Challenges Towards the Ubiquitous Network Society

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A big picture

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Quiz of the day

What is the latest ICT strategic plan in Japan?

From e-Japan to **u-Japan**

Creating Ubiquitous Network Society
Japanese R&D Trends

- National R&D Projects
  - Ubiquitous Networking Project (2003-2008, 5 years)
  - Network Robots Project (2004-2009, 5 years)
  - Sensor Network Project (2005-2008, 3 years)

- Industries
  - Ubiquitous Networking Forum (2002- )
  - Network Robots Forum (2003- )

- Academia
  - IPSJ: SIGUBI (SIG on Ubiquitous Computing Systems)
  - IEICE: URON (Ubiquitous Real-World Oriented Networking)
  - IEICE: Sensor Networking

Outline

- Image of Ubiquitous Network Society
  - Small Stories in 2008

- Smart Space Project
  - What is a Smart Space?
  - uService and uMobile architecture
  - Smart Furniture

- Future Challenges
  - Creating Ubiquitous Services Everywhere

- Summary
Image of Ubiquitous Network Society in Japan: Small Stories: A Love Triangle

RFID on tongue

- Use of RFID for Vending Machines and JR
Context-aware Vending Machine

- Context-aware Advertisement Mirror Display

Purchasing DVD contents into T-shirt

- Shopping by RFID tag
- Downloading DVD content
- Playing DVD on T-shirt
Context-aware & Presence service

- Push-type Info. Service
- Live Info.
- Presence Service
- Property Information

Ubiquitous Services and Applications

- **Service type**: any- vs. only-type
  - At anytime, anywhere, for anyone
  - Only now, only here, only for me/us

- **Ubiquitous Services & Applications**
  - Mobile e-Commerce by RFID
  - Context-aware Vending Machines
  - Context-aware Information Services
    - Presence Service for your friends
    - Push-type information service
Challenges in Creating Ubiquitous Services

- Integrating Real- and Cyber-spaces
- Connecting non-IT objects and IT objects
  - Correlation and fusion of atom and bits
- Creating new services by integrating non-IT and IT Services

What is a Ubiquitous Network?

- A **Ubiquitous Network** is an information and communication network which enables people to access networks, terminals, services and contents at any time or place in a seamless, easy, safe and natural way.
- It realizes **Freedom** from
  - space and time
  - in selection of networks, terminals, services and contents
  - network risks
  - constraints in networking real objects
  - capacity restrictions
Ubiquitous Networks  (c) Ubiquitous Networking forum

Smart Space Development
- our first experimental space -
What is Smart Space?

We mean ...

**Smart Space** is an information environment where every object is connected to networks seamlessly and support for human activities.

Smart Space Project

- Creating a smart environment where many appliances, embedded devices and sensors are seamlessly connected for
  - Human-to-Human
  - Human-to-Object
  - Object-to-Object Communication and Collaboration
Smart Space: UbiComp Environment

Various Smart Spaces in Size

- Smart Room, Office, House
- Smart Car, Train
- Smart Building, Factory
- Smart Campus
- Smart Town, City
- Smart Forest
- Smart Nation
- ...and more
Related Research Projects

- Computing Environment
  - Ubiquitous Computing (M. Weiser)
  - Pervasive Computing
    - IBM PIMA (Platform Independent Application Model) Project
  - Proactive Computing (D. Tennenhouse)
  - Sentient Computing (A. Hopper)

- Smart Information Environment
  - Cooltown (HP Lab.)
  - EasyLiving (Microsoft Research Inc.)
  - UCB Endeavour, MIT Oxygen, CMU Aura…
  - Active Space, Aware Home, …
  - STONE room, SS Lab., …

Building a Smart Space Lab.
Smart Space Lab. (2000)
Problems!

- Space and Time Limitation!
- Cost factor!!!
  - Physical structure was designed for the specific place by the professional architect
  - We cannot demonstrate ubiquitous applications outside of the SS Lab.
  - SS Lab. is not for Open Space.
Smart Space Classification

Real space

Cyber space

uService and uMobile

uService: Ubiquitous Services, embedded networks and devices

uMobile: Wearable and embedded devices
uService: Smart Furniture

Creating Ubiquitous Services
- Private Space
- Public Space

Consists of
- Computing
- Communication
- Sensing
- Actuation

uMobile Examples
Context-aware Ubiquitous Services with Smart Furniture

Smart Lamp
ZSA: A Secure Library System
Service Roaming
u-Photo

Smart Lamp: Environmental Monitor

- Ambient technology
  - Encode Sensor data to Colors
- Coordination with Sensors in Surroundings
  - Number of People
  - Weather Information
  - Network traffic
SF-2: Smart Lamp

- **Context Sensors**:
  - e-code spider
  - RFID tag

- **Context**:
  - No. of People in a room
  - Status of demo programs

- **Adaptive Action**:
  - Display number of people
  - Display different colors

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Personalized Message Board

- **Context sensors**:
  - RFID tag + e-code spider
  - PDA + Wireless LAN

- **Context**:
  - A range of age, sex
  - User’s location

- **Adaptive Action**:
  - Pushing adaptive ad messages
PPNP (Privacy Profile Negotiation Protocol)

- Adjusting Data granularity
  - Protecting private information against public servers

- P3P/APPEL (W3C)
  - Platform for Privacy Preference Project
  - A P3P Preference Exchange Language
  - Service Level
    - L3: do_service(A, B, C)
    - L2: do_service(A, B)
    - L1: do_service(A)

ZSA: A Secure Library System
Basic Assumptions (1)

- Binds objects to users
- Serialized user mobility model for checking the feasibility of non-stop authentication

Service Roaming
Challenges !

Hardware Issues
- Open HW Platforms for uService & uMobile
- Self-Configurability & Reconfigurability
- User Friendliness & Unitrusiveness

Software Issues
- Context Aware Middleware
- Service Roaming & Integration
- Personalization and Privacy Protection
- Smart Hot-Spot Networking
- Time-Space Coordination

Summary

- Challenges in creating Ubiquitous Services Everywhere!
  - Integrating Real- and Cyber-spaces
  - Connecting non-IT objects and IT objects
    - Correlation and fusion of atom and bits
  - Creating new services by integrating non-IT and IT Services
- Realizing Ubiquitous Computing Env.
  by creating Smart Space Everywhere!
  - Smart room, home, car, train, campus, smart env.
  - Smart Furniture is a platform for creating context-aware services in private/public spaces.
    - SF = Comp. + Comm. + Sensor + Actuator