

**On RFID: The Next Step to the Internet of Things**  
**Lisbon, Portugal, 15 - 16 November 2007**

# Smart Systems on Tags the Next Generation Devices for Ubiquitous Sensor Networks

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# Outline

- ➔ Smart Systems on Tags
- ➔ Smart Integrated Systems
- ➔ Ubiquitous Sensor Networks
- ➔ Hybrid Networks
- ➔ RFID End to End
- ➔ IntelliSense RFID
- ➔ Future Scenarios

# Smart Systems on Tag

## ➡ Personality:

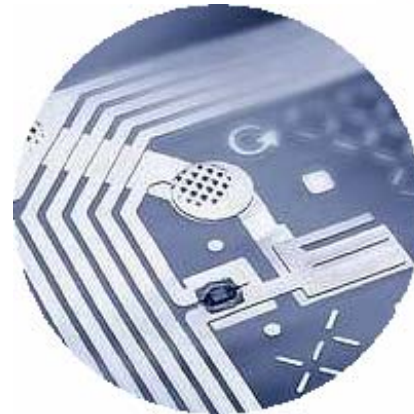
- Sense
- Actuate
- Identify
- Interact
- Interface
- Communicate



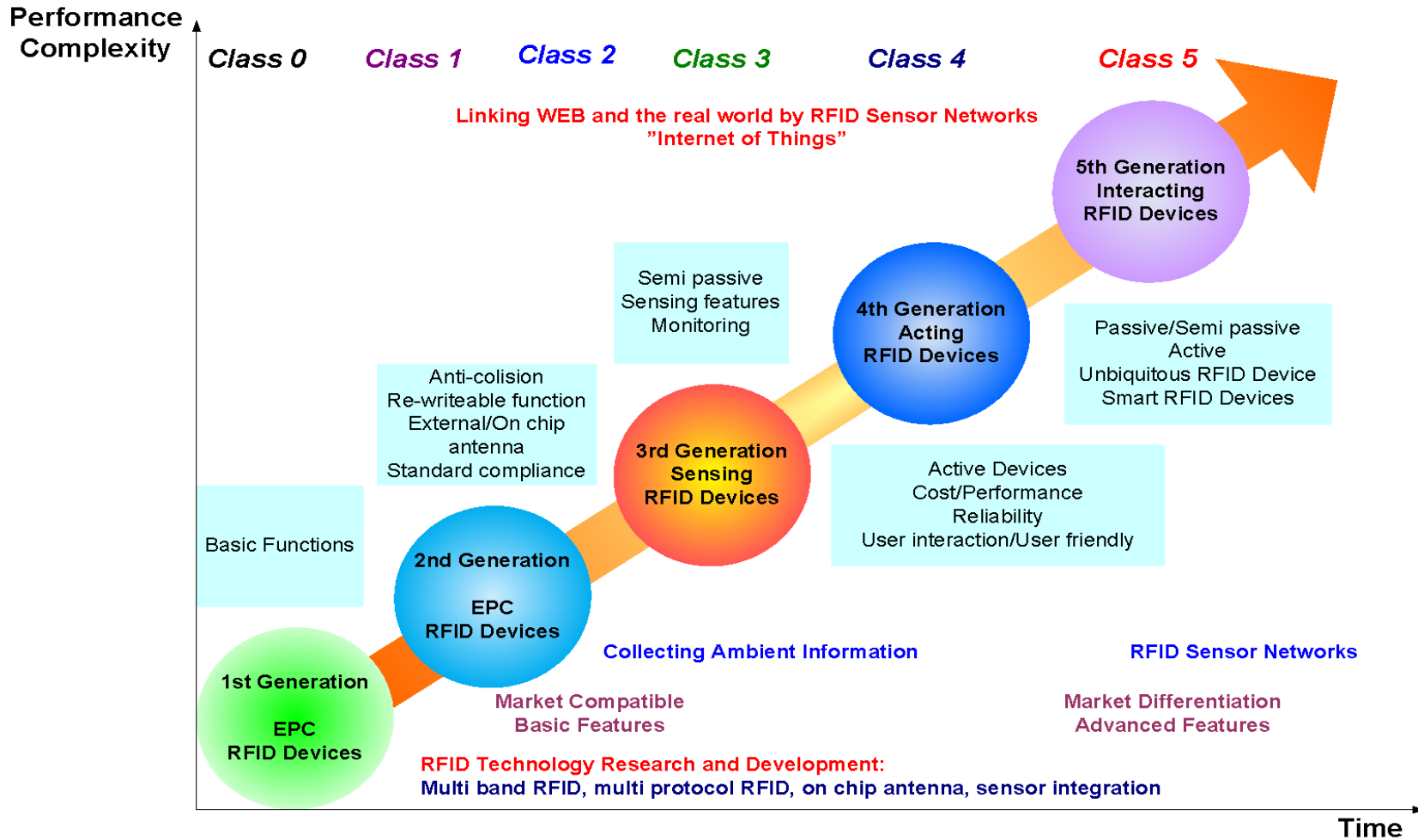
# Smart Systems on Tag

## ➔ Features:

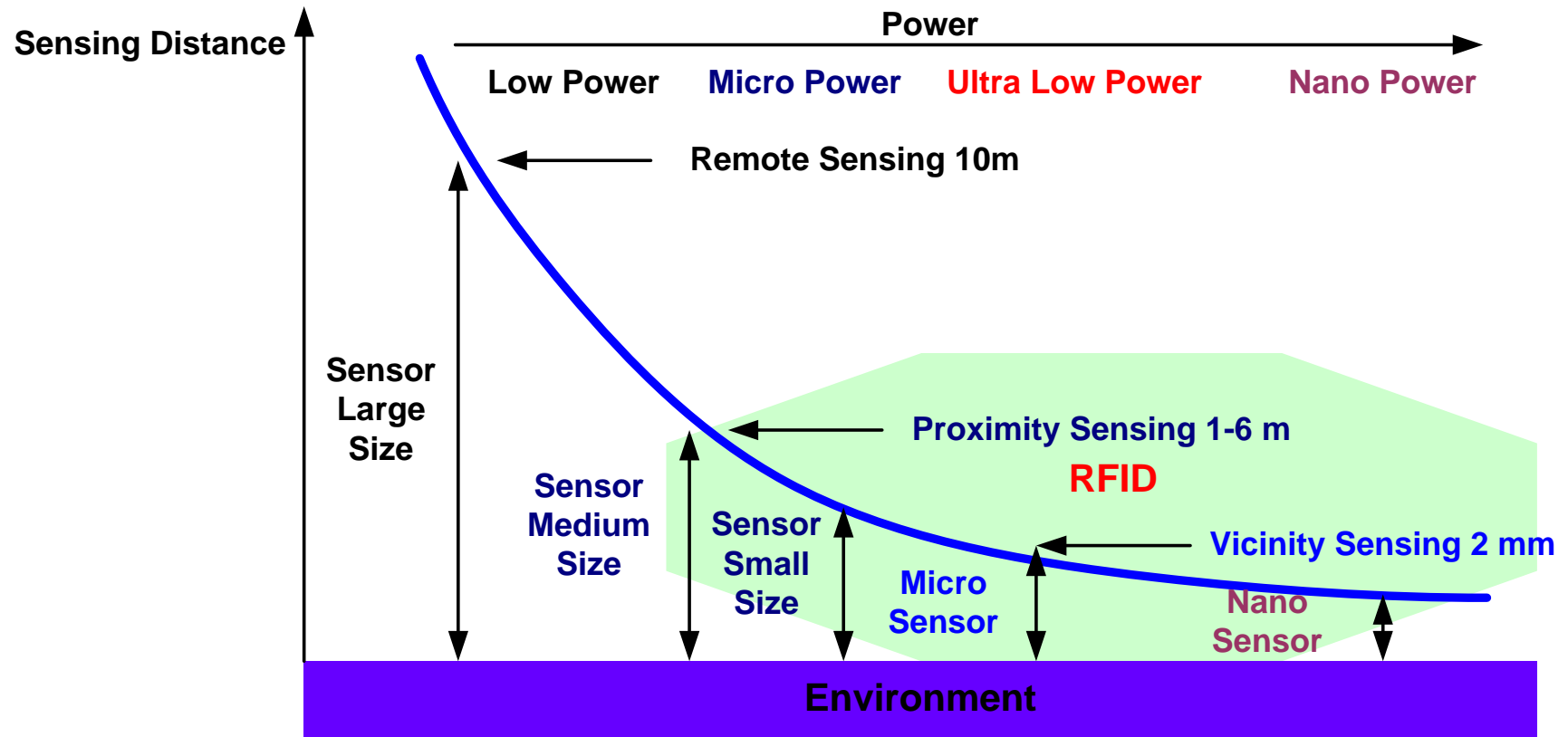
- Small size
- Ultra low power
- Very low cost
- Autonomus
- "Invisible"



# Smart Integrated Systems

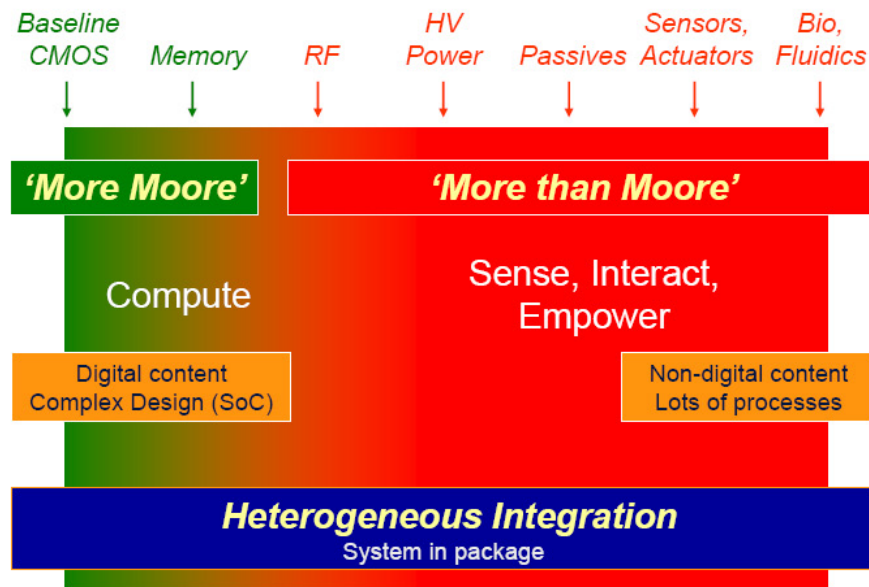


# Wireless Sensing

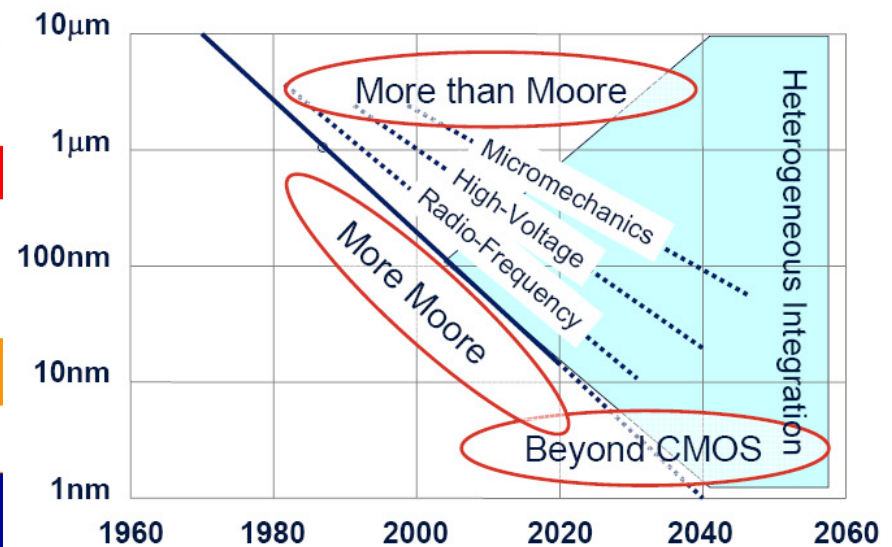


# Integration Technology

More than Moore and Heterogeneous Integration



ENIAC technology roadmap

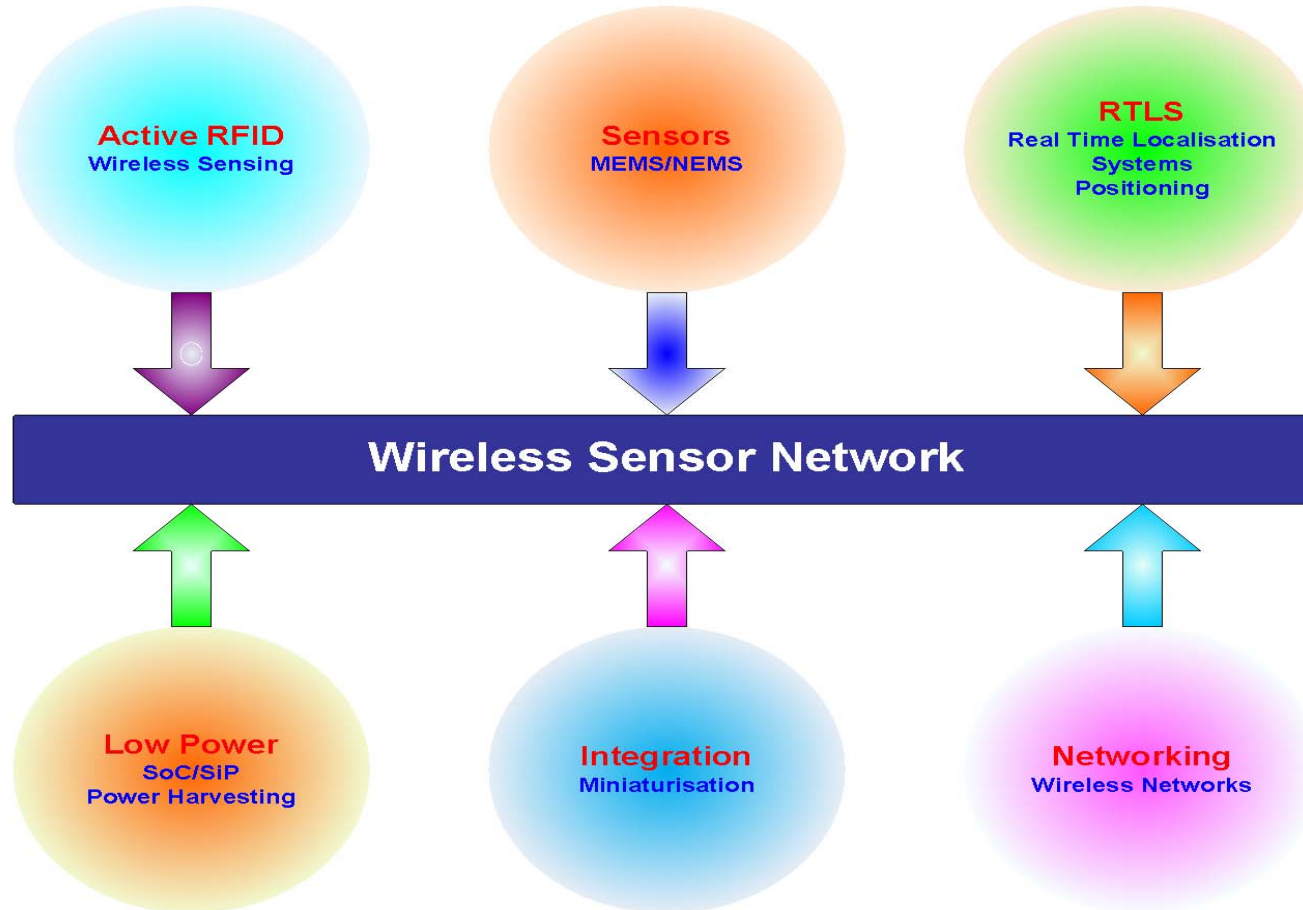


## Ubiquitous Sensor Networks

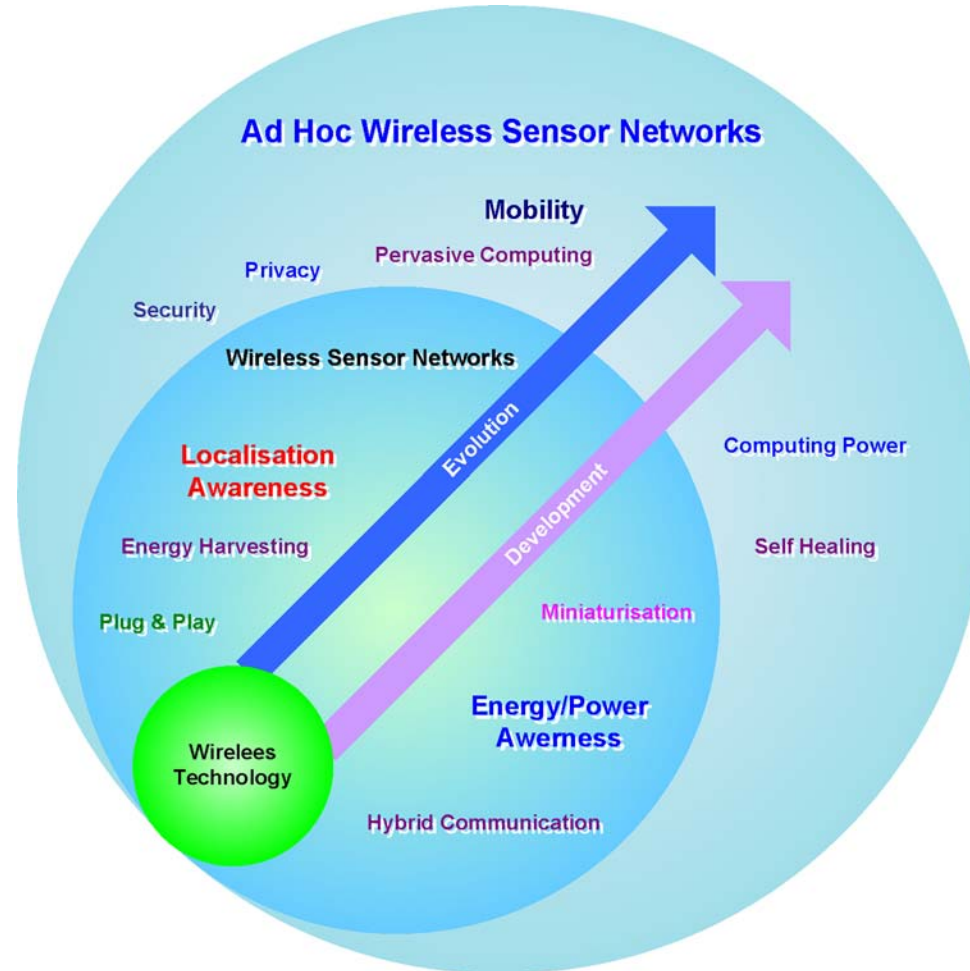
- ➔ Everywhere, everything with RFID tags (*Ubiquitous*)
- ➔ Identifying, sensing (getting environmental information), acting (interacting with the environment) and communicating (*Interacting*)
- ➔ Real time monitoring and actuating via a RFID or sensor network (*Network*)



# Ubiquitous Sensor Networks



# Wireless Sensor Networks



# Hybrid Networks

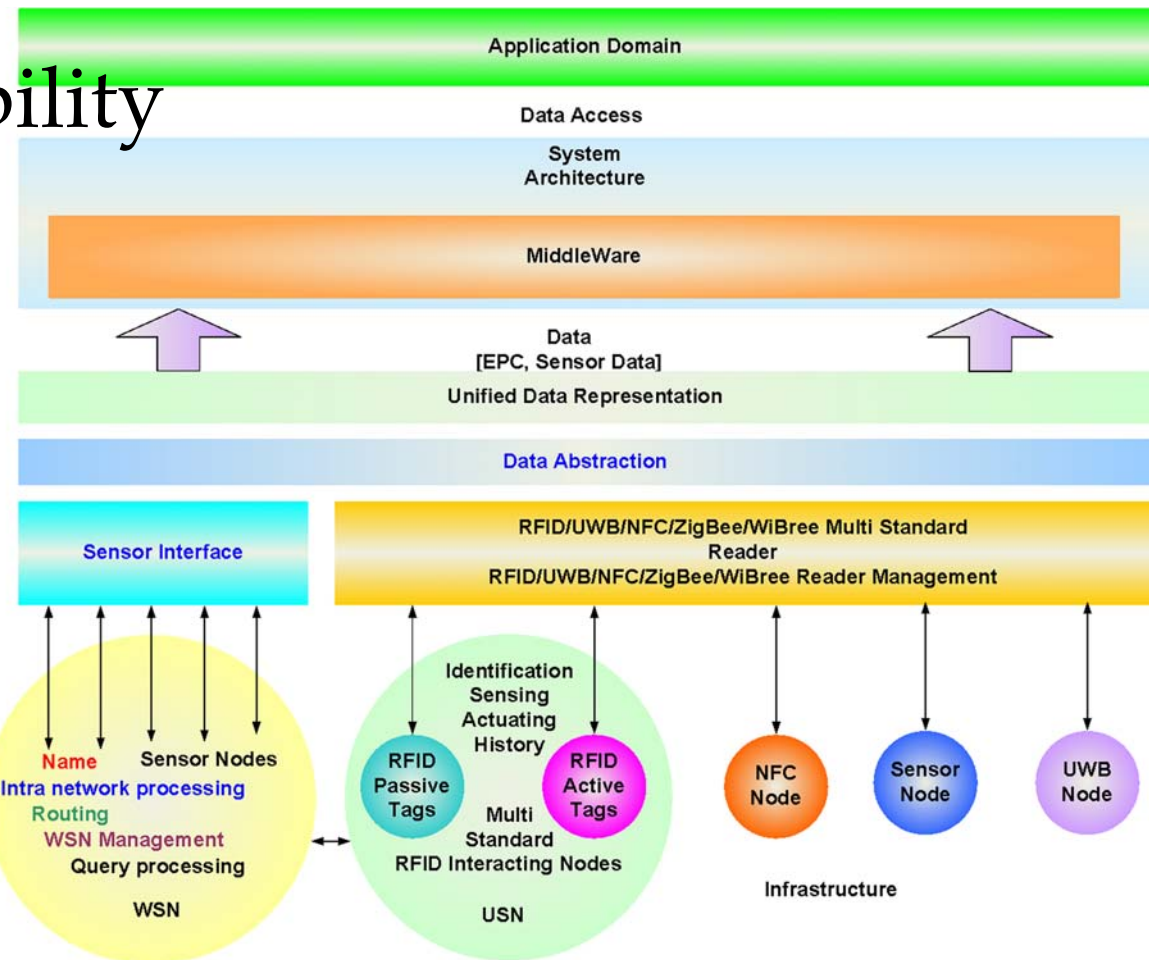
- ➔ Low cost, low power RFID systems can be integrated with other systems to obtain a suitable infrastructure for different applications
- ➔ Combining RFID standard with the existing standards such as: Wi-Fi, Zigbee, etc.
- ➔ Wireless Sensor Networks (WSN)
- ➔ Ubiquitous Sensor Networks (USN)

# Hybrid Networks

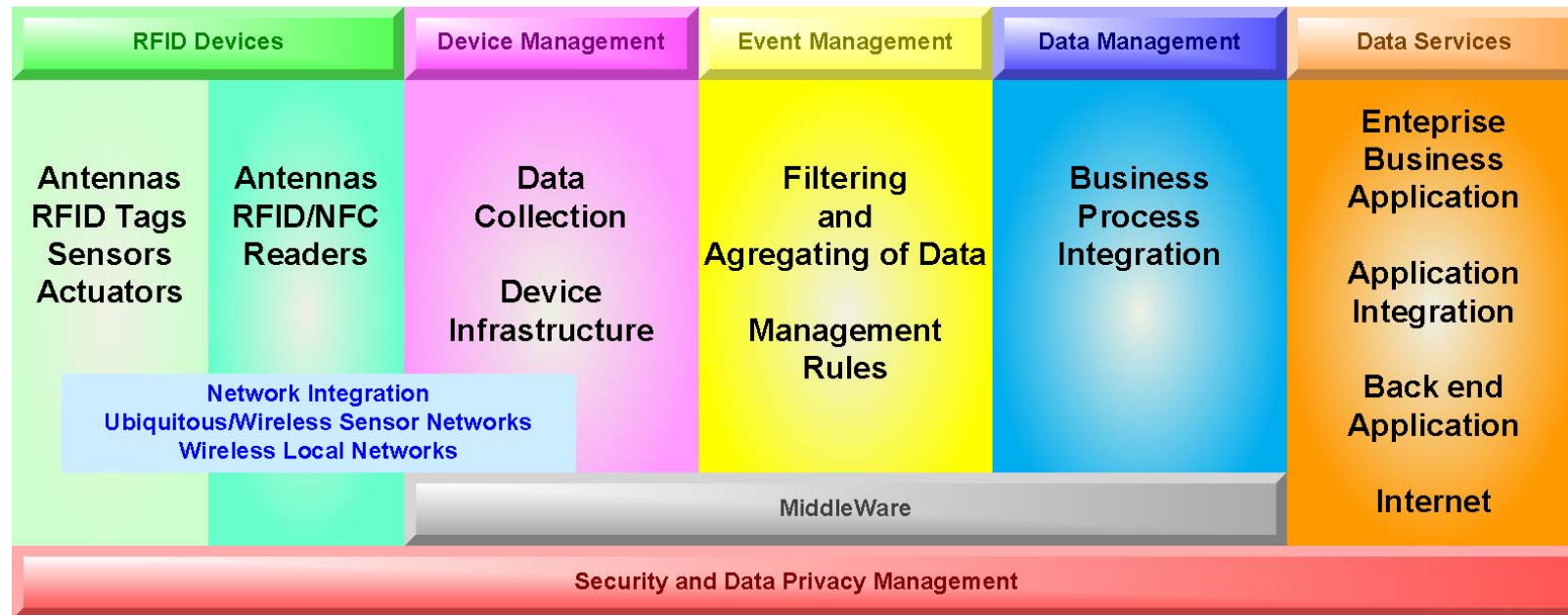
➔ Reconfigurability

➔ Scalability

➔ Modularity



# RFID End to End



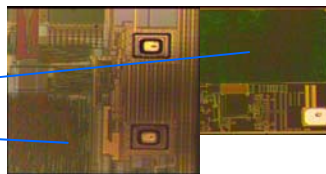
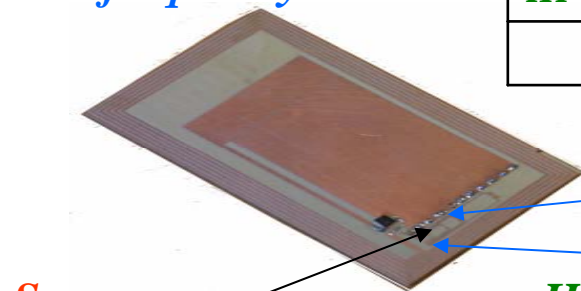
➔ RFID and Sensor Networks are a key enabling technology for building Ubiquitous Life

# IntelliSense RFID

- ➔ Develop technologies that make it possible to use the same RFID solutions in logistics and consumer applications.
- ➔ RFID Platform with sensor integration
- ➔ “One Global Sensing Tag”

*Multi frequency antennas*

HF (MHz)	UHF (MHz)	MW (GHz)
13.56	840-956	2.45



UHF

HF

CHALMERS MC2

IMEGO  
Applied Micro Sensor Systems

SINTEF

VTT



Session Technology Innovation  
15 November 2007



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# IntelliSense RFID

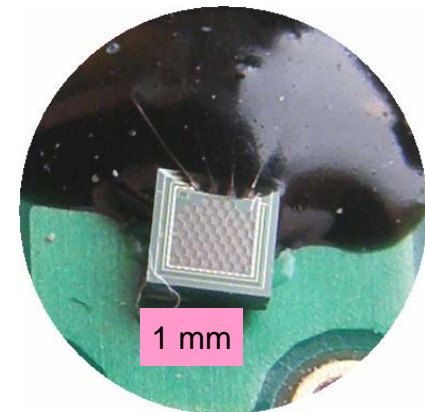
- ➔ Multi band antennas
- ➔ Multi protocol RFID chips (SenseASIC<sup>®</sup>)
- ➔ Passive and active RFID technology
- ➔ Multi sensing: Temperature, pressure, humidity, pH
- ➔ Mixed signal interface and sensors integration



Pressure    Temperature Sensors  
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Humidity Sensor



# Future Scenarios

- ➔ EPC global philosophy aims at developing and disseminating ultra low cost tags with very limited features. The information is centralized on data servers managed by service operators. Value resides in the data management.
- ➔ Add more functions into the tags bringing local services and added value to the tag itself. Smart sensing RFID devices. Smart systems (sensing/monitoring/actuating) on RFID tags.
- ➔ Distributing the information both on centralized data servers and on the intelligent sensing RFID tags and develop the network infrastructure for communication. Smart (sensing/informing/doing) RFID devices and efficient network infrastructure.



# Challenges

- ➔ Environmentally independent Smart RFID Tags (metal, liquid environment)
- ➔ Smart tag networking (inter tag communication and self organising/ad hoc sensor networks)
- ➔ Advanced power supplies (fuel cells, polymer batteries, battery less and self powering/energy harvesting)
- ➔ Real time localisation and tracking
- ➔ Data security (energy efficient encryption technology)
- ➔ Higher frequencies (enhanced positioning resolution, smaller antennas, compact mobile readers)
- ➔ Low power, large capacity memories
- ➔ Communication protocols technologies (low power, bandwidth efficiency)
- ➔ Printable electronics (polymer electronics)

# Challenges for Next Generation

➔ Both mommy and I wear these tracking devices. Nuts!



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