Software Architecture for oneM2M Based Gateway to Interwork with ZigBee Networks for Device Domain

Won-Seok Lee, Sung-Soon Park, Chang-Hee Kang and Hyoung-Kyu Song*
uT Communication Research Institute, Sejong University, Seoul, Republic of Korea
*Corresponding Author: songhk@sejong.ac.kr

Extended Abstract/Poster Paper

Abstract – The Internet of things (IoT) has various service applications. The applications need infrastructures to manage and process data from connected devices. The Vertical structure of the infrastructures increases cost for the development of new applications. IoT platform standards such as oneM2M, and Open Connectivity Foundation (OCF) were established to parallelize the vertical structure of the infrastructures. Other important infrastructure for the IoT service applications is networks for devices. In these networks, devices are connected to a gateway and the gateway is connected to an IoT platform server through the Internet. In this paper, software architecture for oneM2M based gateway to interwork with ZigBee networks for devices is presented.

Keywords: IoT, IoT platform, oneM2M, ZigBee, Bluetooth

1 Introduction

The number of things connected with the Internet increases every year and many service applications using the information of the connected things have been developed. The applications need infrastructures to manage and process data from the things. The developers for the service applications typically use infrastructures dependent on their developments. Since these infrastructures are hard to be used for applications of other developers, development for new applications needs new infrastructures. The vertical structure of the infrastructures increases cost for the development of the new service applications. IoT platform standards such as oneM2M, and OCF were established to provide common service functions for the service applications and parallelize the infrastructure layer. Other important infrastructure for the IoT service applications is networks of device domain. These networks are implemented by using short range, low power communication technologies like ZigBee. The IoT common service entities (CSE) in the gateway and the server provide application entities (AE) with common functions which are necessary for the IoT services.

2 Architecture of oneM2M

The architecture of oneM2M has two domains (field, and infrastructure domain) [1]. Fig. 1 shows the architecture. The field domain is composed of a network of devices and a gateway which provides connection of the network to an IoT server. Infrastructure domain is composed of the IoT server and users using IoT services.

Fig. 1: Architecture of oneM2M

3 ZigBee network

ZigBee is short range, low power communication technology based on IEEE 802.15.4 [2]. This technology is devised for home automation systems, and automatic metering systems. Supported network topologies are star, tree, and mesh. In ZigBee networks, nodes are classified into three types. The types are coordinator, router, and end device. A coordinator type node starts and manages a network. Router nodes extend the network and end devices provide devices with connectivity. In this paper, ZigBee network is implemented by using the XBee pro modules. The modules
provide serial interface for control. To command operations, API packets which have information for the operations must be transmitted to a serial port. Also all feedback information for the operations is received from the serial port.

4 Software architecture

This paper presents software architecture for the IoT gateway. This software architecture is implemented to provide interface for ZigBee networks on the IoT gateway. Fig. 2 shows the architecture of the software. The software is consisted of four entities. These entities perform functions for interworking the gateway with ZigBee networks. An entity for common service functions interacts with the IoT server. This entity is represented as MN-CSE in oneM2M architecture. In case of this implementation, the MN-CSE is a &Cube entity. State information for devices and control messages are transmitted and received through this entity. An entity for formatting and socket interface manages a socket for communicating with the &Cube entity and processes the up and down link messages. To communicate with the &Cube entity, the messages should be compliant with oneM2M format. This entity performs the formatting.

4.1 Uplink and downlink flow

In Fig. 2, uplink and downlink flow are presented. In uplink, ZigBee packets which have state information for the devices in the network are transmitted to the coordinated type XBee module directly connected to the gateway. The received packets are delivered to the entity for processing XBee packets. The entity processes the packets to get source address, container name, and value for state of devices. The container name and data for devices are delivered to the entity for formatting and socket interface. This entity produces string data by formatting the container name and the data for devices. The formatted data is transmitted to the &Cube entity through the socket and the entity transmits the string data to IoT server by using HTTP protocol. Downlink is started from the IoT server. A control message from the server is received by the &Cube entity. The entity for formatting and socket interface gets container name and value for control and transmits the information to the entity for processing XBee packets. The entity for network management also receives the container name and transmits the module address for the container to the entity for processing packets. The entity for processing XBee packets assembles a packet for control and transmits the packet to coordinator type module through the serial port.

5 Conclusion

IoT platform standards such as oneM2M, and OCF were established to reduce the cost for developing new IoT service applications. Other important infrastructure for the IoT services is networks for devices. In this paper, software architecture for oneM2M based gateway is presented. The implemented software provides interface to communicate with ZigBee networks for devices.

6 Acknowledgement

This work was supported by the Korea Institute of Energy Technology Evaluation and Planning(KETEP) and the Ministry of Trade, Industry & Energy(MOTIE) of the Republic of Korea (No. 20161210200670). *Corresponding Author: Hyoung-Kyu Song

References
