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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

　This sub-clause explains general overview of the HEMS(Home Energy Management System) use case.

HEMS is the system to manage the energy usage in home.　HEMS with connecting devices (i.e. home appliances or equipments) realizes the "visualization" of electricity or gas consumption and the "auto control" of devices.

　HEMS typically includes Home Gateway(HGW) and the various devices as follows;

　・Air conditioning system

　・Lighting

　・Smart meter

　・PV(Photovoltaics)

　・Home security

HGW and devices are connected in home by wired or wireless network. HGW controls home appliances and collects usage information through the network.

For example, user operates HGW, and HGW can execute 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, and lighting devices by home area network. In this example, HGW and terminal devices are connected via the cloud server, and user can control HGW by 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 response to the control message. In this use case, 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 controlling system of HGW by using the terminal devices via cloud server(dotted line in Figure.1) is out of scope of this use case.

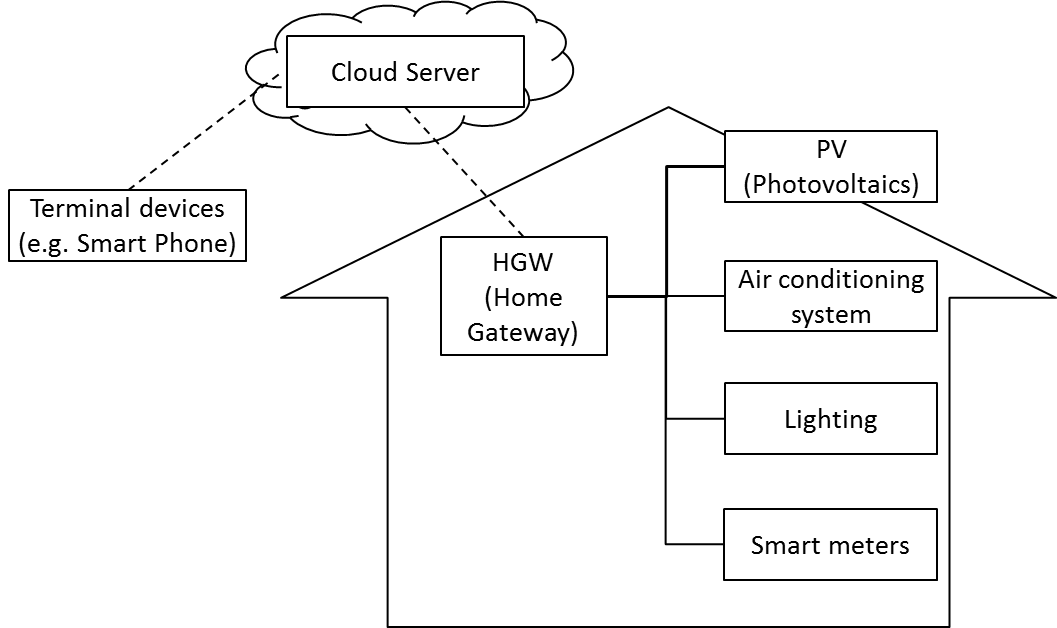


Figure 1— Structure example of HEMS

* + 1. Service scenarios and call flows

This sub-clause describes the service scenario and IEEE 802.21 call flows.

Figure 2 shows the 802.21 system architecture in corresponding to HEMS structure and Figure 3, 4, and 5 shows the command flows corresponding to the different types of communication.

In this case, HGW as “PoS with GM” operates the connecting devices 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 802.21.m as PoS with GM.

PoS with GM transmits control commands to PoSes and controls them. When the PoS with GM collectively controls PoSes, it sends the control command by a multicast transport. PoS sends usage information 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 information of the device to the PoS with GM.

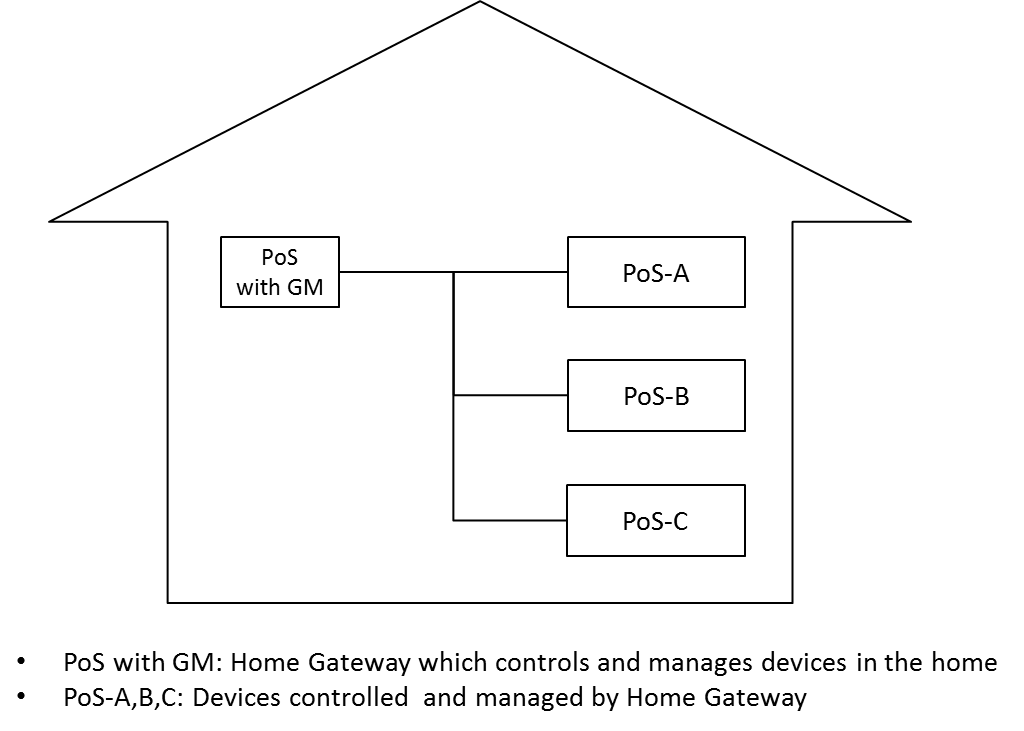


Figure 2—System architecture in 802.21

Table 1 shows the list of Service management primitives used in HEMS use case. 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— Service management primitives for HEMS use case

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| --- | --- |
| 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. |

Figure 3 shows the control command flow from PoS with GM to each PoS and Figure 4 shows the notification command flow from each PoS to PoS with GM.

In Figure3, PoS with GM sends control commands to each 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.

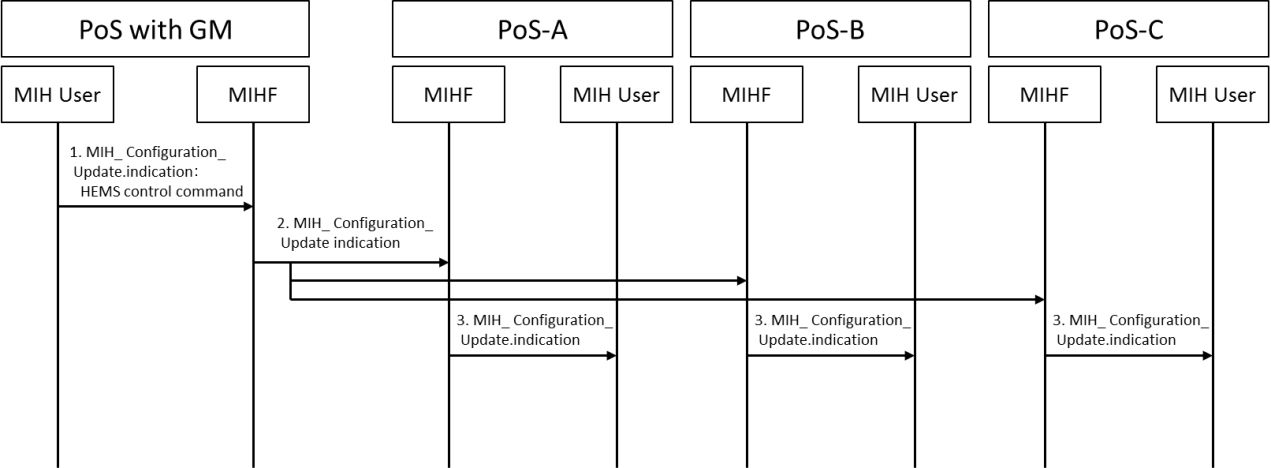


Figure 3—Transmission of the control command

1. MIH User of PoS with GM generates the HEMS control commands for 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 PoS using the MIH\_Configuration\_Update indication message.
3. MIHF of PoS receives the MIH 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.

In Figure 4, each PoS notify their usage state information to PoS with GM

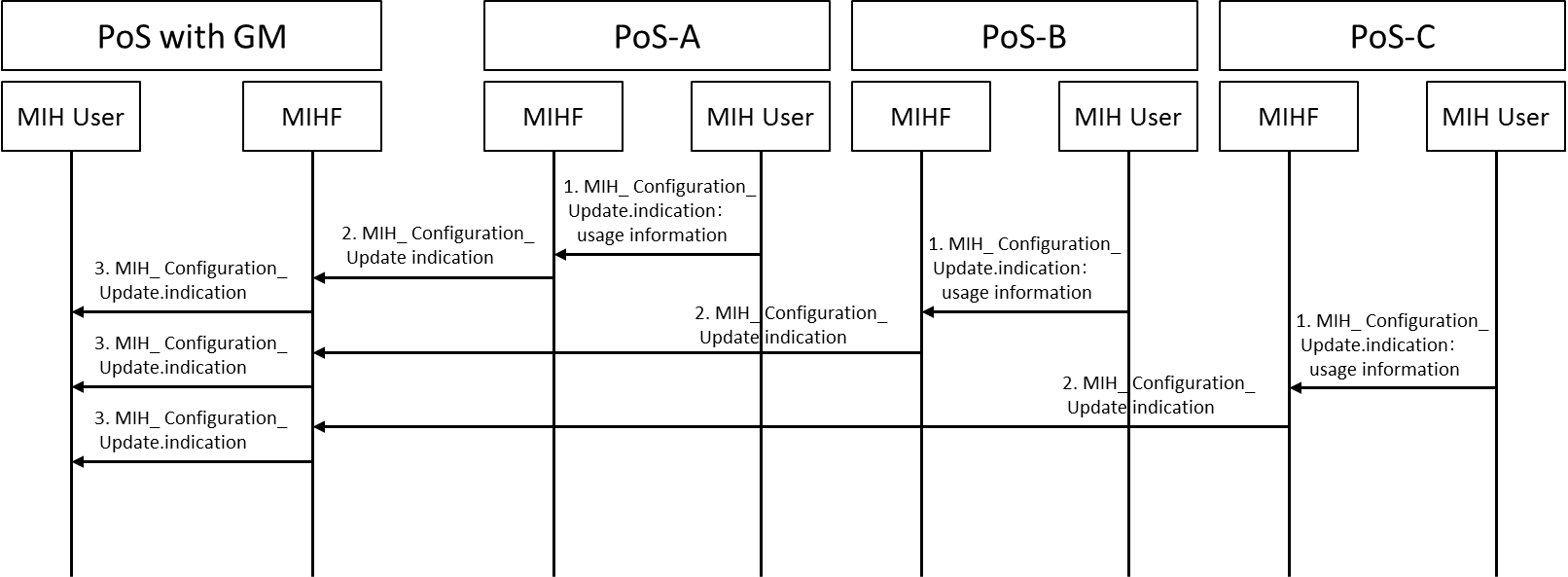


Figure 4—Transmission of the usage information

1. 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.

Figure 5 describes CRL sharing in Home Area Network. In this example, PoS-A having the latest CRL directly sends it with other PoS and PoS with GM under the same Home Area Network.

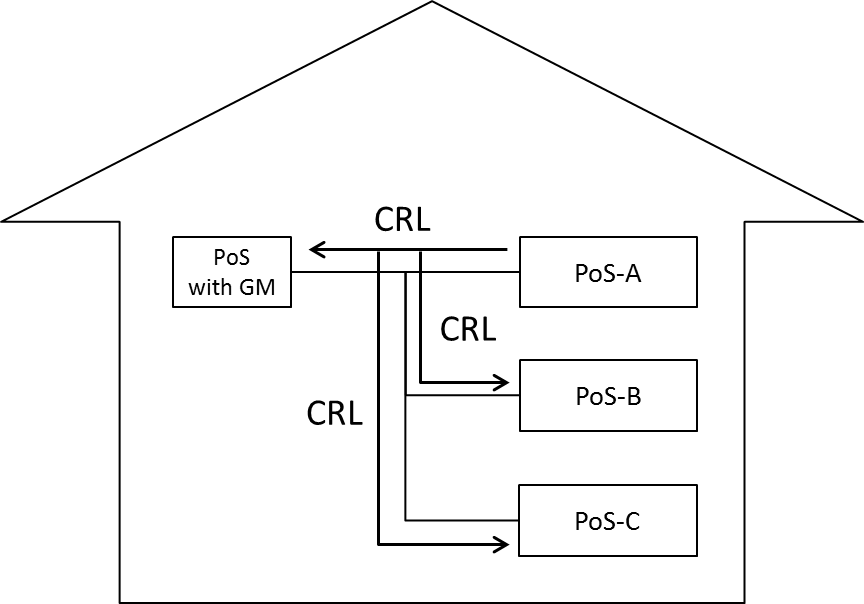


Figure 5—CRL sharing in Home Area Network

Figure 6 shows the command flow described in Figure 5.

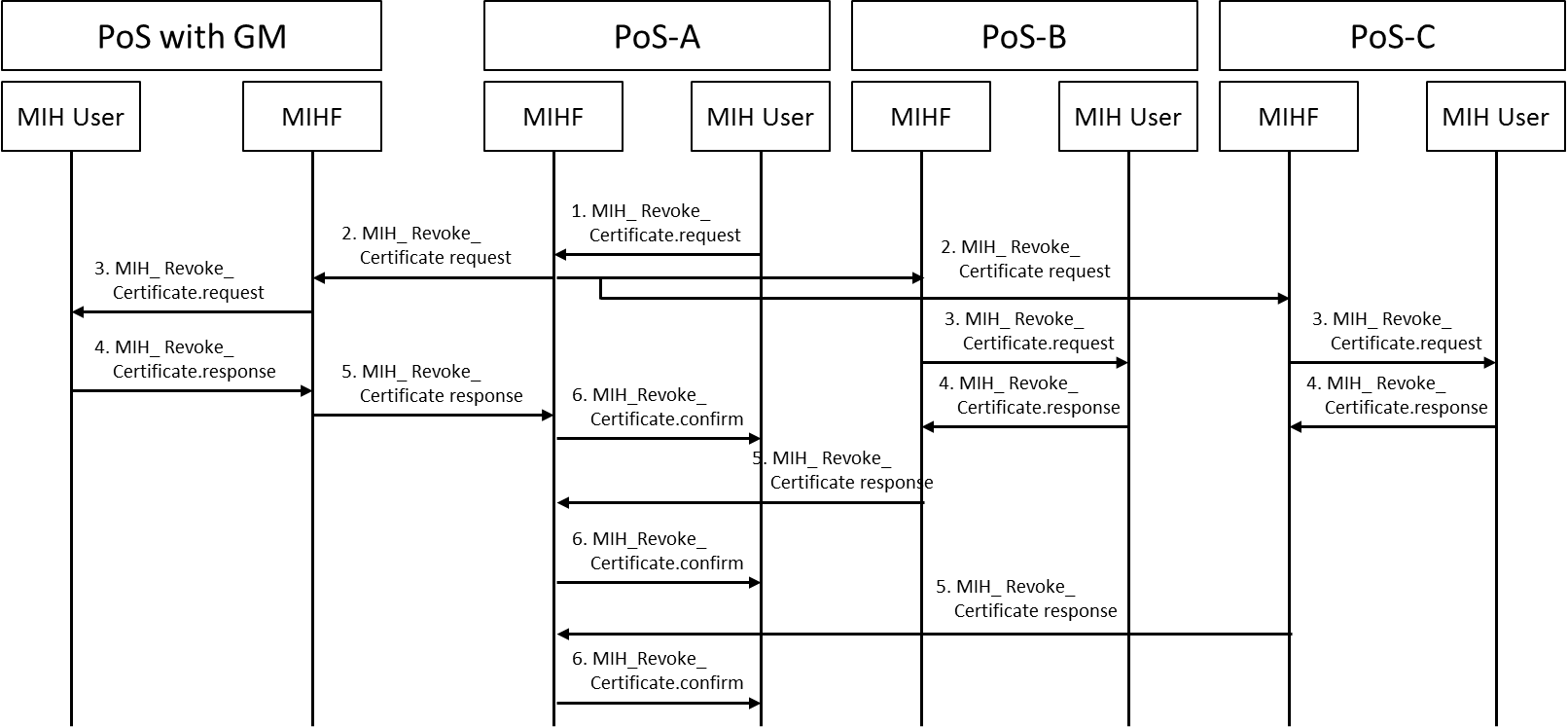


Figure 6—Transmission of CRL

1. If MIH User of PoS shares the CRL, and sends it to the local MIHF using the MIH\_Revoke\_Certificate.request primitive.
2. MIHF of PoS sends the CRL to the PoS using MIH\_Revoke\_Certificate request message.
3. MIHF of PoS receives the MIH\_Revoke\_Certificate request message, and sends it to the MIH User of PoS using the MIH\_Revoke\_Certificate.request primitive.
4. MIH User of PoS receives MIH\_Revoke\_Certificate.request primitive, and generates the acknowledge receipt, and sends it the local MIHF using the MIH\_Revoke\_Certificate.response primitive.
5. MIHF of PoS sends the acknowledge receipt to the PoS using MIH\_Revoke\_Certificate response message.
6. MIHF of PoS receives the MIH\_Revoke\_Certificate response message, and sends it to the MIH User of PoS using the MIH\_Revoke\_Certificate.confirm primitive.