uID Architecture

an Open Foundation for Ubiquitous computing

Ken Sakamura, Ph.D.

Professor, the University of Tokyo

Director, YRP Ubiquitous Networking Laboratory (UNL)

Chair, T-Engine Forum / uID Center

Ubiquitous Computing Technology

- **Very interesting and useful technology**
- **Conventional Usage Pattern:**
  - Closed, proprietary solution in a single organization
- **Our Approach (uID Architecture)**
  - Not limited to a single organization
  - Open Standard
  - Works across organizational boundary and national boundary

Beneficiaries of uID Architecture

- The benefit of RFID technology is shared among producers, distributors, and end-consumers and people beyond simple Supply-Chain Management (SCM)
- Food Traceability Experiment
  - later explained
- Medicine Traceability Experiment
  - later explained

Outline of Today's Speech

1. Basic uID Architecture
2. Wide applicability of open uID Architecture
   - Exemplified by many feasibility study experiments
3. Comparison of approaches taken by uID Architecture / EPCglobal

Basic uID Architecture

- The objective of uID Architecture is to recognize many objects and places in our surrounding

"Context Awareness"

Context Awareness:
Recognizing many objects and places

- Identifying something so that you can tell that it is differentiate from others
- To make machine identification easy, we store a unique identification number (ucode) in a tag and place it on an object or a location
- cf. In our approach, creating and managing the unique number is very important
  - This is why we have uID Center to manage such requirements

Comparison to Barcode

- Similar existing system: optical barcode

1～2：Country Code 3～7：Organization code 8～12：Product code 13：Check Sum

uID vs. Barcode

- The value of barcode is semantic
- The value can tell us
  - the country of origin
  - the organization of origin
  - product classification code
    - and serial number sometimes

  by merely looking at it
- Different packages of a same product line from a company are likely to carry

Barcode is semantic

- It has internal structure
- SAME Barcode
  if serial/model number is not part of barcode
  - Semantic code: policy issues arise because allocation must conform to the imposed internal structure
  - We can't easily allocate unused code space of a country to the others

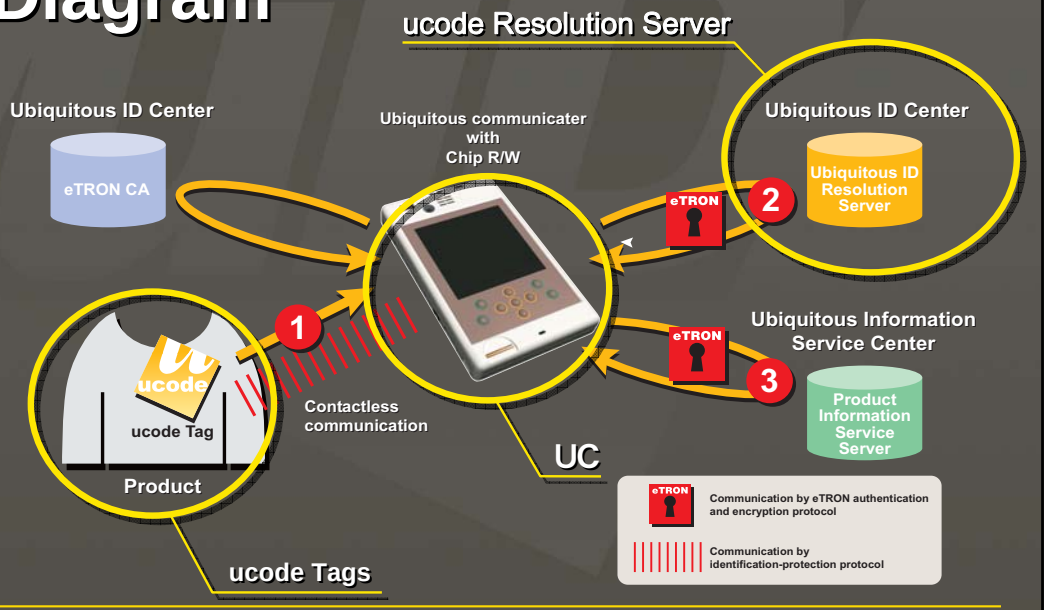
ucode: non-semantic code Mere Identifier

- The value of ucode is a simple identifier
- The value alone can't tell us much
- Only thing we know about it is its UNIQUENESS
- That is, the value is used only once

Short Summary:

- The value of barcode is semantic
- The value of ucode is a simple identifier

Basic uID Architecture Diagram

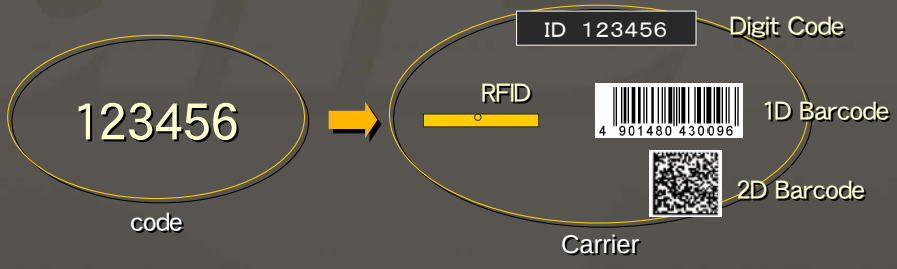


uID Architecture

1. We put a unique identifier (ucode) into tags
   - The tag can an RFID tag and optical tag as well
2. Reading of ucode by UC Terminal
3. Resolution: UC learns the position of Information Server
4. Information acquisition: UC fetches data associated with the ucode
5. Display of fetched data on the screen or an audio output on UC

RFID is not essential for uID Architecture

- Tags can be non-RFID, say, Optical 2D barcode system



- Optical barcode is important for inexpensive products

Features of uID Architecture

- ucode is a simple identifier, and its value doesn't carry meaning
- By using servers via network, we can obtain the information associated with ucode from an information server
- This is the basic operation of uID Architecture

Promotion of uID Architecture

T-Engine Forum and uID Center

T-Engine Forum

- Established T-Engine Forum in 2002
- T-Engine Forum is a non-profit Organization
- Achievements:
  - many feasibility experiments in Japan
- Current status:
  - Close to 500 members world-wide
  - Executive members from outside Japan: Korea, USA and Europe
- T-Engine Forum partners:
  - R&D people in China, Korea, Singapore, Thailand, Vietnam, Australia, and India have begun working with T-Engine Forum

uID Center

- Established uID Center within T-Engine Forum in 2002
- T-Engine Forum and uID Center promote uID Architecture as OPEN standard for everyone in the world
- World largest organization in Ubiquitous Computing field.

Video

World's Smallest RFID Tag

- **Very small and low-cost RFID chip**
  - Cost: under 10¢
  - Size: 0.4mm x 0.4mm
- **Only memory-function (read-only)**
  - It can store up to 128 bits of information.

FRAM Tag

- **FRAM RFID chip**
  - It has 2Kbyte non-volatile rewritable memory area.
- **Features of Ferroelectric RAM**
  - High-speed access
  - High-frequency re-writing, and
  - Low-energy consumption

Active Tag made by UNL

- **DICE: active tag**
  - Weak radio signal communication
  - Anti-collision function to discern 1,000 DICEs in vicinity
  - Power Source: Solar cell and MEMS generator

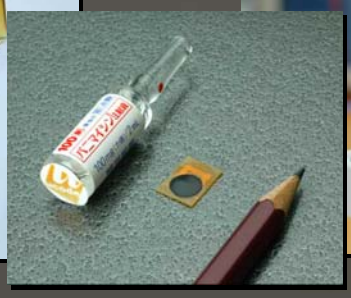
- **Application**
  - Inventory management, tracking of goods during transportation

Endless Applications of uID architecture

Free Mobility Assistance Project

Food Traceability Project

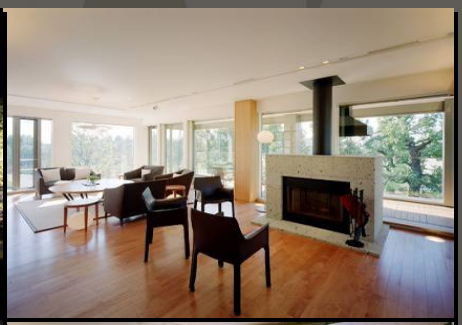
Medical Drugs Traceability



Ubiquitous Computing Project in Hospital




TRON House Project

SCM for Agricultural Produce

Tracing Insecticide Usage

Container Location Management in Warehouse

Recycling Project of Copier Toner Cartridges

Video Summary

- Wide scope of applications of uID Architecture
- Many feasibility study experiments to prove the usefulness of uID Architecture → on-going

uID Architecture / EPCglobal: Different Target and Scope

- **EPCglobal: Only meant for SCM, and for Wal-Mart principally**
- **uID Architecture:**
  - Wide Variety of Applications:
    - SCM
    - Traceability Experiment
    - Location Information Systems to help the aged/handicapped/travelers
  - Wide Variety of Beneficiaries:
    - Producer, distributor, end consumers in SCM
    - The aged, the handicapped and travelers in Location Information Systems, etc.
    - Many more

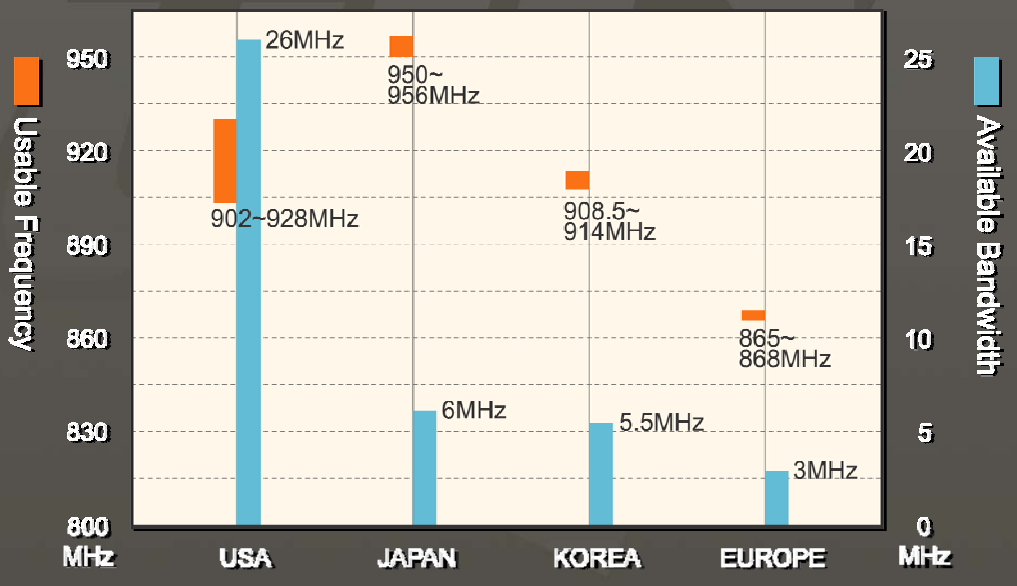
uID Architecture / EPCglobal: TAG difference

- **The limitation with EPCglobal tag**
  - EPCglobal tries to use a single tag that uses UHF 900MHz frequency
- **Problem:**
  - 900 MHz is not easily usable in other countries in Europe, Japan and elsewhere
  - single frequency approach doesn't work in the presence of goods that has metal component or high water contents
  - EPCglobal tag is large and not appropriate for certain applications uID Architecture covers
- **uID Architecture assumes the existence of many tags from the start → It is a given**

Details of Frequency band Issues

- Using 900 MHz frequency range is problematic outside USA since the regulation limits the available bands
  - Japan 6 MHz wide (950~956MHz)
  - Korea 5.5 MHz wide
  - Europe 3 MHz wide
- USA has 26MHz wide available bandwidth (902~928MHz)
  - The regulations are imposed for co-existence with mobile phones and other radio equipment devices
- EPCglobal tags may work well in USA, but does it elsewhere?

UHF TAG OF FREQUENCY USE



Application of Ubiquitous Computing in Housing

Concluding Remarks

- Ready for joint research and development proposal
- T-Engine Forum has been joined many members in the world
- We intend to promote this open uID architecture
- Please join us if you are interested

URLs

- For further information

http://www.ubin.jp

http://www.t-engine.org

http://uidcenter.org