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| Title | **HEMS use case proposal for IEEE802.21.1 draft standard** |
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| Abstract | This document describes the use case for applying IEEE802.21 to HEMS(Home Energy Management System).Home Gateway(HGW) as PoS with GM sends control command to each device as PoS and controls it.  |
| Purpose | To propose the use case for applying IEEE802.21 to HEMS. |
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* 1. HEMS use case
		1. Introduction

　HEMS (Home Energy Management System) is the system to manage the energy usage in home.

　HEMS connects devices (i.e. home appliances or equipments) by network realizes the "visualization" of electricity or gas consumption and the "auto control" of devices.

　HEMS includes following applications and devices;

　・Air conditioning system

　・Lighting

　・Smart meter

　・PV(Photovoltaics)

　・Home security

　This subclause describes the use case of HEMS.

　In HEMS, Home gateway (HGW) and devices are connected in home, HGW controls home appliances through the network. HGW collectively manages devices in home, controls them and collects usage information.

For example, user operates HGW, and HGW executes the collective lightings power off and the centralized control of the air conditioning system. Moreover, devices send usage state of electricity to HGW, and HGW displays the amounts of electric energy in home.

　Figure 1 shows structure example of HEMS. HGW connects to devices such as PV, Air conditioning system, lighting devices by home area network. In this example, HGW and terminal devices are connected via a cloud server, and the user controls HGW using the terminal device. HGW may collectively send a control message to the devices using a multicast transport, and the devices sends usage information to HGW in accordance with the control message. In the use case of HEMS, Media independent service framework (MIS) of IEEE802.21 specifications is applied to the Interface between the HGW and the devices, HEMS performs the collective control of the devices and the acquisition of usage information. The system to control HGW using the terminal devices via cloud server is out of scope of this use case.



Figure 1— Structure example of HEMS

* + 1. Service scenarios and call flows

In the use case of HEMS, HGW operates as “PoS with GM”, devices connect to HGW as “PoS”. HGW controls the power switch or settings of devices, and collects the state of them. HGW operates Multicast Group Management described in IEEE 802.21m as PoS with GM.

　PoS with GM transmits control commands to PoSes as devices, and controls them. If the PoS with GM collectively controls PoSes, it sends the control command by a multicast transport.　PoS sends usage information regularly or non-regularly to the PoS with GM. And, PoS, when receiving the acquisition command of the usage information from the PoS with GM, sends the usage state of the device to the PoS with GM.



Figure 2—System architecture in 802.21

In the use case of HEMS, MIH\_SAPs classified in the Service Management are used. MIH\_LINK\_SAPs used in Link layer are not required, since the control command transmission and the usage information acquisition in HEMS are independent of the media.

Table 1— Services management primitives for HEMS use case

|  |  |
| --- | --- |
| Service management primitive | Comments |
| MIH\_ Configuration\_Update | This command is sent by a PoS to a group of other PoS(es) to update their configuration.In the use case of HEMS, PoS sends the HEMS control command and the usage information. |
| MIH\_Net\_Group\_Manipulate | This command is sent by a PoS to a group of other PoS(es) to create, delete or update a group membership. |
| MIH\_Push\_Certificate | This command is sent by a PoS to another PoS or an MN and it is used for sending of a certificate. |
| MIH\_Revoke\_Certificate | This command is sent by a PoS to a group of PoS(es) and/or an MN to revoke a certificate previously issued by the PoS. |

In the use case of HEMS, PoS with GM sends control commands to PoS. Cipher communication of control commands uses MIH\_Configuration\_Update. Multicast cipher communication from PoS with GM to each PoS uses the MIH protocol protection.



Figure 3—Transmission of the control command

1. The MIH User of PoS with GM generates the HEMS control commands for the PoS, and sends it to the local MIHF using the MIH\_Configuration\_Update.indication primitive.
2. MIHF of PoS with GM sends the HEMS control commands for the PoS using the MIH\_Configuration\_Update indication message.
3. MIHF of PoS receives theMIH Configuration Update indication message, and sends it to the MIH User using the MIH\_Configuration\_Update.indication primitive.
4. MIH User of PoS receives the MIH\_Configuration\_Update.indication primitive, and runs the control command.



Figure 4—Transmission of the usage state

1. The MIH User of PoS generates the usage information, and sends it to the local MIHF using the MIH\_Configuration\_Update.indication primitive.
2. MIHF of PoS sends the usage information to the PoS with GM using MIH\_Configuration\_Update.indication message.
3. MIHF of PoS with GM receives the MIH\_Configuration\_Update indication message, and sends it to the MIH User of PoS with GM using the MIH\_Configuration\_Update indication primitive.
4. MIH User of PoS with GM receives MIH\_Configuration\_Update.indication primitive, and collects the usage information.