

A Surveys based on Cloud Internet of Things Frameworks for Smart Home Service

Changhyung Kim, Kyoung-Yoon Jeong, Sang-Geun Choi, Kyounghak Lee and Chae-Bong Sohn

Abstract—Smart home service has been researched and attempted to commercialized for a long time. Recently, many smart devices that can be used for smart home services have increased, and smart home service based on IoT(Internet of Things) has been developed remarkably following by the development of the wired and wireless network environment.

IoT can be defined as intelligent infrastructure based on information communication. Some examples of IoT services are smart home, health care, and AMI (Advanced Metering Infrastructure). Smart home service is a service that can connect household devices such as home appliances, TV, intelligent power management equipment and wearable appliances.

In this paper, we will examine surveys based on trends of cloud IoT technology and standardization, and an example of an open platform with economic framework.

Keywords—Internet, Internet of Things, Frameworks, Smart Home Service, Cloud.

I. INTRODUCTION

Smart home service is a residential environment technology that enables automatic control and remote control by connecting household appliances, air conditioning, and security devices to the network. This concept has been studied with Intelligent Building, U-City, etc., and various services have been made. Recently, the development of IoT devices has changed into a new technology trend, not an extension of existing services.

The Internet of Things is about connecting internet-enabled devices that relay information back to us, to cloud-based applications and to each other (device to device). These 'smart' devices can be anything from mobile phones, connectivity fridges, washing machines to wearables, equipment or sensor. Recently, changes in the mobile network environment have given wings to IoT Technology. IoT-based smart home service became a catalyst for popularization.

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IoT-based smart home service can remote control home appliances or open and close doors from the outside, but it is a different concept to home automation in which each function can operate independently. For example, when operating an air conditioner device from the outside, the window can be opened and closed without human intervention by communication between the window and the air conditioner device. The development of IoT devices can be based on the development of smart home services. The IoT-based smart home service is a blue ocean that stands out in front of us.

In this paper, surveys based on trends of cloud IoT technology and standardization, and an example of an open platform with economic framework will be examined.

II. BASE TECHNOLOGY

A. What is IoT?

A few years ago, IoT was a new technology, and the standard was not yet established. The definitions of IoT for each organization are followed:

- ETSI (European Telecommunications Standards Institute):
Communication between two or more entities that do not necessarily need any direct human invention.
- IEEE (Institute of Electrical and Electronics Engineers):
Information exchange between a subscriber station and a server in the core network or between subscriber station, which may be carried out without any human interaction.
- ITU (International Telecommunication Union):
A world-wide network of inter-connected objects uniquely addressable, based on standard communication protocols.
- KCC (Korea Communications Commission):
Internet-connected communication technology that intelligently collects, processes, and processes information without human intervention.

B. Concept of Smart Home

The smart home system shows the rapidly changing ICT ((Information & Communication Technology) in the residential environment.

- TTA (Telecommunication Technology Association):
Smart home has defined as "Intelligent information technology that provides a real-life service in a human-centered service environment where lifestyle devices are networked and interact with people

naturally”.

- In the Korea KASH (Korea Association of Smart Home): Smart home has defined as "Smart Home is a human-centered smart-life environment that enables users to enjoy convenience, welfare and safe living by converging IT into the environment of residence”
- In the Korea KCA (Korea Communications Agency): Smart home has defined as “Ubiquitous environment that can be managed to manage home environment conveniently based on wired and wireless communication network and digital device, and environment of residence in which such system is built.”
- Wikipedia has defined smart home as "the use of control systems and information technologies to reduce the need for human work in the production of goods and services."

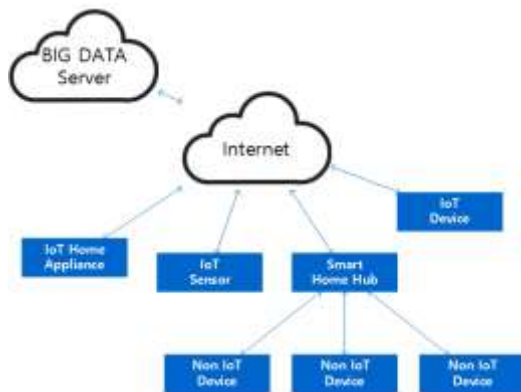


Fig. 1 Smart home Service framework

The basic concept of smart home service is shown in Fig 1.

C. IoT technology as the base technology of Smart Home

● Communication Technology:

Recently, the communication technology environment has rapidly changing from wired to wireless. In the past, it was necessary to consider wiring from the architectural design stage for smart home services. However, with the development of wireless environment, smart home service in existing environment of residence has been facilitated, and the potential market has greatly expanded. IoT communication technology for smart home service can be divided into device-to-device communication and internet communication. Device-to-device communication technologies include BLE, Z-wave, and Zigbee. Internet communication technologies include 3G, 4G, LTE, and WiFi.

● Data acquisition technology:

Data acquisition technologies include various physical sensors for temperature, humidity, illumination, and position; recognitions for fingerprints, irises, facial expressions, and texts; speech recognition to recognize user's speech; and context recognition using artificial intelligence.

● Data Processing and Correct technology:

Data processing is particularly important because IoT generates a huge amount of data. Therefore, data mining, big data, and cloud services are key to IoT technology and are becoming a big issue in recent years.

III. INDUSTRY & MARKET TREND

According to the exhibits at CES, one of the three major consumer electronics exhibitions in the world, IoT and smart home services have become major trends in the consumer electronics industry in recent years. IoT and smart home services have become major trends in the consumer electronics industry in recent years. At CES 2015, convergence is accelerating the convergence of heterogeneous geologists. Most of the participating companies released product strategies and new products with the IoT era in mind, and Samsung Electronics CEO Yun Kyung-keun said in his keynote speech that all products will be connected to IoT within five years [1]. At CES 2016, connected home appliances have been taken up a large number of exhibition spaces aimed at the smart home market. Major consumer electronics companies have presented a smart home solution and platform that integrate them, and many companies have exhibited new-concept consumer electronics that utilize a variety of standards and platforms.

Based on the Smart Things platform acquired in 2014, Samsung presented its direction. We have already secured cooperation with over 200 other companies and presented ecosystems that support smart homes.

LG introduced a gateway called SMARTTHINQ Hub. It is a gateway for smart sensors and connected appliances, and has features such as personal calendar information and music playback through built-in speakers.

Whirlpool presented a variety of connected appliances: a smart refrigerator, a smart front control range that works with Nest, and a smart dishwasher with an Amazon Dash button. Unfortunately, Apple's home-kit linked products were a bit small, and Nest-led ecosystems did not show up. The strongest of the smart home are the alphabet of Nest and Apple. Another move is the Amazon, represented by the echo and dash buttons. If Samsung is able to standardize through multiple alliances and build up its ecosystem with Smart Things, Google (NEST) / Apple / Samsung / Amazon are expected to lead the industry [2].

IV. STANDARDIZATION TREND

In the meantime, smart phone manufacturers are continuously trying to expand their businesses to other devices in order to prepare for the decline in sales due to market saturation. Moreover, they are making efforts to take the initiative in areas such as smart cars, smart TVs and smart home appliances. Not only smart phone manufacturers but also start-ups are launching a variety of products. This will keep confuse the industry atmosphere for a while and the possibility of standardization seems low. The following is the standardization progress of various organizations.

A. OIC (Open Interconnect Consortium):

OIC is composed of six working groups centered on the Board of Directors including Technical Planning, Standard, Open Source, Membership, Ecosystem, and Marketing Working Group. The Working Groups will conduct practical standardization work, and each Working Group can form a Task Group. Among them, the SWG (Standard Working

Group) reviews the relevant requirements and similar cases proposed by the Technical Planning Working Group, defines and develops the technical specifications, and publishes the standards.

IoTivity is a project that implements OIC standards and is managed by OIC. It is currently (April 2015) being released v0.9.0. It defines industry-specific profiles and core frameworks, provides various APIs required for development, and supports a variety of operating systems. The API is RESTful method and provides four blocks: Discovery, Data Transmission, Device Management, and Data Management. [3].

B. *oneM2M*:

OneM2M aims to develop a common service platform to support M2M / IoT service. It is a global standard development cooperation body of M2M common platform that was formed in July 2012 jointly with ESTI(Europe), TIA, ATIS (North America), ARIB, TTC(Japan) and CCSA(China) of 7 SDOs(Standard Development Organizations) including Korea TTA.

OneM2M standardizes the architecture, protocol, security, device management, semantic and testing related to the object Internet service platform including devices, gateways and servers in order to support global M2M / IoT activation and released the oneM2M standard release 1 package, which includes 10 technical specifications in January 2015.

OCEAN (Open Alliance for IoT Standard) is a coalition formed in December 2014 by the Future Department and the Institute of Electronics Engineers to develop a common platform based on oneM2M and to provide an open source platform. It aims to promote the early development and commercialization of various services and to advance into the global market through collaboration among large, medium and small enterprises utilizing standard technologies. There are more than 130 member companies.

C. *Mobius Platform*:

The Mobius platform is meant that connecting physical and virtual spaces to one. It is a server platform that includes registration, data management, subscription, notification, group management, location, security, search, and device management function of the common service functions specified in the oneM2M architecture. Its functionality is implemented in a Resource Oriented Architecture (ROA) and supports RESTful APIs. In addition, the platform supports HTTP, CoAP, and MQTT protocols for data transmission, and provides a security solution for issuing and authentication as an access key when a client is registered based on a separate authentication server. Also, Redis DB, an in-memory database, and Mongo DB, a database based on NoSQL, are used in a hybrid manner to support large volumes of data transferred from many object devices. The Mobius platform implementation is based on JVM (Java Virtual Machine), Tomcat WAS (Web Application Server) and Spring Framework.

D. *&Cube Platform*:

The &Cube platform is a software platform that is embedded in devices for the Internet of Things. It includes CSE (Common Service Entity) functions proposed by oneM2M standard and provides Mobius platform linkage function for device developers to easily develop object Internet devices. Also, it is implemented to operate on JVM, so it can be operated in environments such as Windows, Linux, and iOS as well as Embedded Linux where JVM is running. [4].

V. RECENT RELEASES

Samsung Electronics acquired the SmartThings, an IoT specialist company, and launched the SmartThings Hub in the second half of 2015 and launched TVs and refrigerators with built-in SmartThings Hub at CES 2016. The SmartThings supports third-party devices and applications, and can be remotely controlled from mobile devices of various operating systems.

LG Electronics introduced SmartThinQ™ Sensor, which converts general household appliances into smart home appliances in third quarter 2015, followed by Smart Home Gateway SmartThinQ™ Hub in CES 2016. The SmartThinQ™ Hub communicates with the SmartThinQ™ Sensor to inform the user of the operation status of the appliances. It also supports communication technologies such as Zigbee, and WiFi, and is able to connect various services. Internationally, the hub can be linked to Iris from US distributor Roos and AllJoyn of Allseen Alliance. Nationally, LG Electronics would be planned to link with SK Telecom, KT, LG U-Plus and other external IoT platforms.

Apple has significantly enhanced its HomeKit functionality with the core services of iOS9, announced at WWDC 2015 (World Wide Developer Conference 2015). In addition, official support for the HomeKit service through voice recognition function was announced on the homepage. Thermostat, smart plugs, and other products that support the HomeKit have already been released. In the future, many companies are hoping to launch a product that supports the HomeKit.

Google acquired Nest, an IoT specialist, in early 2014, and saw a huge growth in its SmartHome business. In May 2015, the Google developer event 'Google IO' announced the IoT platform. This platform includes Brillo, which is a small, lightweight and low-power IoT-Only OS, a communications platform Weave that provides cloud connectivity and device-to-device interaction, and UX for controlling IoT devices in Android.

VI. OPEN SOURCE HARDWARE

A. *Arduino*

Arduino is an open source platform based on microcontroller boards developed by interaction designers Massimo Banzi and David Cuartielles for the purpose of pursuing an interactive design experience in an inexpensive way. It features low cost, unlimited scalability and easy accessibility, and supports a variety of operating systems such as Windows, OS X, and

Linux. Both hardware and software are open source, extensible through the C++ library, and can be added using the C language. The development environment is also open, and It is easy to program by providing an easy programming environment for non-experts.

There are UNO, Mega, Nano, etc. which are basic base, and it supports Shield which is mounted and expanding its functions. [5].

B. Raspberry Pi

Raspberry Pi was made in England to distribute low cost educational computers. It is a credit card-sized microcomputer using the BCM2835 chip, which can be used like a computer by connecting a monitor, keyboard and mouse. A variety of applications are being shared, so elementary students have fun and experiment with fresh ideas. They provide low-performance A-type and high-performance B-type boards, camera modules, RCA (Radio Corporation of America), HDMI (High Definition Multimedia Interface), Audio, LAN, USB and GPIO (General Purpose Input / Output). It consists of 512MB RAM, CPU, GPU and SD card slot. [6].

C. Intel Galileo

Galileo is a microcontroller board created by Intel architecture to the Arduino platform. It is compatible with UNO R3 shields and software development environment.

It is more powerful with Quark SoC x1000 processor instead of ATmega. Real Time Clock (RTC) and PCI Express Mini Card expansion slot have been added.

D. Intel Edison

Intel Edison, which is designed for enterprise and professional manufacturers in the IoT industry, provides ease of development during prototype development stage. It is compatible with Brillo, a Google's IoT OS, and features a 500MHz dual-core CPU, 100MHz MCU, dual-band Wifi, Bluetooth 4.0, 1GB DDR, 4GB flash memory and 40 GPIOs. [7].

VII. CONCLUSION

Innovative devices are pouring out, but customers' desires to smart devices and IoT devices are getting hot day by day. Technology infrastructure for popularizing the smart home service is already formed, so that market expansion is to be realized forthwith. However, technology standardization has yet far-off. Moreover, the future prospects of this field could be corrupted because of rivalries for dominating market position, rather than having consultation for offering common services. Therefore, researchers or developers related in the smart home would be in states of confusion and worried that researches or developments elaborately worked could be useless.

In this paper, we organized the latest trend in IoT and smart home services as references to researchers and developers. Also, we suggest frameworks that are feasible at this moment, so that researchers and developers would be helpful.

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