

An evolvable Network of Tiny Sensors (ANTS)

for Public and EPC Sensor Network

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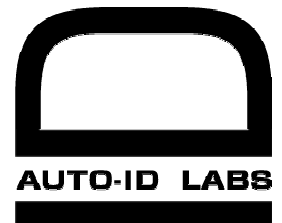
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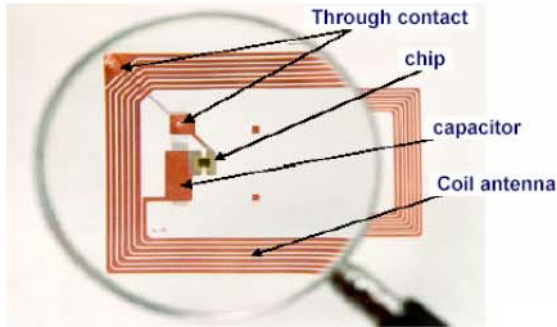
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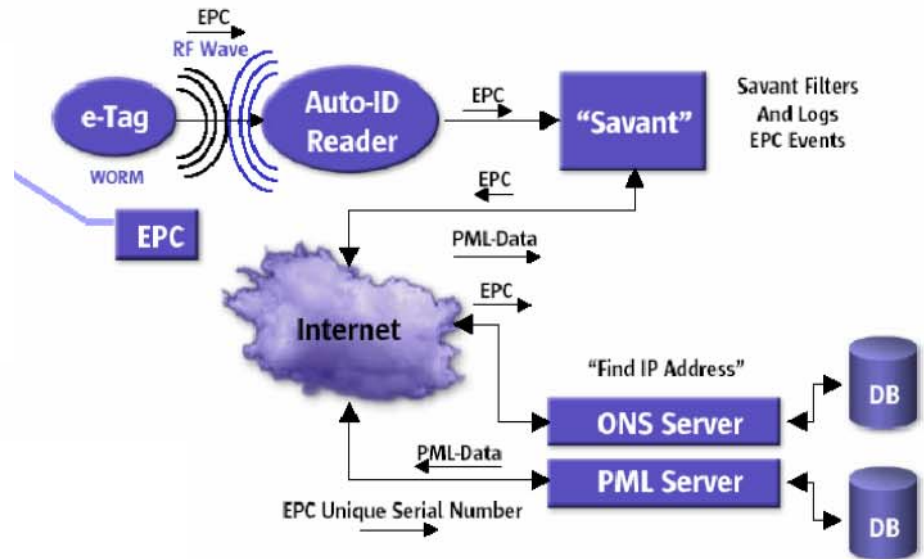
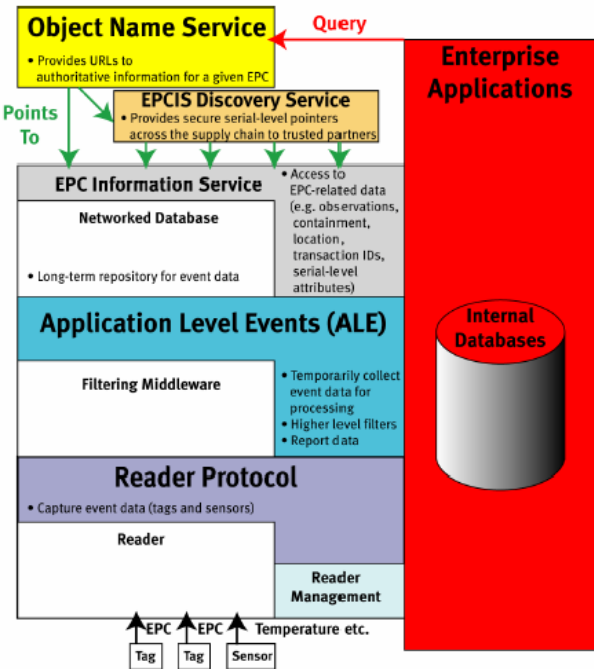
Contents

- What is Ubiquitous Sensor Network?
- ANTS and Public Sensor Network
- Auto-ID Labs and EPC Sensor Network
- Conclusion

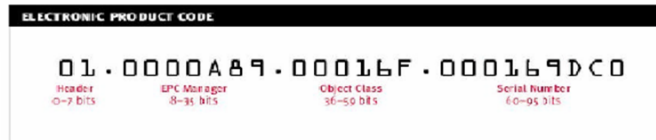
EPC RFID Network Architecture



1. Reader scans and read the EPC
2. Send Data to a computer running middleware
3. Filter Data
4. Query ONS (Object Naming Service)



5. ONS database maps the EPC to a URL
6. URL points to the location where information is stored using PML

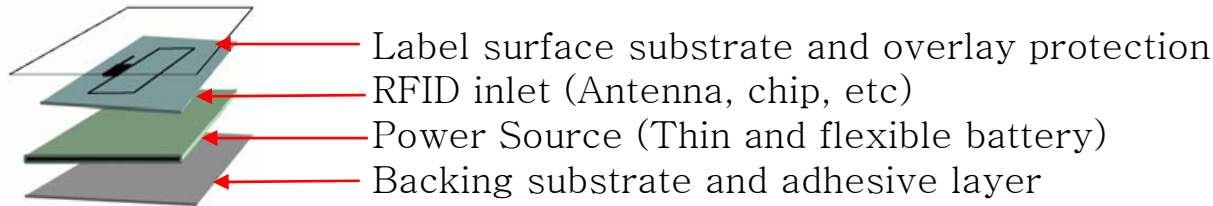


Active Tags

- Battery assisted Long-range Active Tag (eg. Savi)
 - 433.92MHz, 27.8 kbps, 0.6mW, 100m (UHF transceiver)
 - 123KHz, 3.65m, Wake-up LF receiver
 - Lifetime 5years, active twice per day
 - 128KB memory, -30 ~ 70 degrees operating environment

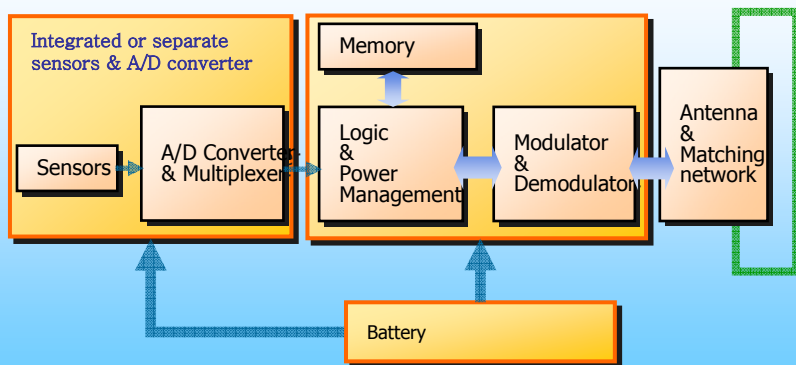


SAL (Smart Active Labels)

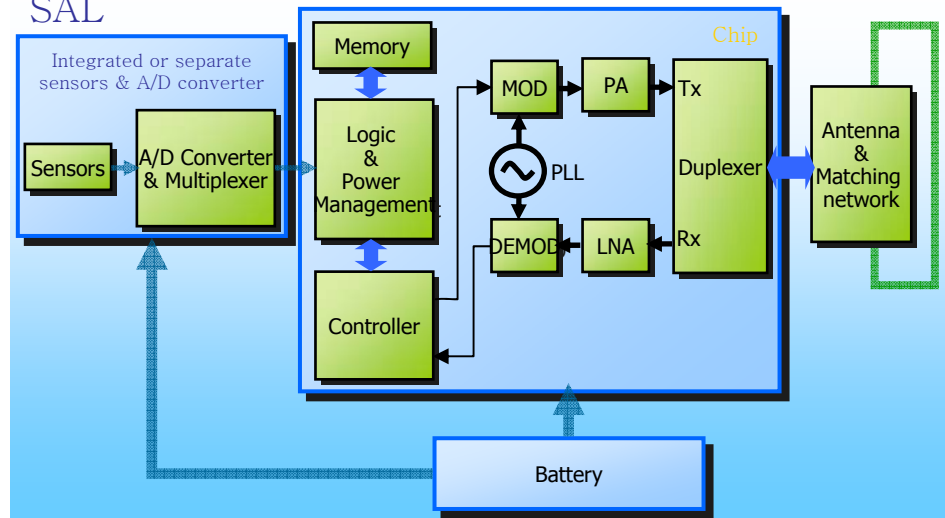


- SAL : Thin and Flexible Labels having an IC and power sources
- Started from early 2002, now has 17 companies
 - Power Paper, Graphic Solutions, KSW microtec, etc
 - 4 sub-working groups: Standard, Technology, User, Demonstration
- Targeting SAL with temperature tracking first

Semi-SAL

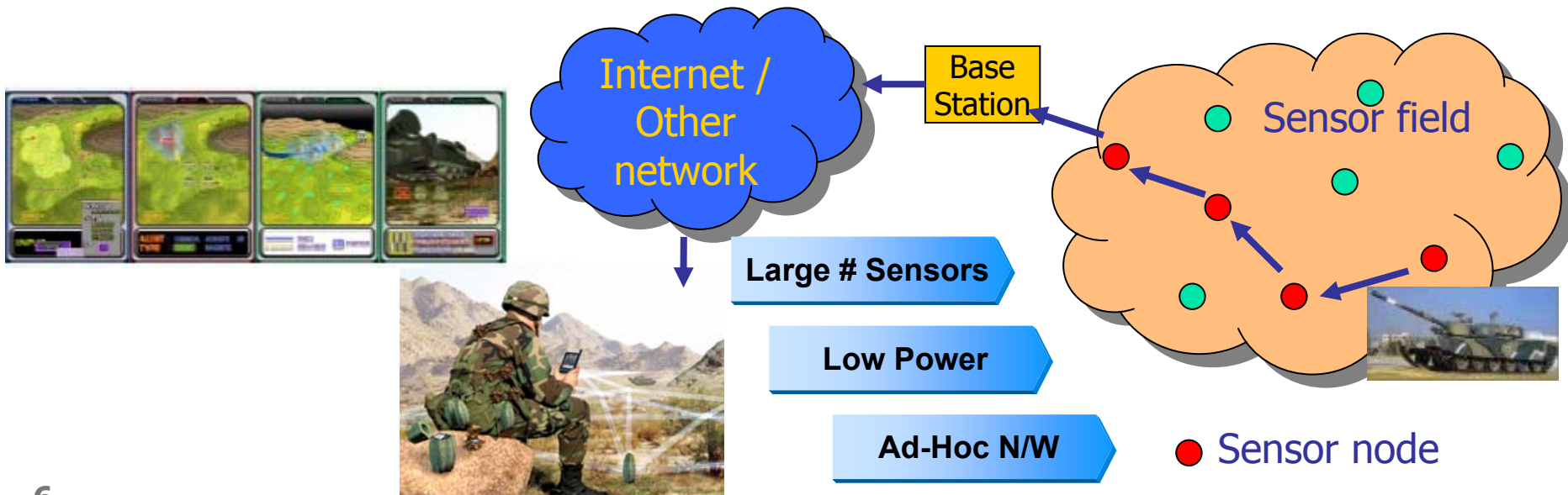
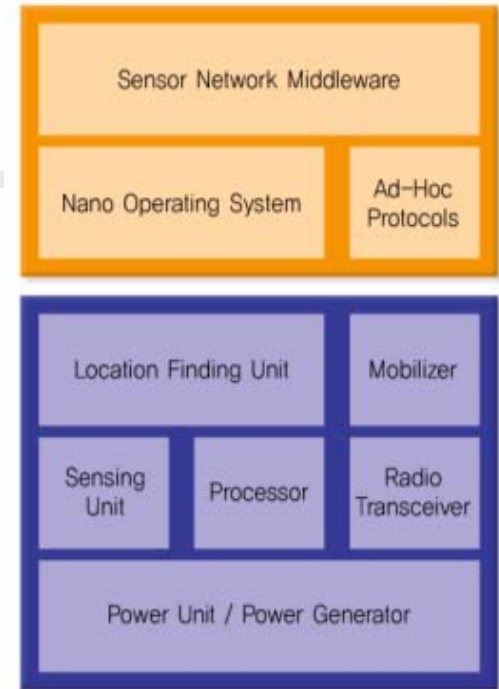


SAL



Sensor Networks

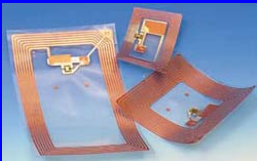
- Network of **sensor nodes** with **computation** & **sensing** & **wireless communication** capabilities
- What we can do with Sensor Networks?
 - Sensing(Actuation) : Motion->Image->Classifier
 - Collaboration : Estimate moving direction & speed
 - Mobile Sensors : Tracking



RFID meets Sensor Network

RFID Research

Sensor Network Research



History

(Read/Write)

Automatic Identification

(Read)

Passive RFID



Battery

(Long range)

Active RFID



Sensors

(Sensing)

Smart Active Label



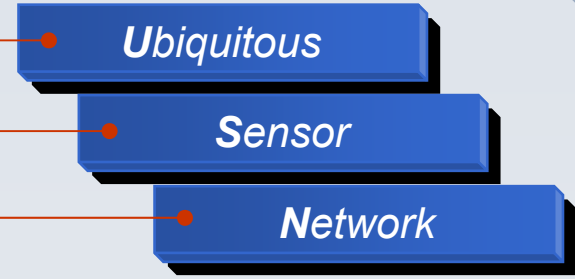
Smart Sensors

(Ad-hoc network)

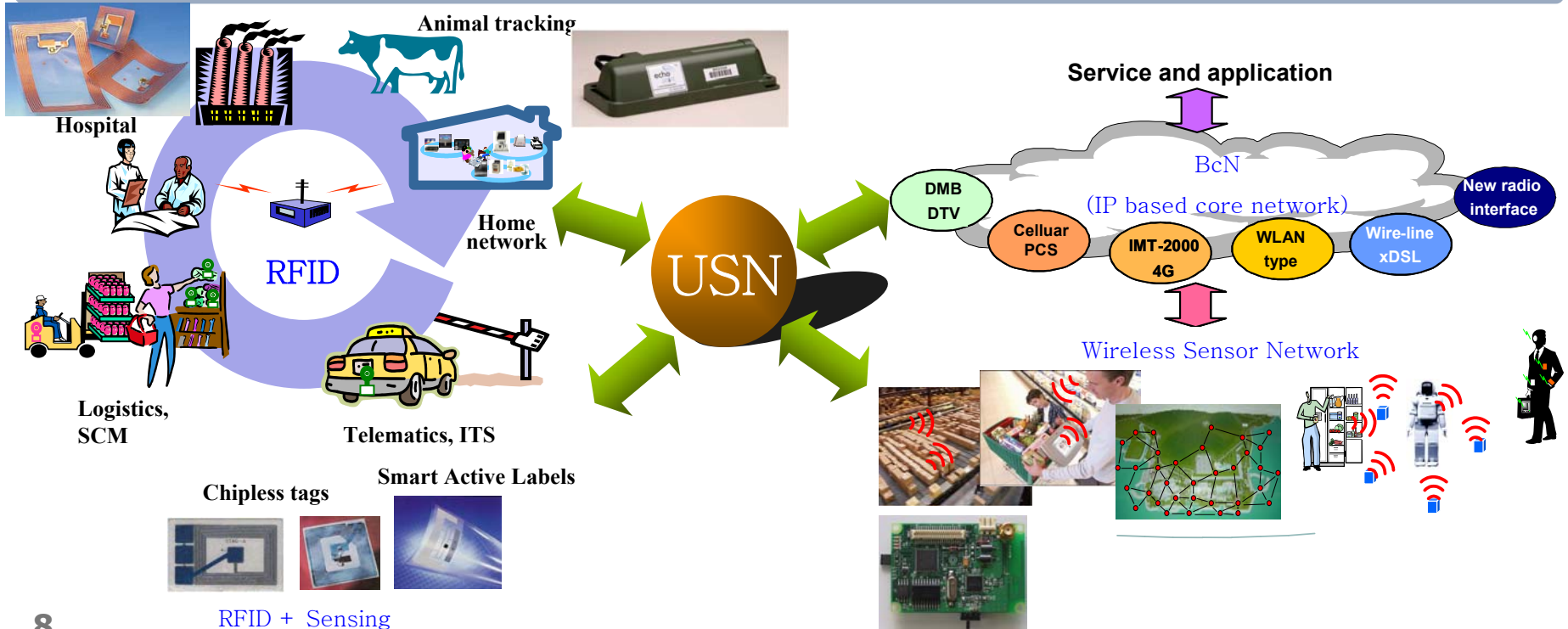
Sensor Network

Ubiquitous Sensor Network

- Everywhere, everything with RFID tags
- Sensing ID and environmental information
- Providing services via network



Read Only **RFID** → Read/Write **RFID** → Sensing **USN** → Networking **USN**



Vision of Korean IT839 Strategy

IT839 Strategy

A master plan for the IT industry, in an effort to gain more growth momentum from the IT sector in Korea.

Introducing and promoting 8 Services

- 2.3 GHz mobile Internet (WiBro) **8**
- DMB service
- Home network service
- Telematics service
- **RFID** based service
- W-CDMA service
- DTV service
- VoIP service

Building 3 infrastructures

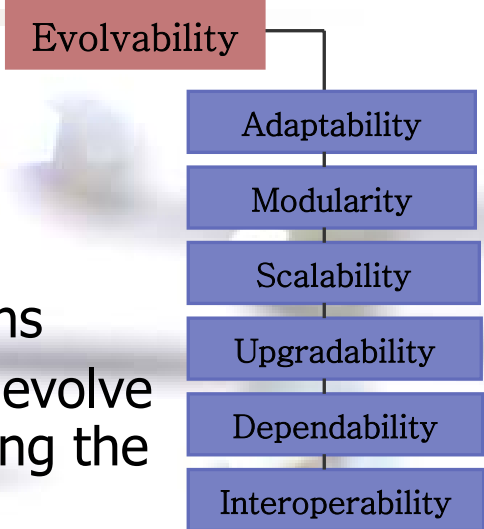
- 3**
- BcN
(Broadband Convergence Network)
- **USN**
(Ubiquitous Sensor Network)
- IPv6

Developing 9 IT New Growth Engine

- NG Mobile Phone **9**
- Digital TV
- Home Network
- IT SoC
- Post PC
- Embedded S/W
- Digital Contents
- Telematics
- Intelligent Robot

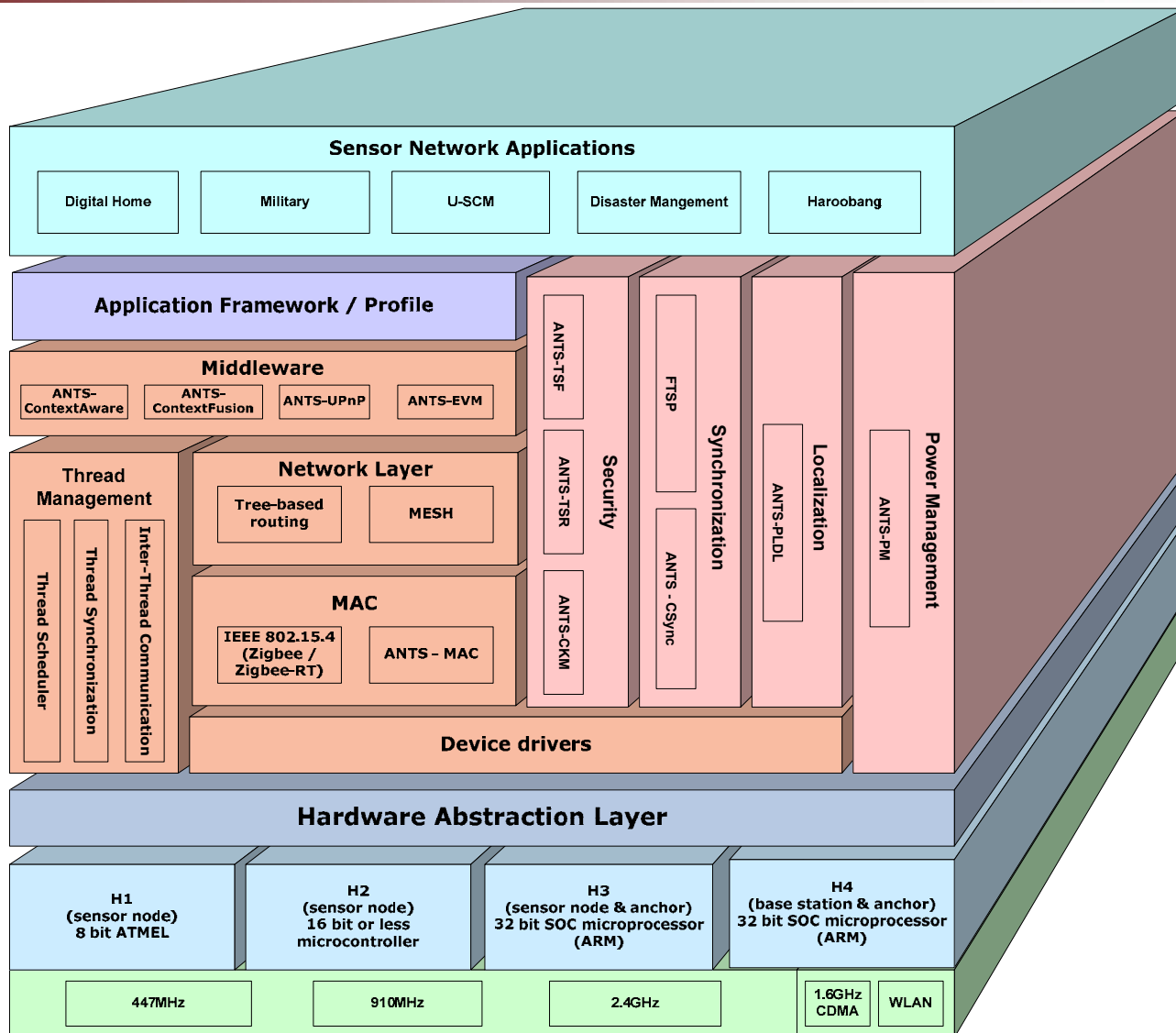
Evolvability in Sensor Networks

- Sensor networks will populate the world as the present Internet does
- Facing a deeply dynamic Future. We need *evolvability*:
 - Adapt to new environments and applications
 - Support of present tendencies and able to evolve according to market innovations, anticipating the future



ANTS Functionality	Evolvability Relation
<i>Hardware</i>	<i>Adaptability</i> (different nodes for different requirements), <i>Modularity & scalability</i> (component based), <i>Upgradability & dependability</i> (fault-tolerant dynamic upgrades), <i>adaptability</i> (by allowing HW and SW updates)
<i>Operating system</i>	<i>Adaptability</i> (different nodes for different requirements), <i>Modularity & scalability</i> (component based), <i>Upgradability & dependability</i> (fault-tolerant dynamic upgrades), <i>adaptability</i> (by allowing HW and SW updates)
<i>Network Architecture</i>	<i>Scalability</i> (with number of micro or macro nodes), <i>Interoperability</i> (providing easy access to gateways)
<i>Communication Protocols</i>	<i>Scalability</i> (with number of nodes) <i>adaptability & dependability</i> (to new or dead nodes and moving nodes or sub-networks)
<i>Localization</i>	<i>Scalability and adaptability</i> (for new generations of nodes) <i>dependability</i> (dead nodes, whichever reason)
<i>Security</i>	<i>Adaptability</i> (new trust values dependent on incoming traffic) <i>scalability & modularity</i> (new security option at applications level) <i>dependability</i> (activity values for dead nodes)
<i>Synchronization</i>	<i>Scalability & adaptability</i> (for new HPLs or LPNs)
<i>Context Awareness</i>	<i>Interoperability</i> (to other networks through BOSS), <i>adaptability & dependability</i> (delivering context data through a secondary context overly network), <i>scalability</i> (not dependent on size of network)

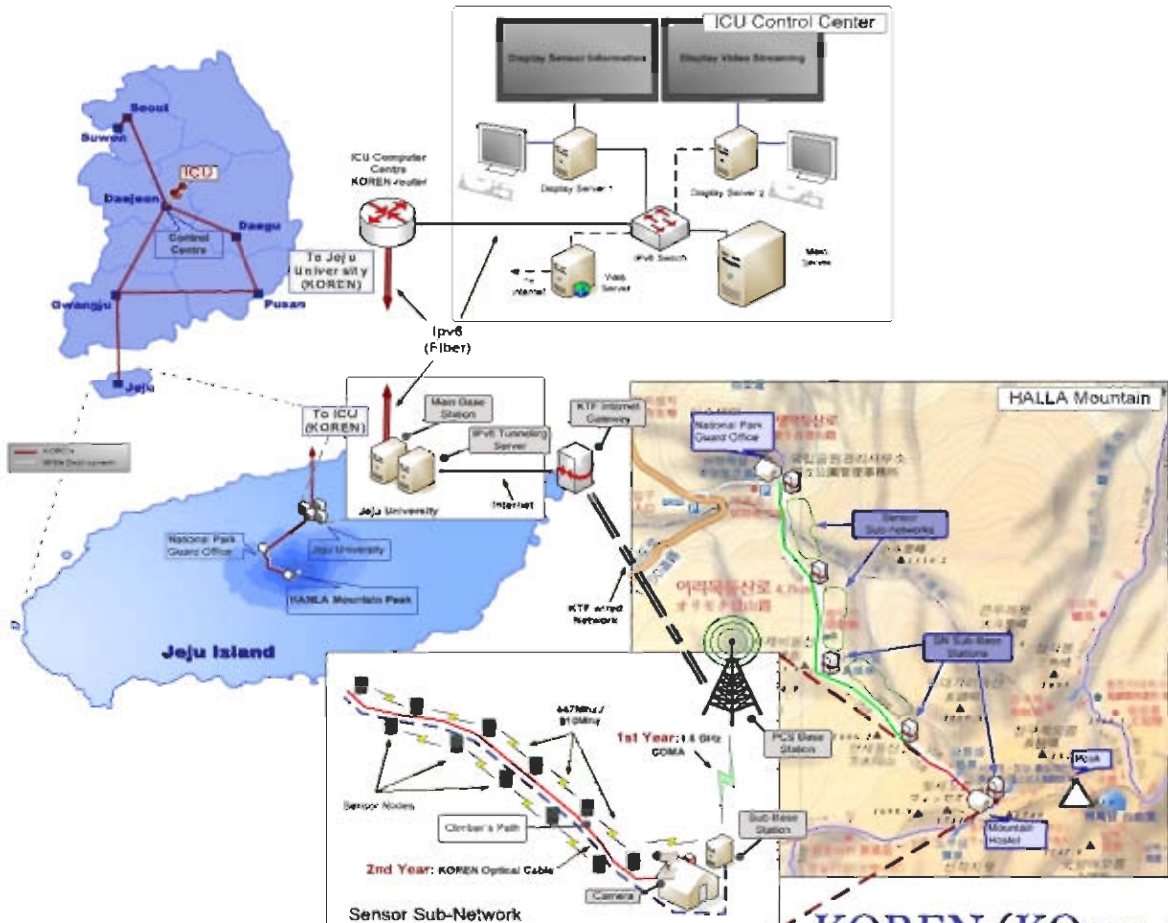
ANTS Hardware & Software Platform



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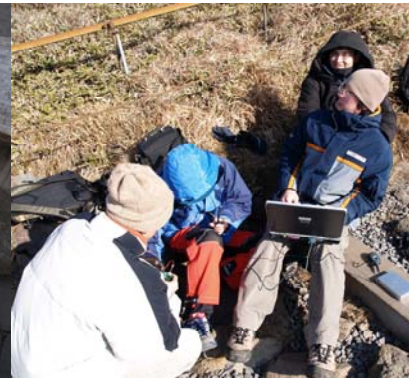
ANTS Pilot Project - Haroobang (Aug. 22, 2005 - Oct.31, 2006)



KOREN (KOREa advanced REsearch Network)

IPv6 USN BCN

ANTS Pilot Project – Haroobang for Disaster management & U-tourism



Field Test in Halla Mountain (1950m high) – Jeju Island

ANTS Pilot Project – Haroobang for Disaster management & U-tourism



**Test Site in Cheju University in Jeju Island
(Jan. 5, 2006)**

Auto-ID Labs Research Focus

**Business,
Application,
Privacy &
Security**

Fundamentally New Business Processes
(Payment, Leasing, Quality Mgmt, Factory Design,
Brand Protection, Grey Markets, Counterfeiting, etc)

**Networking &
Software**

System Architecture vs. Infrastructure
(EPC Sensor Network, NFC, Apps- versus Event-Servers)

**RF & Chip
Design**

From Class 1 to Class 5
(Memory, Semi-active, Active, Sensors, Wireless)

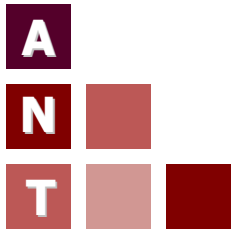
Basic Research

Deployment



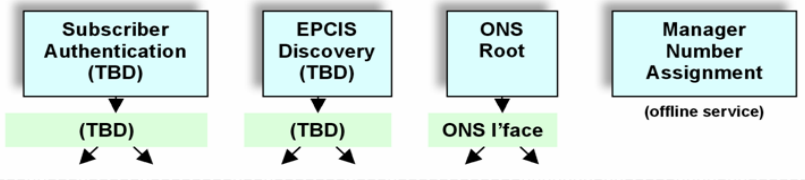
EPC Tag Classification

EPC Tag Class	Tag Class Capabilities
Class 0	Read only, (I.e., the EPC number is encoded onto the tag during manufacture and can be read by a reader, not written to)
Class 1	Read, write once (I.e., tags are manufactured without the EPC number which can be encoded onto the tag later in the field)
Class 2	Read / write / Higher functionality
Class 3	Class 2 capabilities plus a power source to provide increased range and/or advanced functionality, e.g., sensors
Class 4	Class 3 capabilities plus active communication and the ability to communicate with other tags
Class 5	Class 4 capabilities plus the ability to communication with passive tags as well

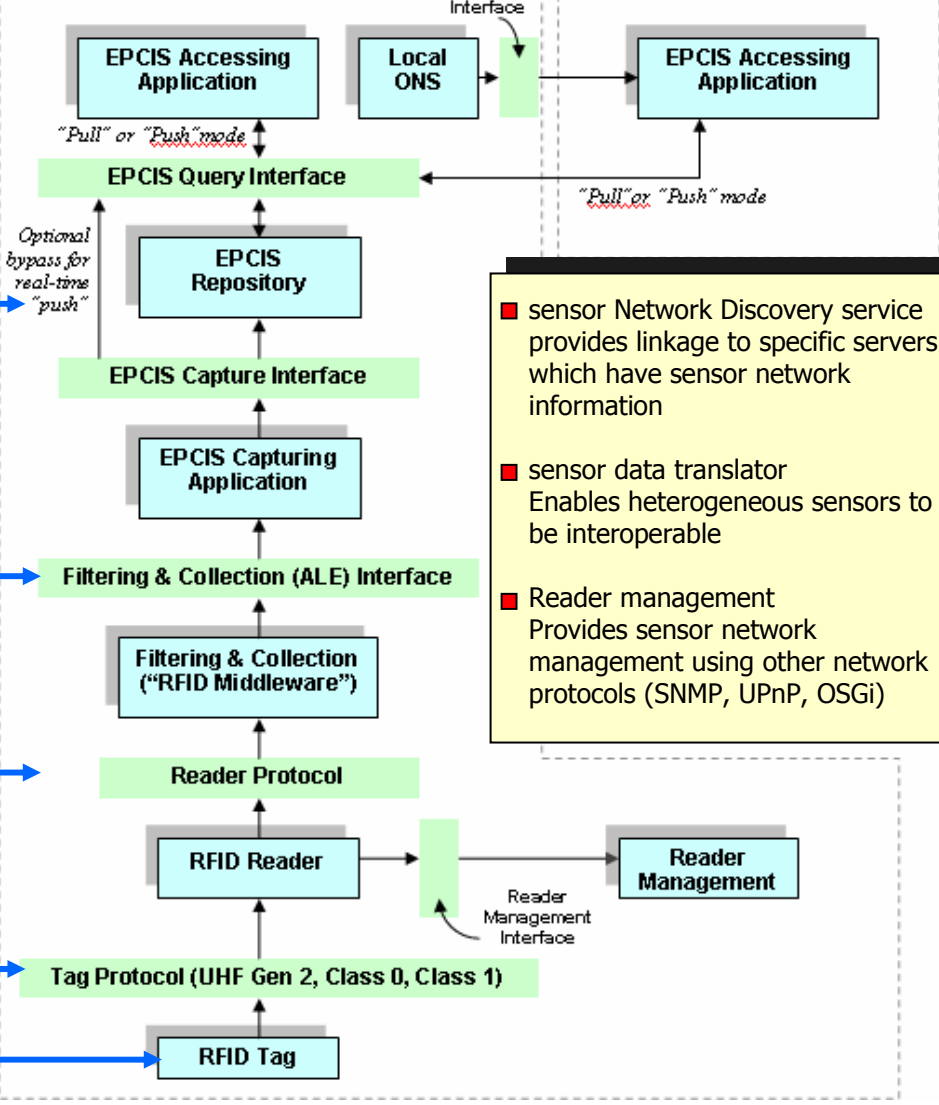


EPC Sensor Network Components

EPCglobal Core Services



EPCglobal Subscriber



- Link sensor data with corresponding master data to change it to valuable information
- Store and maintain updated sensor data with the help of EPCIS repository
- EPCIS provides decision point to react sensor data give commands to Sensor Tag actuator throughout backward communication channel

- Sensor data filtering & aggregation according to type, effective distance, periods, threshold, unit
- Sensor data accumulating (average, reliability)

- Sensor Event manipulation, Sensor Tag Selection
- Sensor data Smoothing
- Translate complex sensor data query from IS to Sensor Tag specific query/operation to inject into BS

- Sensor Identification Memory for Sensor data reading and sensor operation air interface

- Sensor Tag, Active Sensor Tag, Active Sensor Tag Network

- sensor Network Discovery service provides linkage to specific servers which have sensor network information
- sensor data translator Enables heterogeneous sensors to be interoperable
- Reader management Provides sensor network management using other network protocols (SNMP, UPnP, OSGi)

Conclusion

- RFID & Sensor Network is a key enabling technology for Ubiquitous Computing
- Emerging of new generation of Sensor Networks
 - Will change the paradigm of Ubiquitous Sensor Networks
 - New requirement: **evolvability**
- ANTS building a:
 - Complete architecture
 - Flexible and adaptable
 - Prepared for the future
 - *for Public and EPC Sensor Networks*