USN Technology in Korea and R&D in Auto-ID Lab Korea

Sang-Gug Lee
Auto-ID Lab Korea in ICU
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- **RFID/USN in Korea**
  - IT839 Strategy
  - R&D Thrust towards u-Korea
  - Public USN Concept
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  - Roadmap for USN R&D

- **Auto-ID Lab Korea**
  - Theme and members
  - Research focus
  - On-going research
  - Objective
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)
- DMB service
- Home network service
- Telematics service
- RFID-based service
- W-CDMA service
- DTV service
- VoIP service

Building 3 infrastructures

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

Developing 9 IT New Growth Engine

- NG Mobile Phone
- Digital TV
- Home Network
- IT SoC
- Post PC
- Embedded S/W
- Digital Contents
- Telematics
- Intelligent Robot
R&D Thrust towards u-Korea

Integrated Standard Technology of Embedded S/W ('05)

Low-power SoC for Interactive DMB ('06)

S/W Development of Digital Moving Picture Contents with Reality ('07)

Telematics Wireless Telecommunication Integration ('07)

Mobile RFID ('06) Sensor Tag/Sensor Node ('08)

Embedded Component Technology for URC ('08)

Telematics

RFID/USN

IT SoC

Digital Contents

Telematics

4G Mobile Com. ('07) High-speed WiBro System ('05)

Intelligence Integrated Information Broadcasting (SmarTV) ('06) Terrestrial Wave DMB ('06)

Next Generation Mobile Com. ('07)

Next Generation Internet Server ('06)

Wearable Computer ('07)

Home Network

Digital TV

RFID

Embedded SW

Post PC

Low-power SoC for Interactive DMB ('06)

S/W Development of Digital Moving Picture Contents with Reality ('07)

Telematics Wireless Telecommunication Integration ('07)

Mobile RFID ('06) Sensor Tag/Sensor Node ('08)

Embedded Component Technology for URC ('08)
Public USN Concept

- Everywhere, everything with RFID tags
- Sensing ID and environmental information
- Real-time monitoring & control via network

Ubiquitous Sensor Network

Tags
u-Sensor tags
Mobile RFID

BcN

Structural Health Monitoring
Smart Home
Pollution Surveillance

Mother Nature Surveillance
Supply Chain/Cold Chain Mgmt.
Port/Ship Management

Military
Agricultural Management

SCM
USN Applications

◆ Smart building
  ◆ HVAC control
  ◆ Lighting control
  ◆ Intrusion Detection

◆ Factory automation & monitoring
  ◆ Diagnosis (ex. Pole transformer monitoring)
  ◆ Prognosis

◆ Asset Monitoring and Management
  ◆ Inventory management
  ◆ Cold-chain supply management

◆ Structural Health Monitoring
  ◆ Cracks
  ◆ Vibration

◆ Environmental Monitoring
  ◆ Air pollution, earthquake
  ◆ Traffic monitoring system
  ◆ Ecological monitoring
### Roadmap for USN R&D

<table>
<thead>
<tr>
<th>Technology</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
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</thead>
<tbody>
<tr>
<td>u-Sensor Tag</td>
<td>900/433 MHz RFID Systems</td>
<td>Semi-active SAL - Temperature sensor</td>
<td>Fully-active SAL - Humidity, light, and chemical sensors</td>
<td>RFID/USN Test-bed</td>
</tr>
<tr>
<td>RFID Applications</td>
<td>USN Service Modeling</td>
<td>USN based telematics services</td>
<td>USN based telematics services</td>
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<tr>
<td>USN Applications</td>
<td>ex. Logistics, Smart Building, Tracking</td>
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<tr>
<td>USN Middleware</td>
<td>Location based context-aware middleware S/W</td>
<td>Intelligent context-aware middleware S/W</td>
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<tr>
<td>USN Networking and Configuration</td>
<td>Low power communication</td>
<td></td>
<td>High-powered sensor nodes</td>
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<td></td>
<td>Low power routing, Ad-hoc Networking</td>
<td></td>
<td>BcN Networking</td>
<td></td>
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<td></td>
<td>nano/micro/macro-sensor nodes</td>
<td></td>
<td>USN Service Modeling</td>
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<td></td>
<td>u-Sensor Gateway</td>
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#### Sensor Nodes
- **SoC node (MCU+MAC+RF)**
  - Big Coin size
  - 1,000+ node networking
- **Tiny nodes**
  - Small Coin size
  - 10,000+ node networking
# Auto-ID Lab Korea

## Theme: EPC network based Sensor Network Technology

### Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Research Area</th>
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</thead>
<tbody>
<tr>
<td>Sang-Gug Lee</td>
<td>Professor, Research Director</td>
<td>RF/analog chip design</td>
</tr>
<tr>
<td>Daeyoung Kim</td>
<td>Assistant Professor, Associate Research Director</td>
<td>Sensor network H/W &amp; S/W, EPC middleware</td>
</tr>
<tr>
<td>Jae Jeong Rho</td>
<td>Associate Professor</td>
<td>Business model, SCM</td>
</tr>
<tr>
<td>Kwang Jo Kim</td>
<td>Professor</td>
<td>Cryptology and information security</td>
</tr>
<tr>
<td>Seong-Ook Park</td>
<td>Associate Professor</td>
<td>Antenna, microwave system</td>
</tr>
<tr>
<td>Hyuck Jae Lee</td>
<td>Professor</td>
<td>Anti-collision, communication system</td>
</tr>
<tr>
<td>Hyun Cheol Park</td>
<td>Associate Professor</td>
<td>Modem algorithm, base-band</td>
</tr>
</tbody>
</table>
Hardware and communication technology for EPC-based next generation USN

Hardware structure design, low power, high reliability air interface network protocol, etc. for the implementation of EPC class 2, 3, 4, and 5
Research Focus – 2

Middleware technology for EPC sensor network

Development of information expression/management structure of EPC class 2, 3, 4, and 5, internet-based real-time high capacity data search and processing technology
Research Focus – 3

EPC RFID/USN security and privacy protection technology
Tag anti-counterfeiting and privacy protection, light weight cryptography for data security, key management and distribution, authentication protocol, etc.

Business Model Development Framework and Application Service Development for RFID/USN
Development of next generation standard-based application service business model framework
Air Interface for Ad-hoc Active Tags

- **IEEE 802.15.4a Impulse Radio Development**
  - Transceiver: Impulse radio chip
  - Modem: synchronization algorithm
  - MAC: raging, localization

- **Reactive u-Radio Technology**
  - Radio-based wake-up circuits, low power MAC/network
Based on EPC Architecture Framework

Can EPC Architecture Framework support class 3, 4, 5?

Changes will be required!!
Security & Privacy for RFID/USN

RFID
- Data confidentiality
- Tag Anonymity
- Data integrity
- 1-way/Mutual authentication
- Light-Weight (CRC and Hash)-based authentication protocol

Ubiquitous Computing Environments
- User Privacy Protection
- Authentication
  - Users, Devices, Messages
- Authorization
  - Role-based Access Control
  - Context-based Access Control
- Availability
  - Prevention of Denial of Service Attacks
- Data Security
  - Confidentiality
  - Integrity
  - Cryptographic key management & distribution
- Light-Weight Cryptographic Protocols
  - Symmetric & Asymmetric Schemes
  - Hash Functions & Digital Signatures
- Secure EPC network architecture

RFID/USN Applications
Supply Chain, Traffic Information, Transportation, Food, Location Finding, Identification card, Agriculture, Military, etc.

Confidentiality, Authentication, Anonymity, Traceability, Anti-Hacking


Low-Cost (< $5) Cryptographic Primitives
Sym. Crypt. e.g. TEA, Asym. Crypt. e.g. NTRU, Hash e.g. MD5, PUF, RNG e.g. NFSR

Risk Analysis and Security Model
EPC Sensor Network Standardization

Business Model and Privacy/Security
(USN Business Model/Service, USN Privacy/Security)

System/Software Architecture
(EPC Sensor Network Architecture)

IEEE 1451, SAL-C, EPC Class 4 / Class 5
(Sensors, Wireless)