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Necessity and Expectation for an Identification Scheme in IoT Service: Cases in South Korea

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Abstract

Background/Objectives: Individual things should uniquely be identified internationally, so that IoT services can be realized. Thus, a 'standardized, universal identification information system,' which can uniquely identify individual things and entities, is needed. **Methods/Statistical Analysis**: This study investigated the status of the use of identification schemes by industrial sector and by service through a keyword search in order to understand the global status of the use of the identification schemes. In addition, for an empirical analysis of the use of identification schemes in South Korea, a survey on the present condition of use and management of identification schemes was conducted with the entire industry sectors. **Findings:** As a result of a survey on the status of the use and management of identification schemes by industrial area and service investigated, it was found that identification number systems used uniquely for each industry varied. There is no standardized identification scheme used dominantly, but entry of each identification scheme into the IoT environment will play an essential role in implementing IoT service in various fields, such as smart farm, smart city, smart manufacturing, smart building, smart transportation, smart medical care, etc. Services and products in the initial stage of IoT currently implemented are themselves serving as a unique identifier or use a smart sticker or local area communication technology. In terms of technology, they are based on technologies centered on sensing and network rather than technologies about identification scheme. **Application/Improvements:** Not all IoT services must use an identification scheme in the future, an analysis of demands for identification schemes should precede, and based on this, a cost-benefit analysis is needed.

Keywords: Identification Scheme, Internet of Things, Ipv6, Identification, MAC, URL

1. Introduction

The Internet of Things (IoT) is a global service infrastructure in order to provide a service connecting various physical and virtual things based on ICT[1]. It is known that the term, IoT was used first as Kevin Ashton mentioned that, who was the director of the Auto-ID Center under the Massachusetts Institute of Technology (MIT) in the United States in 1999[2]. The Oxford Dictionary defines the IoT as "the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data"[3]. ITU suggested the concept of IoT through its "ITU Internet Report"[4]. While the existing IT allowed transactions of information between humans and things 'anytime' and at 'any place', the IoT is a concept to which 'anything' was added, which allows connections and communications between things and things as well as between humans and humans and between humans and things shown in Figure 1. Organizations that take charge of the standardization of the IoT, too, define the IoT as very various terms such as IoT, M2M, IoE, Web of Things (WoT) and Device to Device (D2D)[5,6]. For the

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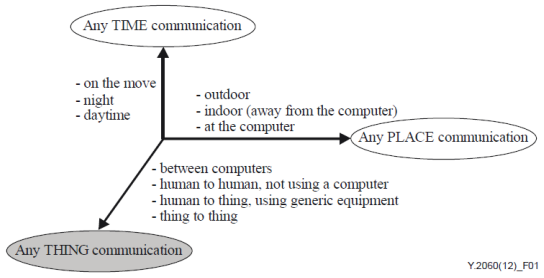

Figure 1. Concept of IoT.

implementation of this IoT, identification, data acquisition, processing and communications technology are used. Based on these, various services are going to be provided, using the information provided by things or acquired from things[7].

For the 'communications between things' at which the IoT aims, a unique identification system is needed, through which various devices, things and contents and services in information spaces can be identified[8]. However, there is no standardized identification scheme system, presently and various identification schemes are applied sporadically by country and service, so a standardized universal identification information system is needed shown in Figure 2.

Thus, this study would investigate the identification schemes used currently and discuss the role and necessity of the key identification scheme in the implementation of the IoT for communications between things.

2. Literature Review

2.1 Concept and Definition of an Identification Scheme

TTA[9] defines the term, integrated identification system as "an identification system used for the integrated identification, authentication and connection of users, networks and service elements". Jun[10] considers IP an identification scheme, noting, "basically, a prerequisite of things connected to the IoT is that they are connected to a network with unique IPs so that their IDs can be identified". The Korea Communications Commission[11] defines the identification system in a communications network of things as "an essential element for implementing a diverse, complex commercial service, which can be found, differentiated and provided, no matter where a thing moves and where one accesses". Individual countries and industries define an identifier in various ways and carry out standardization in numerous standardization groups. However, there is no clear definition about a universally defined identification scheme. Lee[12] mentions the importance of the identification system, noting, "Things in the same or different types existing in this world should be recognized as a unique identification system and address system, which is the very technology that must be settled first for the vitalization of IoT services".

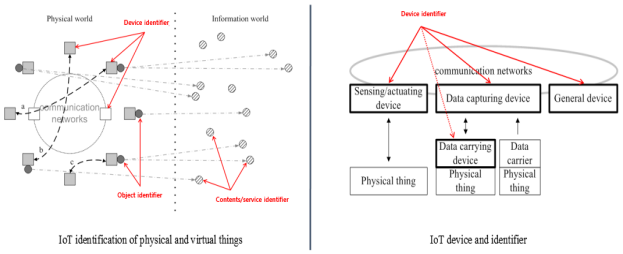

Figure 2. Necessity of an identifier in the era of IoT.

2.2 Research on the Identification Scheme

ITU-T[13] divided potential identifiers related to the network conceived in Recommendation ITU-T Y.3001 through Recommendation ITU-T Y.3031 according to two types by readability and scalability, and the identification framework implemented in the future network was presented, divided into components such as ID discovery services, ID spaces, ID mapping registries and ID mapping services. IoT@Work[14] viewed Uniform Resource Name (URN) system, ISOIEC 9834-1/OID system, EPC global, Digital Object Identifier (DOI) and NetBIOS as the most basic identification schemes. EU-China IoT Advisory Group[15] classified the kinds of IoT identification scheme into application identifiers, communication identifiers and object identifiers. GS1[16] established Standards for RFID tag to which the application features such as locating and reading were added. In July 2014, it revealed 'an open language for the IoT' as an open source. Through revealing the open source, GS1-based IoT infrastructure platform can expand so that it can accept various IoT protocols such as barcode, RFID, Zigbee and 6LoWPAN. OCG[17] began to develop SensorThing API, which is a lightweight standard that can be approached from an IoT device and application. SensorThing API was designed, so that components that could approach using a URI address for the actions of Create, Read, Update and Delete

(CRUD) in certain resources. Thread[18] is coming up with a method for connecting and controlling household devices using 6LoWPAN, an IPv6-based low power wireless short-range personal network. OIC is working on the standardization of close range wireless communications, including Wi-Fi, Bluetooth, ZigBee and NFC in the form of an integrated platform.

3. Status of use of Identification Scheme

This study investigated the status of the use of identification schemes by industrial sector and by service through a keyword search in order to understand the global status of the use of the identification schemes. In addition, for an empirical analysis of the use of identification schemes in South Korea, a survey on the present condition of use and management of identification schemes was conducted with the entire industry sectors. Considering the fact that there is no clear definition of an identification scheme, globally, this study defined it as information that allows the 'unique identification' of the uniqueness of an individual or thing in terms of "identification information". Based on this definition, the status of use was investigated.

3.1 Status of use by Industrial Area

This study conducted a key word search concerning the status of identification scheme-based services. The key word search was conducted based on the categories of Korea Standard Industrial Classification (KSIC) of the National Statistical Office appropriate for the classification of industrial sectors. The KSIC of the National Statistical Office classifies the industrial activities mainly carried out by private businesses into 21 items according to similarity for the characteristics of the Korean industries. This study investigated the status of use based on 17 categories except four categories (N. Business facilities management and business support service industry, R. The arts, sports and leisure related service industry, T. Employment activities in the household and Self-consumption and production activities not classified otherwise; and U. International and foreign organizations) unrelated to identification schemes in the categories of the KSIC. Through an additional search of key words provided by Google 'Suggest,' the survey was conducted, expanding to the relevant page, based on identification schemes with a high frequency.

Key words such as no classification, identification, code, number, sensor, sensing, addressing, naming, IoT and WoT were used in AND/OR combination, which were composed by the combination of 'identification' and IoT that needs the function of identification. The search was conducted by the combination of IDs and identifiers, instead of identification.

Criteria for selection were set up as follows: 1. Whether it has the function of identifying the target object uniquely; 2. Whether it has a system that provides a code/number systematically by standards or statutes; 3. Whether it is used universally, instead of certain operators; and 4. Whether it is obligatorily used based on standards or by statutes.

The results of the search were arranged based on the categories of the 9th standard industrial classification of the National Statistical Office, and the arranged identification schemes are 85. The sectors of industry in which the largest number of identification schemes are used are publishing, video, broadcast communications and information service industry, and in the sectors of industry such as mines and education, it appeared that one identification scheme is used are shown in Figure 3. There was a number of identification schemes uniquely used in each industry. It was found that the government directly managed identification schemes for the purpose of national security for agricultural safety management, food distribution management, location service for relief and rescue, administrative management, medical information and medication management. It is understood that these usually serve as the 'number for management'. In the sectors of manufacturing, wholesale and retail trade, it was found that various product codes of GS1 are used, such as GTIN-13, GS-1 128 and EAN/UPC, and it was found that these identification schemes can accept part of regional networking capabilities like reciprocal position detection. In the transport industry, considering international conflicts or safety issues in high seas and on the sea, a large number of identification schemes to manage aircraft and shipping and identify nationality have been used, but they have conditions of identification only. In the industries of publishing, video, broadcast communications and information service industry, they have been used to protect important contents to secure intellectual property rights and to clarify the issue of revenue allocation, and a number of identification schemes have long been used by the type and shape of the contents.

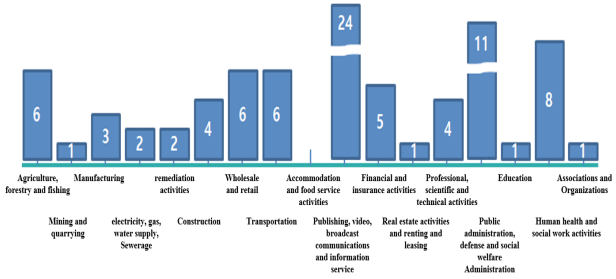

Figure 3. Status of use of identification schemes by each standard industry area.

3.2 Status of use by Each Service

This study investigated the status in which the actually identified scheme is not just used for the purpose of identifying the relevant object (thing or information) but also used for providing a new service by the identification. This did not include the following cases: They are classified by characteristic or group in the status of use for each service, they use a random system, only certain operators use them, and they are recommendations or guidelines. In addition, the cases of identification scheme-based services in South Korea, a number of contents about service plans related to RFID or USN for the construction of u-city or pilot projects on ENUM were found, but whether they were currently in service is not verified, so they were excluded.

Consequently, this study summarized services or pilot projects in South Korea, among the identification schemes for which standardization has already been completed (Mostly, services in progress or pilot projects planned as of August 2015). In terms of service, in the result of a survey on the use of identification schemes, OID, UCI, RFID and URL are mostly used are shown in Table 1.

3.3 Survey on the Status of use of Identification Schemes

Whether the identification schemes confirmed to be currently used, which were drawn through the Internet search above, were in use in the actual industry, was investigated. The survey was conducted for about one month, from the end of August 2015 through the end of September, with 518 domestic companies among the entire industry sectors. Main survey questions include: Whether do they have an identification scheme in use for a special purpose? What is the kind? What is the detailed usage? What difficulty do they have in the use and management of the identification scheme?

126 companies, 24.3% of 518 respondents responded that they were using and managing an identification scheme at the time of the survey. Regarding whether they would plan to introduce a new identification scheme in the future, 11.1% of the businesses currently using an identification scheme responded that they had a plan to introduce a new identification scheme in addition to the identification scheme they were currently using. To the same question, only 7.0% of the businesses that responded that they were not using and managing any identification scheme currently responded that they had a plan to introduce one. Thus, companies that recognized the necessity of an 'identification scheme' were already using many identification schemes and relatively active about the introduction of a new scheme while those that were not using any currently did not recognize the necessity of the introduction in the future, either.

To examine the present status of the use and management of identification schemes, it was found that IPv4, URL, MAC, business registration number and customer number are used mostly. Of the respondent businesses, Internet Service Providers (ISPs) hardly use an identification scheme for contents identification while Contents Service Providers (CSPs) use identification schemes to identify and manage particular types of contents such as SBN, SSN, USID and UMID, etc. It can be derived that there are a lot of differences in the identification schemes used according to the characteristics of the industry. In addition, it was noted that business registration number and customer number are utilized as the basic identification scheme commonly by most operators. Concerning a plan for the introduction of a new identification scheme in the future, since IPv4, IPv6, MAC, URL, business registration number and customer number are most preferred, it can be inferred that the above identification schemes are recognized as having a value as identification schemes by businesses.

It was found that most of the purposes for the present use and management of identification schemes were "identification and management of network equipment". It is noted that it is necessary to solve the difficulty in duplicate management through the standardization of identification schemes as high rates of responses to a question about the difficulties in the use and management of identification schemes were "there are too many kinds of identification information systems to manage" and "It

Table 1. Status of use of identification schemes by service

Classification	Identification scheme	Identification of cultural contents	COI
Authentication of e-signature	OID	ISBN-A (U.S.)	DOI
Authentication of wireless e-signature	OID	Smart band for lost child prevention	UUID
Identification of medical image communication equipment	OID	Smart wireless recharging	UUID
Area of the Internet network management	OID	Trial service of Korean e-mail address	Multilingual email
Area of RFID	OID	GTIN-13	Barcode
Project on trial service of ENUM	ENUM	GTIN-14	Barcode
Project on the assignment of UFID	UFID	RFID-based u-medication sharing system	RFID
Open platform of spatial information	UFID	Project on the construction of common RFID infrastructure for air cargo based on RFID	RFID
The Academy of Korean Studies	UCI	Project on the construction of common system for the manatgement of food safety information based on RFID	RFID
National Research Foundation of Korea	UCI	RFID/USN-based mode intelligence system development	RFID
Seoul Business Agency	UCI	Mobile RFID service	RFID
Munhwa Broadcasting Corporation (MBC)	UCI	Safety management for the distribution of transfusion blood packs based on temperature tags	RFID
Korea electronic publishing association	UCI	Construction of a safety management system for industrial hazards based on gas sensing tags	RFID
National Information Society Agency	UCI	Innovation of clothing distribution management using sewn printing tags	RFID
YouTube	CID	System for identification and search of animals	RFID
SBS Contents Hub YouTube Copyright Committee	CID	Google Physical Web	URL

is burdensome because they are just targets of management, but not data that create new added values".

4. Demand and Service for Identification Schemes for the Implementation of IoT

4.1 Major Industries in the Era of IoT

Through a report, Cisco[19] forecasted that an era will come, when various things such as hats, clothing and shoes are converged on IT technology and that about 50 billion things will be connected by communication by 2020. IBM[20] predicted that 30 billion objects that function as sensors will be connected to a network with the development of sensor and recognition technologies by 2020. Gartner[21] forecasted that the number of objects interconnected via the Internet will reach over 26 billion by 2020 and that the comprehensive benefit created through the sales and uses of IoT technology will approach 1.9 trillion dollars. Gartner picked up the areas such as manufacturing (15%), health care (15%) and insurance (11%) as areas that would create the most added values through the IoT and noted that such added values would be created through the combination of a technology for a particular purpose with an existing common technology. McKinsey [22] announced the results of a study of the method by which the IoT creates a value and obtains a value through companies, people and the economy. McKinsey presented

Table 2. Prediction of demands for identification schemes by industry in the categories of KSIC

KSIC	Status of use of identification schemes (As-Is)	Status of use of identification schemes and example of the future demands for application (To-Be)
Agriculture, forestry and fishing	Livestock farm unique identification number, Beef identification number, Pork identification number, Beef importation and distribution identification number, Agroproduct history tracking number, marine product history number, etc.	Smart farm[23]
Mining and quarrying Electricity, gas, steam and water supply Sewage, waste management, materials recovery and remediation activities	Mine lot number, LPG container number, Power pole number, Standard plastic garbage bag authentication code, Asbestos survey identification number, etc.	Smart city (Automation of power transmission and distribution, Smart grid, etc.)[24]
Manufacturing	Global Trade Item Number (GTIN), Shipping Container Serial Number (SSCC). Vehicle Identification Number (VIN)	Smart manufacture (Industry4.0)[25]
Construction	Elevator management code (QR code/barcode format), UFID, Figure, map, geographic feature standard code, Integrated construction information classification system, etc.	Smart building (Home automation, Building automation, Building structure management, etc.)[26]
Transportation	Airport code, Airline code, Aircraft Registration Marks, Ship identification number, MMSI (Maritime Mobile Service Identity), Car registration number	Smart transportation (Telematics, Fleet management, Autonomous vehicle, etc.)[27]
Accommodation and food service activities	Business registration number, Beef identification number, etc.	Key word advertising and use of signage/brand
Information and communications	UMID (Unique Material Identifier), V-ISAN (International Standard Audiovisual Number version identifier), CRID (Content Reference Identifier), COI (Content Object Identifier), UCI (Universal Content Identifier), DOI (Digital Object Identifier), Grid (Global Release Identifier), USID (Unique Source Identifier), ISBN (International Standard Book Number), ISSN (International Standard Serial Number), etc.	High-tech security controller and identification scheme by the information/communication equipment can be used in machine-to-machine communications
Financial and insurance activities	ISIN (International Securities Identifying Number), CFI (Classification of Financial Instruments), LEI (Legal Entity Identifier), BIC (Bank Identifier Code), Credit card number, etc.	O_2O
Real estate activities and renting and leasing	National basic districts number, geographic feature identification number (UFID), National Digital Map Standard Layer Code, etc.	Immersive communication, Real-time location information-based life service
Business facilities management and business	There are car registration numbers, but there is no industry-specific identification scheme used	Location information-based parking management, etc.[28]
Education	National Information about Education System (NIES) identification number, etc.	U-learning, Immersive communication
Human health and social work activities	There are a number of identification information systems for safe drug distribution (Common globally), and there is a patient identifier for the distribution of medical information, but hospital's inner identification information system is used.	Smart medicine[29]

Human, Home, Retail Environments, Offices, Factories, Worksites, Vehicles, Cities and Outside as areas of value creation of the IoT and forecasted that a lot of added value would be created by the IoT. In particular, he predicted that there would be a lot of changes in the lives of the people who are more active in using technologies, which would completely change the business model not only of general users but also of technology providers.

4.2 Demands for Identification Schemes by Industry in the Era of IoT

As a result of a survey on the status of the use and management of identification schemes by industrial area and service investigated in Section 3, it was found that there was a number of identification number systems used uniquely for each industry. There is no standardized identification scheme used dominantly, but entry of each identification scheme into the IoT environment will play an essential role in implementing IoT service in various fields, such as smart farm, smart city, smart manufacturing, smart building, smart transportation, smart medical care, etc. shown in Table 2.

4.3 Identification Scheme-based Services in the Era of IoT

Services and products in the initial stage of IoT currently implemented are themselves serving as a unique identifier or use a smart sticker or local area communication technology. In terms of technology, they are based on technologies centered on sensing and network rather than technologies about identification scheme. However, for the industrialization and growth of the IoT, studies of identifier classification and development of an identification information service model will become more important. What is of the most importance is in the current era of smart is constructing an ecosystem. A well-ordered ecosystem may have a lock-in effect on partners as well as consumers, so a sustainable business model can be constructed[30]. The number of machines, communications equipment and things connected to the Internet will increase from about 10 billion in 2013 to about 50 billion in 2020, and the range of connection for information delivery will expand from the delivery between humans and humans to the delivery between humans and things, and the delivery between things and things[31]. In this situation, 'identification scheme' can be said to be the beginning of the composition of an IoT ecosystem.

Currently, the IoT is in the initial stage, securing device and network infrastructure is the major key competency and used as a concept in which individual is not differentiated with a sensor node. However, if the penetration of IoT devices gradually increases, it is predicted that the importance of contents and platforms will become greater, and contents and platforms will be integrated and provided for customers in the form of a service[31]. Then, individual and sensor node should be separated, and it is necessary to compose a network that can secure constant connectivity so that they are connected to a public network beyond a sensor network forming an independent network. Once the network with constant connection is composed, the number of things connected to the Internet increases and the number of individuals of the range of connection expands. Therefore, for providing customers with a quality service, the role of an integrated identification scheme that can identify them will become more important. A review on the technology and marketability is needed for the implementation of such an identification scheme-based IoT service.

This study will present an appropriate service, combining the industrial sectors, such as medicine, construction and logistics, where it is expected that the most added value will be created in connection with the implementation of the IoT with barcode, RFID, OID and URI, which are the identification systems for which there will be the most demands in the era of IoT.

4.3.1 Medical Care

In the medical information area, considered one area of IoT, OID has long been used, and the main purpose was managing the contents and medical information generated by medical imaging equipment. The information about them is summarized in "Health and medical information OID"[8]. Like this, for the purposes such as safe medication management, patient management and sharing medical information between hospitals, in the network environment in the hospital, a large number of identifiers, such as RFID code, OID and patient identifier are in use, but the use of medical service in an environment away from the hospital has not yet been confirmed.

U-Health is defined as providing health care and medical service using safely and freely, any time, at any place and by anyone, through a ubiquitous IT technology, a concept that provides health and medical information, service, knowledge and products for consumers and allows the understanding the existing medical system,

anytime and at any place by applying IT technology. This is a concept that covers tele-medicine, tele-health and e-Health.

The Ministry of Knowledge Economy classified u-Health service into 1. Treatment-centered u-Medical for chronic patients; 2. Nursing-centered u-Silver for the elderly over 65; and 3. Health care-centered u-Wellness for the general public[32]. Of them, u-Wellness is the health care service that provides a preventive health care service for the general public leading a normal life. Especially, through 'u-Wellness', the space of medical practice, too, is not limited to hospitals, but it can be directly managed personally or at home, and according to this flow, large hospitals, too, establish subsidiaries or carry out u-health care service in cooperation with a medical information business.

The areas of u-Health technology include bio/life information sensing technology for u-Health; bio/life information analysis technology for u-Health; and u-Health application service technology[33]. Especially, the areas of wellness technology consist of 'sensor technology' for monitoring various vital signs; 'gateway technology' for communications with sensors and data transmission; 'personal wellness data structuralization technology' for structuralizing and processing wellness data; and 'analytical processing technology' for analyzing the status by individual, based on the collected data and providing personalized feedback accordingly, and by the nature of the technology element, they can be divided into data, device and service. U-Health was defined as the area of technology to standardize, into vital information monitoring technology, everyday life monitoring technology and u-Health application service technology[29].

4.3.2 Construction

There is a high interest in the construction and management of smart buildings. This covers environment-friendly energy management of urban buildings such as houses, offices, cultural properties and shopping malls and the implementation of information/communication technology and aims at the implementation of a smart city through combining these smart buildings. By giving integrated identification schemes to buildings or building materials, a smart library that implements easier bibliography information and related information search through the communications among objects such as desks, chairs and books, or a smart museum/art gallery like work description can be implemented, and it is also possible to construct a community safety system for the relaxation and safety of the people.

For various certification systems for intellectualizing buildings or securing connectivity as entities in the era of IoT have already been introduced or the introduction is in review. As one of the evaluation items for these certification systems, if the item, 'Giving and managing an identification scheme' is designated as the basic infrastructure of electricity and ICT, it is expected that the ripple effect will be great. It is expected that the identification scheme may be utilized as an identifier to classify buildings and used as a communication code for the communication between individuals.

As of 2015, Korea Energy Management Corporation of the Ministry of Land, Infrastructure and Transport is preparing for the introduction of a certification system for Building Energy Management System (BEMS) and promoting studies of pilot certification[26]. Management of energy consumption in the building environment comes to the fore as a very important issue, and the system technology that provides the function of energy management in buildings is the BEMS technology. BEMS is a system that installs sensor and measuring equipment in buildings for equipment using energy such as lighting, air conditioning/heating equipment, ventilation equipment and outlet, monitor the usage by each energy source in real time in connection with a communications network and automatically control the collected information about the energy use as the most efficient plan for management through an optimization analysis SW. To construct a BEMS, the convergence among construction technology, information/communication technology and energy technology is needed.

4.3.3 Logistics

Through a report on the 'Internet of Things in logistics' published in collaboration with Cisco[27], DHL predicted that the value created through the IoT will be a total of 8 trillion dollars. Of them, it was predicted that there would be a ripple effect of 1.9 trillion dollars in supply chain and logistics field. In addition, in the future, when it was applied to the IoT technology in the logistics business, it was predicted that innovative logistics operation method would be possible in four sectors such as efficiency and safety of logistics operation, security, customer experience and new business model. In addition, utilizing and

optimizing logistics assets to promote the operation efficiency is one of the most important values of the IoT, and as areas for the promotion of the logistics operation efficiency through the IoT technology, traffic control and vehicle management, resources and energy monitoring and manufacturing automation, etc. were selected.

Through a seminar of smart logistics systems, Korean Agency for Technology and Standards explained that the IoT that can maximize the logistics efficiency through a logistics standardization strategy by the IoT is a key word of smart logistics. Since the IoT facilitates safe storage and delivery of goods and inventory management, it is expected that it will greatly increase customer satisfaction like cost savings. Along with this, the current global logistics business makes various attempts to adapt to the new logistics system suitable for the era of IoT, and the area to which the most importance is attached is the standardization of logistics[34].

5. Conclusion

This study defined "identification information" as information that guarantees the uniqueness of the target object. This study attempted to investigate the identification scheme-based service in the era of IoT by surveying the kinds of identification schemes used in real life (Literature review, the Internet survey and actual condition survey, etc.), based on the definition of the identification scheme, and the major identification schemes and industrial sectors for the implementation of the era of IoT service in the future.

As a result, for the implementation of the IoT, identification schemes in which the largest number of demands is expected, included global standard codes of EPC, such as barcode/RFID, OID and URI, and as areas in which identification scheme-based service can be developed and an analysis of its ripple effect can be conducted, areas of medicine, construction and logistics were selected. Based on this, as identification scheme-based services in the era of IoT, u-Health in the medicine field, evaluation items and BEMS of the certification system of 'the assignment and management of an identification scheme' in the construction field, logistics standardization in the logistics field were presented.

Since, basically, not all IoT services must use an identification scheme in the future, an analysis of demands for identification schemes should precede, and based on this, a cost-benefit analysis is needed for whether it was based on an identification scheme or not. In addition, it is necessary to discuss a concrete business model for the construction of such an identification information service ecosystem, too.

6. Acknowledgment

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