From RFID to the INTERNET of Things

Towards the Network of Tomorrow

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About the "Organisers"

Within DG Information Society and Media, Directorate D "Communications and Networks Technologies" has responsibility for European collaborative R&D on :

- **Communication technologies**
- **Networked Audio Visual Systems**
- **Software Technologies**
- **Trust and Security**
- **Entreprise networking**

   About 1032 M€ of R&D projects currently implemented under FP6 out of a total of 3.5 Bn € for the IST programme

   266 Projects, with industry academia, research centres, and with growing partnership from outside Europe (International co-operation)

   RFID and their likely evolution towards smart networked devices is seen as a key domain relevant to at least the 5 areas above

Objectives of this Workshop

Identification of the technological, societal, economic trends driving the evolution of pervasive networking, including :

- **The system perspective, how networked systems are likely to evolve;**
- **The implications of device connectivity on future network architectures and technologies;**
- **The specific security, privacy, trust and confidence issues;**
- **The service architectures that are needed to support the applications of trillions of connected tags, devices and « things »;**
- **The service composition and delivery prospects;**
- **The role of "open" (software) models**
- **The role of wireless technologies;**
- **The related non R&D issues, such as governance, spectrum, consumer acceptability;**
- **The developments in other regions of the world and prospects of collaboration;**

Short Term Policy debate

This event marks the start of a set of shorter term « Policy » workshops that will take place between March and June 2006

- **RFID Application domains and emerging trends:** RFID offers promising application potential in many domains - pharmaceuticals, health, agriculture, transport, logistics, security and more. This workshop should identify these application domains, prioritise them and formulate recommendations: e.g. what can be done to assess the needs, and to define guidelines on the use of technology in these domains?

- **End-user/consumer issues:** Work will include re-assessing the need to revise the e-privacy directive in relation to RFID; the ethical implications of RFID; the acceptability of technological approaches to build trust – with a special focus on privacy and authentication (tag to reader, reader to tag, reader to network); and to enhance security (there is no privacy without layered security).

- **Interoperability, standardisation, Intellectual Property Rights:** This workshop will discuss interoperability issues and solutions, patents, and so on. The scope of the work should cover all levels of standardisation playing a role in facilitating the rollout of the technology, and include a discussion on governance models and processes for RFID technologies and related database systems when objects of any kind are linked to a data source (Object Naming System, DNS, IPv6, etc.).

- **Frequency spectrum requirements – status and trends:** The RFID technology depends on the availability of spectrum in Europe and worldwide. For UHF and HF RFID tags, a feasible implementation strategy for Europe should be defined. Obstacles, whether technical, economic or political, should be identified and solutions gathering wide support from the Member States should be provided.

Registration at:

http://europa.eu.int/information_society/policy/rfid/workshops/index_en.htm

Until now in FP6 we have looked into

- Network technologies
  - **Lower layer issues for PAN, BAN, AdHoc networks, meshed networks, sensor networks. About 40 M€**
- Networked audiovisual systems
  - **CE device home connectivity beyond 'ZigBee', UWB. About 20 M€**
- Software and Services
  - **Dynamic and context aware services; Reliability and robustness; Self management of distributed and complex systems. About 30 M€**
- Trust and Security
  - **Resilient infrastructures; Trust in the Internet. About 40 M€**
- Enterprise Networking
  - **RFID systems in the context of business processes and value chains . About 35M€**

We now need of a more integrated approach and strategy covering the various facets of the issues when moving towards FP7

Device – Sensors Gaining Momentum

XEROX *« Ultimately there will be hundreds of times more of tiny radio-equipped sensors than there are computers on the internet. It will be like a digital skin on the face of earth. »*

TIME *« Market for wireless sensors could be worth $50 to less than 10 cents each in the same time period »*

INTEL *« Ultimately, the researchers envision smart networks of miniature sensors built into buildings, clothing, hospitals, factories, roads, farms and vehicles to form a proactive computing infrastructure that consumers around the globe will take for granted but can tap into anytime. »*

COMPUTERWORLD *« Tiny wireless sensors may eventually have a huge impact on society. »*

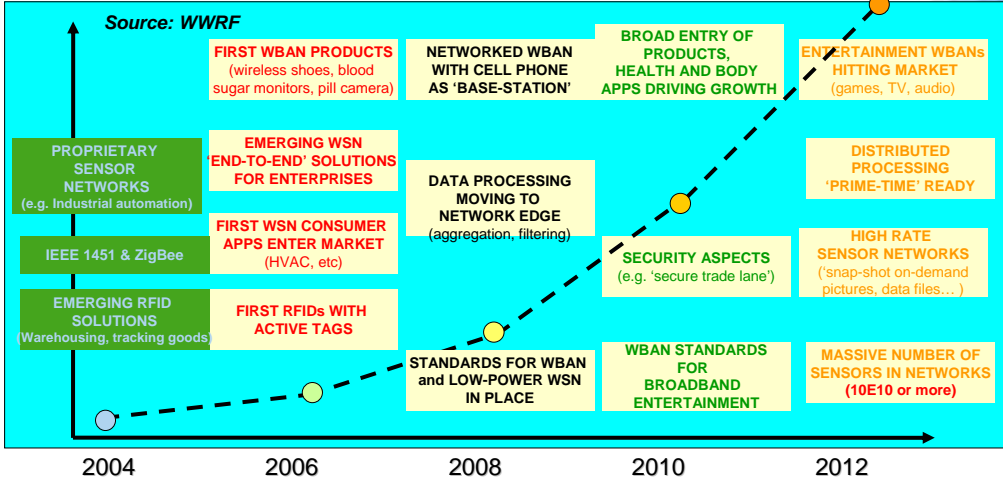**MIT** *« Wireless Sensor Networks is one of the top 10 Technologies that will change the World in 21st Century. »*

1 + Trillion	**RFID / Sensors**
500 Billion Microprocessors	-Location -Humidity -Temperature -Vibration -Liquid -Weight -Motion -Etc.
2 Billion Smart Devices •Vehicles •Appliances •Building Eqpt	
1 Billion Info Devices -Mobile Phones -PDA's	

Personal Computers 300 Million

Wireless sensor networks –road map

WND Penetration

Source: WWRF

FIRST WBAN PRODUCTS (wireless shoes, blood sugar monitors, pill camera)

NETWORKED WBAN WITH CELL PHONE AS 'BASE-STATION'

BROAD ENTRY OF PRODUCTS, HEALTH AND BODY APPS DRIVING GROWTH

ENTERTAINMENT WBANs HITTING MARKET (games, TV, audio)

PROPRIETARY SENSOR NETWORKS (e.g. Industrial automation)

EMERGING WSN END-TO-END' SOLUTIONS FOR ENTERPRISES

DATA PROCESSING MOVING TO NETWORK EDGE (aggregation, filtering)

DISTRIBUTED PROCESSING 'PRIME-TIME' READY

IEEE 1451 & ZigBee

FIRST WSN CONSUMER APPS ENTER MARKET (HVAC, etc)

SECURITY ASPECTS (e.g. 'secure trade lane')

HIGH RATE SENSOR NETWORKS ('snap-shot on-demand pictures, data files…)

EMERGING RFID SOLUTIONS Warehousing, tracking goods)

FIRST RFIDs WITH ACTIVE TAGS

STANDARDS FOR WBAN and LOW-POWER WSN IN PLACE

WBAN STANDARDS FOR BROADBAND ENTERTAINMENT

MASSIVE NUMBER OF SENSORS IN NETWORKS (10E10 or more)

2004   2006   2008   2010   2012

Key application domains: security, health-ageing , environment, logistics (the Internet of things) , mobile robotics

An important Driver for « Beyond 3G » systems

Ubiquitous intelligence and true context-awareness relies on wireless networked de
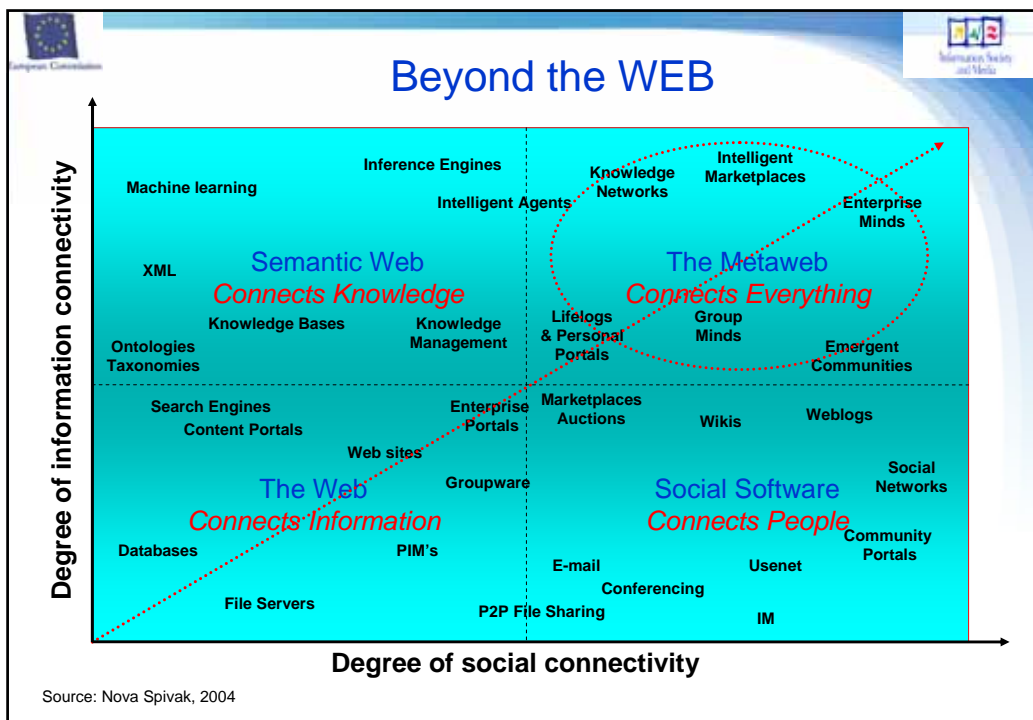

Picture from R. Kurzweil: "The age of spiritual machines", p. 188

Storage - the Lifelogs

Tomorrow we will store everything we have ever said. Then everything we have ever seen. This storage (and processing, and bandwidth) will make us all networkable in ways we never dreamed.

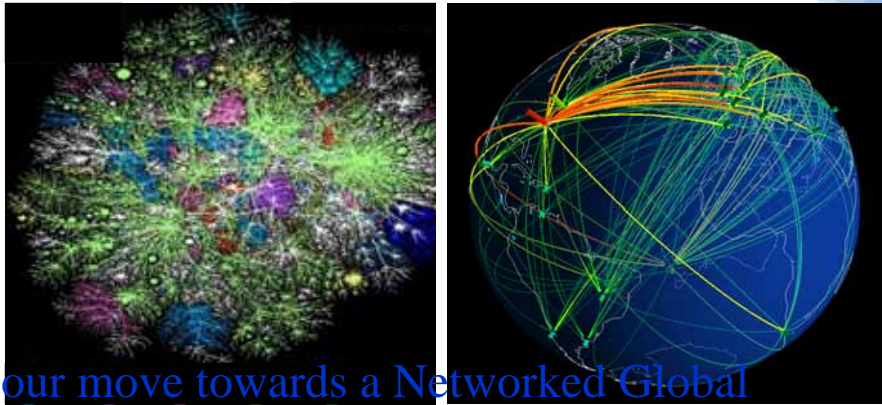# Beyond the WEB

Source: Nova Spivak, 2004

Towards an augmented information space

- **Devices bring in another layer of information and knowledge, beyond what can be today searched on servers**

- **« Towards device knowledge »:** how to make sense of the high-volume of data

  - « Google for devices and sensors? »

  - Data management (current IT systems cannot handle such volumes of data)

- **« No Wireless Device Network will live alone »:** how to integrate WSN to the global network (create the « gateways »)

Networked nervous system

In our move towards a Networked Global Community of content, objects, resources, devices, human beings, how can our collective IQ be augmented?

How do we assess, select, implement, monitor,

Others are also looking for solutions

• US/NSF

- Creating new core functionality:
- Developing enhanced capabilities:
- Deploying and validating new architectures:
- Designing new architectures;
- Building higher-level service abstractions:
- Building new services and applications:
- Developing new network architecture theories

Japan/Korea

- Ubiquitous Japan; Ubiquitous Korea
- All encompassing system approach, combining:
  - device connectivity,
  - selected applications e.g in the medical domain,
  - wireless networks evolution (beyond 3G),
  - service architectures,
  - IPv6 based networking, optical core.

What do we want to achieve?

- Overcome the increasingly visible limitations of today's networks, notably in terms of flexibility, reliability, security, and manageability
- Enable exploration of new network architectures and distributed system capabilities
- Cope with unprecedented scalability and complexity problems
- Facilitate disruptive innovations, most notably at the edges of the network
- Cater, in networking terms, to the needs of the tera and nano media content creators, aggregators and distributors
- Create new opportunities for all stakeholders, from component suppliers, subsystem manufacturers, system integrators, software solution providers to network operators and service providers
- Empower the user with greater choice and more control
- Ensure balanced and governance models

Networks also have an economic and social dimension

At the end of the day the only question is:

What are the requirements for the global network of tomorrow, how can we built it and what should it look like?

The IST programme is already largely opened to international cooperation. This will be further supported under FP7, as international cooperation projects will not only be evaluated in terms of excellence but also on criteria of specific cooperation with countries/regions or international organisations on areas of mutual interest and benefit.

FP7 - The next R&D Framework Programme

- Covers the 2007-2013 period
- Legislative texts (FP, SP) to be finally agreed by parliament and Council in second semester 2006
- ICT, an important part of FP7 (ca 30%)
- Budget under discussion
- Current priority - defining the Work Programme:
  - **End of March 06: Skeleton including topics and proposed budgets**
  - **22-23 March: IST-C ICT-RTD**
  - **4-5 May: Austrian Presidency Conference on European Technology Platforms**
  - **End of May 06: First draft work programme**
  - **June: 1st draft to IST-C**
  - **Fall 2006: Formal decision**
  - **Nov/Dec 06: First call**
  - **Feb/Mar 07: Closure and evaluation**