifically supporting the development, deployment and evolution of open source software
- Lack of coordination of current and future research efforts
- ➔ Coordination and support actions (CSA)

Obj 1.2	Instruments: IP, STREP, CSA
Call 5	Budget CP: 107 M€
110 M€	Budget CSA: 3 M€

Remember: The Work Programme text is the official reference for the call
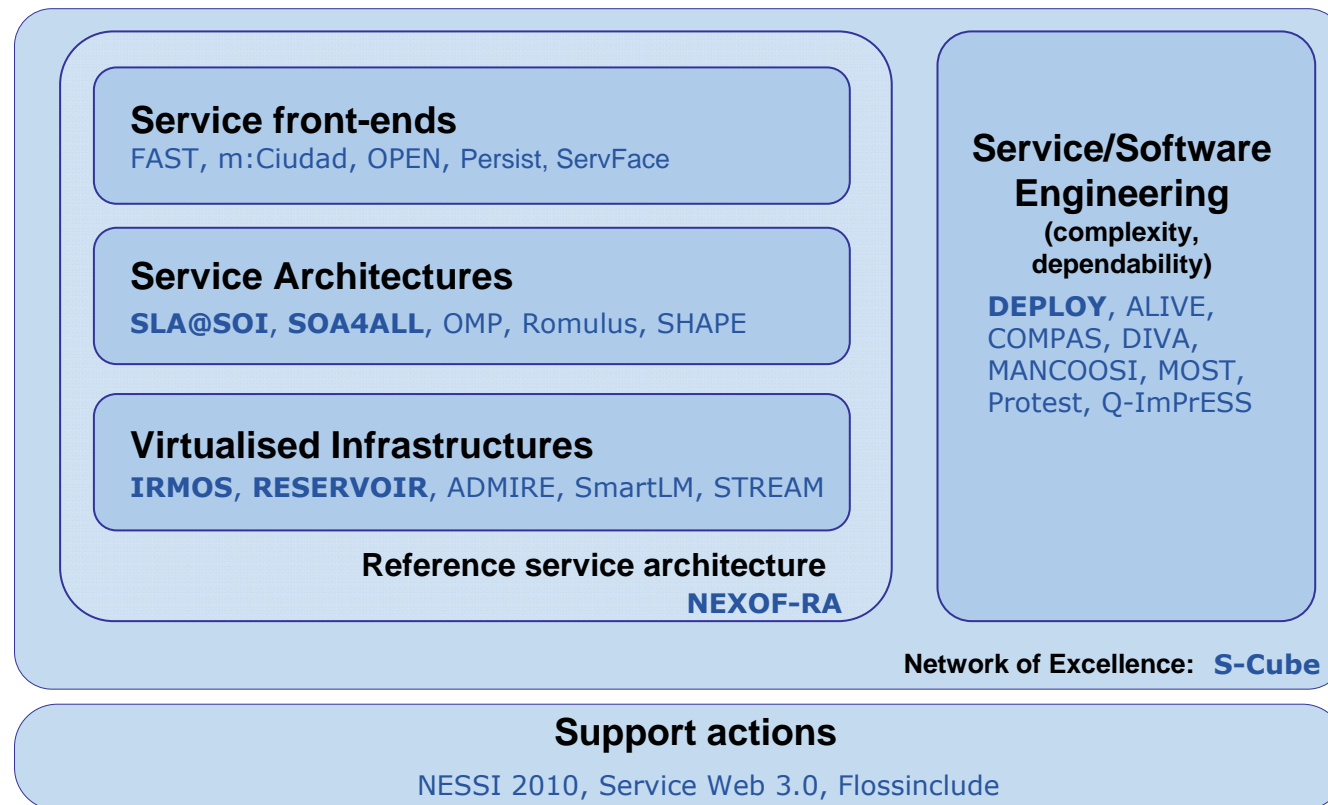
WP2009-10
Objective 1.2, Expected Impact

- Service development, management and interoperability in a converged environment
  - ➔ Contribution to Future Internet
- Improving scalability, predictability, responsiveness and throughput
  - ➔ Technological advances in software/service engineering
- Infrastructure operators with innovative service offerings on scalable infrastructure
  - ➔ More competitive environment
- Standardised open (source) platforms and interfaces
  - ➔ Lowered barriers for service providers
- Innovative service front ends and higher user empowerment
  - ➔ Massive uptake of high-added value services
- Platforms enabling "third party generated services"
  - ➔ More advanced/dynamic online communities
- Flexible and resilient platforms for software/service engineering, design, development, management and interoperability
  - ➔ Strengthened European industry for software, software services, and Web services
- Tailored technologies
  - ➔ Meeting key societal and economical needs

Text in black:	enablers, outcomes
Text in blue:	Work Programme expected impact

Remember: The Work Programme text is the official reference for the call

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European Commission
Information Society and Media

WP2009-10
Current FP7 projects under Objective 1.2

Service front-ends
FAST, m:Ciudad, OPEN, Persist, ServFace

Service Architectures
SLA@SOI, **SOA4ALL**, OMP, Romulus, SHAPE

Virtualised Infrastructures
IRMOS, **RESERVOIR**, ADMIRE, SmartLM, STREAM

Reference service architecture
NEXOF-RA

Service/Software Engineering
(complexity, dependability)

DEPLOY, ALIVE, COMPAS, DIVA, MANCOOSI, MOST, Protest, Q-ImPrESS

Network of Excellence: S-Cube

Support actions
NESSI 2010, Service Web 3.0, Flossinclude

- 181 M€ invested, 120 M€ EC contribution
- Timeframe 2008-2011

http://cordis.europa.eu/fp7/ict/ssai/projects_en.html

Conclusions

- Future Internet is happening
- Internet of Services is a major element of Future Internet
- Issues with Internet of Services
- Role of semantics
- Business models: 'factors' and strategies to consider
- FP7 allows for further research in Internet of Services
- Interdisciplinary research is needed for the Future Internet
- Research is a means to an end

For more information

FP7
http://cordis.europa.eu/fp7/
http://cordis.europa.eu/fp7/ict/

Software & Service Architectures and Infrastructures
http://cordis.europa.eu/fp7/ict/ssai/

Future Internet
http://ec.europa.eu/foi
http://www.future-internet.eu/

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