# Future Internet

## *An opportunity for Europe*


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**Director – Converged Networks and Services**
**European Commission**


Jozef Stefan Institute, 28 March 2008, Ljubljana, Slovenija

# A New Perspective is needed

Nazca Indians of Peru
(ca 400 BC - 800 AD,
The Lines were first spotted when commercial airlines began flying across the Peruvian desert in the 1920's

# The Internet – Issues and Problems

- Was based on the end-to-end principle
- Many services are no longer based on end-to-end communications but rather on the retrieval of information
- Complexity is on the rise and functionalities are no longer being executed at the end points
- Has been dominated by client-server applications
- Is now hampered by the shortage of IPv4 addresses
- Suffers from performance bottlenecks created by the insertion of middle boxes such as NATs and firewalls
- New applications and services are harder to deploy
- ISPs  have put in place traffic shaping and engineering tools to cope with the choking of the routing system
- Was built on the assumption of co-operating agents where mutual trust was the rule and where  the receiver is willing to receive whatever the sender is sending
  - Increasing amounts of spam, phishing, botnets, malware, virus etc
  - The lack of trust leads to considerable opportunity and transaction costs
  - Unwanted traffic in the form of spam etc is a direct consequence of the very low additional costs for sending packets of data

# The Internet – A move towards wireless

- Traffic has been evolving from fixed to wireless
- Traditional PC is progressively giving in to the mobile device as the preferred gateway to the Internet
- While the PC was and is open and can be tinkered with, mobile information appliances are mostly locked-down with users being severely controlled.
- Wireless terminals can now be attached to multiple networking access points
  - Can wireless users trust the point of attachment and the network behind the access point?
- Wireless traffic is more expensive to carry than fixed traffic.
  - How to curb the volume of unwanted (wireless) traffic
  - Should the economics of the Internet be changed to reflect traffic evolution?
  - Is there a need to invent new compensation schemes and use them in particular for congestion control?

# The New NET - the user dimension

- User needs are dynamic
- Users want zero service configuration, personalisation roaming
- Users are today more interested in accessing an information source rather than connecting to a device
- Users seek to have content authentication
- New levels of service guarantees are needed
  - The increasing number of users, connected devices and information objects leads to new levels of complexity,
  - There are new demands for naming and addressing of information objects
  - There are new requirements for network configuration agility

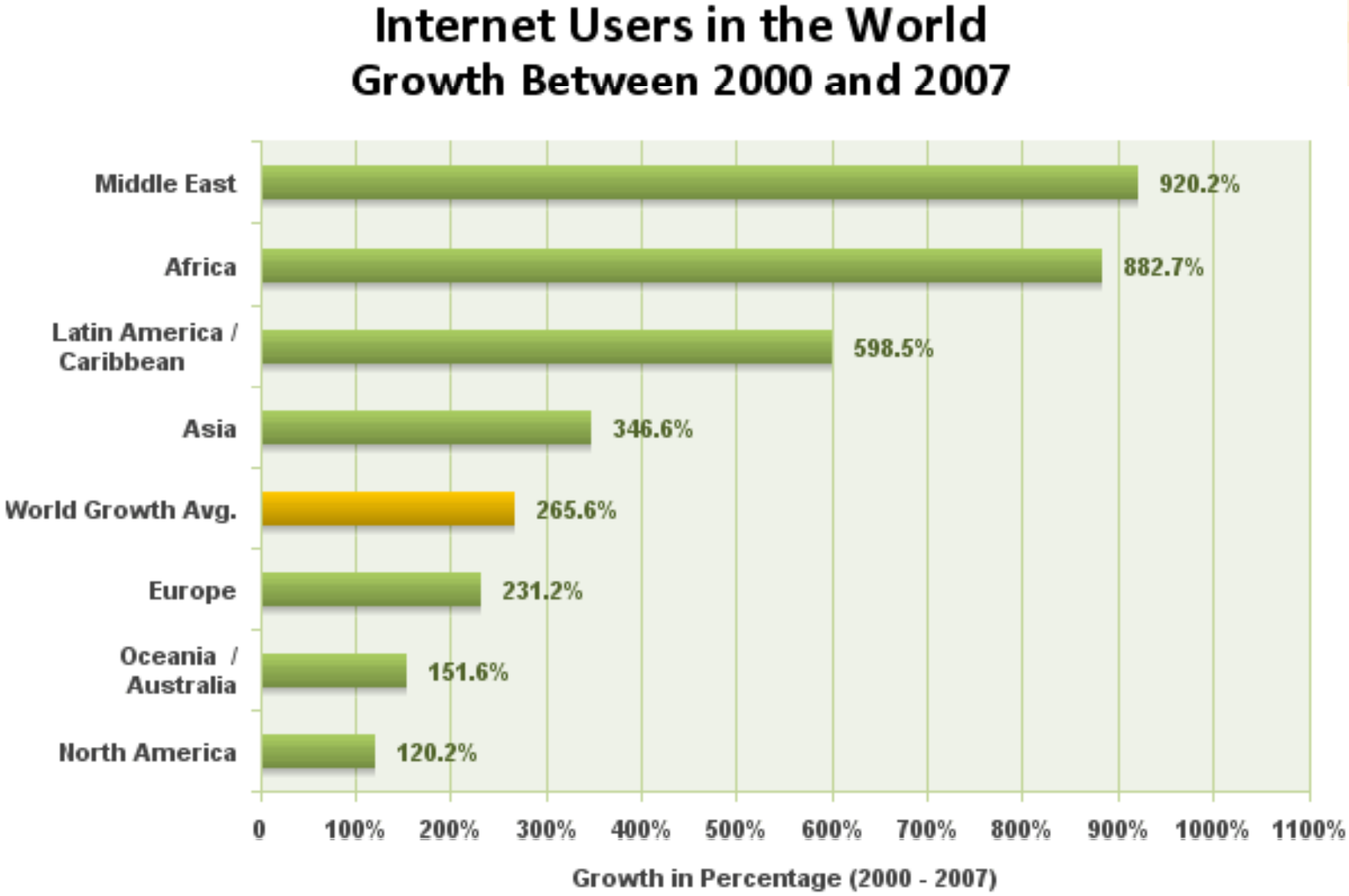
# The New NET must be designed

- **Not separate from society but rather as an intrinsic part of the society**
- **To offer new levels of reliability and dependability**
- **To offer built-in privacy and security and new rules for accountability**
  - No privacy discrimination
  - No reputation threats
  - Privacy of data content and consumption in addition to connected devices
  - No user lock-ins

# The New NET must support

- New forms of communication
- New applications, new usage and traffic patterns
- New information flows (e.g. sharing of experiences)
- New naming and addressing information objects
- New identity management schemes
- New content distribution mechanisms
- New approaches to indexing and metadata definitions
- New business models adapted to the regulatory framework, a dynamic network infrastructure, different interests at play
- New emerging opportunities in transport, sustainable development, energy, health, ageing, entertainment

# World Internet Stats




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



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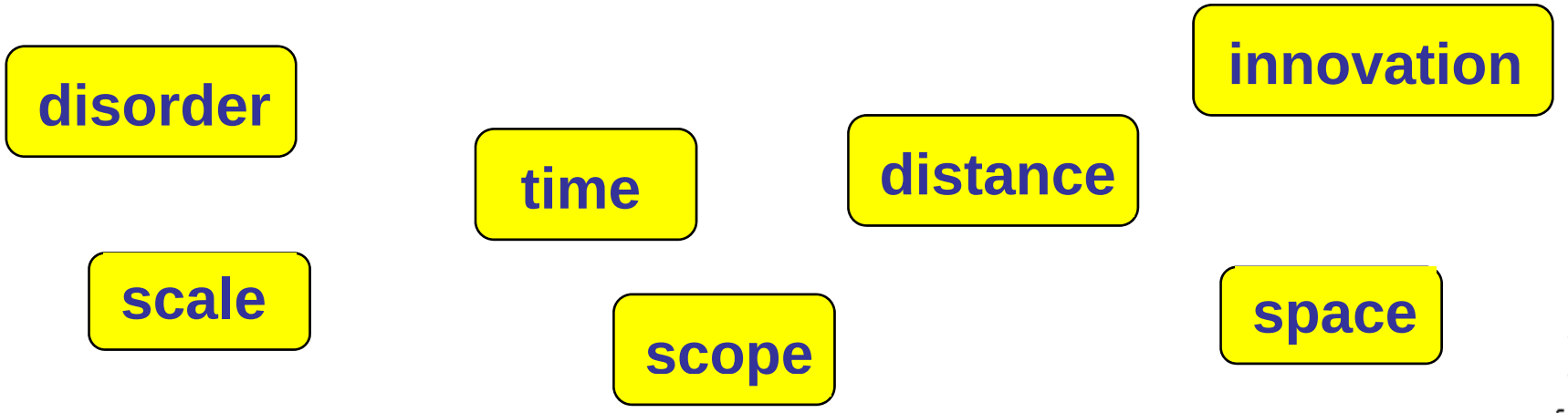
# Long Wave Events


# Our reference frame is being challenged

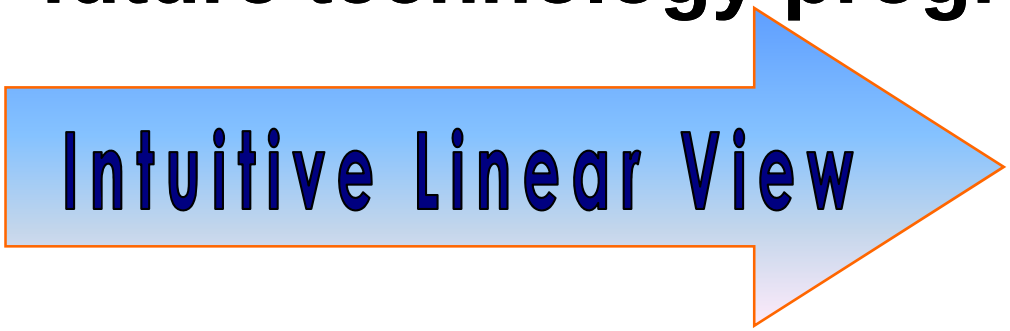
- We can not see long wave events because we can not comprehend them.
- We do not recognise threats, because they are far beyond previous experiences.

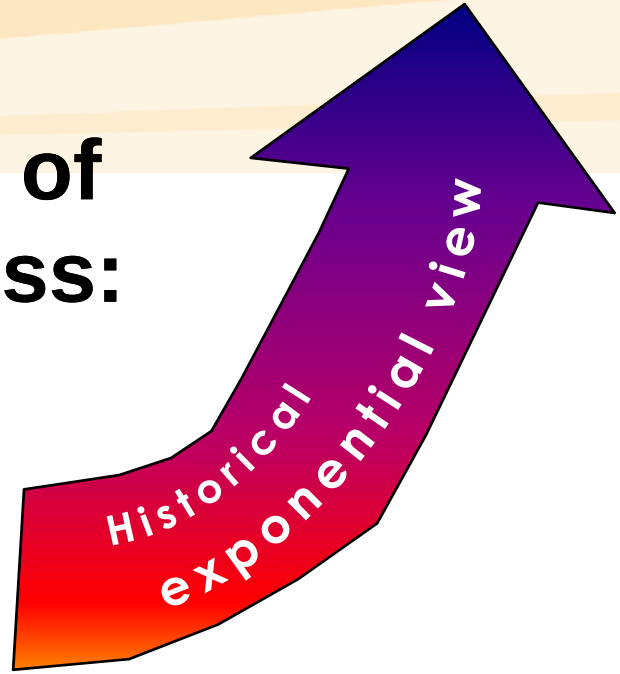



- Decision makers are often reluctant or incapable to recognise long wave trends.

# Power of technology progress

**We dramatically underestimate the power of future technology progress:**




**We tend think of a future period at today's rate of progress…**

**our memories are dominated by our recent experience.**

**But we are doubling our rate of progress every ten years…**

**So in this century we will experience 20,000 years of progress at today's rate.**

# 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 public sion released in August
- ***eB*** launched in September 1997. public in 1998, and bought Pal in 2002.
- ***Orkut*** which is a social netwo vice was launched in January oogle.
- ***Facebook*** is a social ng website launched in 200
- ***hi5*** is a soci king website, which, throughe was one of the 25 most visite the web. The company was 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 1999

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

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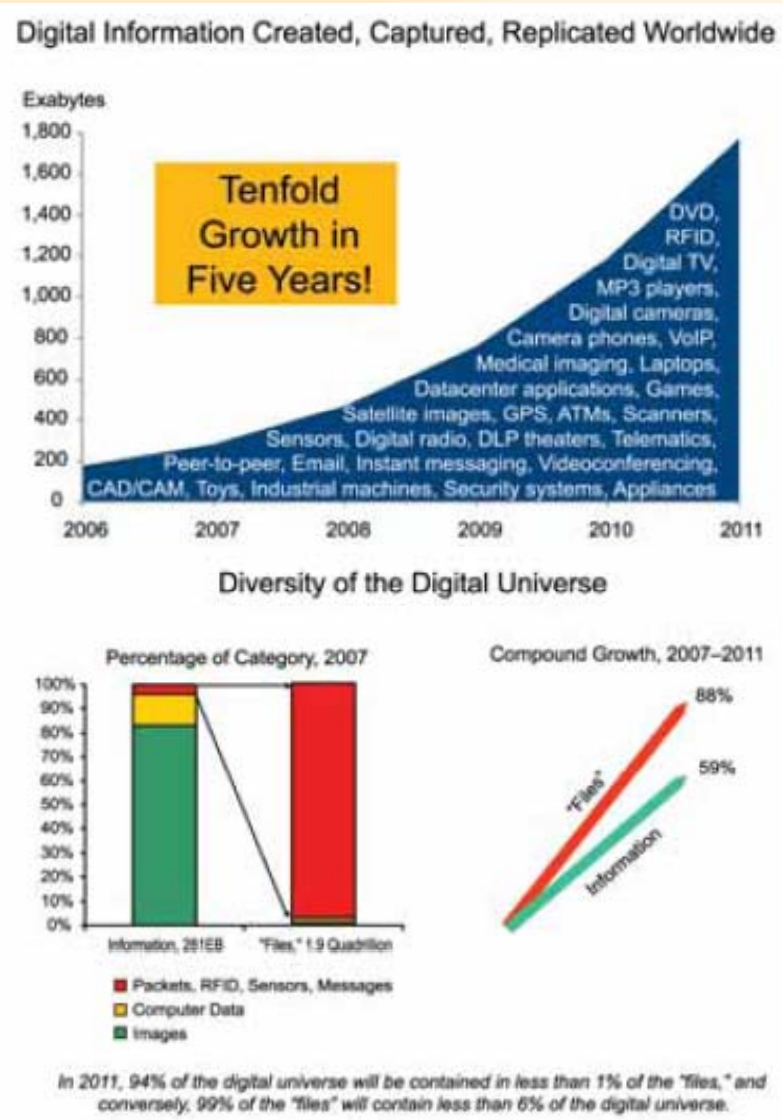
0 Blogs in 1992, over 75 Million today – 120000 created every day

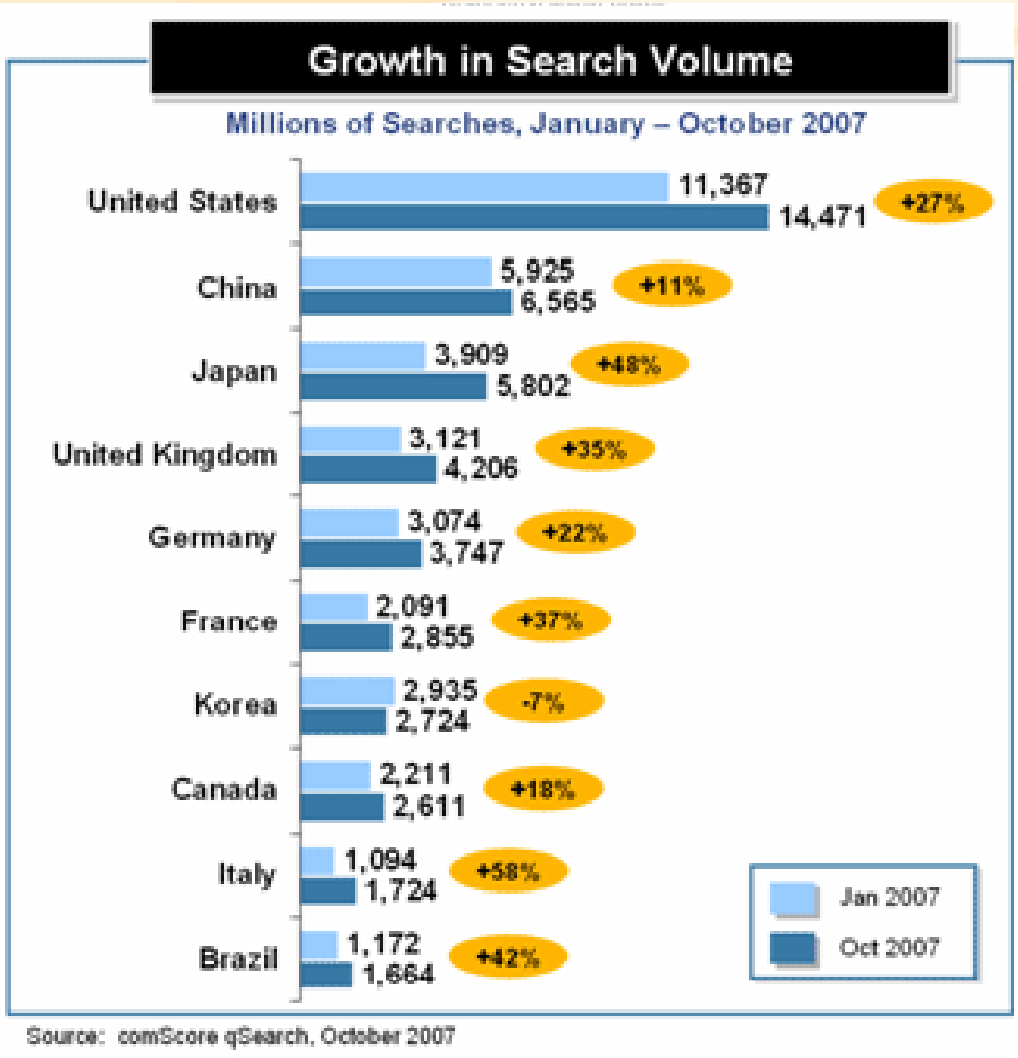
# The Digital Universe is Expanding

- The digital universe in 2007 = 281 exabytes or 281 billion gigabytes. By 2011, the digital universe will be 10 times the size it was in 2006.
- The diversity of the digital universe can be seen in the variability of file sizes, from 6 gigabyte movies on DVD to 128-bit signals from RFID tags.
- The tiny signals from sensors and RFID tags and the voice packets that make up less than 6% of the digital universe by gigabyte, account for more than 99% of the "units," information containers". The information created in 2011 will be contained in more than 20 quadrillion — 20 million billion — of these "files."
- Approximately 70% of the digital universe is created by individuals, but enterprises are responsible for the security, privacy, reliability, and compliance of 85%.

Source: http://www.emc.com "An Updated Forecast of Worldwide Information Growth Through 2011, **March 2008**



# On-line Search





- **Total of 69 Billion searches in October 2007**
- **Conducted by 775 million people representing 12% of the world's population**
- **33% growth from January to October 2007**

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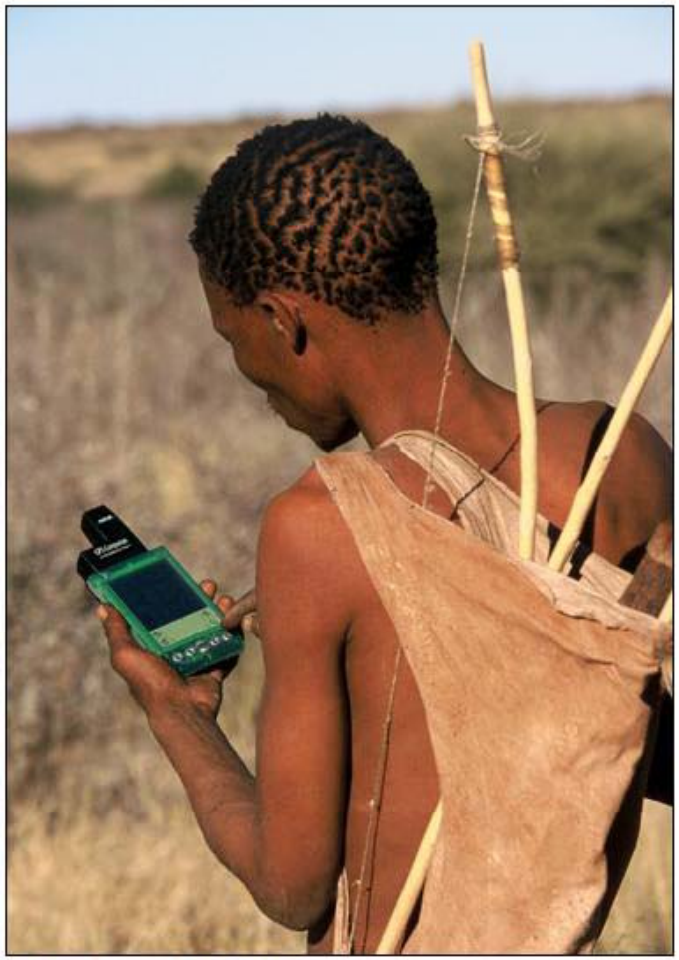
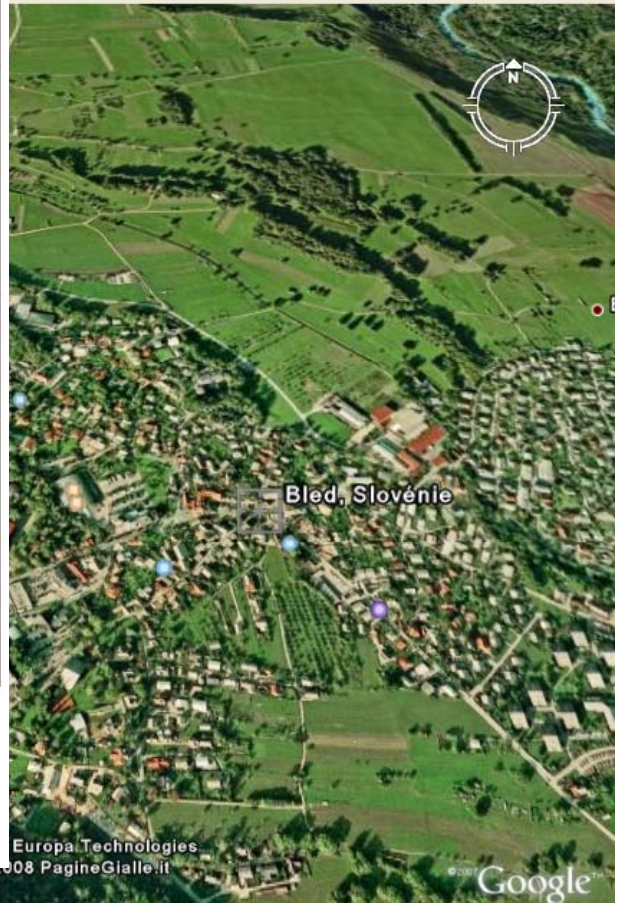
# 3D Geo Visualisation is changing our perceptions



CyberTracker; www.cybertracker.co.za/

**CyberTracker in Action**
Researchers have developed a software for PDAs that turns the Bushmen of the Kalahari Desert into digital wildlife trackers. The screen of this PDA displays more than 40 animal species, subspecies and plants. The icons also cover activities such as drinking, feeding, running, fighting, mating and sleeping.



# Social Networking – A Massive Move


- 1 Billion people in Social Networking Websites WorldWide
- 154 Million people accessing a Social Networking Website every day
- 3 Billion minutes spent on Social Networking every day
- 8 Billion pages accessed on Social Networking Websites every day

YouTube Broadcast Yourself™

SECOND LIFE

LinkedIn

facebook

plaxo beta Your address book for life

XING

myspace.com a place for friends

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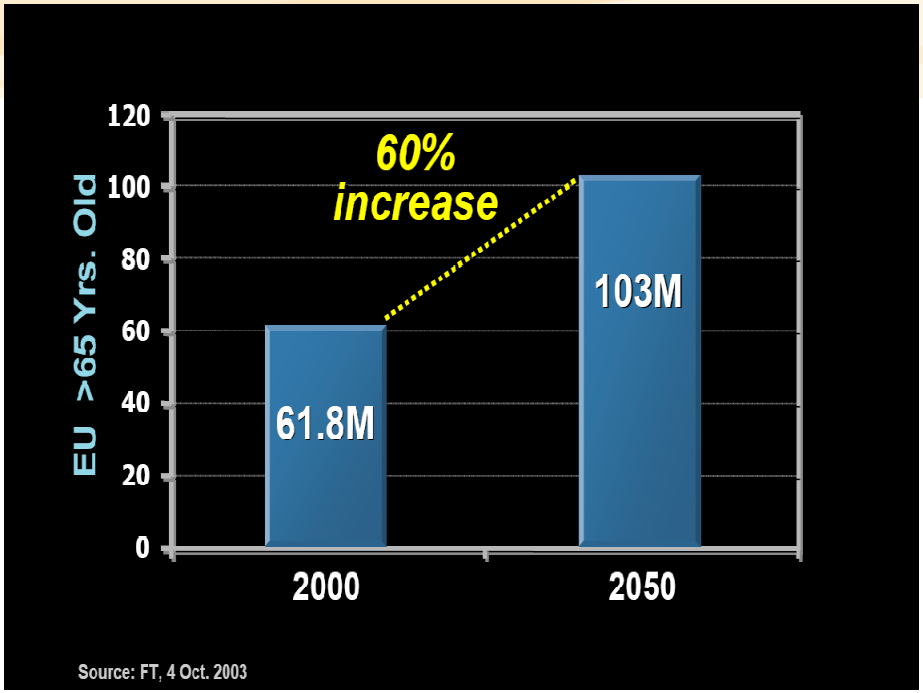
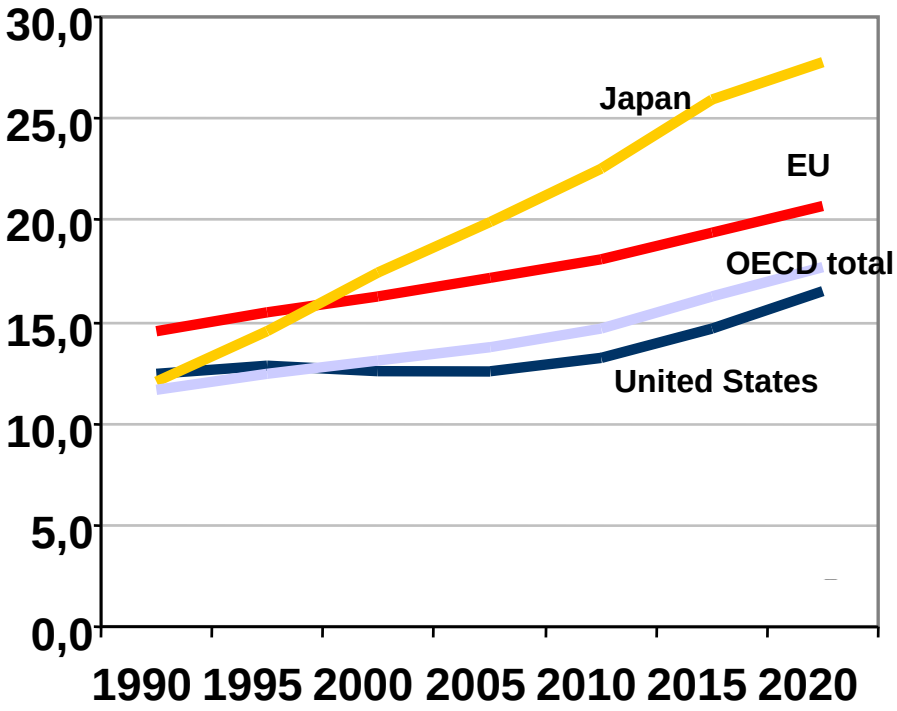
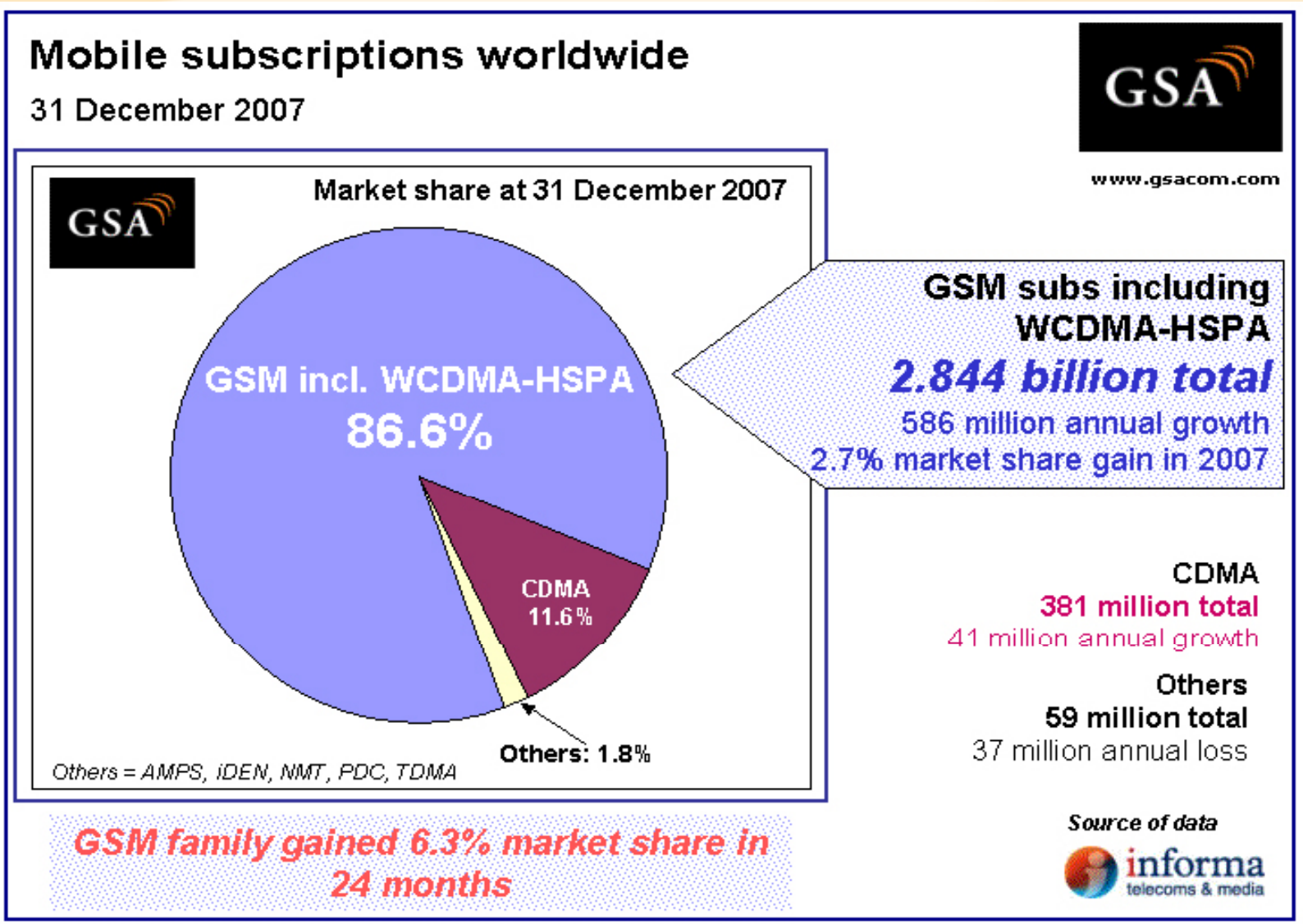
# Population is Ageing




**Population aged 65 and over**
**(Ratio to the total population, in %, source OECD)**

# The Future Internet will be a Mobile Internet

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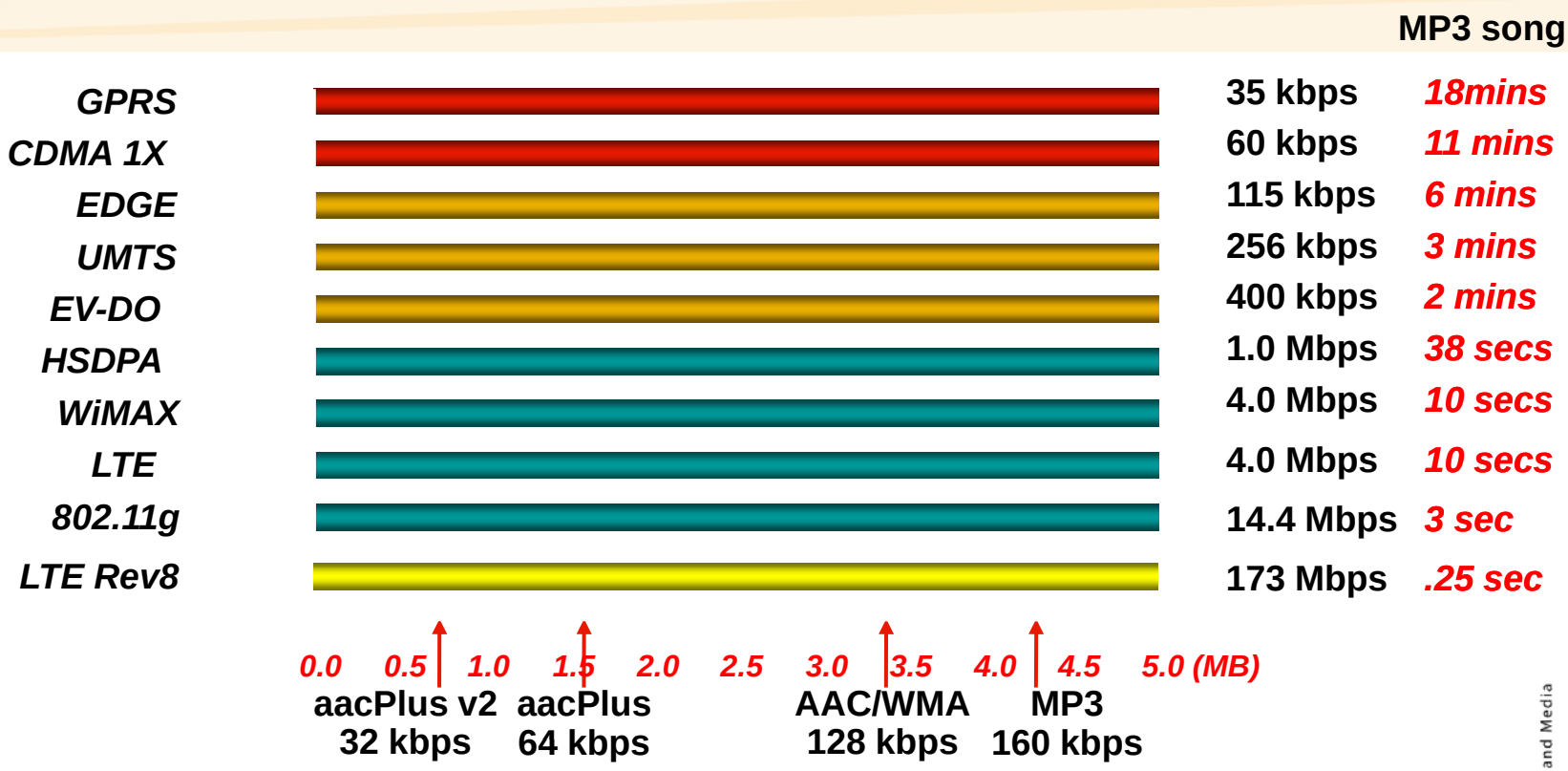
# Average download rates




**LTE Rev 8. took another big step forward with an announced specification approval by the 3GPP in Jan 2008. LTE is the 2010 (at the earliest) next generational follow-up to today's GSM/UMTS data networks offering 326Mbps peak downloads (173Mbps demonstrated) and 86Mbps uploads.**

# Mobile Social Networking on the Rise

- **GyPSii** allows users to share their real life experiences in the virtual world using mobile devices and the web. It is a social networking, search & location based suite of integrated mobile and web applications - for users to share, view & upload pictures, video, text and points of interest with a Geo-location
- **bliin** allow users to find and follow friends across the world and share experiences via the hanset and over the web. Users can share position and geo-tagged photo's from the handset in real-time.
- **myGamma.com** is a mobile internet community, where people worldwide exchange ideas and express themselves as a way of keeping in touch with friends
- **MOSH by Nokia** aims to bridge the gap between the mobile and desktop social networking with a cross-platform design (upload, share, collect, or download various media from the mobile phone as well as the desktop)










**2.3 percent of the global population of mobile users, are already using the mobile handset for social networking. Market forecasts indicate that the penetration rate would reach 12.5 percent in the next five years**

# Prototype of a smart portable appliance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# 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**

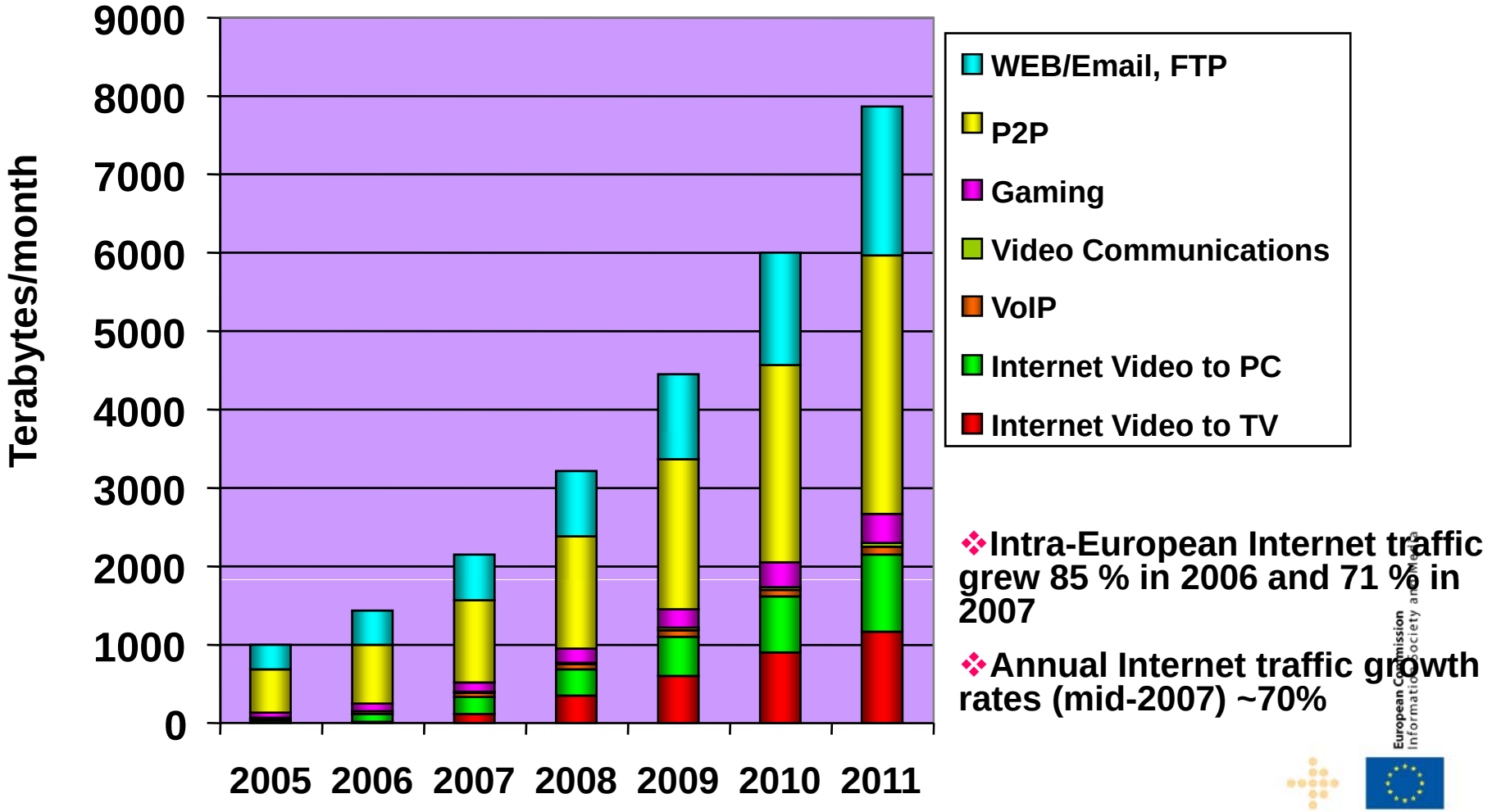
## *Transmission*

**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**

# Estimates of Global Consumer Internet Traffic



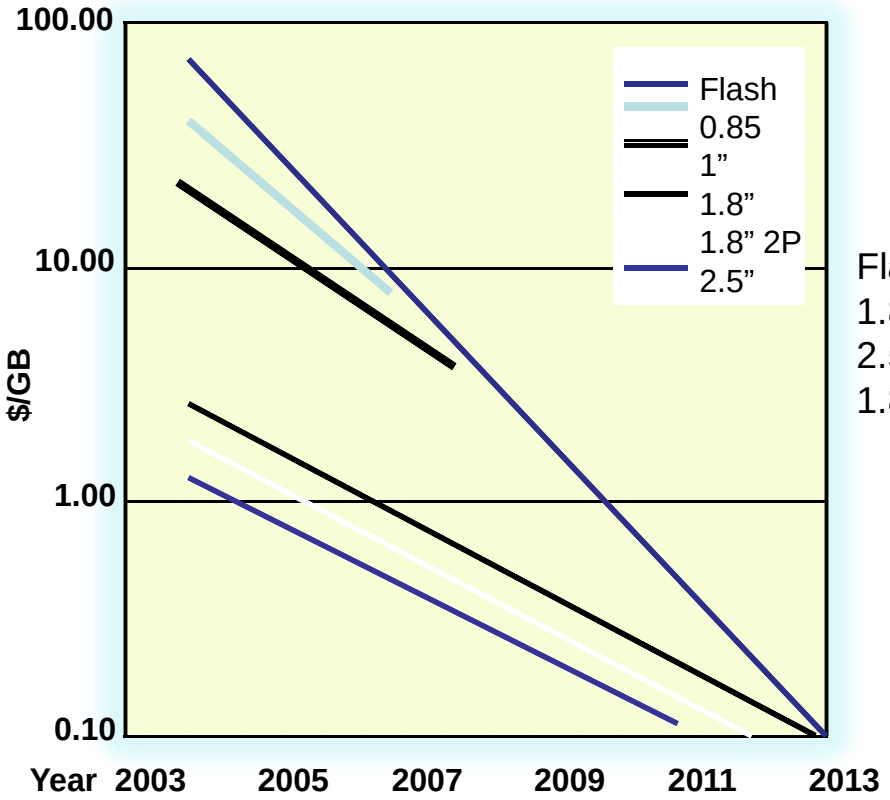

- Intra-European Internet traffic grew 85 % in 2006 and 71 % in 2007
- Annual Internet traffic growth rates (mid-2007) ~70%

Source: Cisco- Global IP Traffic Forecast and Methodology, 2006-2011

# Price of Memory

- **Price of memory** such as semiconductors and hard disk drive **is likely to continuously drop**.
- **Decrease of both memory and network cost is likely to shift further digitalization**. As a result, most of the functions and communications currently realized by analog technology will be digitalized and **software is expected to become 1) larger in size, 2) more complex, and 3) widely used in various areas**.

**Forecast of Memory Price per GB (flash and HDD)**




Flash: flash memory
1.8”: used for i-Pod
2.5”: used for laptop
1.8” 2P: two disc in one HDD

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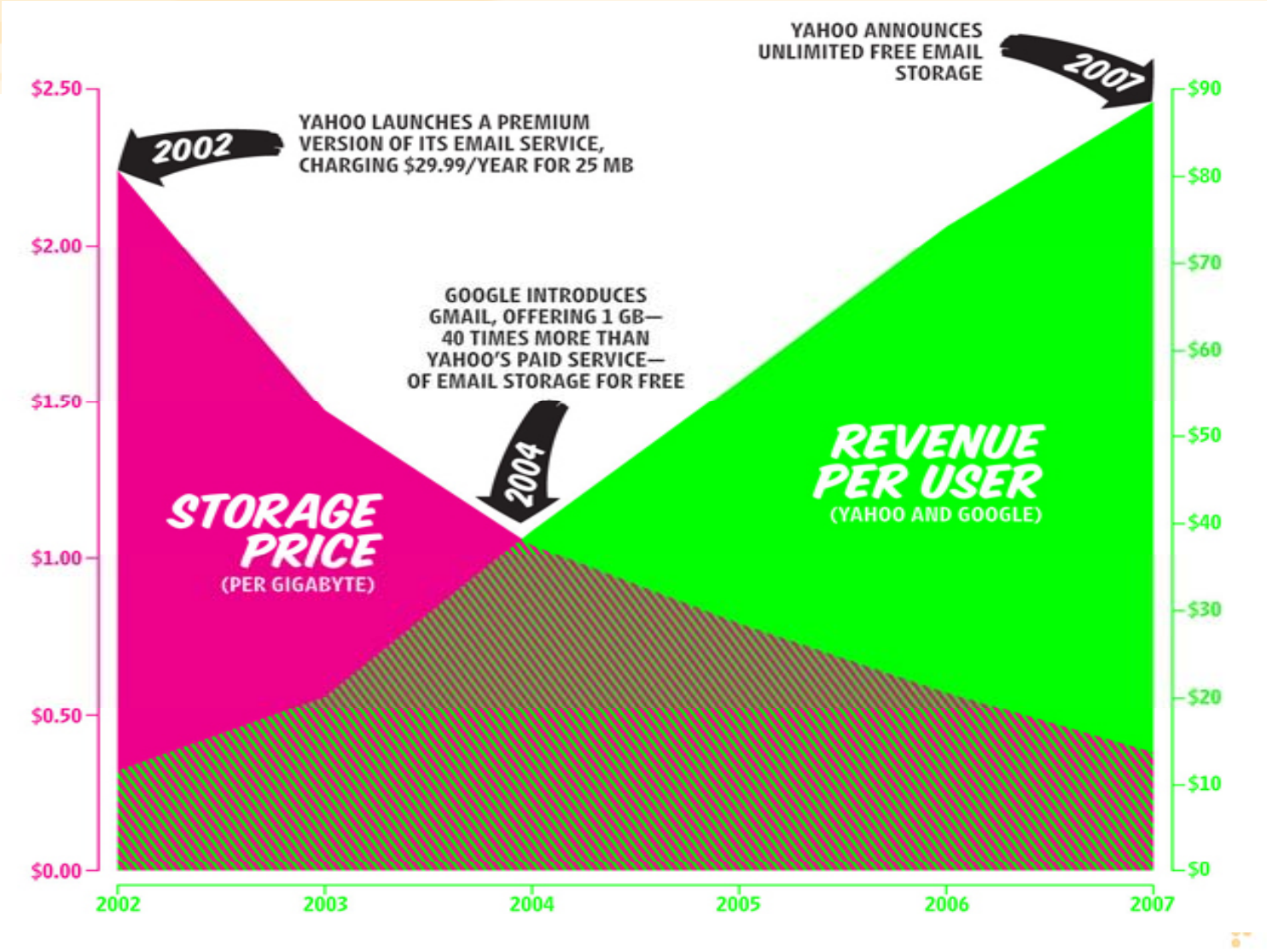
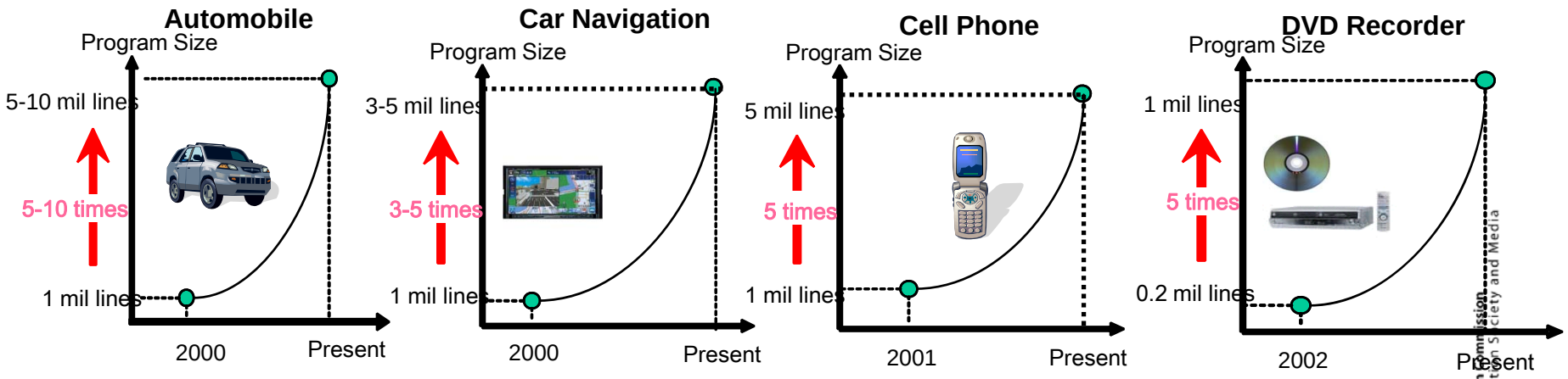
# The Era of Free-Economics




Source: http://www.wired.com/techbiz/it/magazine/16-03/ff_free_webmail

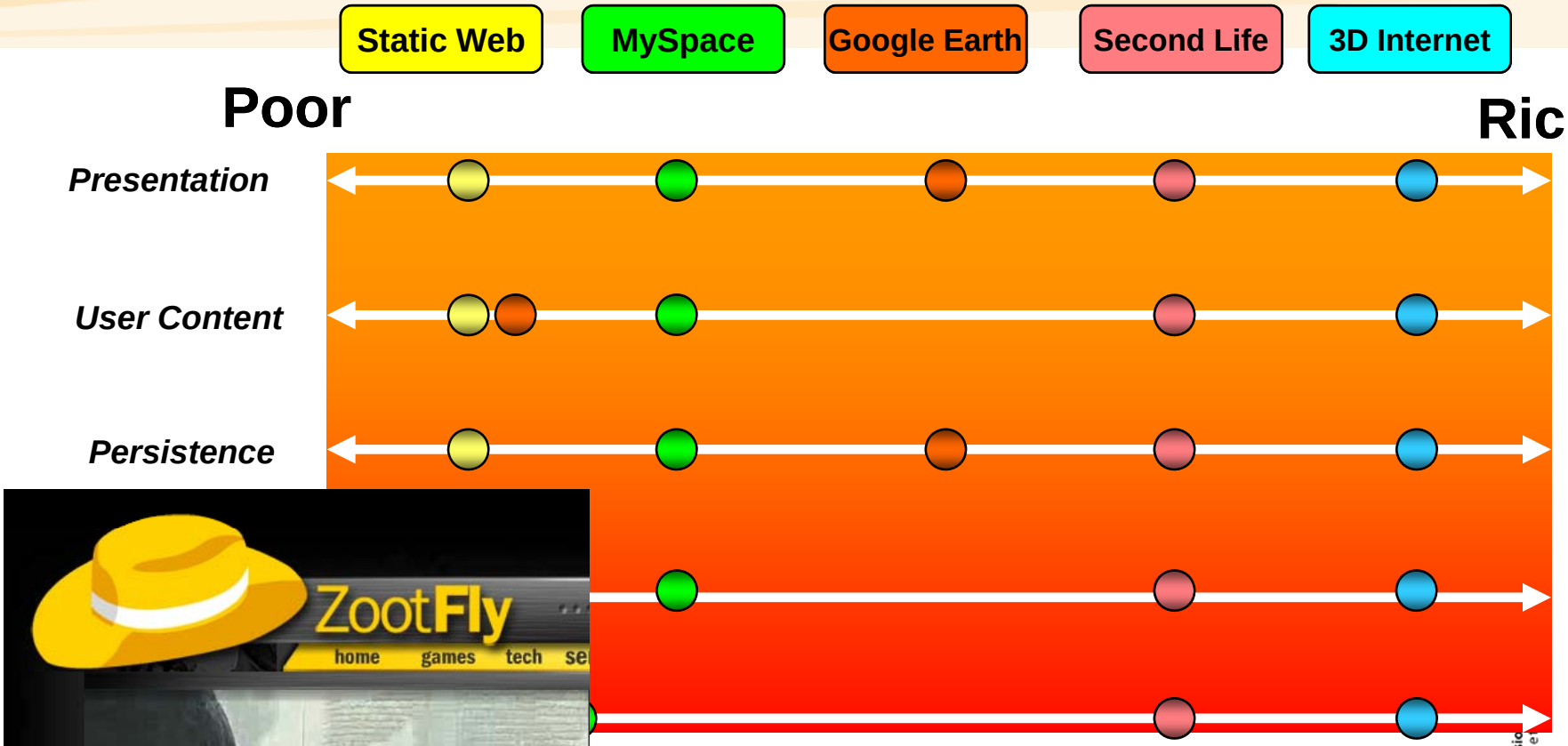
# Increasing Software Pervasiness

- Software should no longer be assimilated to computer software
- Size of embedded software has grown 5 to 10 times in the last five years
- Software for energy management
- Software for security




**Software has become a critical functional element of our ICT life**

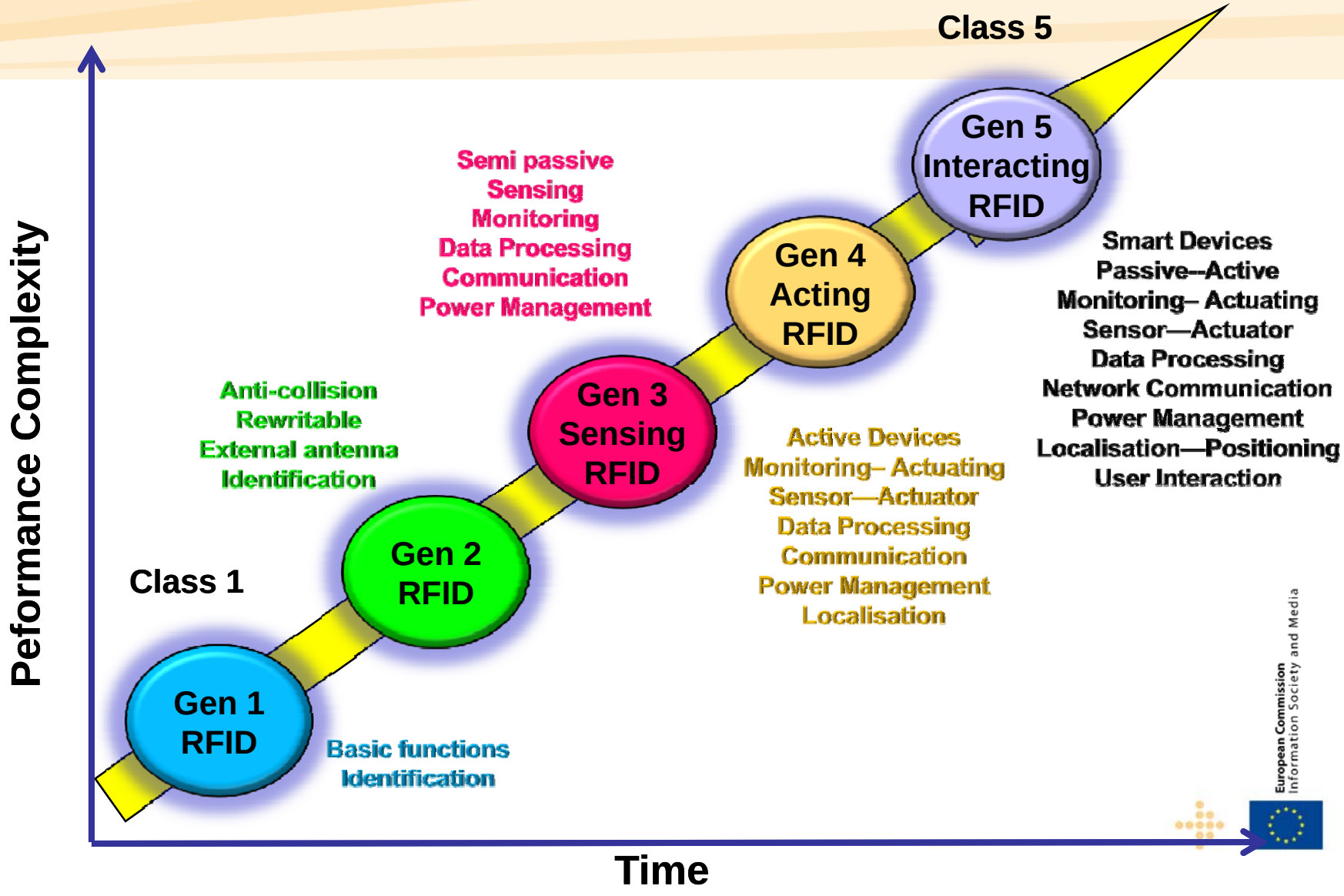
# Will the Internet evolve towards 3D?



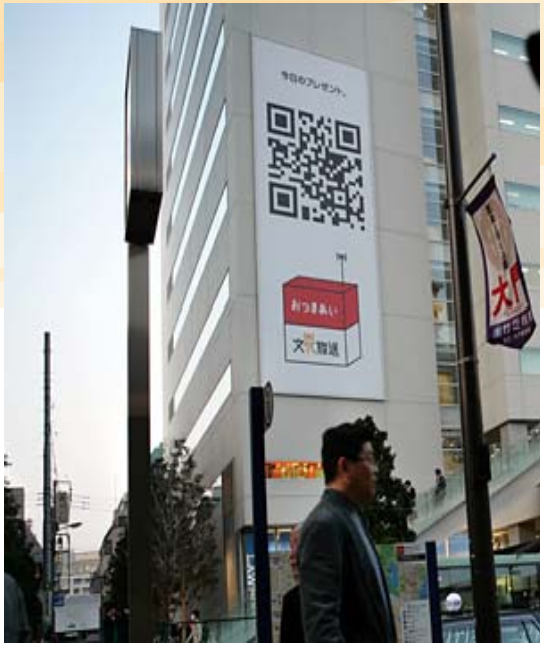


d on-line games provide a rich
n to understand 3D services

# Linking the WEB and the Real World



# Which tags?



« Smart Dust »



**The most advanced chip (0.15mm*0.15mm) has a 128 read-only memory capable of storing 10*38 unique IDs**

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# Affordable & Sustainable Internet

- The estimated power consumption resulting the Internet traffic increase will be multiplied by 5 in the next 15 years.
- The mobile Internet will be a major contributor to these figures
- Technologies to minimise such energy consumption (and associated expenditures) will be more and more on demand (e.g. virtualisation, sensors, etc)

## Avatars consume as much electricity as Brazilians

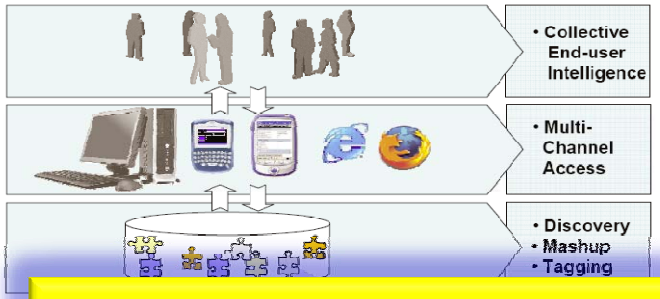
DECEMBER 05, 2006

Tony Walsh has, as others do, some doubts about whether Second Life is sustainable as a business. But he also poses another question that I hadn't come across before: "Is Second Life sustainable ecologically?"

He quotes Philip Rosedale, the head of Linden Lab, the company behind the virtual world: "We're running at full power all the time, so we consume an enormous amount of electrical power in co-location facilities [where they house their 4,000 server computers] ... We're running out of power for the square feet of rack space that we've

# Europe is active in driving the Future Internet

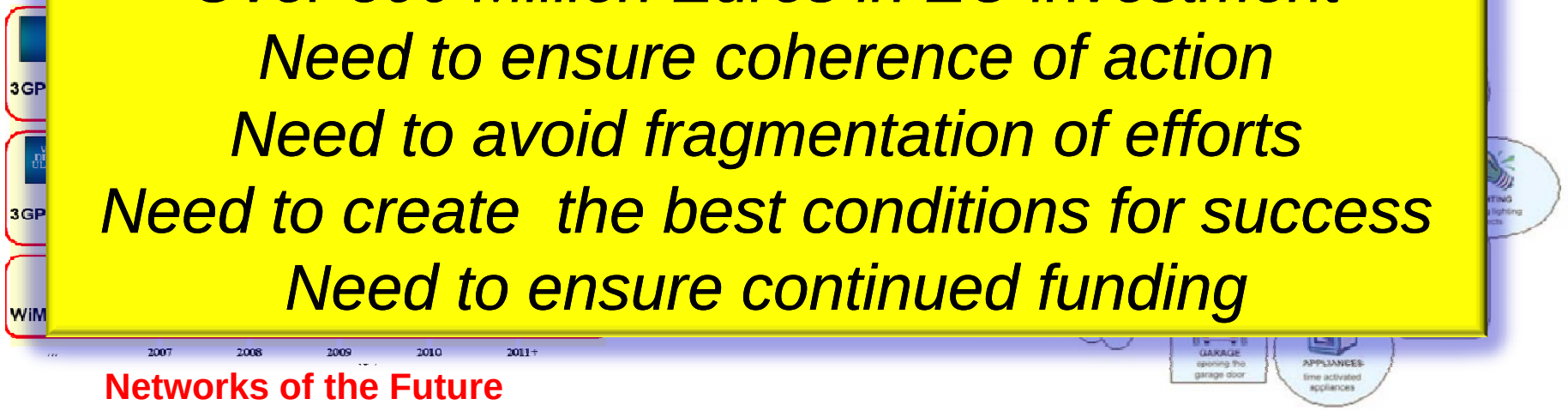
**Internet of Services, Service Web**




**Trust**

**3D Internet**

*Large number of FP7 R&D projects*
*Over 300 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*

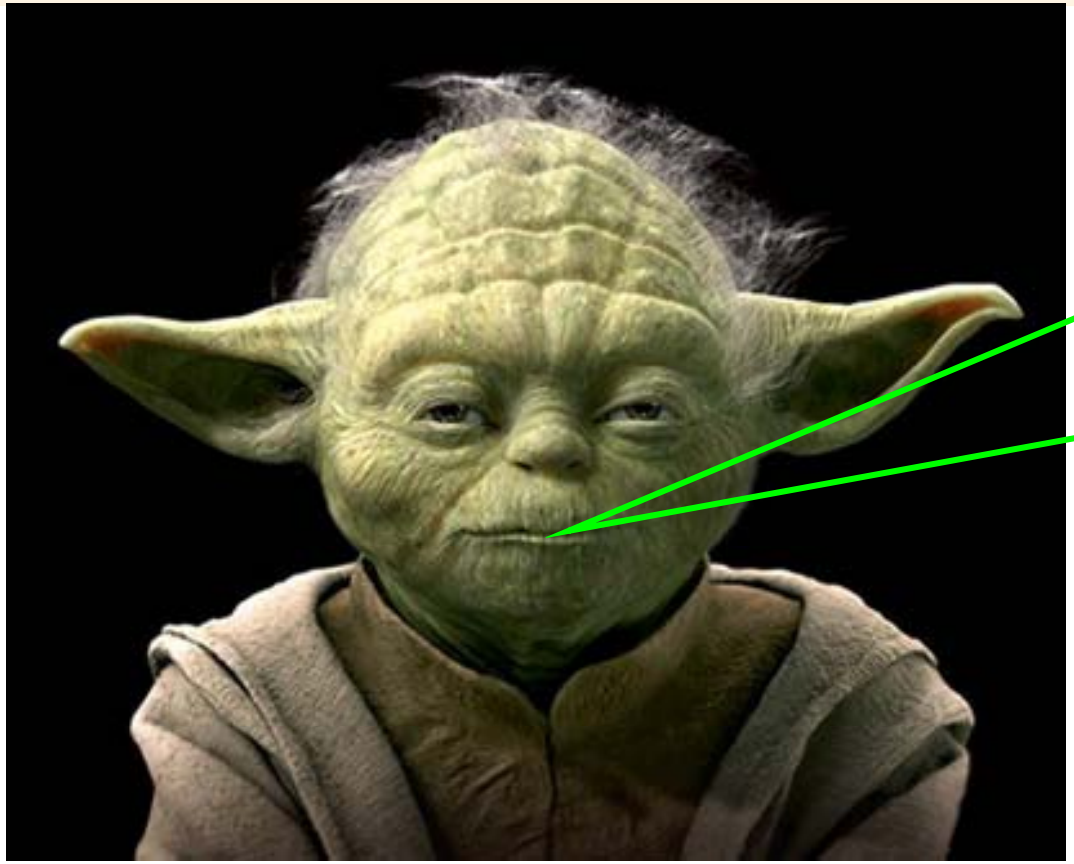



**Networks of the Future**

**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**

# Questions?



**The only real source of renewal and growth in the longer term is deep, strategic innovation**