Ubiquitous ID Technologies 2011

by

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1.1 Open ucode Architecture : Ubiquitous ID Architecture

Ubiquitous ID Center aims to realize the next generation information distribution infrastructure based on ubiquitous ID architecture. Ubiquitous ID architecture is a wide-area distributed information service architecture for retrieving related information from objects and places in the real world that are identified by ucodes.

1.1.1 Ubiquitous Computing

The background of ubiquitous ID is “Ubiquitous Computing” that is a new paradigm of information communication technology. This field, referred to as the “Internet of Things” in the EU and the “物聯網” in China, is receiving attention all around the world.

Ubiquitous computing is a technology with which computers and sensors that have reduced in size due to recent advances in computer technology are embedded in various objects and places in our surroundings, and they communicate with each other and process information in a coordinated manner to offer useful services for humans such as performing information services and environmental control. (Figure 1.1).

In realizing ubiquitous computing as described above, the most important concept is context awareness. This

Designed by Ken Sakamura

Figure 1.1 Ubiquitous Computing Image

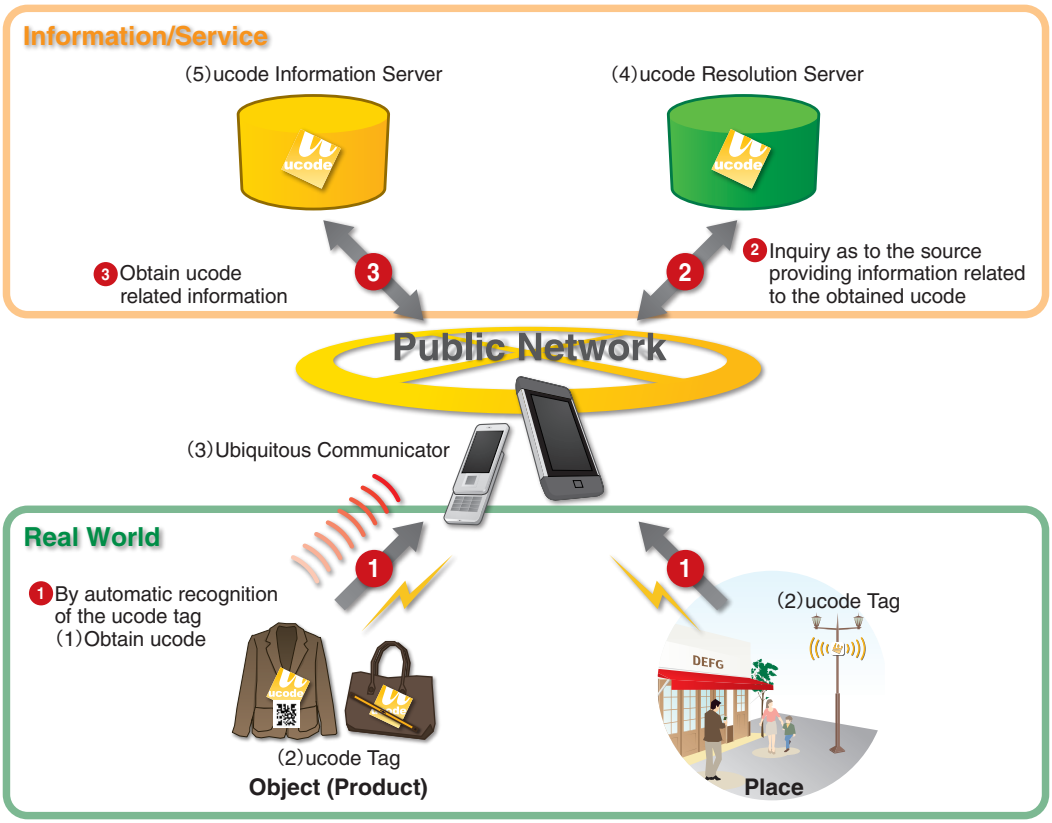


Figure 1.2 Functional Architecture Outline of Ubiquitous ID Architecture

means that countless computers and sensors embedded in our surroundings recognize the real world situations so that they are used to offer advanced information services and to perform environment control.

Here, the easiest-to-understand "context" of the situation in the real world is what the object in front of us is and what our current location is, for example. If computers can automatically recognize such context, more convenient services can be offered to users.

In order to realize such context-awareness, it is necessary to recognize objects and places reliably. With current technology, the surest and easiest method of recognizing objects and places is to assign a number (ID: Identifier) to the target which you want to automatically recognize, store the ID in a medium from which the ID can be easily and automatically recognized by a computer, and attach the medium to the object or place. For example, the most practical methods are to print the ID as a bar code so it can be read automatically with a scanner, or to store the ID in an electronic tag typified by RFID (Radio Frequency IDentification) tags so it can automatically be read via radio wave.

1.1.2 Ubiquitous ID Architecture Components

Ubiquitous ID architecture is a wide-area distributed architecture for retrieving information and services from objects and places in the real world that are identified by ucodes.

Ubiquitous ID architecture has two assumptions. The first assumption is that various objects and places in the real world can be identified by numbers called ucode. To recognize this ucode automatically, bar codes, electronic tags, sensors, etc. (these are called ucode tags) where this ucode is stored are embedded in objects and places to which ucodes are assigned.

The second assumption is the establishment of an always available network environment, i.e., the ubiquitous networks of the 21st century, as the base. Of course, since there are places where an favorable digital communication environment cannot be established in the real world, the option to operate in such an environment has also been prepared.

Ubiquitous ID architecture consists of five components: (1) ucode, (2) ucode tag, (3) ubiquitous communicator, (4) ucode resolution server and (5)

ucode information server (Figure 1.2).

The method of acquiring information from ucode based on the ubiquitous ID architecture is as follows. First, a ubiquitous communicator reads the ucode from a ucode tag using the automatic recognition technology. There are several ways of reading ucodes, such as automatic receipt of signals that active tags transmit, automatic RFID reading, and bar code scanning. Next, the ubiquitous communicator inquires the ucode resolution server as to the source providing information related to the read ucode. The ucode resolution server returns the source of the provided ucode information based on the ucode obtained from the ubiquitous communicator. Finally, the ubiquitous communicator connects to the information provision source which has been acquired from the ucode resolution server and acquires contents and services.

The following explains each component of ubiquitous ID architecture.

❶ ucode: Number which can be issued by anyone, anytime, and for anything

A ucode is a number to identify objects and places in the real world. This ucode is an identifier system which identifies all targets. In addition to objects and places in the real world, ucodes are used to identify abstract targets such as digital contents, concepts, and meanings.

ucodes simply function only as identification numbers in ubiquitous ID architecture. In other words, attributes of objects and places to be identified are not guaranteed to be described in the ucode number itself. However, in the process of object classification management, there are cases in which it may be desirable to encode the attributes of the identification target into the ucode, depending on the operations of the user. Therefore, Ubiquitous ID Center does not prohibit encoding of the attributes of identification targets into the ucode.

The details of ucode will be explained in "1.2 ucode" (p. 7).

❷ ucode tag: Tag agnostic

ucodes tags are media to store ucodes. While ucodes are uniquely assigned numbers for identifying objects, in other words, abstract data, ucode tags are physical media which are attached to objects and places in order to link the ucodes with the objects and places. The ucode tags are implemented in the form of a tag in which a ucode is printed out, or an RFID tag in which a ucode is written, etc.

Ubiquitous ID Center is tag agnostic. Many types of tags can be used as ucode tags. These include print tags such as bar codes and two dimensional bar codes, electronic tags without batteries such as passive RFID, and types of tags equipped with batteries which notify IDs to terminals push-style such as radio wave beacons (markers), infrared ray beacons (markers), and active RFID. Since there are differences among these tags in technical and cost aspects, a universal tag which satisfies all requirements does not exist. Therefore, rather than forcibly unifying these tags, Ubiquitous ID Center has established the tag certification system, in which the most suitable tag can be selected according to the target to be embedded and the situation of use. The tag certification system will be explained in "1.3 ucode tag" (p. 9).

❸ Ubiquitous Communicator: A bridge terminal between ucode and information

Ubiquitous communicator is a terminal for obtaining ucodes from ucode tags. It receives information services related to the ucodes and provides the information to the user. The ubiquitous communicator receives information services by accessing the corresponding ucode information server for the obtained ucode. The details of the ubiquitous communicator will be explained in "1.4 Ubiquitous Communicator" (p. 11).

❹ ucode Resolution Server: Wide-area distributed database to retrieve the information from ucodes

The ucode resolution server is a wide-area distributed database server that manages the corresponding relationship between ucodes and the servers (ucode information servers) that provide information, content and services related to the ucodes. When a ubiquitous communicator makes an inquiry to the ucode resolution

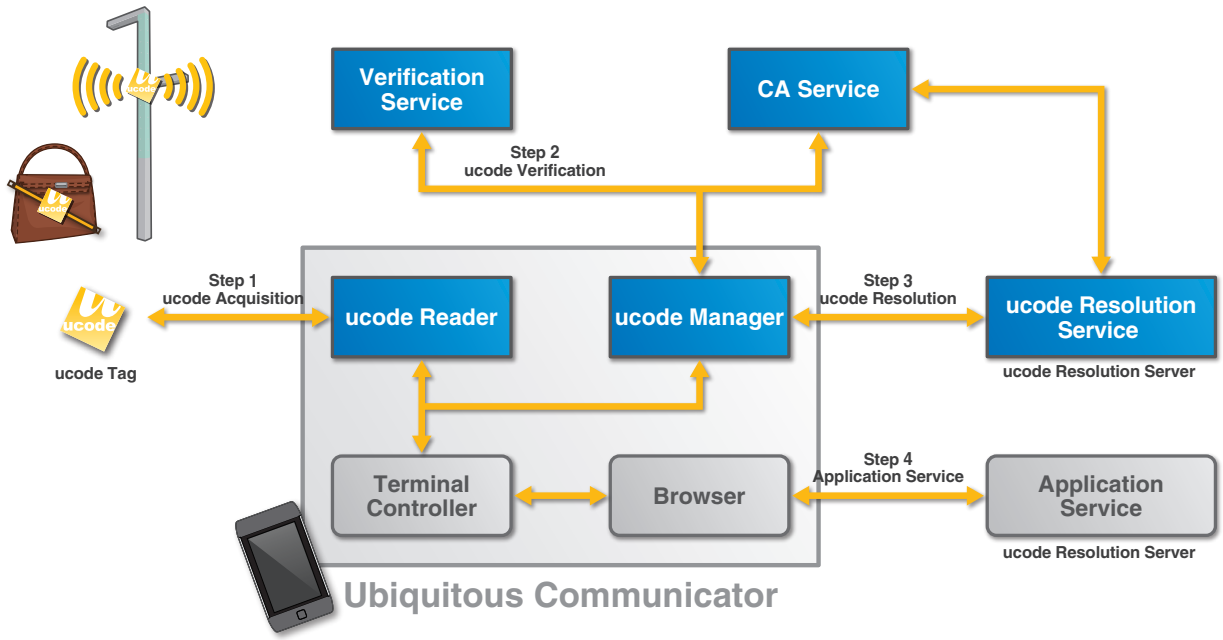


Figure 1.3 Basic Architecture

server about a ucode, the ucode resolution server returns the address of the server providing information and services related to the ucode. The ucode resolution server manages information on the association of the ucode with its content location. In other words, it is the core system of the ubiquitous ID architecture which is the bridge between the “real world” consisting of objects and places to which ucodes are assigned and the "virtual world" consisting of information systems.

With a search engine, you need keywords to retrieve information about the objects and places in front of you. With the ucode resolution server, retrieving information on objects and places is possible if their ucodes alone can be obtained even when you don't know anything (clues) about the object or place you would like to inquire about.

Due to the ucode characteristic of identifying all “objects” and “places,” the ucode resolution server needs to manage an immense number of corresponding relationships between ucodes and content locations. The ucode resolution server consequently offers the mechanism in which multiple servers are widely distributed in order to manage ucodes. This system allows for support of an explosive increase in the number of ucodes. In other words, the ucode resolution servers have a multi-layered tree configuration. The upper servers are assumed to be operated by countries or the ISO, and lower servers by enterprises or individuals.

❺ ucode Information Server: Provider of content and service

The ucode information server provides the information and services on a ucode, and can be reached via the ucode resolution server.

1.1.3 Ubiquitous ID Architecture System Configuration

This section explains the implementation architecture of ubiquitous ID architecture based on the actual system components.

1.1.3.1 Basic Architecture

Figure 1.3 shows the basic implementation architecture based on the functional structure of ubiquitous ID architecture. The basic architecture has 5 major components: (1) ucode tag, (2) uID client (Ubiquitous Communicator), (3) ucode resolution server, (4) ucode information server and (5) CA server. Within these components, uID client consists of 4 more detailed modules: ucode Reader, ucode Manager, Browser and Terminal Controller.

The ucode Reader is a manager or library that provides integrated APIs for reading ucodes to various types of ucode tags. This module provides getucode(), which is a basic function for retrieving ucodes from ucode tags.

ucode Manager is a manager or library that receives ucodes obtained by the ucode Reader as parameters and issues requests for ucode resolution and signature verification. This module receives link information (typically, URLs for web services, etc.) for connecting to the ucode information server from the ucode resolution server.

Browser is a module to realize a user interface for receiving information services on ucodes. It is generally a web browser but in some cases a unique user interface is provided.

Terminal Controller is a module to control the mentioned ucode Reader, ucode Manager, and Browser.

Based on this structure, ubiquitous communicators acquire information from ucodes in accordance with the following steps.

Step 1 : ucode Acquisition

The Terminal Controller sends a request to the ucode Reader and acquires a ucode from a ucode tag. At this time, it sometimes receives an electronic signature from the ucode tag in addition to the ucode.

Step 2 : ucode Verification

If the ucode acquired from the ucode tag includes an electronic signature, the Terminal Controller sends a request for signature verification to the ucode Manager. The ucode Manager sends the received ucode and signature to the signature verification service.

If the signature is correct, the Terminal Controller proceeds to the next step. Otherwise, the Terminal Controller controls the Browser to notify the user that the signature is not correct, and exits.

Step 3 : ucode Resolution

The Terminal Controller sends a request for ucode resolution to the ucode Manager based on the ucode acquired in Step 1 and context information including

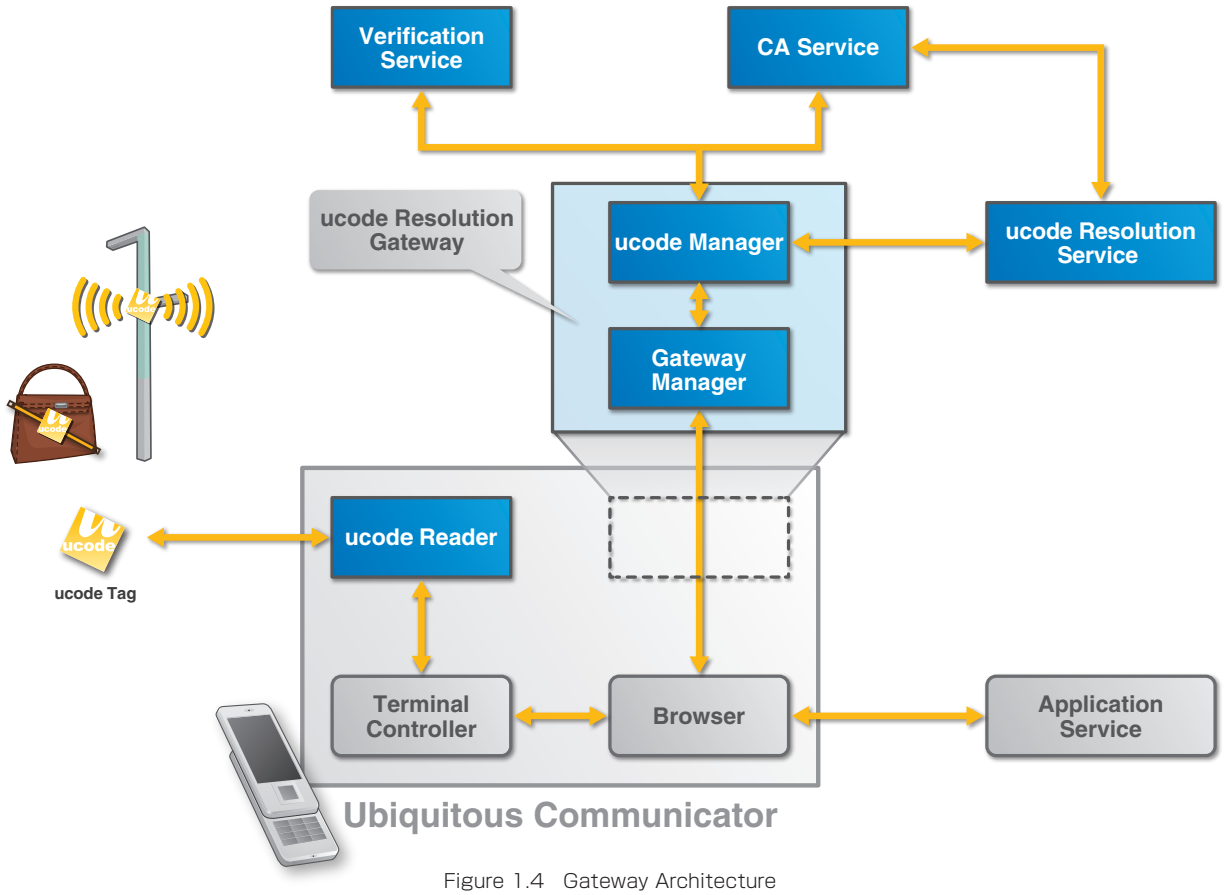


Figure 1.4 Gateway Architecture

user attributes and requests regarding services. The ucode Manager sends the appropriate ucode and additional information to the ucode resolution service to make a request for ucode resolution to the ucode resolution service. The ucode resolution service returns link information for application services as a resolution result.

Step 4 : Receiving Application Service

The Terminal Controller sends the information on links for application services acquired in Step 3 to the Browser. The Browser connects to the service specified by the Terminal Controller and provides the user with the information/service on the acquired ucode.

1.1.3.2 Gateway Architecture

Gateway architecture is architecture for using ubiquitous ID architecture without making any modifications to existing terminals for commercial use or adding any application software (Figure 1.4).

The gateway architecture provides the ucode Manager module that uID client has in its basic architecture as a web service called ucode Resolution Gateway. Therefore, if the ubiquitous communicator includes a web browser, ubiquitous ID architecture can be used.

The behavior of this architecture is explained with the example of reading a ucode in a two dimensional barcode format (ucodeQR) using the camera function of a mobile phone.

Step 1 : ucode Acquisition

The Terminal Controller sends a request to the ucode Reader and acquires a ucode from the two dimensional bar code. Specifically, the Terminal Controller turns on the camera device to read and display the ucodeQR. The information acquired from the two dimensional bar code is displayed in URL format to access the Gateway Manager.

If a user requests to connect to the displayed URL, the Terminal Controller controls the Browser. The Browser connects to the Gateway Manager.

Step 2 : ucode Verification

The Gateway Manager receives the connection request from the Browser. If the received parameter includes an electronic signature, the Gateway Manager connects to the signature verification service, and the ucode Manager sends the received ucode and signature to the signature verification service.

If the signature is correct, the Gateway Manager proceeds to the next step. Otherwise, the Gateway Manager displays the page to notify the user that the signature is not correct, and exits.

Step 3 : ucode Resolution

The Gateway Manager sends a request for ucode resolution to the ucode resolution service based on the ucode received from the Browser. The ucode resolution service returns link information for application services as a resolution result. Then, the Gateway Manager returns the acquired link information to the Browser and requests page transition.

Step 4 : Receiving Application Service

The Browser connects to the service received from the Gateway Manager and provides the user with the information/service on the acquired ucode.

1.2 ucode

ucode is an identification number which can be issued by anyone anytime for anything. ucodes can be issued for content and information which do not exist in the real world and for more abstract concepts as well as objects and places in the real world. The ucode system is a 128 bit fixed length (2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456 ≒ 3.4×10^{38}) identifier system. A mechanism to extend the code length in units of 128 bits has been prepared to meet the future demands so codes longer than 128 bits can be defined.

When a ucode is issued to an object or place in the real world, the ucode is stored in a ucode tag such as a bar code, a two dimensional code, or an RFID tag.

ucode is simply an identification number. There is no relationship between the number and the attribute and the meaning of the target to which the ucode was assigned. Ubiquitous ID architecture basically stores such information as attributes and meaning of the target in databases. The attribute and the meaning information can be retrieved from the databases by using the ucode as a key.

Since ucode is an identification number, it is essential to maintain the uniqueness of issued ucodes. In other words, multiple targets with the same ucodes assigned shall never exist in the world. Moreover, when the target of an issued ucode vanishes, the ucode is also destructed. The same ucode shall never be reused later. ucodes attached to vanished subjects are no longer used. Therefore, the uniqueness of a ucode is guaranteed both in space and over time.

1.2.1 ucode Management Structure

In order to secure the convenience of ucode issuance/management, the structures of management fields and allocation units illustrated in Figure 1.5 and 1.6 are defined. However, these are simply the structures for management. The ucode structure does not have a relationship with the attributes and the meaning of the target to which ucode is issued.

ucode consists of five fields called Version, Top Level Domain Code (TLDC), Class Code (CC), Second Level Domain Code (SLDC), and Identification Code (IC).

● Version

The version is the version number of the ucode standard. The current version is "0000" (in binary representation).

● Top Level Domain Code

ucode space is managed by dividing it into subspaces called "Domains." In other words, a domain is a subspace, and is the management unit of ucode. A domain consists of two levels. The upper level domain is called Top Level Domain (TLD). TLD has a fixed length of 108 bits. Top Level Domain Code (TLDC) is the identification number for TLD.

Figure 1.5 ucode (128-bit basic length) Structure

	CC(4bits)	SLDC+IC(104bits)	
	1000	Reserved	
Class A	1001	SLDC(8bits)	IC(96bits)
Class B	1010	SLDC(24bits)	IC(80bits)
Class C	1011	SLDC(40bits)	IC(64bits)
Class D	1100	SLDC(56bits)	IC(48bits)
Class E	1101	SLDC(72bits)	IC(32bits)
Class F	1110	SLDC(88bits)	IC(16bits)
	1111	Reserved	

Figure 1.6 Defined CC Value and Bit Boundary Between the SLDC and IC

● Class Code

ucodes where the first bit of the Class Code (CC) is 1 are 128 bits in length. In this case, the lower 3 bits of the CC indicate the boundary for the second level domain code and the identification code. A ucode whose first bit of CC is 0 is an extended code that consists of 256 bits or more.

● Second Level Domain Code

The second level domain is one level below TLD and is simply called a domain usually. The domain space has 6 different sizes ranging from 16 bits to 96 bits (multiple of 16 bits), and these are called Class A to Class F according to the size of the space. Second Level Domain Code (SLDC) identifies each domain. When the bit length of SLDC is added to the bit length of the domain space, it is always 104 bits (fixed).

● Identification Code

Identification Code (IC) is an identification number itself in each domain.

1.2.2 Features of ucode

Compared to existing various code systems assigned to objects, ucode has the following advantages.

1. ucode is a code to identify individual objects, not to display product types like product code.
   Product codes such as EAN, UCC, and JAN identify the type of product from each vendor. Therefore, the same product code is assigned to two packages

of the same products. However, for ucode, different numbers are issued to individual packages even if they are the same product.

2. ucode can be allocated to places, content, and concepts as well as objects.
   ucode is the only code system that can identify objects, places, and content universally.
3. ucode does not depend on application fields and business types.
   ucode is not a code system to be used only in specific industries, for example, logistics. ucode is a code system that can be allocated for various targets such as electric products, food, places, and music content irrespective of applications and the business types. This is because ucode aims only to identify individual items as objects and places only, and it is a simple numbering system without any meaning in itself at all. Therefore, ucode is very effective especially for services and item management across multiple industries and applications as well as for services that manage places and objects in the same system.
4. ucodes do not contain meaning and are simple serial numbers.
   The basic architecture stores information on the attribute and meaning of objects and places on a server in a network. This approach is effective especially for applications where the meaning and nature of the objects and places to which ucodes are allocated change from moment to moment.
   Take a guardrail on a road, for example. Guardrails are products produced in a factory until they are delivered to a construction site. When they are installed at the side of a road, they can become one component of the place. Lastly, they are removed. Until they are destroyed, they have the nature of industrial waste. In this manner, even when the meaning (product/place/waste) changes from moment to moment according to the life cycle of an object, the ucode can simply continue to identify the item.
5. ucode is tag agnostic for storage purposes.
   ucodes can be stored in every type of tag such as bar codes, two dimensional bar codes, RFID and active tags. Therefore, the optimal tag according to the application and usage environment can be selected to use a ucode.
6. ucode is secure.
   Ubiquitous ID architecture, the system for handling ucodes, has incorporated eTRON function which is the ubiquitous security framework. Therefore, strong security and privacy information protection can be achieved.

1.3 ucode Tag

ucode tags are the media for storing ucodes.

The ubiquitous ID architecture is tag agnostic. A wide variety of tags can be used as ucode tags such as print tags including bar codes and two dimensional codes as well as electronic tags typified by RFID and smart cards. This results from the fact that the optimal tag for storing a ucode differs depending on the application and usage environment.

- Low cost tags
- Readable tags even if they are placed on metal surface
- Readable tags even if they are placed on water-rich objects
- Readable tags over long/short distance
- Tags requiring high security level

1.3.1 ucode Tag Certification System

Ubiquitous ID Center classifies various ucode tags from two viewpoints. One is the communication method to retrieve ucode from tags and the other is security levels for the storage method of ucodes and ucode retrieval method. The former classification is called "Interface Category" (Table 1.1) and the latter is called "Security Class" (Table 1.2).

Ubiquitous ID Center certifies ucode tags in order to handle various types of ucode tags comprehensively as part of establishment of infrastructure technology for using ucodes. The certification of ucode tags is a procedure to confirm there are no problems with using a certain tag as a ucode tag. A tag certified by this

procedure is called a "Certified ucode Tag." As of December 2010, there are 46 kinds of certified tags.

Certification criteria have been established for each interface category of ucode tags to certify ucode tags. The criteria are released as a set of specification. The respective criteria are derived from the following seven basic policies.

1. Tag type

A tag must fit in one of the categories in Table 1.1.

2. To guarantee the uniqueness of ucodes

The ucode values must be unique. Therefore, ucode tags must guarantee the uniqueness of the ucode.

3. Distinction from non-ucode tags

ucode tags should be distinguishable from non-ucode tags based on the same standard. If this is not possible, tag readers will misidentify and obtain IDs of non-ucode tags as ucode IDs. This is not convenient to the applications.

4. Principle of no response

In an environment where many tags of different protocols and methods exist together, it is preferable that a tag should produce no response to reading attempts in non-compatible methods. If we assume a ubiquitous computing environment where various tags exist as ucode tags and where tags are embedded everywhere, this point is important.

Table 1.1 Classification of ucode Tags by Interface Category

Category	Content Outline
0	Print Tag
1	Passive RFID Tag/Smart Card
2	Active RF Tag (built-in battery type)
3	Active Infrared Tag (built-in battery type)
4	Acoustic Tag

Table 1.2 Classification of ucode Tags by Security Class

Category	Content Outline
0	Function to detect missing or lost data
1	Anti physical duplication/forgery
2	Identification prevention function
3	Tamper-resistant function/function to control access for each resource
4	Function to construct secure communication channels with unknown nodes
5	Resource management function using a timer
6	Update function of internal programs/ security information

5. Guarantee of the ucode acquisition function

The ability to read ucodes from tags correctly must be guaranteed.

6. Guarantee for the interoperability of the interface

This means that Ubiquitous ID Center can disclose information if interface information is necessary for the development of multi readers that enable different certified tags to interoperate with each other.

7. To clearly display the existence of ucode tags

Clearly displaying the ucode mark is one of the conditions for certification so the existence of the ucode tag can be visibly identified easily.

1.3.2 New ucode Tag Category/Acoustic Tag

Acoustic tag has been newly added as a ucode tag category this year. Acoustic tags perform communication by modulating digital information into sound. Modulation using the range of inaudible frequency band for humans is possible. Therefore, data can be sent by modulating into popular music.

Since the acoustic tags are able to realize data communication by emitting sound from standard speakers and picking it up with a microphone, the lack of a necessity for special devices is one of its characteristics. In addition, multiple devices can receive sound at the same time. Another benefit is easy adjustment as the receiving range can be adjusted using the volume controls on the speakers. Furthermore, if the data is broadcast by televisions, it can also be used in program coordination services.

The first acoustic tag to be a certified tag is “INFOSOUND” from Yamaha Corporation. The maximum transmission rate is approximately 80bps but with high noise resistance, data can be transmitted to within a field of 10m or more. Yamaha Corporation has

Figure 1.7 Various Types of Ubiquitous Communicators

developed "INFOSOUND Browser" which is an application for Apple "iPhone" to use "INFOSOUND." When signals modulated by the special tool are emitted from speakers, received by the "iPhone" microphone, and then demodulated by "INFOSOUND Browser," a variety of information can be distributed. Assumed application examples include the distribution of coupons and information to mobile devices by internal speakers in a large home appliance store, or distribution of campaign URLs and coupons by outdoor advertisement and shop front POP displays which can emit sound.

1.3.3 ucode Certified Tag

Ubiquitous ID Center has certified 46 kinds of tags as ucode tags as of December, 2010. The certified tags are listed in Table 1.3.

1.4 Ubiquitous Communicator

Ubiquitous Communicator (UC) is a new information provision terminal which is completely different from PCs and Smartphones. The biggest characteristic of UC is that it is a communication tool between ubiquitous computing environment and people. That is why it is called "Ubiquitous Communicator."

There are three types of communications: "communication with objects," "communication with people" and "communication with environments." The ubiquitous communicator has those three functions.

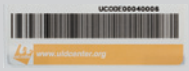
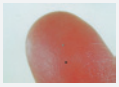
"Communication with objects" is the reading of ucodes from IC tags, bar codes, etc. assigned to all objects in our surroundings and acquisition of information on the objects.

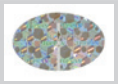
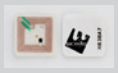
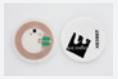
"Communication with people" is literally an interaction among people using UCs and other services through the network.

"Communication with environments" means that UCs collect information from sensors installed in the environment and ucode markers installed in locations, either directly or through the network, and recognize information on the environment of the location or control facilities/devices, home appliances, etc. based on the recognized information.

The functions to be provided by ubiquitous communicators are the following four: (1) ucode Reader, (2) ucode Manager, (3) Browser and (4) Terminal Controller. The first function, ucode Reader acquires ucodes from ucode tags. The second function, ucode Manager accepts ucodes, etc. acquired from ucode readers as inputs and issues queries for ucode signature verification and ucode resolution. The third function, Browser connects to the application service obtained as the result of the ucode resolution, and provides user interfaces to receive information services related to the ucode. The fourth, Terminal Controller controls the functions of the ucode Reader, ucode Manager and Browser with the application software on the terminal side.

Table 1.3 List of ucode Certified Tags (As of December, 2010)

Certification Number	Certification Class		Tag Name	Vendor Name	Certification Date	Remarks	
	Category	Class					
00-001	0	0	Barcodes [Code-128]	SATO CORPORATION	2003.12.3	UID-C000022-01.A0.01	
00-002	0	0	Barcodes [Code-128]	Toppan Printing Co., Ltd.	2003.12.3		
00-003	0	0	Barcodes [Code-128]	Dai Nippon Printing Co., Ltd.	2003.12.24		
00-004	0	0	2D barcode [QR]	SATO CORPORATION	2003.12.3	UID-C000025-0.00.01	
00-005	0	0	2D barcode [QR]	Toppan Printing Co., Ltd.	2003.12.3		
00-006	0	0	2D barcode [QR]	Dai Nippon Printing Co., Ltd.	2003.12.24		
00-007	0	0	Digital Watermark	NTT	2003.12.3		
00-008	0	0	ColorCode	ColorZip Inc.	2006.5.17	UID-DR00016-0.00.02	
00-009	0	0	FPcode	Fujitsu Limited	2007.11.28		
00-010	0	0	metalphoto S0354tag QR	Toko Kagaku CO.,LTD.	2010.1.20	UID-C000025-0.00.01	
00-011	0	0	metalphoto S0354tag C128	Toko Kagaku CO.,LTD.	2010.1.20	UID-C000022-01.A0.01	
01-001	1	1	Mu-Chip	Hitachi, Ltd.	2003.6.23	Frequency band: 2.45GHz Memory type: ROM	
01-002	1	1	T-Junction	Toppan Printing Co., Ltd.	2003.6.23	Frequency band: 2.45GHz Memory type: N/A	
01-003	1	4	eTRON/16-AE45X	YRP Ubiquitous Networking Laboratory, Sakamura Laboratory at The University of Tokyo, Renesas Electronics Corporation	2003.6.23	Frequency band: 2.45GHz Memory type: RAM Capacity: N/A	
01-004	1	1	MB89R116	Fujitsu Semiconductor Limited	2004.3.19	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 2048bytes	
01-005	1	1	MB89R118	Fujitsu Semiconductor Limited	2004.3.19	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 2048bytes	
01-006	1	1	Mu-Chip R/W	Hitachi ULSI Systems Co., Ltd.	2004.12.7	Compliant standard: ISO/IEC18000-4 Frequency band: 2.45GHz Memory type: RAM Capacity: N/A	
01-007	1	1	MB97R7020	Fujitsu Limited	2005.7.7	Compliant standard: ISO/IEC18000-6 Type B Frequency band: 950MHz Memory type: RAM 256bytes	
01-008	1	1	MB89R119	Fujitsu Semiconductor Limited	2005.7.7	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 256bytes	
01-009	1	1	Mu-Chip RTK101	Hitachi, Ltd.	2005.12.13	Frequency band: 2.45GHz Memory type: ROM	

Certification Number	Certification Class		Tag Name	Vendor Name	Certification Date	Remarks	
	Category	Class					
01-010	1	0	μ-Chip Hibiki	Hitachi, Ltd.	2006.11.21	Compliant standard: ISO/IEC18000-6 Type C Frequency band: 950MHz Memory type: RAM 240bits	
01-011	1	0	TSL102LC	Lintec Corporation	2007.11.28	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 112bytes	
01-012	1	1	Large Cast RFtag for Block (TGC2)	Toppan Printing Co., Ltd.	2007.11.28	Compliant standard: ISO/IEC11785 FDX-B Frequency band: 135kHz Memory type: RAM Capacity: N/A UID-C000015-0.00.03	
01-013	1	1	Thin-Laminated RFtag (TGL2)	Toppan Printing Co., Ltd.	2007.11.28	Compliant standard: ISO/IEC11785 FDX-B Frequency band: 135kHz Memory type: RAM Capacity: N/A UID-C000015-0.00.03	
01-014	1	1	IC hologram	Toppan Printing Co., Ltd.	2008.7.16	Frequency band: 2.45GHz (Mu-chip) Memory type: ROM	
01-015	1	1	TS-L102LU	Lintec Corporation	2008.11.12	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 112bytes	
01-016	1	1	TS-L112H2	Lintec Corporation	2008.11.12	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 160bytes	
01-017	1	1	TS-L112HF	Lintec Corporation	2008.11.12	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 160bytes	
01-018	1	1	On metal sheet tag E503100	Dai Nippon Printing Co., Ltd.	2008.11.12	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz	
01-019	1	0	TS-L102LCU01	Lintec Corporation	2009.5.20	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 112bytes	
01-020	1	0	TS-L102NCU01	Lintec Corporation	2009.5.20	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: RAM 112bytes	
01-021	1	1	Plate Type Inmetal IC Tag(Read/Write) PTNS4025-EH20 PTNS6540-EH30 PTNS8654-EH30 PTNA4025-EH20 PTNA6540-EH30 PTNA8654-EH30	HANEX Co., Ltd.	2009.5.20	Frequency band: 135kHz Memory type: RAM 2048bits	
01-022	1	1	Plate Type Inmetal IC Tag(Read only) PTNS4025-EU20 PTNS6540-EU30 PTNS8654-EU30 PTNA4025-EU20 PTNA6540-EU30 PTNA8654-EU30	HANEX Co., Ltd.	2009.5.20	Frequency band: 135kHz Memory type: ROM	

Certification Number	Certification Class		Tag Name	Vendor Name	Certification Date	Remarks	
	Category	Class					
01-023	1	0	SATO HF105 × 55	SATO CORPORATION	2010.2.17	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: EEPROM 112bytes	
01-024	1	0	SATO HF80 × 55	SATO CORPORATION	2010.2.17	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: EEPROM 112bytes	
01-025	1	0	SATO HF50 × 30	SATO CORPORATION	2010.2.17	Compliant standard: ISO/IEC15693 Frequency band: 13.56MHz Memory type: EEPROM 112bytes	
01-026	1	1	μ-Chip N Model	Hitachi, Ltd.	2010.11.11	Compliant standard: ISO/IEC 18000-6C Frequency band: 860-960MHz	
02-002	2	1	Local Area Search (LAS) 300 Series	E&M,Inc.	2005.12.13	Frequency band: 135kHz Memory type: ROM UID-C000014-0.00.03	 
02-003	2	0	Info Sign	NEC Engineering, Ltd.	2006.5.17	Frequency band: 2.45GHz Memory type: N/A	
02-004	2	0	RFtag03RX	Nomura Engineering Co., Ltd.	2006.10.17	Frequency band: 315MHz Memory type: N/A	 
02-005	2	0	Wireless Marker Active tag	YRP Ubiquitous Networking Laboratory	2006.11.21	Frequency band: 429MHz Memory type: N/A	
02-006	2	1	TagFront sensor tag	Fujitsu Limited	2008.11.12	Frequency band: 950MHz Memory type: N/A	
02-007	2	1	BT-950ST (-T1,-T2,-T3)	Panasonic Corporation	2009.11.11	Frequency band: 950MHz(950-956MHz) Memory type: N/A	
02-008	2	1	P2-950U	Panasonic System Networks Co., Ltd.	2010.10.13	Frequency band: 950MHz (950-956MHz)	
04-001	4	1	INFOSOUND	Yamaha Corporation	2010.11.11		

Note: A code that starts with "UID" is the specification number released by T-Engine Forum. Refer to the following webpage.
http://www.t-engine.org/japanese/spec.html

1.4.1 Various Types of Ubiquitous Communicators

The Ubiquitous communicator for business use was developed as a terminal which has the ability to endure heavy-duty use in work sites. It provides environment resistance such as the high level of dust/water resistance and robustness required for business use, and is equipped with a high-speed bar code reader, IC tag reader and numeric keypad. Since WAN communication function can be equipped as an option in addition to IEEE802.11b/g wireless LAN, it can be used for applications using ucodes in a wide range of sites.

The Smartphone-type ubiquitous communicator with

a large screen displays content containing a wealth of information such as video, still images, texts in various languages, and audio output, and focuses on intuitive operation using touch panel. In particular, it provides the optimal design as a push-style information provision terminal which can provide guidance of towns and sightseeing destinations, navigations, etc. by simply walking with a UC and receiving signals from wireless ucode markers and infrared ucode markers installed on locations.

1.4.2 Various Types of ucode Readers

There are also various kinds of ucode readers. These devices read signals from ucode IC tags, infrared ucode markers and wireless ucode markers, extract ucodes and notify Smartphones and mobile phones using close-range radio, etc. so that they can be used as ubiquitous communicators. The ucode readers can be selected according to the situation of use.

1.5 uID 2.0—Realization of Richer Ubiquitous Computing World Based on ucR

Ubiquitous ID Architecture 2.0 is an extended version of ubiquitous ID architecture by incorporating meta information processing technology called ucR (ucode Relation) in the ucode resolution step. As a result, richer description of the real world and context-aware ucode resolution based on it can be realized.

1.5.1 ucR Basic Theory

The model which describes the situation (context) of the real world, in other words, the relationship between objects and places as a relationship between the ucodes assigned to objects and places is called "ucode Relation model" (ucR model). ucR model identifies the concept of "relationships between ucodes" as well as objects and places with ucodes. Information which can become the attribute value of objects and places to which ucodes are assigned, such as strings, web page URLs and numerical values is called an atom in the ucR model.

Figure 1.8 Various Types of ucode Readers

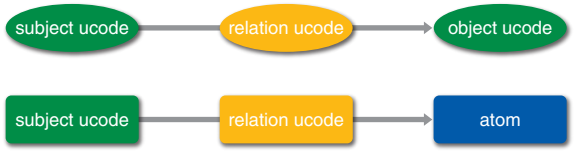


Figure 1.9 ucR unit

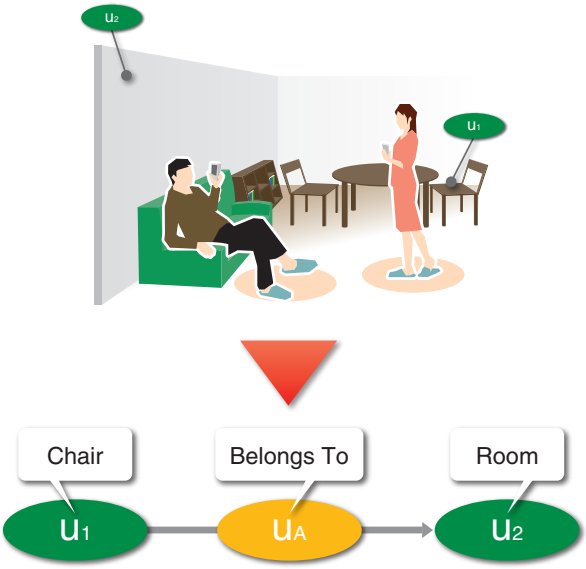


Figure 1.10 Example of ucR unit (1)

The triplet of (ucode, relation ucode, ucode) or (ucode, relation ucode, atom) is called ucR unit. This is the basic unit used in ucR model (Figure 1.9). In addition, if a triplet is compared to a sentence where the relation ucode is the predicate, the ucode that corresponds to the subject of the sentence is called a subject ucode, and the ucode that corresponds to the object or the complement of the verb is called an object ucode. The structure of triplet is quite simple. Yet it has a high representation power for situations in the real world.

(Example 1) Description of Place

Suppose ucode: u_1 is assigned to one of the chairs and ucode: u_2 is assigned to the room respectively as identifiers. Furthermore, suppose ucode: u_A is assigned

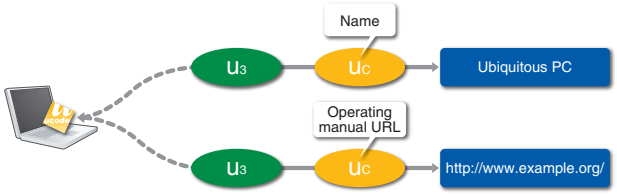


Figure 1.11 Example of ucR unit (2)

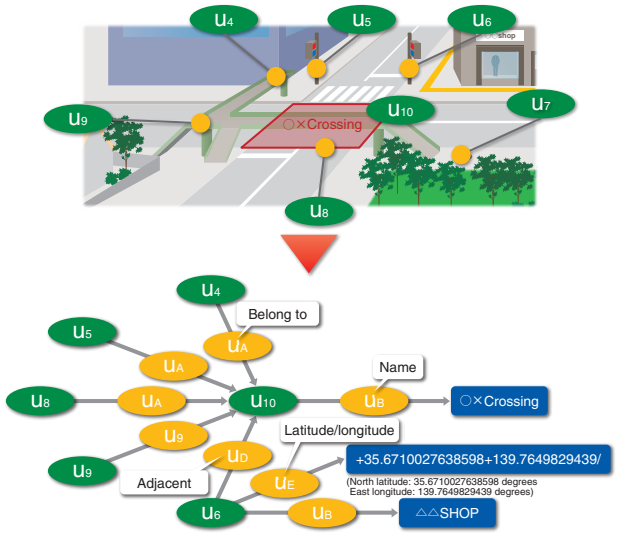


Figure 1.12 Example of ucR Graph

to indicate the relationship of "belong to." In this case, the situation of "a chair is in the room" is described by connecting two ucodes, u_1 and u_2, with the relation ucode: u_A (Figure 1.10).

(Example 2) Product Information

Suppose there is a computer product named "ubiquitous PC" and the operating manual is published on http://www.example.org/.

Here, suppose, u_3 is assigned as a ucode to identify the computer product and ucode u_B is assigned to the relationship of "name" while ucode u_C is assigned to the relationship of "operating manual URL." In this case, the ucR unit describing the situation of "the name of this product is ubiquitous PC and the operating manual is available at http://www.example.org/" is illustrated in Figure 1.11.

Suppose this room is located on the sixth floor of ABC building in the example of Figure 1.10. Then, this room is said to 'belong to' "the sixth floor of the building," and the sixth floor of the building 'belongs to' "ABC building." These can be described with ucR units respectively. In addition, the names and addresses of the room and the building can also be associated with the ucR units. Thus, a directed graph associating multiple ucodes and atoms with relation ucodes is called a ucode Relation Graph (ucR graph). Atoms only appear in the leaves of the ucR graph (Figure 1.12).

In ucR, the data structure does not have to be defined beforehand. Information related to a ucode can be freely updated by adding and deleting the ucR unit. Therefore, cases of frequently changing context can be supported; such as adding a new kind of service to a certain place or conversely halting a certain kind of service, launching the coordination of multiple services or the merger of companies relocating users for a certain service as customers for other services etc.

1.5.2 ucR Databases and ucode Resolution

The ucode Relation Database (ucR Database) manages ucR graphs. Therefore, in a ucR database, information on the relationships between ucodes is also managed in addition to the reference addresses of information and the contents related to individual objects and places to which ucodes are assigned.

ucode resolution for the ucR model means selecting relevant information corresponding to the situation from the ucode based on the ucR graph. For example, with the ucR graph such as the one in Figure 1.12 in a ucR database, information on latitude and longitude of places, and their inclusion and connectivity relationship between places can be inquired by ucode resolution.

In the ucode resolution protocol in the ucR model, commands are also provided for pattern matching of graphs in addition to commands to obtain ucR units and ucR graphs from the ucR database. Therefore, when the graph structure is already known, information can also be efficiently obtained from the ucR database.

1.5.3 ucR Schema and ucR SOAP API

As previously mentioned, with ucR, rich information description and the retrieval of many patterns related to the rich information representation is possible. Since ucR is not used to determine data schema like a relation database, it is also suitable to describe each item with different natures individually.

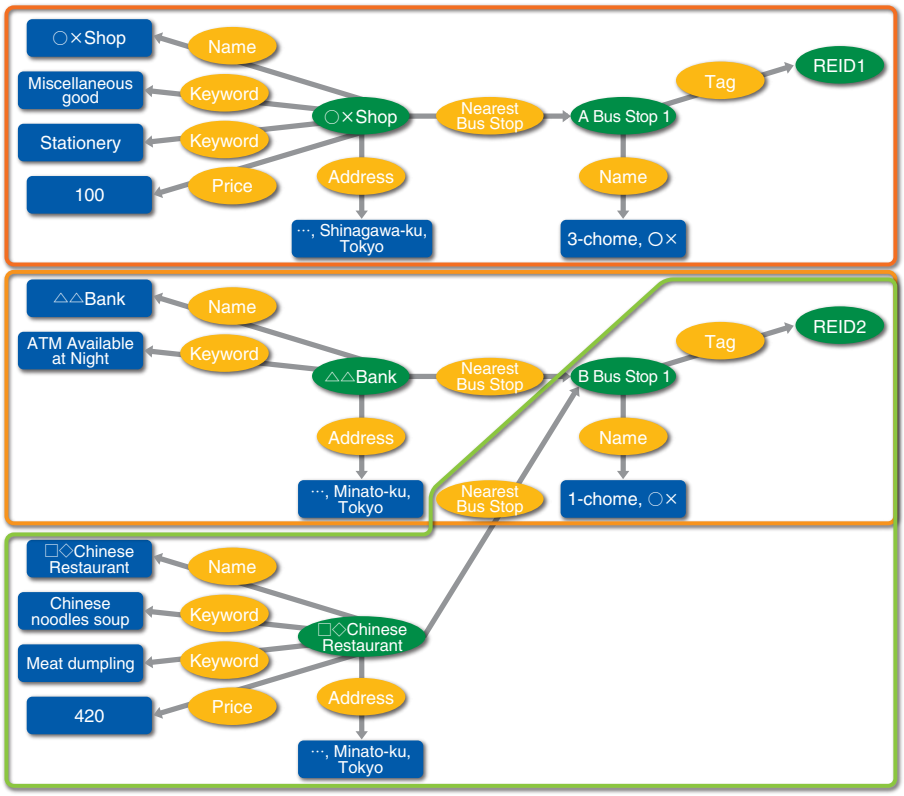


Figure 1.13　ucR Graph Structure Often Seen in Space Information Service
(Note: In this graph, the ucode part is represented with characters to make it easy to read.)

However, in practice, all information is not so individualistic in this manner. Rather, we see many cases where a large amount of information with the same structure repeatedly appear. For example, Figure 1.13 is an example of a ucR graph used by a space information service application. Similar structures appear in the enclosed parts in the figure. The repeated ucR unit is one connected by relation ucodes for the names, keywords, price, address, and nearest bus stop from the node that displays the facility, and there is a ucR unit connected by relation ucodes for the tags and names from the ucode for the nearest bus stop. Such structures repeatedly appear.

ucR Schema is an abstraction of such repeatedly appearing structures in this way. ucR Schema allocates variables to each node of the abstracted ucR graph (Figure 1.14). By using the ucR Schema, you can make inquiries without being aware of the ucR graph structure, in other words, without knowledge of the graph structure.

Although this ucR Schema is apparently similar to the scheme used in a relational database, there is a significant difference. A relational database schema defines the structure of data to be inserted beforehand. Therefore, the structure of data stored in the database should basically follow the schema of the database. On the other hand, the ucR Schema defines a pattern of a ucR graph beforehand. The ucR Schema does not follow the data structure within an ucR database. Thus, while the flexibility and the universality of the ucR model is maintained, highly abstract and easy-to-use inquires can be described from an application.

ucR SOAP API is a SOAP 1.2 compliant API to access ucR databases using such ucR Schema. With this API, information in the ucR database can be registered, updated, and retrieved by use of variable names defined by the ucR Schema. Also, we can use many ucR schemas and switch them timely, and conduct mashups with other applications.

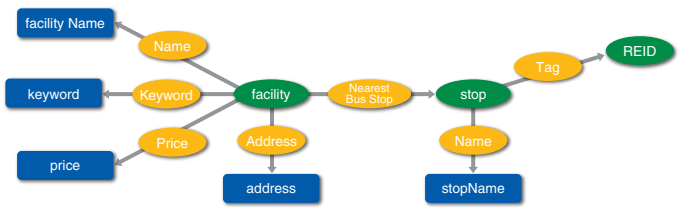


Figure 1.14　ucR Schema Example

2 Cases of "ucode" Utilization

Many projects that used “ucode” were carried out again this past fiscal year. The infrastructure to connect objects and places by utilizing a common code called “ucode” has steadily spread. The cases below are the introduction to these initiatives.

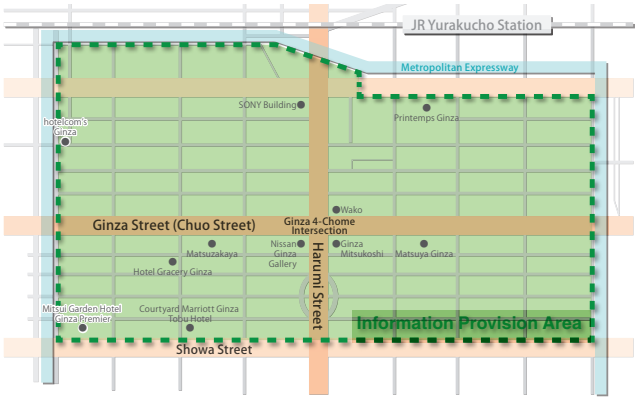


Figure 2.1 Service Area of Tokyo Ubiquitous Technology Project in Ginza

2.1 Tokyo Ubiquitous Technology Project

The ‘Tokyo Ubiquitous Technology Project’ (http://www.tokyo-ubinavi.jp/) is a trial in which the Tokyo Metropolitan Government has cooperated with the Ministry of Land, Infrastructure, Transport and Tourism, as well as local shopping districts with the aim of realizing an information provision service that will further raise the appeal and vitality of the district and make it possible for anyone to walk around the district safely. This is to be achieved through the use of ubiquitous computing technology, which allows necessary information to be accessed ‘anytime, anywhere, and by anyone.’ This trial has been carried out in Japan’s iconic shopping district, Ginza, and various other places in the Metropolitan area every year since 2006.

2.1.1 Tokyo Ubiquitous Technology Project in Ginza

A large number of contents and services to provide to users have been prepared this year through cooperation with local merchants’ associations so that more people including tourists from overseas can enjoy Ginza. Also, the service area has been spread to cover the entire Ginza area (Figure 2.1). Terminals that can receive this service (Ubiquitous Communicators) can be rented from various places in Ginza, such as in front of the Tokyo Metro Information Center, Ginza Street Guide, and hotels around Ginza.

Moreover, the Ubiquitous Communicator provides services such as ‘Tour Guide’ to visit a wealth of sightseeing spots in Ginza, ‘audio programs’ which introduce various stories related to Ginza through narrations and images, and ‘Guidebook’ to introduce a variety of information about sightseeing not only in the Ginza area, but also in the rest of Tokyo. The contents are available in four languages: Japanese, English, Chinese (traditional and simplified), and Korean.

Furthermore, this year’s services are also linked with ‘kokosil’ (see Page 21), a regional information portal site which brings together a variety of information

Table 2.1 Private companies Participating in the ‘Tokyo Ubiquitous Technology Project’ Public Experiment

Selected companies	Name of the experiment
Toppan Printing Co., Ltd.	Ginza electronic poster experiment using NFC phone and NFC tag
Yokosuka Telecom Research Park, Inc. Gourmet Navigator Incorporated	Verification of usefulness of content provision system using ubiquitous location information technology
TAD Co., Ltd.	The 57 Stations of Tokaido Ubiquitous Guide Project
Personal Media Corporation	Ubiquitous location information system using e-book terminals
Oki Electric Industry Co., Ltd.	Free mobility assistance experiment using ‘eSound engine’
Toppan Printing Co., Ltd. PASCO Corporation Ubiquitous Computing Technology Corporation	Technical verification of the “ucode” tag, location information system, and Ubiquitous application systems that use them
Sumitomo Osaka Cement Co., Ltd.	Feasibility Study Experiment in quality and maintenance management of buildings, etc

about the Ginza district. When this information has been viewed on a PC and favorite facilities and stores have been registered to Bookmarks, the Ubiquitous Communicator informs the user as they approach the relevant locations while walking around the district.

2.1.2 Experiments by Private Companies

Along with the general lending out of Ubiquitous Communicators, Ginza, the experiment field, has been released to private companies with the aim of advancing the practicability and commercialization of Ubiquitous ID technology, and each participating company is verifying its own technology. This year, 10 companies in 7 groups listed in Table 2.1 are carrying out experiments until March 2011 utilizing the "ucode" infrastructure installed in the Ginza area.

2.1.3 Metropolitan Government Ubiquitous Sightseeing Guide

Although the Shinjuku area experiment in the 'Tokyo Ubiquitous Technology Project 2009' ended in March 2009, an all-year-round operation of the guide service in the Observatories in the Tokyo Metropolitan Government Building No. 1 and the conference hall tour in the conference hall of the Tokyo Metropolitan Assembly started in April 1, 2009 in response to many requests from the monitors that they continue throughout the year.

In the Observatories on the 45th floor in the Tokyo Metropolitan Government Building No. 1, it is possible to see various contents related to the scenery seen from the windows. The viewer is presented with not only a simple display of the scenery in front of them, but a panoramic photograph which allows them to move the screen up and down and side to side with their finger. Touching the numbers attached to buildings in the photo will then show details of the building (Figure 2.2). In the conference hall tour furthermore, plenary sessions are explained though narrations and photos using a Ubiquitous Communicator. The tour gives an easy-to-understand explanation of not only how the Tokyo Metropolitan Government proceeds, but also

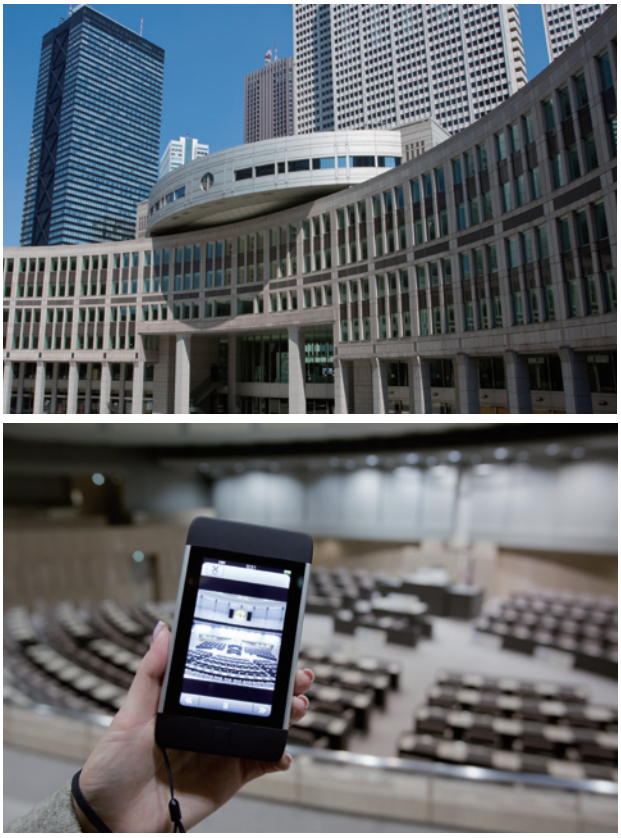


Figure 2.2 View of the Metropolitan Government Building Ubiquitous Guide

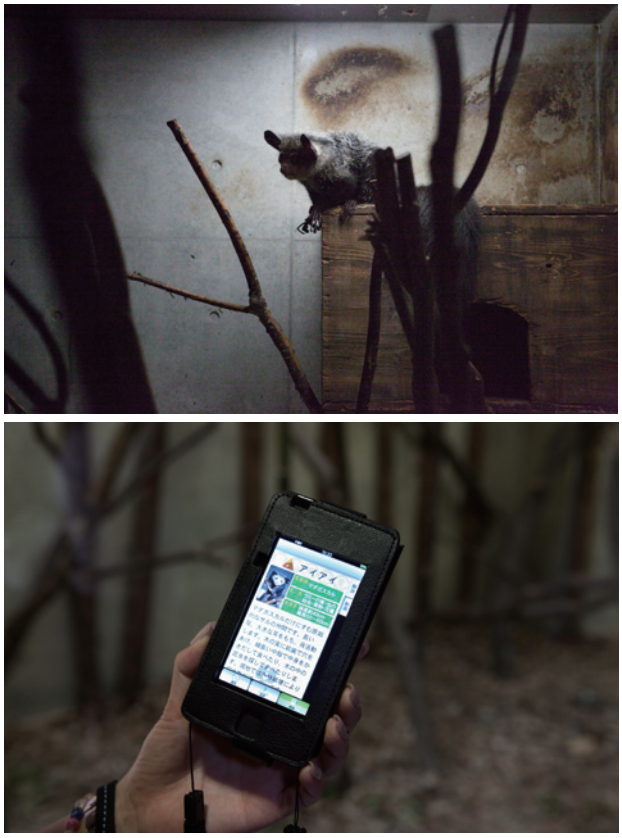


Figure 2.3 Animals in 'Aye-aye Forest', Ueno Zoo, and Related Information Screen

how the seat order in the chamber is decided, where the seat of the governor of Tokyo is, how many gallery seats there are, and the size and shape of the chamber.

Quite a number of foreign tourists visit the Tokyo Metropolitan Government Building because it is also introduced in 'Japon, Le Guide Vert, Michelin.' The Metropolitan Government Ubiquitous Sightseeing Guide is very popular among foreign tourists because the content is available in Japanese, English, Chinese (traditional and simplified), and Korean. By using Ubiquitous Communicators to acquire information, this service plays a part in giving people a better understanding of the wonder of Japan.

2.1.4 'Portable Information System', Ueno Zoo

Carried out as a real service at Ueno Zoo, Tokyo, the portable information service using Ubiquitous Communicators was started with the 'Ueno E-Navigation Experiment' in 2005. In 2010 this popular service reached its fourth year since the time it started. It was initially carried out only in the East Garden, but has gradually expanded, and with the installation of IC tags and wireless markers, service is now also offered in the "Aye-Aye Forest" which was newly opened in the West Garden in FY2009 (Figure 2.3).

The introduction from FY2010 of a terminal equipped with a larger LCD display and battery than those of the previous type made it possible to see more clearly outside and use for extended periods. Investigation into the realization of the provision of more dynamic information is planned for the future, including a structure to reflect the daily changes in animal information as and when they occur.

Furthermore, the operation of a Ubiquitous electric cart experiment has been underway at Ueno Zoo since June 2010 with the purpose of widening the range of visitors by making it possible for people such as senior citizens for whom walking is more difficult to move freely around the zoo and enjoy watching the animals (Figure 2.4).

This was initially targeted at senior citizens and physically-challenged people, but as of November 2010 the target age was lowered to 20 and over. From this,

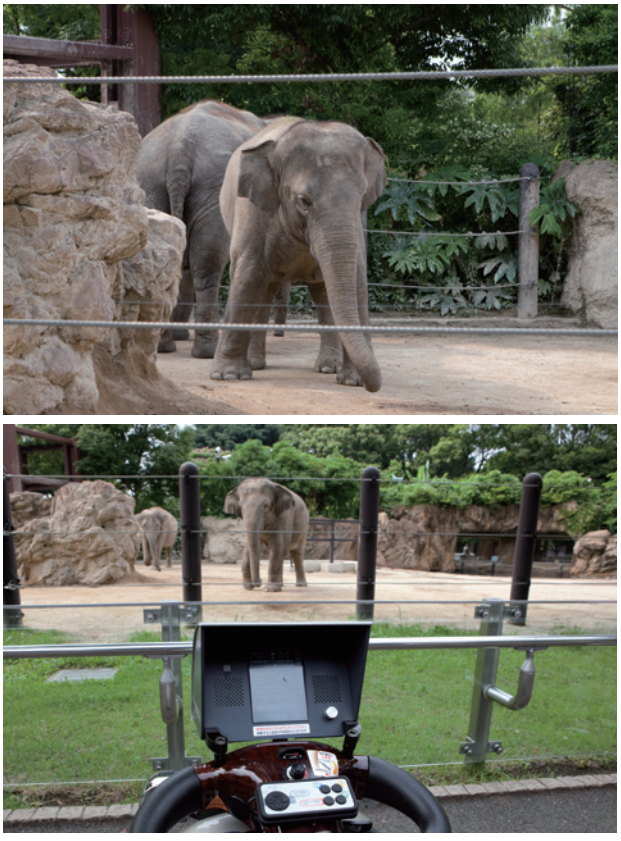


Figure 2.4 Elephants Seen from a Ubiquitous Electric Cart

Figure 2.5 View of the use of the Ubiquitous Garden Guide System

an investigation that incorporates a real operation has been carried out by collecting the results of the experiences of an even greater number of people. The operation of the experiment is scheduled to continue until the end of January 2011.

2.1.5 Hama-rikyu Onshi Teien Gardens Ubiquitous Garden Guide System

Covering an area the size of five Tokyo Domes, Hama-rikyu Gardens is a huge park located near JR Shimbashi Station and Yurikamome Shiodome Station.

As Hama-rikyu Gardens are cultural property gardens that have been nationally designated as special places of scenic beauty and special historic sites, a sightseeing guidance is carried out by using Ubiquitous Communicators instead of putting explanatory billboards in the gardens.

In the Ubiquitous Garden Guide System, “ucode” wireless markers are installed in the gardens, and visitors are provided with a wealth of information from both past and present relating to the locations by acquiring “ucodes” from the markers with a Ubiquitous Communicator (Figure 2.5). Moreover, the garden guide is available in Japanese, English, Chinese (traditional and simplified), and Korean. Visitors from overseas are also enjoying sightseeing in the Gardens by borrowing Ubiquitous Communicators.

2.2 'kokosil,' Location Information Portal Site

Services providing town information about restaurants, sightseeing spots, and transportation facilities have spread rapidly in recent years. UC Technology has started the operation of 'kokosil,' a location information portal which has a particular focus on linkage with the ubiquitous infrastructure for location information among other services.

'kokosil' provides services to a variety of terminals assuming two scenarios: at home and in town (Figure 2.6). For example, at home, it is possible to carry out a preliminary study or submit a review on a PC. In town,

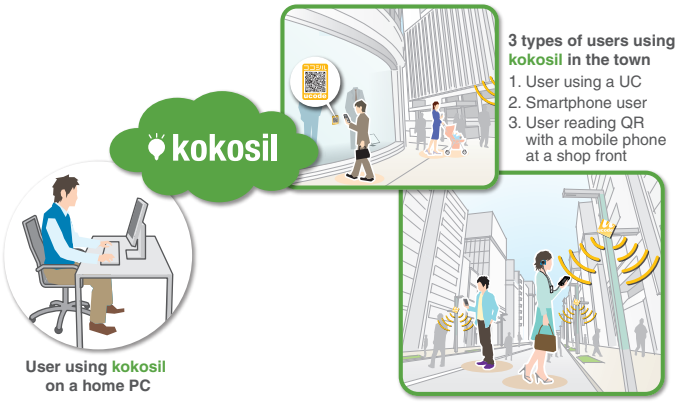


Figure 2.6 Basic Concept of kokosil

it is possible to send street directions or store information push-style to mobile terminals.

The push-style location information service is the biggest characteristic of 'kokosil.' This is the function to automatically display information that is in accordance with contexts such as the user's interests or present location on a mobile terminal. Content of location information registered in kokosil will be automatically delivered to the user while they are walking around the town carrying a mobile terminal with kokosil linkage function such as a Ubiquitous Communicator or a Smartphone. By linking with the ubiquitous infrastructure for location recognition, 'kokosil' can provide finely-tuned services even indoors and in underground malls where GPS is not usable.

'kokosil' provides various plans for visitors to walk around the town on such infrastructures. 'kokosil Tour Guide,' which is provided in the Tokyo Ubiquitous Technology Project, is also one of these. 'kokosil Tour Guide' links with the navigation function of the Ubiquitous Communicator and guides visitors to the town's sightseeing spots in order. By offering guidance around the town along “lines,” which have extensiveness in terms of space and time, rather than “dots,” 'kokosil Tour Guide' helps visitors make new discoveries.

2.3 Cases of Utilization in "ucode" Locations that Have Spread to Many Regions

Location information services and mobility assistance services utilizing “ucode” have spread to many regions in Japan (Figure 2.7). Below is the introduction to those

typical cases.

Refer to “2.1 Tokyo Ubiquitous Technology Project” (Page 18) for the cases in Tokyo.

2.3.1 Intelligent Control Point and Location Information Code

With the aim of realizing a ‘society where necessary location information is usable anytime, anywhere, and by anyone,’ the Geospatial Information Authority of Japan has installed ’Intelligent Control Points’ (Figure 2.8), control points to which IC tags are attached, and is striving for the advancement of maintenance management and utilization of control points. The Intelligent Control Point is positioned in ‘Basic Plan for the Advancement of Utilizing Geospatial Information’ decided by the Cabinet in April 2008. To date, IC tags have been attached to approximately 20,000 triangulation points in urban areas nationwide and maintenance of the intelligent control points has been carried out.

A ‘Location Information Code’ generated by the latitude, longitude, and height is recorded in the IC tag of the Intelligent Control Point. The Location Information Code uses a “ucode” (128 bits) structure and the latitude, longitude, and height (stratum), etc. are embedded in the lower 64 bits of the code as shown in Figure 2.9.

Based on the latest trends in society and technology, the Geospatial Information Authority of Japan has examined specific measures to utilize the location information infrastructure including control points as

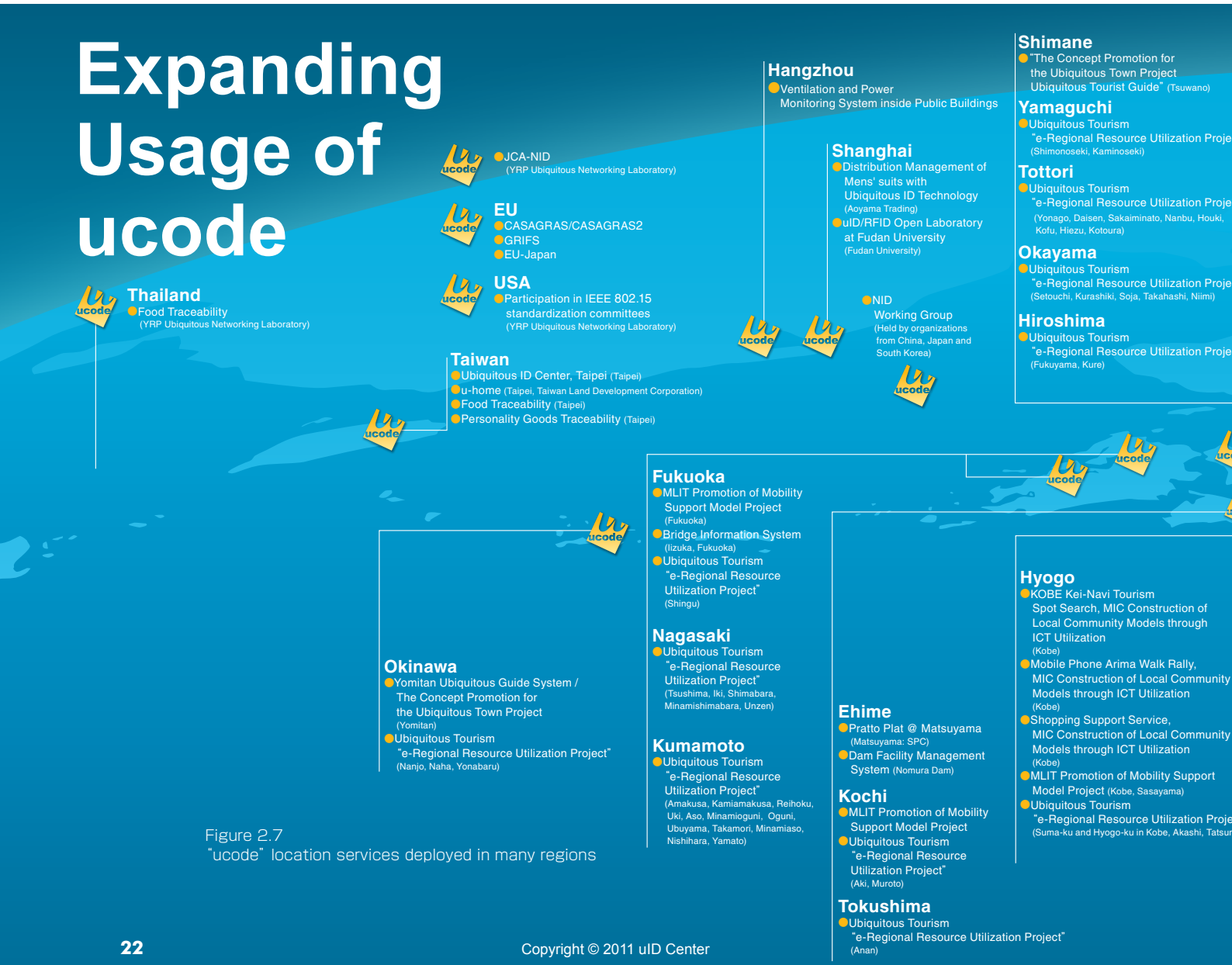


Figure 2.7
“ucode” location services deployed in many regions

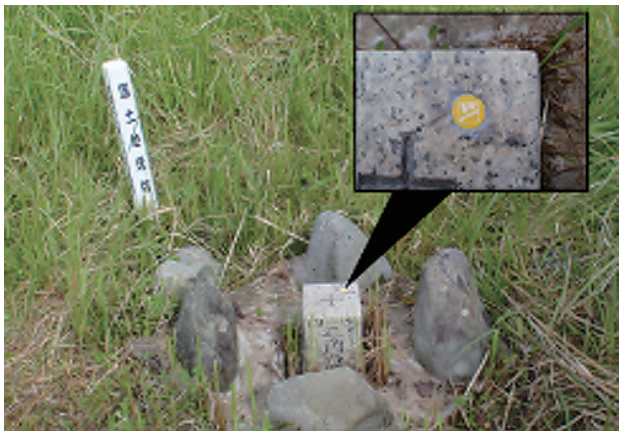
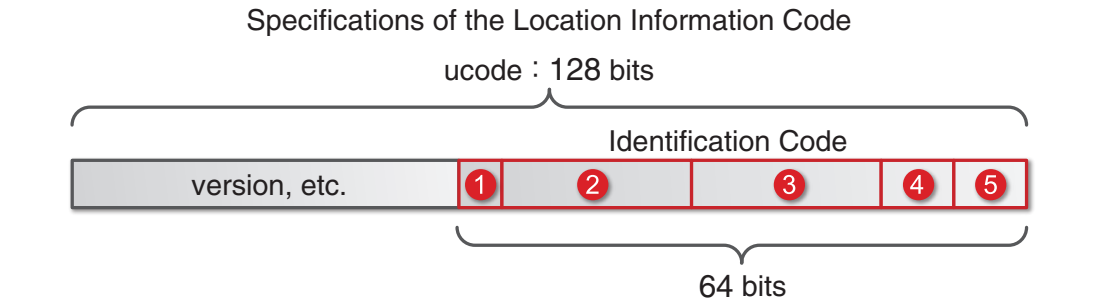


Figure 2.8　Intelligent Control Point

not only the standard for surveying, but also as a structure that will meet a wide range of society's needs relating to location, such as positioning and navigation. Based on the results of these examinations, it is now aiming at the realization of seamless positioning whether indoors or outdoors by building a structure capable of utilizing anchor points (location information points) that link real space up to a numerical map, principally including Intelligent Control Points, to withdraw information related to location, with the Location Information Code as the key.

2.3.2 'Let's Use Signage,' a digital signage system applying ucode (LaLaport KASHIWANOHA)

Between September 3 - 20, 2010 at LaLaport KASHIWANOHA (Chiba Prefecture), the YRP Ubiquitous Networking Laboratory and Mitsui Fudosan Co., Ltd. introduced the next generation digital signage to



❶Classification: 2 bits (4 patterns)

❷Latitude: 23 bits……North latitude: (+) 0° to 90,° South latitude: (-) 0° to 90°

❸Longitude: 24 bits……East longitude: (+) 0° to 180,° West longitude: (-) 0° to 180°

❹Height (stratum): 8+1 bits……(The highest building: 160 floors) 256 strata and the middle of the stratum

❺Number of identifications: 6 bits……2^6=64 pieces identifiable

* Latitude and longitude are displayed to one decimal place every few seconds.

Expresses the location with an error of 0.1 second (approximately 3m)

Figure 2.9 Encoding Specifications of the Location Information Code

operate a pilot service for customers and visitors to the town that utilized state-of-the-art ubiquitous technology (Figure 2.10).

This digital signage system aimed at providing finely-tuned information corresponding to interaction with the user and situations such as those of location, time and user. During the period of the experiment, 7 types of services including the following items were provided: (1) The 'LaLaport indoor guidance service' which displays the direction the user should follow on the signage terminal with direct expressions that use arrows when a ucodeQR printed on a pamphlet for store use is held over it, (2) the 'Quiz Rally' in which visitors collect stamps by answering quiz questions given by the signage, the answers for which can be obtained by visiting the store, (3) the 'Real-Time Information Service from Stores' in which tenants themselves send information on bargains, etc. real time, to visitors, (4) the 'Posting Corner' where general visitors use their mobile phones to read a ucodeQR printed on stands placed in stores and restaurants within the building and make a post of "what I like about this place" in relation to that particular location.

The Quiz Rally in particular was received well and more than 200 visitors participated from the very first day. The number of participants steadily increased after that and more than 2,300 visitors used it during the period of the event. There were also a large number of tenants who used the Real-Time Information Service from Stores, and timely information was provided, such as announcements of limited-period sales and distribution of trial vouchers.

Figure 2.10 Digital Signage Terminal (above) and its Screen (below)

Figure 2.11 'ucoupon' Card (left) and Information Provided After Reading it (right)

Figure 2.12 A ucodeQR Tag Plate Installed in a Tourist Spot (left) Homepage of 'Furusato Ubiquitous' (right)

2.3.3 Miya Sightseeing Hospitality Guide (Utsunomiya City)

Council for the Promotion of the Utsunomiya Hospitality Information Transmission Project of Utsunomiya City has been carrying out the 'Miya Sightseeing Hospitality Guide' since May 1, 2010. This project is a ubiquitous service project that has visitors register as members, and then presents those members with attractions of Utsunomiya according to their particular attributes or to the time/location in which the information is sent. Information for 'only now,' 'only here,' and 'only you' about Utsunomiya is sent by using a mobile phone to read a ucodeQR printed on cards called 'ucoupons' that are distributed in stores (Figure 2.11).

This service collects a record of transmission and usage of the information. This makes it possible to analyze where visitors went, what kind of information they saw, what they did, etc. This also makes it possible to objectively evaluate the actions and spending habits of visitors that have been happening in the town. Based on the above evaluation, it has become possible to confirm whether or not the information or service provided was valid, whether or not the visitors took the expected actions from the information to which they were guided, etc.

This service allows understanding of visitors' needs, as well as the fit/gap analysis of the town information and services at an early stage, based on which we can formulate appropriate initiatives, and furthermore, collect feedback on the initiatives.

2.3.4 Ubiquitous Furusato Tourism System, 'e-Regional Resource Utilization Project' (Furusato Foundation)

As part of the 'e-Regional Resource Utilization Project,' the Japan Foundation For Regional Vitalization (commonly called the Furusato Foundation) has since FY2008 operated the 'Furusato Ubiquitous Common Platform' to manage the information (content) possessed by regions such as local authorities and tourism associations, in a unified manner, coordinate multiple local authorities under common themes such as nature, literature, history, culture and festivals, and send the information. To date, 16 councils nationwide composed of approximately 140 municipalities are sending information using this common platform (Figure 2.12).

This platform has the following features:

1. Information provision related to space (location)

By simply installing a "ucode" plate (a plate with ucodeQR) in real space, information related to that space (location) can be easily provided.

2. Information can be sent with an easy operation

Information can easily be sent by anyone by simply inputting content such as text, images, audio or video, as well as information relating to the location in which the "ucode" is installed from the dedicated Web page.

3. Information provision in accordance with context

Information is provided according to the user's situation and the context. Information to suit every

situation is provided: examples may include people collecting information on a PC at home before taking a trip, or people using their mobile phone etc. to view information while they are in situ on their trip. Moreover, provision of information is possible in each native language for foreign tourists.

2.3.5 InfoScope Utilizing MR (Mixed Reality) Technology (Yokosuka City)

Since June 2010, YRP Ubiquitous Networking Laboratory has been operating 'InfoScope,' an information provision service that aims to achieve regional stimulation through the extension of length of stay and increase of number of visitors/tourists, etc. by overlaying actual scenery and providing information on areas surrounding sightseeing destinations (Figure 2.13). At present, general citizens, visitors, and tourists can freely use terminals installed at 5 locations in 4 facilities in Yokosuka City at no charge.

Figure 2.13 (Left) Overview of InfoScope (middle) Information Provided (right) Children using the Service

The technical characteristics of this service are that it overlays information on images of the real world to an extremely high degree of location precision. It features content such as natural objects (sea, ports, peninsulas, islands, etc.), historic buildings (waterways, bridges, historic ruins, coastal barriers, etc.), buildings, facilities, etc. (power plants, steel plants, research institutes, universities, restaurants, accommodations, livestock farms, parks, etc.), and others (bus schedules, shipping information, etc.), and corresponds to the diversity of ideas and preferences of the viewer. It can be used for not only for sightseeing, but also for educational purposes. Moreover, it is possible to see the content while communicating in a group thanks to the large screen of the monitor. It can also be used by people from overseas as it is available in English.

2.3.6 Yomitan Village Ubiquitous Guide (Yomitan Village, Okinawa Prefecture)

Yomitan Village is blessed with tourist resources of nature, culture, history, etc., and the number of visitors using various tourist facilities has been increasing year after year. However, tourists who visited Yomitan Village mainly stayed for only short periods of time, so there was a need for tourist promotion to make the village a more suitable place to stay and take excursions and to increase the use of the community bus service (Otori Bus) under operation in the entire village area.

This is why Yomitan Village has constructed the 'Yomitan Village Ubiquitous Guide' through the Yomitan Ubiquitous Village Construction Project, utilizing the subsidies for the Concept Promotion for the Ubiquitous Town Project and Promotion of The Use of Regional Telecommunications Technology granted by the Ministry of Internal Affairs and Communications.

Figure 2.14 (Left) Terminal for Yomitan Village Ubiquitous Guide System (middle) Outline of the Service of Yomitan Village Ubiquitous Guide System (right) Installed "ucode" Wireless Marker

This service has a mechanism to identify locations using "ucodes" sent from wireless markers near the Otori Bus stops, tourist facilities, etc. and automatically provide tourist information corresponding to that location when visitors are taking an excursion around the village with a dedicated mobile terminal Ubiquitous Communicator. By following a bus route, it is possible to enjoy the whole of Yomitan Village (Figure 2.14).

This service is carried out through a regionally-based cooperation of industry, government, and academia, with the system being constructed over a period of approximately 6 months, and a lending service starting from August 2010.

Efforts centered around a regional council to enrich the content and further improve the services are planned for the future.

2.3.7 "Ubi-navi," Tsuwano Ubiquitous Sightseeing Guide (Tsuwano-cho, Shimane Prefecture)

Tsuwano-cho is a tourist destination that is famous as Little Kyoto of San-in, and scenery from the Edo period to Showa era remains throughout the entire town. Moreover, it has produced a wealth of well-known personalities and cultural figures including the masterful novelist Ogai Mori, and notable and historical sites can be found all over the town.

Tsuwano-cho has started the Tsuwano Ubiquitous Sightseeing Guide "Ubi-navi" service in July 2010, with the aim of revitalizing the regional society by using these tourist resources to create a resort town with increased numbers of tourists and repeat visitors, and improving the level of convenience for tourists when they are strolling around the town.

In "Ubi-navi," markers to transmit radio waves and infrared rays were installed in a total of 44 places (30 in outdoor places near the town's major tourist courses and 14 in facilities such as museums), and the mechanism for transmitting "ucodes" to display locations was improved. As they approach a notable site, tourists with a Ubiquitous Communicator receive a signal from the marker, and information originating from each location is automatically provided to the terminal. With photos, videos, and narrations, the information that is provided includes information that can only be seen at 'that time,' such as during the period of an event, as well as historical information etc. This has realized the concept of 'the entire town being an art museum' and provided tourists with information services that seamlessly connect indoors and outdoors.

This service has been operating a lending service since July 2010. Based on this service, efforts to further improve services by utilization for not only tourist information, but also in the area of assistance for the physically-challenged etc. are planned for the future.

Figure 2.15 'Ubi-navi' Terminal (above) Using the Service (below)

2.3.8 Initiatives for Permanent Establishment of a Ubiquitous Information Provision System in Takatsu-Oyama Kaido (Kawasaki City)

The Takatsu-Oyama Kaido is a highway connecting Oyama (Isehara City, Kanagawa Prefecture) to Akasaka (in Edo, the present Tokyo) with a large number of historical and cultural resources. In cooperation with the Kobayashi Laboratory of Meiji University and YRP Ubiquitous Networking Laboratory, the Oyama Kaido Action Forum and Takatsu Ward Office have installed panels with ucodeQRs in the town, and are cooperating with regional residents to carry out initiatives aimed at the construction of participatory ubiquitous contents, the examination of a management system, and the permanent establishment of a Ubiquitous Information Provison System.

The experiment was implemented during 'Oyama Michi Machi Week,' an event held by the Action Forum (from November 7-14, 2010) (Figure 2.16). The purpose of the experiments consisted of the following three points: (1) To measure the effect of improvements of suitability for excursions through resource information provision, (2) To construct a management system for permanent establishment of ubiquitous information transmission system, and (3) To conduct a usability study of the design of the panel and the mobile site aimed at permanent establishment. Participants are provided with historical and cultural resource information in a quiz format when they use their mobile phone to read panels with ucodeQRs installed around the town. Having obtained the excursion data of participants using a GPS, this trial confirmed that the participants took excursions around not only the Oyama Kaido, but also surrounding historical resources and parks (Figure 2.17).

2.4 Utilization of ucodes for Objects

There are numerous examples of assigning ucodes to housing, building materials, and assets, etc. for management purposes. Some typical case examples are introduced below.

Figure 2.16 ucodeQR Panel Installed in a History Guide

Figure 2.17 Participant's Excursion Trace (Nov.7, 2010, GPS data)

2.4.1 Full-scale ucode Application in the Management of Historical Information of Houses

As the declining birthrate and aging population has meant a bigger burden on society, and global environmental concerns and the problem of waste have worsened, the conversion from a consumer-driven society of "scrap and build" to a stock-oriented society of "creating good products, properly looking after them, and using them carefully over a long period of time" is now an urgent issue in housing related fields.

In order to continue using a house for many generations, effective use of past records of the house (historical information of a house) over a prolonged period is important for the equipment update, repair/remodeling, buying and selling and other stages. For that reason, in addition to a system for passing on historical information of a house even after ownership changes, it is important to manage this information from the time of construction so that such information can be used later for remodeling.

As an effort to realize this objective, organizations called information service organizations that specialize in managing historical information of houses were established and a service to assist house owners launched. In addition, the Historical Information of House Accumulation/Utilization Promotion Council (http://www.iekarute.or.jp/, Figure 2.18) was established following a pilot program (2009). The Council is responsible for the distribution of identification numbers called “Common IDs” for the purpose of identifying individual houses uniquely as well as protecting personal information and privacy.

Figure 2.18 Logo for “Iekarute” (House Medical Chart) which is a nickname for historical information of houses

The Council assumes the role of gathering information on houses separately managed by multiple information service organizations. Information service organizations and the Accumulation/Utilization Promotion Council manage historical information of houses by using “Common IDs” that uniquely identify houses as the key. ucode has been adopted for this “Common ID.” (Figure 2.19)

These schemes have been established, and the service of storing historical information of houses over a long period of time by information service organizations for historical information of houses was launched and “Common IDs” for 1.35 million houses were distributed. Use has already begun.

The Historical Information of House Accumulation/Utilization Promotion Council consists of corporate members and groups related to services for historical information of houses such as home supply businesses, information management businesses, and home maintenance management businesses. As of November 2010, there are 40 full member organizations and 7 associate member organizations. The Council determined that the nickname for the historical information of houses would be “Iekarute” (medical chart for houses), decided on a logo (the lines symbolize a house, the squares a medical chart and the dots the

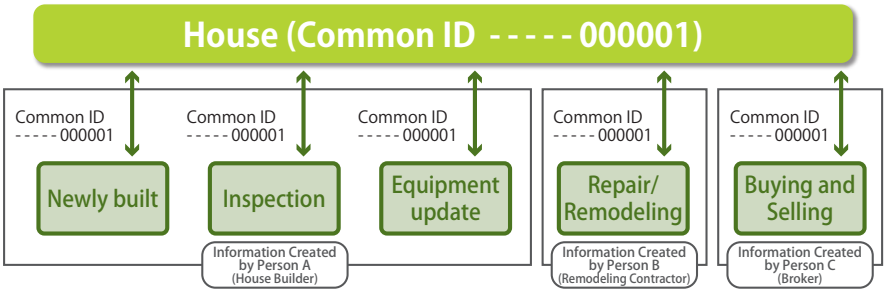


Figure 2.19 Adoption of ucodes as IDs that uniquely identify houses

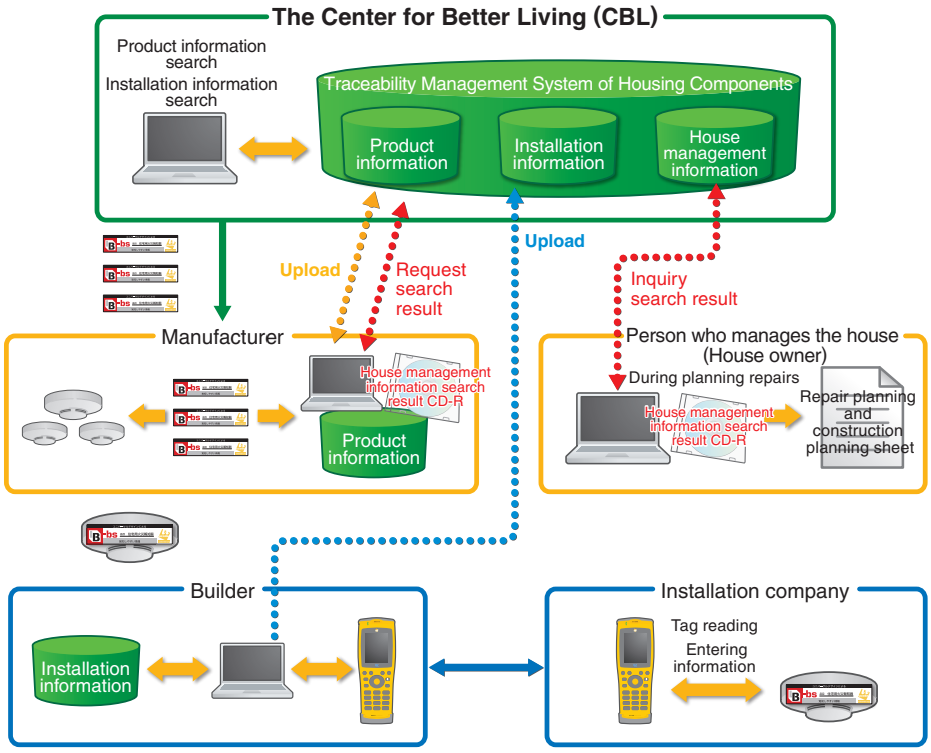


Figure 2.20 Structure of Traceability Management System of the Housing Components

accumulation of information in the logo), and is promoting dissemination.

2.4.2 Traceability Management System of Housing Components

"Who built this house? What kind of housing components are used? Who brought these components? And how were they used and examined?" The Center for Better Living is operating "Traceability Management System of Housing Components" that can resolve those concerns of dwellers. (Figure 2.20). The operation of this Traceability Management System began in February 2006 with the focus on fire alarms, and information on the installation locations of approximately 1.6 million fire alarms for houses has been registered/managed with ucodes as of the end of November, 2010.

2.4.3 Cyber Concrete

Concrete, an important construction material, consists of a very large number of processes from material design to manufacturing, quality control, transportation/delivery, casting (constructing), mold removal from the concrete, and curing. Its later maintenance management can be included in these processes. In addition, concrete has a unique feature where its properties/form changes over time by the minute. Therefore, for concrete structures that are used over a long period of time, a great deal of effort is required for accurately and systematically organizing the properties of the fresh concrete and circumstances during construction or its inspection history, etc. Moreover, there is the aspect of difficult information communication/sharing.

Sumitomo Osaka Cement Co., Ltd. also regards the application of ubiquitous technology as effective in the construction field for assisting the use of the structure “for a long period time” and “safely/without anxiety.” In other words, Sumitomo Osaka Cement believes that by introducing ubiquitous technology, clear process responsibility, accurate information communication and sharing, securing traceability, and the construction of systematic utilization system will be realized, and as a result, reliability related to houses/structures, etc. will be further improved. Such concrete with traceable information as mentioned above is called "cyber concrete."

2.4.3.1 Concrete Test Specimen Management System

For fresh concrete, whether or not the target strength is met or not is inspected by applying a load to a test specimen (test piece) created from mixed concrete after the test specimen has reached the prescribed age. The duties are specifically illustrated by the following example. First, during the creation of the test specimen, the number of the mold used for creating the test specimen, concrete mix proportion, and site name, etc. are recorded in field notes, etc. When the mold is removed, in order to know which batch of concrete this "concrete was created from as well as when and where it was delivered," an identification number is manually copied on the bottom, etc. of the test specimen after hardening. After the prescribed curing period elapses, the test specimen is selected using the identification number on the bottom, etc., and a strength test conducted. The results of the strength test are recorded in the field notes, etc. described earlier, and later, the results are entered and stored in a database in the office following the strength test.

However, in this method, visual confirmation and manual data transcription are repeated many times, and it goes without saying this method is subject to a high risk of human error. In addition, if there are many types of concrete and a large number of test specimens handled, the management of all these types and pieces becomes complicated and a great deal of effort is required.

In the concrete test specimen management system, ucodes on IC tags are read and site information from database displayed on an R/W is selected and linked. Since embedding these IC tags in test specimens allows individual test specimens to be identified, secure traceability can be realized. In addition, by utilizing the system for entering test results and organizing data as well, test efficiency and accuracy can be improved.

Figure 2.21 Fresh Concrete Quality Assurance Information System in Use

2.4.3.2 Fresh Concrete Quality Assurance Information System

The "Fresh Concrete Quality Assurance Information System" that includes transportation management was developed as an upgrade of the Concrete Specimen Management System (Figure 2.21). This system coordinates the commercially available fresh concrete quality control system "SuperNet XL-Q" with the fresh concrete shipment management system "SuperNet PS-S" by linking everything to ucodes. Furthermore, the system extends to include transportation management when connected to an external network.

In SuperNet XL-Q and SuperNet PS-S, shipment schedules are entered as an original function. After shipment instructions are provided in accordance with the application procedure, a delivery memo and receipt are output from the printer. In the "Fresh Concrete Quality Assurance Information System," ucodeQR are automatically printed in the remarks column of the delivery memo and receipt respectively. In other words, unique identification numbers are assigned to each respective delivery memo and receipt for individual cement trucks and uniqueness is secured with ucodes.

The person in charge of receiving the delivery at the site carries a portable R/W and reads the ucodeQR printed in the delivery memo remarks column when fresh concrete arrives at the site and is received. The fresh concrete is verified with the "Fresh Concrete Quality Assurance Information System" server using the read ucodes as the key, and the history of receipt is added to the server as related information of the ucodes. Furthermore, ucodeQR printed in the delivery memo remarks column are read during the onsite acceptance test as well, and the test result is added to

the server as related information of this ucode. If the test specimen is collected, a series of information accompanying a single cement truck is organized and saved with one identification number by linking the ucode of the IC tag embedded in the test specimen to the ucode on delivery memo. In addition, for test result information, by setting the automatic creation of data sheets where concrete related information is copied by reading ucodeQR and making inquiries in the "Fresh Concrete Quality Assurance Information System," organizing data becomes simpler and more reliable than in the past.

In this way, all information related to quality and shipment is organized in an integrated fashion using ucode, and respective information does not need to be consolidated in one location. By making the network external and having the ucode work like a bridge, information from multiple information servers can be retrieved. As an application, we believe that construction records can also be extended to systems with wider application areas by using the ucodeQR printed on the delivery memo remarks column.

The "Fresh Concrete Quality Assurance Information System" deploys application software on the Internet as well (so-called ASP; Application Service Provider). Authorized users provided with IDs (user name) can use application software using browser software in environments connected to the Internet. This makes immediate information sharing among site offices which conduct construction management and fresh concrete plants possible and will contribute to service deployment with various types of additional value also.

2.5 International Cooperation/Standardization of Ubiquitous ID Center

2.5.1 TRON Intelligent House "u-home" and Ubiquitous ID Center Showroom (Taiwan)

High-rise Taiwan Land Development Corporation Financial Center Building is located near Taipei Station. The 3rd model room of TRON Intelligent House "u-home" (Figure 2.22) and T-Engine/Ubiquitous ID Showroom have been established on the 2nd floor in the basement of this building.

In u-home, markers that transmit ucode to show locations and sensors that detect people are installed all over the place. When a sensor detects a person, light is automatically turned on, and when the person is gone, unnecessary light is actively turned off. Depending on the time and the brightness outside of the house, coordination of the brightness of the illumination, curtains, etc., is implemented (the model room is in a basement, so this is done virtually). In case BGM or BGV is set, these will also be coordinated.

If the user wants to control the devices himself/herself, Ubiquitous Communicator (UC) is used. UC recognizes location ucode, and works as a remote controller for the room the user is in. Touch panel switches are installed on the wall too, controlling the room just like UC does. Touch panel switches are not displayed always for energy-saving purposes, and only when we get close to them, the control screen appears automatically.

The top screen of UC displays information including the date, time, current weather, temperature and weather forecast, as well as the current state of the house in the floor plan (Figure 2.23). Here, information regarding whether lights are on, in which room there are people, whether visitors or packages have arrived, etc. is displayed with icons. In addition, the current energy consumption is displayed in the lower right-hand corner of the screen using a graph and figures making it easy to see.

Figure 2.22 TRON Intelligent House Model Room "u-home" that Opened in Taiwan

By letting us see how much energy is consumed constantly, in other words by “visualization,” energy saving is achieved through psychological effects. u-home is contributing to energy saving in this way.

2.5.2 International Standardization Activities for Ubiquitous ID Technology

Ubiquitous ID Center promotes international standardization activities related to ucode and ubiquitous ID technology.

In August 2008, ITU-T (International Telecommunication Union Telecommunication Standardization Sector, Headquarters: Geneva, Switzerland) approved Recommendations (F.771[1], H.621[2]) regarding network information service that provides information service through a network using electronic tags, etc. These recommendations are made based on ubiquitous ID technology. Following the recommendations, proposals for H.IDscheme, an international standard for ID code systems, and H.IRP, an international standard that includes specifications for ucode resolution service, are being presented.

Each international standardization organization such as ITU-T, ISO/IEC, etc., does not create a standard which is similar to any standard created by other organizations in the same technical field. Therefore, they establish a committee that handles coordination between standardization organizations (Joint Coordination Activity: JCA). JCA is established between each standardization group, and if proposals for similar standards are submitted in the same technical field, JCA coordinates matters related to those proposals. Ubiquitous ID Center found out that a proposal similar to H.IDscheme and H.IRP, which the Center submitted to ITU-T, had been made to a committee in ISO/IEC. Currently, the Center is aiming for the approval of the final recommendation through JCA-NID (JCA regarding the use of ID in a network environment) Committee, handling coordination between ITU-T and ISO/IEC.

[1]F.771："Service description and requirements for multimedia information access triggered by tag-based identification"（Editor: Y. Takashima/YRP UNL）

[2]H.621："Tag-based ID triggered multimedia information access system architecture"（Editor: Y. Takashima/YRP UNL）

Figure 2.23　Top Screen of UC

T-Engine Forum Admission Guide

Who is T-Engine Forum?

T-Engine Forum is an NPO with the activity of international scope to promote the standards to improve the efficiency of real-time embedded systems development and to develop the infrastructure to implement ubiquitous computing environment.

- T-Engine Forum conducts the followings: creation of the specification of real-time OS based on open architecture, "T-Kernel," distribution of its open source code, promotion of the distribution of middleware implemented on T-Kernel, and specification creation and publication, promotion of standard development environment T-Engine.
- T-Engine Forum designs and maintains ITRON specification.
- T-Engine Forum writes the specification of ucode, which is the universal number to identify "objects" and "places" as well as conducts the specification creation, utilization, and promotion of ubiquitous ID architecture, which is an application of ucode.
  - Operates Ubiquitous ID Center, which is in charge of issuing/managing ucode.
  - Conducts standardization activities toward achieving ubiquitous computing environment, and plays a coordinating role among governmental/ international organizations.

Policy

- The specifications created through the forum activities will be released to the public worldwide in an easy–to–access manner to anyone after review by members. For example, the source code of real-time OS, "T-Kernel" has been downloadable for free since January 2004.
- The forum does not create just technical specifications but performs the study of intellectual property rights (IPR) system appropriate for the embedded industry. For example, the studies are reflected in the license system such as “T-License” established in consideration of how open and free OS specifications can be utilized in business scene or how the rights of users (companies) can be protected without causing any problems after the use of specifications, etc.

Various Meetings

- Executive Committee

  [Only Executive Committee members can attend.]

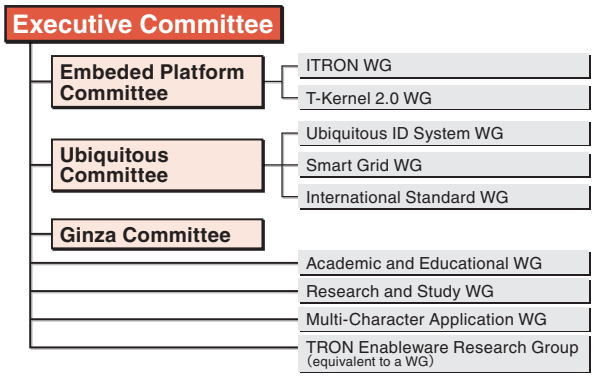
  - Decision-making body of T-Engine Forum consisting of Executive Committee members
- Committee

  [A- and Executive Committee members can attend.]

  - T-Engine Platform Committee, Ubiquitous Committee and Ginza Committee are held. This is where the WG activities are reported.
- Working Group

  [A- and Executive Committee members can attend.]

  - Studying particular topics



Activities

[General Meeting]

- The general meeting is held four times a year to report the forum activities to members, introduce the products of members, and promote exchanges of information among members. Members can attend a speech by Professor Ken Sakamura, Chair of T-Engine Forum.

[General meetings for A- and B-members and for A- and e-members are respectively held, which those having respective memberships can attend.]

[Participation in Seminars]

- Seminars related to T-Engine, T-Kernel, ubiquitous ID technology are held.

[available to each membership type]

[Obtaining Information]

- Members will obtain information on T-Engine, T-Kernel, ubiquitous ID technology through websites and e-mail magazines.
- Members will obtain the following information at the members-only webpage: (However, available information is different depending on membership types. Separate contracts or applications may be required for some types of information.)
  - The latest and updated information of T-Kernel, µT-Kernel, T-Kernel Standard Extension, MP T-Kernel, selectable adaptation patch, and tool, etc. prior to the public release.
  - Activity reports of general meetings, committees, and selectable WGs
  - Seminar texts or sample codes, etc.
  - Members can widely disseminate information on their own products related to T-Engine and/or T-Kernel to the public.

[Exhibit]

- The forum introduces T-Engine, T-Kernel and ubiquitous ID technologies to the public, hosting TRONSHOW, an annual technology exhibition where the results of TRON Project and related projects are shown, and making presentations at various exhibits.

[Cooperation for Various Feasibility Study Experiments]

- T-Engine Forum has participated in the activities of “Free Mobility Assistance Project” across Japan, including “Tokyo Ubiquitous Technology Project.” It has conducted a variety of preparations and coordination and has worked together to improve the experiment environments.

[Information for the Media]

- The forum disseminates information on T-Engine, T-Kernel, and ubiquitous ID technology to the press and cooperates with the media for news gathering activities.

The TRON Engineer Certification Examination

- Many problems occur due to the lack of criteria to measure technical skills objectively when development work is outsourced. Such outsourcing happens often due to the scarcity of embedded engineers. To resolve them, T-Engine Forum conducts the "TRON Engineer Certification Examination." The purposes of the examination are to objectively measure the technical skills of engineers who use embedded real-time OS such as T-Kernel and ITRON specification OS, etc., in order to improve the status of engineers with high technological skills and to stimulate the entire embedded systems industry.
  - The examination is for embedded real-time systems development engineers in companies that utilize or consider utilizing TRON specification OS such as T-Kernel and ITRON specification OS, etc.
  - The examination time is 90 minutes.
  - The perfect score is 100 points, and a pass/fail judgment is not made.
  - T-Engine Forum members can take the examination at a discount.

Ubiquitous ID Center

- T-Engine Forum operates Ubiquitous ID Center that issues and manages ucodes.
- Developing and certifying the following core technology for ucodes:
  - Data carrier devices to store ucodes (RFIDs, smart cards, active chips, etc.)
  - Devices that communicate with data carrier devices (Ubiquitous Communicators)
  - Communication infrastructure that can retrieve information associated with ucodes
  - Secure wide-area distributed systems for ucodes and information associated with the ucodes
- Supporting overseas branches of Ubiquitous ID Center, which issue and manage ucodes abroad
- Collecting and providing information toward the realization of ubiquitous computing environments
- Conducting standardization activities and coordinating with government agencies or international organizations toward the realization of ubiquitous computing environments

T-Engine Forum membership types

・Executive Committee member

- Executive Committee members can
  - participate in the decision-making processes for policies and strategies of T-Engine Forum.
  - participate in the Executive Committee meetings, Committee meetings, working groups, general meetings, and seminars.
  - have all the privileges that A-, B-, and e-members have and can browse all of the members-only websites.

・A-member

- Companies that manufacture hardware, develop various middleware, or provide its development environment in the embedded systems industry can participate in T-Engine Forum. Companies that provide products related to ucode tag such as RFID tags or QR codes, etc. and their reader devices related to Ubiquitous ID technology or web services using ucodes can also participate in the forum.
- Those that develop products using T-Engine and/or T-Kernel and would like to be deeply involved in the specification creation and development of T-Engine and/or T-Kernel find A-member type suitable for their needs.

- Those that develop ubiquitous-related technologies and/or products and would like to be deeply involved in the specification creation and development of Ubiquitous ID technology, etc. and provider services find A-member type suitable for their needs.
- A-members can
  - access information of T-Engine, T-Kernel, and Ubiquitous ID technology, etc. prior to the releases to B- and e-members.
  - participate in committees, working groups, general meetings, and seminars.
  - demonstrate their own products or services related to T-Engine, T-Kernel, and Ubiquitous ID technology to other members by showcasing at general meetings.
  - enjoy the privileges that B- and e-members have and browse all of the members-only websites.

・B-member

- Companies that manufacture hardware, develop various middleware, or provide its development environment in the embedded systems industry can participate in T-Engine Forum.
- Those that consider developing products using T-Engine and/or T-Kernel find B-member type suitable for their needs.
- B-members can
  - access information of T-Engine and T-Kernel, etc. prior to the releases to the public.
  - participate in general meeting for B-members and seminars.
  - browse the B-members-only website.

・e-member

- Companies that provide products related to ucode tag such as RFID tags or QR codes, etc. and their reader devices related to ubiquitous ID technology or web services using ucodes can participate in the forum. Furthermore, the users of such products in all industries and public sectors such as food, retail, distribution, construction, and contents industries, local governments, and government agencies, etc. can participate.
- Those that use Ubiquitous ID technology and eTRON find e-member type suitable for their needs.
- e-members can
  - access information of Ubiquitous ID technology prior to the release to the public.
  - conduct various feasibility study experiments using the Experimental Activity Procedure (EAP).
  - participate in general meeting for e-members and seminars.
  - browse the e-members-only website.

・Academic member

- Academic parties that use T-Engine, T-Kernel, ubiquitous ID technology, and eTRON can participate in the forum.
- Academic members can
  - participate in unit as university, faculty, department, or individual laboratory.
  - receive 48-bit ucode allocation.
  - participate in seminars.
  - browse the academic members-only website.

・Liaison member

- Organizations that conduct the research and development of open architecture which they can promote with T-Engine Forum.
- Liaison members can
  - participate in some types of meetings if the participation is approved by the Executive Committee.
  - browse the liaison members-only website.

・Supporting member

- For those that provide financial support for the activities of T-Engine Forum.
- Supporting members are not involved in the formulation or approval of forum standards.
- Supporting members can
  - receive 48-bit ucode allocation.
  - participate in general meeting and seminars.
  - browse the supporting members-only website.

Membership Type/ Activity content	Executive Committee members	A-members	B-members	e-members	Academic members	Liaison members	Supporting members
Participation in Executive Committee meeting	○	×	×	×	×	×	×
Participation in General meeting	○	○	○	○	×	△*1	○
Participation in Committee meeting	○	○	×	×	×	△*1	×
Participation in WGs	○	○	×	×	×	△*1	×
Participation in Seminars	○	○	○	○	○	△*1	○
A-members-only website	○	○	×	×	×	×	×
B-members-only website	○	○	○	×	×	×	×
e-members-only website	○	○	×	○	×	×	×
Academic members-only website	○	×	×	×	○	×	×
Liaison members-only website	○	×	×	×	×	○	×
Supporting members-only website	○	×	×	×	×	×	○
ucode Allocation (General)	○	○	×	○	○	×	○
ucode Allocation (Provider)	○	○	×	○*2	×	×	○
Monthly e-mail magazine distribution	○	○	○	○	○	○	○

*1: Can participate if approved by the Executive Committee *2: If pay three shares or more

【T-Engine Forum Annual Fee and Validity Period of Membership】

T-Engine Forum's activities are held on an annual basis from April 1 to March 31. Irrespective of the timing of participation, the membership is valid only for the applicable year. Only a legally incorporated organization can join in T-Engine Forum.

- Executive Committee members:
  A-members that pay 3,000,000 yen or more
- A-members: one share 1,000,000 yen/year
  (Please pay one or more shares.)
- B-members: one share 100,000 yen/year
  (Please pay one or more shares.)
- e-members: one share 100,000 yen/year
  (Please pay one or more shares.)
- Academic members: Free/year
- Liaison members: Free/year
- Supporting members: one share 1,000,000 yen/year (Please pay three or more shares.)

Application for participation or inquiries

For inquiries, please contact T-Engine Forum Secretariat.

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URL: http://www.t-engine.org/index.html

Member Organization List

(January 31, 2011: 295 members)

Executive Committee members 17

Aplix Corporation
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DENSO CORPORATION
eSOL Co., Ltd.
FUJITSU LIMITED
Fujitsu Semiconductor Limited
Hitachi, Ltd.
Hitachi ULSI Systems Co., Ltd.
NEC Corporation
Nihon Unisys, Ltd.
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Oki Electric Industry Co., Ltd.
Personal Media Corporation
Renesas Electronics Corporation
SATO CORPORATION
TOPPAN PRINTING CO., LTD.
Yokosuka Telecom Research Park, Inc.

A-members 19

Advanced Driver Information Technology GmbH (Germany)
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Alpine Electronics, Inc.
CORE CORPORATION
GAIA System Solutions Inc.
Hitachi Information & Control Solutions, Ltd.
ITOCHU Corporation
Japan Traceability Association
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Microsoft Corporation (USA)
NEC Soft, Ltd.
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TOSHIBA CORPORATION
TOSTEM CORPORATION
Ubiquitous Computing Technology Corporation
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YAMAHA CORPORATION
YAZAKI CORPORATION

B-members 96

Advanced Polytechnic Center
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Grape Systems Inc.
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Yokogawa Digital Computer Corporation
ZUKEN ELMIC, INC.

e-members 73

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AOMORI PREFECTURAL GOVERNMENT
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Araki Laboratory, Department of Electronics and Photonic Systems Engineering, Faculty of Engineering, Hiroshima Institute of Technology

Aso Business Computer College

Centre for High Performance Embedded Systems, Nanyang Technological University, Singapore (Singapore)

Cybermedia Center, Osaka University

Dalian Martime University (China)

Department of Civil Engineering, HanYang University (Korea)

Department of Computer Science, University of Yamanashi

Department of Control and Computer Engineering, Numazu College of Technology

Department of Electrical and Electronics Engineering, Kokushikan University

Department of Electrical and Electronic Engineering, School of Electrical and Computer Engineering, National Defense Academy of Japan

Department of Information Science, Osaka Institute of Technology

EHIME ELECTRONIC BUSINESS COLLEGE

Electronics Design Lab., Hanoi University of Technology (Vietnam)

Employment and Human Resources Development Organization of Japan Tochigi

Environmental Design and Information Technology Laboratory, Division of Sustainable Energy and Environmental Engineering, Graduate School of Engineering, Osaka University

Faculty of Information Technology, Ho Chi Minh City University of Technology (Vietnam)

Farm Management, Division of Natural Resource Economics, Graduate School of Agriculture, Kyoto University

Field Monitoring Research Team, National Agricultural Research Center, National Agriculture and Food Research Organization

Fu Jen Catholic University (Taiwan)

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Fukuyama University

Furukawa Laboratory, GRADUATE SCHOOL OF MEDIA DESIGN, KEIO UNIVERSITY

Future Robotics Technology Center, Chiba Institute of Technology

Graduate School, Gunma University, Shiraishi Laboratory

Haruyama Laboratory, The Graduate School of System Design and Management, Keio University

Hiroshima City University

Hong Kong R&D Centre for Logistics and Supply Chain Management Enabling Technologies (China)

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HOSHI Lab., TOKAI Univ.

Hunan University, School of Computer and Communication, Embedded System&Laboratory (China)

Iijima Laboratory, Faculty of Science and Technology, Keio University

Inaba-Inamura laboratory, Dept. of Mechano-Informatics, Faculty of Engineering, Univ. of Tokyo

Industrial Technology Research Institute/Identification and Security Technology Center (ISTC) (Taiwan)

Information-technology Promotion Agency, Japan

Inha University (Korea)

Institute for Information Industry (Taiwan)

Integrated System Design Lab. (IMAI Lab.), Osaka University

Intelligent robot laboratory, University of Tsukuba

Japan Electronics College (Nihon Densi Senmon Gakko)

Kanagawa Prefectual Fujisawa Vocational Training School

Kasetsart University (Thailand)

Koshizuka Laboratory, The University of Tokyo

Kuninaka Labo, Institute of Space and Astronautical Science

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Minoru KUBOTA Laboratory, Chiba Institute of Technology

Miyanaga Lab., Tokyo University of Science MOT

Mizuno Labo, Institute of Space and Astronautical Science

Mizusawa Laboratory, Aoyama Gakuin University

National Institute of Advanced Industrial Science and Technology (AIST)

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Research Collaboration Center, Kochi University of Technology

Research Initiative for Advanced Infrastructure with ICT

Research Institute of Computer Applications, South China University of Technology (China)

Research Institute of Management and Information Science, Shikoku University

RFID CENTER in Ajou University (Korea)

RFID Center, Head of the Business Informations Systems Institute, Haute Ecole Valaisanne (Switzerland)

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Urban and Architectual Design Lab.

Yashiro Lab., Institute of Industrial Science, The University of Tokyo

Yokohama National University Kuramitsu Lab

Yoshidome Laboratory, Department of Robotics and Mechatronics, Faculty of Creative Engineering, Kanagawa Institute of Technology

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