

## IoT(Internet of Things) based Smart City Services for The Creative Economy

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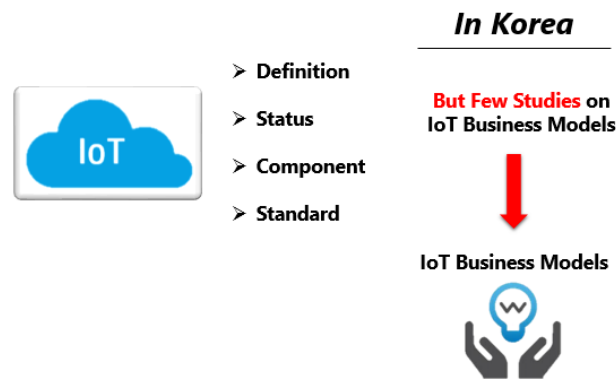
### Abstract

*The Internet of Things (IoT) is a pervasive technology in the IT industry, and several companies and governments have tried to make references with the IoT in the past. However, in the manufacturing, retail, and social overhead capital (SOC) industries, successful best practices are built recently. In this paper, I have outlined the tangible IoT based service models, which are helpful to the academic and industrial world for a better understanding of the IoT business. The South Korean government has suggested a “creative economy” as the country’s new economic development paradigm, and strived to establish a creative economic ecosystem by building platforms. IoT is one of the technologies focused on the implementation of the “creative economy”. Therefore, the central government and many local governments are eager to invest on the IoT area in order to build smart cities.*

**Keywords:** *IoT, Internet of Things, Smart city, Creative economy, Sensor, Business model*

### 1 Introduction

In this study, such as Figure 1., the domestic and international studies on IoT were reviewed, the definition and market size of the IoT were examined, and the investment trends related to IoT in advanced nations were investigated. Furthermore, the IoT services, which are suitable for the Korean situation and can be implemented immediately, are introduced in order to assist the government officials, industries, and academic circles in establishing smart cities.



**Figure 1. Introduction of IoT in Korea**

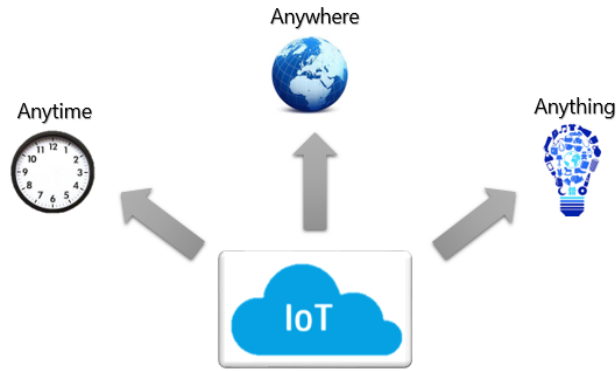
## 2 Related Works

Byun, Kim, Sa, and Others(2016) in the proceeding paper, ‘Smart City Implementation Models based on IoT(Internet of Things) Technology’, outlined IoT based smart city business(service) model[1]. Gaur, Scotney, Parr, and Mcclean(2015) stated in their paper, ‘Smart City Architecture and its Application Based on IoT’, that the IoT and wireless sensor network contribute a large amount of data. In order to take advantage of the increasing amounts of data, there is a need for new methods and techniques for an effective data management for the IoT[2]. Meanwhile, Park and Rue(2015) introduced in their paper, ‘Analysis on Smart City Service Technology with IoT’, the technologically advanced countries’ IoT based smart city service models. Examples of this are the smart grid, parking management system, smart home, smart farms using foreign cases, and basic introduction[3]. Ji, Ganchev, O’droma, Zhao, and Zhang(2014) presented in their paper, ‘Cloud-Based Car Parking Middleware for IoT-Based Smart Cities: Design and Implementation’, the generic concepts of using cloud-based intelligent car parking services in smart cities as an important application of the Internet of Things paradigm. They showed a high-level view of the smart parking system middleware and demonstrated the provision of car parking services[4].

## 3 IoT

### 3.1 Definition of IoT

The rapid development of information technology (IT) has brought forward a hyper connected society in which objects are connected to mobile devices and the Internet and communicate with one another[5]. In the 21st century, we want to be connected with anything anytime and anywhere, which is already happening in various places around the world. The core component of this hyper connected society is IoT, which is also referred to as Machine to Machine (M2M) communication or Internet of Everything (IoE).



**Figure 2. Definition of IoT**

### 3.2 IoT Market Size

According to Cisco, which is the leading IoT solution provider, the number of things connected to the Internet (terminals, network devices, and machines) is expected to increase from approximately 200 million in 2000 to approximately 10 billion in 2013. At this rate, approximately 50 billion things, including people, are expected to connect to the Internet, and the IoT infrastructure will spread rapidly by 2020. Cisco claims that the IoT will be expanded to the IoE (Internet of Everything).

Examples of IoT applications will increase gradually in every industry. The IDC predicts that the global market for IoT will exponentially grow from \$655 billion in 2014 to \$1.7 trillion in 2020[6].

### 3.3 Implementation Status of the Major Countries

#### (1) USA

In 2009, the Department of Energy established the 'Grid 2030 Plan' to invest 386.2 billion Won in an M2M-based smart grid project and other projects. Since 2012, they have been operating the Domain Awareness System (DAS) that connects the private and public CCTVs and sensors in New York City in order to prevent terrorism. The National Intelligence Council (NIC) selected the IoT as one of the disruptive civil technologies that will affect the national competitiveness and provide national support until 2025.



**Figure 3. Smart Grid 2030 Plan**

## (2) China

The Chinese State Council announced that they would invest 6 trillion Won in the IoT areas, including smart grid, in the mid-term to long-term science and technology development plan (2006~2020), and build an IoT industrial complex and research center near Shanghai in 2010. As a strategy to promote national projects and support policy, the Ministry of Industry and Information announced the IoT 12-5 Development Plan, which covers the national core technology development, industrialization, standard research, and establishment. The detailed goals of the IoT 12-5 Development Plan include over 500 major research achievements in the sensor, transmission, processing, application, and other technology areas, the establishment of more than 200 standards, and the cultivation of 10 industrial special districts and over 100 core enterprises.

## (3) EU

In 2009, the EU announced the IoT Action Plan to invest 76.9 billion Won in the IoT research and development, and the construction of clusters. They selected a 'future network basis' as one of the top seven R&D projects for the seventh term since 2009. They are now promoting R&D and pilot services according to the action plan with the goal of infrastructure construction to prepare for the connection of several billion population and several trillion things. Since 2005, they have obligated the installation of the vessel monitoring system (VMS) in all ships in Europe.

## (4) Japan

They included a plan to develop M2M technologies and services based on the sensor network in the 'i-Japan 2015 Strategy' in 2009. In 2011, they funded 3.8 trillion Won for the development of the neighborhood-level technologies for things and devices. In order to create new industries based on the recent ICT convergence, they set the direction of the Internet of Computer (IoC) to Internet of Things (IoT) through digitalization and networking, and released policies and action plans for the cultivation of the top six strategic areas and infrastructure development projects.

## **4. Smart City Implementation Models based on IoT**

Recently, many local governments have been aiming to implement an IoT-based smart city through the construction of a test bed for IoT verification and an integrated infrastructure. This movement also corresponds to the creative economy that is emphasized by the Korean government. In this chapter, smart city implementation models based on IoT that can be implemented by local governments are described through examples.



Figure 4. Smart City Implementation

#### 4.1 Smart Traffic Service

##### (1) Service Outline

Major smart traffic services include smart parking services to prevent illegal parking and facilitate convenient parking[7], citizen participation-oriented illegal parking prevention services, and smart safe crosswalk services. Smart parking refers to the construction of a platform that enables real-time checking of available space and parking prices in areas that require parking and facilitation of reservation/payment through Web and mobile connections. The citizen participation-oriented illegal parking prevention service is an improvement of the illegal parking crackdown system of the traffic authority by allowing citizens (including victims of illegal parking) to conveniently report such violations through their smartphones[8]. Furthermore, the smart safe crosswalk service can contribute to the prevention of pedestrian accidents and secondary car accidents by detecting pedestrians in children protection zones, and alerting pedestrians and approaching vehicles through electronic display boards.

##### (2) Service Diagram

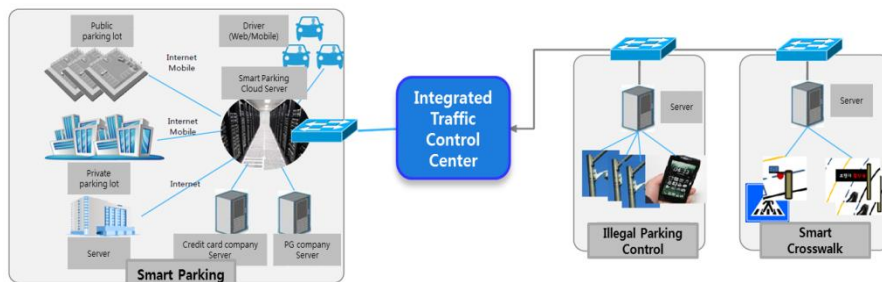


Figure 5. Smart Traffic Service Diagram

#### 4.2 Smart Education Service

##### (1) Service Outline

This service provides real-time, interactive high-definition lectures that feel like face-to-face meetings at home through high-definition (HD) services and wide-area Internet infrastructure. Instructors participate in the lectures by using equipment in

private educational institutes or separate places, and even foreign language teachers in other countries can access this service through the Internet.

(2) Service Diagram

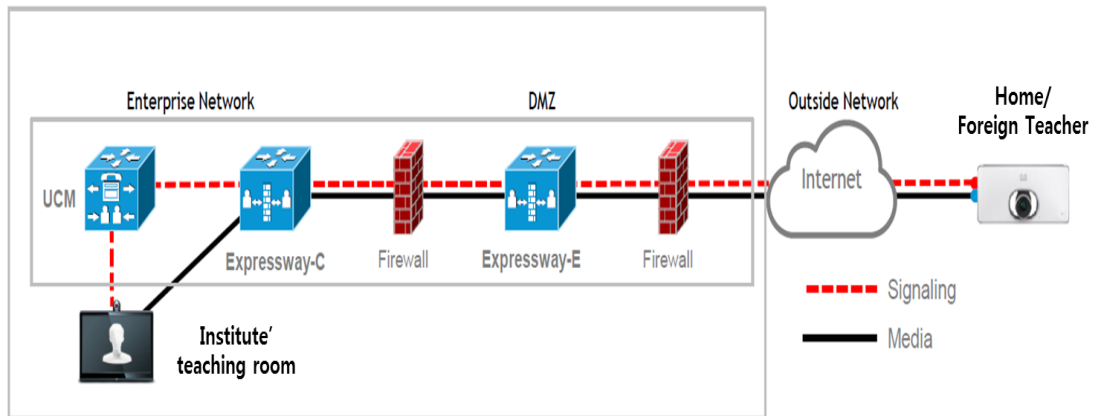


Figure 6. Smart Education Service Diagram

### 4.3 Smart Healthcare Service

(1) Service Outline

Basically, continuous health care is required regularly or irregularly based on information about biorhythms during the daily life of individuals. This will enable us to reduce unnecessary medical expenses and to discover diseases in early stage, thereby laying the ground for saving medical expenses. Individual biorhythms (pulse, blood pressure, *etc.*) are automatically registered together with personal information through the basic medical devices installed in every individual household, health center, dong office, *etc.* The system can be configured in such a way to periodically accumulate health information and send the current health condition through big data analysis via mobile devices or allow users to access the portal and check the health information. In addition, a system for exchanging medical image data (PACS, MRI, CT) between general hospitals and small and medium partner hospitals is needed to save the cost of duplicate image data.

The remote home care with such smart healthcare services has significance because it can minimize medical expenses and prevent unexpected accidents of the alienated elderly people such as senior citizens who live alone.

(2) Service Diagram



**Figure 7. Smart Healthcare Service**

## 5 Conclusion

This study is significant in outlining general information about IoT, such as definition, market size, and status of IoT, which has become a hot IT topic nowadays, and in presenting applicable IoT business models to help business entities and research institutes participating in related projects build a smart city as part of the future vision of local governments by reflecting the new information paradigm of IoT. A limitation of this study, however, is the lack of available data in Korea that hinders the required empirical analysis on the benefits of IoT technology. We hope that more research in this field will be conducted in the future.

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