Next-Generation Ubiquitous Network Strategy
—Targeting Living/Urban Space beyond Distribution Supply Chains—

Tadashi TSUJI

Nomura Research Institute
The concept of a ubiquitous network society presented under the u-Japan Strategy by the Ministry of Internal Affairs and Communications has already passed the stage of national strategy and policy, and has rapidly entered the implementation stage.

Specifically, with the aim of reforming distribution processes, progress has been made on a worldwide basis in developing infrastructures that can lead to a ubiquitous network society, such as the EPCglobal Network and the GDSN (Global Data Synchronization Network) principally in the United States and Europe. As a result, a situation is emerging where “things” are directly connected to networks all over the world.

In contrast, Japan has been failing to move quickly due to resistance to innovations in business models and social practices, which are necessary in realizing a ubiquitous network society. Accordingly, Japan has currently surrendered the position of a front-runner to the United States and Europe.

Nevertheless, efforts to achieve a ubiquitous network society are projected to go beyond the current first phase focused on distribution reforms and eventually enter the second phase targeting everyday life and urban space. There is ample possibility for Japan to serve as a front-runner at the next stage.

In order to secure an international competitive edge at this new stage of achieving a ubiquitous network, new plans must be formulated that include reforms in business and social practices in close linkage with international society working towards the development of standards and conducting related activities. For this purpose, it is also vitally important that the private sector and the government create a clear vision and establish specific strategies for making that vision a reality.
I Ubiquitous Network Society Becoming a Reality

A “society where anyone can access anything and any service anywhere and at any time” is called a ubiquitous network society. In Japan, under the “u-Japan Plan,” steady progress has been made in formulating policies with the ubiquitous network playing a central role and in establishing a national strategy that is aimed at improving international competitiveness.

As seen in research and development activities under the theme of ambient intelligence promoted by the European Union (EU), and the “u-Korea Promotion Strategy” and “Ubiquitous IT 839 Strategy” in Korea, moves towards a ubiquitous network society are also underway in other countries, although the United States has distanced itself from these activities. In accordance with such strategies, each country has been promoting the development of social infrastructure including broadband (high-speed, large-capacity) networks and the establishment of required structures such as electronic authentication and the protection of personal information.

However, the achievement of a ubiquitous network society requires much more than simply formulating policies, developing infrastructure and establishing a legal framework. It will only become a reality through successively developing and providing services that are truly useful for the industry and consumers.

Furthermore, making a ubiquitous network society a reality means nothing but thoroughly reforming various structures and mechanisms already in place. These efforts will entail extremely profound and large-scale activities that cover industry, public services, everyday life as a whole, and are as widespread as international society. Accordingly, it is no longer the case that “if a single change is made, the overall picture will change.” Continuous activities directed towards realizing a ubiquitous network society are necessary in every field on a systematic basis.

These activities will also involve an extremely high level of hurdles because many issues must be resolved from a global perspective. These diverse issues include not only the development of technologies but also a legal framework, business rules, social practices and relationships among people, companies and society. In addition, we also face the problem that the methodology that has been functioning in Japan up to now will not easily continue to function effectively to resolve these complicated issues. As such, a breakthrough in the aspect of methodology is also required.

1 On the Eve of a Ubiquitous Network Society

It appears that the term “ubiquitous” has been fully accepted into Japanese society.

The term “ubiquitous computing,” which was promoted in the 1980s in the United States, meant a world where computer chips were embedded in anything and anywhere. A situation has later arisen in which all of these computer chips are connected via a network with the emergence of a single worldwide network based on the Internet. The situation has been facilitated by the rapid development of broadband networks, the fast spread of wireless networks as seen in the popularization of mobile phones and a quick shift of all information to a digital format. The situation will further expand in terms of depth and coverage, changing the world to one where computer chips connected by the network could be found at any location of society including homes and offices (Figure 1).

Such a change was recognized in Japan, which was quick to promote the spread of web usage by mobile phones within society and was established as part of the concept of the ubiquitous network. Since 2004, as seen in various policies, the ubiquitous network paradigm has been adopted as the basis of Japan’s national IT strategy. These include the “u-Japan Policy” as the information and communications policy, the “Vision for Information Economy and Industry” as the industrial structure policy, the “Principles for Science and Technology Basic Plans” as the science and technology policy and the “UNS Strategic Programs” as the research and development strategy in the IT (information technology) field. (UNS stands for Ubiquitous Network Society.)

The ubiquitous network that served as the basis of the IT strategy, as explained above, has already gone beyond the level of policy/strategy, and the environment to use this network practically is being developed at a rapid pace. Specific moves include the development of broadband networks, a shift of television broadcasting to a digital and interactive format, the diversification of applications for use in mobile phones and the enhancement of car navigation systems. Upon entering 2006, a ubiquitous network society is rapidly becoming a reality in every field in Japan as well as in the rest of the world.

2 “u-Japan Strategy” Pursuing the Emergent Value Creation

The “e-Japan Strategy” promoted by the Japanese government was initially designed to advance the rapid development of broadband networks in which Japan appeared to be somewhat behind other countries and to establish an environment for electronic commerce and electronic governments based on such infrastructure. The “e-Japan Strategy II” further advanced this strategy and shifted its focus from the development of infrastructure to the effective utilization of networks. Under this new strategy, seven important areas were selected as the fields in which IT utilization must first be promoted. The fields are medical service, food, lifestyle, small and
medium enterprise financing, knowledge, employment and labor, and public service.

As such, the policies adopted for activities conducted under these two strategies consisted primarily of the development of broadband network infrastructure and the creation of applications utilizing that infrastructure. What actually took place under these policies included the development of broadband mobile networks as represented by third-generation mobile phones, the emergence of diverse applications used on these networks, the realization of digital and interactive TV broadcasting, the enhancement of car navigation systems and the emergence of ETC (electronic toll collection system).

This means that while the term “ubiquitous” has gradually penetrated into Japanese society at the initial stage of the 2000s, actual moves related to this term were still confined to the development of wired and wireless broadband network infrastructure and the advanced utilization of that infrastructure.

By setting a new goal, the “u-Japan Strategy” adopted “emergent value creation” as its basic concept for policy evolution. Specifically, this strategy pursues the goal of “establishing a utilization environment where ICT (information and communications technology) penetrates into every corner of life similar to grass roots, generating creative ICT uses and giving rise to new values. At the same time, new and unexpected values are generated by synergies based on the linkage of these creative uses.” As such, this strategy aims at taking a step beyond the goals so far pursued, i.e., promoting the development of networks and the creation of applications.

In other words, this policy can be considered as a plan to give birth to a ubiquitous network society where “all people and things are connected” by networks, whether wired or wireless, and all information and services become available to “anyone and anything anywhere and at any time” by making the best use of ICT.

To achieve this goal, the “u-Japan Strategy” involved three directions: (1) the development of the ubiquitous network, (2) the advancement of ICT utilization and (3) the development of a usage environment. As compared to past strategies, what is significant is that the development of the ubiquitous network includes new networks connecting “things” such as electronic tag and sensor networks rather than simply meaning an integrated wired and wireless broadband communications network.

Several times, past strategies did refer to this point to some extent such as the utilization of RFID (radio frequency identification = radio IC tag). However, this technology has often been discussed under preconceived concepts such as simply affixing RFID tags to objects to track their movements, or affixing RFID tags having a large memory capacity to “things” to integrate “things” and “information.” The concept that RFID tags are affixed to all “things” in the world and are directly connected to networks throughout the world has not necessarily been well articulated. Accordingly, various issues that may emerge in such a case have not been fully discussed.

3 A World of Networks Where “Things” Participate

Currently, because of rapid progress in technology, the cost of RFID tags has been dropping at a rapid pace. The target cost of 5 yen per tag has been within the realm of
reality. The production cost of RFID tags is structured in such a way that the cost declines sharply if the number of tags produced increases. Accordingly, if progress is made in the development of technology, the fields where such tags are applied are identified and the number of tags produced rapidly increases, the cost is expected to decline to an affordable level (Figure 2). As is evident with the costs of a variety of semiconductor products including ICs (integrated circuits), if the usage of tags is further increased, the cost can be further reduced.

With respect to the accuracy of reading the tags, tests conducted just a few years ago revealed that the rate of accurate reading was less than 50 percent. However, at present, it has become practically possible to increase the rate to a level that causes no problems in implementing tests (99.9% or more, although the rate depends on conditions). The reality of the emergence of a world where RFID tags are affixed to all “things” is rapidly approaching.

However, as the feasibility of affixing RFID tags increases, it has finally been recognized that it would be extremely difficult to practically read millions, hundred millions or even trillions of RFID tags, transmit their signals through networks and manage these tags, and that a number of issues still remain that must be overcome to achieve this goal.

Strategies prior to the u-Japan Strategy adopted a paradigm where the development of networks basically predicated on the existence of “people” formed the core element although there were some exceptions. The existence of “terminal devices” has been assumed in developing most applications. A wide array of services have then been designed and developed on the assumption that “people” operate these “terminal devices.” As is clear when we see the world of the Internet, the Internet is, roughly speaking, a world of using “web browsers” and handling “e-mail messages.” Of course, there could be an argument that EDI (electronic data interchange) is also used. However, the use of EDI that was implemented on a purely machine-to-machine basis was limited to large companies although the volume of data handled was significant. At that time, the situation was such that it was reasonable to consider that general EDI use was predicated on the use of terminal devices.

Unlike such a paradigm that is predicated on “terminal devices,” in a world where “things” are directly connected to networks, it becomes necessary to link “things” and “information” without the aid of people, to identify the status of far more than millions, even billions or a gargantuan amount of “things” (specifically, understanding when and through what route such things are moved, their status, and how such things are handled), and to control the movements of these “things.”

To this end, an extremely large volume of information must be collected, compiled and processed based on decisions made in a short time. In addition, worldwide consensus is required to establish the minimum requirements to handle “things” on the network, such as names of “things,” locations of “things” and keys to match “things” and information. It is only after fulfilling such minimum requirements that a world where “things” are directly connected to networks can be established. Accordingly, in order to build such a world, the standardization and development of standard specifications as well as the establishment of various related rules become essential on a global basis.

As such, connecting all “people” and “things” to a single worldwide network is a paradigm presented under the u-Japan Strategy. The establishment of such a new paradigm will enable new “emergent value creation” and will provide a foundation for resolving social and economic issues—this is one of the underlying concepts of the u-Japan Strategy.

Figure 2. Cost Structure of RFID Tags

With respect to inlets, because development and mask creation costs constitute the largest cost factors, the overall cost will decline sharply if a large number of RFID tags are produced (economy of scale). For example, if 100 million yen is required for the total cost of development and mask creation, the overall cost will be 1 yen plus variable costs if 100 million RFID tags are produced.

The cost of antennas is also sharply declining by employing printing technology, etc.

Note: IC = integrated circuit.
II Rise of the Ubiquitous Network Infrastructure

The u-Japan Strategy mapped out plans to achieve a ubiquitous network society where “things” are directly connected to a network covering the entire world. In fact, the development of infrastructure to achieve such a society has already begun.

The moves to improve the efficiency of distribution services, which started in the United States, have spread all over the world. Wal-Mart Stores, the largest retail company in the distribution industry, took the lead in these moves through its supply chain revolution. Late in the 20th century, rapid progress was made in the advancement of information systems that could serve as infrastructure for improving the efficiency of distribution services. Through these achievements, it is currently becoming commonplace to conduct product transactions on a worldwide network.

To facilitate such transactions, international efforts are underway to standardize product codes and unify product information corresponding to such codes because inconsistent systems were used in the past, e.g., the EAN (European Article Number) used in Europe and the UPC (Universal Product Code) used in Canada and the United States.

Along with these moves, a mechanism is being established to improve distribution efficiency in which RFID tags are affixed to pallets and boxes for transportation and to individual products within a store to identify and manage them in real physical distribution networks via electronic networks.

Furthermore, these two moves supplement each other and are being integrated to form a worldwide information system infrastructure. The former moves are represented by the GTIN (Global Trade Item Number) and the GS1 (Global Synchronization Network). The latter moves consist of the EPC (Electronic Product Code) Global Network. The European EAN and US UPC were consolidated to create GS1 (Global Standard 1), a single international organization that now conducts worldwide standardization activities.

1 Revolution of the Distribution Infrastructure

Computers are capable of storing a vast amount of data and processing that data very quickly. However, in order to identify how “things” are moving in the real world, data must first be acquired to identify and locate “things” and to tell how they are being transported.

In order to visualize events in a world of computers and networks that are taking place within a “thing” in the real world, it is necessary to connect a “thing” with “information” that includes its name, attributes, its location and how it is handled at such location.

One of the ultimate conveniences to be brought about under a ubiquitous network society is the ability to acquire the ultimate visibility of the real world by integrating the movements of “things” in the real world with the movements of “information” on the network. In other words, it becomes possible to instantly know what things are moving in what way at any location.

Indeed, this is the realization of ultimate convenience. Actually, efforts are being made principally in the distribution industry to establish a mechanism in which a large volume of “things” (products) that are distributed worldwide networks is linked with “information” consisting of product names and locations.

Specifically, to trace the movements of “things” in the real world on the network, RFID tags must first be affixed to “things” and readers installed at each station must be able to read codes written on RFID tags. The mechanism proposed under the EPCglobal Network provides methods for achieving these procedures. Procedures to link comprehended codes with product “information” will require the GS1 mechanism.

(1) EPCglobal Network—a dynamic network linking RFID tags and individual product information

The EPC (Electronic Product Code) refers to a code structure developed to identify and manage products based on units of product serial numbers. The EPC is written in an RFID tag affixed to a product, case or pallet.

The EPC contains only a minimum amount of information such as a product identification number. Product information and dynamically changing lifecycle information (e.g., the date of manufacture, warehousing information, manufacture lot information, expiration date,) are stored on databases distributed on the network (Figure 3).

Using the EPC as a trigger, the EPCglobal Network makes inquiries to EPC IS (EPC Information Service), which is a product database installed at the manufacturer’s site, for a variety of information about each product. EPCglobal is leading the development of EPC standards.

Auto-ID Center, which is the predecessor of EPCglobal, was established in 1999 with its headquarters located at the Massachusetts Institute of Technology in the United States for the purpose of developing a next-generation bar code system. At that time, Wal-Mart was conducting tests on affixing RFID tags to individual product units as well as to cases and pallets. Wal-Mart is already affixing RFID tags to product cases and pallets to visualize inventory and efficiently move a vast amount of inventory. Wal-Mart was also considering affixing RFID tags to individual product units to find out about sold-out products as soon as possible.

Spurred on by such an environment, in 2003, the Auto-ID Center announced the original RFID data format standard, “EPC Tag Version 1.0.” Soon after the announcement, the Auto-ID Center was closed. The research organization, Auto-ID Labs, and the standardization...
organization, EPCglobal, were then established to take over the roles performed by the Center.

Because the innovative activities conducted by the Auto-ID Center were taken over by Auto-ID Labs and EPCglobal, the United States gained a firm position in taking the lead in the standardization activities for RFID tags used for the distribution of products all over the world. The fact that the Department of Defense has required the use of EPC-based RFID tags in logistics management also contributed to the facilitation of the expansion of the EPCglobal Network.

The “second-generation EPC” protocol currently proposed by EPCglobal is likely to be adopted as the standard protocol during fiscal 2006 by the ISO (International Organization for Standardization). In parallel with this move, each country has increasingly been accelerating its activities toward developing RFID technology in logistics management also contributed to the facilitation of the expansion of the EPCglobal Network.

The “second-generation EPC” protocol currently proposed by EPCglobal is likely to be adopted as the standard protocol during fiscal 2006 by the ISO (International Organization for Standardization). In parallel with this move, each country has increasingly been accelerating its activities toward developing RFID technology in an attempt to propose specifications for international standards. In the future, new proposals for standards will be presented one after another, naturally including those submitted by Japan. Through such competition among various countries, a better mechanism will no doubt be established.

(2) GDSN—product catalog information synchronization process network

The GDSN provides a framework to facilitate the convenience of the players in the distribution industry by managing basic product information on a centralized basis (Figure 4). Simply by registering product information in a single data pool, a manufacturer can distribute its product information to wholesalers and retailers that require such information. From their perspective, wholesalers and retailers will be able to acquire needed product information merely by registering their business fields and required product attributes. While the GDSN now proves to be a significant mechanism, the first studies to establish this system were actually started for negative reasons.

From the last few years of the 1990s to the early years of the 2000s, so-called eMarketplaces (markets of business-to-business electronic commerce) were launched in succession as the commercial usage format of the Internet. With the number amounting to around 300, eMarketplaces were organized at an extremely fast pace, and were expected to dramatically improve the efficiency of the world’s supply and demand chains. However, eMarketplaces in the United States and Europe rapidly disappeared soon after their emergence. Now, only a small number of such marketplaces remain.

One of the reasons for such early disappearances was intense competition under the status of saturation caused by the IT bubble. Because user companies had also pointed out the inefficiency of using multiple eMarketplaces, the competition among marketplaces had become extremely fierce. In order to overcome such a competitive status, market-to-market interconnections, i.e., interconnections among eMarketplaces, started around 2000.

However, after the start of M-to-M connections, a major problem surfaced. In EDI operations chiefly consisting of order information from retailers to manufacturers, unmatched product codes were frequently generated. In addition, some 40 percent of EDI messages that had already been exchanged resulted in useless information due to the unmatched codes. Under

Notes: EPC = electronic product code, EPC IS = EPC information service, ONS = object name server, RFID = radio frequency identification (radio IC tag), WMS = warehouse management system.

Source: The Distribution Systems Research Institute.

Figure 3. Product Information Registration Process of the EPCglobal Network

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such a situation, it was by no means possible to expect efficient distribution via the Internet. Companies that had already made large investments in this field started discussions about how to recover the loss they had already made.

In the process of these actively evolving discussions, manufacturers and retailers that were operating eMarketplaces had become aware that a primary problem causing the situation was attributable to inconsistent infrastructures that served as the base of transactions. At that time, even the number of digits used for product codes was inconsistent between the United States and Europe (12-digit UPCs were used in the United States and Canada whereas 13-digit EANs were used in Europe), causing a major hindrance. Inconsistent items also included product catalog information such as trading-party codes, product names, delivery destinations, etc. The method to use such items was also different.

To handle this problem, industrial associations organized by manufacturers and retailers got together and established the GCI (Global Commerce Initiative). In its activities to work out solutions, as the unified opinions of private-sector companies engaged in distribution services all over the world, the GCI started to make proposals to the governments of the countries of member companies, their standardization organizations and system vendors for improving the existing infrastructures in order to form an optimum supply chain.

Retailers participating in these activities included Walmart in the United States, Metro in Germany, Tesco in the United Kingdom and Carrefour in France, as well as AEON in Japan. As manufacturers, P&G (Proctor & Gamble) and Kraft Foods in the United States, Unilever in the UK/Netherlands and Kao and Ajinomoto in Japan participated in this global user group.

These efforts have led to the development of the GTIN product code standard that integrates EAN and UPC standards. Starting in January 2005, this new standard has begun to be implemented in other countries. In Japan, under the current plan, preparations are being made with the aim of adopting this standard in March 2007.

Actually, GCI member companies consist of retailers and manufacturers that have been competing fiercely in their respective fields. In the past, it was difficult to imagine adopting a common framework even though such a mechanism was projected to bring about mutual benefits. However, GCI member companies reached full agreement in that infrastructural operations such as the development of product master data lists and the conversion of product codes are not issues for which a company’s competitive predominance should be displayed, rather they are issues for which common procedures should be established.

Instead, competition should be focused on strategic operations that are implemented above this common infrastructure, such as product development strategies, mechanisms to prevent a shortage or disposal of products, product marketing strategies, product line-ups and advertisements. It was acknowledged that while companies should make every effort in these strategic operations by making full use of their original and creative ideas, competing companies should cooperate with each other with respect to the development of infrastructure that serves as the base for their strategic operations. This concept has enabled the rapid start-up of the GTIN in other countries and motivated the development and spread of the GDSN.

It is said that consulting firms in the United States and Europe have largely contributed from the third-party standpoint to the process towards forming such a common recognition among companies with differing interests by helping them establish a vision, analyzing support data and providing coordination among companies with various objectives. It is hoped that think tanks and consulting firms will also be active participants in these aspects in Japan.
(3) The EPCglobal Network and the GDSN

When the EPCglobal Network and the GDSN become available, the following mechanism will be used to conduct supply chain operations (Figure 5).

A manufacturer first affixes an RFID tag containing an EPC or product code for each product unit to each manufactured product unit and, at the same time, registers product information in the product catalog information database. As multiple product units are boxed and multiple boxes are loaded onto pallets for transportation, RFID tags are also affixed to these boxes and pallets. The EPCs of these products are read by RFID readers during the transportation process such as at an assembly plant, in a truck, at a distribution center and at a retail store. However, just reading an EPC does not indicate the nature of the product and where it is to be delivered because the EPC contains no product information.

At the next step, the EPC is used as a key to search the network for product information. At this stage, the EPCglobal Network is searched through an ONS (object name server) to find the pertinent product catalog information database.

At the same time, information registered by the manufacturer in the product catalog information database is provided through the GDSN mechanism. This information, which is continually updated and integrated, can be accessed by any distribution center and retailer throughout the world. A problem with the conventional infrastructure existed regarding this aspect. Because outdated or erroneous information often remains on the network, finding the appropriate reference is difficult. Consequently, efforts are being made to use the GDSN mechanism to resolve this problem.

As such, only after the EPCglobal Network and the GDSN as well as RFID are combined, will “things” be able to be connected directly to a single worldwide network, and these “things” will then be linked with the correct information on the network.

With respect to the GDSN, careful attention must also be given to the uniformity of product information in the process by which a manufacturer registers products in the GDSN. To register product catalog information, a manufacturer usually gathers information from various departments such as product planning, design and development, and selects and determines the product attributes to be released. However, because the information dispersed within a company is often not uniform, a manufacturer must limit the point of information release to a single department to properly manage such information.

Figure 5. Relationship between the EPCglobal Network and the GDSN

Notes: 3PL = third party logistics, EDI = electronic data interchange, PIM = product information management, PLU = price look-up, POS = point of sales information management.
As a company, if a manufacturer is unable to control the flow of disclosed information, situations inevitably arise where multiple items of information are provided for a single product. In some cases, erroneous information might be provided.

Unless consideration is given to the degree to which information is integrated within a company, it is difficult to keep correct links between “things” and “information” on the network. The PIM (Product Information Management) solution is available for ensuring the uniformity of product information within a company, and is actually being used by a number of companies in the manufacturing industry as the tool used for linkage with the GDSN.

While the EPCglobal Network and the GDSN were originally developed for different purposes and followed separate paths, these two mechanisms are now linked under GS1, which is mentioned in a previous section of this paper, for further development. Codes to uniquely identify products and offices that are used in this environment are also standardized (Figure 6). The GTIN is used for product codes and the GLN (Global Location Number) is used for office codes. In this way, a scheme is established and maintained to prevent any data mismatch.

Because the EPCglobal Network indicates “the movements of products on the physical distribution network” and the GDSN provides “uniform product information,” the linkage of these two synchronized networks consequently enables the linkage of “things” and “information” that describes what things are (Figure 7). This is one view of infrastructure supporting a ubiquitous network society where “things” are directly connected to the network.

Not until 2000 did discussions start on the EPCglobal Network and code inconsistencies, and it was after 2002...

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**Figure 6. Correlation of Product Information between the EPCglobal Network and the GDSN**

- **GDSN**
  - Customer information
  - Category information
  - Target category information
  - Transaction-related information

- **EPCglobal Network**
  - Basic product information
    - Product name
    - Brand name
    - Color
    - Weight
    - Height
    - Other
  - Production-related information
    - Production lot
    - Production date
    - Expiration date
    - Other
  - Lifecycle history information

Source: EPCglobal.

**Figure 7. Integration of the GDSN and the EPCglobal Network**

- **Global registry**
  - GDSN
    - Product synchronization process

- **Data pool**
  - Relationship-dependent information
    - Basic product information

- **EPCglobal Network**
  - Secure Internet exchange network
    - ONS
    - Mutual authentication infrastructure

- **Internal enterprise systems**
  - EPC IS (product information DB)
  - EPC middleware
  - EPC reader
  - Enterprise systems
    - ERP
    - WMS
    - CMS etc.

- **PIM**

Source: EPCglobal.

Notes: CMS = cash management system, DB = database, ERP = enterprise resource planning.
that agreement was reached on the concept of the GDSN. Nevertheless, the use of the GTIN began in January 2005, and implementation of the GDSN was started. Despite the fact that the development of common practices to be applied all over the world is an extremely large undertaking, it is awe-inspiring that such a major task is moving forward at an extremely fast, unprecedented pace.

This fast pace no doubt reflects the explicit intention and leadership of GCI, a global user group consisting of the major multinational companies that drive the world market, in promoting global standardization. In the case of UN/EDIFACT (United Nations Rules for Electronic Data Interchange for Administration, Commerce and Transport; registered as ISO9735 in 1988), which is a global EDI protocol developed by undergoing extreme difficulties, it is said that more than 20 years were required to establish these rules. Compared to these rules, it is evident that the current moves are distinctive.

2 Two Issues Facing Ubiquitous Network Infrastructure

While the EPCglobal Network and the GDSN provide the mechanism to link “things” with “information” on the network, two issues remain to be resolved in order for the two networks to function as social infrastructure. They are measures to accommodate high traffic (communications volume) and to evolve this infrastructure among small and medium enterprises.

The two networks are aimed at synchronizing “things” and “information” that are always at the latest status in order to enable access “at any time, anywhere and to any thing.” They constitute a dispersed database structure with the world’s single Yellow Pages as the center, i.e., Route ONS and Global Registry, respectively (Figures 3 and 4).

Regarding the first issue of high traffic, in the past, each transaction was based on a unit of each EDI element such as ordering, shipment and billing. This means that even if the ordered quantity was 100 or 10,000, the data processed was for one transaction. However, with these synchronized networks, transactions are generated on units of individual products or items. In particular, on the EPCglobal Network, the number of transactions generated corresponds to the number of product units manufactured. Furthermore, information that dynamically changes in the process of product distribution must also be stored.

In addition, because transactions also occur to search for information in addition to register information, a vast volume of traffic will be generated on the network. This will inevitably require the development of a network that can endure high traffic and its backup systems as the infrastructure for a ubiquitous network society. However, in point of fact, at the current stage, an overall picture of such an environment has not yet been articulated. Experi-

3 Shift of Paradigm towards a Ubiquitous Network Society

As explained previously in this paper, a ubiquitous network society is already entering the stage of realization. However, as we have just begun the development of infrastructure, many issues remain to be resolved. However, even under such conditions, the picture of the step following the currently ongoing step to achieve a ubiquitous network has started to become visible.

1 Further Evolution of the Ubiquitous Network

The realization of a ubiquitous network society starts with the development of infrastructure for the synchronization process of linking “things” and “information” that expresses their meanings. This development is moving forward in the flow of the supply chain revolution currently taking place in the world. Specifically, two mechanisms are being developed, i.e., the EPCglobal Network and the GDSN. The synchronization of information on stock-keeping units is being promoted, and it
is becoming possible to track information on serial items on the physical distribution network.

The synchronization of information on stock-keeping units is effective before the start of product sales. This is because it enables, in particular, players purchasing products to “become aware of new product information in advance” and place orders for such products. It also helps prevent POS (point of sales) system registration errors and losses caused by inconsistencies in product codes at the time of ordering by EOS (electronic ordering system).

In contrast, information on serial items takes effect at the time products are placed in the distribution system after product sales are started. From the supplier perspective, trace-forward functions are necessary to locate their products to enable the collection of products if any defect is discovered in products already shipped. Accordingly, the use of EPC as a unique product identifier (ID) brings about practical solutions to suppliers. Information on serial items is also useful for retailers and consumers for trace-back investigations to determine the place of origin and distribution route with respect to a product that one has.

As such, the objectives of the infrastructure for a ubiquitous network society that is being developed under the concept of providing solutions to problems facing distribution operations are focused on accurately linking a vast amount of “things” and “information” that are circulated all over the world.

If this evolution is thought of as the first phase of the ubiquitous network, the next phase is assumed to include “people” in the linkage between “things” and “information.” “Things” that are distributed as products can basically serve their purposes if they can be moved efficiently on the physical distribution network. While there may be cases in which product information is linked to “who” and “where” on a physical distribution network, “people” as individuals are not involved here. However, once they are purchased by “people,” the products will become “things” possessed by individuals, and “information” expressing such relationships will also belong to individuals.

This situation cannot be adequately explained simply by the relationship between “things” and “information.” For example, a third-party person other than the owner scanning a product to which an RFID tag is affixed to see what it is might be committing a crime if such an act is regarded as an infringement of personal privacy.

In contrast, if a person loses a product but the name of the owner is contained in the “information” linked to the “thing,” a finder can return the product to the owner. In this case, the reading of the “information” linked to the “thing” is not considered a problem but rather a convenience. Such a situation encourages the proactive reading of information.

Therefore, the second phase of the ubiquitous network that comes after a simple linkage between “things” and “information” is expected to raise a curtain by developing infrastructure where “people” make use of the links between “things” and “information” by participating in the first-phase network (Figure 8).

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**Figure 8. Development Stages of the Ubiquitous Network**

[Diagram showing the development stages of the ubiquitous network, from zeroth to second stage, with links and information flows depicted.]
2 Ultimate Convenience and Ultimate Vulnerability

As explained above, “people” will participate in the network during the second phase of the ubiquitous network. The view of opponents to the affixing of RFID tags to products is that if an RFID tag is affixed to a “thing” possessed by an individual person and that if another “person” could read such information, this might lead to the disclosure of confidential information about the individual. Of course, such a situation could make the individual uneasy and should not be permitted.

Conversely, however, an RFID tag affixed to a “thing” that one possesses enables the owner to know what it is and how to use it, leading to significant improvement of convenience. Example situations include automatically notifying the owner of the expiration date of a food item and enabling the finding of a lost item.

This obviously indicates that both ultimate convenience and ultimate vulnerability are concurrently inherent in a ubiquitous network society. While it is extremely important to properly address this problem to achieve a ubiquitous network society, attention should be given to the links among “things,” “information” and “people” in examining measures to deal with such a problem.

Controlling the linkage will enable the control of the connections between “information,” “people” and “things.” For example, if a code recorded on an RFID tag affixed to a “thing” read by a third-party person is linked with “information” corresponding to this thing, or if such information is disclosed, it is possible to know what the thing is. However, if this link is concealed and only the owner knows the link, the code of a thing read by a third-party is merely a code and its meaning remains unknown.

As such, properly controlling the linkage between “things” or “people” and “information” in a ubiquitous network society will constitute a paradigm of the second phase of the ubiquitous network.

Actually, in the environment of EPCglobal and the GDSN, a similar issue has already emerged, which is known as disclosure control. For example, information on a certain processed food item such as name, attributes, size, weight, etc. can naturally be disclosed to all parties. However, the purchase price of this item by a specific retailer becomes information that should not be known by anyone other than those concerned. Because information that can be disclosed to anyone and information that should only be disclosed to specific persons coexists, control is required on what “information” is to be disclosed to what “person (company)” and at what time.

In particular, increased attention is given to this function in Japan. Because of complicated trading practices inherent in Japan, disclosure control has become a major issue. Conversely, in other countries, as seen in the Robinson-Patman Act, price discrimination for each trading partner is prohibited if the trading quantity and payment conditions are the same. In other words, because restrictions are imposed on changing trading conditions depending on purchaser, disclosure control has not yet become a major issue at the current stage.

3 Focus Shifting to Living/Urban Space

It would be reasonable to consider that the specific concept of the second phase of the ubiquitous network is that “things” linked with “information” through the network will enter into society and everyday life (Figure 9). Compared to the first phase where most developments have been promoted by industry, the focus of the second phase will shift to consumers and living space. Accordingly, the issues to be dealt with during the second phase will be how to effectively use the ubiquitous network in such an environment.

In particular, when products to which RFID tags are affixed enter households, offices and urban space, the major issue will be how to use such information and how to facilitate its use (Figure 10).

Here again, clarification is required with respect to who controls the linkages among “things,” “people” and “information” and how they are controlled. Furthermore, the technology that supports “people” who intend to control such linkages should also be identified. The resolution of these matters is inevitable to achieve ultimate convenience in a ubiquitous network society. In addition, how to plan and how to establish the appropriate mechanisms to deal with these issues will influence the measures that address ultimate vulnerability.

Japan is situated in a good position to become a front-runner in exploring new fields in this regard because it possesses accumulated research results concerning the utilization of the ubiquitous network under living and urban environments through the development of mobile phones and PDAs (personal digital assistants).

In the future, what element technologies, what infrastructures and international standards should be established? What reforms of business models as well as structural reforms are required? For Japan to take the lead as a front-runner under these requirements, what are the strategies that will become important? What strategies are required to establish a competitive edge in international society? All of these issues must be discussed seriously and in detail.

IV Challenges in Achieving a Ubiquitous Network Society

1 Unstoppable Flow toward a Ubiquitous Network Society

As discussed in previous sections of this paper, the features of a ubiquitous network society envisioned under
the u-Japan Strategy include the fact that "things" are connected to the network by means of RFID tags and sensor networks, in addition to the further progress in utilizing existing broadband networks.

A change from the network connecting "people" and "people" to the network connecting "people" and "things" means a shift to a society where actions of people such as formulating plans and providing instructions based on information are closely linked with the reality of instantly identifying how "things" actually move based on such instructions and where problems exist.

In order to build such a society, however, the development of infrastructure to link "things" and "information" is required as the first phase of a ubiquitous network society, as discussed in Chapters II and III. The creation of infrastructure for this purpose has already started with

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Japan, which had somewhat lagged behind other countries in these moves, has already started to catch up. Perhaps it will not be until 2010 to 2020 that such infrastructure actually penetrates into every corner of society, because much more time is required to develop such infrastructure.

Naturally, during this period, we will face many issues that will require breakthroughs. These matters include the issue of cost, putting an end to traditional commercial practices through the application of the ubiquitous network to a real society, making carefully considered modifications of standards, reviewing the social structure, etc.

However, as these issues are overcome, the integration of “things” and “information” by means of RFID tags and sensor networks will keep moving forward. The reason is relatively simple. For example, consider the supply chain in a particular industry where things are produced, transported, sold and used. No matter how closely the links are established at each stage of this flow on the network and no matter how carefully plans are formulated to implement supply chain operations, the ability to deal with exceptions and plan changes is limited unless the actual “thing” movements are directly identified.

In contrast, in a ubiquitous network society, “thing” movements will be linked directly with information on the network (Figure 11). As such linkages become possible, it is obvious that exceptions and unavoidable uncertainties such as sudden changes in plans and actual demand fluctuations can be handled more effectively.

From the long-term perspective, a clear gap will emerge in competitiveness between those supply chains where such quick responses are possible and those where such responses are not possible. Efficient and highly competitive mechanisms will, after all, survive in the world markets.

As such, it is reasonable to consider that moves towards a ubiquitous network society are unstoppable and will keep moving forward.

2 Requirements for Becoming a Front-Runner

At this stage of accelerated movements towards a ubiquitous network society, the roles Japan will play will be extremely significant. At the first phase of a ubiquitous network society, the development of infrastructures is underway all over the world based on the paradigm proposed by the United States and Europe. Japan will remain the same in continuing to largely contribute to the promotion of such development at present as well as in the future. However, it is true that the United States and Europe played the roles of front-runners in the development of infrastructures at this stage.

Japan was first in the world to propose the concept of the ubiquitous network. However, due to special characteristics inherent in its distribution industry, Japan lagged behind the United States and Europe in moves based on specific needs of supply chains principally in the distribution industry. It is also true that another reason for such a delay was attributable to a lack of sufficient “speed.”

As explained in the previous sections, the moves of the GDSN and the EPCglobal Network were very rapid, and major reforms were implemented in only four to five years under the strong initiative of private-sector user company groups. Through such rapid activities, they were able to successfully take the initiative throughout the world.

In contrast, Japan was unable to catch up with such quick moves of the United States and Europe. Of course, there is a reason for such inability. Traditional distinctive
characteristics inherent in the distribution industry prevented Japan from taking such moves. If this situation remains, however, it will also be difficult for Japan to become a front-runner during the next stage of achieving a ubiquitous network society.

3 Expectations of Future Activities and Three Issues

Taking a composed view of the current status, several matters requiring attention to promote future activities to achieve a ubiquitous network society come to mind.

First, even though the concept can smoothly be established, there are a number of problems peculiar to Japan in facilitating specific activities, and difficulties will be encountered in many cases. From some aspects, the achievement of a ubiquitous network society means reforming existing business models and/or social practices, which constitutes a bottleneck for Japan. Accordingly, it is especially important for Japan to establish a clear-cut vision and formulate a strategy to eliminate this bottleneck.

Second, competition as well as cooperation is required with international society including the United States and Europe. To discuss the development of EPC standards, for example, daily meetings are held in English by means of voice teleconferencing. The reality is that unless we integrate ourselves into communities of other parties in international conferences, we will hardly be recognized as a full-fledged member in the discussions. Considering this reality, in some ways it is too much to expect Japan’s standardization organizations, which are established for each individual industry, to respond to such a situation.

If Japan intends to become a world front-runner in terms of strategy, it would be necessary to make increased efforts to establish and support organizations that include private-sector representatives as part of its national strategy to promote such international activities. More active involvement of the private sector will also be required, as is seen in the cases of the United States and Europe.

Third, overall processes should be accelerated. I think that just two to three years ago, only a limited number of people believed that the GDSN and the EPCglobal Network would become a reality. We are not used to international movements being made at such a fast pace. These highly accelerated movements in some parts of the world require that Japan also speed up the implementation of strategies. While it is easy to talk about speeding up, it is not at all easy to actually implement it. If we follow the movements of the GDSN and the EPCglobal Network in the United States, what are required include a stronger initiative taken by the private sector than that at present, a clear vision of government support for such activities and innovative research based on accurately identified world trends.

At the second phase toward achieving a ubiquitous network society, adequate preparations must be made by focusing once more on the actions necessary to promote strategy for Japan to take the lead in building a ubiquitous network society as a front-runner in the world, as set forth in the u-Japan Strategy.

References

Tadashi TSUJI is a chief researcher at the Center for Knowledge Exchange & Creation and general manager of the Business Innovation Department at NRI. His specialties include social systems, IT strategies and management strategies.
As a leading think tank and system integrator in Japan, Nomura Research Institute is opening new perspectives for the social paradigm by creating intellectual property for the benefit of all industries. NRI’s services cover both public and private sectors around the world through knowledge creation and integration in the three creative spheres: “Research and Consulting,” “Knowledge Solutions” and “Systems Solutions.”

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Inquiries to: Corporate Communications Department
Nomura Research Institute, Ltd.
E-mail: nri-papers@nri.co.jp
FAX: +81-3-5533-3230