

Which Network(s) for our Future?

PARADISO Workshop
8/09/11

Luis Rodríguez-Roselló
Head of Unit “Future Networks”
Information Society and Media DG
European Commission
Brussels, Belgium

Which Networks for our Future?

The Policy makers perspective

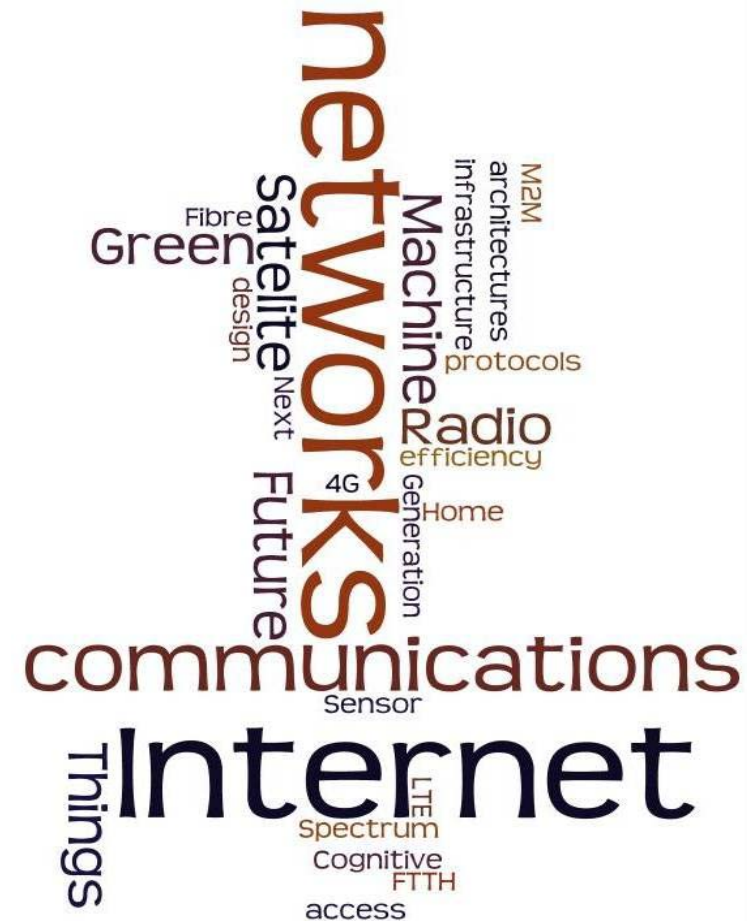
Connecting the Digital Society

Future Networks Research aims at:

Contributing to achieving the Digital Agenda overall aims: research on communications infrastructure as part of the **ultrafast Internet of the future**

Leading to lower costs technologies, better access, seamless integration of mobile and fixed networks by...

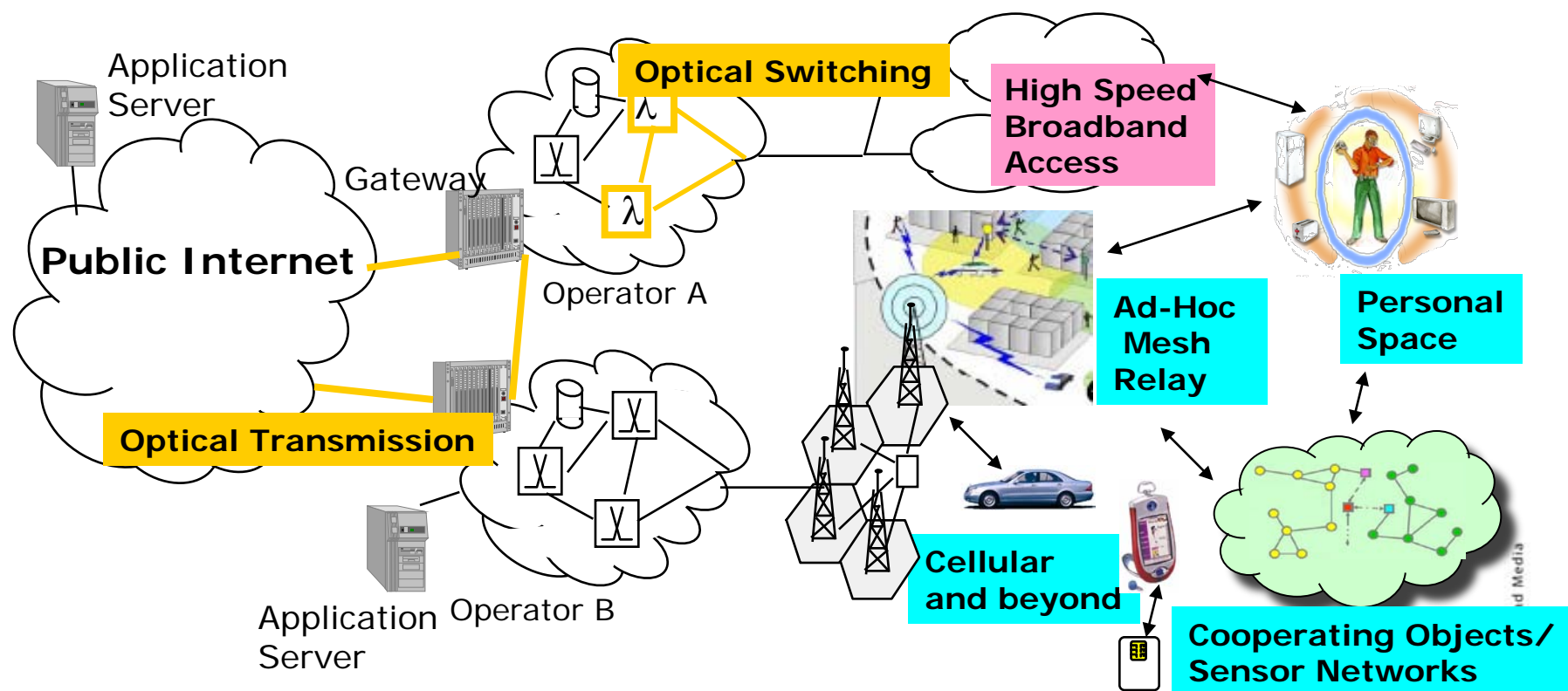
- enabling **full connectivity anywhere**, easier access to ICT-enabled services, notably Internet-based applications
- ensuring that every European has a **broadband connection to the digital society**



Which Networks for our Future?

Engineers' perspective

Internet architecture optimally designed for future broadband fixed and mobile access



Which Networks for our Future? Citizens' perception

Science or Fiction?



Stairway to Heaven or ...Highway to Hell?

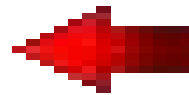


European Commission
Information Society and Media

Main trends affecting research and innovation in the communications networks area: Anytime, anywhere, anything?

Societal drivers:

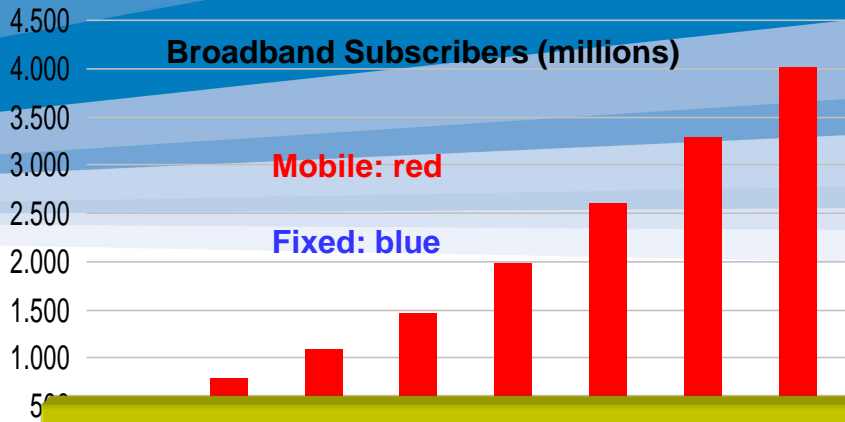
- Urbanisation
- Smart cities
- Mobility
- Information availability
- Social networks
- Privacy
- Security
- Energy efficiency
- Demographic trends
- Healthcare
- Education
- ...



Research & Technology drivers:

- Capacity/Efficiency
- Service/Content centricity
- Virtualisation & “Cloudification”
- Cognition
- Context awareness
- Manageability
- Self-organisation
- Self-optimisation
- Cross-layer optimisation
- Flexibility
- Smart environments, Sensors M2M
- ...

Trend: Wireless Internet



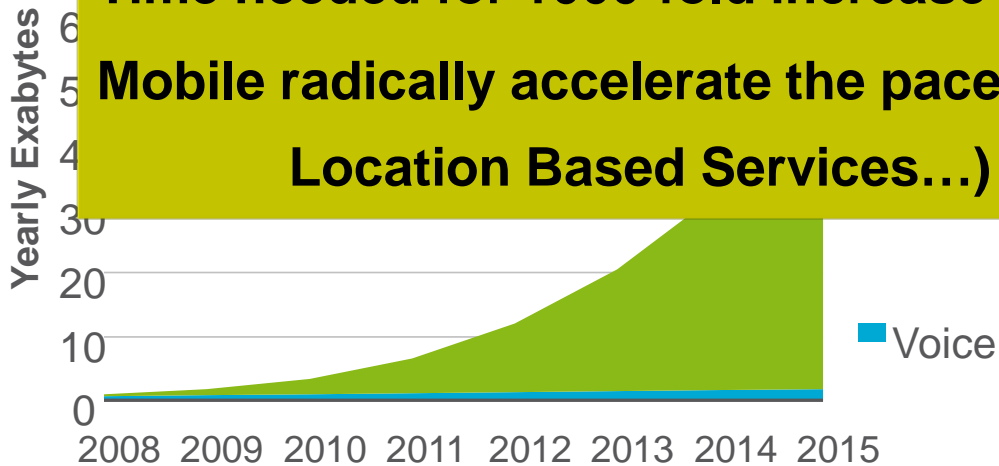
- **515 million** WCDMA/HSPA subscribers
- **10 million** new HSPA subscribers per month, 220 million in total
- **>2100 HSPA** devices are launched from 214 suppliers

Time needed to deploy 100 3G networks world-wide: 4 years

Time needed to deploy 100 HSPA enabled networks: 1 year

Time needed for 1000-fold increase (1PB/mo to 1EB/mo): 6 years

Mobile radically accelerate the pace of changes (Apps, Mash-ups, Location Based Services...)



208 operators in 80 countries are investing in LTE
GSA, May 11, 2011

- 154 LTE network commitments in 60 countries
- 54 pre-commitment trials in 20 more countries
- 20 commercial LTE networks launched
- At least 81 LTE networks are anticipated to be in commercial service by end 2012

Mobile – Internet inter-working today: mainly patches

Media – Over The Top services (superposition of layers)

Trend: Towards Service/Content Networks Virtualisation and “Cloudification”

- Network services will eventually become another service cloud: Connectivity as a service, Software-defined Networks; ad-hoc networks
- The network becomes integral part of the (mashed up) service capabilities;
- Flexible Spectrum allocation, Cognitive Radio
- Some issues:
 - Interoperability across clouds with end to end “across multiple clouds”
 - Data security, privacy (by design);
 - Transparency, policy consistency
 - Blurring distinctions between Over The Top and “traditional operators”
 - Slicing and autonomy versus global stability
 - Risk of compartmentalisation
- Innovation enabler, but requiring strong co-operation across multiple actors
- In the long term: Content-aware networks (user-to-content instead of host-to-host, content-aware traffic engineering –much beyond current P2P...), Context aware (real time awareness, adaptive, on-demand...)

Democratisation of the Network

Towards a Seamless Information Space

Trend: Green ICT/Low energy Networks

Ultrafast, highest performance

Wireless and Radio Networks

- Strong incentive for Energy efficient radio, as radio network represents about 90% of operators OPEX
- Energy consumption of Mobile Networks is growing fast
- Uneven load: 10% sites carry 50% traffic, room for optimisation;
- Requires holistic approach: components, traffic optimization, protocols...Multi layer issue
- ICT research; EARTH, target to decrease energy consumption in radio access by 50%

Optical networks

- Strong potential for energy efficiency;
- Despite all technology improvements, router energy will become unsustainable beyond 2020 because of traffic increase
- FTTH could lead to a bottleneck at the core network
- Calls for optical architecture with lowest possible switching layer, traffic aggregation, all optical end-to-end architecture (requires radio over fiber interfaces)

Towards multigranular, cognitive, elastic, adaptive seamless, E2E Wireless and Optical Networks

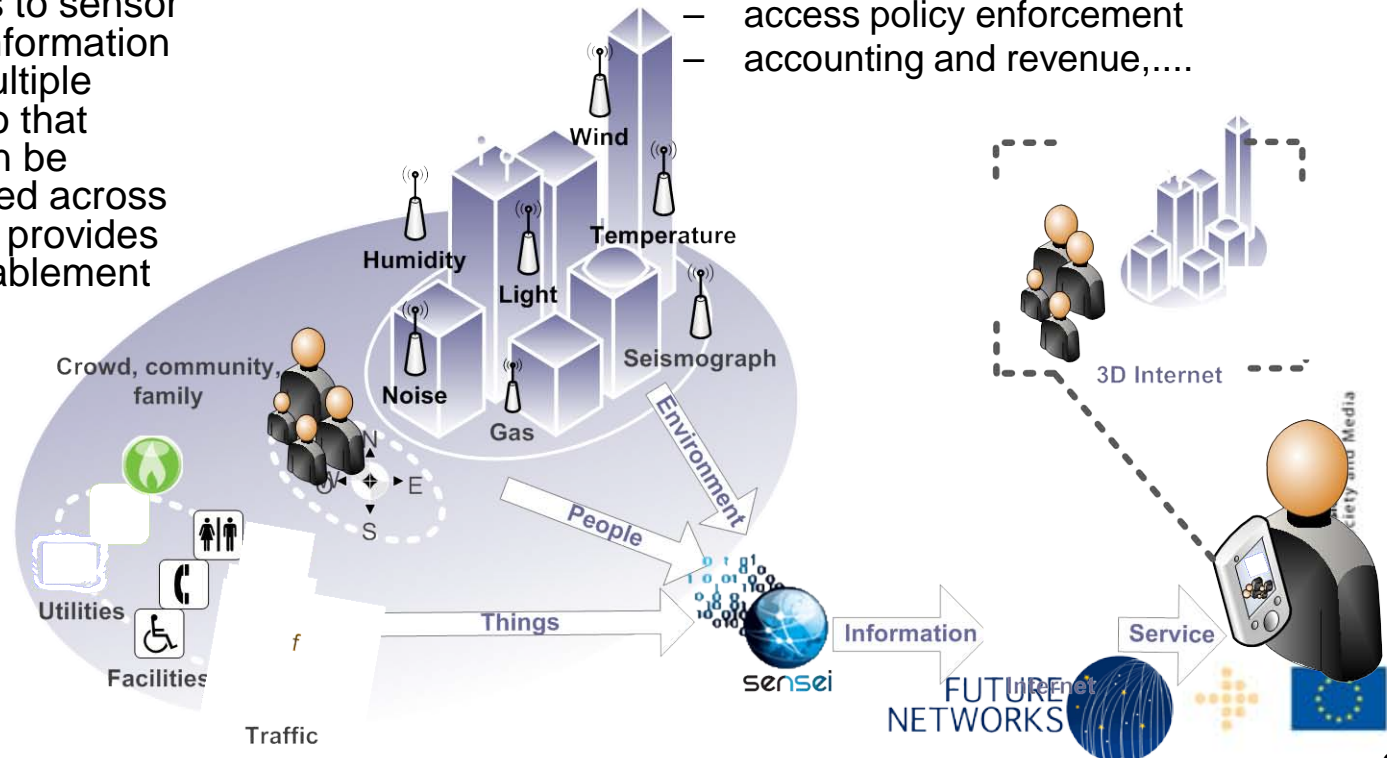
Trend: Smart environments enabled by networked sensors (“real world” Internet, context awareness...)

- Common sensor and actuator information infrastructure across cities

- provides secure and reliable access to sensor and actuator information services for multiple players, and so that information can be efficiently shared across “verticals”, this provides application enablement

- Sensor information enablement

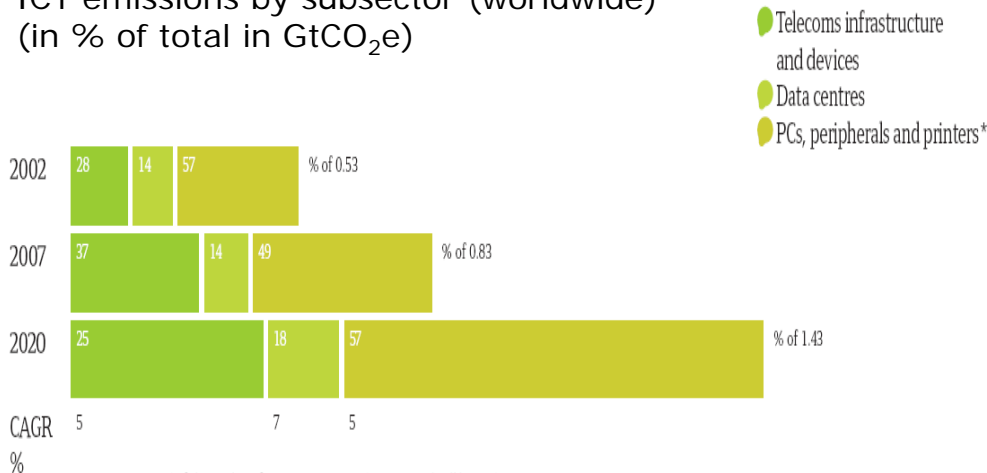
- aggregation and collection of data
- directory services
- data brokering and service composition
- information federation
- privacy and integrity protection
- access policy enforcement
- accounting and revenue,....



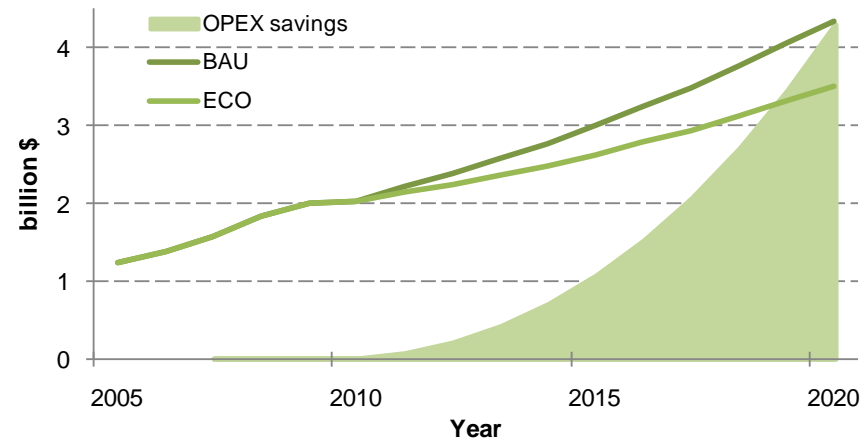
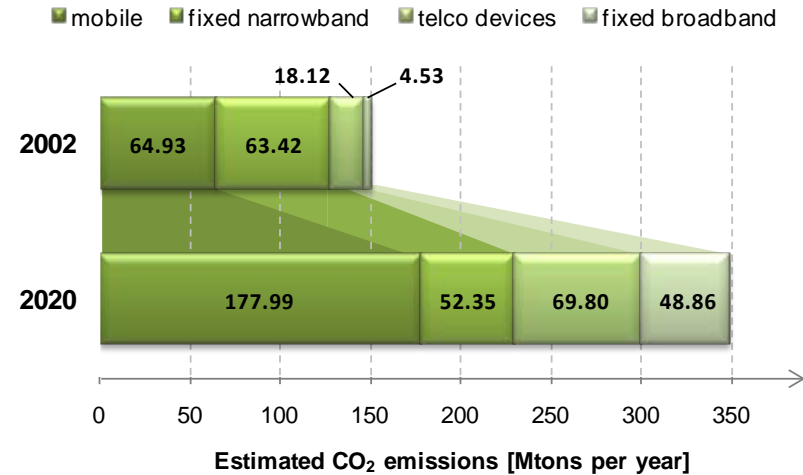
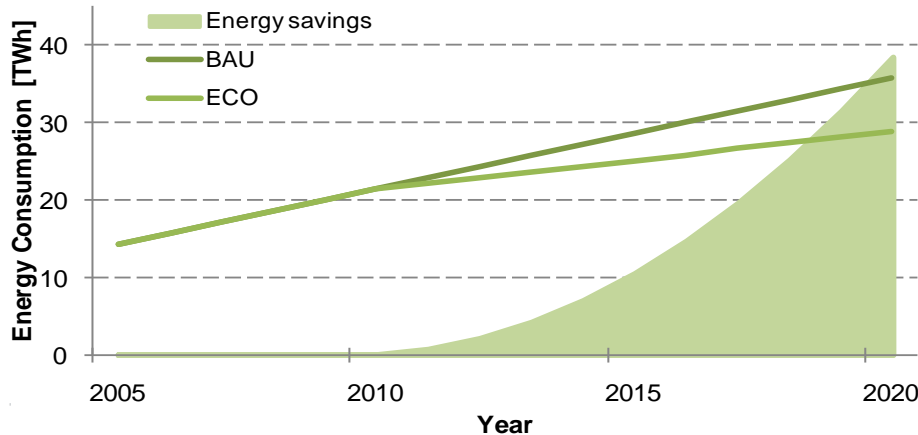
Trend: Networks need to go “Green”

- The Global e-Sustainability Initiative (GeSI) estimates an overall network energy requirement of about 21.4 TWh per year in 2010 for European Telcos, and foresees a figure of 35.8 TWh per year in 2020 if no green network technologies will be adopted.

ICT emissions by subsector (worldwide)
(in % of total in GtCO₂e)



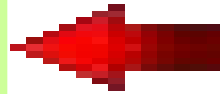
* Printers were 11% of the total ICT footprint in 2002, 8% in 2007 and will be 12% in 2020.



Mix of technologies for a new generation of users

R&D on Multiple Future Internet Technologies with application to smart systems/infrastructures should be trend setting → **virtuous tech/apps circle**

- **Devices (growth and diversity)**
 - Smart Phones, Tablets
 - Sensors/M2M...
- **True Mobile Broadband**
 - LTE Advanced
- **Enabling Capabilities**
 - Real Time Context Based
 - Real Time Social Networking communication
 - Everything networked
- **Global optimization of available capacity**
 - Pervasive 'cloud' services
 - New architecture models
 - Optimized content delivery
 - Virtualisation/Software defined networking
- **Secure and Trusted environments (privacy by design)**
- **Energy efficiency**
- **Further increase of capacity**



- Novel application capabilities
- Innovation space
- Empowering users
- New social opportunities
- Multiple end users personalised applications with an increasing focus on mobile and real time → a seamless, dynamic and flexible information space
- ...but ensuring privacy, low emissions...

Thank you for your attention!

Luis Rodríguez-Roselló

Head of Unit

“Future Networks”

European Commission, DG INFSO-D, Brussels

<http://cordis.europa.eu/fp7/ict/future-networks>