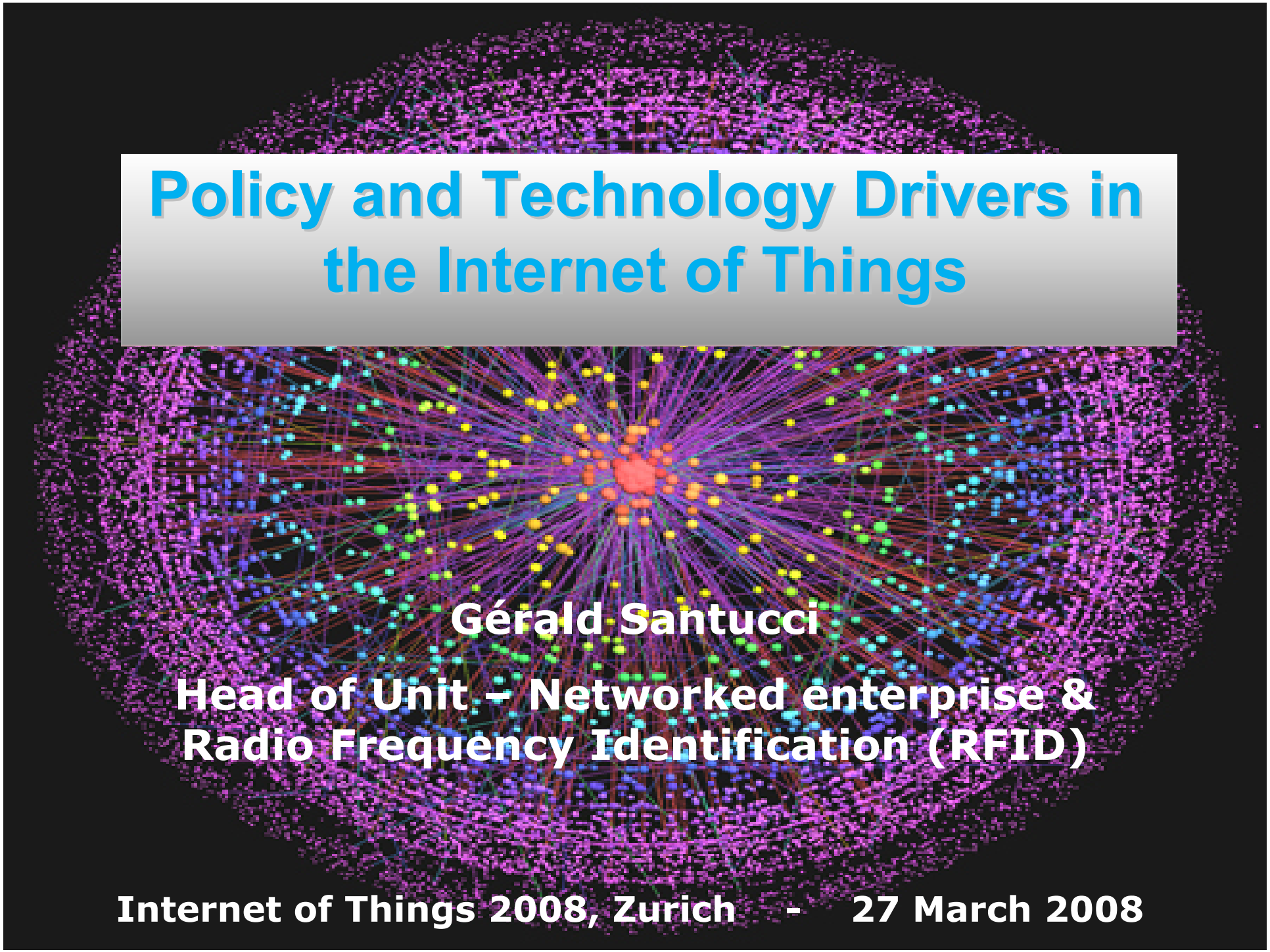
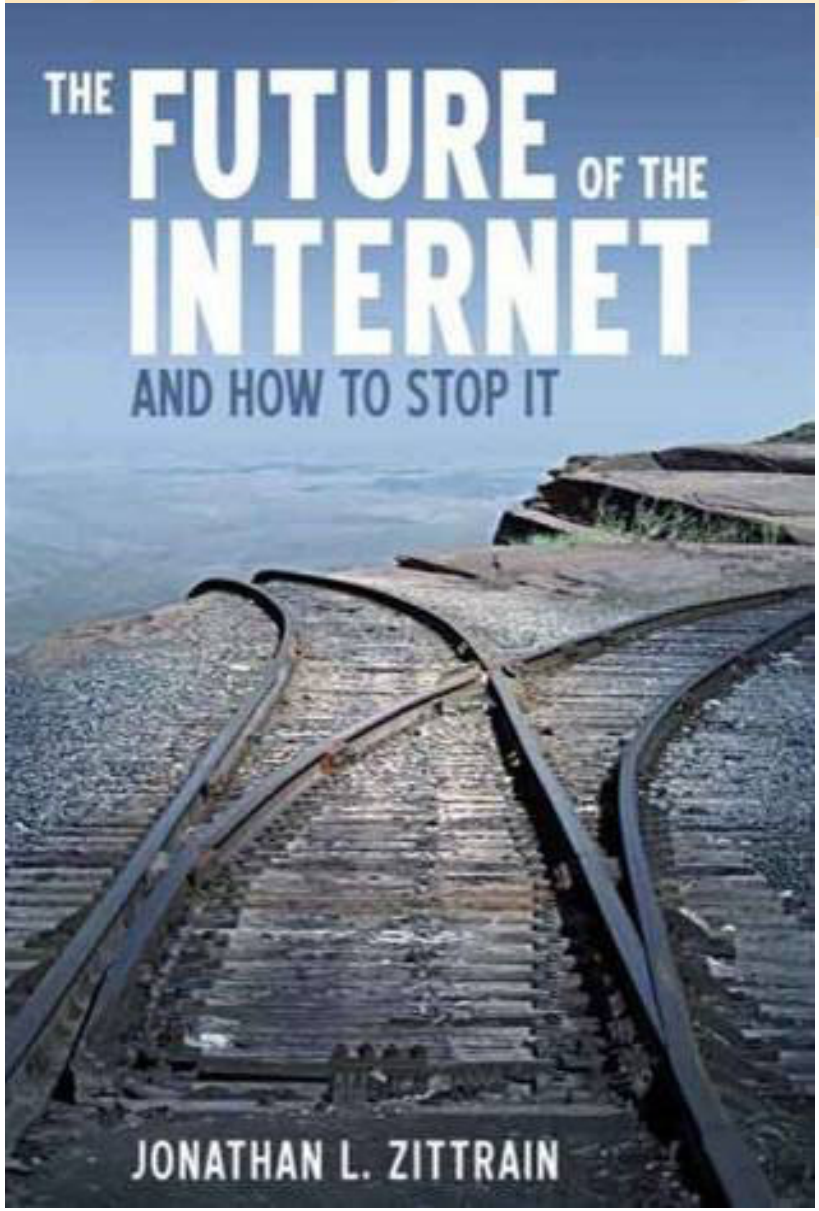


Policy and Technology Drivers in the Internet of Things

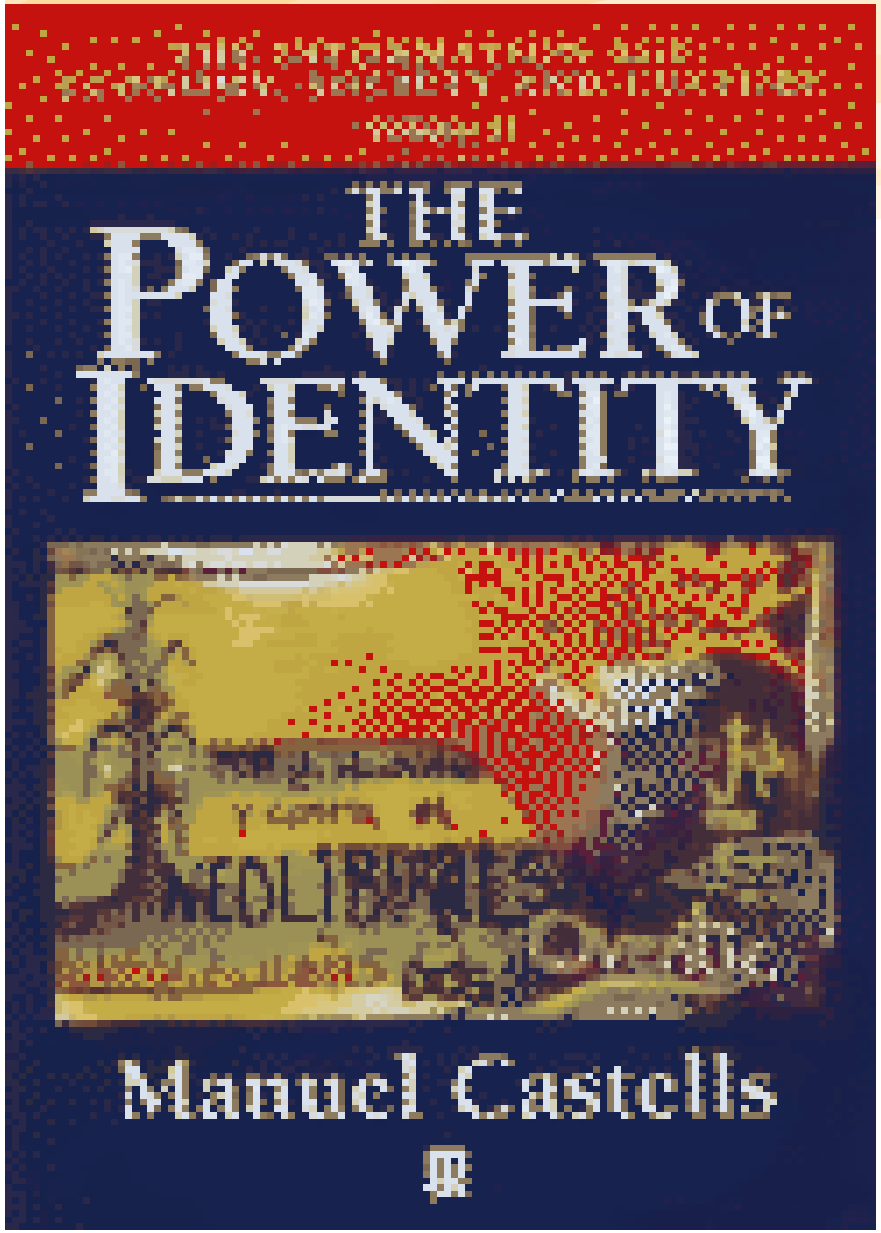
Gérald Santucci

Head of Unit – Networked enterprise & Radio Frequency Identification (RFID)

Internet of Things 2008, Zurich - 27 March 2008



"With the unwitting help of its users, the generative Internet is on a path to a lockdown, ending its cycle of innovation—and facilitating unsettling new kinds of control. IPods, iPhones, Xboxes, and TiVos represent the first wave of Internet-centred products that can't be easily modified by anyone except their vendors or selected partners. As tethered appliances and applications eclipse the PC, the very nature of the Internet—its "generativity," or innovative character—is at risk."



"Our world and our lives, are being shaped by the conflicting trends of globalisation and identity. The information technology revolution, and the restructuring of capitalism, have induced a new form of society, the network society. It is characterised (...) by a culture of real virtuality constructed by a pervasive, interconnected, and diversified media system."

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"RFID is kind of the amoeba of the wireless computing world"

Kevin Ashton

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Europe and the Internet of Things

- **Commission Communication** on RFID COM(2007) 96 of 15 March 2007
- **Commission Recommendation** on privacy, data protection and information security aspects of RFID usage (July 2008)
  - Public consultation http://ec.europa.eu/yourvoice/ipm/forms/dispatch?form=RFIDRec
- **RFID Expert Group** (June 2007-March 2009)
- **Commission policy document** on the Internet of Things (< December 2008)
- **EU Presidency Conferences** – from RFID to IoT
  - Berlin, 26-27 June 2007
  - Lisbon, 15-16 November 2007

The “Future Internet” Challenges

- Distributed architecture of the Internet
- End-to-end characteristics of the architecture
- Open architecture of the Internet
- Neutral access
- Clear layering
- Resilience to physical network disruption

From an EU perspective, any further redesign of the architecture of global networks will have to respect these basic principles and characteristics

Many forces and interests are at work

- **From an economic perspective**
  - Move towards Next Generation Networking may lead to some form of centralised control within an inherently distributed architecture
- **From a technological perspective**
  - Certain approaches, e.g. those discussed within the "Autonomic Communication" context, might damage the end-to-end characteristics of today's architectures
- **From a political perspective**
  - Since the Internet is increasingly seen as a "critical infrastructure", security and robustness are becoming issues of major public policy concern
- **From a user perspective**
  - Emergence of Virtual Worlds

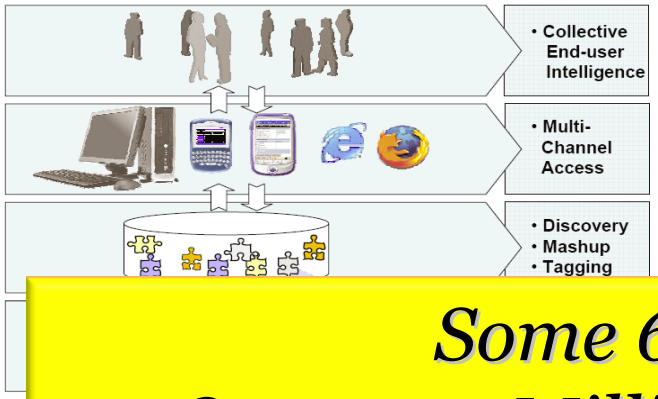
The emerging visions for the "Future Internet"

- To increase the performance of the infrastructure supporting the Internet
- To improve the services offered through the Internet
- To exploit the potential of Internet-enabled Virtual Economies
- To integrate more effectively the world of the Internet with the physical world

Discarding the "evolutionary approach", let's focus here on the "clean-slate" paradigm

The many dimensions to the Future Internet

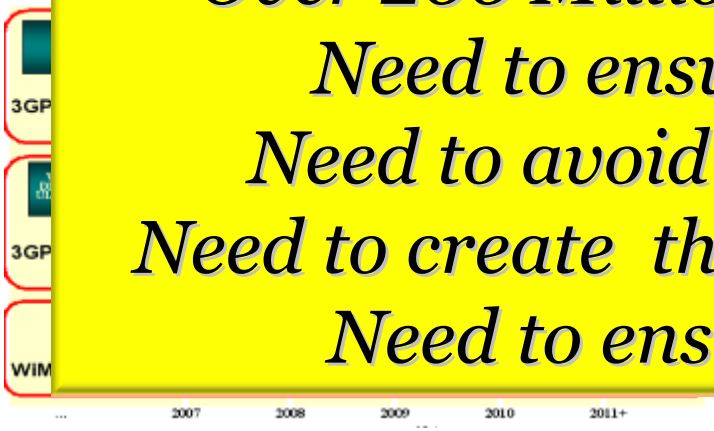
Internet of Services, Service Web



3D Internet

Trust

Some 68 FP7 R&D project
Over 200 Million Euros in EU investment
Need to ensure coherence of action
Need to avoid fragmentation of efforts
Need to create the best conditions for success
Need to ensure continued funding



Networks of the Future

Internet of Things

Sources: 3GPP, 3GPP2, Qualcomm, WiMAX Forum
http://www.alexandria.unisg.ch/EXPORT/DL/38496.pdf
http://www.itu.int/osg/spu/publications/internetofthings/
Second Life

An Internet of Services

- The Internet will offer services for all areas of life and business
- A complex services infrastructure, based on Service Delivery Platforms, will be required
- Building blocks for IoS are SOA, Web 2.0 and Semantics

An Internet of 3D Worlds and Virtual Worlds

- Trailblazers of new business models on the Internet are social communities of online gamers
  - Second Life, MMORGs
- Increased technological capabilities are needed
- Additional requirements on search-and-find technologies

An Internet of Things

- Real world objects have an individual digital presence
- Vision of a future where each item or thing is networked and can communicate information about itself or from itself to other objects and to computer systems
  - IPv6 might generate an addressable continuum of computers, sensors, actuators, telephones and 'things'
- First applications have started
  - NSF project at University of Washington
- By 2015, new applications will exist where things communicate autonomously amongst themselves
  (Prof Michael ten Hompel)
- "Blogjects" (Prof Julian Bleecker)

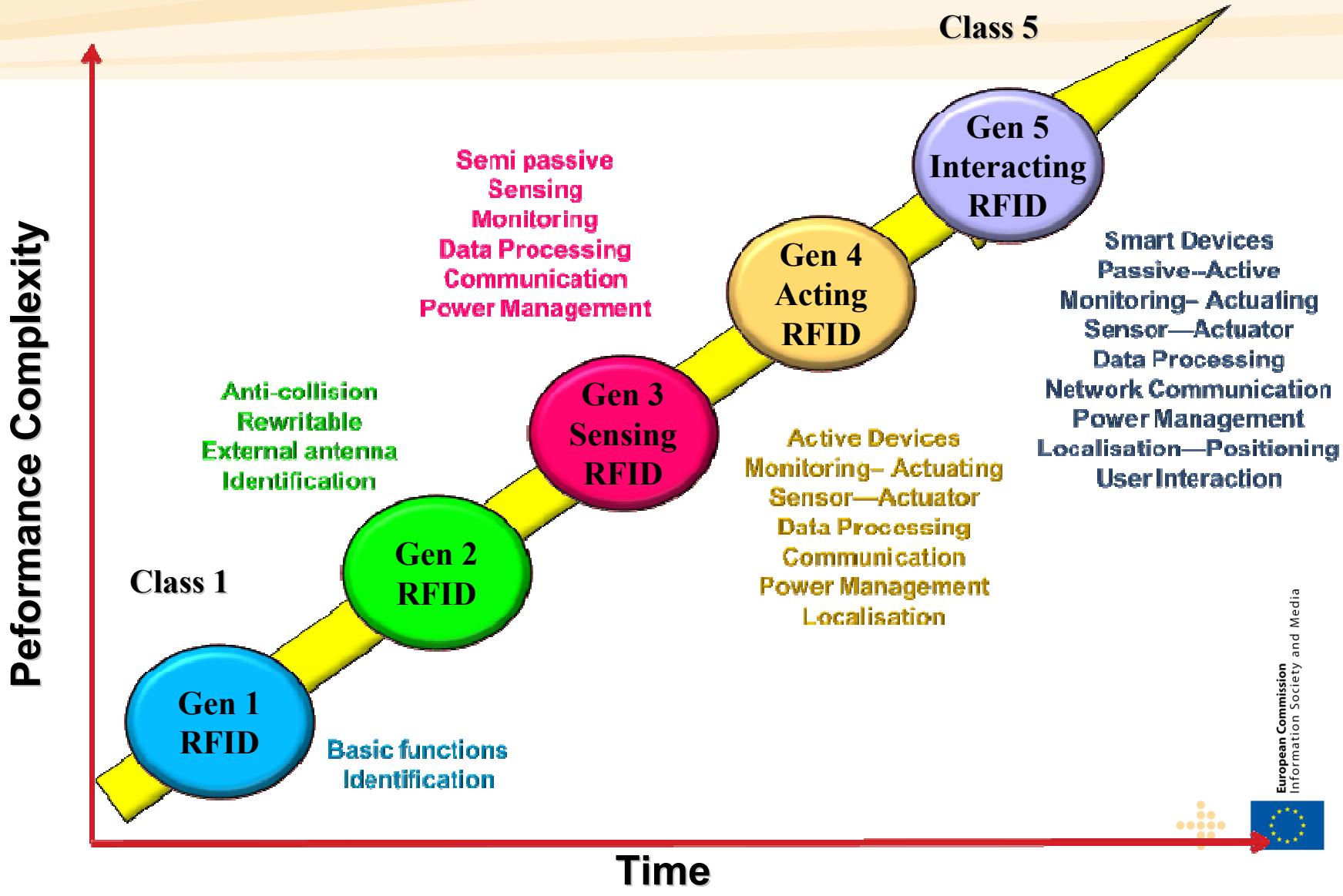
How Europe is supporting the Internet of Things?

- **IST Advisory Group and ICT in FP7**
  - Edge technologies
  - Networking technologies
  - Middleware systems
  - Platform services
  - Web service technologies
- Cluster of European RFID Projects (CERP)
- **Coordination and Support Actions** (FP7 Call 1)
  - CASAGRAS www.rfidglobal.eu
  - GRIFS www.grifs-project.eu/
- **Joint EC/EPoSS initiative**
  - Workshop 11-12 February 2008
  - Framework Paper to follow soon
- **Conference "Internet of the Future – Internet of Things"**
  - Under French Presidency of the EU
  - Nice, 6-7 October
  - http://www.internet2008.eu/ (provisional website)

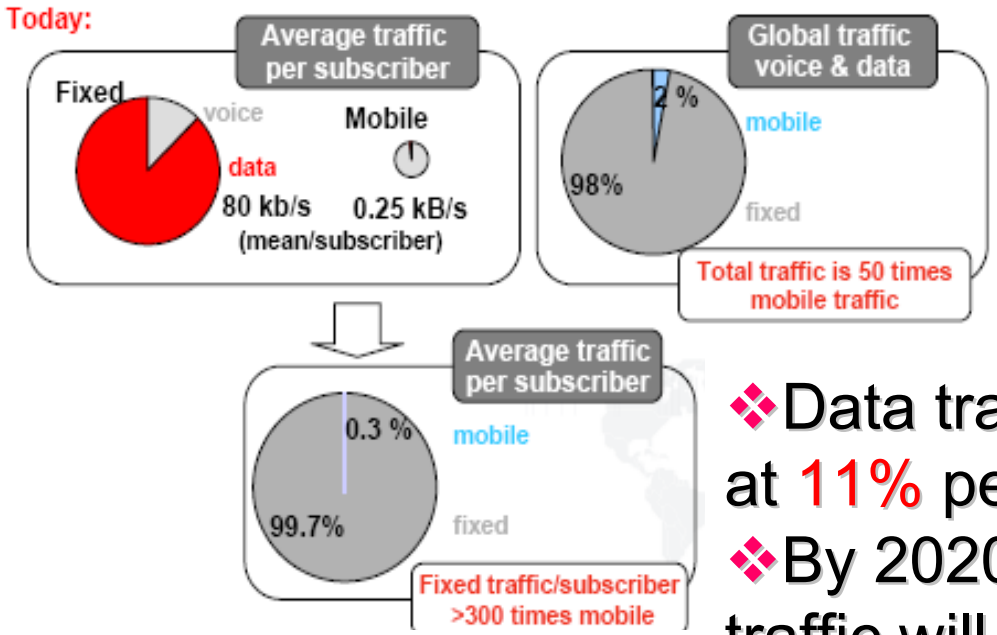
The Underlying Network and Service Infrastructure

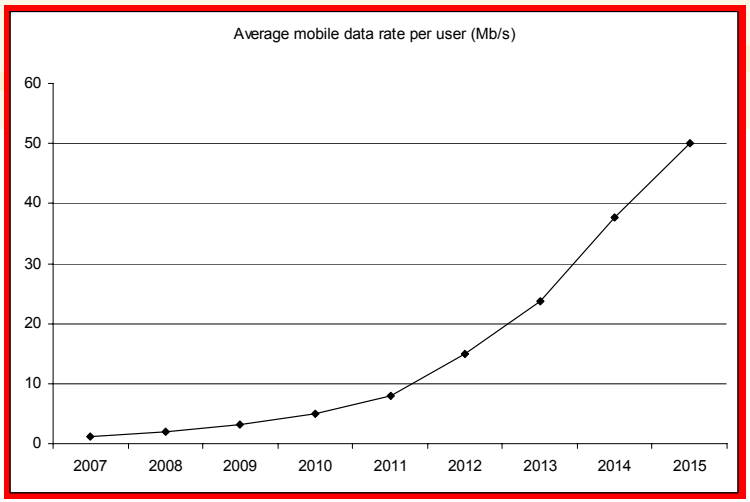
- Growing demand for broadband and mobility
- Key features of the network and service infrastructure in the Future Internet:
  - Connectivity services
  - Computing resources as services
  - Information and knowledge services
  - Business, government and societal services
  - Sense and action on the real world
  - Support of dynamic business relationships and value chains
  - Vertical services and horizontal services (identity, trust, location, brokering…)

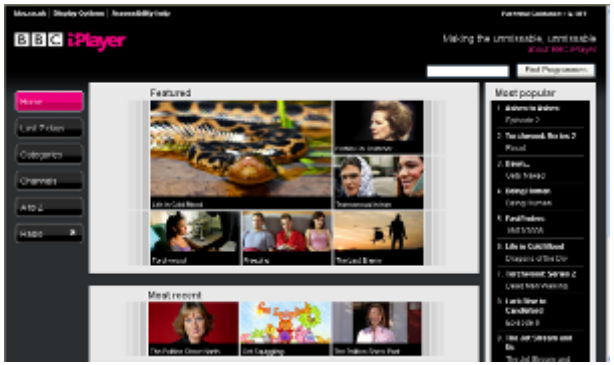
Linking the Web and the Real World



Traffic Projections to the Year 2020







- Data traffic per subscriber growing at 11% per annum
- By 2020 even at half this rate the traffic will double by 2020
- DSL penetration will reach 100% of households
- Total fixed and mobile traffic could reach 200 times the mobile traffic today

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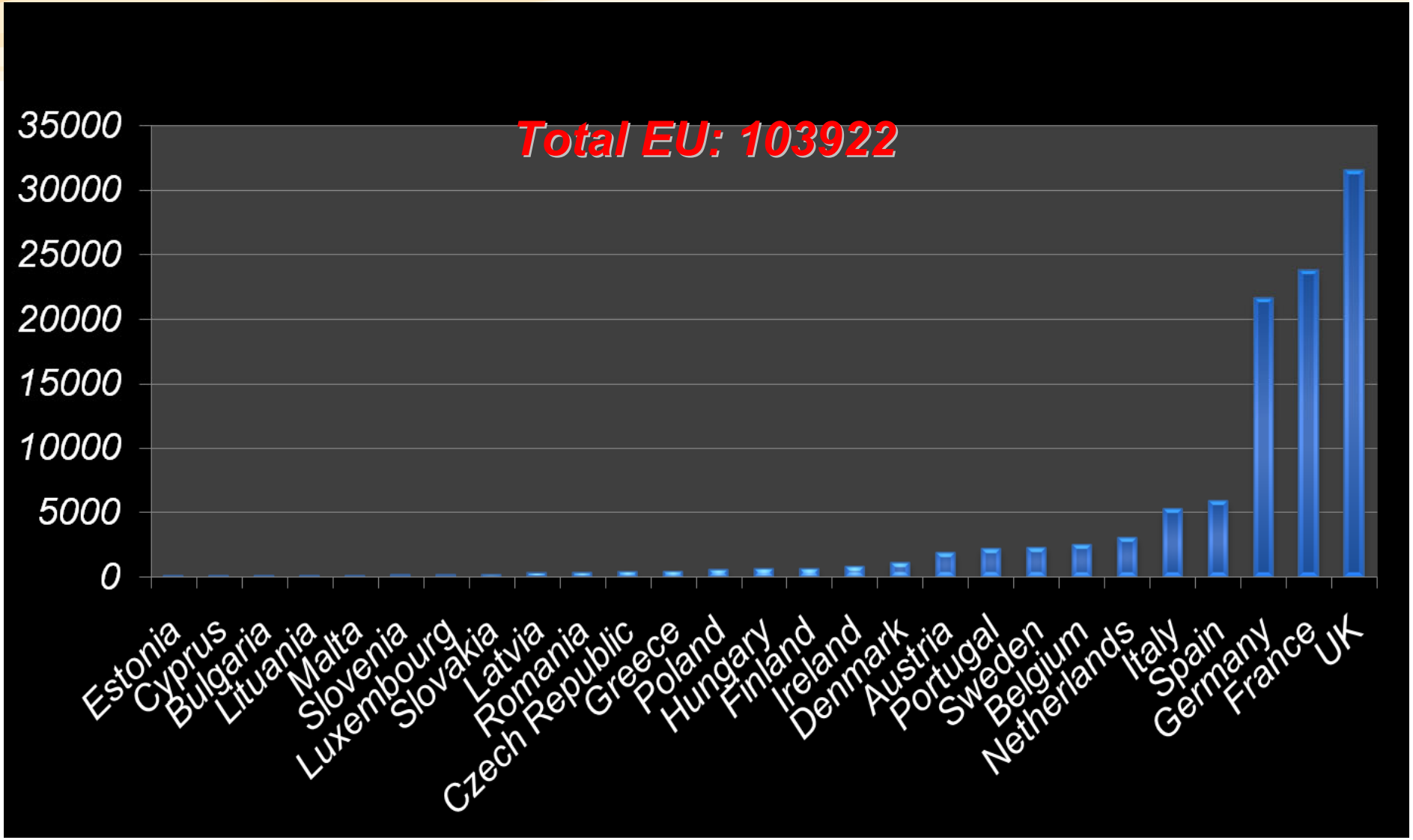
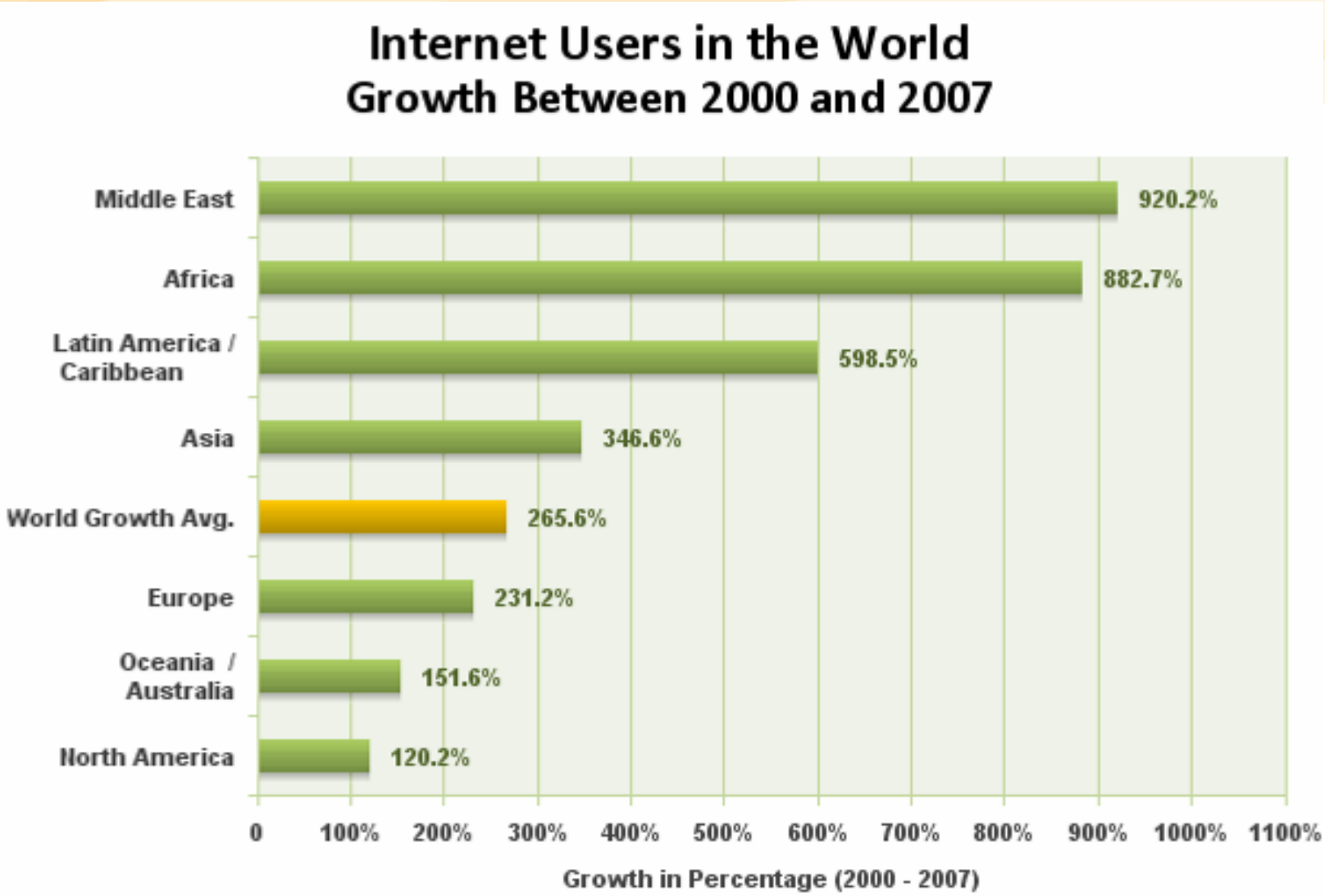
EU - WiFi Hot Spots

February 4, 2008



Note: 240,199 free and pay Wi-Fi locations in 135 countries – Source: http://www.jiwire.com

World Internet Stats



Note: Total World Internet Users estimate is 1,319,872,109 for year-end 2007.

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Ten Years of Internet Evolution

- ***Google*** Inc. opened its doors In September 1998
- ***Flickr*** was launched in February 2004
- ***Myspace*** was created in 1999
- ***PayPal*** is the result of a March 2000 merger between two companies. As of the end of Q4 2006, PayPal operates in 103 markets, and it manages over 155 million accounts.
- ***YouTube*** was founded by early employees of PayPal. The dom "YouTube.com" was activat February 2005.
- ***Skype.com*** and S domain names were re April 2003. First publi sion released in August
- ***e*** launched in September 1997. public in 1998, and bought yPal in 2002.
- ***Orkut*** which is a social netw vice was launched in January Google.
- ***Facebook*** is a socia g website launched in 200
- ***hi5*** is a soci king website, which, throughb was one of the 25 most visit the web. The company was f 2002 and as of December 2007, ver 98 million members.
- ***Wikipedia*** was created in 2001. It has grown rapidly into one of the largest reference Web sites with more than 75000 contributors working on some 9Million articles in 250 languages.
- ***Second Life*** was launched in 2003. It only came to international attention via mainstream news media in late 2006 and early 2007
- ***Alibaba*** the world's largest online import-export marketplace was launched in 199

We are still at the early stages of innovation and of business models

0 Blog in 1992, over 75 million today – 120,000 created every day

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End-user needs are changing

Digital TV Penetration	**2006 16% of worldwide TV households had digital TV (or 25-30% in Western Europe)** **Digital TV penetration forecast: 34% in 2008** **Western Europe + 59%** **North America +62%**
Home cinema and speaker systems	**2000 – 2006 (+20 million): volume X3** **2006-2010 forecast (+19 millions): +72%**
Household Connectivity	**In France 2004 – 2006: Internet equipment +39%, BB: +105%, Wi-Fi: +329% (9% of the households)**

Sources: Digiworld 2007 Dataxis

The Economics of Storage, Processing and Transmission are rapidly changing

Processing

From basic up to 3D
Varying power demands
Multiple operating systems
From 1 transistor to multiple cores

Transmission

From wireless to fibre
Multiple technologies
From body area to satellite
Spectrum efficiency gains

Storage

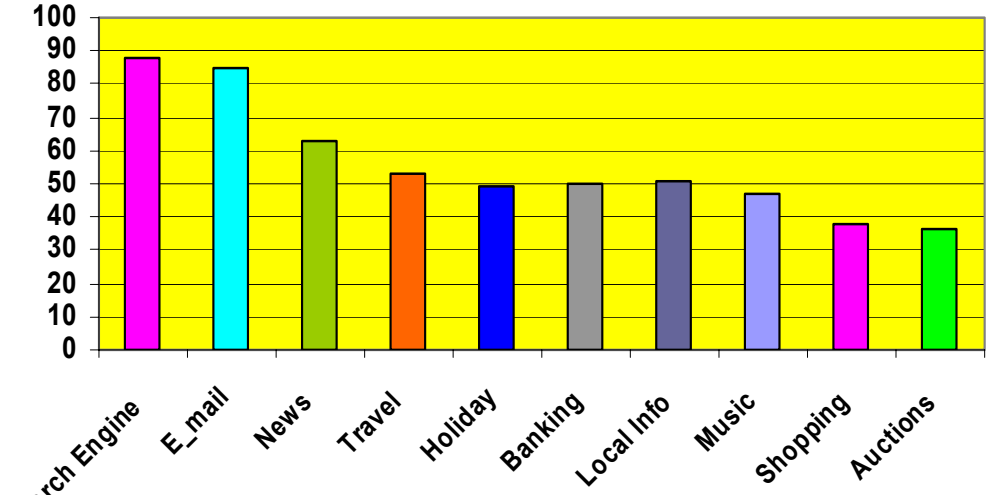
From 1 byte to multiple Terabyte
Multiple technologies
Cost per byte disappearing

Beyond the network architecture lies a more complex future…

Beyond "nuts and bolts" how will knowledge and meaning be handled?

Watch TV	+5%
Listen to Radio	+12%
Use the Internet	+28%
Read Newspapers	-2%
Read Magazine	-11%

Trend 2004-2006, Mediascope Europe survey



2006, statistics most visited web sites

Search Engines are rapidly becoming our gateway to knowledge:

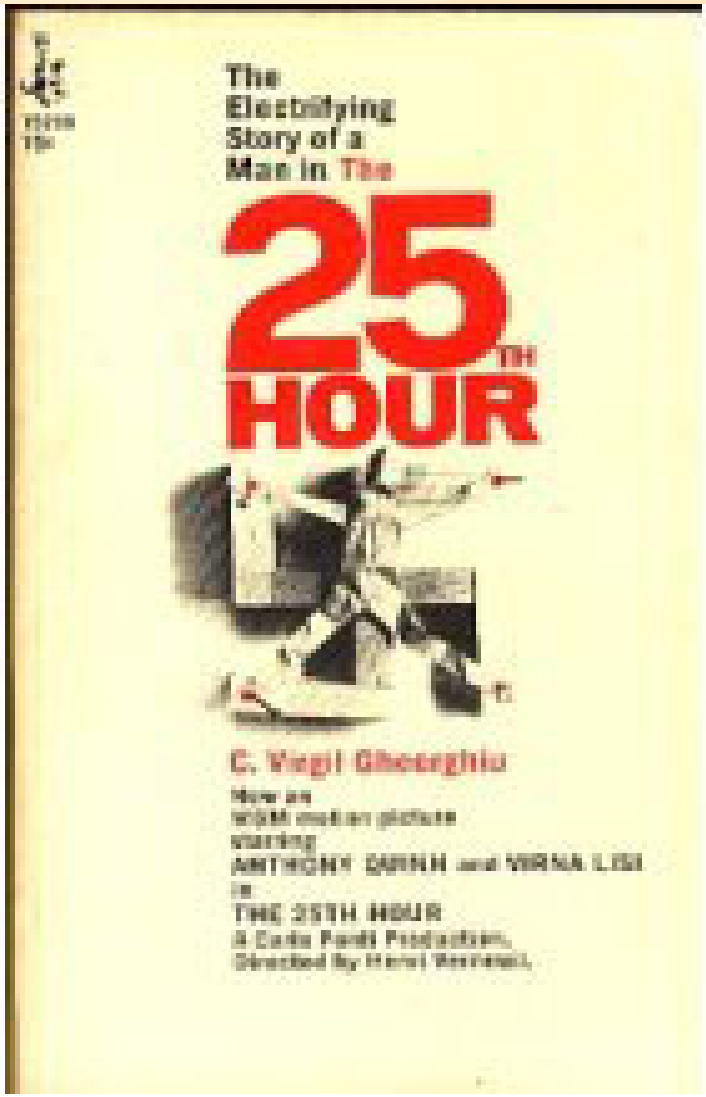
- Obscure ranking or biased ranking algorithms (e.g. price comparators)
- Proprietary filtering mechanisms
- Proprietary meta data and indexing mechanisms
- Need of open Standards for "Democracy" and Information access?

Security, Privacy and Trust in the Internet of Things

- In the Future Internet Trust will be critical
  - "Can we trust the people we meet?"
  - "Can we trust the data or the knowledge?"
- New conceptual frameworks, technologies and tools are needed
- Who's responsible and accountable in the 'hyper-connected' society?

Governance of the Internet of Things

- It is still time to avoid the problems of DNS
- GS1 France model: towards a system of joint distributed ONS roots?
- Ensuring Business Continuity.
- Evaluating Security implications
- Facilitating Transparency and Non-Discrimination
- Revisiting Privacy in IoT
- Avoiding proprietary monoculture and *de facto* monopoly



"Men will be considered as equal, as identical, and treated according to the same laws which apply to technical slaves, without any possible concern for their human natures."

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Brave or not, a New World…

- *"Whereas the Internet of Machines was limited to human agents, in the Internet of Things objects are also active participants in the creation, maintenance and knitting together of social formations through the dissemination of meaningful insights that, until now, were not easily circulated in human readable form"*

Julian Bleecker

Use the Internet of Things to Change the world or just Surrender to it?

- **Tokyo Ubiquitous Technology Project**
- **NSF-DoC sponsored report of 2002 on NBIC**
  - "*Improving human performance*", i.e. human development through implants, not through development of individual knowledge!
  - "*Transformation of Civilisation*", i.e. new ethical principles to accommodate brain implants, robots, etc.

The Internet of Things deserves a societal debate to preserve Human Authenticity

Thank You!

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