

Cooperation between Telecommunication Enterprises in Japan and Other Countries in Smart Home Standardization Efforts—Activities of the HGI/ZigBee Alliance

Takefumi Yamazaki, Nobuyuki Akazawa, Akihiro Otaka, Nobuhiro Takagi, Kenji Muto, Takenao Nakagawa, and Kazuyuki Terao

Abstract

The technical issues that are important for the business development of smart home technology are being addressed through cooperation and solution-sharing with telecom companies around the world in international standardization activities. These activities include the sharing of technical requirements by telecom companies in the Home Gateway Initiative and the use of requirements documents for standardization in the ZigBee Alliance. This article reports the current states of these activities.

Keywords: smart home, HGI, ZigBee

1. Introduction

The term *smart home* refers to devices in the home that are connected to services via the Internet. These services are being developed by telecom companies around the world, for example, AT&T's Digital Life [1] and Deutsche Telekom's QIVICON [2]. An important factor in developing smart home business is the in-home wireless communication protocol for connecting a home gateway and other customer premises equipment with various devices such as home appliances, sensors, and actuators.

NTT is working to create an environment that facilitates smart home business development and to expand the market by cooperating with other telecom companies through the Home Gateway Initiative (HGI) [3], which is an influential organization in the telecommunications industry. The HGI members are

focusing on improving ZigBee and other important in-home wireless communication protocols.

2. HGI activities

2.1 Overview of HGI

HGI was founded mainly by European telecom companies in 2004 for the purpose of writing specifications for applications and technology with respect to the requirements of home gateways. The members are telecom companies and vendors of systems, chips, software, and hardware. The members from Japan include NTT, NEC, Oki Electric Industries, Sumitomo Electric Industries, Hitachi, and Mitsubishi Electric. The basic plan is to effectively apply existing technology and to collect and organize common specifications for home gateways on the business development and technical fronts rather than

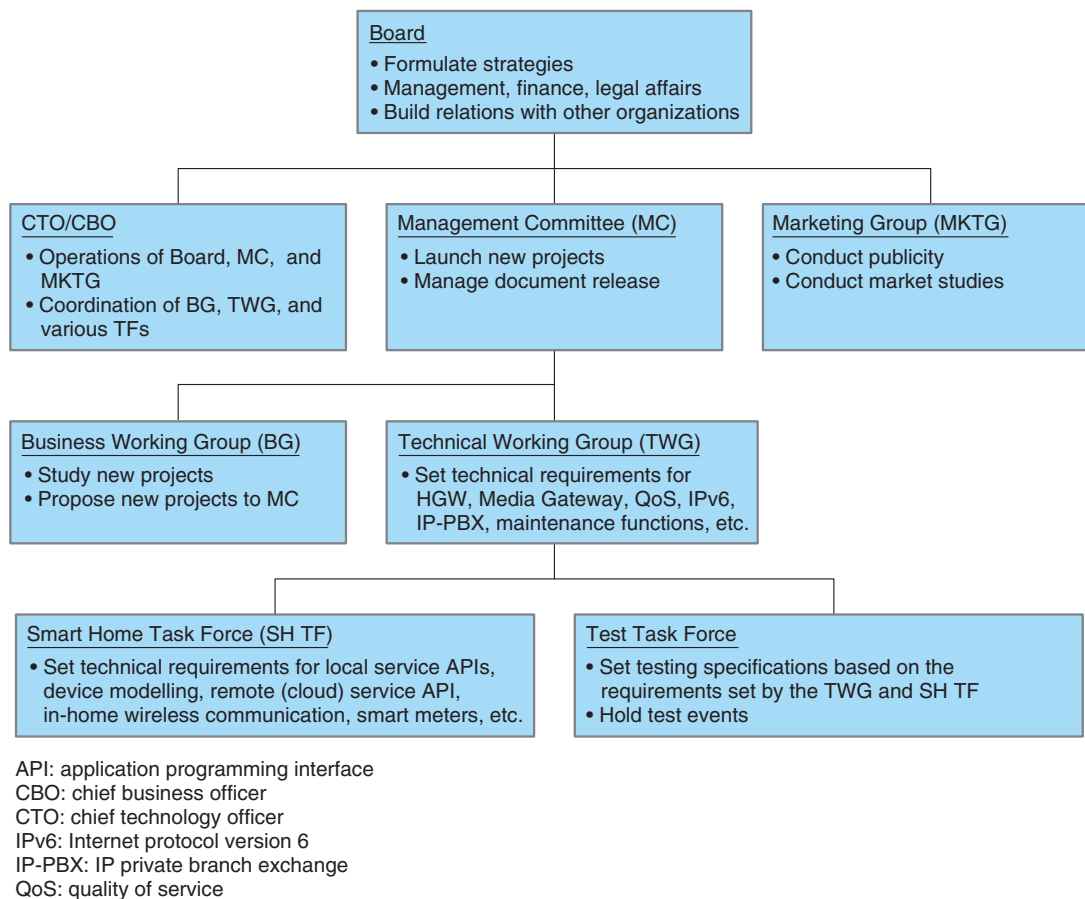


Fig. 1. HGI organization and roles.

writing new specifications.

The HGI organization and roles are shown in **Fig. 1**. Work on the technical requirements documents is mainly being done by the Technical Working Group. The completed specification documents concerning home networks and M2M (machine-to-machine) are submitted to the relevant standards organizations for feedback via liaisons. The Technical Working Group utilizes the feedback from the standards organizations to set new specifications.

2.2 Activities of Smart Home Task Force

The technical requirements for realizing smart home services are being discussed by the Smart Home Task Force, which produces a requirements specifications document (**Table 1**). The main technical fields and topics include use cases, architecture and system requirements, the operating environment of home gateways, in-home wireless communication protocols, and device models.

The home gateway operating environment is being specified mainly by Deutsche Telekom and Orange (formerly France Telecom) as sets of software modules and performance requirements for running in a Java/OSGi (Open Service Gateway initiative) software environment. HGI periodically holds test events to validate the specified performance requirements. Those events are held to determine whether or not the technology can meet the requirements and to build relationships among members.

2.3 Setting technical requirements for in-home wireless communication (RD039)

In cooperation with Deutsche Telekom, Orange, NEC, and other members, we have been working in the Smart Home Task Force to set the technical requirements for existing in-home wireless communication protocols from the viewpoint of providing smart home services (RD039) [4].

Document RD039 sets the requirements that

Table 1. HGI Release Documents.

Number	Title
HGI-RD001-R2.01	Home Gateway Technical Requirements: Residential Profile V1.01
HGI-GD002-R2.01	Remote Access Guidelines
HGI-GD003-R2	Parental Control in the Home
HGI-GD004-R2	Performance Metrics
HGI-GD006-R2	IMS (Internet protocol Media Subsystem) Enabled HG
HGI-RD007-R2	Requirements for HG Interworking with an External NT (Network Termination)
HGI-RD008-R3	HG Requirements for Software Execution Environment
HGI-RD009-R3	Requirements for an Energy Efficient Home Gateway
HGI-RD010-R3	Home Gateway Requirements for Multiple Session Support
HGI-GD013-R2	QoS Whitepaper
HGI-RD015-R3	Requirements for Common Power Supply for Home Networking Equipment
HGI-RWD016-R3	HG and Home Network Diagnostics Module Requirements
HGI-GD017-R3	Use Cases and Architecture for a Home Energy Management Service
HGI-RD024	Requirements for an NGA (Next Generation Access) (Active Line Access) Capable NT
HGI-RD026	IP-PBX Module Requirements
HGI-RD027-R3	Home Gateway QoS Module requirements
HGI-RD039	Requirements for Wireless Home Area Networks (WHANS) Supporting Smart Home Services
HGI-RD048	HG Requirements for HGI Open Platform 2

in-home wireless communication protocols must satisfy for usability (e.g., simple setup, setup support), communication reliability (e.g., averting interference, coverage), maintenance functions (e.g., testing functions, remote support), and security (e.g., authentication, encryption). NTT has proposed technical requirements for simplified pairing, optimized power consumption, appropriate addressing on restart, and isolation for when network problems occur, based on assumed improvements in the ZigBee IP (Internet protocol) expected to be used in Japan.

The technical requirements were completed in May 2014 and formally released as RD039. Through collaboration with the Broad Band Forum (BBF) [5], another standards organization in the smart home field that was established in May 2013, HGI made RD039 available to BBF members as well.

3. ZigBee Alliance Activities

3.1 ZigBee Alliance

The ZigBee Alliance [6] was established in October 2002 to set wireless sensor network standards and ensure interconnectability. This alliance follows the IEEE (Institute of Electrical and Electronics Engineers) 802.15.4 standard for the physical layer and MAC (media access control) layer, and is proceeding with the standardization for the higher layers includ-

ing network layers and application interfaces. The members include telecom companies and vendors of systems, chips, software, and hardware. Companies from Japan that are participating include NTT, Oki Electric Industries, NEC, Toshiba, and others. In Japan, ZigBee SIG (special interest group) Japan cooperates with the ZigBee Alliance and other regional organizations to conduct information campaigns and carry out market studies and market development in collaboration with member corporations.

The ZigBee Alliance organization and roles are shown in **Fig. 2**, and the process of setting the technical requirements is shown in **Fig. 3**. The ZigBee Marketing Steering Committee (ZMSC) and the Market Working Groups compile use cases and market requirements in the Market Requirements Document (MRD), which is submitted to the ZigBee Architecture Review Committee (ZARC). ZARC passes the MRD on to the appropriate Working Groups (WGs), which produce Technical Requirements Documents (TRDs). The TRDs define the technical scope, and specifications are written based on them.

3.2 Activities in the Technical WG

NTT explained the in-home wireless technical requirements using the HGI RD039 document described in section 2.3 at the ZigBee Alliance in order to clarify to the Alliance members that ZigBee

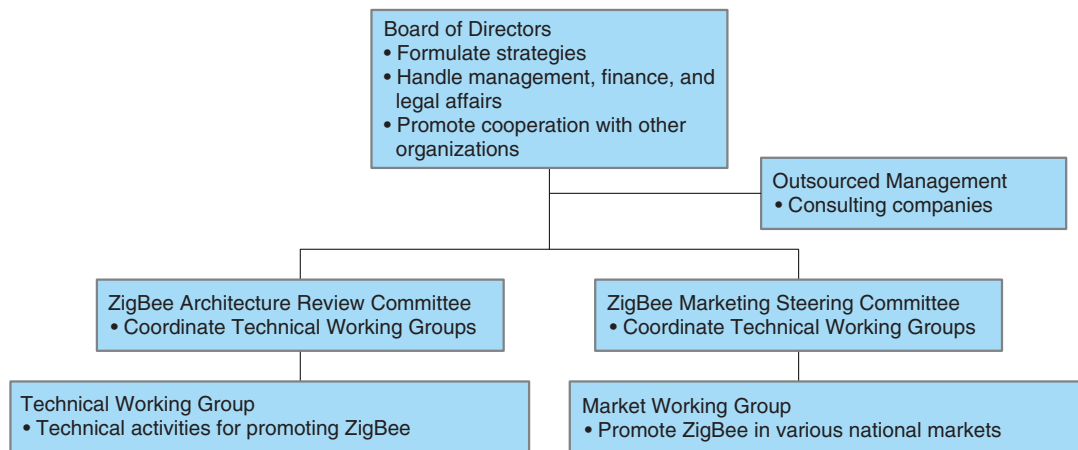


Fig. 2. ZigBee Alliance organization and roles.

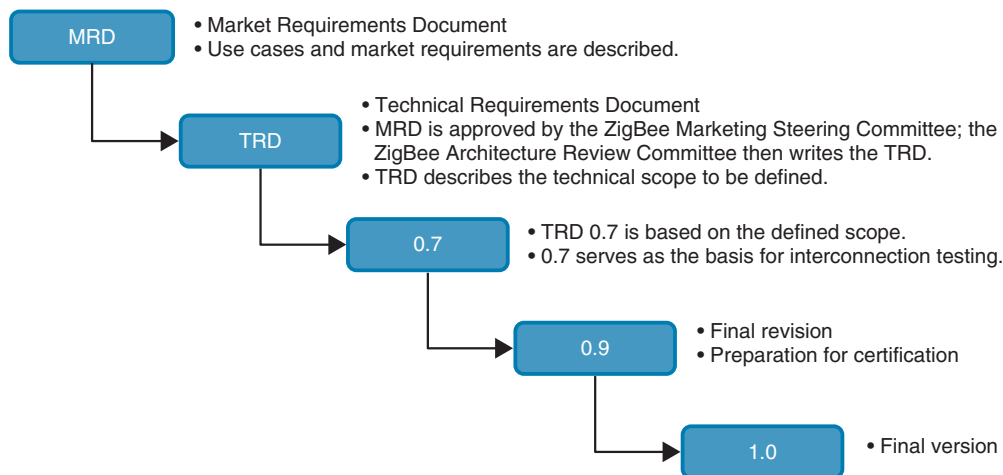


Fig. 3. Process of setting technical requirements in ZigBee Alliance.

specifications should also follow such requirements. Also, as a member of the ZigBee Technical WG, we regularly compare the HGI in-home wireless technical requirements and the ZigBee technical specifications to check for correspondence. Simple connection functions for which there are no corresponding ZigBee technical specifications were proposed as new functions that are now being studied. The work on the MRD and TRD described in Fig. 3 had been completed as of June 2014.

4. Publicity activities at exhibitions

In addition to using HGI RD039 to build relation-

ships with the ZigBee Alliance and other wireless standards organizations, we are promoting improvements of in-home wireless communication protocols through presentations at international exhibitions. So far, we have made presentations at the Broad Band World Forum (BBWF; October 2013) in the Netherlands and at Wireless Japan 2014 (May 2014) in Japan (Fig. 4).

5. Conclusion

We have described our work toward developing smart home business through cooperation with telecom companies in other countries in the arena of



Fig. 4. Presentation at Wireless Japan 2014.

international standardization, including HGI and the ZigBee Alliance. We will continue to participate in international standardization activities in the relevant technological fields and to collaborate with other telecom companies in solving problems and promoting services for smart home systems.

References

- [1] Website of AT&T Digital Life,
<http://www.att.com/shop/digital-life.html>
- [2] Website of Qivicon,
<https://www.qivicon.com/>
- [3] Website of HGI,
<http://www.homegateway.org/>
- [4] HGI RD039,
<http://www.homegateway.org/publis/RD039-Req-for-Wireless-home-area-networks.pdf>
- [5] Website of Broad Band Forum,
<http://www.broadband-forum.org/>
- [6] Website of ZigBee Alliance,
<http://www.zigbee.org/>

**Takefumi Yamazaki**

Senior Research Engineer, Supervisor, NTT Service Evolution Laboratories.

He received the B.E. in physical engineering from the University of Tokyo in 1986 and joined NTT the same year. He moved to NTT Service Evolution Laboratories in 2006. He is involved in standardization activities related to home networking. He is a member of the board of directors of both OSGi Alliance and HGI. He is also Chair of the Next Generation Home Network System WG in the Telecommunication Technology Committee.

**Kenji Muto**

Senior Manager, Strategic Business Development, Global Business Office, NTT EAST.

He received the B.Ec. in economics from Rikkyo University, Tokyo, in 1997 and an MBA from Emory University, Atlanta, GA, USA, in 2008. He is currently responsible for global carrier relations and strategic business development. Before moving to the Global Business Office, he was in charge of corporate sales strategies for Yamagata Prefecture.

**Nobuyuki Akazawa**

Senior Manager, 1st Division, New Business Development HQ, NTT EAST.

He received the B.E. from Nagoya Institute of Technology in 1987 and joined NTT the same year. He has worked in the areas of telecommunication equipment, corporate sales, and corporate planning. He is currently responsible for developing home gateways.

**Takenao Nakagawa**

Manager, Strategic Business Development, Global Business Office, NTT EAST.

He received the M.E. in global environment and energy engineering from the University of Tokyo in 2006 and joined NTT the same year. His work has focused on customer support, network management, and home gateway development. He is currently involved in global carrier relations and standardization.

**Akihiro Otaka**

Executive Manager, NTT Access Network Service Systems Laboratories.

He received the B.S. and M.S. in physics from the University of Tokyo in 1989 and 1991, respectively. He joined NTT in 1991 and engaged in developing optical lithography technologies for LSI fabrication. In 1998, he began working on the development and standardization of optical access systems such as Gigabit and 10 Gigabit EPON. From 2010 to 2014, he was with NTT EAST R&D Center, where he worked on optical access, wireless access, and wireless home networks. He joined NTT Access Network Service Systems Laboratories in 2014.

**Kazuyuki Terao**

Senior Manager, Alliance Development Office, Marketing Department, NTT WEST.

He received his M.S. in electrical engineering from Kyoto University in 1996 and an MBA from Indiana University, Bloomington, IN, USA, in 2005. He is currently responsible for designing the "HIKARI" box that enables users to access the Internet and various applications on TV and also for managing its sales and marketing. Before moving to his current department, he was in charge of planning technology strategies and budgeting for all research activities at the R&D Center. He also led research projects related to smart communities such as HEMS and M2M at the R&D Center.

**Nobuhiro Takagi**

Engineer, NTT Broadband Platform.

He received the M.E. in electrical engineering and computer science from Shibaura Institute of Technology, Tokyo, in 2006. He joined NTT EAST in 2006 and engaged in the development of Wi-Fi and various wireless devices. He moved to NTT Broadband Platform in 2014 and works in the maintenance section.