



Workshop Internet of Things

LAAS-CNRS

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Internet Of Things (IOT)



Definitions:

- “**Things** having **identities** and virtual personalities operating in smart spaces using intelligent interfaces to **connect and communicate** within social, environmental, and **user** contexts.”
- “Interconnected **objects** having an **active** role in what might be called the **Future Internet**.”

Semantically:

- “A **world-wide network** of interconnected **objects** uniquely **addressable**, based on **standard** communication protocols.”



Applications



- *Add intelligence and new functionalities to already well accepted devices (mobile phone, PDA, smart cards...)*
- Retail
 - Replacement of bar code (cost, privacy issues both for the retailer and the consumer)
- Logistics
 - Automatization of warehouses: improving efficiency of processes, better asset management, proactive planning
 - New ways for business deals: Marketplace formed by Things in transit that a customer could place a request on the IOT
- Pharmaceutical
 - Counterfeiting prevention, customer information, avoid incompatible drugs...
- Food traceability
- Ambient and assisted living:
 - Health, intelligent home, transport, people security



Wider technological trends

- “Exaflood” or “Data deluge”, is the explosion of the amount of data collected and exchanged. Some numbers: in the year 2015 more than 220 Exabytes of data will be stored. ***Imperative to find novel ways and mechanisms to find, fetch, and transmit data.***
- The energy required to operate the intelligent devices will dramatically decrease: ***search for a zero level of entropy where the device or system will have to harvest its own energy.***
- ***Miniaturisation of devices is also taking place amazingly fast.*** The objective of a single-electron transistor is getting closer, which seems the ultimate limit, at least until new discoveries in physics.
- Another important trend is towards ***autonomic resources***. The ever growing complexity of systems will be unmanageable, and will hamper the creation of new services and applications, unless the ***systems will show self-* properties, such as self-management, self-healing and self-configuration.***



Enablers



- **Energy**: development of new and more efficient and compact energy storage like batteries, fuel cells, and printed/polymer batteries etc; as well as new energy generation devices coupling energy transmission methods or energy harvesting using energy conversion.
- **Intelligence**: Capabilities such as context awareness and inter-machine communication are considered a high priority for the IoT. Additional priorities are the integration of memory and processing power, the capacity of resisting harsh environments, and an affordable security. Furthermore, the development of ultra low power processors/microcontrollers cores designed specifically for mobile IoT devices and a new class of simple and affordable IoT-centric smart systems will be an enabling factor.



Enablers

- **Communication**: New, smart multi frequency band antennas, integrated on-chip and made of new materials: On-chip antennas must be optimised for size, cost and efficiency (coil on chip, printed antennas, embedded antennas, multiple antenna, 3D structures). Modulation schemes and transmission speed allowing multi-frequency energy efficient communication protocols and transmission rates. New methods of effectively managing power consumption at different levels of the network design are needed, from network routing down to the architecture of individual devices.
- **Integration**: Integration of smart devices into packaging, or better, into the products themselves will allow a significant cost saving and increase friendliness of products. Integration of chips and antennas into non-standard substrates like textiles and paper, and development of new substrates, conducting paths and bonding materials adequate for harsh environments and for ecologically sound disposal. System-in- Package (SiP) technology allows flexible and 3D integration of different elements such as antennas, sensors, active and passive components into the packaging, improving performance and reducing the tag cost.



Enablers



- **Interoperability**: Future tags must integrate different communication standards and protocols that operate at different frequencies and allow different architectures, centralized or distributed, and be able to communicate with other networks unless global, well defined standards emerge.
- **Standards**: Without clear and recognized standards such as the TCP5/IP6 in the Internet world, the expansion of the Internet of Things beyond RFID solutions cannot reach a global scale. Sustainable fully global, energy efficient communication standards that are security and privacy centered and are using compatible or identical protocols at different frequencies are therefore needed.
- **Manufacturability**: Costs must be lowered to less than one cent per tag, and production must reach extremely high volumes, while the whole production process must have a very limited impact on the environment.



Ubiquitous Intelligent Devices

- Even more pervasive revolution than today's Internet and mobile communication
- New generation of Intelligent Devices:
 - Interoperability through novel protocols
 - Self-configuration, self-management, etc.. to allow integration into any operational environment : “Plug & Play” technology
 - Need for standardization of protocols and configuration mechanisms
 - Operation in harsh environment
 - Appropriate EDA tools
 - Reliability of the ubiquitous intelligence: individual entities supposed to make intelligent decisions in cooperation. How do they converge to a solution?
 - Fault protection: how to assess that a device is really faulty (or malicious) and how to prevent the propagation of this fault to other devices?



Barriers



Absence of governance

- Without an impartial governing authority, it will be impossible to have a truly global “Internet of Things” accepted by states, companies, trade organizations and the common people.
- 2 different, non-compatible & competitive proposals: EPCglobal and Ubiquitous Networking Lab
- What could be the governance of the IOT and how different should it be from the governance of today’s internet?

Privacy and Security

- Need for a technically sound solution to guarantee privacy and security
- Should be addressed by the forthcoming standards to define different security features to provide confidentiality, integrity or availability services